Environmental Impact Statement

Proposed Wind Farm Development at Cloncreen & Adjacent Townlands, Co. Offaly

Volume 1: Non-Technical Summary & Environmental Impact Statement

Bord na Móna
Naturally Driven

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Planning & Environmental Consultants

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1 INTRODUCTION

1.1 Introduction

This Environmental Impact Statement (EIS) has been prepared by McCarthy Keville O'Sullivan Ltd. on behalf of Bord na Móna Powergen Ltd., which intends to apply to An Bord Pleanála for planning permission to construct a wind energy development and all associated infrastructure at Cloncreen and adjacent townlands, Co. Offaly, as listed in Table 1.1 below.

Table 1.1 Townlands within which the Proposed Development occurs

Townland
Proposed Wind Farm Development including Grid Connection & Site Access
Cloncreen
Clongarret
Esker More
Rathvilla or Rathclonbracken
Ballinrath
Ballynakill
Ballykilleen
Additional Proposed Transport Route Works Areas
Ballina
Ballinagar

The proposed wind energy development will encompass 21 No. wind turbines up to a tip height of 170 metres. The application meets the threshold for wind energy set out in the Seventh Schedule of the Planning and Development Act 2000, as amended, and is therefore being submitted directly to An Bord Pleanála in accordance with Section 37E of the Planning and Development Act 2000, as amended.

The proposed wind farm site is located at Cloncreen bog in eastern Co. Offaly, approximately 4.5 kilometres southwest of Edenderry at its nearest point. The villages of Clonbullogue and Rhode are located approximately 2.0 kilometres southeast and 7.0 kilometres northwest of the site respectively.

Cloncreen is a single peat production bog unit within the Bord na Móna Derrygreenagh peat production bog group, regulated under the Environmental Protection Agency (EPA) IPC Licence No. P503-01 (Bord na Móna Allen Peat Ltd.). The land-use/activities within the proposed development site comprise a mix of active peat extraction, bare cutaway peat, re-vegetation of bare peat, former borrow pit area, telecommunications (a 40-metre mast) and wind measurement (a single 100-metre meteorological mast). The southern section of the site is traversed by the existing 110 kV Thornsberry/Cushaling electricity transmission line and associated pylons. There are also a number of Bord na Móna rail lines that pass through the bog facilitating the transportation of milled peat and ash and a small canteen area for employees known as the 'tea centre'.

Land-use in the immediate surrounding area comprises a mix of agriculture, commercial forestry, cutaway peatlands and energy production including Edenderry Power Plant and Mountlucas wind farm. There is also an EPA-licenced ash repository (Licence No. W0049-02, Bord na Móna Energy Ltd.) used for disposal of ash from the power plant.

Edenderry Power Plant is currently co-fired with a mix of peat and biomass and is located directly east of the Cloncreen site. The operational Mountlucas wind farm is located 4.2 kilometres to the west of the Cloncreen site. Mountlucas comprises 28 no. turbines, with a total maximum power output of 84 Megawatts (MW), and has been in operation since 2014.

1.1.1 Guidance and Legislation

McCarthy Keville O'Sullivan Ltd. were appointed as Environmental Consultants on this project and commissioned to prepare an EIS which fulfils the requirements set out by the Environmental Protection Agency (EPA) in the *'Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2002) and Schedule 6 of the Planning and Development Regulations 2001, relating to the information to be contained in an EIS. Regard has also been had to the Advice Notes on Current Practice in the Preparation of EIS (EPA, 2003) and to *'Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment'*, published by the Department of the Environment, Community and Local Government (DECLG) in March 2013. Relevant considerations under the *'Wind Energy Development Guidelines for Planning Authorities'* (DOELG, 2006) have also been taken into account.

The EPA is currently revising the *'Guidelines on the Information to be Contained in Environmental Impact Statements'* and the '*Advice Notes on Current Practice (in the preparation of Environmental Impact Statements)'*. The draft guidelines and advice notes (September 2015) are currently at draft stage following consultation which closed in October 2015. Cognisance of these draft guidelines have also been taken into account in compiling this EIS.

The '*Wind Energy Development Guidelines for Planning Authorities'* (2006) are also currently the subject of a targeted review. The proposed changes to the assessment of impacts associated with onshore wind energy developments are outlined in the document *'Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review'* in relation to noise, proximity and shadow flicker (December, 2013). A consultation process in relation to the document is currently being undertaken by DECLG. In advance of the updated Wind Energy Development Guidelines being published, the noise and shadow flicker predictions presented in this EIS therefore also consider the current consultation guidance with regard to the proposed development.

This EIS will accompany the planning application for the proposed development to be submitted to An Bord Pleanála. On 22nd July 2016, An Bord Pleanála determined that the proposed development met the requirements for Strategic Infrastructure Development (SID) under Section 37b of the Planning and Development Act, 2000 as amended.

This EIS has been prepared in line with the requirements of the amended Environmental Impact Assessment (EIA) Directive 2014/52/EU which came into force on the 15th May 2014 and Directive 2011/92/EU of 13th December 2011 on the assessment of the effects of certain public and private projects on the environment. Member States have until 16th May 2017 to transpose the amended EIA Directive into national legislation.

1.2 The Applicant

The applicant for the proposed development is Bord na Móna Powergen Ltd., a subsidiary of Bord na Móna plc. Bord na Móna plc is a publically owned company, originally established in 1946 to develop and manage some of Ireland's extensive peat resources on an industrial scale, in accordance with government policy at the time.

Bord na Móna's lands extend to approximately 80,000 hectares in total and are located mainly in the Irish midlands. In 2011, Bord na Móna published a *'Strategic Framework for the Future Use of Peatlands'*, which reviews and assesses the land bank resource, identifies key issues and considers options for future land-use. The Strategy recognises that the potential for the development of wind energy as an after-use of cutaway peatlands is significant. Bord na Móna has since conducted a detailed site selection exercise to identify the optimal site for development of a large-scale wind energy project. The result of that exercise indicated that a significant number of sites within the Bord na Móna landbank would meet the relevant criteria, with Cloncreen bog being identified as the optimal site for the proposed development. The assessment of the suitability of sites for this type of development is an ongoing process within Bord na Móna Powergen Ltd. and is subject to technical, commercial, national and local plan and policy influences.

Bord na Móna Powergen currently manages and operates a portfolio of thermal and renewable assets, namely Edenderry Power Plant a peat/biomass generating unit, Cushaling peaking plant, Bellacorick, Mountlucas and Bruckana wind farms, and the Drehid landfill gas facility. Included in this portfolio of assets is Mountlucas Wind Farm, comprising 28 No. wind turbines, which is located approximately four kilometres west of the Cloncreen site and has been in operation since 2014.

1.3 Brief Description of the Proposed Development

The proposed development comprises the construction of 21 No. wind turbines and all associated works. The proposed turbines will have a blade tip height of up to 170 metres. The applicant is seeking a ten-year planning permission. The full description of the proposed development, as per the public planning notices, is as follows:

i. 21 No. wind turbines with an overall blade tip height of up to 170 metres and all associated hard-standing areas.
ii. 1 No. borrow pit.
iii. 1 No. permanent Anemometry Mast up to a height of 120 metres.
iv. Provision of new site access roads and associated drainage.
v. 1 no. 110 kV Electrical substation, which will be constructed at one of two possible locations on site: either Option A in Ballykilleen townland or Option B in Cloncreen townland. The electrical substation will have 2 no. control buildings, associated electrical plant and equipment, and waste water holding tank.
vi. 2 No. temporary construction compounds, one of which will be located in the townland of Esker More and the other at one of two possible locations: either Option A in Ballykilleen townland or Option B in Cloncreen townland.
vii. All associated underground electrical and communications cabling connecting the turbines to the proposed substation at either Ballykilleen or Cloncreen townland.
viii. All works associated with the connection of the proposed wind farm to the national electricity grid, which will be either to the existing Cushaling substation via underground cable (Option A) or to the existing Thornsberry/Cushaling 110 kV line via overhead line (Option B).
ix. Demolition of existing canteen 'tea centre' building.
x. Removal of existing telecommunications mast.
xi. Removal of existing meteorological mast.

xii. New access junctions, improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and construction access, including: temporary upgrade of R420/R402 junction, temporary road widening at 1 no. location on R402 in Ballinagar, upgrade of R402/L1003 junction, road upgrade along the L1003 and new construction phase site entrance, and upgrade of existing site entrance on R401.
xiii. All associated site development works.

The site of the proposed development measures 960 hectares. The maximum proposed permanent footprint of the proposed development measures 40.1 hectares, which represents approximately 4% of the primary study area.

The planning application for the proposed wind farm includes for all necessary connections to the electricity grid. All elements of the proposed project, including grid connection, have been assessed as part of this EIS.

The planning application includes 2 No. substations and associated grid connections; however, only one substation and associated grid connection will ultimately be constructed. The proposed wind farm will connect to the grid via one of the following methods:

- **Option A**: construction of a 110 kV substation in the eastern section of site, to connect to existing 110 kV Cushaling substation at Edenderry Power Plant. Connection will be via underground cable approx 1.7km in length, located within Bord na Móna lands and curtilage of the public road.

Or

- **Option B**: construction of a 110 kV substation in southern section of site, to connect to existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site. Connection will be via two short sections of overhead line, (less than 0.1km).

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

1.4 Need for the Proposed Development

1.4.1 Renewable Energy Targets

In the context of increasing energy demand and prices, uncertainty in energy supply and the effects of climate change, our ability to harness renewable energy such as wind power plays a critical role in creating a sustainable future.

The Department of Environment, Heritage and Local Government has set a target for Ireland of 40% of total electricity consumption to come from renewable resources by 2020, as part of an overall renewable energy target of 16%. This target forms part of the Government's strategy to make the green economy a core component of its economic recovery plan for Ireland. It is envisaged that wind energy will provide the largest source of renewable energy in achieving this target. To achieve the target of 40% of total electricity consumption coming from renewable sources will require the installation of 3,931 Megawatts (MW) of wind farm projects in Ireland by 2020.

EU countries have agreed on a new 2030 Framework for climate and energy, including EU-wide targets and policy objectives for the period between 2020 and 2030. These targets aim to help the EU achieve a more competitive, secure and sustainable energy system and to meet its long-term 2050 greenhouse gas reductions target. The specific targets include at least a 27% share of renewable energy consumption.

Looking beyond 2020, Ireland will therefore have to meet even more demanding climate change and renewable energy supply obligations in order to play its part in achieving the European climate and energy ambitions. In addition, Ireland currently has one of the highest external dependencies on imported sources of energy, such as coal, oil and natural gas. The development of additional indigenous wind energy generating capacity will not only help to reduce carbon emissions but will also improve Ireland's security of energy supply.

The proposed project will be capable of providing power to approximately 33,007 households every year. See detailed calculations in Section 3.3.1.6 of this EIS.

1.4.2 Reduction of Carbon Emissions

This production of renewable energy will assist in achieving the Government's and EU's stated goals of ensuring safe and secure energy supplies, promoting an energy future that is sustainable and competitively priced to consumers whilst combating energy price volatility and the effects of climate change. The recently published Energy White Paper in 2015 outlines an ambitious Greenhouse gas reduction target of between 80% to 95% out to 2050. Furthermore, if national carbon emissions targets are divided out amongst each county, each Local Authority may be responsible for meeting its own targets. In addition to a reduced dependence on oil and other imported fuels, the generation of electricity from wind power by the proposed development will displace between approximately 2.2 to 4.2 million tonnes of carbon emissions from the largely carbon-based traditional energy mix, depending on the methodology used (based on the SEM Mid-Merit Plant, EU-Fossil Fuel Comparator (FFC) and 'Load Following' Combined Cycle Gas Turbine Plants, as described in section 9.2 of this EIS).

1.4.3 Economic Benefits

'The Value of Wind Energy to Ireland' report, published by Pőyry in March 2014, states that growth of the wind sector in Ireland could support 23,850 jobs (construction and operational phases) by 2030. If Ireland instead chooses to develop no more wind, then by 2030 the country will be reliant on natural gas for most of our electricity generation, at a cost of €671 million per annum in fuel import costs.

At a Regional Level, the proposed development will help to supply the rising demand for electricity, resulting from renewed economic growth, in the Midlands region. The EirGrid report *'All-island Generation Capacity Statement 2016 – 2025'* (SONI & EirGrid, 2016) notes that with a return to electricity demand growth in recent years and strongly positive economic predictions for the next decade, electricity demand forecasts are high over this time. During construction, additional employment will be created in the region through the supply of services and materials to the wind farm.

The proposed development will also have a number of long-term and short-term benefits for the local economy. The proposed development will represent an investment of approximately €110 million in the local area, with approximately €30 million of the total cost relating to on-site works, relying heavily on local contractors and suppliers.

The project will create up to 120 jobs during the construction phase which is expected to last 18 to 24 months. In addition to this, there will also be income generated by local employment from the purchase of local services. On a long-term scale, the proposed development will create up to six jobs during the operational phase relating to the maintenance and control of the wind farm.

The proposed wind farm also creates an opportunity to generate real tangible benefits for the local community who may not have a direct involvement in the project. It is proposed to deliver these benefits through a Community Gain Scheme, which will invest approximately €1.88 million in the local community over the life of the project. Bord na Móna Powergen Ltd. currently oversees two existing Community Gain Schemes for the Mountlucas and Bruckana Wind Farms. In addition to the Community Gain Scheme, two additional schemes in relation to the proposed Cloncreen wind farm are being explored with the local community. These are a Near Neighbour scheme and a Community Ownership Scheme. Further details on proposed local and community benefits are presented in Section 3.4 of this EIS.

1.5 Purpose and Scope of the EIS

The purpose of this EIS is to document the current state of the environment in the vicinity of the proposed development site and to quantify the likely significant effects of the proposed development on the environment. The compilation of this document served to highlight any areas where mitigation measures may be necessary in order to protect the surrounding environment from the possibility of any negative effects arising from the proposed development.

It is important to distinguish the Environmental Impact Assessment (EIA) to be carried out by An Bord Pleanála, from the Environmental Impact Statement (EIS) accompanying the planning application. The EIA is the assessment carried out by the competent authority, which includes an examination that identifies, describes and assesses in an appropriate manner, in the light of each individual case and in accordance with Articles 4 to 11 of the Environmental Impact Assessment Directive 2011/92/EU (as amended), the direct and indirect effects of the proposed development on the following:

a) human beings, flora and fauna,
b) soil, water, air, climate and landscape,
c) material assets and the cultural heritage, and
d) the interaction between the factors mentioned in paragraphs (a), (b) and (c).

The EIS submitted by the applicant provides the relevant environmental information to enable the EIA to be carried out by the competent authority. The information to be contained in the EIS is prescribed by statutory regulation.

1.6 Structure and Content of the EIS

1.6.1 General Structure

This EIS uses the grouped structure method to describe the existing environment, the potential effects of the proposed development thereon and the proposed mitigation measures. Background information relating to the proposed development, scoping and consultation undertaken and a description of the proposed development are presented in separate sections. The grouped format sections describe the effects of the proposed development in terms of human beings, flora and fauna, soils and geology, water, air and climate, noise, landscape, cultural heritage and material assets such as traffic and transportation, together with the interaction of the foregoing.

The chapters of this EIS are as follows:

- Introduction
- Background to the Proposed Development
- Description of the Proposed Development
- Human Beings
- Flora and Fauna
- Ornithology
- Geology and Soils
- Hydrology and Hydrogeology
- Air and Climate
- Noise
- Landscape
- Cultural Heritage
- Material Assets
- Interactions of the Foregoing

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

1.6.2 Description of Likely Significant Effects

As stated in the *'Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2002), an assessment of the likely effects of a proposed development is a statutory requirement of the EIA process. The statutory criteria for the presentation of the characteristics of potential effects requires that potential significant effects are described with reference to the extent, magnitude, complexity, probability, duration, frequency, reversibility and trans-frontier nature (if applicable) of the effect.

The classification of effects in this EIS follows the definitions provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- *'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements'* (EPA, 2003)
- *'Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2002)

Table 1.2 presents the glossary of impacts as published in the EPA guidance documents. Standard definitions are provided in this glossary, which permit the evaluation and classification of the quality, significance, duration and type of effects associated with a proposed development on the receiving environment. The use of standardised terms for the classification of effects ensures that the EIA employs a systematic approach, which can be replicated across all disciplines covered in the EIS, as advised in *'Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2002). The consistent application of terminology throughout the EIS facilitates the assessment of the proposed development on the receiving environment.

Table 1.2 Classification Terminology (EPA, 2002/3)

Characteristic	Type	Description
Quality	Positive	A change which improves the quality of the environment.
	Neutral	A change which does not affect the quality of the environment.
	Negative	A change which reduces the quality of the environment.
Significance	Imperceptible	An impact capable of measurement but without noticeable consequences.
	Slight	An impact 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 impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
	Profound	An impact which obliterates sensitive characteristics.
Duration	Short-term	Impact lasting one to seven years
	Medium-term	Impact lasting seven to fifteen years
	Long-term	Impact lasting fifteen to sixty years
	Permanent	Impact lasting over sixty years
	Temporary	Impact lasting for one year or less
Type	Cumulative	The addition of many small effects to create one larger, more significant, impact
	'Do Nothing'	The environment as it would be in the future should no development of any kind be carried out.
	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 impact is of greater significance than the sum of its constituents.
	'Worst Case'	The effects arising from a development in the case where mitigation measures substantially fail.

Each effect is described in terms of its quality, significance, duration and type, where possible. A 'Do-Nothing' effect is also predicted in respect of each environmental theme in the EIS. Residual effects are also presented following any effect for which mitigation measures are prescribed. The remaining effect types are presented as required or applicable throughout the EIS.

1.7 Project Team

1.7.1 Project Team Responsibilities

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

The EIS project team comprises a multidisciplinary team of experts with extensive experience in the assessment of wind energy developments and in their relevant area of expertise. The qualifications and experience of the principal staff from each company involved in the preparation of this EIS are summarised in Section 1.7.2 below. Each chapter of this EIS has been prepared by a competent expert in the subject matter. Further details on project team expertise are provided in the Statement of Authority at the beginning of each impact assessment chapter.

Table 1.3 Project Team

Consultants	Principal Staff Involved in Project	EIS Input
McCarthy Keville O' Sullivan Ltd. Block 1 GFSC Moneenageisha Road Galway	Brian Keville Michael Watson Jimmy Green Lorraine Meehan Pat Roberts Dervla O' Dowd Barry O'Loughlin Susan Doyle Evelyn Sikora Dr. John Staunton Owen Cahill James Newell	EIS Project Managers, Scoping and Consultation, Preparation of Natura Impact Statement, EIS Sections: ▪ 1. Introduction ▪ 2. Background to the Proposed Development ▪ 3. Description of the Proposed Development ▪ 4. Human Beings ▪ 5. Flora & Fauna ▪ 6. Ornithology ▪ 9. Air & Climate ▪ 11. Landscape & Visual ▪ 13. Material Assets (non-Traffic) ▪ 14. Interaction of the Foregoing
Hydro Environmental Services 22 Lower Main Street Dungarvan Co. Waterford	Michael Gill David Broderick Grainne Barron	Flood Risk Assessment, Drainage Design, Preparation of EIS Sections: ▪ 7. Soils & Geology ▪ 8. Hydrology & Hydrogeology
Applied Ground Engineering Consultants (AGEC) The Grainstore Singletons Lane Bagnelstown Co. Carlow	Gerry Kane Paul Jennings	Preparation of Peat Stability Assessment & Peat Management Plan

Consultants	Principal Staff Involved in Project	EIS Input
AWN Consulting The Tecpro Building Clonshaugh Business & Technology Park Dublin 17	Damian Kelly Dermot Blunnie	Baseline Noise Survey, Preparation of EIS Section 10: Noise and Vibration
Tobar Archaeological Services Saleen Midleton Co. Cork	Annette Quinn Miriam Carroll	Preparation of EIS Section 12: Cultural Heritage
Alan Lipscombe Traffic and Transport Consultants Claran, Headford, Co. Galway	Alan Lipscombe	Swept Path Analysis, Preparation of EIS Section13: Material Assets - Traffic and Transport

1.7.2 Project Team Members

1.7.2.1 McCarthy Keville O'Sullivan Ltd.

Brian Keville B.Sc. (Env.)

Brian Keville has over 15 years' professional experience as an environmental consultant having graduated from the National University of Ireland, Galway with a first class honours degree in Environmental Science. Brian was one of the founding directors of environmental consultancy, Keville & O'Sullivan Associates Ltd., prior to the company merging in 2008 to form McCarthy Keville O'Sullivan Ltd. Brian's professional experience has focused on project and environmental management, and environmental impact assessments. Brian has acted as project manager and lead-consultant on numerous environmental impact assessments, across various Irish counties and planning authority areas. These projects have included large infrastructural projects such as roads, ports and municipal services projects, through to commercial, mixed-use, industrial and renewable energy projects. The majority of this work has required liaison and co-ordination with government agencies and bodies, technical project teams, sub-consultants and clients.

Michael Watson, MA; MCIWM

Michael Watson has over 15 years' experience in the environmental sector. Following the completion of his Master's Degree in Environmental Resource Management, Geog from National University of Ireland, Maynooth he worked for the Geological Survey of Ireland and then a prominent Cork based private environmental & hydrogeological consultancy. Michael's professional experience includes managing Environmental Impact Assessments on behalf of clients in the wind farm, waste management, commercial and industrial sectors nationally. These projects have required liaising with the relevant local authorities, Environmental Protection Agency (EPA) and statutory consultees as well as coordinating the project teams and sub-contractors. Michael has significant experience in the EPA Industrial Emissions, IPPC and Waste licensing regimes managing licence applications and subsequent regulatory compliance on behalf of clients in the waste and industrial sectors. Michael also has a Bachelor of Arts Degree in Geography and Economics from NUI Maynooth.

Jimmy Green BA, MRUP; MIPI

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

Lorraine Meehan B.Sc. (Env.)

Lorraine Meehan graduated from NUI Galway in May 2006 with a first class honours degree in Environmental Science. Lorraine has gained extensive experience with McCarthy Keville O'Sullivan since joining the company shortly after graduating, working primarily on Environmental Impact Assessments and Strategic Environmental Assessments. Lorraine has acted as Project Manager on numerous Environmental Impact Statements, Constraints & Feasibility Reports and Site Selection Reports for a wide range of projects, including renewable energy projects, roads, power lines and municipal services projects, and large-scale commercial, mixed-use and residential developments. Lorraine has also completed the Introduction, Background to the Proposed Development, Description of the Proposed Development, Human Beings, Air and Climate, Landscape, and Telecommunications sections of these EISs, in addition to numerous site constraints and layout maps, and has coordinated the scoping and consultation exercises with the relevant statutory and non-statutory bodies.

Pat Roberts B.Sc. (Env.)

Pat Roberts joined MKO (then Keville & O'Sullivan Associates) in 2005 following completion of a B.Sc. in Environmental Science. Prior to joining the company, Pat worked extensively in Ireland, the USA and UK as a tree surveyor, having previously worked with The National Trust in Cornwall for three years. He also has over five years' practical conservation experience working both as a volunteer and employee in National Parks in Texas, Utah and at Exmoor National Park in the UK. Patrick has worked as project manager and ecologist on over 150 ecological assessments completed by the company to date, including a wide range of work within sensitive ecological areas. He has extensive experience of on-site supervision of construction and civil engineering works and has worked closely with construction personnel at the set up stage of construction sites in the design systems to prevent environmental damage.

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

Dervla graduated with a first class honours B.Sc. in Environmental Science from NUI, Galway in 2005 and joined Keville O'Sullivan Associates in the same year. Dervla has gained extensive experience in the project management and ecological assessment of the impacts of various infrastructural projects including wind energy projects, water supply schemes, road schemes and housing developments nationwide and has also been involved in the compilation of Environmental Impact Statements, with emphasis on sections such as Flora & Fauna, and acted as EIS coordinator on many of these projects. Dervla has also provided site supervision for infrastructural works within designated conservations areas and has also been involved in the development of environmental/ecological educational resource materials. Currently, Dervla is responsible for coordinating ecological work required on major infrastructural projects, with emphasis on wind energy projects.

Barry O'Loughlin B.Sc. (Env), M.Sc.
Barry O'Loughlin is an experienced ecologist with over seven years' professional experience in the area of ecological consultancy. He holds a B.Sc. in Environmental Science from NUI Galway (2008) and a Master's degree in Applied Ecology, from University College Cork (2010). Prior to joining McCarthy Keville O'Sullivan as Project Ecologist in March 2015, Barry worked as a Senior Project Ecologist in an environmental and engineering firm based in Cork and worked as a project ecologist for over four years in Co. Kerry where he led and managed a wide range of development projects including wind farms, overhead and underground electricity transmission projects, quarry and ancillary developments, flood relief schemes, road schemes, etc. He has undertaken extensive habitat surveys and mapping for large scale development led and conservation led projects nationwide.

Barry possesses a broad range of experience in habitat survey and mapping, flora and bryophyte identification, ornithological survey and monitoring, wetland inventory surveys, peatland assessments, baseline ecological surveys, Geographical Information Systems (GIS), report compilation, mammal surveys, nature conservation studies and ecological monitoring. He is a regular contributor to the Irish Wetland Bird Survey (IWeBS) with BirdWatch Ireland (BWI) and The Irish Hen Harrier Winter Roost Survey with NPWS.

Susan Doyle B.Sc., M.Sc.
Susan is a qualified assistant ecologist with McCarthy Keville O'Sullivan. She completed her primary degree in Zoology at Trinity College Dublin and went on to complete her Masters in Ecological Assessment at University College Cork. Susan has extensive field survey skills, including vegetation relevés of vascular plants and bryophytes, habitat identification and mapping, winter and breeding bird survey, bat survey, small mammal survey, terrestrial invertebrate and freshwater macroinvertebrate sampling and animal radiotracking. Susan is trained in the ecological applications of GIS, MapInfo and statistics programmes used in the analysis and interpretation of ecological data. She also has experience in Annex I habitat quality assessment, Phase 1 habitat survey, Ecological Impact Assessment and Appropriate Assessment (including Natura Impact Statements).

Evelyn Sikora BA, MPLAN, MIPI
Evelyn Sikora graduated as from Edinburgh College of Art with a degree in Landscape Architect and also holds a Masters in Planning and Sustainable Development from University College Cork (2010). She has worked as a Landscape Architect on a range of projects including commercial, residential and recreational projects and has also experience in planning projects relating to employment, recreation and natural heritage. Evelyn has completed the Landscape and Visual Impact Assessment for numerous wind farm projects, ranging from single-turbine developments to large-scale projects of up to 50 turbines. Evelyn is a Corporate member of the Irish Landscape Institute.

John Staunton PhD, B.Sc. (Env.)
John Staunton joined McCarthy Keville O'Sullivan Ltd. in October 2014 following completion of a PhD and B.Sc. in Environmental Science. His main duties include input

into EISs and other reports, ecological surveys, planning and literature searches, landscape impact assessment and site visits. John has proven report writing, presentation and interpersonal skills and can work well with large interdisciplinary teams. Prior to joining the team at MKO, John developed many project design, field, laboratory, data analysis and writing skills during his PhD research and research assistant positions.

Owen Cahill B.Sc., M.Sc.
Owen Cahill joined MKO as an Environmental Engineer in October 2013. Owen completed a Master's Degree in Environmental Engineering at Queens University Belfast, following his primary degree in Construction Management. Owen brings considerable experience to his role having previously worked for a Belfast-based environmental consultancy and large-scale building and civil engineering contractors in the West of Ireland. Owen has gained considerable experience in Hydrogeology, Renewable Technologies, Water & Wastewater Engineering, Contaminated Land, Waste Management & Engineering Hydrology. Owen previously worked as an Environmental Technician with Pentland MacDonald, Environmental Consultancy specialising in contaminated land and as a Site Engineer with O' Malley Construction based in Co. Galway.

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

1.7.2.2 Hydro Environmental Services Ltd.

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

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

Grainne Barron
Grainne is an environmental scientist and prepares all HES graphics using a variety of mapping and illustration software (AutoCAD, ArcGIS, Mapinfo etc). She has a keen eye for detail and colour and can apply her knowledge and experience to create aesthetic and creative graphical output for all types of projects.

1.7.2.3 AGEC Ltd.

The geotechnical aspects of the report, which will be incorporated into the Geology & Soils and Hydrology & Hydrogeology sections of the EIS, will be completed by AGEC Ltd. AGEC has extensive experience in the production of Peat Stability Assessments for wind energy developments. AGEC provides specialist geotechnical engineering and engineering geology advice to local authorities, contractors and consultants, particularly for infrastructure projects forming part of the National Development Plan and also for private commercial and residential developments as they move on to sites with more complex ground conditions.

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

Paul Jennings
Paul Jennings is a Senior Geotechnical Engineer and Director of AGEC with over 25 years' experience of design and construction of sub-surface structures, foundations, earthworks, infrastructure and earth-retaining structures; planning, supervision and interpretation of ground investigation; and providing expert geotechnical advice and reporting. Paul has particular experience in providing expert advice for slope stability problems, soft ground engineering, infrastructure, deep-excavations and forensic investigation of landslides.

1.7.2.4 AWN Consulting Ltd.

Damian Kelly
Damian Kelly (Principal Acoustic Consultant) holds a B.Sc. from DCU and a M.Sc. from QUB. He has over 15 years' experience as an acoustic consultant and is a member of the Institute of Acoustics. He has extensive knowledge in the field of noise modelling and prediction, having developed many of the largest and most complex examples of proprietary noise models prepared in Ireland to date. He has extensive modelling experience in relation to wind farm, industrial and road infrastructure projects. He is a sitting member of the committee of the Irish Brach of the Institute of Acoustics.

Dermot Blunnie
Dermot Blunnie (Acoustic Consultant) holds a MSc in Applied Acoustics and has completed the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control. He is also an associate member of the IOA. He has extensive knowledge in aspects of environmental surveying, modeling and impact assessment, particularly for wind energy developments.

1.7.2.5 Tobar Archaeological Services

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

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

1.7.2.6 Alan Lipscombe Traffic and Transport Consultants

Alan Lipscombe (B.Eng. Hons.) MIHT

In January 2007 Alan Lipscombe set up an independent traffic and transportation consultancy providing advice for a range of clients in the private and public sectors. Prior to this Alan was a founding member of Colin Buchanan's Galway office having moved there as the senior transportation engineer for the Galway Land Use and Transportation Study. Since the completion of that study in 1999, Alan has worked throughout the West of Ireland on a range of projects including: major development schemes, the Galway City Outer Bypass, Limerick Planning Land-Use and Transportation Study, Limerick Southern Ring Road Phase II, cost benefit analyses (COBA) and various studies for the NUI Galway. Before moving to Galway in 1997, Alan was involved in a wide variety of traffic and transport studies for CBP throughout the UK, Malta and Indonesia. He has particular expertise in the assessment of development related traffic and transport modelling and is an accomplished analyst who has experience of a wide variety of modelling packages and methods.

2 BACKGROUND TO THE PROPOSED DEVELOPMENT

This section of the EIS presents information on Energy and Climate Change policy and targets, the strategic planning context for the proposed development, the site selection and design process, a description of the proposed development site and planning history, the assessment of alternatives, scoping and consultation, and the cumulative impact assessment process.

2.1 Energy Policy and Targets

2.1.1 Renewable Energy

Renewable energy resources include solar, wind, water (hydropower, wave and tidal), heat (geothermal) and biomass (wood, waste) energy. These sources are constantly replenished through the cycles of nature, unlike fossil fuels, which are finite resources that are becoming increasingly scarce and expensive to extract. Renewable energy resources offer sustainable alternatives to our dependency on fossil fuels as well as a means of reducing greenhouse gas emissions and opportunities to reduce our reliance on imported fuels. These resources are abundantly available in Ireland, yet only a fraction has been tapped so far (*Sustainable Energy Authority of Ireland* (SEAI) website, www.seai.ie). A gradual shift towards increasing our use of renewable energy resources would result in:

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

Renewable energy development is recognised as a vital component of Ireland's strategy to tackle the challenges of combating climate change and ensuring a secure supply of energy. Ireland is heavily dependent on the importation of fossil fuels in order to meet its energy needs, with imported fossil fuels accounting for 85% of all energy consumed in Ireland in 2014, at an estimated cost of €5.7 billion *('Energy Security in Ireland: A Statistical Overview'* (SEAI, January 2016).

2.1.2 EU Policy

The European Union (EU) Directive on the Promotion of the Use of Energy from Renewable Sources (Directive 2009/28/EC) was adopted on 23rd April 2009. This Directive establishes a binding target of 20% of overall EU energy consumption to come from renewable sources by 2020, as well as a binding 10% minimum target for energy from renewable resources in the share of transportation fuels. Ireland's target under Directive 2009/28/EC is for renewable resources to account for 16% of total energy consumption by 2020. Directive 2009/28/EC legally obliges each Member State to:

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

Failure to meet EU targets on the use of energy from renewable sources could result in sanctions in the form of EU fines.

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

The Framework sets three key targets for the year 2030:

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

Ireland currently has no national targets for 2030 and the process of allocating the EU targets at Member State level has been ongoing since 2014. The European Commission published its proposal for an effort sharing regulation on the allocation of national targets for greenhouse gas emissions for the period 2021-2030 in July 2016. The proposal implements EU commitments under the Paris agreement on climate change (COP21) which discussed below in Section 2.2.2.2.2, and marks an important milestone in the allocation to Member States of a package of climate targets that were formally adopted as part of the 2030 Climate and Energy Framework.

2.1.3 National Policy

2.1.3.1 National Strategy for Intensifying Wind Energy Development 2000

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

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

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

2.1.3.2 Ireland's Energy Policy Framework 2007 – 2020

A Government White Paper entitled *'Delivering a Sustainable Energy Future for Ireland: The Energy Policy Framework 2007 – 2020'* was published by the Department for Communications, Marine and Natural Resources in 2007. In 2014, 85% of Irish energy requirements were imported, as described in Section 2.1.1 above. Combined with our peripheral location, this reality leaves Ireland vulnerable to supply disruption and imported price volatility, as stated in the White Paper. The primary objectives of the Government's energy policy as set out in the Paper are security of supply, environmental sustainability and economic competitiveness. The Energy Policy Framework 2007 – 2020 sets out clear actions, targets and timeframes for meeting these interlinked objectives.

Ireland's energy policy priorities are framed in the context of the European Union. Directive 2009/28/EC on the Promotion of the Use of Energy from Renewable Sources sets a target for Ireland for 16% of energy consumption to come from renewable sources by 2020. This target will be made up of contributions from renewable energy in electricity (RES-E), renewable energy in transport (RES-T) and renewable energy for heat and cooling (RES-H):

- RES-E: Renewables contribution to gross electricity consumption 40% by 2020;
- RES-T: Renewables (biofuels & the renewable portion of electricity) contribution to transport energy 10% by 2020; and
- RES-H: Renewable contribution to heat (Thermal requirement - heating & cooling) 12% by 2020.

The 2007 Government White Paper sets a more ambitious target of 33% for energy consumption from renewable sources by 2020. In Ireland, it is widely acknowledged that the vast majority of the renewable electricity requirement is expected to be met through the development of indigenous wind power, as Ireland has a strong wind resource potential, with one of the best onshore wind speed averages in Europe (*'The Value of Wind Energy to Ireland',* Pőyry, 2014).

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

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

As of September 2016, there are 240 wind farms on-line and operational, in 27 counties on the island of Ireland. The current grid connected and operational installed wind capacity on the island of Ireland is 3,083 Megawatts (MW). It is estimated that 1 MW of wind capacity can provide enough electricity to supply approximately 650 homes. Based on this figure, an installed capacity of 3,083MW can provide enough electricity to power over 2 million homes. (Source: IWEA website, figures correct as of 6th September 2016).

2.1.3.3 Strategy for Renewable Energy 2012 – 2020

The Government's Strategy for Renewable Energy 2012 – 2020 was published by the Department of Communications, Energy and Natural Resources in May 2012. It acknowledges the national importance of developing renewable energy and confirms the Government's commitment to this. It notes the significant potential for Ireland to become a renewable energy exporter within a short time and the Strategy seeks to realise this.

The Strategy sets out 5 no. strategic goals, the first of which is as follows:

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

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

- *Support delivery of the 40% target for renewable electricity through the existing GATE processes. A further targeted Gate may be developed, if necessary, following a review of the take-up of Gate 3 offers, while developing a next phase plan led approach for additional onshore capacity in future.*
- *Review with the Department of Environment and CER the scope for further streamlining authorisation and planning processes for renewable energy projects.*
- *Implement REFIT 2 for onshore renewable energy and maintain a predictable and transparent REFIT support framework for onshore wind which is cost competitive.*
- *Provided the cost benefit analysis is positive, put in place the necessary legal and planning and infrastructure framework to support the development of onshore and offshore wind as an export opportunity without cost for the Irish consumer and to the benefit of the economy, in the context of the cooperation mechanisms under the Directive.*

2.1.3.4 White Paper on Energy Policy in Ireland 2015 – 2030

On 12th May 2014, *The Green Paper on Energy Policy in Ireland* was launched, marking the start of a public consultation process on the future of Ireland's energy policy over the medium to long-term. The Department of Communications, Climate Action & Environment acknowledged that energy is an integral part of Ireland's economic and social landscape and that *"a secure, sustainable and competitive energy sector is central to Ireland's ability to attract and retain Foreign Direct Investment and sustain Irish enterprise. The three key pillars of energy policy are to focus on security, sustainability and competitiveness".* (Source: http://www.dcenr.gov.ie/energy/ga-ie/Energy-Initiatives/Pages/White-Paper-on-Energy-Policy-in-Ireland-.aspx)

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

The White Paper states the advances in Ireland's energy efficiency and renewable energy and generation use between 2007 and 2015. Renewable electricity sources (which include wind) accounted for nearly 23% of Ireland's electricity consumption in 2015, which is just over halfway to Ireland's 2020 target of 40% (*Energy in Ireland: Key Statistics 2015'*, SEAI, December 2015).

The policy framework sets out a vision for a low carbon future that maintains Ireland's competitiveness and ensures a supply of affordable energy. The paper advises that a range of policy measures will be employed to achieve this vision and will involve amongst many things, generating electricity from renewable sources of which there a plentiful indigenous supplies and increasing the use of electricity and bio energy to heat homes and fuel transport.

The White Paper states that onshore wind continues to be the main contributor of renewable energy, -18.2% of total generation and 81% of renewable electricity (RES-E) in 2014. The White Paper indicates that a total of 3,500-4000 MW of onshore renewable generation capacity is likely to be required to achieve the 2020 target of 40% RES-E. To achieve this target, the average rate of build of onshore wind generation will need to increase up to 260 MW per year from the current rate of build which is about 170 MW per year.

2.2 Climate Change Policy and Targets

2.2.1 The Impacts of Climate Change

Climate change in the context of EU and national policy refers to the change in climate that is attributable to human activity arising from the release of greenhouse gases into the atmosphere and which is additional to natural climate variability (Department of the Environment, Heritage and Local Government, 2006). In 2008, the Environmental Protection Agency (EPA) published the results of a study entitled *'Climate Change – Refining the Impacts for Ireland'*, as part of the STRIVE (Science, Technology, Research and Innovation) Programme 2007 – 2013. This report states that mean annual temperatures in Ireland have risen by 0.7 ° Celsius (C) over the past century. Mean temperatures in Ireland relative to the 1961 to 1990 averages are likely to rise by 1.8 to 4.0° C by the 2050's and by in excess of 2° C by the end of the century due to climate change.

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

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

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

2.2.1.1 Water Resource Management

The hydrological impacts of projected climate change will encompass significant reductions in soil moisture storage in the nine representative catchments across Ireland. Soil moisture deficits will commence earlier and extend later in the year as the century proceeds. This will result in a tendency for groundwater recharge to be lower for longer, sustained periods, increasing the risk of drought when a dry summer follows a drier than average winter. The STRIVE report states that such impacts would be felt greatest in catchments more dependent on groundwater, such as the Suir, Blackwater and Barrow. Significant changes in streamflow are likely to occur, with implications for flood management in Winter and water resource availability in Summer:

"In the vital water supply rivers of the east, for example, streamflow reductions in excess of 70% can be expected for some autumn months by the end of the century."

2.2.1.2 Agriculture

The STRIVE report states that the principal challenges to agriculture will come from wetter Winter and drier Summer soils, though increased temperatures will also play an important role. Different challenges will be posed in different regions, depending on crop type and dairying output. The report stresses however that Irish agriculture can, if positioned appropriately, adapt successfully to the challenges of climate change.

2.2.1.3 Biodiversity and Natural Ecosystems

Changes in species behaviour and viability and in ecosystem distribution across Ireland will occur in conjunction with the projected climate changes. Changes in the timing of life-cycle events such as leafing, bud burst and leaf fall can be expected as preliminary responses and will be instrumental in altering biodiversity. The report states that particularly vulnerable ecosystems can be identified where successful adjustment to new conditions is unlikely. The most vulnerable habitats include sand dunes, lowland calcareous grasslands, montane heath, raised bogs, calcareous fens, turloughs and upland lakes. Increased decomposition of Irish peatlands will be facilitated mainly by cracking during drier periods and will be further exacerbated by compositional changes. The suitable climate area for fens may have declined by 40% by mid-century with corresponding losses for raised and blanket bogs of over 30% and 45% for turloughs over the same period.

2.2.2 Greenhouse Gas Emission Targets

2.2.2.1 Background

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

2.2.2.2 Targets for Reductions in Greenhouse Gas Emissions

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

2.2.2.2.1 Doha Amendment to the Kyoto Protocol

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

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

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

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

2.2.2.2.2 COP21 Paris Agreement

COP21 was the 21st session of the Conference of the Parties (COP) to the United Nations Convention. Every year since 1995, the COP has gathered the 196 Parties (195 countries and the European Union) that have ratified the Convention in a different country, to evaluate its implementation and negotiate new commitments. COP21 was organised by the United Nations in Paris and held from 30th November to 12th December 2015.

COP21 closed on 12th December 2015 with the adoption of the first international climate agreement (concluded by 195 countries and applicable to all). The twelve-page text, made up of a preamble and 29 articles, provides for a limitation of the temperature rise to below 2°C and even to tend towards 1.5°C. It is flexible and takes into account the needs and capacities of each country. It is balanced as regards adaptation and mitigation, and durable, with a periodical ratcheting-up of ambitions.

2.2.2.2.3 Emissions Projections

In 2016, the EPA published an update on Ireland's Greenhouse Gas Emission Projections to 2020. Ireland's target is to achieve a 20% reduction of non-Emissions Trading Scheme (non-ETS) sector emissions, i.e. agriculture, transport, residential, commercial, non-energy intensive industry and waste, on 2005 levels, with annual binding limits set for each year over the period 2013 – 2020.

Greenhouse gas emissions are projected to 2020 using two scenarios; *'With Measures'* and *'With Additional Measures'.* The *'With Measures'* scenario assumes that no additional policies and measures, beyond those already in place by the end of 2014 are implemented. The *'With Additional Measures'* scenario assumes implementation of the 'With Measures' scenario in addition to full achievement of Government renewable and energy efficiency targets for 2020, as set out in the National Renewable Energy Action Plan and the National Energy Efficiency Action Plan.

The EPA Emission Projections Update notes the following key trends:

- Ireland's non-Emissions Trading Scheme (ETS) emissions are projected to be 6% and 11% below 2005 levels in 2020 under the 'With Measures' and 'With Additional Measures' scenarios, respectively. The target for Ireland is a 20% reduction.

- Ireland is projected to exceed its annual binding limits in 2016 and 2017 under both scenarios, 'With Measures' and 'With Additional Measures'.

- Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by 12 Mt CO_2 (metric tonnes of Carbon Dioxide) equivalent under the 'With Measures' scenario and 3 Mt CO_2 equivalent under the 'With Additional Measures' scenario.

The EPA report states that *"Failure to meet 2020 renewable and energy efficiency targets will result in Ireland's emission levels moving even further from its emission reduction targets".* The report also concludes:

- The latest projections estimate that by 2020 non-ETS emissions will be at best 11% below 2005 levels compared to the 20% reduction target. Emission trends from agriculture and transport are key determinants in meeting targets, however emissions from both sectors are projected to increase in the period to 2020.

- It is clear that Ireland faces significant challenges in meeting emission reduction targets for 2020 and beyond (EPA, 2016, *'Greenhouse Gas Emission Projections to 2020 – An Update'*)

2.2.3 National Climate Change Policy

2.2.3.1 National Policy Position on Climate Action and Low Carbon Development

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

2.2.3.2 Climate Action and Low Carbon Development Act 2015

The Climate Action and Low Carbon Development Act 2015 was signed into law on 10 December 2015. The Act provides for the establishment of a national framework with the aim of achieving a low carbon, climate resilient, and environmentally sustainable economy by 2050, referred to in the Act as the "*national transition objective*".

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

- A national mitigation plan (to lower Ireland's level greenhouse emissions);
- A national adaptation framework (to provide for responses to changes cause by climate change);
- Tailored sectoral plans (to specify the adaptation measures to be taken by each Government ministry); and
- Establishment of the Climate Change Advisory Council to advise Ministers and the Government on climate change matters.

2.2.3.3 National Mitigation Plan

Work is currently underway on developing the National Mitigation Plan, the primary objective of which will be to track implementation of measures already underway to reduce greenhouse gas emissions and identify additional measures in the longer term and progress the overall national low carbon transition agenda to 2050. The first iteration of the National Mitigation Plan will place particular focus on putting the necessary measures in place to address the challenge to 2020 but also in terms of planning ahead to ensure that appropriate policies and measures will be in place beyond that.

The Plan will incorporate sectoral mitigation measures to reduce greenhouse gases, to be adopted by relevant Ministers with responsibility for key sectors, including agriculture, transport, energy and the built environment. With regard to energy production, the electricity generation sector will focus on addressing emissions associated with the production of electricity and will include measures to ensure that new technologies can be ready for incorporation into Ireland's electricity system and that the cost of existing technologies can be lowered.

2.2.3.4 National Climate Change Adaptation Framework

Ireland's first National Climate Change Adaptation Framework (NCCAF), which was published in December 2012, aims to ensure that adaptation actions are taken across key sectors and also at local level to reduce Ireland's vulnerability to climate change. The NCCAF requires the development and implementation of sectoral and local adaptation plans which will form part of the national response to the impacts of climate change. Each relevant Government Department (or State Agency, where appropriate) are required to prepare adaptation plans for their sectors. 12 Sectors were identified in total including Transport, Flood Defence, Agriculture and Energy. The Climate Action and Low Carbon Development Act 2015 (see section 2.2.3.2) puts the development of National Climate Change Adaptation Frameworks and Sectoral Adaptation Plans on a statutory basis.

The Climate Action and Low Carbon Development Act 2015 states that the first statutory National Climate Change Adaptation Framework has to be approved by Government by 9 December 2017 and will be reviewed at least every 5 years after that. Following approval of the statutory National Adaptation Framework, Section 6 of the Act requires the Government to request all relevant Government Ministers to prepare sectoral adaptation plans covering the relevant sectors under their remit within a specified time period.

2.3 Strategic Planning Context

2.3.1 National Spatial Strategy 2002 – 2020

The National Spatial Strategy (NSS) is a twenty-year planning framework designed to achieve a better balance of social, economic, physical development and population growth between regions. The Strategy provides a national framework for the long-term development of Ireland, the key aim of which is to promote the potential of regions through policies that attract and generate investment and jobs and encourage more people to live in every region. While it is noted that the successor to the NSS the National Planning Framework (NPF) is currently being prepared in the absence of the NPF it remains pertinent to refer to the NSS as a nationally strategic policy document. Key objectives of the NSS include sustaining a strong competitive economic position, achieving balanced regional development and promoting the economic and social strengths and resources of rural areas. The spatial and sustainability objectives and the environmental protection and climate change objectives of the NSS are described below.

2.3.1.1 Spatial and Sustainability Objectives

The National Spatial Strategy states the need to make best use of natural resources, bring jobs closer to where people live, and ensure a high quality natural and built environment. The fundamental approach of the NSS is to encourage greater spatial balance by strengthening areas and places in a structured way. The spatial structure of Ireland is strongly influenced by the location of investment, which in turn influences where people work and live. Balanced regional development, which is a key objective of the NSS, is the development of the full potential of each area economically, socially and environmentally, in order to contribute to the optimal performance of the state as a whole. Potential and linkages are named as key concepts in this process. Potential relates to the capacity that an area possesses or could in the future possess for development arising from the endowment of its natural resources, infrastructure and location relative to markets. Linkages in terms of good transport, communications and energy networks are vitally important in enabling places and areas to play to their strengths.

The NSS identifies that rural areas play a vital role to play in contributing to balanced regional development. This involves utilising and developing the economic resources of rural areas, including agriculture and food, marine, tourism, forestry and renewable energy. It states that there is a challenge however to support agriculture while at the same time finding alternative employment in or close to rural areas in order to sustain rural communities. The NSS recognises that rural areas that are particularly remote or have structural disadvantages require strategic, targeted measures to support rural population growth.

The NSS states that movement of people to the areas where investment and jobs are generated, or can be drawn to, as well as natural population increase, reinforces the population base of these areas and fuels future population growth. The Strategy recognises that Ireland must continue to trade on its *"green image"*. It states that strong indigenous growth will be sustained and mobile international investment attracted by factors that include reliable access to energy. The NSS also states that business is likely to align itself closely with local strengths, facilities, talents and skills.

Investment opportunities for development in an area are linked to its potential in terms of natural resources, tourism, and access to key energy infrastructure. The NSS identifies that natural resource development, among other sectors, has a key role to play as a primary economic base for vibrant and diversified communities in rural areas and in providing work for which many of the skills required are available locally.

2.3.1.2 Environmental Protection and Climate Change Objectives

The policies and actions of the NSS with regard to protection of the environment focus on limitations on greenhouse gas emissions in the context of the National Climate Change Strategy, measures to support sustainable agriculture and initiatives to address the impact of transport on the environment. The targets and obligations for Ireland with regard to climate change and greenhouse gas emissions are described in Section 2.2.2above.

2.3.2 Draft National Planning Framework

The Department of Housing, Planning, Community and Local Government is currently formulating a new National Planning Framework (NPF) to succeed the NSS. In December 2015, the Department published '*A Road Map for the delivery of the National Planning Framework 2016*' which sets out its scope and content of the proposed NPF:

> *"The NPF will be the long-term, 20-year strategy for the spatial development of Ireland that will promote a better quality of life for all, with sustainable economic growth and an environment of the highest quality as key underlying principles. The NPF will influence regional strategies and county development plans as it will be the central planning policy document for the Country and through this it will provide a clear vision to guide future development and investment decisions".*

Appendix II of the Department's Roadmap documents sets out potential strategic themes for the proposed NPF, including the subject of 'Transitioning to a Low Carbon Society'. It is anticipated that the NPF will be finalised by the first quarter of 2017.

2.3.3 Draft Renewable Electricity Policy and Development Framework

A key objective of the Energy White Paper, discussed above in Section 2.1.3.4, was to publish a '*Renewable Electricity Policy and Development Framework'* (REPDF) to underpin planning and development of larger scale renewable electricity generation development on land. It is envisioned that the REPDF will contribute towards meeting Ireland's future energy needs, particularly up to 2030 and beyond, as informed by national and European policy. The REPDF, which will have a spatial dimension, is intended to optimise the opportunities in Ireland for renewable electricity generation development on land at significant scale, to serve both the All-island Single Electricity Market (SEM) and possible potential, future export markets which may occur post-2020. The Framework will be reviewed at five-yearly intervals.

The Department of Communications, Climate Action & Environment note that the development of the REPDF is to be informed by the carrying out of a Strategic Environmental Assessment (SEA), including compiling an Environmental Report; an Appropriate Assessment (AA) under the Habitats Directive 92/43/EEC, including compiling a Natura Impact Statement; and widespread consultation with the public, stakeholders and certain statutorily designated organisations. The most recent phase of consultation closed on the 22nd April 2016 and it is anticipated that the REPDF will be finalised in the fourth quarter of 2016 to provide guidance to citizens, industry, An Bord Pleanála, and other public authorities, for use in conjunction with the Planning Guidelines on Wind Energy Development and other more general planning guidance.

2.3.4 Regional Planning Guidelines for the Midlands Region 2010 – 2022

The Regional Planning Guidelines for the Midlands Region formulates public policy for the region covering the administrative areas of Counties Laois, Offaly, Westmeath and Longford. The Plan provides a long-term strategic planning framework for the sustainable development of the Region for the period up to 2022 and seeks to implement the planning framework set out in the National Spatial Strategy (NSS) published in 2002, whilst providing direction to County Development Plans.

The broad vision for the Regional Strategy is:

> *"By 2022, the Midland Region will be a successful, sustainable and equitable region full of opportunities for its expanded population."*

Chapter 3 of the RPGs outlining the regional Economic Development Strategy recognises an opportunity for the region to harness the potential for renewable energy development arising from the presence of cutaway bogs. Section 3.3.4.6 acknowledges that renewable energy in all its forms offers significant potential for the development of the rural economy, including, inter alia, wind energy potential, within the broader objective of reducing carbon emissions and developing alternative renewable energy sources. Section 3.4.6.1 'Renewable Energy' supports the development of wind energy generation throughout the region, subject to appropriate siting considerations as set out in the *Wind Energy Development Guidelines*, DoEHLG (2006), Local Authority Wind Strategies and compliance with environmental and landscape designations. The RPGs acknowledge that the development of the renewable energy sector in the Midland

Region will significantly contribute to the national target of generating 40% electricity from renewable sources by 2020.

Relevant economic development policy objectives include:

- **Policy EDP3**: actively encourage the sustainable development of the region's sectoral opportunities, including, inter alia, Green Enterprise; by facilitating the provision of the necessary infrastructure for the development of the lands identified for the sectoral opportunities.

- **Policy EDP13:** encourages and supports the sustainable diversification of the rural economy throughout the region, in a manner that sustains the attractiveness and status of the rural environment.

Chapter 5 sets out the key physical infrastructure needs of the border region which are required to ensure the successful delivery and implementation of the Settlement and Economic Strategies.

A key area of priority investment is Energy Provision. The Plan recognises the considerable potential that exists for the exploitation of renewable energy generation, particularly wind. The RPGs strongly supports the national targets for renewable energy and reducing energy consumption, and seeks to contribute to achieving these targets through the development of sustainable energy policies and practices. The RPGs suggest the region can avail of the opportunity to use its existing power stations to make the transition from peat to renewable energy sources. The region also has substantial renewable energy potential to accommodate large scale energy production in the form of wind farms and bio energy fuel sources.

The RPGs recognise that the potential for renewable energy generation such as wind energy will require connectivity to the electricity transmission network. Such connectivity will be required to sustain power transfers between wind generation in the West and the main load centre of Dublin. The upgrading of the transmission network will facilitate power flows from both renewable and conventional sources to maximise the use of existing power corridors. In this regard, these RPGs promote the improvement and expansion of the transmission network throughout the Midland Region.

The RPGs recognise the opportunity and potential for the region to harness renewable energy development arising from the presence of cutaway bogs. The RPGs acknowledge that the peatlands and associated cutaway have potential to "*accommodate large scale energy production in the form of wind farms and bioenergy*". In this regard Section 3.3.4.6 of the guidelines states the following:

> *"Worked out peatland areas, offer potential for renewable energy installations including wind energy. With a strong history of energy production and an extensive electricity transmission network in place, the potential exists for a smooth transition to renewable energy from fossil fuels. This opportunity can result in related employment opportunities in manufacturing, servicing and research and development activities."*

In relation to Energy Infrastructure, the relevant policies include:

- **TIP33:** Support the sustainable development of the infrastructure required to assist the Midland Region in the delivery of renewable energy particularly in the context of the existing energy infrastructure in the region and the need to make a transition from peat to renewable energy;

- **TIP34:** Support the Midland Energy Agency to assist the Local Authorities and other stakeholders in delivering energy efficiency solutions, stimulating the increased uptake of renewable energy sources and the promotion of clean and sustainable transport.

Chapter 6 outlines the importance of environment, heritage and amenities at the regional strategic scale. The Environment and Amenities Strategy for the Midland Region is underpinned by a recognition and respect for the diversity of environmental assets within the region and the need to have regard for and promote awareness of the complex interrelationships both between its natural and manmade elements.

2.3.5 Offaly County Development Plan 2014 – 2020

The *Offaly County Development Plan 2014-2020* (CDP) was adopted by Members of Offaly County Council on 15th September 2014 and is effective from 13th October 2014. The CDP outlines the overall strategy for the proper planning and sustainable development of County Offaly over the period 2014-2020. The plan is set within the context of the National Spatial Strategy 2002-2020 and the Midland Regional Planning Guidelines 2010-2022.

On the subject of renewable energy, the CDP states that:

> *"It is anticipated that developments of renewable energy will be a significant feature over the lifetime of the plan."* (Section 3.74.3 of the CDP refers)

Section 3.5 states that site suitability is an important factor in determining the suitability of wind farms (turbines), having regard to possible adverse impacts associated with for example residential amenities, landscape, including views or prospects, wildlife, habitats, designated sites, protected structures or bird migration paths and compatibility with adjoining land uses. The CDP seeks to achieve a reasonable balance between responding to overall positive Government policy on renewable energy and enabling the wind energy resources of the Planning Authority's area to be harnessed in a manner that is consistent with proper planning and sustainable development.

Section 3.7 of the CDP outlines the policies energy development. Relevant polices include:

- **EP–01:** *It is Council policy to support national and international initiatives for limiting emissions of greenhouse gases and to encourage the development of renewable energy sources.*

- **EP–02***: It is Council policy to facilitate the continual development of renewable energy sources having regard to the proper planning and sustainable development of the area concerned, the protection of amenities, landscape sensitivities, European Sites, biodiversity, natural heritage, and built heritage, and where such proposals comply with policy contained in the County Development Plan, in the interests of proper planning and sustainable development.*

- **EP–03:** *It is Council policy to encourage the development of wind energy in suitable locations, on cutaway bogs within the wind energy development areas open for consideration identified in Map 3.2, in an environmentally sustainable manner and in accordance with Government policy, having particular regard to the Wind Energy Strategy for the County and Section 3.5.1, which states that appropriate buffers should be provided, which shall be a minimum of 2km from Town and Village Cores, European designated sites, including Special Areas of Conservation (SAC) and Special Protection Areas (SPA), and national designations, Natural Heritage Areas (NHA). Wind Energy developments on cutaway bogs should generally be developed from the centre out. The Area around Corracullin Bog, (Area 4 in Wind Energy Strategy), is omitted from the Wind Energy Development Area.*

The proposed wind farm site is located in an area designated as suitable for wind energy development; see Section 2.3.4 below.

- **EP–04:** *Cumulative effects of wind farm development can arise as the combined consequences of proposals for more than one wind energy development within an area or proposal(s) for new wind energy development(s) in an area with one or more existing or permitted developments. Offaly County Council will monitor cumulative impact assessments of wind energy proposals over the lifetime of the plan and cumulative impacts will be a material consideration in the assessment of any planning application for wind energy development.*

- **EP–09:** *It is Council policy to require any applicant for energy generation facility to provide details of all transmission infrastructure associated with the development and to assess the impact of this infrastructure on both the environment and landscape as a material consideration of the planning decision.*

Section 3.8 of the CDP states its objectives in relation to Energy. Pertinent objectives include:

- **EO–01:** *It is an objective of the Council to achieve a reasonable balance between responding to government policy on renewable energy and in enabling the wind energy resources of the county to be harnessed in an environmentally sustainable manner. This will be implemented having regard to the Council's Wind Energy Strategy as follows:*
  1. In Areas open for consideration for Wind Energy Development, as identified in Map 3.2, the development of Wind Farms and smaller wind energy projects shall be open for consideration.
  2. In all other areas Wind Energy Developments shall not normally be permitted – except as provided for under exemption provisions and as specifically described in Section 5.4 of the Wind Energy Strategy and Policy EP – 05.

- **EO–02***: It is an objective of the Council to facilitate the promotion and construction of energy efficient developments throughout the county*.

- **EO–05**: *It is an objective of the Council to assist the Midland Energy Agency in delivering energy efficiency solutions, stimulating the increased uptake of renewable energy sources and the promotion of clean and sustainable transport.*

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

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

The Plan states that some areas of cutaway bog may be appropriate for other sensitively designed and located developments, including renewable energy (wind farms, biomass crops), and/or industrial use. The County Development Plan identifies Areas of High Amenity, to protect and enhance areas of scenic and amenity value in the County Offaly which are worthy of special protection in order to preserve their uniqueness and amenity value. The proposed development site is not located within an Area of High Amenity.

Protected Views in Co. Offaly include several views in the vicinity of Croghan Hill and nearby townlands to the northwest. The closest of these protected views is approximately 8 kilometres northwest of the proposed development site boundary. There are no scenic routes in Co. Offaly within 20 kilometres of the proposed development site. The nearest Scenic Route in Co. Offaly is located on the R421 Regional Road, southwest of Tullamore. Further details in relation to protected views and scenic routes are presented in Section 11.3 of this EIS: Landscape and Visual.

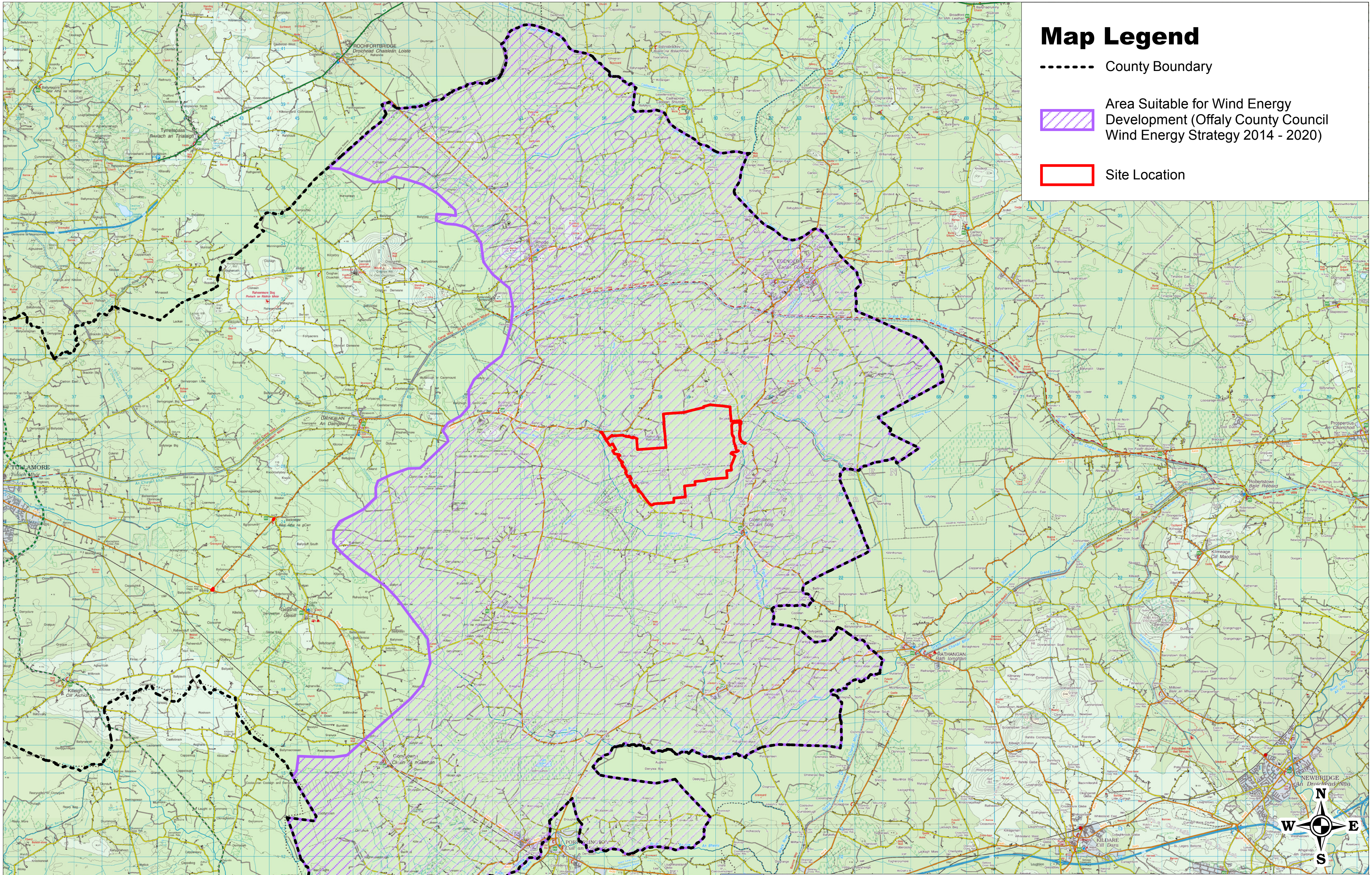
Chapter 8 of the CDP deals with development and technical standards and ensures the orderly and sustainable development of the County through the setting out of objectives and standards for the management of development. Section 8.23 of the CDP on Development and Technical Standards deals with wind energy. This section advises that all planning applications for wind energy turbines or windfarms shall be assessed against the DEHLG's publication *Wind Energy Development Guidelines*, *2006*, (and any subsequent guidelines) and the *Offaly County Council's Wind Strategy*.

2.3.6 Wind Energy Strategy for County Offaly Methodology Statement 2014

The *Wind Energy Strategy for County Offaly Methodology Statement 2014* forms part of the *Offaly County Development Plan 2014-2020*. The objective of this methodology statement is to evaluate and analyse the potential wind energy resource within County Offaly, to define environmental and planning considerations for wind energy development and to make recommendations on wind energy resource development policy and practice. This Statement informs the *County Offaly Wind Energy Strategy 2014 to 2020* (WES).

The strategy outlines the rationale of Offaly County Council's policy towards wind energy developments in the County and will form the basis for assessment of planning applications for wind energy development and will assist in the decision making process.

The Wind Energy Strategy Map (see Figure 2.1), shows the Strategy for Wind Energy development in the County, in particular showing areas where applications for Wind Energy developments will be open for consideration, subject to site specific considerations and layout.



MAP TITLE: **Offaly Wind Energy Strategy: Suitable Area**		MAP NO.: **Figure 2.1**	SCALE: **1:175,000**
PROJECT TITLE: **150504 - Cloncreen Wind Farm EIS, Co. Offaly**			DATE: **11-08-2015**
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The WES states that these are areas that are likely to be suitable for all scales of wind energy on account of a combination of factors that include:

- Available access to suitable grid connections (within 10 kilometres);
- The absence of compelling environmental constraints; and
- Low densities of adjacent residential development.

The WES states that applications for wind turbines in the Suitable Areas are acceptable in principle, subject to conformance with all other requirements of the County Development Plan, including objectives relating to landscape protection and the protection of residential amenity. The rationale behind this policy is to minimise the impacts of large-scale developments on the environment of Co. Offaly as a whole, while maximising the potential for optimal and efficient grid connection. The WES anticipates that all wind farm sites within the Suitable Area for Wind Energy Development will be intensified in future by:

- Taller turbines with larger swept areas;
- Higher densities (closer spacing of turbines);
- More advanced technology with higher efficiencies of energy capture.

The WES identifies six main areas within the County for potential wind farm development. The proposed development site is located in Area 2: Area from Clonygowan to Clonbullogue. The Strategy found that this area is suitable for large-scale wind farm development, as follows:

> *"2. Area from Clonygowan to Clonbullogue: Having regard to the very low levels of existing dwellings, large land-holdings, reasonable access to grid, reasonable road access and existing cut-over bogs, this area is suitable for large-scale wind farm development."*

2.3.7 Other County Development Plans

The proposed development is located exclusively within the administrative boundary of Offaly County Council; nonetheless, visual impact and amenity considerations within the wider area are items considered within Section 11.3 of the EIS and summarised below.

2.3.7.1 Kildare County Development Plan 2011 – 2017

The Kildare county boundary is located approximately 3.6 kilometres west of the proposed development site. The relevant landscape policies and objectives of the Kildare County Development Plan are discussed in Section 11.3.3 of the EIS.

2.3.7.2 Westmeath County Development Plan 2014 – 2020

The Westmeath county boundary is located approximately 9.0 kilometres from the proposed development site. The relevant landscape policies and objectives of the extant Westmeath County Development Plan are discussed in Section 11.3.4 of the EIS.

2.3.7.3 Laois County Development Plan 2011 – 2017

The Laois county boundary is located approximately 11.5 kilometres from the proposed development site. The relevant landscape policies and objectives of the extant Laois County Development Plan are discussed in Section 11.3.5 of the EIS.

2.4 Selection of the Optimum Site

2.4.1 Selection of Candidate Sites

As the cost of building each megawatt of electricity-generating capacity in a wind farm is in the region of €1.6 million to €2.0 million, it is critical that the most suitable site for development of the proposed wind farm be chosen. Sites selected for the development of a wind farm must be suitable for consideration under a number of criteria, such as:

- Consistent wind speeds;
- Low population density;
- Reasonable access to the national electricity grid.
- No close proximity to Designated sites
- Planning Policy Context

Bord na Móna conducted a technical review of potential candidate sites for wind energy projects, on land which is either cut away or will be cut away before 2021. As part of the site selection process, known constraints were applied across the entire landbank of approximately 80,000 hectares to determine unsuitable areas for wind turbines. The constraints themselves are derived from various industry and regulatory guidelines and available Geographical Information Systems (GIS) datasets. This methodology was used to generate a list of potential sites for further consideration with the level of information currently available. These sites, identified as having a higher potential for wind farm development, were then brought forward for site-specific assessment, as detailed below.

These site-specific assessments were conducted by the Bord na Móna wind development team with input from relevant subject experts where required, e.g. the Bord na Móna Ecology and Land & Property teams. This exercise initially reviewed the entire Bord na Móna landbank, which resulted in a refined list of potentially 25 project sites, with a typical target capacity of between 50 MW and 100 MW. A high proportion of these potential projects have had grid connection applications submitted to EirGrid, mainly in 2014, with two in previous years. The main aim of this study was to gauge the sites with the best potential to deliver a successful wind farm project by the early to mid-part of the next decade, i.e. 2020 - 2025. The ultimate end goal of the development team was to select a project to bring forward, for which preliminary engineering designs and a planning application would be prepared.

2.4.2 Site-Specific Assessment

For the site-specific assessment of candidate sites, criteria were chosen which not only covered the broad range of issues which can arise in wind farm development, but also allowed for direct comparison of the candidate sites to each other to determine their relative suitability for wind farm development. The site-specific selection criteria and outline of basis for assessment for each criterion are listed in Table 2.1.

Table 2.1 Site-specific Selection Criteria

Criterion	Basis for Assessment
Grid Access/Capacity	Grid Access/Capacity means potential of the National Grid to accommodate future projects on the network. The proximity of the project to suitable grid nodes (i.e. those with spare capacity) should facilitate a project being selected for a grid connection offer.
County Development Plans and Zoning	County Development Plans typically indicate the areas of a county which are deemed preferred, open to consideration and not suitable for wind farm development. Bord na Móna has committed not to develop wind farms in areas deemed unsuitable.
Proximity to Houses	Refers to how close turbines are to residences.
Wind Resource Assessment	The available wind resource (i.e. wind speed) directly translates into how much potential electrical output comes from the site.
Environmental Sensitivity	Environmental Sensitivity is the ecological sensitivity of the site based on proximity to sensitive areas within or around the site.
Cumulative Impact	Depends on the landscape's capacity to absorb wind farm developments.
Aviation	Airspace control and use to be considered.
Land Use	Internal issue to Bord na Móna relating to the residual peat depth, production plans and alternative uses.
Communications Infrastructure	Telecoms masts and signals to be considered.
Flood Plain Analysis	Flood Plain Analysis assesses the wind farm's location in terms of historical flooding data.
Supporting Infrastructure	Sites with better road access require less modifications or upgrade to the local infrastructure to facilitate construction.

2.4.3 Site Selection Results

The site assessment scores for each criterion where determined and a shortlist of sites deemed suitable for a large-scale wind energy development was compiled. Of these sites, Cloncreen emerged as the highest scored, closely followed by similarly high-scoring sites that meet the relevant criteria. Due to the close proximity of potential grid connection, it was deemed that Cloncreen should be progressed for detailed assessment and planning consideration.

Further details on the identification of Cloncreen as the optimal site for the proposed development are presented under the individual site-selection criteria described below.

Grid Access/Capacity

Cloncreen is located directly west of the Bord na Móna-operated Edenderry Power Plant. The southern section of the site is traversed by the existing 110 kV Thornsberry/Cushaling electricity transmission line and associated pylons. The site therefore scored very highly with regard to grid connection.

County Development Plans and Zoning
The candidate sites for the proposed project span across Counties Kildare, Laois, Longford, Meath, Offaly, Tipperary and Westmeath. County Development Plans and Wind Energy Strategies, where available, typically indicate the areas of a county which are zoned as preferred, open to consideration or not suitable for wind farm development. Bord na Móna has committed not to develop wind farms in areas deemed unsuitable.

Cloncreen is one of a number of candidate sites that is located within an area deemed suitable or preferred for wind energy development by the relevant County Development Plans, and which therefore scored highly with regard to this criterion. Sites located within undesignated wind development areas or areas open for consideration scored lower.

Proximity to Houses
It was found that in general Bord na Móna sites are surrounded by low density rural housing, and most sites have a relatively large proportion of their land area free from proximity issues. However longer, narrower sites have a higher potential for a larger proportion of their land area constrained out due to proximity issues to houses or population centres.

The Cloncreen site measures approximately 1,000 hectares and is of sufficient size to accommodate a large-scale wind energy development, while maintaining the required set-back distance from houses in the surrounding area.

Wind Resource Assessment
Wind resource assessment is the process by which wind power developers estimate the future energy production of a wind farm. Accurate wind resource assessments are crucial to the successful development of wind farms.

The Irish Wind Atlas, published by the Sustainable Energy Authority of Ireland (SEAI), uses long term weather model data to predict the long term average wind speeds in Ireland, and is used by wind developers and local authorities to determine the best locations for future wind farm development.

A review of Irish Wind Atlas datasets found that the more westerly sites have the highest mean wind speeds, while wind speeds in the midland bog groups are typically between 7 and 8 metres per second. These wind speeds are conducive to the development of a wind farm. On site wind measurement at Cloncreen indicates that the average wind speeds at this location correspond to the Irish Wind Atlas data.

Environmental Sensitivity
Environmental sensitivity is a key factor in identifying suitable sites for wind farm development. The assessment of environmental sensitivity among the candidate sites included a review of proximity to Natura 2000 sites, biodiversity of the lands within the sites themselves, and acknowledgement of any other site-specific ecological data that has already been captured. Of the candidate sites, Cloncreen was found to have a low ecological sensitivity, and therefore scored high in this regard.

Cumulative Impact
Cumulative impact refers to the ability of the landscape and environs to absorb multiple wind farm developments and any other developments, planned or permitted within the immediate area. The landscape's capacity to absorb wind farm developments can be subjective and can vary from area to area.

Currently there are only a limited number of wind farm developments existing or with planning permission in the midlands area. The proposed development site at Cloncreen is located four kilometres west of the operating Mountlucas Wind Farm, which comprises 28 no. turbines. This site scored relatively high with regards to cumulative impact however, given the capacity of the receiving landscape.

Aviation
Clonbullogue aerodrome is located approximately 2.3 kilometres south of the Cloncreen site boundary. In this regard therefore, Cloncreen did not score highly in this particular criterion as part of the initial site selection process. An aviation/parachuting safeguard area of 2.7 kilometres has been included as part of the constraints in the design of the wind farm layout. No turbines are proposed within 2.7 kilometres of the Clonbullogue runway – see Section 13.2 of this EIS for further details on aviation and parachuting.

Land Use
As part of the ongoing peat resource assessments within Bord na Móna, the available peat deposits are determined for each bog unit and the level of peat extraction is projected over the coming years. On this basis, an estimate of when certain bogs would near the end or cease active peat extraction was made. Some bogs are predicted to be completely cutaway by 2020, with no other activities on site, and therefore more readily available for potential wind farm development. Other bogs may have areas predicted to have significant peat reserves remaining beyond 2020. In addition, some bogs may have areas allocated to other use. These factors may considerably reduce the net area available for wind farm development on that particular bog.

Cloncreen obtained the highest score with regard to land-use; it is projected that peat extraction will cease at this site in 2018. Construction of the proposed wind farm will only commence once peat extraction has ceased.

Communications Infrastructure
Many of the sites have telecoms point-to-point microwave signals crossing them. A telecommunications mast is located on the Cloncreen site, which therefore scored low in this regard. However, this issue can typically be overcome by engineered solutions, i.e. wind farm layout design or additional telecom relay masts. Planning permission has been granted on sites where significant telecoms infrastructure is located. For this reason, this criterion does not significantly impact on overall project viability.

Flood Plain Analysis
Flood Plain Analysis assesses the wind farm's location in terms of historical flooding data. The assessment methodology used this historical flooding data to consider the percentage area of a site which has previous flooded, the percentage area within one kilometre of a site which has previously flooded and recorded flooding points within one kilometre of a site. In addition, whether the site has pumped or gravity drainage system is also considered.

No significant flooding issues were identified at the Cloncreen site, which scored highly in this regard.

Supporting Infrastructure
The proximity of the existing road and electricity transmission network were considered in terms of ease of delivery of turbine components and relative cost of potential grid connection. Cloncreen scored highly with regard to supporting infrastructure, in terms of road network and potential grid connection.

2.5 Site Design, Constraints and Facilitators Methodology

2.5.1 Site Layout

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

Throughout the preparation of the Environmental Impact Statement process, the layout of the proposed development has been revised and refined to take account of the findings of all site investigations, which have brought the design from its first initial layout to the current proposed layout. The design process has also taken account of the recommendations and comments of the relevant statutory and non-statutory organisations, inputs arising from public consultation and individuals, as detailed in Section 2.9.

2.5.2 Constraints Mapping

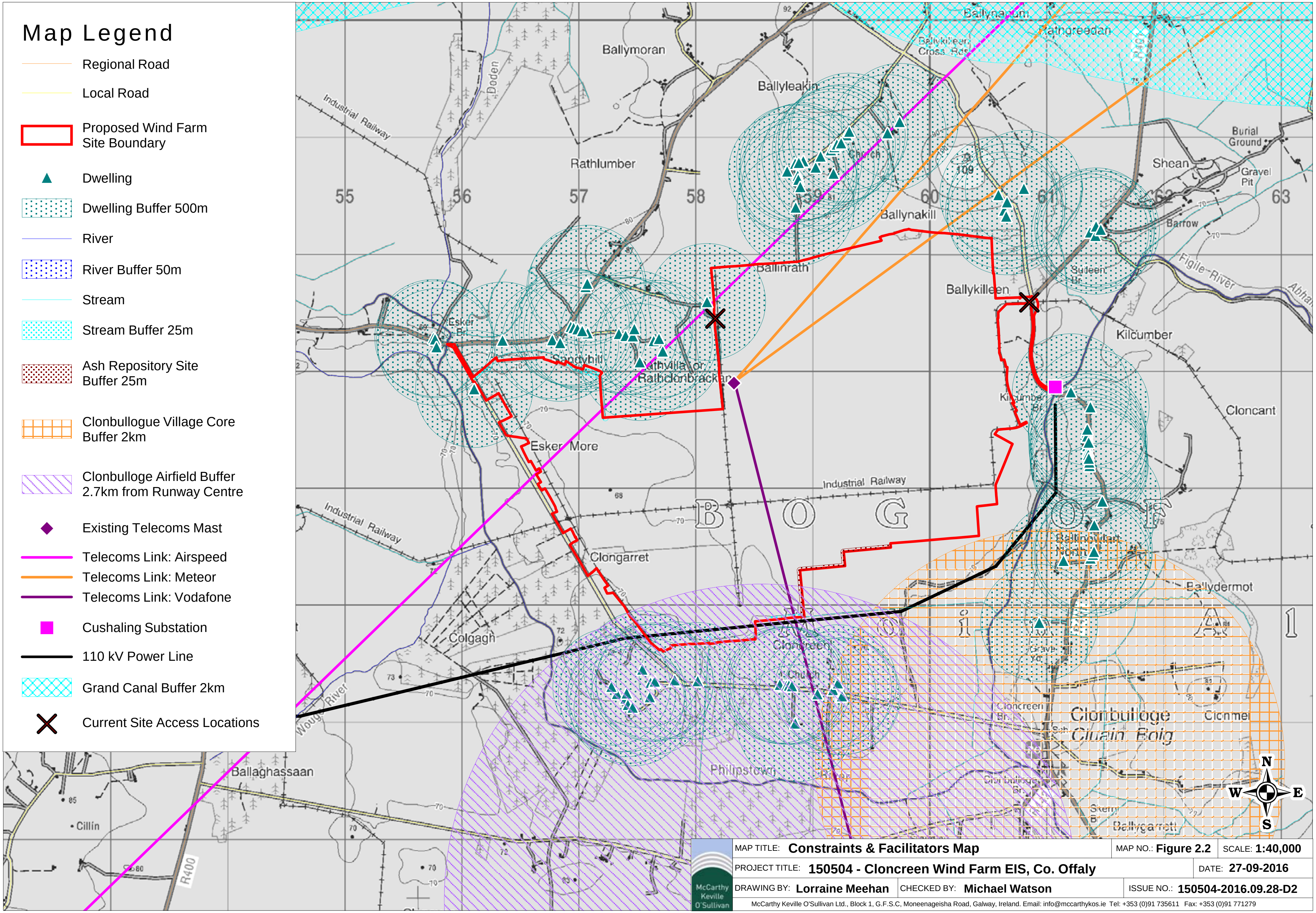
Constraints mapping involves the marking of buffer zones around different types of constraints in order to identify areas in which no turbines will be sited. The known constraints at the site that were mapped initially at the outset of the EIS process included:

- Dwellings plus minimum 500-metre buffer;
- 2 km setback from the core of Clonbullogue Village;
- Ash repository plus 25-metre buffer;
- Rivers plus 50-metre buffer;
- Streams plus 25-metre buffer;
- Telecoms links plus buffer of a size requested by the relevant;
- Parachuting/Aviation safeguard area of 2.7 kilometres
- 2 km setback from the Grand Canal (as per Offaly County Council policy)

The initial constraints and facilitators map is shown in Figure 2.2. The constraints and facilitators led approach resulted in the identification of a viable area, within which the wind farm development may take place. The known facilitators at the site include:

- Available lands for development;
- Proximity to suitable grid connection;
- Existing access points and general accessibility of all areas of the site due to peat extraction activity; and
- Limited extent of constraints.

Following the mapping of all known constraints and facilitators, detailed site investigations were carried out by members of the project team. The ecological assessment of the site encompassed habitat mapping and extensive surveying of birds and other fauna. This assessment, as described in Sections 5 and 6 of this EIS on Flora and Fauna and Ornithology, optimised the site for the siting of turbines or the carrying out of any development works, such as the construction of roads. The hydrological and geotechnical investigations of the site examined the proposed locations for turbines, roads and other components of the proposed development, such as the substation, borrow pit and the construction compound. If any specific areas were considered as being unsuitable for the siting of turbines or roads, etc. they would have been avoided, however, this did not arise in this instance. The turbine layout for the proposed wind



MAP TITLE: Constraints & Facilitators Map		MAP NO.: Figure 2.2	SCALE: 1:40,000
PROJECT TITLE: 150504 - Cloncreen Wind Farm EIS, Co. Offaly			DATE: 27-09-2016
DRAWING BY: Lorraine Meehan	CHECKED BY: Michael Watson		ISSUE NO.: 150504-2016.09.28-D2

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farm has also been informed by wind data and the results of noise and shadow flicker modelling, as they became available.

During the design and EIS processes, as the turbine layout was amended or updated, as required, and the revised coordinates were circulated to all members of the project team in order to ensure that the most up to date layout was being assessed. The previous turbine layouts considered during the design process are described in Section 2.8 of the EIS on Alternatives.

2.6 Site of the Proposed Development

2.6.1 Site Location

The site of the proposed wind farm is located in the townlands of Cloncreen, Clongarret, Esker More, Rathvilla or Rathclonbrackan, Ballinrath, Ballynakill and Ballykilleen, Co. Offaly. The proposed transport route works areas are located in the townlands of Ballina, Ballinagar, and Esker More, Co. Offaly. The proposed wind farm site is located on Cloncreen bog, in eastern Co. Offaly, approximately 4.5 kilometres southwest of Edenderry at its nearest point. The villages of Clonbulloge and Rhode are located approximately 2.0 kilometres southeast and 7.0 kilometres northwest of the site, respectively.

Cloncreen is a single peat production bog unit within the Bord na Móna Derrygreenagh peat production bog group, regulated under the Environmental Protection Agency (EPA) IPC Licence No. P503-01 (Bord na Móna Allen Peat Ltd.). The land-use/activities within the proposed development site comprise a mix of active peat extraction, bare cutaway peat, re-vegetation of bare peat, former borrow pit area, telecommunications (a 40-metre mast) and wind measurement (a single 100-metre meteorological mast). The southern section of the site is traversed by the existing 110 kV Thornsberry/Cushaling electricity transmission line and associated pylons. There are also a number of Bord na Móna rail lines that pass through the bog facilitating the transportation of milled peat and ash and a small canteen area for employees known as the 'tea centre'.

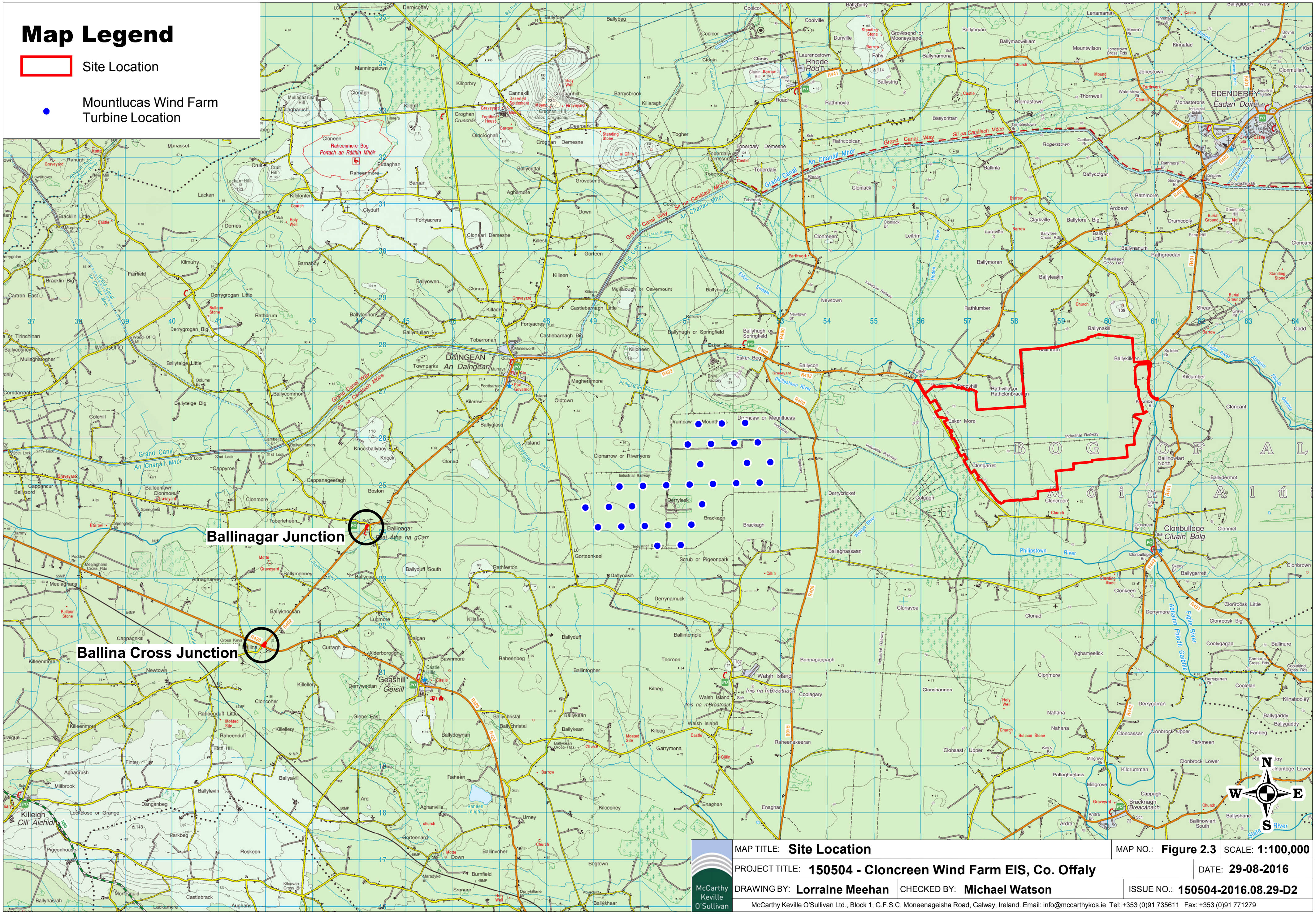
The proposed wind farm site measures approximately 1,000 hectares, The Grid Reference co-ordinates for the approximate centre of the site are E258900 N226400. A site location map is presented in Figure 2.3. Figure 2.4 shows an aerial view of the proposed wind farm site.

2.6.2 Site Access

The proposed development site is located west of the R401 Edenderry to Clonbullogue road. The R400 Regional Road is located approximately 2.7 kilometres west of the site, and the R402 is located approximately 0.3 kilometres north of the site, at its nearest point. The site is bordered to the west and south by local roads. The site itself is served by a number of existing road access points and it is also accessible by the Bord na Móna rail lines.

2.6.3 Physical Characteristics of Site and Surrounding Lands

The topography of the site is flat, and lies at an elevation of approximately 70 metres O.D. The surrounding landscape is of a similar topography, with the most significant feature being Croghan Hill, located approximately 10.3 kilometres northwest of the site, at an elevation of 234 metres O.D. The site is located within the Barrow drainage catchment.



Map Legend

Site Location

Mountlucas Wind Farm Turbine Location

MAP TITLE: Site Location		MAP NO.: Figure 2.3	SCALE: 1:100,000
PROJECT TITLE: 150504 - Cloncreen Wind Farm EIS, Co. Offaly			DATE: 29-08-2016
DRAWING BY: Lorraine Meehan	CHECKED BY: Michael Watson		ISSUE NO.: 150504-2016.08.29-D2

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MAP TITLE: **Site Aerial**		MAP NO.: **Figure 2.4**	SCALE: **1:25,000**
PROJECT TITLE: **150504 - Cloncreen Wind Farm EIS, Co. Offaly**			DATE: **31-08-2015**
DRAWING BY: **Lorraine Meehan**	CHECKED BY: **Michael Watson**		ISSUE NO.: **150504-2015.08.31-D1**

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Land-use in the surrounding landscape comprises a mix of agriculture, forestry, cutaway peatlands and energy production. The main existing significant energy infrastructure in the local area is Edenderry Power Plant, located directly east of the Cloncreen site, associated grid infrastructure in the form of 110 kV pylons network (and in particular the Thornsberry/Cushaling line and Cushaling Substation), and the operational Mountlucas Wind Farm, located 4.0 kilometres to the west of the site. Mountlucas comprises 28 no. turbines, with a total power output of 84 Megawatts (MW), and has been in operation since early 2014. Clonbulloge aerodrome is located circa. 2.7 kilometres south of the nearest proposed turbine location (see Section 13.2 of the EIS for details on the aerodrome buffer zone).

Figure 2.5 presents the location of the proposed development site in relation to designated areas within a 15-kilometre radius. There are no designated areas bordering or overlapping with the proposed development site. The closest Natura 2000 site, i.e. Special Area of Conservation (SAC) or Special Protection Area (SPA), is the Long Derries, Edenderry SAC, located approximately 5.1 kilometres east-northeast of the site. The closest SPA to the proposed wind farm site is the River Boyne and River Blackwater SPA, located approximately 19.3 kilometres northeast of the site.

The closest national designated site, i.e. Natural Heritage Area (NHA) or proposed NHA (pNHA), is the Grand Canal pNHA, located approximately 3.5 kilometres north of Cloncreen, at its closest point.

2.7 Planning History

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

2.7.1 Study Area

A review of Offaly Council Planning Register shows that there have been a number of planning applications lodged within the proposed wind farm site. The following is a record of the relevant planning applications lodged within the proposed Cloncreen site.

Telecommunications Mast

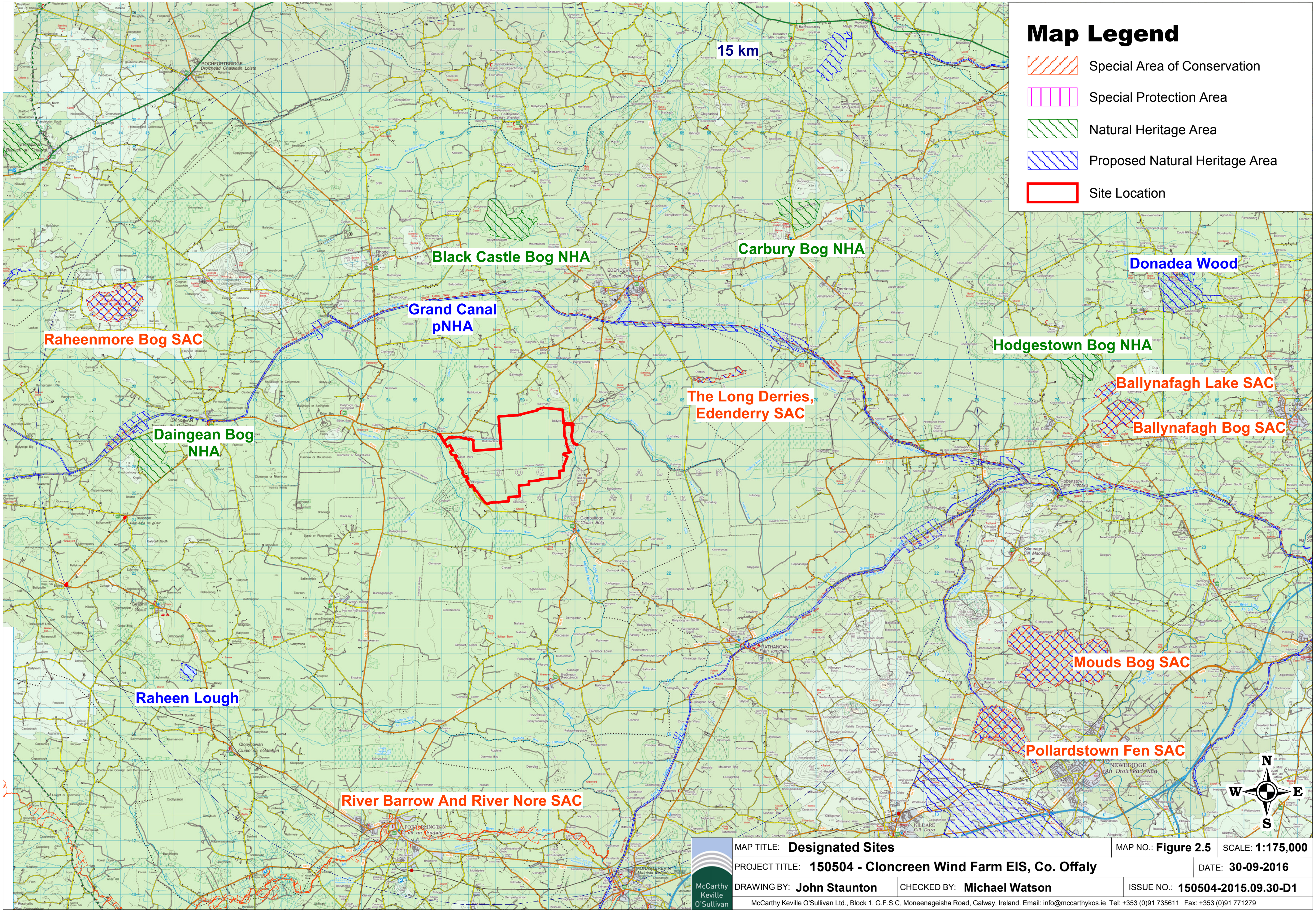
- **Pl. Ref. No. 95/325:** Planning application by Bord na Móna to erect a radio mast. Permission was granted by the Planning Authority on the 26/09/1995 subject to 6 no. conditions.

Anemometry Mast

- **Pl. Ref. 13/161:** Planning application by Bord na Móna Energy Limited to erect a guyed wind monitoring mast, with instruments, up to 100m in height. The purpose of the proposed mast is to assess the suitability of the company's adjacent lands for wind farm development. Permission was granted by the Planning Authority on the 21/11/2013 subject to 4 no. conditions.

Railway Bridge

- **Pl. Ref. No. 99/160:** Planning application by Peat Energy Division Bord na Móna for the development of a railway underbridge in the townland of Clongarret, Clonbullogue. Permission was granted by the Planning Authority on the 21/07/1999 subject to 2 no. conditions.



MAP TITLE: Designated Sites		MAP NO.: Figure 2.5	SCALE: 1:175,000
PROJECT TITLE: 150504 - Cloncreen Wind Farm EIS, Co. Offaly			DATE: 30-09-2016
DRAWING BY: John Staunton	CHECKED BY: Michael Watson	ISSUE NO.: 150504-2015.09.30-D1	

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- **Pl. Ref. No. 97/699:** Planning application by Bord na Móna for the development of a railway underbridge in the townland of Ballykilleen. Permission was granted by the Planning Authority on the 15/05/1998 subject to 6 no. conditions.

2.7.2 Applications in the Vicinity of the Proposed Wind Farm Site

The majority of planning applications in the immediate vicinity of the Cloncreen site are related to the provision and/or alteration of one-off housing and agricultural developments. Applications which are not of an individual domestic or agricultural nature in the vicinity of the EIS study area include the following:

Ash Repository

- **Pl. Ref. 98/482:** Planning application by Bord na Móna to develop a peat ash repository for deposition of peat ash. Permission was granted by the Planning Authority on the 17/09/1998 subject to 10 no. conditions.

- **Pl. Ref. 05/1267/ An Bord Pleanála ABP Ref. PL19.216998:** Planning application by Bord na Móna Energy Limited to develop an ash repository for deposition of peat ash, meat and bone meal, ash and biomass ash on the site of the existing peat ash repository facility. Permission was granted by An Bord Pleanála on the 25/07/2006 subject to 7 no. conditions.

- **Pl. Ref. 07/1256:** Planning application by Bord na Móna Energy Limited for the construction of an office and toilet facilities including septic tank and a Bord na Móna puraflow system. This development is related to an activity which is covered under an integrated pollution control licence number 503 which covers peat extraction in the area. Permission was granted by the Planning Authority on the 28/11/2007subject to 2no. conditions.

Edenderry Power Station

- **Pl. Ref. 98/437:** Planning application by Edenderry Power Limited for the construction of a peat power 120 mw electricity generating station. Permission was granted by the Planning Authority on the 23/07/1998 subject to 20 no. conditions.

- **Pl. Ref. 98/493:** Planning application by Edenderry Power Limited for a Pumphouse for water abstraction from Figile River. Permission was granted by the Planning Authority on the 16/09/1998 subject to 9 no. conditions.

- **Pl. Ref. 98/922:** Planning application by the ESB for a 110 KV overhead transmission line loop serving proposed Europeat 1 power station. Permission was granted by the Planning Authority on the 27/01/1999 subject to 1 no. condition.

- **Pl. Ref. 04/25:** Planning application by Edenderry Power Limited for development described as consisting of a 14,750m^2 (1.48ha) concrete slab for the storage of biomass. A full retention oil interceptor, settlement tanks, and associated works will collect rain water runoff from the slab for diversion into the existing surface water management system the operation of which is incorporated into the existing IPPC licence in force at the facility. A 1,700m^3 storage silo, an embankment, with an area of 6,750m^2 (0.68ha) Permission was also sought to accept 100 kt per annum of biomass in addition to that already permitted under planning grant PL 19.211173 for use in co-fuelling. The application related to development that is for the purposes of an activity in relation to which an integrated pollution prevention and control licence. This application was deemed incomplete, and invalidated on 20/01/2004.

- **Pl. Ref. 04/210:** Planning application by Edenderry Power Limited for the material change of use of the electricity generating station from use as a power station for the generation of electrical power station from the combustion of peat, to use as a power station and a waste recovery facility for the generation of electrical power from the combustion of a mix of fuels including biomass in the form of wood material and recovered (treated) meat and bone meal. Permission was granted by the Planning Authority on the 08/02/2005 subject to 15 no. conditions, the decision was later appealed to An Bord Pleanála who granted permission with revised conditions on the 12/07/2005 subject to 11 no. conditions.

- **Pl. Ref. 06/1040:** Planning application by Eirgrid PLC for alterations to the existing 110kV electrical transformer station consisting of 110kV line bay, 110kV end mast 17.75m high and associated equipment. Concrete bases and foundations associated with all steel supports. Permission was granted by the Planning Authority on the 15/11/2006 subject to 3 no. conditions.

- **Pl. Ref. 06/1106:** Planning application by the Eirgrid PLC for erect a new 110kV overhead electricity line, approximately 31 kilometres in length from the existing Cushaling 110kV station beside Edenderry power generating station in the townland of Ballykilleen to the existing Thornsberry 110kV station northeast of Tullamore in the townland of Derrynagall or Ballydaly and realign 350 metres of the existing Derryiron - Thornsberry 110kV line in the townland of Derrynagall or Ballydaly. The proposed 110 kV line would consist of three overhead wires and be erected over, or in the vicinity of the townlands of Derrynagall or Ballydaly, Ballycosney, Corndarragh, Ballyteige little, Ballyteige big, Cappyrow, Clonmore, Annagharvey, Ballymooney, Ballycrumlin, Ballinagar, Ballycue, Ballyduff south, Rathfeston, Gorteenkeel, Ballynakill, Scrub or Pidgeonpark, Brackagh, Ballaghassaan, Derrycricket, Colgagh, Clongarret, Cloncreen, Ballinowlart north, Ballykilleen, Kilcumber. Permission was granted by the Planning Authority on the 20/10/2006 subject to 10 no. conditions, the decision was later appealed to An Bord Pleanála who granted permission with revised conditions on the 23/03/2007 subject to 4 no. conditions.

- **Pl. Ref. 07/1691:** Planning application by Bord na Móna PLC for the development of two electricity generation units each having a maximum power output of 52 megawatts. Each power unit to include an air inlet filter, a turbine generator set and auxiliary systems including control system and electrical equipment. This application was supported by an EIS and is related to development that comprises or is for the purpose of an activity in relation to which a licence under Part IV of the Environmental Protection Agency Act, 1992 as amended is required. Permission was granted by the Planning Authority on the 25/03/2008 subject to 4 no. conditions.

- **Pl. Ref. 11/113**: Planning application by Edenderry Power Limited for development which will consist of a 14,750m2 (1.48ha) concrete slab for the storage of biomass, which in the context of this application refers to energy crops (primarily willow & miscanthus), forestry residues, woodchips and pulp wood only. A full retention oil interceptor, settlement tanks, and associated works will collect rain water runoff from the slab for diversion into the existing surface water management system the operation of which is incorporated into the existing IPPC licence in force at the facility. A 1,700m3 storage silo will be erected for the storage of dry biomass, which in the context of this application refers to agricultural residues of vegetal origin and dry wood pellets only. an embankment, with an area of 6,750m2 (0.68ha) will be constructed along the north western boundary of the facility using the material excavated during the construction of the concrete slab, the embankment will be landscaped to complement the existing hedgerows on the south western boundary. permission is also sought to accept 100kt per annum of biomass (as defined above) in addition to that already permitted under PL 19.211173 for use in co-fuelling, this material will be transported by road and requires permission for the delivery of twenty-eight loads per day in addition to those already permitted under planning grant PL.19.211173. the application relates to development that is for the purposes of an activity in relation to which an integrated pollution prevention and control licence under Part IV of the environment protection agency act, 1992 as amended, is required. Permission was granted by the Planning Authority on the 05/10/2011 subject to 7 no. conditions.

- **Pl. Ref. 09/149:** Planning application by Bord na Móna PLC for alterations to the existing 110 kV Cushaling station to include the installation of two new 110 kV line bays, associated surge arrestors circuit breakers disconnects, current and voltage transformers modification of the existing coupler cubicle to include a circuit breaker and current transformer ancillary works include alterations to the existing inner and outer compound fences extension to the existing control room to accommodate the control cabinets for the extension works relocation of the existing septic tank, puraflo treatment system and percolation area. Permission was granted by the Planning Authority on the 06/07/2014 subject to 2 no. conditions.

- **Pl. Ref. EX12012:** Extension of Duration application by Eirgrid PLC for a new 110kV overhead electricity line, approximately 31 kilometres in length from the existing Cushaling 110kV station beside Edenderry power generating station in the townland of Ballykilleen to the existing Thornsberry 110kV station northeast of Tullamore in the townland of Derrynagall or Ballydaly and realign 350 metres of the existing Derryiron - Thornsberry 110kV line in the townland of Derrynagall or Ballydaly the proposed 110 kV line will be erected over, or in the vacinity of the townlands of Derrynagall or Ballydaly, Ballycosney, Corndarragh, wood of o, Ballyteige little, Ballyteige big, Cappyrow, Clonmore, Annagharvey, Ballymooney, Ballycrumlin, Ballinagar, Ballycue, Ballyduff south, Rathfeston, Gorteenkeel, Ballynakill, Scrub or Pidgeonpark, Brackagh, Ballaghassaan, Derrycricket, Colgagh, Clongarret, Cloncreen, Ballinowlart north, Ballykilleen, Kilcumber the 110kV line will consist of three overhead wires. Permission was granted by the Planning Authority on the 27/03/2012 subject to 2 no. conditions.

- **Pl. Ref. 13/72**: Planning application by Edenderry Power Limited for the continued use and operation of the previously permitted peat and biomass co-fired power plant in the townland of Ballykilleen, Clonbullogue, Co. Offaly; thereby postponing removal of the electricity generating station in continuation with the grant of planning permissions (Offaly County Council planning register reference number pl2/98/437 / An Bord Pleanála reference PL.19.107858 and Offaly County Council planning register reference number pl2/04/210 / An Bord Pleanála reference PL.19.211173). No new structures are proposed as part of this application and Edenderry Power Limited is not proposing any change to existing operations, fuel inputs or emission limit values at the facility as part of this application. The application related to development (the continued use and operation of the peat and biomass co-fired power plant) that is an activity in relation to which an integrated pollution prevention and control (IPPC) licence under Part IV of the Environmental Protection Agency Act, 1992 as amended, is required. No changes to the existing IPPC licence were proposed as a consequence of this planning application. An Environmental Impact Statement (EIS) accompanied the application. Permission was granted by the Planning Authority on the 21/06/2013 subject to 10 no. conditions, the decision was later appealed to An Bord Pleanála who granted permission with revised conditions on the 19/11/2013 subject to 8 no. conditions. An Taisce subsequently secured a court order overturning a planning permission for the continued operation of a Bord na Móna peat-powered power plant. The court has granted a stay on the order until 14th October 2016 to allow time for An Bord Pleanála to decide on a new planning application involving a wider environmental impact assessment (see Pl. Ref. 15/129, ABP PL19.245295 below).

- **Pl. Ref. 14/144:** Planning application by Edenderry Power Limited for a feedstock handling system to enhance the existing control and metering system on site. The development consisted of a covered feedstock receiving station with a capacity of 400m^3 ('hopper') with associated concrete slab. The development also included a screen house for the removal of ferrous and oversize material, as well as associated quality control sampling equipment, and incline and by pass conveyors of 688m^2 to tie into the existing feedstock storage and handling system. The application related to development that is for the purposes of an activity requiring an integrated pollution prevention and control license under Part IV of the Environmental Protection Agency Act, 1992 as amended. Permission was granted by the Planning Authority on the 29/08/2014 subject to 7 no. conditions, the decision was later appealed to An Bord Pleanála who granted permission with revised conditions on the 19/03/2015 subject to 6 no. conditions.

- **Pl. Ref. 15/129:** Planning application by Edenderry Power Limited for the extension of the continued use and operation, until the end of 2030, of the previously permitted peat and biomass co-fired power plant currently existing and operating; thereby postponing removal of the electricity generating station required under the grant of planning permissions (Offaly county council reference PL2/98/437 / an Bord Pleanála Reference PL.19.107858 and Offaly County Council reference PL2/04/210 / An Bord Pleanála reference PL.19.211173). The application relates to development (the continued use and operation of the peat and biomass co-fired power plant) that is an activity with industrial emissions. The power plant currently operates under an Environmental Protection Agency Industrial Emissions (formerly IPPC) licence (register reference number P0482-04) for the above mentioned activity. No changes to this existing IE/IPPC licence are proposed as a consequence of this planning application. Permission was granted by the Planning Authority on the 13/07/2015 subject to 7 no. conditions. The decision was appealed by a third party to An Bord Pleanála, however no decision has been made.

Solar Farm at Clonin, Rhode, Co. Offaly

Pl. Ref. 16/246: Planning application for the development of a solar PV energy development with a total site area of circa 96.6 hectares, to include one single storey electrical substation building and associated compound, electrical transformer and inverter station modules, storage modules, solar pv panels ground mounted on support structures, access roads, fencing and associated electrical cabling, ducting, CCTV and other ancillary infrastructure, additional landscaping as required and associated site development works. This application is currently at Planning stage.

Other Applications

- **Pl Ref. 95/445:** Planning application for an extension to existing dwelling house. The planning authority granted planning permission on the 14th November 1995 subject to 4 no. conditions.

- **Pl. Ref. 98/955:** Planning application for 3 no dormer houses and 3 no effluent treatment systems. The Planning Authority granted permission on the 25th August 1999 subject to 12 no. conditions.

- **Pl. Ref. 00/1198:** Planning application for a dwelling house, garage, septic tank & effluent treatment system**.** The planning authority granted planning permission on the 17th May 2001 subject to 15 no. conditions.

- **Pl. Ref. 00/635:** Planning application for a dwelling house. The planning authority granted planning permission on the 30th April 2001 subject to 17 no. conditions.

- **Pl. Ref. 00/822:** Outline permission application for a dwelling house and septic tank. The planning authority refused planning permission on the 8th October 2001.

- **Pl. Ref. 02/489:** Planning application for dwelling house, detached domestic use garage & effluent treatment system. Permission was refused by the Planning Authority on the 6th January 2003.

- **Pl. Ref. 02/1310:** Planning application for dwelling house, septic tank and puraflo effluent treatment system. Permission was granted by the Planning Authority on the 6th May 2003, subject to 13 no. conditions.

- **Pl. Ref. 03/668:** Planning application for the erection of a four-bedroom dwelling house, waste treatment system, detached garage, proposed bored well and all ancillary site works. Permission was granted by the Planning Authority on the 12/11/2003 subject to 13 no. conditions.

- **Pl. Ref. 03/767:** Retention application for the retention of plant hire repair workshop and storage for plant hire goods, incorporating compound for external storage of plant hire goods and access road. The Planning Authority refused planning permission on the 17th September 2003.

- **Pl. Ref. 08/684:** Planning application for the construction of workshop, offices, stores and garage comprising of two no. industrial units, construction of truck wash, fuelling area, effluent treatment system, access road, front boundary entrance gates and yards. The Planning Authority granted permission on the 20th February 2009 subject to 12 no. conditions.

- **Pl. Ref. 09/496:** Retention application for a change of use of agricultural building to an auto salvage and recycling unit. retention permission for storage building and permission to construct a new storage building. The planning authority refused permission on the 3rd August 2010.

- **Pl. Ref. 10/342:** Planning application for (a) construction of a storey and a half dwelling house with associated treatment system and percolation area; (b) the construction of a detached garage/fuel store; (c) all associated site works, including entrance and boundary treatments. The planning authority refused permission on the 19th November 2010.

- **Pl. Ref. 11/102:** Planning application for (a) construction of a storey-and-a-half dwelling house with associated treatment system and percolation area, (b) construction of detached garage/fuel store, and (c) all associated site works including entrance and boundary treatments. The planning authority granted permission on the 8th August 2011.

- **Pl. Ref. 11/279:** Retention application for existing auto salvage/scrap and auto recycling yard and associated works and buildings. The existing development falls within the requirement for a waste licence. The planning authority granted permission on the 18th January 2012.

- **Pl. Ref. 14/12:** Planning application for an extension to existing dwelling house. The planning authority granted planning permission subject to 4 no. conditions.

- **Pl. Ref. 16/177:** Planning application for infilling of lands with material consisting of clean, uncontaminated soil and stones and for the crushing of concrete on a sporadic basis (which is not for infilling on the site) prior to its removal for reuse. This site is located at Shean, adjacent to the R401 Regional Road north of Edenderry Power Station, and is currently still at planning stage.

There have been a number planning applications within the Cloncreen, Clongarret, Esker More, Rathvilla or Rathclonbrackan, Ballinrath, Ballynakill and Ballykilleen townlands that are not mentioned above, this is due to the distance of the application sites to the red line boundary. The subject applications were primarily one-off dwelling houses or related to agricultural purposes.

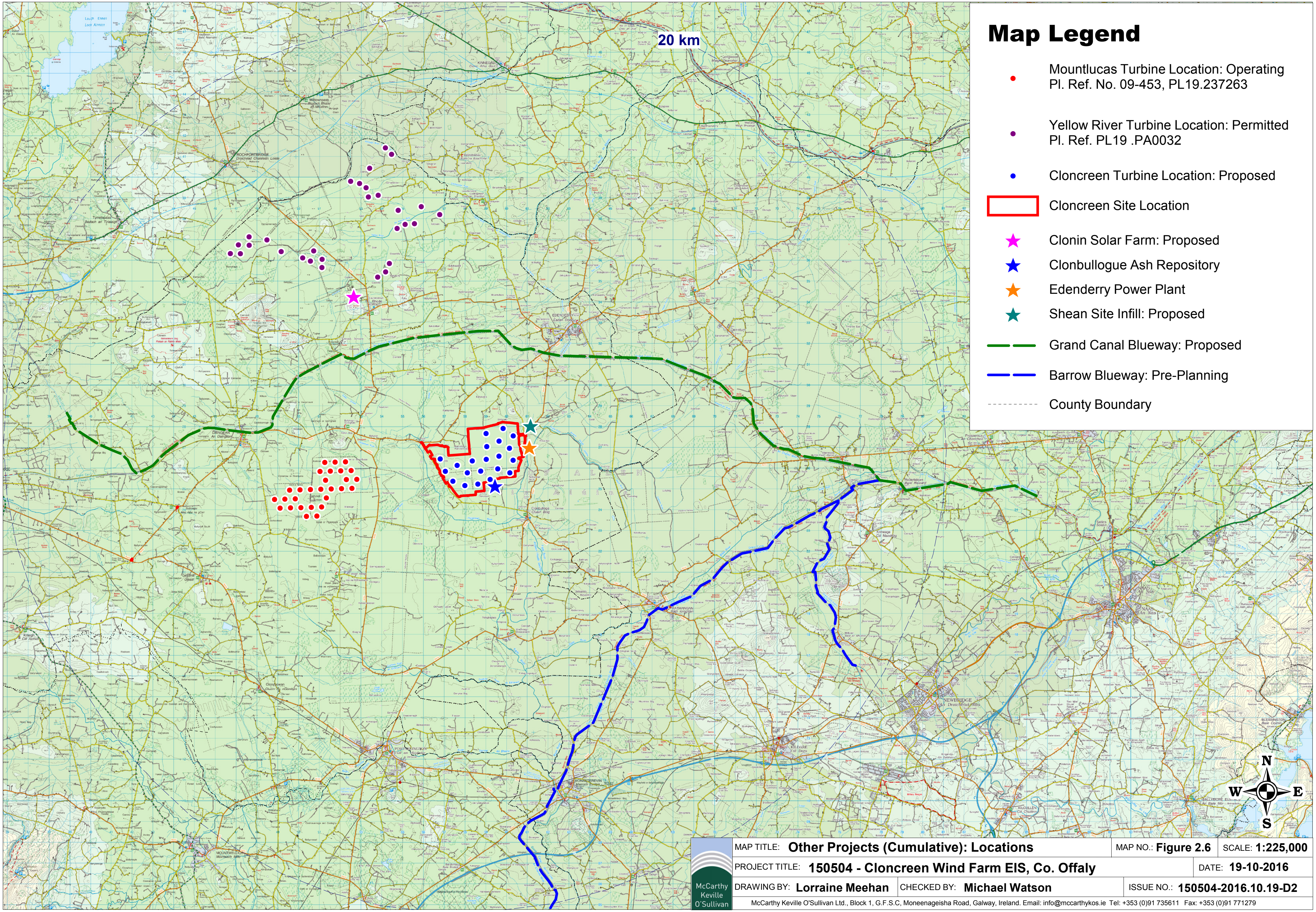
2.7.3 Other Wind Farm Sites Within 20 Kilometres

The relevant planning history of the wind farm applications located within 20 kilometres of the proposed Cloncreen wind farm site is summarised below. This record below lists the main relevant applications in relation to the various wind farm sites. It is not intended to be exhaustive and list every application associated with the sites. The locations of the other wind farm sites are shown in Figure 2.6.

2.7.3.1 County Offaly

Mountlucas Wind Farm

- **Pl. Ref. 09/453, ABP Ref. PL19.237263:** Application by Bord na Móna Energy Ltd. for the construction of a wind farm comprising thirty-two turbines of up to 100 metre hub height and up to 112 metre rotor diameter with a total height not exceeding 156 metres; a transformer and crane hardstanding area at each turbine; underground electrical and communication cables linking the turbines; internal site tracks; a permanent meteorological lattice mast 100 metres high; a 110 kV substation and associated equipment and control


20 km
Map Legend
Mountlucas Turbine Location: Operating
Pl. Ref. No. 09-453, PL19.237263
Yellow River Turbine Location: Permitted
Pl. Ref. PL19 .PA0032
Cloncreen Turbine Location: Proposed
Cloncreen Site Location
Clonin Solar Farm: Proposed
Clonbullogue Ash Repository
Edenderry Power Plant
Shean Site Infill: Proposed
Grand Canal Blueway: Proposed
Barrow Blueway: Pre-Planning
County Boundary
N
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MAP TITLE: Other Projects (Cumulative): Locations
MAP NO.: Figure 2.6
SCALE: 1:225,000
PROJECT TITLE: 150504 - Cloncreen Wind Farm EIS, Co. Offaly
DATE: 19-10-2016
DRAWING BY: Lorraine Meehan
CHECKED BY: Michael Watson
ISSUE NO.: 150504-2016.10.19-D2
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building with associated septic tank and treatment system; extension to an existing borrow pit; drainage; and associated works.

- **Development Address:** Townlands of Drumcaw or Mountlucas, Clonarrow or Riverlyons, Brackagh, Scrub or Pidgeonpark, Island, Clonad, Gorteenkeel, Ballynakill and Derrycricket, Tullamore, Co. Offaly.

  Mountlucas Wind Farm is located approximately 4.2 kilometres west of the proposed Cloncreen wind farm site, at its nearest point.
- **Decision:** 32 no. turbines granted by the Planning Authority (Offaly County Council). Decision upheld by An Board Pleanála on appeal who omitted 2 no. turbines by condition.

Yellow River Wind Farm

- **ABP Ref. PL19.PA0032:** Strategic Infrastructure Development application by Green Wind Energy (Wexford) Ltd. for a fifteen year permission to develop of a wind farm comprising thirty-two turbines of up to 110m hub height and up to 113m rotor diameter with a total height not exceeding 166m; a transformer and crane hardstanding area at each turbine; underground electrical and communication cables linking the turbines; internal site tracks; a permanent meteorological lattice mast 100m high; a 110 kV substation and associated equipment and control building with; temporary construction compound; vehicular access and internal access tracks; one road bridge upgrade at Corbetstown, and construction of eight stream/river crossings and associated works.

- **Development Address:** Townlands of Derryarkin, Derryiron, Coolcor, Coolville, Ballyburly, Greenhills, Bunsallagh, Derrygreenagh, Knockdrin, Wood, Killowen, Corbetstown, Carrick, Garr and Dunville – to the north of Rhode, Co. Offaly.

  Yellow River Wind Farm is located approximately 8.7 kilometres north-west of the proposed Cloncreen wind farm site, at its nearest point.

- **Decision:** 29 no. turbine wind farm granted subject to 24 no. conditions.

2.7.3.2 County Kildare/Meath

Maighne Wind Farm

- **ABP Ref. PL09.PA0041:** Application by Element Power Ireland Ltd. for the erection of up to 47 no. wind turbines with an overall tip height of up to 169 metres; construction of foundations and hardstanding areas in respect of each turbine; Construction/upgrade of 9 no. site entrances from public roads; construction of approximately 31 kilometres of new site access tracks and associated drainage; 3 no. borrow pits; 4 no. temporary construction site compounds and associated parking areas; drainage and sediment control systems; 1 no. electricity substation (which will operate at a voltage up to 220kV) and all associated works.

- **Development Address:** Townlands of Moyvally, Calf field, Ballyonan, Tanderagee, Royaloak, Ballynakill, Drumsru, Cappanargid, Barnaran, Cloncurry, Glenaree, Derrybrennan, Lullymore, West, Kilpatrick, Drummond, Ballybrack, Lullymore East, Nurney, Haggard, Ballyshannon, Coonagh, Ballinderry, Williamstown, Freagh, Cadamstown, Knockcor, Collinstown, Calfstown, Dreenan, Ballina, Ballynadrumny, Feighcullen, Cloncumber, Ballynakill Lower, Ballyteige North, Allenwood, South, Ballynakill Upper, Derryvarroge, Clonagh, Ballynamullagh, Parsonstown, Kilmurry, Loughnacush, Killyon, Mucklon, Dysart, Clonkeeran, Coolree, Mulgeeth, Drehid, Hortland, Dunfierth, Kilshanchoe, Kilkeaskin, Johnstown, Gorteen, Donadea, Donadea Demesne, Dunmurraghill, Baltracey, Kilnamoragh North, Derrycrib, Knockanally, Painestown, Hodgestown, Newtownmoneenluggagh, Loughtown, Killickaweeny, Nicholastown, Pitchfordstown, Cappagh, Killbrook, Killeighter, Cloncurry, Boycetown, Taghadoe, Donaghstown, Barreen, Derrinstown, Bryanstown, Kealstown, Graiguelin, Co. Kildare and the townlands of Boolykeagh, Johnstown, Ballycarn, Dolanstown, Balfeaghan, Calgath, Kemmins Mill, Martinstown, Milltown, Phepotstown, Barstown, Mulhussey, Longtown, Jenkinstown, Warrenstown, Collistown, Cullendragh, Culcommon, Ballynare, Ribstown, Portan, Co. Meath

This site is located approximately 9.0 kilometres to 12.0 kilometres northeast, east and southeast of the proposed Cloncreen wind farm site, at its nearest point.

- **Decision:** This application was refused planning permission by An Bord Pleanála on 14th October 2016.

2.8 Alternatives

2.8.1 Introduction

Article 5 of the Environmental Impact Assessment (EIA) Directive (85/337/EEC) states that the information provided in an Environmental Impact Statement (EIS) should include an outline of the main alternatives studied by the developer and an indication of the main reasons for the final choice, taking into account the environmental effects. The consideration of alternatives typically refers to alternative sites, designs and processes.

This section of the EIS contains a description of the alternatives that were considered for the proposed development, in terms of site selection, other land-use options for the site, wind farm output, turbine model and number, site layout and transport routes to the site.

The consideration of alternatives is an effective means of avoiding environmental impacts. The Environmental Protection Agency document *'Guidelines on the Information to be Contained in Environmental Impact Statements'* (EPA, 2002) states that it is important to acknowledge however the existence of difficulties and limitations when considering alternatives. These include hierarchy, non-environmental factors and site-specific issues, as described below.

Hierarchy
EIA is concerned with projects. The EPA guidelines state that in some instances neither the applicant nor the competent authority can be realistically expected to examine options that have already been previously determined by a higher authority, such as a national plan or regional programme for infrastructure.

Non-environmental Factors
EIA is confined to the environmental effects that influence consideration of alternatives. However, other non-environmental factors may have equal or overriding

importance to the developer of a project, when considering alternatives, for example project economics, land availability, engineering feasibility or planning considerations.

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

2.8.2 Alternative Sites

Bord na Móna conducted a review of its entire landbank in order to identify potential sites for wind energy. From this initial review, a shortlist of 25 candidate sites for the proposed development was identified, as described in Section 2.4 above. All candidate sites were then assessed with regard to the specified criteria, including grid access/capacity, County Development Plan policy and zoning, proximity to houses, wind resource, environmental sensitivity, landscape capacity/cumulative impact, aviation, existing land use, communications infrastructure, flood plain analysis, in order to identify the optimum site for the proposed development. This assessment of potential candidate sites ensured that all alternative locations for the proposed development have been considered, with the most suitable site being identified for the proposal.

2.8.3 Alternative Land-uses

2.8.3.1 'Do-Nothing' Option

Over the coming decades, increasingly greater areas of the Bord na Móna land bank will come out of peat production and be available for alternative land uses. Bord na Móna's '*Strategic Framework for the Future Use of Peatlands*' (2011) sets out a strategic framework for the consideration of future potential uses of cutaway peatlands. The document is available to view at www.bordnamona.ie.

An alternative land-use option to developing a wind farm at the proposed development site would be to leave the site as it is once peat extraction ceases, which is projected to occur in 2018. A Site Rehabilitation Plan would be implemented to encourage re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas. In implementing the 'Do-Nothing' option, however, the opportunity to capture a significant part of County Offaly's renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment and investment would also be lost.

2.8.3.2 Other Land-Use Options for the Site

As peat production ceases over the coming years, Bord na Móna will be presented with the opportunity to create new landscapes. Research work, mainly in the form of demonstration projects, has been ongoing since the 1970's. The research and demonstration projects informed the understanding of the nature of industrial peatlands and facilitated the development of a knowledge base that has been built up over decades. The alternative uses that have been examined over that timeframe are wind energy, biomass, coniferous forestry, horticulture, grassland, cereal growing, growth of cranberries and blueberries, biodiversity/ecosystem services and amenity/tourism related afteruses.

Wind farm development on Bord na Móna lands commenced in 1992 with the construction and operation of the Bellacorick wind farm, Co. Mayo. Since then two additional wind farms were constructed and became fully operational in 2015 at Bruckana and Mount Lucas. This alternative use of cutaway peatlands has been clearly demonstrated to be successful.

Short rotation forestry trials carried out in the 1970's directly on cutaway bog, without intrusive conversion of the growing medium, did not survive and died out within a few years. Further trials in 2005 on well prepared cutaway failed to provide the necessary yield to make the growing of willow biomass viable. The yield was less than 20% of the yield attainable on good arable land.

Afforestation was initially envisaged as the most favourable option for the after-use of post-production peatlands. Trials on this particular use date back to 1955. The initial trials were favourable; however, the growing performance was poor. In 1996, the BOGFOR research programme was set up by a group of organisations that included Bord na Móna, Collite, the COFORD Council for Forest Research and Development and University College Dublin. Arising from this research, a further 10 trial sites have been developed in the last 15 years. None of the sites have demonstrated 100% success. A further trial using a bedding plough was established in 2010. Trials of this type of afteruse are ongoing.

Horticultural trials were carried out in Lullymore during the 1960's up to the 1970's. A range of field vegetables were successfully grown during the trials. However, it was not possible to replicate the success of the trial at other locations. The peat type at Lullymore is unique and the research did not transfer to other demonstration sites.

The techniques for the conversion of cutaway to grassland was developed during the 1970's and 1980's. A total of 1,500 hectares of cutaway were successfully converted and were subsequently sold to the private sector. The ability to convert cutaway to grassland requires specific conditions and it is estimated that a small percentage of cutaway (10%) would be suitable for this use. Furthermore, due to the level of cost associated with this type of conversion, the economic circumstances are presently not favourable.

Cereal growing was also examined. However due to the specific mixture of macro and micro nutrients required at certain stages its growth, this option did not prove successful.

Cranberries and Blueberries both require acidic media for their growth and were therefore trialed on deep acidic peat. Despite the successful establishment of cranberries, the necessary weather conditions to promote the development of fruit did not prevail and are not typical of the midland region. Neither plants are considered as a viable option.

The potential Biodiversity and Ecosystem Services that may arise from the careful management of rehabilitated cutaway peatlands has been recognised in the development of the 2010-2015 Bord na Móna Biodiversity Action Plan and the more recent the new Biodiversity Action plan 2016-2021. Bord na Móna has rehabilitated close to 12,000 hectares of the company's boglands which amounts to over fifteen percent of its total landholding to date. As part of that work, the company has actively restored over 1,000 hectares of raised bog since 2009 and aims to increase this figure in the next six years.

The flagship project that demonstrates the amenity and tourism potential of cutaway peat lands is Lough Boora parklands in Co. Offaly (http://www.loughboora.com/). The parklands include a range of tourism and amenity activities, including walking and cycling trails, fishing and angling amenities and opportunities for bird watching The amenity use of the Mountlucas Wind Farm illustrates that this particular after use of cutaway peatlands may comprise more than one use and may also facilitate additional developments.

In addition to the alternative land uses listed above, Bord na Móna is also exploring the potential for the development of an aquaculture project on cutaway peatlands and also the potential to site solar farms within those areas that are post production. However, notwithstanding the range of uses considered and explored by Bord na Móna over its lands, the proposed wind farm development has been identified as the most beneficial and sustainable use of the cutaway bog at the proposed site.

2.8.4 Alternative Turbine Numbers and Model

The proposed wind farm will have a minimum power output of approximately 63 Megawatts (MW). Having regard to the available wind resource and the selected power output for the proposed wind farm, it is proposed to install 21 No. turbines at the site using wind turbines in the 3 MW range. Such a wind farm could also be achieved on the proposed site by using smaller turbines (for example 1.5 MW machines). However, this would necessitate the installation of 42 No. turbines to achieve the same site output.

Furthermore, the use of smaller turbines would not make efficient use of the wind resource available having regard to the nature of the site. A larger number of smaller turbines would result in the wind farm occupying a greater footprint within the site, with a larger amount of supporting infrastructure being required (i.e. roads etc.) and increasing the potential for environmental impacts to occur. The proposed number of turbines takes account of all site constraints and the distances to be maintained between turbines and features such as roads and houses, while maximising the wind energy potential of the site. The 21-turbine layout selected for the site has the smallest development footprint of the other alternatives considered, while still achieving the required output at a more consistent level than would be achievable using different turbines.

The turbine model to be installed on the site will be the subject of a competitive tendering process. The maximum height of the turbines that will be selected for construction on the site will not exceed 170 metres when measured from ground level to blade tip. For the purposes of this EIS the worst-case scenario of turbines within this size envelope has been assessed (e.g. tallest turbine within defined range has been assessed for visual impact, loudest for noise, longest rotor diameter for shadow flicker and blade transport, etc.). The EIS therefore provides a robust assessment of the turbines that could be considered within the overall development description. The use of alternative smaller turbines at this site would not be appropriate as they would fail to make the most efficient use of the wind resource passing over the site.

2.8.5 Alternative Layouts

2.8.5.1 Turbine Layout

The final proposed turbine layout takes account of all significant site constraints and the distances to be maintained between turbines and from houses, roads, etc. The layout is based on the results of all site investigations and environmental assessments that have been carried out during the EIS process. As information regarding the site of the proposed development was compiled and assessed, the number of turbines and the proposed layout were revised and amended to take account of the physical constraints of the site and the requirement for buffer zones and other areas in which no turbines could be located. The selection of turbine number and layout has also had regard to wind-take, noise and shadow flicker impacts and the separation distance to be maintained between turbines. The EIS and wind farm design process was an iterative process, where findings at each stage of the assessment were used to further refine the design, always with the intention of minimising the potential for environmental impacts. The development of the final proposed wind farm layout has resulted from feedback from the assessments carried out during preparation of this EIS and information supplied from the Public Consultation process.

The initial constraints study identified a significant viable area within the proposed development site, in which a potential turbine layout was developed. This turbine layout was then refined a number of times following feedback from the project team during detailed site investigations and from consultees, including public consultation. The final proposed turbine layout represents the fourth iteration of the proposed turbine layout. The earlier alternative layouts ranged in size from 19 to 22 No. turbines. The adjustments through each layout iteration encompassed minor placement changes to turbines to ensure sufficient distances were maintained from sensitive receptors and constraints, and to maintain the required separation distances between turbines.

2.8.5.2 Road Layout

Access tracks are required on-site in order to enable transport of turbines and construction materials to each of the turbine locations. Such tracks must be of a gradient and width sufficient to allow safe movement of equipment and vehicles. The alternative road layouts considered were based on the earlier versions of the proposed turbine layout, as described in Section 2.8.5.1 above. As turbine locations were assessed and finalised, the most suitable routes between these points were identified, taking into account the physical constraints of the site and utilising the most direct route between turbines in order to minimise the footprint.

The internal road network has also been designed to allow for the safe movement of vehicles around the site. During the operational phase, part or all of the road network will be available for recreational users as set out in the amenity proposals for the project presented in Chapter 3, subject to health and safety restrictions, for example around the borrow pit or when maintenance work is being carried out at specific turbines or locations around the site.

2.8.5.3 Location of Ancillary Structures

The ancillary structures required for the proposed development include the site entrances and temporary construction compounds, passing bays, electricity substation, cabling, borrow pit and meteorological mast.

2.8.5.3.1 Construction Compound

Construction compound locations were considered adjacent to the existing site entrances, i.e. the eastern entrance and the 'tea centre' entrance from the north, and adjacent to the proposed new western site entrance. In assessing the final proposed turbine layout, the optimal locations for the temporary construction compounds were identified; two temporary construction compounds will be used for the storage of all construction materials and turbines components, as required. One compound will be located close to the proposed construction phase site entrance, with the second being located adjacent to the substation that will be constructed (either Option A or Option B, as described in Section 1.1 of this EIS). The areas selected for the siting of the compounds were deemed to be most suitable in terms of the absence of constraints, and proximity to initial construction areas.

2.8.5.3.2 Electricity Substation and Grid Connection

The planning application includes 2 no. substations and associated grid connection options. Only one substation and associated grid connection will ultimately be constructed, as described in Section 1.3 of this EIS. The proposed wind farm will connect to the grid via a short section of overhead line or via underground cable along onsite roads, Bord na Móna lands and the curtilage of the public road. All cabling between turbines and the onsite substation will be laid underground; an alternative to this would be to use overhead cabling. This however would give rise to additional visual impacts, therefore the preferred option is to use underground cabling within the site.

2.8.5.3.3 Borrow Pit

The majority of fill and stone material required for the construction of access roads and turbine bases will be obtained from the existing onsite borrow pit, proposed to be extended as part of the proposed development. Use of the existing borrow pit represents an efficient use of existing onsite resources and eliminates the need to transport large volumes of construction materials along the surrounding public road network to the site.

An alternative borrow pit area was also investigated in the south-eastern section of the site. However, it was identified by the assessment of borrow pit options that the overburden material from this area would be less suitable for use as an engineered fill than that sourced from the existing borrow pit area.

2.8.6 Alternative Transport Route and Site Access

Wind turbine components (blades, nacelles and towers) are not manufactured in Ireland and therefore must be imported from overseas and transported overland to the site of a proposed development. With regard to the selection of a transport route to the proposed development site, alternatives were considered in relation to turbine components, general construction-related traffic, and site access locations.

In assessing the most suitable route for turbine transport, cognisance was taken of the haul route used for Mountlucas Wind Farm, which is located approximately 4.2 kilometres west of the proposed development site. This route utilised National and Regional roads, with a minimal requirement for junction accommodation works. This approach was deemed preferable to using local roads, which would require significant upgrade works. The proposed turbine haul route to Cloncreen will therefore use the same haul route along the M6 motorway and N52 National Secondary Road, and access the site via Regional Roads R420 and R402 between the N52 and the site. This route has proven suitable for the transport of turbine components, and the updated transport analysis (as presented in Section 13.1 of this EIS), shows that only minor accommodation works will be required to accommodate the proposed Cloncreen turbines.

During the construction phase, turbine access to the site will be via the R402 and the L1003, the junction of which is proposed to be upgraded as part of the proposed development. It is proposed to construct a new site entrance from the L1003 into the western side of the site. Some construction traffic (non-turbine transport vehicles only) will also utilise the existing site entrance from the R401 on the eastern side of the site.

Some equipment (primarily excavators) will also access the site using the existing site access to the tea centre. This access point may also be used intermittently during the operational phase to access this area of the site; however, the volume of traffic here will be significantly less than that currently associated with peat extraction works.

All construction traffic will use the designated haul routes only. An alternative to this would be to allow for more direct access to the site using multiple approach routes; however, this is more likely to give rise to additional traffic and road impacts.

2.9 Scoping and Consultation

2.9.1 Scoping

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

A Scoping Document, providing details of the application site, the proposed development and the proposed scope of the EIS, and inviting the comments and input of consultees, was prepared by McCarthy Keville O'Sullivan (MKO) and circulated on 10th September 2015. The proposed final turbine layout was also circulated to all consultees for comment on 22nd April 2016.

2.9.2 Scoping Responses

Table 2.2 presents a summary of consultee responses. Copies of all scoping responses are included in Appendix 2-1 of this EIS. The recommendations of the consultees have informed the EIS preparation process and contents. Table 2.3 presents the key points from the scoping responses, and notes where they have been addressed in this EIS.

Table 2.2 Scoping Response Summary

No.	Consultee	First Consultation Response (Scoping Document issued 10th September 2015)	Second Consultation Response (Proposed Final Layout issued 22nd April 2016)
1	An Taisce	Email received 11/09/15	No response as of 30/09/16
2	BAI (Broadcasting Authority of Ireland)	No response as of 30/09/16	Email received 22/04/16
3	Bat Conservation Ireland	No response as of 30/09/16	No response as of 30/09/16
4	BirdWatch Ireland	Email received 02/02/16	No response as of 30/09/16

No.	Consultee	First Consultation Response (Scoping Document issued 10th September 2015)	Second Consultation Response (Proposed Final Layout issued 22nd April 2016)
5	BT Communications Ireland	Email received 14/09/15	Email received 28/04/16
6	Commission for Communications Regulation	Email received 14/09/15	No response as of 30/09/16
7	Commission for Energy Regulation	No response as of 30/09/16	No response as of 30/09/16
8	Dept. of Agriculture, Food and the Marine	No response as of 30/09/16	No response as of 30/09/16
9	Dept. of Arts, Heritage and the Gaeltacht	Letter received 20/10/15	Email received 04/05/16. Letter received 14/06/16
10	Dept. of Defence	Email received 07/10/15	No response as of 30/09/16
11	Eircom Ltd.	No response as of 30/09/16	No response as of 30/09/16
12	EPA	No response as of 30/09/16	No response as of 30/09/16
13	ESB Telecoms	Email received 14/09/15	Email received 07/06/16
14	Fáilte Ireland	No response as of 30/09/16	No response as of 30/09/16
15	Geological Survey of Ireland	No response as of 30/09/16	No response as of 30/09/16
16	Health Service Executive	Letters received 18/09/15 & 14/10/15	No response as of 30/09/16
17	Inland Fisheries Ireland	Letter received 18/09/15	No response as of 30/09/16
18	Irish Aviation Authority	Letter received 02/11/15	Email sent to Bord na Móna 30/06/16
19	Irish Environmental Network	Email received 14/09/15	No response as of 30/09/16
20	Irish Peatland Conservation Council	Letter received 29/09/15	No response as of 30/09/16
21	Irish Red Grouse Association	No response as of 30/09/16	No response as of 30/09/16
22	Irish Raptor Study Group	No response as of 30/09/16	No response as of 30/09/16
23	Irish Parachute Club	Letter received 29/09/15	Further letter received 19/05/16.
24	Irish Sports Council, Dept. of Tourism, Transport & Sport	No response as of 30/09/16	No response as of 30/09/16
25	Irish Water	No response as of 30/09/16	No response as of 30/09/16
26	Irish Wildlife Trust	No response as of 30/09/16	No response as of 30/09/16
27	Kildare County Council Planning Section	Letter received 08/10/15	Letter received 03/05/16

No.	Consultee	First Consultation Response (Scoping Document issued 10th September 2015)	Second Consultation Response (Proposed Final Layout issued 22nd April 2016)
28	Meteor Mobile Communications Ltd.	Email received 21/09/15	Email received 27/04/16
29	Transport Infrastructure Ireland (previously NRA)	Letter received 18/09/15	No response as of 30/09/16
30	O2 Ireland	No response as of 30/09/16	No response as of 30/09/16
31	Office of Public Works	No response as of 30/09/16	Letter received 24/05/16
32	Offaly County Council Planning / Roads / Environment Sections, Heritage Officer	Letter received 16/10/15. Meetings held – see Section 2.9.3 below	Meetings held – see Section 2.9.3 below
33	RTE Transmission Network Ltd.	Email received 16/09/15	Email received 29/04/16
34	South Eastern River Basin District	No response as of 30/09/16	No response as of 30/09/16
35	Sustainable Energy Authority of Ireland	No response as of 30/09/16	No response as of 30/09/16
36	Tetra Ireland Communications Ltd.	Email received 28/09/15	Email received 29/04/16
37	The Heritage Council	No response as of 30/09/16	No response as of 30/09/16
38	Three Ireland Ltd.	No response as of 30/09/16	Email received 25/04/16
39	Towercom	No response as of 30/09/16	No response as of 30/09/16
40	TV3	Letter received 24/09/15	No response as of 30/09/16
41	UPC Communications Ireland	Email received 18/09/2015	No response as of 30/09/16
42	Vodafone Ireland	Email received 23/09/2015	Email received 22/04/16
43	Airspeed	Email received 15/09/15	Email received 04/05/16
44	Offaly County Council - Telecoms	No response as of 30/09/16	No response as of 30/09/16
	Additional Consultation (Flora & Fauna):		
45	Irish Whooper Swan Study Group	Email received 01/02/16	-
46	Mr. Colm Malone, Local NPWS Ranger	Phone call with MKO Ecologist 13/01/16	-
47	Mr. Alyn Walsh (NPWS), Greenland White-fronted Goose Expert Ornithologist	Phone call with MKO Ecologist 15/10/15	-

Table 2.3 Review of Scoping Responses

No.	Consultee	Key Scoping Response Points	Comment
1	An Taisce	▪ Consultation for any proposal to be integrated with a peat-cutting cessation and restoration plan by Bord na Móna for all of its landholdings.	▪ Peat-cutting works are projected to cease at Cloncreen in 2018, prior to construction of the proposed development. All commercial extraction of energy peat by Bord na Móna will cease in 2030.
2	BirdWatch Ireland	▪ See Item No. 10 below: Irish Whooper Swan Study Group consultation	▪ See Item No. 10 below: Irish Whooper Swan Study Group consultation
3	Department of Arts, Heritage and the Gaeltacht	▪ Ecological survey of the site required, including the route of any access roads, pipelines, cables etc., to survey habitats and species present. Any improvement or reinforcement works required for access and transport along the proposed haul route to also be subjected to ecological impact assessment.	▪ Ecological survey of site, including access roads, grid connection route and turbine haul route completed – See Chapter 5: Flora & Fauna, Chapter 6: Ornithology, Appropriate Assessment (AA) Screening Report, and Natura Impact Statement (NIS)
		▪ EIS to detail survey methodology, timing and results.	▪ Completed – See Sections 5.2 and 6.2
		▪ EIS to cover the whole project, including construction, operation and restoration / decommissioning phases.	▪ Completed – each phase is addressed throughout EIS
		▪ EIS to include Alternatives examined.	▪ Completed – See Section 2.8
		▪ Inland Fisheries Ireland (IFI) should be consulted.	▪ Completed – See Section 2.9.1
		▪ Baseline data on designated sites, habitats and species available online.	▪ Baseline data reviewed as part of desk study – See Section 5.3
		▪ Assess impacts, where applicable, with regard to: Natura 2000 sites, protected species and habitats, landscape features of major importance for wild flora and fauna, and biodiversity in general.	▪ Completed – See Section 5.4
		▪ EIS to assess cumulative impacts with other plans and projects, including non-wind farm projects.	▪ Completed – See Section 2.10 and cumulative impact section of each EIS chapter. Cumulative plans addressed in Natura Impact Statement
		▪ EIS to address the issue of invasive alien plant and animal species.	▪ Completed – See Section 5.4.3.6

		▪ EIS should provide an estimate of the length of hedgerow that will be lost, if any. Where trees or hedgerows have to be removed, there should be suitable planting of native species in mitigation. Where possible, hedgerows and trees should not be removed during the nesting season (i.e. March 1st to August 31st).	▪ Completed – See Section 5.4.3
		▪ Bat roosts may be present in trees, buildings and bridges. Bat roosts can only be destroyed under licence under the Wildlife Acts and a derogation under the Habitats Regulations, and such a licence would only be given if suitable mitigation measures were implemented. Where so-called bat friendly lighting is proposed as mitigation it should be proven to work as mitigation.	▪ No bat roosts are present on site, on grid connection route or on proposed turbine haul route – See Section 5.3.3.2
		▪ Any watercourse or wetland impacted on should be surveyed for the presence of protected species and species listed on Annexes II and IV of the Habitats Directive, such as Otter, Salmon, Lamprey, Freshwater Pearl Mussel, White-clawed Crayfish, Frogs, Newts and Kingfisher.	▪ Completed – See Section 5.3.3.2
		▪ Construction work should not impact on water quality, and measures should be detailed to prevent sediment and/or fuel runoff into watercourses.	▪ Noted – See Section 3.3.13.2 for measures to prevent sediment and/or fuel runoff into watercourses
		▪ If applicable the EIS should take account of the guidelines for Planning Authorities entitled *"The Planning System and Flood Risk Management"* (Department of the Environment, Heritage and Local Government, 2009).	▪ Completed – See Chapter 8: Hydrology & Hydrogeology and Appendix 8-1 for Flood Risk Assessment
		▪ Ground and surface waters quality should be protected during construction and operation of the proposed development and if applicable the applicant should ensure that adequate sewage	▪ Noted – See Section 3.6 for ground and surface water quality protection measures. See Sections 3.3.7 and 3.3.11 for sewage treatment and water supply proposals

		treatment facilities and water supplies are or will be in place prior to any development.	
		▪ Survey work should include 2 years of bird data. Survey methodologies should follow best practice and if necessary be modified to reflect the Irish situation. It is important that bird migration routes are considered as well as routes of birds travelling on a daily basis between roosting and feeding areas.	▪ Noted – See Section 6.2 on bird survey methodology
		▪ A bat survey will be required.	▪ Completed – See Section 5.2.2.3
		▪ Complete project details including construction management plans (CMPs) need to be provided in order to allow an adequate EIS and appropriate assessment to be undertaken. The CMPs and other such plans must present adequate and effective mitigation, supported by scientific information and analysis, and be feasible within the physical constraints of the site.	▪ Completed – See Section 3: Description chapter and Construction & Environmental Management Plan in Appendix 3-2
		▪ If applicants are not in a position to decide the exact cable route location and details at time of application, then they need to consider the range of options that may be used in their assessment so that all issues are covered.	▪ Two potential grid connection options have been identified and are assessed in the EIS – See Section 5.3.3
		▪ EIS should identify any pre and post-construction monitoring which should be carried out. The applicant should not use any proposed post-construction monitoring as mitigation to supplement inadequate information in the assessment. Post-construction monitoring should include bird and bat strikes/fatalities including the impact on any such results of the removal of carcasses by scavengers. Monitoring results should be made available to the competent Authority and copied to this Department. A plan of action needs to be agreed at planning stage with the Planning Authority if the results in future	▪ Noted – See Sections 5.5 and 6.8 on monitoring proposals

		show a significant mortality of birds and/or bat species.	
		▪ Should the exact height and rotor diameter of the turbines to be used not be known at EIS stage then the assessment of impacts must be applicable to a variety of turbine heights and rotor diameters which could be used. This should be made clear in EIS.	▪ Completed – See Section 3.3.1
		▪ In order to carry out the appropriate assessment screening, and/or prepare the Natura Impact Statement (NIS), information about the relevant Natura 2000 sites including their conservation objectives will need to be collected. Other relevant Local Authorities should be consulted to determine if there are any projects or plans which, in combination with this proposed development, could impact on any Natura 2000 sites.	▪ Completed – See Section 2.9.1 regarding consultation, and accompanying Natura Impact Statement (NIS)
		▪ If proposed development is adjacent to a Natura 2000 site and involves landscaping or a garden, care should be taken to ensure that no terrestrial or aquatic invasive species are used which could impact negatively on these sites.	▪ Proposed development is not located adjacent to Natura 2000 site. No terrestrial or aquatic invasive species will be used in landscaping.
		▪ Where there are impacts on protected species and their habitats, resting or breeding places, licenses may be required under the Wildlife Acts or derogations under the Habitats Regulations. Should this survey work take place well before construction commences, it is recommended that an ecological survey of the development site should take place immediately prior to construction to ensure no significant change in the baseline ecological survey has occurred.	▪ Noted – See Section 5.5
		▪ Previous archaeological surveys of the bog should be examined.	▪ Completed – See Section 12.2.1

		▪ A new survey of the bog should be carried out. Survey work should be undertaken by an archaeologist working under the terms of an excavation licence.	▪ Noted – See Section 12.2.3 on survey methodology
		▪ Proposed site layout should be considered in light of the surveys.	▪ Noted – See Section 12.1.3
		▪ Implications of substations and grid connection for archaeological remains should be assessed.	▪ Completed – See Section 12.4.3.3
		▪ Archaeological mitigation should be suggested, to take place in advance of and/or during groundworks.	▪ Noted – See Sections 12.4.3 and 12.4.4
		▪ It is likely, that where material is to be preserved in situ, empirical measurement into the future of hydrology of the site will be required.	▪ Noted – See construction phase mitigation measures in Section 12.4.3
4	Department of Defence	▪ Consult with Air Corps, Casement Aerodrome; specific lighting requirements to aid visual acquisition of wind farms.	▪ Turbine lighting scheme will be agreed with Irish Aviation Authority, Department of Defence and the Planning Authority in advance of turbine construction.
5	Health Service Executive (HSE)	▪ Effective consultation process required with the local community, prior to submission of planning application and during the construction and operational phases. EIS should include details of the consultation process and outcome.	▪ Completed – See Section 2.9.4
		▪ EIS should include assessment of any likely impact on the River Barrow and mitigation measures for same.	▪ Completed – See Section 5.4.2, Chapter 8: Hydrology & Hydrogeology, and the Natura Impact Statement
		▪ The risk of any spillage of fuel from plant and equipment must be addressed.	▪ Completed – See Section 3.3.13.2
		▪ Wells should be identified, and possible negative impacts on well quality or yield addressed.	▪ Completed - Chapter 8: Hydrology & Hydrogeology
		▪ If tree felling is involved, any negative impact on water quality should be addressed.	▪ Completed – Chapter 8: Hydrology & Hydrogeology
		▪ All dwellings must be clearly identified on the maps for noise and shadow flicker. Indicate likely impact	▪ Completed – See Section 4.7.4 on shadow flicker and Section 10.5.2 on noise

		by noise during construction and operational phase, and shadow flicker during operational phase. Remediation measures should be clearly outlined in the event of non-compliance.	
		▪ Dust minimisation plan should be submitted for approval prior to the commencement of any development.	▪ Noted – See Section 3.3.13.5 and Construction & Environmental Management Plan (Appendix 3-2) for dust control measures
		▪ Details of provision of potable water supply and sanitary accommodation for staff to be included.	▪ Completed – See Sections 3.3.7 and 3.3.11
		▪ Proposals for decommissioning must demonstrate there will be no adverse environmental impacts during this stage and afterward.	▪ Noted – See Section 3.10. Decommissioning phase included in impact assessment sections of EIS chapters.
		▪ No comments from Emergency Management Office.	▪ Noted.
6	Inland Fisheries Ireland	▪ Smaller watercourses and the Bord na Móna drainage network have the potential to convey deleterious matter from construction works to the Philipstown and Figile Rivers. Systems should be put in place to ensure there shall be no discharge of suspended solids or any other deleterious matter to watercourses during the construction / operational phase and landscaping works.	▪ Noted – See Section 3.6 on Site Drainage
		▪ All natural watercourses to be traversed during site development and road construction works should be effectively bridged prior to commencement. If temporary crossing structures are required, IFI approval will be necessary. Design and choice of temporary crossing structures must provide for passage of fish and macroinvertebrates, protection of important fish habitats, and prevent erosion and sedimentation.	▪ Noted. No new watercrossings are proposed as part of the development. One existing culvert will be extended at the western boundary of the site.
		▪ Access for angling on the Philipstown and Figile Rivers will be required; thus it would be helpful to identify proposed locations for construction and operational access.	▪ Noted – See Section 3.5 on turbine haul route and site access locations. Access to the Philipstown and Figile Rivers will not be affected.

		▪ The crossing of important fisheries waters in relation to the grid connection should be addressed.	▪ No water crossings are required as part of grid connection works – See Section 3.3.9
		▪ Permanent crossing structures should not damage fish habitat or create blockages to fish and macroinvertebrate passage.	▪ Noted. No new watercrossings are proposed as part of the development. One existing culvert will be extended at the western boundary of the site.
		▪ OPW should be consulted at an early stage in the design process regarding flood risk management.	▪ Completed – See Section 2.9.1
		▪ Specific design recommendations are provided for bridges and culverts, and bank protection works.	▪ Noted
		▪ Guidelines provided on the timing of instream works.	▪ No instream works are required
		▪ Assess and critically review the soil type and structure at proposed turbine and access road locations.	▪ Completed – See Chapter 6: Soils & Geology and Peat Stability Assessment in Appendix 7-1
		▪ Incorporate best practices into construction methods to minimise discharges of silt/suspended solids to waters. A comprehensive plan should be drawn up with specific measures to address the high potential for silt pollution of nearby watercourses during works on site.	▪ Completed – See Section 3.6
		▪ Natural flow paths should not be interrupted or diverted so as to give rise to or create potential for erosion.	▪ Noted. Natural flow paths will not be interrupted or diverted
		▪ Pre-cast concrete should be used whenever possible, to eliminate the risk to aquatic life. When cast-in-place concrete is required, all work must be done in the dry and isolated from any water that may enter the drainage network. Specific controlled and environmentally safe vehicle washout areas must be provided.	▪ Noted – See Section 3.3.13
		▪ All oils and fuels should be secured in secure bunded areas, and particular care and attention should be taken during refuelling and maintenance operations on plant and equipment. All plant and equipment should carry oil/fuel spill kits.	▪ Noted – See Section 3.3.13.2

		▪ Where site works involve discharges of drainage water to receiving rivers and streams, temporary oil interceptor facilities should be installed and maintained.	▪ Noted – See Section 3.6.5
		▪ No instream works on or with the potential to impact on fisheries waters shall be carried out with the written approval of IFI.	▪ Noted. No instream works are proposed
7	Irish Environmental Network	▪ Scoping request has been forwarded to all members.	▪ Noted.
8	Irish Parachute Club	▪ Club has safety concerns for proposed turbines within five kilometres of Clonbullogue Airfield; considers any such structures as a serious hazard to flying and parachuting operations at the airfield. Statutory Instrument S.I. 235 of 2008 refers.	▪ Safety Report commissioned by Bord na Móna in 2015; identified requirement for 2.7-kilometre exclusion zone around the airfield, in line with International Civil Aviation Organisation requirements. ▪ Buffer zone of 2.7 kilometres applied to airfield during site design process. No turbines are proposed within 2.7 kilometres of Clonbulloge Airfield – See Section 13.2.4. ▪ S.I. 235 of the Planning and Development Regulations 2008 relates to '*the construction, erection or placing <u>within the curtilage of an industrial building or light industrial building, or business premises</u> of a wind turbine*', which is not the case in this application.
9	Irish Peatland Conservation Council	▪ Aerial image shows small remnant of intact raised bog habitat within proposed development area. Ensure this area fully classified and described in EIS.	▪ Area of intact raised bog habitat is outside the proposed development area – See habitat map with proposed development footprint in Section 5.3.3.1
		▪ There should be strong consultation links with the Bord na Móna Ecology team. Current and historical reports from the Ecology team should be reviewed and be included as part of the EIS.	▪ Completed – See Section 5.2.1
10	Irish Whooper Swan Study Group	▪ Direct consultation with MKO Ecology team; Study Group unaware of any significant historical swan	▪ Noted – See Section 6.2.1

		flocks in the area; recommended contacting BirdWatch Ireland for latest I-WeBS data. ▪ BirdWatch Ireland sent list of sites on database that are either wholly or partially within Co. Offaly.	
11	Kildare County Council Planning Section	▪ Landscape issues which arose in the Maighne Wind Farm proposal, and which are considered to be of relevance for the Cloncreen proposal include: cumulative wind farm landscape impacts; the significant eastward expansion of the visible presence of wind farms; visual impact on the cultural landscape; the availability of long-range views; landscape value of lowland areas; impacts on the setting of protected structures and the existing rural landscape skyline character; impacts on historic designed landscapes of demesne character; impacts on views and prospects to and from protected structures; impact of new site access tracks; proximity of sensitive receptors; localised landscape impacts; visual dominance of turbines; the angle of view used in photomontages.	▪ All landscape and visual impacts are addressed, including cumulative impacts – See Section 11: Landscape & Visual. This chapter of EIS identifies sensitive visual and landscape receptors and assesses predicted impacts, including on Kildare County Council designated views and landscapes, and on settlements. As Maighne Wind Farm was refused planning permission by An Bord Pleanála on 14th October 2016, these turbines are therefore not considered in the cumulative impact assessment. ▪ Photomontages are produced using a narrower angle of view; 120 degrees where possible.
		▪ Detailed pre-construction surveys in relation to access roads and haul routes are required.	▪ No sections of site access road or turbine / construction haul routes are located in Co. Kildare.
		▪ Detailed pre-construction surveys in relation to grid connection routes are required. Grid connection routes to be identified in the EIS. Kildare Water Services will consider the impact of all elements of the development on services within Co. Kildare.	▪ No sections of grid connection route are located in Co. Kildare.
		▪ Suitable scaled mapping should be provided which identifies noise and shadow flicker result data relation to the location of dwellings and other buildings.	▪ Completed – See Section 4.7.4 on shadow flicker and Section 10.5.2 on noise
		▪ Revised Wind Energy Development Guidelines have yet to be finalised.	▪ Noted – See Section 1.1.1 on draft guidelines

		▪ A determination on the wind turbine make / model should be finalised as part of the proposal, as it would add more certainty and clarity to all studies and assessments undertaken for the application.	▪ Noted – See Section 3.3.1.2. Turbine size will not exceed the proposed dimensions. Each EIS section assesses the worst-case scenario with regard to turbine model / size; exact make and model of the turbine will be dictated by a competitive tender process.
12	Mr. Colm Malone – NPWS Ranger	▪ Telephone correspondence with MKO Ecology team regarding ecological records within the area	▪ See Section 6.2.1
13	Mr. Alyn Walsh – NPWS Ranger	▪ Telephone correspondence with MKO Ecology team regarding Greenland White-fronted Goose records in the Study Area	▪ See Section 6.2.1
14	Office of Public Works (OPW)	▪ OPW drainage channels require a 10-metre maintenance strip along the edge of the channel to be maintained.	▪ Access to OPW channels will not be affected by the proposed development.
		▪ New culverts / bridges on any watercourse or changes to existing structures will require Section 50 consent from OPW.	▪ Noted. It is proposed to extend an existing culvert at the western boundary of the site
		▪ OPW website has information on any past flood events in Ireland. Data may be obtained by searching for specific locations.	▪ Completed – See Appendix 8-1 for Flood Risk Assessment
15	Offaly County Council	▪ Site is located within a Wind Energy Development Area as set out in Map No. 3.2 of the County Development Plan (CDP) 2014 – 2020. EIA should take into account the Energy Strategy in Chapter 3 of the CDP and associated policies and objectives.	▪ Completed – See Section 2.3.4
		▪ CDP Policy EP-03 states that a minimum two-kilometre buffer is required from town and village cores, which is relevant due to proximity of Clonbullogue Village.	▪ Noted. Two-kilometre buffer applied to Clonbullogue Village core during site design process. Village core is located 2.2 kilometres from the nearest proposed turbine (T7).
		▪ CDP Policy EP-03 requires that wind energy developments on cutaway bogs should generally be developed from the centre out.	▪ Noted. Layout has been developed to optimise site. Layout designed from the centre out as per Policy EP-03 – See Section 11.3.2.
		▪ Cumulative impact with Mountlucas wind farm should be addressed, including in photomontages.	▪ Completed – See Section 11.8.2 and accompanying Photomontage Booklet.

		▪ Cutaway bogs are of moderate landscape value; refer to this and associated sections of CDP.	▪ Completed – See Section 11.3.3
		▪ Local and regional roads are founded on peat soils and may need rehabilitation to cater for traffic in the construction and operational phases. Traffic and Transport Assessment should be carried out.	▪ Completed – See Section 13.1 for Traffic and Transport Assessment
		▪ Road Safety Audits are required on any proposed alterations to the existing public road network.	▪ Noted. Minor accommodation works only are required on public road network – See Section 13.1.7.2
		▪ The closest European site is approximately five kilometres away. A separate Appropriate Assessment Screening Report, and if applicable, Natura Impact Statement, should accompany the planning application.	▪ Completed – See accompanying Appropriate Assessment Screening Report and Natura Impact Statement.
		▪ Contact the relevant stakeholders for the aviation and telecommunications aspects of the EIA, including the Irish Aviation Authority.	▪ Completed – See Sections 2.9.1 and 13.2.3.2
		▪ Regard must be had to the current *'Wind Farm Energy Development Guidelines for Planning Authorities'* (2006).	▪ Completed – See Section 1.1.1
		▪ Construction and operational noise should be assessed according to the relevant guidelines.	▪ Completed – See Sections 10.5.1 and 10.5.2
		▪ The grid connection should form part of the planning application and EIA.	▪ Completed – See Section 3.1 and impact assessment sections of each EIS chapter.
		▪ Flooding occurred in this area in August 2008 and available data should be used in the assessment. Assess flood risk and proposals relating to surface water discharge. Include mitigation measures to reduce or eliminate impacts on water quality.	▪ Completed – See Appendix 8-1 for Flood Risk Assessment
		▪ Direct and indirect impacts to be presented for all stages of the development. Describe impacts in terms of quality, significance, duration and type.	▪ Completed – See Section 1.6.2 and impact assessment sections of each EIS chapter.

		▪ EIS should outline any difficulties encountered in undertaking the EIA.	▪ Completed – see methodology section of each EIS chapter.
		▪ Alternatives should be described, including sites, layout and design.	▪ Completed – See Section 2.8
		▪ Have regard to future legislation / strategies / guidelines.	▪ Completed – See Section 1.1.1
		▪ Provide details of proposed source of water supply, methods of wastewater disposal and proposed waste management practices.	▪ Completed – See Sections 3.3.7 and 3.3.11
		Note – See Section 2.9.3 also on Pre-Planning Meetings with Offaly County Council	
16	Transport Infrastructure Ireland	▪ Provides general guidance for preparation of the EIS.	▪ Noted – See Section 13.1
		▪ Consultation should be had with the relevant Local Authority/National Roads Design Office.	▪ Completed – See Sections 2.9.1 and 2.9.3
		▪ Address any potential significant impacts on the national road network and junctions with national roads in the proximity of the proposed development.	▪ Noted – there are no junctions with national roads in the proximity of the proposed development. See Section 13.1.2
		▪ Assess visual impacts from national roads.	▪ Completed – See Section 11.6.1
		▪ Assess cumulative impacts.	▪ Completed – See Section 13.1.9.4
		▪ Subject to meeting the appropriate thresholds, a Traffic and Transport assessment should be carried out, having regard to the relevant NRA guidelines on traffic, noise and vibration impacts.	▪ Completed – See Section 13.1 for Traffic and Transport Assessment
		▪ Clearly identify the proposed haul routes and assess the network to be traversed.	▪ Completed – See Sections 13.1.2, 13.16, 13.1.7
		▪ Note locations of existing and future national road schemes in relation to potential cabling routes.	▪ Noted – there are no existing or future national road schemes in proximity to the grid connection routes
	Telecommunications Operators:		
17	Airspeed	▪ Potential interference issues to broadband link from Turbine 1.	▪ Noted. See Section 13.2.5.3 on siting of Turbine 1 and calculation of required clearance zone from Airspeed link.

18	Broadcasting Authority of Ireland (BAI)	▪ No issues from wind farms on existing FM networks. ▪ Proposed development is not located close to any existing or planned FM transmission sites.	▪ Noted.
19	BT Communications	▪ Proposal has no impact on the BT network.	▪ Noted.
20	Commission for Communications Regulation (ComReg)	▪ Provided a list of operators in vicinity of the site.	▪ Noted – additional operators identified by ComReg were contacted as part of the scoping and consultation exercise.
21	ESB Telecoms	▪ Proposal has no impact on the ESB radio network.	▪ Noted.
22	Irish Aviation Authority	▪ If proposal is permitted, applicant to provide details for an agreed scheme of aviation obstacle warning lights, coordinates and elevations for built turbines, and notification at least 30 days prior to erection of turbines.	▪ Turbine lighting scheme will be agreed with Irish Aviation Authority (IAA), Department of Defence and the Planning Authority in advance of turbine construction. ▪ Turbine coordinates and elevations will be supplied to the IAA, and notification provided at least 30 days prior to erection of turbines.
		▪ Proximity to Clonbullogue Airfield and potential impact on parachuting activities of the Irish Parachute Club noted in email to Bord na Móna (30/06/16)	▪ Bord na Móna commissioned the preparation of a Safety Report by a leading European expert on parachuting activities. There are no turbines proposed within the 2.7km exclusion zone from Clonbullogue Airfield required by IAA guidelines and included in the Safety Report; see Section 13.2.4 for further details.
23	Meteor Mobile Communications	▪ Potential interference issues to telecommunications link currently operating from onsite mast, and due to Turbines 20 and 21.	▪ Noted. It is proposed to remove the existing onsite telecommunications mast as part of the proposed development; the required mitigation will be agreed with Meteor pending a grant of planning permission, to avoid any disruption to coverage. See Section 13.2.5.2 for details.
24	RTÉ Transmission Network (2rn)	▪ 2rn has no microwave link paths in the general vicinity and therefore no concerns regarding interference.	▪ Noted – See Section 13.2.3.2. Standard RTE 2rn Protocol Document will be signed by wind farm developer.

		▪ Risk of interference to domestic Saorview reception is minimal; however, in the event of this occurring, it can be addressed by the realignment of aerials to an alternative transmitter.	
25	Tetra Ireland Communications	▪ Proposal presents no network or coverage concerns.	▪ Noted.
26	Three Ireland	▪ Proposal will have no impact on the H3GI microwave transmission.	▪ Noted.
27	TV3	▪ TV3 is a customer of RTE Transmission Network; refer to Item No. 23 above	▪ Noted – See Item No. 23 above
28	UPC Communications Ireland	▪ Proposal will not affect any UPC MW radio links.	▪ Noted.
29	Vodafone Ireland	▪ Potential interference issues to telecommunications link currently operating from onsite mast, due to Turbines 5 and 13.	▪ Noted. It is proposed to remove the existing onsite telecommunications mast as part of the proposed development; the required mitigation will be agreed with Vodafone pending a grant of planning permission, to avoid any disruption to coverage. See Section 13.2.5.2 for details.

2.9.3 Pre-Planning Meetings

2.9.3.1 Offaly County Council

Pre-planning Meetings were held with the Planning Department of Offaly County Council in relation to the proposed development. These meetings were held in the County Council offices. The first meeting was held on 16th June 2015 and was attended by representatives of the planning department. At this meeting the principle of the proposed development at this location was discussed as were the provisions of the extant *Wind Energy Strategy for County Offaly*. The discussion also included reference to the comprehensive site selection process which was undertaken and the key facilitators and constraints of the preferred site. Other items for discussion included the project schedule, identification of haul routes, the potential for amenity use, noise and shadow flicker impacts at existing wind farms, and the importance of community engagement and consultation with Offaly County Council.

A second meeting was held with the Planning Authority on 23rd November 2015, which was attended by representatives of the planning, roads and environment departments. At this meeting, an update was provided to the planning authority regarding the various assessments that were being carried out as part of the EIS preparation as well as discussing the community consultation exercises undertaken and the public information evening. A selection of photomontages was also presented at the meeting. Other items for discussion included visual impact, transportation routes and assessing the impact of surface water discharge.

A third meeting was held with the Planning Authority on 13th May 2016, which was attended by representatives of the planning, roads and environment departments. At this meeting, an update was provided to the planning authority regarding the various assessments that were being carried out as part of the EIS preparation and the final site layout was presented for review. A selection of photomontages was also presented at the meeting representing the updated layout. Other items for discussion included the transport of large turbine components, the importance of flood risk assessment and the quality of receiving waters, and impacts of the new EIA Directive.

2.9.3.2 Kildare County Council

A Pre-Application Meeting was held with the Planning Department of Kildare County Council in relation to the proposed development on 26th August 2015. The discussion included reference to the comprehensive site selection process which was undertaken and the key facilitators and constraints of the preferred site. The items discussed at the meeting included the proposed turbine height, haul route assessment, grid connection, visual impact on Kildare hilltop views and scenic routes, impacts on bats and birds, impacts on protected structures, the structure of the community benefit proposals, and cumulative impact with other wind farm projects.

2.9.4 Public Consultation

A series of public information sessions were held in local community centres in June/July and December 2015, as detailed below:

Table 2.4 Public Information Sessions

Public Information Session	Date and Time
Edenderry GAA centre	30th June 2015 and 9th December 2015 (3.00pm-9.00pm)
Ballyfore GAA centre	1st July 2015 and 10th December 2015 (3.00pm-9.00pm)
Clonbullogue Hall	2nd July 2015 and 8th December 2015 (3.00pm-9.00pm)

2.9.4.1 Public Information Session No.1

Details regarding the first consultation session in June/July 2015 was advertised in the four local papers (Midland Tribune, Offaly Independent, Offaly Topic, Tullamore Tribune) in the two weeks prior to the event. Posters advertising the session were handed in to local shops in Edenderry and Clonbullogue. The shops in Edenderry were:

- Mangans Centra
- Tesco
- Dunnes Stores
- Lidi
- Aldi
- The Library
- The Post Office
- Brady's Spar
- Lawless Hardware
- Sweeneys Topaz

Notice also placed in local parishes newsletters. Details of the event were also available on Bord na Móna's corporate website.

Representatives of Bord na Móna were present at the public events to discuss the proposal with attendees and to answer any queries. Background information regarding the proposed development was displayed at the public event, which was attended by approximately 70 members of the public over the three information sessions. In addition to the project information on display at the Public Information Evening, the following items were also made available:

- Information leaflets outlining the project background and proposals for the proposed development site were available to all attendees.
- A Comments/Queries Box and Comment Cards were provided at the meeting, inviting attendees to submit any comments or queries that they might have.
- The Sign-In sheet provided space for addresses and phone numbers.

The June and July public information events formed part of the early stage consultation on the project, at which preliminary plans were presented and feedback sought from attendees.

2.9.4.2 Public Forum Clinic

A Public Forum Clinic was held over four weeks every Tuesday, Wednesday and Thursday in July between 2-4pm in Edenderry Library, Ballyfore GAA and Clonbullogue Hall respectively, with the exception of Wednesday 29th July in Ballyfore. The Clinics were advertised in the four local papers the week commencing the 4th July 2015 (Midland Tribune, Offaly Independent, Offaly Topic and Tullamore Tribune) and also on

Bord na Móna's website. Material available at the public sessions was made available for download on the Bord na Móna website following the sessions.

Issued raised included set back distances from Ballykilleen Hill, carbon offset from the agricultural sector and community benefit arising from the proposed wind farm.

2.9.4.3 Public Information Session No.2

Details regarding the second consultation session in December 2015 was advertised in the four local papers (Midland Tribune, Offaly Independent, Offaly Topic, Tullamore Tribune) in the week prior to the event. Advertisement on Midland 103 radio over 3 days, 3 times a day on on the 4th, 5th and 7th of December. Parish priests were asked to include notices in local parish newsletter: Edenderry, Rhode and Clonbullogue. Postal note was issued to approximately 250 homes regarding consultation times. Advertised on Corporate website and material available for download following the sessions.

Representatives of MKO and Bord na Móna were present at the public events to discuss the proposal with attendees and to answer any queries, which was attended by approximately 64 members of the public over the three information sessions.

Queries raised by the public during the information evening included questions in relation to visual impact, distances between turbines and dwellings, community gain schemes, roads/local infrastructure, shadow flicker, noise, cumulative impact, grid access/capacity, the site boundary, health impacts of turbines, potential for devaluation of property, impacts on the aviation industry, turbine heights, wind resources, ecological sensitivity, community ownership, turbine numbers, other planned wind farms and renewable energy policy.

These issues were explained to the relevant parties and are further comprehensively addressed throughout this EIS within the relevant section.

Following the Public Consultations, a postal note was issued to approx. 250 homes with the information booklet that was available at the sessions enclosed. This booklet contained information on the proposed wind farm in addition to background information regarding renewable energy and details, maps and drawings (including photomontages) regarding the proposed development. The booklet indicated that detailed studies had been commissioned to assess the impact of the proposed development on the local environment, including:

- Human beings and material assets;
- Ecology;
- Noise levels;
- Traffic;
- Landscape and visual impact;
- Soils, geology and hydrogeology;
- Hydrology;
- Cultural heritage and archaeology; and
- Air quality and climate.

2.9.4.4 Cloncreen Community Engagement Forum

The Cloncreen Community Engagement Forum is an additional communications channel that enables Bord na Móna to engage with interested groups and communities in the vicinity of the proposed development. The Forum is independently chaired. There are over 50 voluntary members on the forum representing areas such as Ballinowlart

North, Ballinrath, Ballyburley, Ballycon, Ballykilleen, Clonbullogue, Esker, Rathlumber, Rathvilla, Rhode, Scrubb and Walsh Island. The forum has established 10 working groups based on key issues/concerns they have identified, including the following groups:

- Near Neighbour;
- Property Devaluation;
- Temporary Structures;
- Alternative Energy;
- Communications Strategy;
- Health Impact Studies;
- Environmental Impact Studies;
- Energy Policy/White Paper;
- Community Gain Scheme; and
- Land/Adjacent Bogs.

The Cloncreen Community Engagement Forum have convened nine meetings to date: 15th October 2015 Edenderry Power Plant, 23rd November 2015, 1st February 2016, 9th March 2016 (Steering Group only), 10th May 2016, 16th May 2016 and 23rd May 2016 and 27th June all in Clonbullogue and the 7th of July (Tullamore Court Hotel).

Final Layout Map Distribution
The final layout map was posted to 493 homes within two kilometres of the boundary of proposed development in April 2016. The letter contained details on setback distances, nearest residence, number of turbines and proposed max height. It also included an invite to visit Mountlucas Wind Farm. An A3 size map of the final layout with buffer zones was also issued along with the letter.

Mountlucas Wind Farm Newsletter
The Mountlucas Wind Farm Newsletter has also contained information on the proposed Cloncreen Wind Farm. This leaflet is distributed by a third party provider to approx. 8,000 homes covering the areas of Bracknagh, Clonbullogue, Daingean, Edenderry, Geashill, Rhode and Walsh Island. To date 2 editions of this newsletter have been distributed and both have contained information on Cloncreen Wind Farm.

1st Newsletter October 2015: Text in relation to Cloncreen:
In June, Bord na Móna announced its intention to develop a wind farm on Cloncreen bog – located close to the eastern boundary of Co. Offaly. The purpose of the proposed wind farm is to generate renewable electricity for the domestic electricity market in Ireland. The development will be of similar size and capacity to Mountlucas Wind Farm. It will be located to the north west of Clonbullogue, south of Ballyfore and south west of Edenderry. Based on an area comparison with the Mountlucas Wind Farm it is estimated that between 20 and 30 turbines could be located at the Cloncreen site. We would like to thank all that attended the 1st Pre- Planning Public Consultation sessions in July. It is envisaged that the 2nd Pre –Planning Public Consultation sessions will be held in December. Details will be published later. Planning Public Consultation sessions will be held in December. Details will be published later. If you would like further information on the proposed Cloncreen project please contact: Tel: 045 – 439800 Email: Cloncreenwindfarm@bnm.ie or visit: www.bordnamona.ie/wind/current-projects

2nd Newsletter January 2016: Text in relation to Cloncreen
Proposed Cloncreen Wind Farm - We would like to take this opportunity to thank all those who attended the pre-planning public consultation sessions in Ballyfore,

Clonbullogue and Edenderry in December. It is envisaged that the wind farm will comprise of 22 turbines. The proposed maximum height of the turbines will be 170m. The proposed setback distance in the draft wind energy development guidelines is 500m. Due to a combination of constraints, the distance to the nearest house from a turbine on the proposed layout is in excess of 700m. Should it be consented the proposed wind farm will give rise to a range of benefits at a local level. At peak construction it is estimated that between 100 – 120 people will be employed on the site. All material that was on display at the sessions - including a map of the proposed layout - can be found on our website: www.bordnamona.ie. If you would like further information on the proposed Cloncreen project please contact: Tel: 045 – 439800 Email: Cloncreenwindfarm@bnm.ie or visit: www.bordnamona.ie.

Cloncreen Wind Farm Newsletter
Following on from the Community Engagement Forum meeting on the 10th May a project specific newsletter was issued to homes in the vicinity of the proposed development. This newsletter answered 12 questions that were raised at the Engagement Forum meeting on the 10th May. Covering topics such as the substation, location of turbines, distance to nearest home, construction time frame, community gain scheme, access roads, benefits of the development locally and shadow flicker.

House to House Calls
Since August 2015, Bord na Móna Personnel have being calling house to house within a 2km radius of the boundary of the site to inform them about the project. Where there was no one at home a notice was dropped through the letterbox where possible, stating "Sorry we missed you" and explained that the company called to brief them on the project. The notice contained contact details if they requested a call back or would like more information the project.

Mountlucas Wind Farm Visits
7 people expressed interest in visiting Mountlucas Wind Farm either as part of a group tour or individually on foot of the letters issued with the final layout in April. Also in association with the Electricity Association of Ireland Bord na Móna have held monthly open days of Mountlucas Wind Farm. Details of these open days have been advertised in the local press. As of July 2016 – 6 open days have been held: 5th November 2015, 5th December 2015, 5th February 2016, 5th March 2016, 9th April 2016 and 15th June 2016. Over 150 attendees, made up of a mixture of local people (from Co. Offaly) and people from other parts of the country visited the site

2.10 Cumulative Impact Assessment

The EIA Directive[1] requires that the description of likely significant effects of a project includes an assessment of cumulative impacts that may arise. The factors to be considered in relation to cumulative effects include, inter alia, flora and fauna, soil, water, landscape and cultural heritage. The potential for cumulative impacts arising from the proposed development in combination with other Projects has therefore been fully considered. This section of the EIS provides an overview of other projects located within the wider area that have been considered within the cumulative impact assessments. The methodology used for carrying out the cumulative assessment is set out below.

[1] Environmental Impact Assessment Directive 85/337/EEC as amended by Directive 97/11/EC and 2003/35/EC

2.10.1 Methodology for the Cumulative Assessment of Projects

The potential for cumulative effects to arise from the proposed development was considered in the subject areas of human beings, flora and fauna, soil, water, climatic factors, landscape, cultural heritage and material assets. To comprehensively consider potential cumulative impacts, the final section of each relevant chapter within this EIS includes a cumulative impact assessment.

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

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

1. To establish the range and nature of existing projects within the cumulative impact study area of the proposed development, including grid connection and associated works.
2. To summarise the relevant projects which have a potential to create cumulative impacts.
3. To identify the projects that hold the potential for cumulative interaction within the context of the proposed development and discard projects that will neither directly or indirectly contribute to cumulative impacts.

Assessment material for the cumulative impact assessment was compiled on the relevant developments within 20 kilometres of the proposed development site. The cumulative impact assessment encompasses all projects with the potential to give rise to cumulative impacts with the proposed wind farm development, during their construction, operational or decommissioning phases. A planning review of smaller developments, such as one-off housing and agricultural buildings, was also completed, as detailed in Section 2.7 above. These developments have already been built or are located too far from the proposed development site boundary to have any likely significant cumulative effect with the proposed wind farm.

The material on cumulative projects was gathered through a search of relevant online Planning Registers (including Offaly County Council, Westmeath County Council, Meath County Council, Kildare County Council, Laois County Council, and the An Bord Pleanála website in relation to Strategic Infrastructure Development projects), reviews of relevant EIS documents, planning application details and planning drawings, and served to identify past and future projects, their activities and their environmental impacts. These projects are summarised in Section 2.10.2 below.

2.10.2 Projects Considered in Cumulative Assessment

The projects considered in relation to the potential for cumulative impacts and for which the relevant data was reviewed (e.g. individual EIS's, layouts, drawings etc.) are listed below.

Clonbullogue Ash Repository

- References: Offaly County Council Pl. Ref. 05/1267, ABP Ref. PL19.216998, EPA Waste Licence W0049-02
- Applicant: Bord na Móna Energy Ltd

- Description: Planning application by Bord na Móna Energy Limited to develop an ash repository for deposition of peat ash, meat & bone meal, ash and biomass ash on the site of the existing peat ash repository facility at Cloncreen, Clonbullogue, Co. Offaly. Permission was granted by An Bord Pleanála on the 03/04/2006 subject to conditions.
- Status: Operating

Edenderry Power Plant

- References: Offaly County Council Pl. Ref. 13/72, ABP PL.19.242226
- Applicant: Edenderry Power Ltd.
- Description: The application related to development (the continued use and operation of the peat and biomass co-fired power plant) that is an activity in relation to which an integrated pollution prevention and control (IPPC) licence under Part IV of the Environmental Protection Agency Act, 1992 as amended, is required. No changes to the existing IPPC licence were proposed as a consequence of this planning application. An Environmental Impact Statement (EIS) accompanied the application
- Status: Application originally granted consent by Offaly County Council on 21/06/2013, subject to 10 no. conditions. ABP upheld the local authority's decision and granted permission subject to 8 no. conditions. An Taisce subsequently secured a court order overturning a planning permission for the continued operation of a Bord na Móna peat-powered power plant. The court has granted a stay on the order until the 14th October 2016 to allow time for An Bord Pleanála to decide on a new planning application involving a wider environmental impact assessment (see Pl. Ref. 15/129, ABP PL19.245295 below).

- References: Offaly County Council Pl. Ref. 15/129, ABP PL19.245295, IED Licence P0482-04
- Applicant: Edenderry Power Ltd.
- Description: Planning application by Edenderry Power Limited for the extension of the continued use and operation, until the end of 2030, of the previously permitted peat and biomass co-fired power plant currently existing and operating. Permission was granted by the Planning Authority on the 13/07/2015 subject to 7 no. conditions. The decision was appealed by a third party to An Bord Pleanála, however no decision has been made.
- Status: Proposed

Peat Extraction: Allen Group

- Reference: IPC Licence P0503-01
- Applicant: Bord na Móna Allen Peat Ltd.
- Description: Peat extraction (milling, harrowing, ridging and harvesting of peat into stockpiles, and transportation of peat) from Allen Group of Bogs, located in Counties Offaly, Laois, Kildare & Westmeath
- Status: Operating

Peat Extraction: Derrygreenagh Group

- Reference: IPC Licence P0501-01
- Applicant: Bord na Móna Energy Ltd.
- Description: Peat extraction (milling, harrowing, ridging and harvesting of peat into stockpiles, and transportation of peat) from Derrygreenagh Group of Bogs, located in Counties Westmeath, Offaly and Meath
- Status: Operating

Barrow BlueWay

- Applicant: Waterways Ireland
- Description: Upgrade of existing navigation towpath along Barrow Navigation (and Barrow Line of Grand Canal), to provide a multi-use shared leisure route (2.5m width) connecting Lowetown, Co. Kildare to St. Mullins, Co. Carlow. Proposed route measures approx. 113 km in length
- Status: Pre-Planning

Grand Canal Blueway Shared Walking and Cycling Route

- Applicant: Waterways Ireland and Offaly County Council
- Description: Proposals to develop a high quality shared cycleway and footway from Digby Bridge at Cappancur, east of Tullamore Town, to connect to the existing cycle network of Lough Boora Discovery Park at Turraun, through upgrading the existing towpaths of the Grand Canal. The proposed Blueway route is 20.2km west of the proposed wind farm site at its nearest point, but does overlap with the turbine haul route
- Status: Planning (Section 8)

Eastern and Midlands Regional Water Supply Project

- Reference: Pre-Planning
- Applicant: Irish Water
- Description: On 26th November 2015, Irish Water published the Preliminary Options Appraisal Report which identified abstraction from the Parteen Basin in Tipperary as the 'Emerging Preferred Option' for a new source of water supply for the Eastern and Midlands Region. The emerging preferred option corridor traverses part of the proposed wind farm site.
- Status: Pre-Planning

Clonin North Solar Farm

- Reference: Offaly County Council Pl. Ref. 16/246
- Applicant: Highfield Solar Ltd.
- Description: The development of a solar PV energy development with a total site area of circa 96.6 hectares, to include one single storey electrical substation building and associated compound, electrical transformer and inverter station modules, storage modules, solar PV panels ground mounted on support structures, access roads, fencing and associated electrical cabling, ducting, CCTV and other ancillary infrastructure, additional landscaping as required and associated site development works
- Status: Proposed

Shean Site Infill

- Reference: Offaly County Council Pl. Ref. 16/177
- Applicant: A. Cocoman
- Description: infilling of lands with material consisting of clean, uncontaminated soil and stones and for the crushing of concrete on a sporadic basis (which is not for infilling on the site) prior to its removal for reuse. one temporary onsite portable toilet and one temporary portacabin which will serve as an office for the duration of the infilling process.
- Status: Proposed

Other Wind Farm Projects
Other wind farm projects previously detailed in Section 7.3.3 (Planning History) were also considered for the potential to give rise to cumulative effects. The locations of these project in relation to the proposed development are shown in Figure 2.6, and include the following:

Mountlucas Wind Farm:
- References: Offaly County Council Pl. Ref. 09/453, ABP PL19.237263
- Applicant: Bord na Móna Energy Ltd.
- Description: Wind farm comprising 28 no. turbines of tip height 150m, with associated infrastructure, at Mountlucas and adjacent townlands, Co. Offaly
- Status: Operating

Yellow River Wind Farm:
- Reference: ABP PL19.PA0032
- Applicant: Green Wind Energy Ltd.
- Description: Wind farm comprising 29 no. turbines of tip height 156m to 166m, with associated infrastructure, north of Rhode, Co. Offaly
- Status: Permitted

Maighne Wind Farm was refused planning permission by An Bord Pleanála on 14th October 2016, and therefore this project is not included in the cumulative impact assessment.

The assessment of the influence of these projects on the proposed development was established through the creation of a matrix (Table 2.5 overleaf). The matrix identifies the potential for other projects to interact with the proposed development by having the potential to give rise to cumulative impacts.

- Human Beings
- Shadow Flicker
- Flora and Fauna
- Hydrology and Hydrology
- Air and Climate
- Noise and Vibration
- Landscape
- Material Assets
- Traffic
- Cultural Heritage

The results of the assessment provided a foundation for a further comprehensive assessment to be carried out and detailed in the relevant sections of the EIS.

Table 2.5 Project Cumulative Impact Assessment Matrix

	Projects: / Topic:	Clonbullogue Ash Repository	Edenderry Power Plant	Peat Extraction: Allen Group	Peat Extraction: Derrygreenagh Group	Barrow BlueWay	Grand Canal Blueway	Eastern & Midlands Regional Water Supply Project	Clonin North Solar Farm	Mountlucas Wind Farm	Yellow River Wind Farm	Shean Site Infill
Cloncreen Wind Farm	**Human Beings**	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
	Shadow Flicker	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✗
	Flora & Fauna	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✗
	Hydrology & Hydrogeology	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗
	Air & Climate	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓	✓
	Noise	✓	✓	✓	✓	✗	✗	✗	✗	✓	✓	✗
	Landscape	✓	✓	✓	✓	✓	✗	✓	✓	✓	✓	✗
	Material Assets	✓	✓	✓	✓	✗	✗	✓	✓	✓	✓	✗
	Traffic	✓	✓	✓	✓	✗	✓	✓	✗	✗	✗	✓
	Cultural Heritage	✗	✗	✓	✓	✗	✗	✓	✗	✓	✗	✗

3 DESCRIPTION OF THE PROPOSED DEVELOPMENT

3.1 Introduction

This section of the Environmental Impact Statement (EIS) describes the proposed development and its component parts. The proposed development comprises:

i. 21 No. wind turbines with an overall blade tip height of up to 170 metres and all associated hard-standing areas.
ii. 1 No. borrow pit.
iii. 1 No. permanent Anemometry Mast up to a height of 120 metres.
iv. Provision of new site access roads and associated drainage.
v. 1 no. 110 kV Electrical substation, which will be constructed at one of two possible locations on site: either Option A in Ballykilleen townland or Option B in Cloncreen townland. The electrical substation will have 2 no. control buildings, associated electrical plant and equipment, and waste water holding tank.
vi. 2 No. temporary construction compounds, one of which will be located in the townland of Esker More and the other at one of two possible locations: either Option A in Ballykilleen townland or Option B in Cloncreen townland.
vii. All associated underground electrical and communications cabling connecting the turbines to the proposed substation at either Ballykilleen or Cloncreen townland.
viii. All works associated with the connection of the proposed wind farm to the national electricity grid, which will be either to the existing Cushaling substation via underground cable (Option A) or to the existing Thornsberry/Cushaling 110 kV line via overhead line (Option B).
ix. Demolition of existing canteen 'tea centre' building.
x. Removal of existing telecommunications mast.
xi. Removal of existing meteorological mast.
xii. New access junctions, improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and construction access, including: temporary upgrade of R420/R402 junction, temporary road widening at 1 no. location on R402 in Ballinagar, upgrade of R402/L1003 junction, road upgrade along the L1003 and new construction phase site entrance, and upgrade of existing site entrance on R401.
xiii. All associated site development works.

The planning application for the proposed wind farm includes connection to the national electricity grid. All elements of the proposed project, including grid connection and any works required on public roads to accommodate turbine delivery, have been assessed as part of this EIS.

The planning application includes 2 No. substations and associated grid connections as well as a temporary construction compound close to each substation; however, only one substation and associated grid connection and temporary construction compound will ultimately be constructed. The proposed wind farm will connect to the grid via one of the following methods:

- **Option A:** Construction of a 110 kV substation in the eastern section of the site. This substation will connect to the National Grid via an underground cable (approximately 1.7 kilometres in length) running from the substation to the existing 110 kV Cushaling substation at Edenderry Power Plant, located directly east of the proposed wind farm site. The proposed underground cable will be located on Bord na Móna lands and within the curtilage of the public road.

Or:

- **Option B:** Construction of a 110 kV substation in the southern section of the site. This substation will connect to the National Grid via a short section of overhead line (less than 0.1km) to the existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site.

Both substations and grid connection options have been assessed as part of this EIS. All upgrades and improvements to sections of the public road network along turbine delivery route have also been assessed.

3.2 Development Layout

The layout of the proposed wind farm development has been designed to minimise the potential environmental effects of the wind farm, while at the same time maximising the energy yield of the wind resource passing over the site. A detailed constraints study, as described in Section 2.5 of this EIS, has been carried out in order to ensure that turbines and ancillary infrastructure are located in the most appropriate areas of the site.

The overall layout of the proposed development is shown on Figure 3.1. This drawing shows the proposed locations of the wind turbines, electricity substation (options A and B), borrow pit, anemometry mast, internal roads layout and the main site entrances. Detailed site layout drawings of the proposed development are included as Appendix 3-1 to this report.

3.3 Development Components

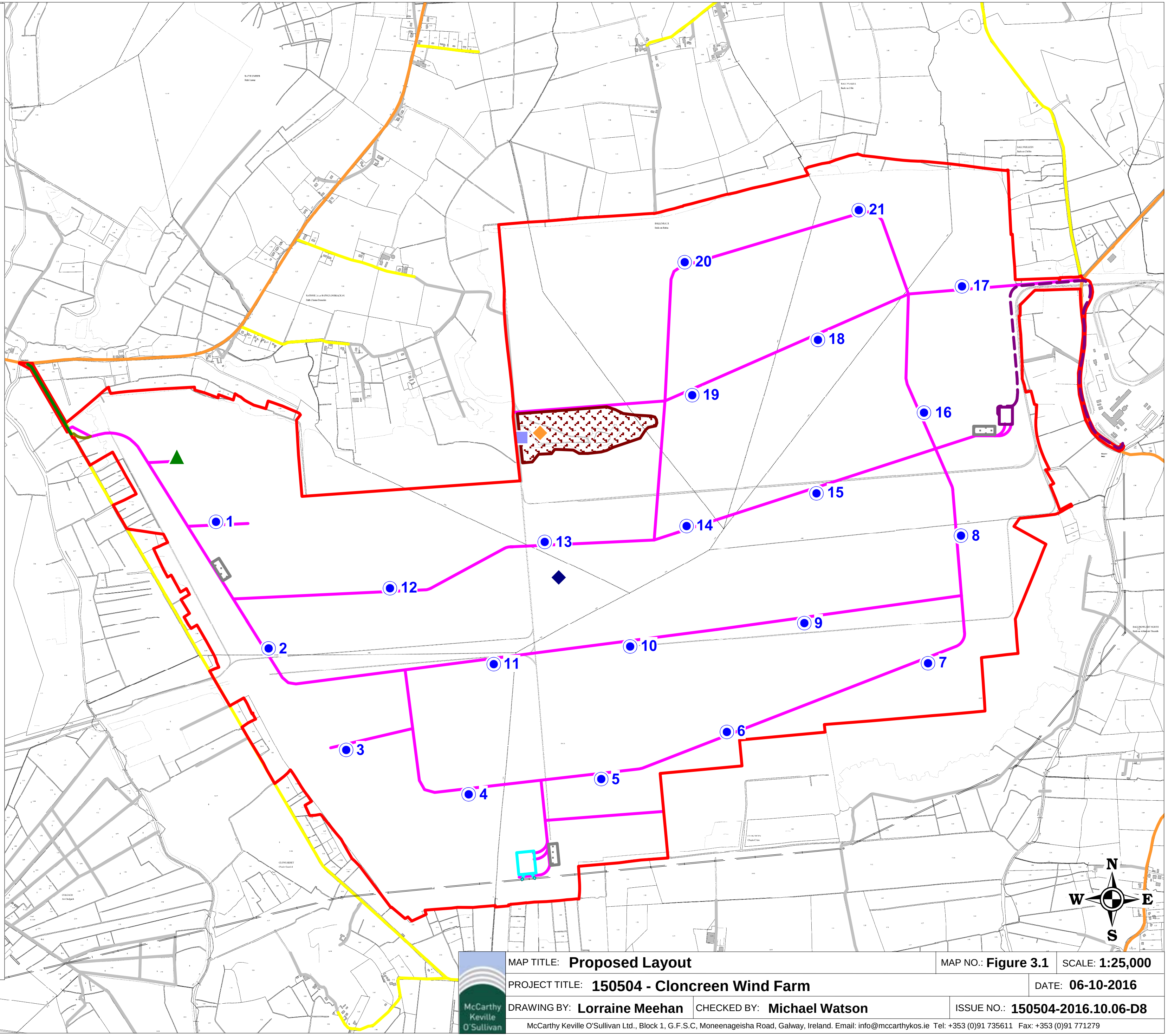
3.3.1 Wind Turbines

3.3.1.1 Turbine Locations

The proposed wind turbine layout has been optimised using wind farm design software (a combination of WAsP, WindPro and WindFarmer) to maximise the energy yield from the site, while maintaining sufficient distances between the proposed turbines to ensure turbulence and wake effects do not compromise turbine performance. The Grid References co-ordinates of the proposed turbine locations are listed in Table 3.1 below. The final ground level of the turbine foundations will be determined by the actual ground conditions at each proposed turbine location and may differ slightly from those levels listed in Table 3.1 below.

Map Legend

- Regional Road
- Local Road
- Track
- Proposed Turbine Location
- Proposed Road
- Proposed Turbine Entrance Road
- Proposed Borrow Pit
- Proposed Met Mast
- Existing 'Tea Centre' to be Demolished
- Existing Telecommunications Mast to be Removed
- Construction Compound
- Proposed Substation: Option A
- Proposed Grid Connection Option A: Underground Cable
- Proposed Substation: Option B
- Proposed Grid Connection Option B: Overhead Line
- Existing 110 kV Overhead Line
- Existing Road to be Widened
- Existing Met Mast to be Removed
- Site Boundary



MAP TITLE: **Proposed Layout**	MAP NO.: **Figure 3.1** SCALE: **1:25,000**
PROJECT TITLE: **150504 - Cloncreen Wind Farm**	DATE: **06-10-2016**
DRAWING BY: **Lorraine Meehan** CHECKED BY: **Michael Watson**	ISSUE NO.: **150504-2016.10.06-D8**

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Table 3.1 Proposed Wind Turbine Locations and Elevations

Turbine	Easting	Northing	Top of Foundation Elevation (m OD)
1	256800	226488	70
2	257048	225892	68
3	257413	225414	68
4	257989	225205	68
5	258613	225277	68
6	259204	225499	70
7	260151	225822	68
8	260306	226423	69
9	259569	226011	70
10	258749	225901	70
11	258107	225818	69
12	257619	226175	69
13	258347	226393	69
14	259015	226468	69
15	259626	226622	69
16	260132	227002	69
17	260311	227596	70
18	259633	227344	70
19	259041	227084	71
20	259006	227710	71
21	259825	227955	71

3.3.1.2 Turbine Type

Wind turbines use the energy from the wind to generate electricity. A wind turbine, as shown in Plate 3.1 below, consists of four main components:

- Foundation unit
- Tower
- Nacelle (turbine housing)
- Rotor

Plate 3.1 Wind turbine components

The proposed wind turbines will have a ground to blade tip height of up to 170 metres. Within this turbine-size envelope, various configurations of hub height, rotor diameter and ground to blade tip height may be used. The exact make and model of the turbine will be dictated by a competitive tender process, but it will not exceed a tip height of 170 metres. Modern wind turbines from the main turbine manufacturers have evolved to share a common appearance and other major characteristics with only minor cosmetic differences differentiating one from another. The wind turbines that will be installed on the site will be conventional three-blade turbines, that will be geared to ensure the rotors of all turbines rotate in the same direction at all times. The turbines will be white or off-white matt colour.

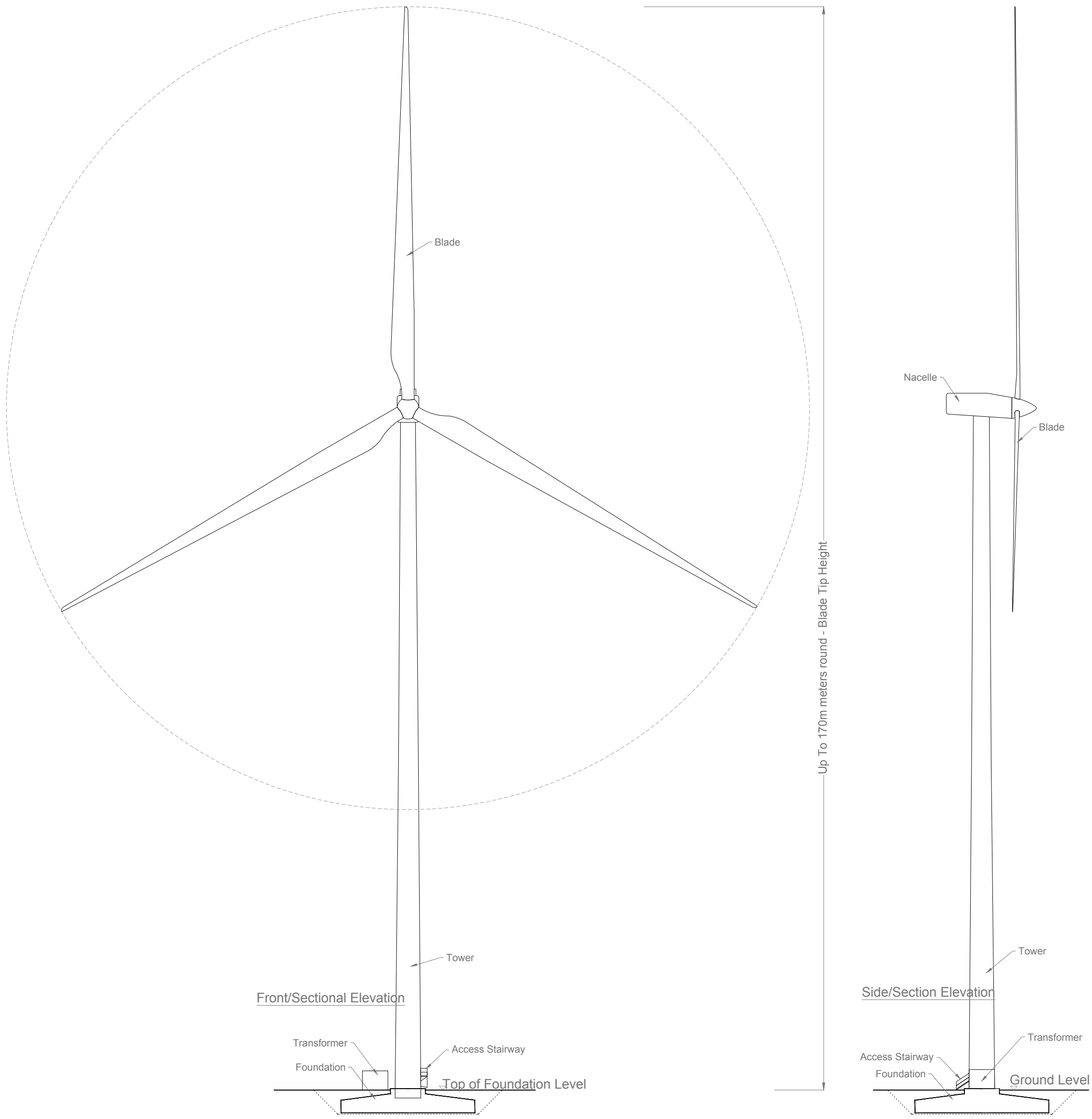
For the purposes of this EIS, various types and sizes of wind turbines (within the 170-metre tip height envelope) have been selected and considered in the relevant sections of the EIS to assess the worst-case scenario. Turbine design parameters have a bearing on the assessment of shadow flicker, noise, visual impact, traffic and transport and ecology (specifically birds), as addressed elsewhere in this EIS. In each EIS section that requires the consideration of turbine parameters as part of the impact assessment, the turbine design parameters that have been used in the impact assessment have been specified.

At the turbine selection stage of the project, pre-construction, new turbines models or variants may be available that were not on the market at the pre-planning and EIS preparation stage, that would better suit the site and fit within the proposed size envelope. Should this circumstance arise, the specific parameters of the new turbines will be assessed for their compliance with the criteria set out and considered in this EIS, the relevant guidance in place at the time and any conditions that may be attached to any grant of planning permission that might issue.

A drawing of the maximum size envelope of the proposed wind turbine is shown in Figure 3.2. The individual components of a typical geared wind turbine nacelle and hub are shown in Figure 3.3 below.

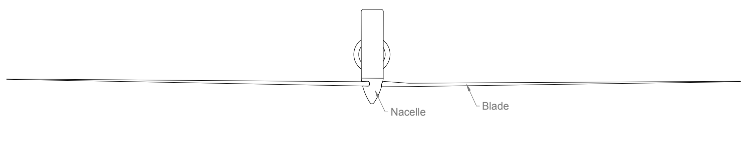
Drawing Notes

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



Front/Sectional Elevation

Side/Section Elevation



Plan

Figure 3.2

DRAWING TITLE:

Wind Turbine Elevation & Plan

PROJECT TITLE:

Cloncreen Wind Farm, Co. Offaly

DRAWING BY: Shane O Connor	CHECKED BY: Michael Watson
PROJECT No.: 150504	DRAWING No.: Figure 3.2
SCALE: 1:750 @A3	DATE: 05.10.2016

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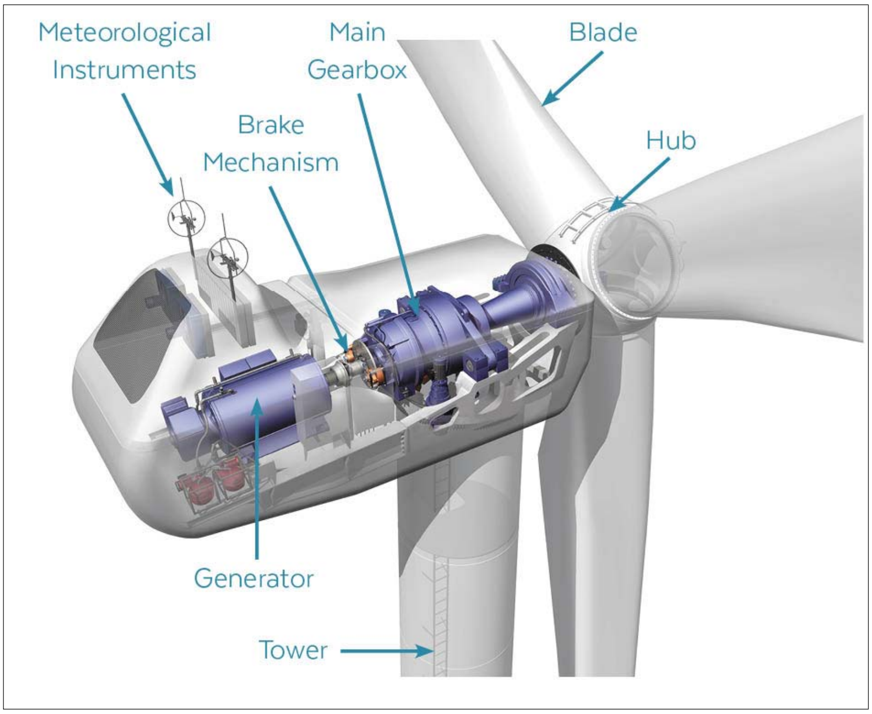

Figure 3.3 Turbine nacelle and hub components

Figure 3.4 shows a typical turbine layout, including turbine foundation, hard standing areas, assembly area, access road, surrounding works area and typical drainage design detail.

3.3.1.3 Turbine Foundations

Each wind turbine is secured to a reinforced concrete foundation that is installed below the finished ground surface. The size of the foundation will be dictated by the turbine manufacturer, and the final turbine selection will be the subject of a competitive tender process. Different turbine manufacturers use different shaped turbines foundations, ranging from circular to hexagonal and square, depending on the requirements of the final turbine supplier. The turbine foundation transmits any load on the wind turbine into the ground. The typical horizontal and vertical extent of a turbine's foundation is shown in Figure 3.2.

After the foundation level of each turbine has been formed using piling methods or on competent strata, the bottom section of the turbine tower or "can" is levelled (Plate 3.2 below). Reinforcing steel is then built up around and through the can (Plate 3.3 below), and the outside of the foundation is shuttered with demountable formwork to allow the pouring of concrete.

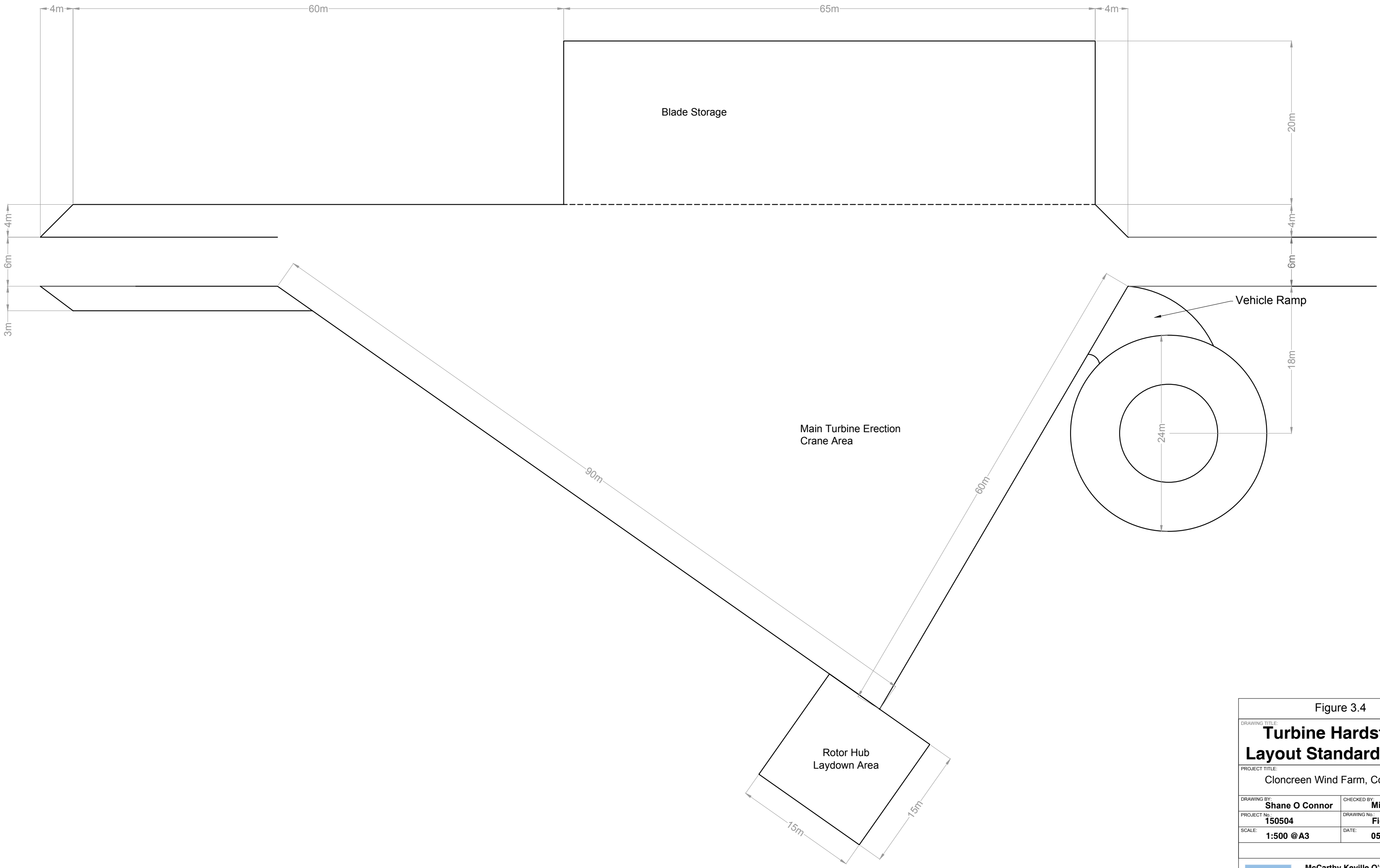

Figure 3.4

DRAWING TITLE:

Turbine Hardstand Layout Standard Detail

PROJECT TITLE:

Cloncreen Wind Farm, Co. Offaly

DRAWING BY: Shane O Connor	CHECKED BY: Michael Watson
PROJECT No: 150504	DRAWING No: Figure 3.4
SCALE: 1:500 @A3	DATE: 05.10.2016

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Plate 3.2 Levelled turbine tower 'can'

Plate 3.3 Steel reinforcement being added

3.3.1.4 Hard Standing Areas

Hard standing areas consisting of levelled and compacted hardcore are required around each turbine base to facilitate access, turbine assembly and turbine erection. The hard standing areas are typically used to accommodate cranes used in the assembly and erection of the turbine, offloading and storage or turbine components, and generally provide a safe, level working area around each turbine position. The hard standing areas are extended to cover the turbine foundations once the turbine foundation and tower can are in place. The sizes, arrangement and positioning of hard standing areas are dictated by turbine suppliers. The turbine hardstanding areas shown on the site layout drawings included as Appendix 3-1 and shown in Figure 3.4. The hard standing area is intended to accommodate a crane during turbine assembly and erection. The hard standing areas shown on the detailed layout drawings included in Appendix 3-1 to this report are indicative of the sizes required, but the extent of the required areas at each turbine location may be optimised on-site depending on topography, position of the site access road, the proposed turbine position and the turbine supplier's requirements.

3.3.1.5 Assembly Area

Unbound, levelled assembly areas will be located on either side of the each hard standing area as shown on Figure 3.4. These assembly areas are required for offloading turbine blades, tower sections and hub from trucks until such time as they are ready to be lifted into position by cranes.

3.3.1.6 Power Output

The proposed wind turbines will typically have a rated electrical power output in the 3.0 to 3.3 Megawatt (MW) range and potentially higher depending on further wind data analysis, power output modelling and turbine development over the period up to construction. Turbines of the exact same make, model and dimensions can also have different power outputs depending on the capacity of the electrical generator installed in the turbine nacelle. For the purposes of this EIS, a rated output of 3.0 MW has been used to calculate the power output of the proposed wind farm, which would result in an estimated installed capacity of 63 MW.

The proposed wind farm has the potential to produce up to 165,564 MWh (megawatt hours) of electricity per year, based on the following calculation:

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

where: A = …… The number of hours in a year: 8,760 hours
B = …… The capacity factor, which takes into account the intermittent nature of the wind, the availability of wind turbines and array losses etc: 30%

C = ... Rated output of the wind farm: 63 MW

The capacity factor of a wind farm takes into account the intermittency of the wind and is based on average wind speeds. A load factor of 30% is used here, based on the average figure for Ireland (average load factor for 2010-2015 is 29.6% rounded up to 30% for calculation purposes), as referenced by the Sustainable Energy Authority of Ireland *'Renewable Electricity in Ireland 2015 (2016 Report, SEAI)'*.

The 165,564 MWh of electricity produced by the proposed wind farm would be sufficient to supply 33,007 Irish households with electricity per year, based on the average Irish household using 5.016 MWh of electricity in 2011 (the latest figure available from Sustainable Energy Authority of Ireland; *'Energy in the Residential Sector'*, SEAI, 2013).

The 2011 Census of Ireland (the most recent Census data available) recorded a total housing stock of 30,750 in Co. Offaly. Per annum, based on a load factor of 30%, the proposed wind farm would therefore produce sufficient electricity for all households in Co. Offaly, plus an additional 2,257 households.

3.3.2 Site Roads

The proposed development site is accessed via the R402 and R401 Regional Roads and via a local road off the R402 (the L1003), which travel generally in north-south and northeast-southwest directions, east and northwest of the site respectively.

Applied Ground Engineering Consultants Ltd. (AGEC) were appointed to assess the extent and condition of the existing site ground conditions, and specify the type of upgrade work or new road required to access all locations on site. There are no existing roadways onsite which require upgrade.. In general, 'excavate and replace' type roads will be used for the construction of the new roads. The AGEC specification of the road types required on-site is included in Appendix 7-1 of this EIS (Peat Management Plan).

Straight sections of proposed roadways will require a running width of approximately six metres to accommodate the transportation of large turbine components. Corners and junctions will have to be wider than six metres to allow the trucks to manoeuvre around bends. All site access roads that it is proposed to use as part of the proposed development, both existing and proposed, will comply with the turbine supplier's requirements. The material required for upgrade and construction of roads within the site will be obtained from the onsite borrow pit and commercial quarries, as detailed in Section 3.3.3 below.

3.3.2.1 New Roads

New roadways will be required for access to turbine locations. It is proposed to construct 21.5 kilometres of new roadway as part of the proposed development. The routes of the proposed new roads are shown in Figure 3.1.

New roadways will have a running width of approximately six metres, with wider section at corners and on the approaches to turbine locations. The proposed new roadways incorporate passing bays to allow two trucks pass easily while traveling around the site.

All new roadways will be constructed with a camber to aid drainage and surface water runoff. The gradient and slope of the camber will depend on the site characteristics where the road is actually being constructed.

3.3.2.2 Road Construction

3.3.2.2.1 New Excavated Roads

The construction methodology for excavate and replace roads, outlined in detail in AGEC's *Peat Management Plan* in Appendix 7-4 of the EIS, is summarised as follows:

- Prior to commencing the construction of the excavated roads movement monitoring posts should be installed in areas where the peat depth is greater than 2.0m.
- Interceptor drains should be installed upslope of the access road alignment to divert any surface water away from the construction area.
- Excavation of roads shall be to the line and level given in the design requirements. Excavation should take place to a competent stratum beneath the peat (as agreed with the site designer).
- Road construction should be carried out in sections of approximately 50m lengths i.e. no more than 50m of access road should be excavated without re-placement with stone fill unless otherwise agreed with the resident engineer on site.
- All excavated peat shall be placed/spread alongside the excavations.
- Side slopes in peat shall be not greater than 1 (v): 2 or 3 (h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes will be required. Battering of the side slopes of the excavations should be carried out as the excavation progresses.
- The surface of an excavated access road is typically overlaid with up to 500mm of selected granular fill. This may vary depending on designer requirements.
- A layer of geogrid/geotextile may be required at the surface of the competent stratum (to be confirmed by the designer).
- Where slopes of greater than 5 degrees are encountered along with relatively deep peat (i.e. greater than 1.5m) and where it is proposed to construct the access road perpendicular to the slope contours it is best practice to start construction at the bottom of the slope and work towards the top, where possible. This method avoids any unnecessary loading to the adjacent peat and greatly reduces any risk of peat instability. It should be noted that slopes greater than 5 degrees are not envisaged on site.
- A final unbound surface layer shall be placed over the excavated road, as per design requirements, to provide a road profile and graded to accommodate wind turbine construction and delivery traffic.

A typical section of a new excavated road is shown in Figure 3.5.

3.3.3 Borrow Pit

3.3.3.1 Description

There is a former rehabilited gravel pit located in the north central section of the site. This pit was used historically by Bord na Móna for their own use mainly for the construction and upgrading of railways and other infrastructure within the site and wider bog complex. The gravel pit was used over many years but most intensely between 1995 and 2000. The gravel pit is not in use and the rehabilitation of the borrow pit site has been completed, however there remains a gravel resource at this location and it is intended to use this resource as part of the wind farm development.

It is therefore proposed to develop one on-site borrow pit as part of the proposed wind farm development, the location of which is shown on Figure 3.1. AGEC completed an

S:\2015\1549 Cloncreen Wind Farm (McCarthy KOS)\CAD\1549 Floating Road Detail Rev 0.dwg

FOR INFORMATION

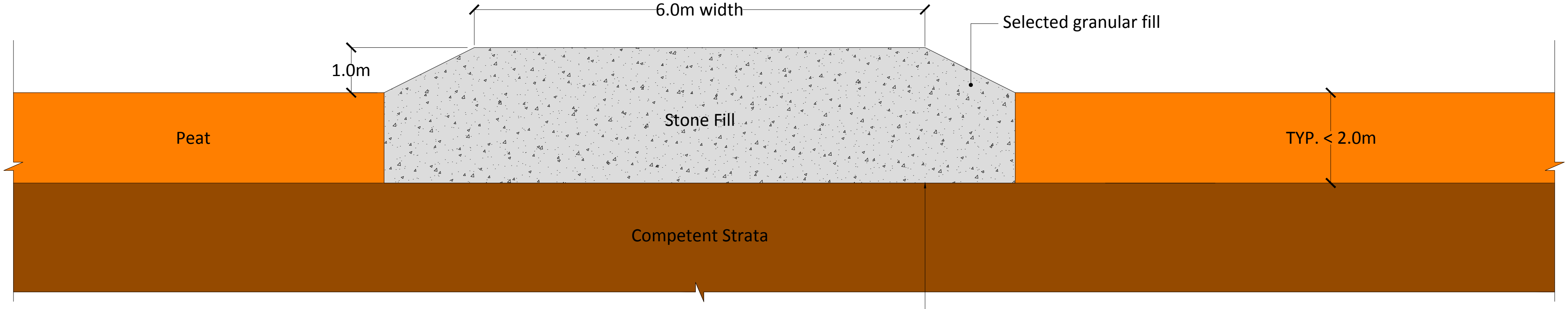

Figure 3.5 - Type C New Excavate & Replace Access Road

Scale: N.T.S. @ A4

Rev 2

Date: 26/09/2016

intrusive investigation of the proposed borrow pit area to determine the suitability and quantity of the resource present. The AGEC *Borrow Pit Assessment Report 2015* is included as Appendix G of the AGEC Peat Stabilty Assessment Report (see Appendix 7-1 of this EIS). It is proposed to obtain a significant volume of all rock and hardcore material that will be required during the construction of the proposed development from the on-site borrow pit which is located centrally within the site and will reduce the need to source materials offsite.

Table 3.2, below, outlines the location, area of the borrow pit and the calculated estimate of hardcore material available to be excavated.

Table 3.2 Borrow Pit Location and Area

Borrow Pit No.	Location		Area (Ha)	Estimated Hardcore Material (m3)
	Easting	Northing		
1	258,500	226,250	11.17	320,000

The borrow pit location is shown on Figure 3.1 and in the detailed layout drawings included as Appendix 3-1 to this EIS. The borrow pit will, on removal of all necessary and useful rock, be reinstated and made safe from a health & safety perspective and the slopes will be graded using the overburden currently at this location which will also encourage a return to the existing habitats at the borrow pit currently.

There is an estimated 168,000 m^3 of overburden present at the proposed borrow pit location which will be stripped back and stockpiled within the borrow pit footprint and will be available for the reinstatement process post construction. Figure 3.6 shows the proposed borrow pit following rehabilitation.

Post-construction, the borrow pit area will be permanently secured and a stock-proof fence or berms will be erected around the area to prevent access. Appropriate health and safety signage will also be erected on this fencing and at locations around the fenced area.

3.3.3.2 Gravel Extraction Method

The extraction of rock from the borrow pit is a work stage of the proposed project which will be a temporary operation run over a short period of time relative to the duration of the entire project. As outlined in the AGEC *Borrow Pit Assessment Report 2015* (see Appendix G of the Peat Stabilty Assessment Report in Appendix 7-1 of the EIS), there is a layer of overburden present at the borrow pit location which will be stripped back and stockpiled using standard track mounted excavators. The extraction method for the useful rock below will be relatively simple as the rock resource is a weathered sand and gravel conforming to use for construction of roads and other infrastructure and therefore excavator's will be used to excavate the gravels and stockpile them within the borrow pit area pending loading onto trucks for use around the site.

3.3.4 Sand and Stone Requirements

The volumes of granular fill (sand and stone) required for the construction of the proposed development, outlined in Table 3.3 below, have been estimated based on the proposed development footprint and the proposed final levels for the various intrastructure. Construction grade granular fill and higher quality, final surfacing fill (including sand) will both be required for the construction of the proposed development. Granular fill volumes have been estimated using the following methodology:

Rehabilitation Plan Notes 1:
Overburden present at existing borrow pit area (168,000m³) to be placed around the perimeter to creating graded slopes and placed across the entire base of borrow pit area to approx. 1m above water table (69mod). Following extraction of useable sand and gravel.

Rehabilitation Plan Notes 2:
Two nationally rare plant species, Basil Thyme (Clinopodium acinos) and Blue Fleabane (Erigeron acer) occur within the proposed borrow pit. Section 5.5.3 of the EIS outlines the proposed mitigation in relation to the preservation of living plants and rehabilitation of suitable habitat for the protected species. The methodology is summarised as follows:

- Existing plants from the identified areas within the development footprint will be carefully excavated by hand with a shovel ensuring that the root system and surrounding rooting substrate remain intact. These plants will be moved to a prepared area with suitable substrate and habitat conditions for the calcicole species.
- Following the removal of the plants, the grave/subsoil from identified areas within the development footprint shall be stripped and separately stored, covered and clearly marked within the development site boundary. the stockpile of the gravel/subsoil shall be temporarily fenced to avoid contamination or unnecessary disturbance.
- During reinstatement, a thin layer of the stripped gravel/subsoil, containing the residual floral seed bank, shall then be spread evenly over gravel substrate.
- These areas shall then be temporarily fenced off and allowed to regenerate naturally.

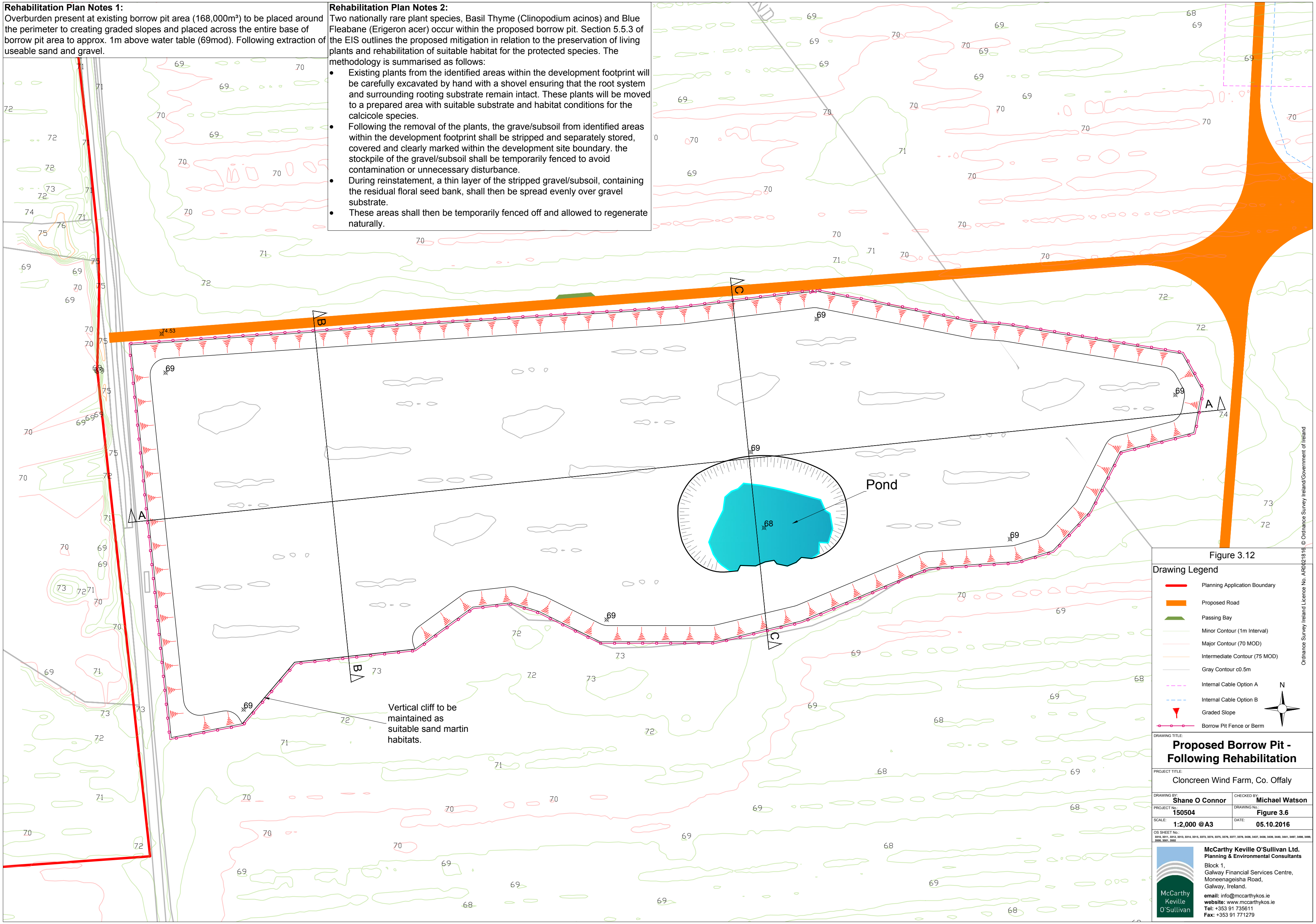

Figure 3.12

DRAWING TITLE:
Proposed Borrow Pit - Following Rehabilitation

PROJECT TITLE:
Cloncreen Wind Farm, Co. Offaly

DRAWING BY: **Shane O Connor**	CHECKED BY: **Michael Watson**
PROJECT No.: **150504**	DRAWING No.: **Figure 3.6**
SCALE: **1:2,000 @A3**	DATE: **05.10.2016**

OS SHEET No.: 3310, 3311, 3312, 3313, 3314, 3315, 3373, 3374, 3375, 3376, 3377, 3378, 3436, 3437, 3438, 3439, 3440, 3441, 3497, 3498, 3499, 3500, 3501, 3502

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- The peat located beneath all proposed hardstanding areas (excluding the substation compounds) and roads will be excavated and replaced with construction grade granular fill up to the existing ground level.
- The hardstanding areas and roads will be constructed to approximately 1 metre above the existing ground level. The first 500mm above ground level will comprise construction grade granular fill and the final 500mm surface layer will comprise higher quality, final surfacing materials generally washed gravels.
- The proposed substation compounds, whichever option is constructed, will both be constructed to approximately 70 metres OD. The peat excavated beneath the compound footprint will be replaced and brought up to 69.5 metres OD with construction grade granular fill. The final 500mm will comprise the higher quality, surfacing materials.
- The internal site underground cable trenches will be approximately 1200mm in depth. The cable trench will be backfilled up to 600mm with sand, within which the ducting will be placed. Suitable materials from the excavations of the trenches will be reinstated to form the final layer of the trench

Table 3.4 outlines the sources of both the construction grade and surfacing granular fill. The construction grade granular fill will be sourced from both the onsite borrow pit and from local quarries. The higher quality, surfacing granular fill and sand will be sourced from local quarries.

Table 3.3 Approximate Granular Fill Voumes Required

Development Component	Area (m2) (approximate)	Construction Grade Fill (m^3)	Higher Quality Final Surface Layer Fill (m^3)
Turbine No. 1	4,506	9,138	2,460
Turbine No. 2	4,506	8,681	2,460
Turbine No. 3	4,506	10,040	2,460
Turbine No. 4	4,506	7,834	2,460
Turbine No. 5	4,506	9,952	2,460
Turbine No. 6	4,506	4,545	2,460
Turbine No. 7	4,506	5,083	2,460
Turbine No. 8	4,506	3,913	2,460
Turbine No. 9	4,506	5,083	2,460
Turbine No. 10	4,506	11,439	2,460
Turbine No. 11	4,506	9,233	2,460
Turbine No. 12	4,506	4,276	2,460
Turbine No. 13	4,506	3,913	2,460
Turbine No. 14	4,506	4,996	2,460
Turbine No. 15	4,506	3,012	2,460
Turbine No. 16	4,506	5,177	2,460
Turbine No. 17	4,506	4,088	2,460
Turbine No. 18	4,506	4,632	2,460
Turbine No. 19	4,506	5,446	2,460
Turbine No. 20	4,506	5,170	2,460
Turbine No. 21	4,506	6,388	2,460
New Access Roads	176,802	263,063	78,929

Development Component	Area (m2) (approximate)	Construction Grade Fill (m^3)	Higher Quality Final Surface Layer Fill (m^3)
Construction Compounds*	8,000	17,618	4,273
Substation (Option A)	5,000	21,500	2,500
Underground Cable Route (Option A to site exit)	10,800 (c. 1200mm depth)	-	5,800
Substation (Option B)	8,500	48,450	4,250
Underground Cable Route (Option B)	9,000 (c. 1200mm depth)	-	4,900
Met Mast	100	244	156
L1003 Upgrade	C 400m length	-	1,350
Totals (Option A)		**434,462**	**144,667**
Totals (Option B)		**461,412**	**145,517**

* 2 No options are provided for one of the proposed construction compounds. The figures are 'worst case' assuming that the compound location on the deepest peat will be constructed

Table 3.4 Sources of Granular Fill

Source	Construction Grade Fill Volume (m^3) (approximate)		Higher Quality Final Surface Layer Fill (m^3) (approximate)	
	Option A	Option B	Option A	Option B
On-site Borrow Pit	320,000	320,000	-	-
Off-site Quarries	114,462	141,412	146,667	145,517

3.3.5 Peat Management Plan

3.3.5.1 Quantities

The quantity of peat and other subsoils, requiring management on the site has been calculated, as presented in Table 3.5 below. These quantities were calculated by AGEC as part of the *Peat Management Plan* in Appendix 7-4 of this EIS.

Table 3.5 Peat and overburden volumes requiring management

Development Component	Area (m^2) (approximate)	Peat Volume (m^3) Option A (approximate)	Peat Volume (m^3)Option B (approximate)
21 no. Turbines	Assumed a typical turbine foundation dig out (where applicable)	590	
21 no. Crane Hardstands	Plan area of triangular hardstand is c. 2,690m^2, plan area of rectangular hardstand is c. 1,816m^2, plan area of square hardstand is c. 225m^2	98,770	

<table>
<tr><th>Development Component</th><th>Area (m²) (approximate)</th><th>Peat Volume (m³) Option A (approximate)</th><th>Peat Volume (m³)Option B (approximate)</th></tr>
<tr><td>New Proposed Access Roads (includes lay-bys)</td><td>Total length of new proposed access road is c. 21.5km</td><td colspan="2">213,385</td></tr>
<tr><td>1 no. Site Entrance Construction Compounds</td><td>Plan area is c. 4,000m²</td><td colspan="2">6,240</td></tr>
<tr><td>Substation and construction compound (Option A)</td><td>Plan area of substation platform is c. 5,000m² and construction compound is c. 4,000m²</td><td>5,760</td><td rowspan="2">-</td></tr>
<tr><td>Underground cable – Option A</td><td>c. 600 wide x 1200mm deep trench. Length of cable route is 18km (approx.)</td><td>13,920</td></tr>
<tr><td>Substation and construction compound (Option B)</td><td>Plan area of substation platform is c. 8,500m² and construction compound is c. 4,000m²</td><td rowspan="2">-</td><td>32,040</td></tr>
<tr><td>Underground cable – Option B</td><td>c. 600 wide x 1200mm deep trench. Length of cable route is 15km (approx.)</td><td>11,760</td></tr>
<tr><td>Met Mast</td><td>Assumed a 10 x 10m dig out for the met mast foundation</td><td colspan="2">85</td></tr>
<tr><td colspan="2">Total</td><td>338,750m³ Option A</td><td>362,870m³ Option B</td></tr>
</table>

3.3.5.2 Peat Management

The management of excavated peat and the methods of storage are described in detail in AGEC's *Peat Management Plan* in Appendix 7-4 of this EIS.

The site which is generally flat consists predominantly of bare locally re-vegetated cut-away peat and intact shallow peat with an extensive drainage network. The site has been extensively harvested by Bord na Mòna using mechanical harvesting equipment resulting in a well drained and extensively trafficked peat. Bord na Móna has considerable experience in the handling of peat in these circumstances, both during peat production operations and during wind farm construction projects, particularly the adjacent Mountlucas wind farm which is located on a very similar type of terrain. This experience has shown that the most environmentally sensitive and stable way of handling and moving of peat is its placement across the site and at locations as close as possible to the excavation areas.

The proposed methodology as outlined in the AGEC Peat Managemetn Plan are summarised below.

- All excavated peat will be placed/spread alongside the excavations for the infrastructure elements on site, where possible. A typical example is given in Figure 3.7 which shows a cross section with placed/spread peat either side of an access road.

S:\2015\1549 Cloncreen Wind Farm (McCarthy KOS)\CAD\1549 Floating Road Detail Rev 0.dwg

FOR INFORMATION

agec geotechnical engineering consultants

Notes:

1) Material will spread to a depth not exceeding 2.0m in height.
2) See section 6.3 of the Peat Management Plan for further guidelines.
3) Indicative locations are given for drainage measures such as drainage ditches and silt fences.

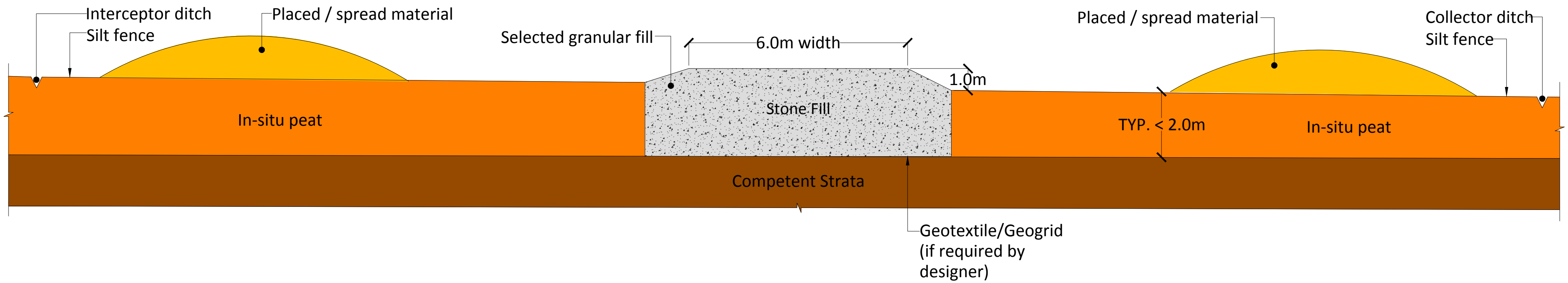

Figure 3.7 - Placed / Stored Material - Typical Cross Section

Scale: N.T.S. @ A4

Rev 2

Date: 26/09/2016

- During the construction process the peat will be relayed to the side by an excavator and spread on the bog on one or both sides of the excavations.
- The peat will be spread not exceeding 2.0m in height shall be tracked in to ensure it is adequately compacted and stable and graded to complement the topography and drainage system on the site.
- Where practical, it should be ensured that the surface of the placed peat is shaped to allow efficient run-off of surface water. Where possible, shaping of the surface of the spread peat should be carried out as placement of peat progresses. This will reduce the likelihood of debris run-off and ensure stability of the spread peat.
- As a general guide and using the excavated peat volumes in Table 2 of the AGEC report, a spread peat footprint of up to 7.0m is likely each side of the infrastructure elements on site. This will vary across site in line with the in-situ peat within the development footprint.
- The placement of excavated peat is to be avoided without first establishing the adequacy of the ground to support the load. This may involve a visual inspection by competent personnel. The placement of peat may require the use of long reach excavators and low ground pressure machinery in localised areas.
- Where there is any doubt as to the stability of the peat surface then no material shall be placed on to the peat surface.
- Finished/shaped side slopes in the placed peat is likely to be in the region of 1 (v): 2 to 3 (h). This slope inclination should be reviewed during construction, as appropriate. Where areas of weaker peat are encountered then slacker slopes may be required.
- All placed/spread peat will be allowed to revegetate naturally from the extensive seed source of the plants that have already colonised in the area. Alternatively and possibly in addition seeding of the placed peat could be carried out which would aid in stabilising the placed peat in the long term.
- Movement monitoring instrumentation may be required in deeper in-situ peat areas. The locations where monitoring is required will be identified prior to construction works commencing on site.
- Supervision by a geotechnical engineer or appropriately competent person is recommended for the works.
- An interceptor drain should be installed upslope of the placed peat areas to divert any surface water away from these areas. This will help ensure stability of the placed peat and reduce the likelihood of debris run-off.
- All the above mentioned general guidelines and requirements should be confirmed by the designer prior to construction.

3.3.6 Electricity Substations

It is proposed to construct one 110 kV electricity substation within the site, at one of two locations (Option A or B as set out in Section 3.1 above) as shown in Figure 3.1. The layouts of the proposed substation options are shown on Figure 3.8 and Figure 3.9. The construction and electrical components of the electricity substations will be to Eirgrid specifications. Further details regarding the connection between the site substations themselves and then on to the national electricity grid are provided in Section 3.3.8 of this EIS chapter. The footprint of the proposed electricity substation Option A measures c.80 metres in length by c.60 metres, and for Option B c.104 metres in length and c.82 metres in width, and will include two wind farm control buildings and the electrical substation components necessary to consolidate the electrical energy generated by each wind turbine, and export that electricity from the wind farm substation to the national grid.

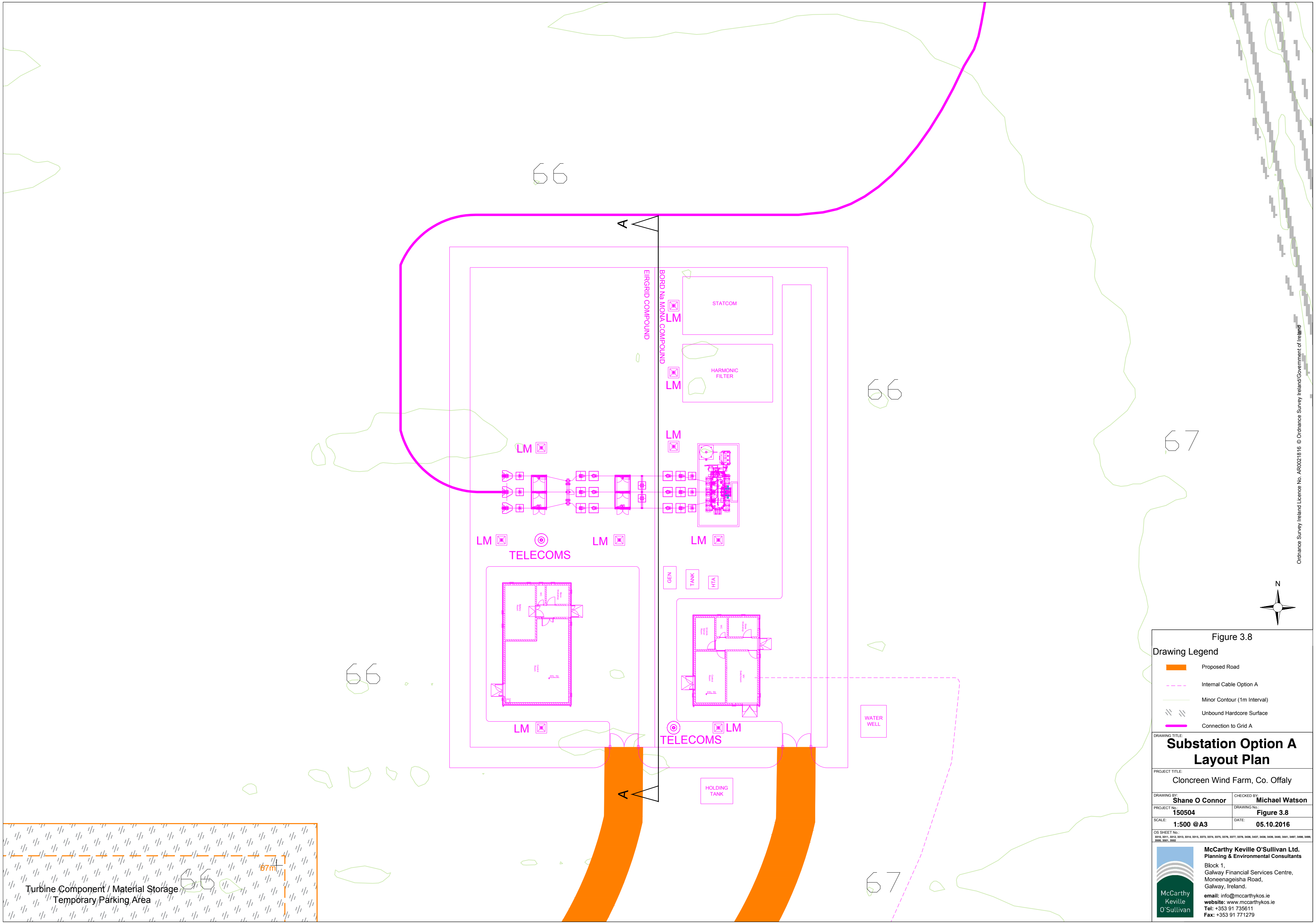

Figure 3.8

Drawing Legend

- Proposed Road
- Internal Cable Option A
- Minor Contour (1m Interval)
- Unbound Hardcore Surface
- Connection to Grid A

DRAWING TITLE:
Substation Option A Layout Plan

PROJECT TITLE:
Cloncreen Wind Farm, Co. Offaly

DRAWING BY: **Shane O Connor**	CHECKED BY: **Michael Watson**
PROJECT No.: **150504**	DRAWING No.: **Figure 3.8**
SCALE: **1:500 @A3**	DATE: **05.10.2016**

OS SHEET No.:
3310, 3311, 3312, 3313, 3314, 3315, 3373, 3374, 3375, 3376, 3377, 3378, 3436, 3437, 3438, 3439, 3440, 3441, 3497, 3498, 3499, 3500, 3501, 3502

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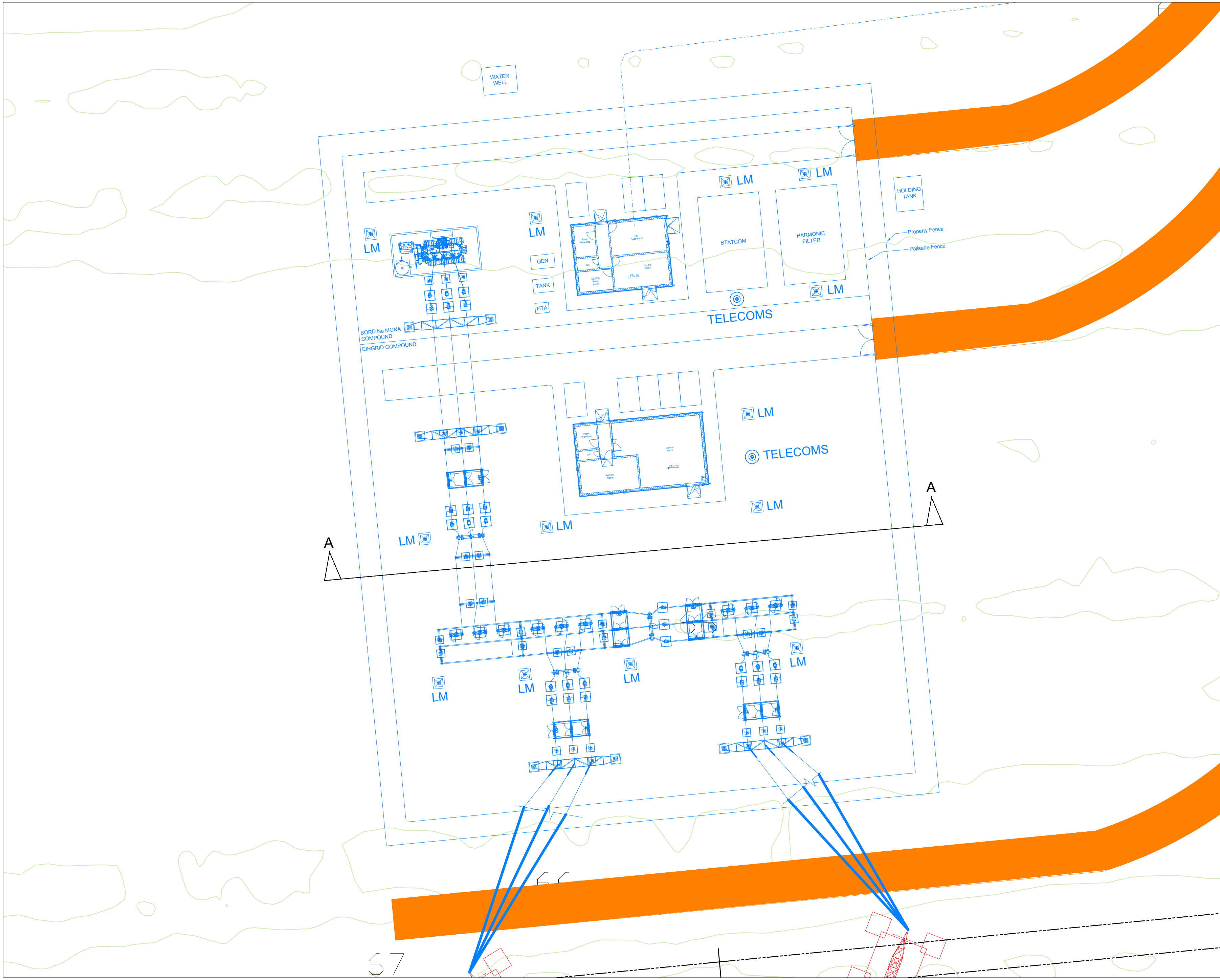

Figure 3.9

Drawing Legend

- Proposed Road
- Internal Cable Option B
- Existing 110kV Overhead Lines
- Minor Contour (1m Interval)
- Unbound Hardcore Surface
- Connection to Grid B

DRAWING TITLE:

Substation Option B Layout Plan

PROJECT TITLE:

Cloncreen Wind Farm, Co. Offaly

DRAWING BY: **Shane O Connor**	CHECKED BY: **Michael Watson**
PROJECT No.: **150504**	DRAWING No.: **Figure 3.9**
SCALE: **1:500 @A3**	DATE: **05.10.2016**

OS SHEET No.: 3310, 3311, 3312, 3313, 3314, 3315, 3373, 3374, 3375, 3376, 3377, 3378, 3436, 3437, 3438, 3439, 3440, 3441, 3497, 3498, 3499, 3500, 3501, 3502

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3.3.7 Wind Farm Control Buildings

Two wind farm control buildings will be located within whichever substation compound is constructed. Control Building 1 will measure c.18 metres by c.10 metres and c. 6 metres in height. Control Building 2 will measure c.14 metres by c. 10 metre by c. 6 metres in height. Layout drawings of the control buildings are shown on Figures 3.10 and 3.11.

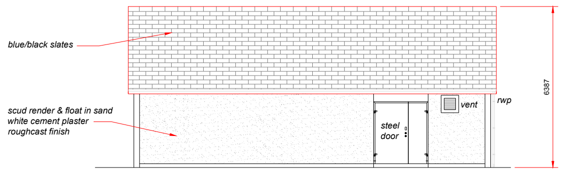
The wind farm control buildings will include staff welfare facilities for the staff that will work on the proposed wind farm during the operational phase of the project. Toilet facilities will be installed with a low-flush cistern and low-flow wash basin. Due to the specific nature of the proposed development there will be a very small water requirement for occasional toilet flushing and hand washing and therefore the water requirement of the proposed development is small. It is proposed to install a groundwater well adjacent to the substation in accordance with the Institute of Geologists Ireland, *Guide for Drilling Wells for Private Water Supplies (March 2007)*. The well will be flush to the ground and covered with a standard manhole. A pump house is not required as an in-well pump will direct water to a water tank within the roof space of the control building.

It is proposed to manage wastewater from the staff welfare facilities in the control buildings by means of a sealed storage tank, with all wastewater being tankered off site by permitted waste collector to wastewater treatment plants. It is not proposed to treat wastewater on-site, and therefore the EPA's 2009 *'Code of Practice: Wastewater Treatment and Disposal Systems Serving Single Houses (p.e. ≤ 10)'* does not apply. Similarly, the EPA's 1999 manual on *'Treatment Systems for Small Communities, Business, Leisure Centres and Hotels'* also does not apply, as it too deals with scenarios where it is proposed to treat wastewater on-site.

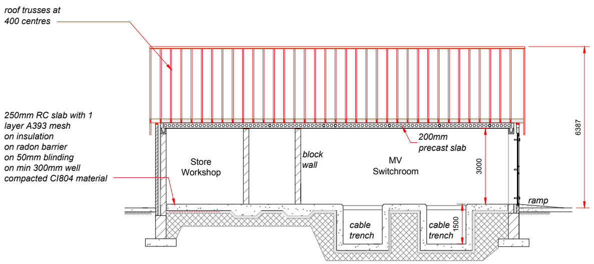
Such a proposal for managing the wastewater arising on site has become standard practice on wind farm sites, which are often proposed in areas where finding the necessary percolation requirements for on-site treatment would be challenging, and has been accepted by numerous Planning Authorities and An Bord Pleanála as an acceptable proposal. The proposed wastewater storage tank will be fitted with an automated alarm system that will provide sufficient notice that the tank requires emptying. Full details of the proposed tank alarm system can be submitted to the Planning Authority in advance of any works commencing on-site. The wastewater storage tank alarm will be part of a continuous stream of data from the sites turbines, wind measurement devices and electricity substation that will be monitored remotely 24 hours a day, 7 days per week. Only waste collectors holding valid waste collection permits under the Waste Management (Collection Permit) Regulations, 2007, will be employed to transport wastewater away from the site. When the final destination of the materials is known following the appointment of a permitted contractor, this information can be submitted to the Planning Authority if necessary.

3.3.8 Underground Cabling

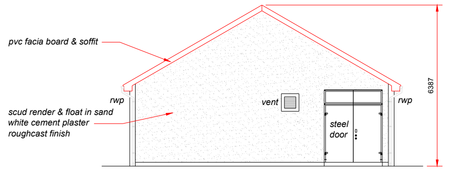
Each turbine will be connected to the on-site electricity substations via an underground 33 kV (kilovolt) electricity cable. Fibre-optic cables will also connect each wind turbine to the wind farm control building in the substation compounds. The electricity and fibre-optic cables running from the turbines to the substation compounds will be run in cable ducts approximately 1.2 metres below the ground surface, along the sides of roadways. The route of the cable ducts will follow the access track to each turbine location. Depending on which substation is constructed there are two internal cable connection options. The route options are included on the site layout drawings included



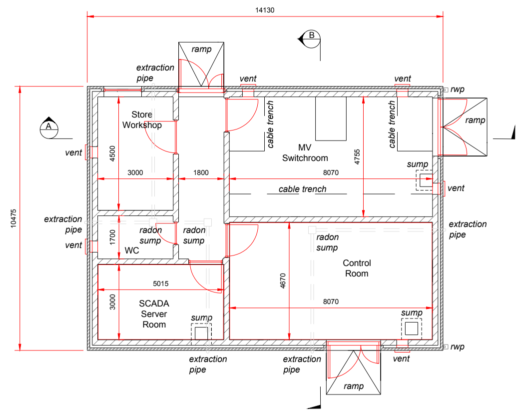
Substation Option A = West Elevation
Substation Option B = North Elevation



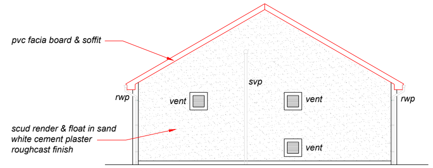
SECTION A-A



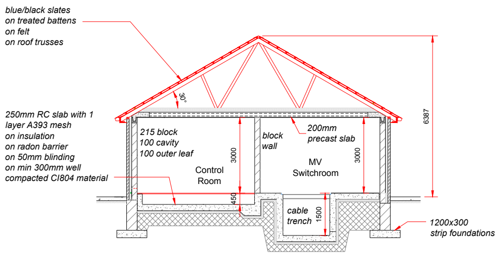
Substation Option A = South Elevation
Substation Option B = East Elevation



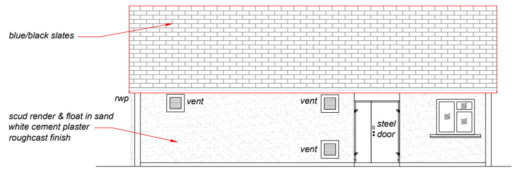
FLOOR PLAN



Substation Option A = North Elevation
Substation Option B = West Elevation



SECTION B-B



Substation Option A = East Elevation
Substation Option B = South Elevation

Figure 3.10

DRAWING TITLE:
Customer Control Building

PROJECT TITLE:
Cloncreen Wind Farm, Co. Offaly

DRAWING BY: **Shane O Connor**	CHECKED BY: **Michael Watson**
PROJECT No.: **150504**	DRAWING No.: **Figure 3.10**
SCALE: **1:200 @A3**	DATE: **05.10.2016**

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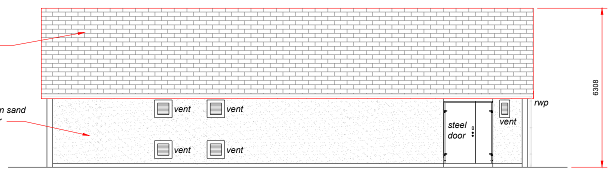
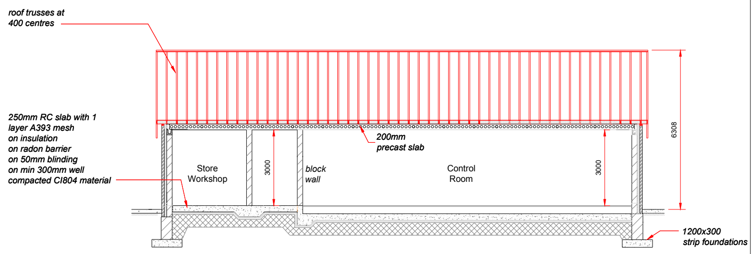
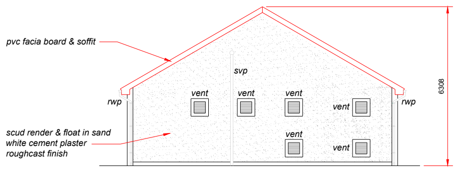


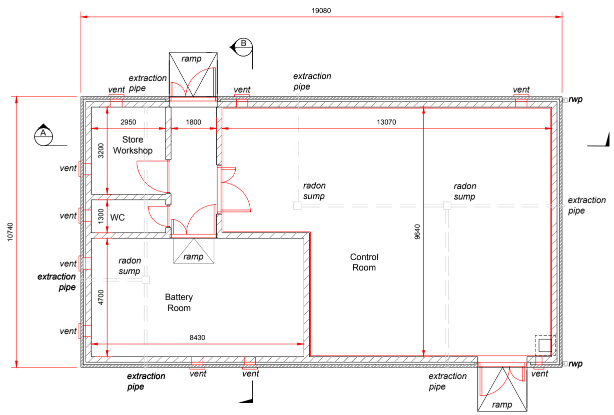
Substation Option A = West Elevation
Substation Option B = South Elevation



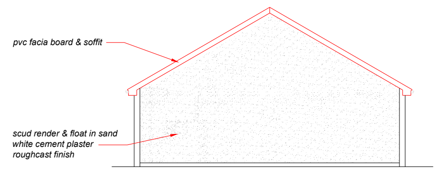
SECTION A-A



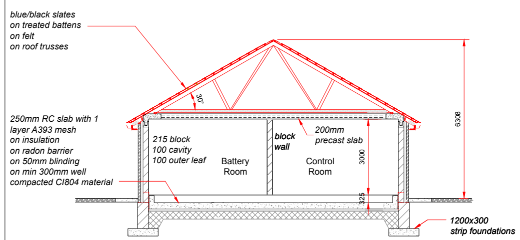
Substation Option A = North Elevation
Substation Option B = West Elevation



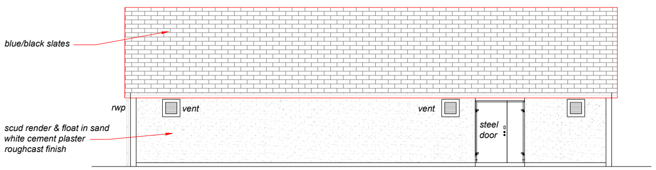
FLOOR PLAN



Substation Option A = South Elevation
Substation Option B = East Elevation



SECTION B-B



Substation Option A = East Elevation
Substation Option B = North Elevation

Figure 3.11

DRAWING TITLE:
Eirgrid Control Building

PROJECT TITLE:
Cloncreen Wind Farm, Co. Offaly

DRAWING BY: Shane O Connor	CHECKED BY: Michael Watson
PROJECT No.: 150504	DRAWING No.: Figure 3.11
SCALE: 1:200 @A3	DATE: 05.10.2016

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as Appendix 3-1 to this report. The position of the cable trench relative to the roadways is shown in Figure 3.1.

3.3.9 Grid Connection

A connection between the proposed development site and the national electricity grid will be necessary to export electricity from the proposed wind farm.

There are 2 No. substations and associated grid connections options; however, only one substation and associated grid connection will ultimately be constructed. This is to allow the national grid operator, Eirgrid flexibility when deciding on which is technically preferable from their perspective.

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

- **Option A:** Construction of a 110 kV substation in the eastern section of the site. This substation will connect to the National Grid via an underground cable (approximately 1.7 kilometres in length) running from the substation to the existing 110 kV Cushaling substation at Edenderry Power Plant, located directly east of the proposed wind farm site. The proposed underground cable will be located on Bord na Móna lands and within the curtilage of the public road.

Or:

- **Option B:** Construction of a 110 kV substation in the southern section of the site. This substation will connect to the National Grid via a short section of overhead line (less than 0.1km) to the existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site.

The grid connection route options are shown on Figure 3.1.

3.3.10 Anemometry Mast

One permanent anemometry mast is proposed as part of the proposed development. The anemometry mast will be equipped with wind monitoring equipment at various heights. The mast will be located as shown on the site layout drawing in Figure 3.1. The mast will be a slender, free-standing structure up to 120 metres in height.

The mast will be constructed on a hardstanding area sufficiently large to accommodate the crane that will be used to erect the mast, adjacent to an existing track.

3.3.11 Temporary Construction Compounds

Two temporary construction compounds are proposed within the site of the proposed development. One will be located in the townland of Esker More, along the western boundary of the site and the other will be located at one of two possible locations depending on which substation (Option A or B) will be constructed.

The locations, dimensions and total areas of the temporary construction compounds are outlined in Table 3.6 below. The locations of the proposed construction compounds are shown on the site layout drawing in Figure 3.1.

Table 3.6 Proposed Construction Compounds

Construction Compound No.	Location		Dimensions (m) (approx.)		Area (m^2) (approx.)
	Easting	Northing	Length	Width	
1 Esker More	256,830	226,250	100	40	4,000
2 Ballykilleen	260,430	226,920	100	40	4,000
3 Cloncreen	258,390	224,920	100	40	4,000

The construction compounds will consist of temporary site offices, staff facilities and car-parking areas for staff and visitors. The layouts of these construction compounds are similar to each other, as per that shown on Figure 3.12. Construction materials and turbine components will be brought directly to the proposed turbine locations following their delivery to the site.

Temporary port-a-loo toilets located within a staff portacabin will be used during the construction phase. Wastewater from staff toilets will be directed to a sealed storage tank, with all wastewater being tankered off site by permitted waste collector to wastewater treatment plants.

Temporary electrical supply will be provided from the existing supply to the adjacent pumping stations.

3.3.12 Junction Accommodation and Public Road Works

Improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads will be required, in particular a temporary upgrade of the R420/R402 junction, temporary road widening at 1 no. location on the R402 in Ballinagar, upgrade of the R402/L1003 junction, road upgrade along the L1003 and the new construction phase site entrance and upgrade of the existing site entrance on the R401. The locations of these junctions and an overview of the proposed acoomodation works are shown on the layout drawings in Appendix 3-1 of this EIS.

The upgrade of the R420/R402 junction will be an extension of a previous upgrade carried out as part of the works required to transport large turbine components to the Mountlucas wind farm during its construction in 2014. This upgrade will consist of clearing back the existing vegetation at the junction, excavation of material to allow the placing of stone within the redlined area. Following this the area will be finished in tar and chip. A series of removable bollards will be placed along the existing road edge in order to preserve the structure of the junction outside of those periods when deliveries of components are underway. A permanent fence will be erected once the deliveries are completed restoring the junction to its existing configuration. The hardstanding area created to accommodate the works will be top soiled over and allowed to reseed naturally.

The temporary widening of the R402 in Ballingar is required to accommodate the movement of large components (specifically transportation of blades) around this bend. The temporary works will require the temporary removal of the existing footpath, vegetation and boundary wall that form part of the public park area. Further excavations will be required to allow the importation of suitable fill material to build the area back up to the existing road level. The extended area will then be stoned over to allow the traverse of the vehicles carrying the large components. Once the deliveries are completed the area will be reinstated in accordance with the requirements of Offaly County Council.

Project Design Drawing Notes

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2. Drawings not to be used for construction/contract conditions.
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4. Do not scale off this drawing. Figured metric dimensions only should be taken off this drawing.
5. All contractors, whether main or sub-contractors, must visit the site and are responsible for taking and checking any and all dimensions and levels that relate to the works.
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7. Layout plans show typical Turbine rotor diameter as per turbine drawing.

Drawing Legend

- Proposed Road
- Internal Cable Option A
- Internal Cable Option B
- Minor Contour (1m Interval)
- Unbound Hardcore Surface

N

Figure 3.12

DRAWING TITLE:

Construction Compound Layout

PROJECT TITLE:

Cloncreen Wind Farm, Co. Offaly

DRAWING BY: **Shane O Connor**	CHECKED BY: **Michael Watson**
PROJECT No.: **150504**	DRAWING No.: **Figure 3.12**
SCALE: **1:500 @A3**	DATE: **05.10.2016**

OS SHEET No.: 3310, 3311, 3312, 3313, 3314, 3315, 3373, 3374, 3375, 3376, 3377, 3378, 3436, 3437, 3438, 3439, 3440, 3441, 3497, 3498, 3499, 3500, 3501, 3502

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The upgrade to the junction of the R402/L1003 is required to facilitate the movement of vehicles carrying large turbine components off the R402 and onto the L1003. The swept path analysis indicates that road widening will be required at this junction to facilitate these vehicle movements. The land on the southern side of the R402 between the bridge over the Phillipstown River and the junction will be elevated using suitable fill material to the level of the existing road. The required area to accommodate the large turbine component movements will be surfaced and a series of temporary bollards installed. The bollards will be removed when the widened area is required for deliveries and replaced when not in use in order to preserve the junction configuration. Once the deliveries have been completed a permanent fence will be erected in order to preserve the integrity of the junction and prevent unauthorised access to the hard standing area.

It is proposed that the existing L1003 local road is widened to 6 metres from the junction of the R402 and L1003 to the proposed western entrance to Cloncreen wind farm. This is shown on the layout drawings in Appendix 3-1 of the EIS. This widening will involve the creation of a c. 0.5-metre wide verge on the eastern side of the road and extension of the road width a distance of 6 metres to the west from the newly created verge. In order to accommodate this, the following works will need to be carried out along the western edge of the existing road.

- Removal of the existing vegetation to a maximum distance of 10m from the existing road edge.
- Extension of the road edge to ensure a full 6m width up to the proposed site entrance.
- Realignment of the centreline of the road
- In-fill of the required area along the western edge of the L1003 to facilitate these widening works,
- The creation of an appropriate side slope from the new edge into the adjacent agricultural land,
- The movement of the existing open drainage features to accommodate the works
- A programme of planting along the new drainage feature in parallel to the road
- Installation of a timber and rail fence.

The proposed works would result in a permanent upgrade of the L1003 from the R402/L1003 junction to the proposed site entrance.

A new site entrance is required along the L1003 to facilitate the delivery of the construction materials and turbine components. There are two proposed components that will make up this temporary entrance:

1. A construction entrance will be located adjacent to the northern boundary of Bord na Móna lands on the eastern side of the road. This entrance will facilitate deliveries of stone, concrete, steel and other equipment/materials.
2. The second component will be a large turbine component entrance that will have a larger footprint that will include the footprint of the proposed construction entrance. This entrance will be used for large turbine component delivery only. Passive screening will be put in place as part of the construction of this element to ensure maximum screening possible between the L1003 and the large turbine roadway as it extends in to Bord na Móna Lands. The extent of this entrance will be restricted in a similar fashion to the proposed junction upgrades through the use of temporary bollards that will be removed and reinstated as required.

Appropriate sightlines will be established to both the north and south of the proposed site entrance to accommodate exiting traffic. Once the large turbine components deliveries cease the large turbine component entrance will be permanently fenced off to the road verge. The large turbine component entrance and roadway will be covered in top soil and allowed to reseed naturally. Once the construction phase of the wind farm is completed and the wind farm is fully operational the construction entrance will then be permanently fenced off. In this case as there are other entrances to the site to facilitate operational traffic, the construction roadway will covered in topsoil and a suitable replanting programme completed to encourage re growth.

The detailed layout drawings of the proposed works are included as Appendix 3-1 and is shown on Figure 3.1.

3.3.13 Site Activities

3.3.13.1 Environmental Management

All proposed site activities will be provided for in an environmental management plan. A Construction Environmental Management Plan (CEMP) has been prepared for the proposed development, and is included in Appendix 3-2 of this EIS. The CEMP includes details of drainage, peat and overburden management and waste management. It is intended that the CEMP would be updated prior to the commencement of the development, to include all mitigations measures, conditions and or alterations to the EIS and application documents that may emerge during the course of the planning process, and would be submitted to the Planning Authority for written approval.

3.3.13.2 Refuelling

Wherever possible, vehicles will be refuelled off-site. This will be the case for regular, road-going vehicles. However, for construction machinery that will be based on-site continuously, a limited amount of fuel will have to be stored on site.

On-site refuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axle custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located. It is not practical for all vehicles to travel back to a single refuelling point, given the size of the cranes, excavators, etc. that will be used during the construction of the proposed wind farm. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use.

Only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations.

3.3.13.3 Concrete Deliveries

Only ready-mixed concrete will be used during the construction phase, with all concrete being delivered from local batching plants in sealed concrete delivery trucks. The use of ready-mixed concrete deliveries will eliminate any potential environmental risks of on-site batching. When concrete is delivered to site, only the chute of the delivery truck will be cleaned, using the smallest volume of water necessary, before leaving the site. Concrete trucks will be washed out fully at the batching plant, where facilities are already in place.

The small volume of water that will be generated from washing of the concrete lorry's chute will be directed into a temporary lined impermeable containment area, or a Siltbuster-type concrete wash unit (http://www.siltbuster.com/sheets/RCW.pdf) or equivalent. This type of Siltbuster unit catches the solid concrete and filters and holds wash liquid for pH adjustment and further solids separation. The residual liquids and solids can be disposed of off-site at an appropriate waste facility. Where temporary lined impermeable containment areas are used, such containment areas are typically built using straw bales and lined with an impermeable membrane. Two examples are shown in Plates 3.4 and 3.5 below.

Plate 3.4 Concrete washout area

Plate 3.5 Concrete washout area

The areas are generally covered when not in use to prevent rainwater collecting. In periods of dry weather, the areas can be uncovered to allow much of the water to be lost to evaporation. At the end of the concrete pours, any of the remaining liquid contents is tankered off-site. Any solid contents that will have been cleaned down from the chute will have solidified and can be broken up and disposed of along with other construction waste.

Due to the volume of concrete required for each turbine foundations, and the requirement for the concrete pours to be continuous, deliveries are often carried out outside normal working hours in order to limit the traffic impact on other road users, particularly peak period school and work commuter traffic. Such activities are limited to the day of turbine foundation concrete pours, which are complete in a single day per turbine.

The risks of pollution arising from concrete deliveries will be further reduced by the following:

- Concrete trucks will not be washed out on the site, but will be directed back to their batching plant for washout.
- Site roads will be constructed to a high standard to allow transport of the turbine components around the site, and hence, concrete delivery trucks will be able to access all areas where the concrete will be needed. No concrete will be transported around the site in open trailers or dumpers so as to avoid spillage while in transport. All concrete used in the construction of turbine bases will be pumped directly into the shuttered formwork from the delivery truck. If this is not practical, the concrete will be pumped from the delivery truck into a hydraulic concrete pump or into the bucket of an excavator, which will transfer the concrete to the location where it is needed.
- The arrangements for concrete deliveries to the site will be discussed with suppliers before work starts, agreeing routes, prohibiting on-site washout and discussing emergency procedures.

- Clearly visible signage will be placed in prominent locations close to concrete pour areas specifically stating washout of concrete lorries is not permitted on the site.

3.3.13.4 Concrete Pouring

Because of the scale of the main concrete pours that will be required to construct the proposed wind farm, the main pours will be planned days or weeks in advance. Special procedures will be adopted in advance of and during all concrete pours to minimise the risk of pollution. These may include:

- Using weather forecasting to assist in planning large concrete pours, and avoiding large pours where prolonged periods of heavy rain is forecast.
- Restricting concrete pumps and machine buckets from slewing over watercourses while placing concrete.
- Ensuring that excavations are sufficiently dewatered before concreting begins and that dewatering continues while concrete sets.
- Ensuring that covers are available for freshly placed concrete to avoid the surface washing away in heavy rain.
- Disposing of surplus concrete after completion of a pour in agreed suitable locations away from any watercourse or sensitive habitats.

3.3.13.5 Dust Suppression

In periods of extended dry weather, dust suppression may be necessary along haul roads and around the borrow pit area to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads and site compounds to prevent the generation of dust. Silty or oily water will not be used for dust suppression, because this would transfer the pollutants to the haul roads and generate polluted runoff or more dust. Water bowser movements will be carefully monitored, as the application of too much water may lead to increased runoff.

3.3.13.6 Vehicle Washing

Wheels or vehicle underbodies are often washed before leaving sites to prevent the build-up of mud on public (and site) roads. It is not anticipated that vehicle or wheel washing will be required as part of the construction phase of the proposed development because site roads will be already formed using on-site materials before other road-going trucks begin to make regular or frequent deliveries to the site (e.g. with steel or concrete). The site roads will be well finished with compacted hardcore, and so the public road-going vehicles will not be travelling over soft or muddy ground where they might pick up mud or dirt.

A road sweeper will be available if any section of the public roads were to be dirtied by trucks associated with the proposed development.

3.4 Community Benefit Proposal

3.4.1 Background

Bord na Móna presently operate two wind farm community gain schemes at its wind farms in Mountlucas and Bruckana. These schemes were established in 2014 thanks to the help and cooperation of the communities surrounding the wind farms. The Community Gain Schemes for Bruckana and Mountlucas Wind Farms were set up on the basis of community involvement and public consultation. In order to establish a benefit structure Bord na Móna consulted with the relevant communities on a number of aspects prior to the introduction of the benefit scheme:

- What type of projects, facilities and local developments should be supported by the benefit?
- How far from the boundary of the wind farm should these benefits be distributed?
- What criteria should be applied in selecting and prioritising projects for support under the scheme?
- How should the benefits scheme be governed and administered?

Written submissions were sought from all interested parties, including individuals and organisations who lived or operated in the region around both wind farms. A list of specific criteria was established by Bord na Móna in consultation with the local community; these criteria provided the framework guidance under which local community groups, clubs and associations can apply to the Fund for financial assistance. Qualifying categories are applied as an initial screen on submissions; for a submission to be considered for funding under the Scheme it must satisfy at least one of the following:

a) Amenity
b) Community facilities
c) Culture/Heritage
d) Education/Schools
e) Recreation/Health

An annual fund of €1,000/MW of installed capacity per annum, index-linked for the lifetime of each project was established. The annual fund for Mountlucas Wind Farm Community Gain Scheme is €84,000, while the Bruckana Wind Farm Community Gain Scheme is €42,000. This is in line with the recommendations of the published IWEA protocol for community benefit (*Good Neighbour: IWEA Best Practice Principles in Community Engagement & Community Commitment. Irish Wind Energy Association, March 2013.)* The funding has benefited schools, childcare services, community development groups, active retirement associations, youth clubs, resident's associations, community alert groups, parents associations, town halls, group water schemes, sports clubs, social initiatives, as well as other community facilities.

3.4.2 Cloncreen Community Benefit

Bord na Móna is proposing to replicate its proven Community Gain scheme model in the context of the Cloncreen Wind farm. In accordance with the IWEA best practice an annual fund of €1,000/MW of installed capacity per annum, index-linked for the lifetime of the project will be established. This fund will look to support the local community, through funding of projects and services over and above those required to be provided by the local authority. Bord na Móna will seek to be fair and equitable in its dealings with the local community, consult and engage with the local community and try to remedy genuine concerns the local community may have about the project.

To this end, Bord na Mòna set up the Cloncreen Community Engagement Forum in 2015. The Cloncreen Community Engagement Forum is an additional communications channel that enables Bord na Móna to engage with interested groups and communities in the vicinity of the proposed development. The Forum is independently chaired. There are over 50 voluntary members on the forum representing areas around the wind farm. The forum has established a number of working groups based on key issues/concerns they have identified. Two of the working groups are addressing issues around community benefit. There is a specific working group for a near neighbour scheme and also a working group relating to Community gain with a focus on community ownership. The Cloncreen Community Engagement forum is presently focussed on the development of a near neighbour scheme. A set of proposals have been made to Bord na Mòna who have developed a road map to the development of a near neighbour scheme for the proposed wind farm. Work on this issue, community ownership and other issues will continue to progress over the coming months and will continue throughout the consenting process.

3.5 Access and Transportation

3.5.1 Site Entrances

The site of the proposed development will have one site entrance for the purposes of turbine delivery, which is into the western side of the site via the R402 and a local road, the L1003. This entrance will also be used for the majority of general construction traffic. The junction at the R402 and the local road and the local road itself for about 430 meters will require upgrade to accommodate the abnormal loads related to turbine delivery. The proposed works and new site entrance location is shown on the layout drawings included in Appendix 3-1.

When the wind farm becomes fully operational the proposed new site entrance will be closed by erecting fencing. The construction entrance area will be replanted. The large turbine component entrance will be covered in topsoil and allowed to reseed naturally. The large turbine entrance may on occasion be re-opened and used should new blade or tower sections be required over the course of the wind farms lifetime.

There is an existing entrance into the eastern side of the site via the R401 in the townland of Ballykilleen which is proposed for a portion of the general construction traffic and for during the operational phase. Minor upgrade works will be required to the eastern entrance in order to accommodate access and egress of construction vehicles. The location of these entrances is shown on the site layout drawings in Figure 3.1.

There is an existing entrance to the site at the north central section off a local road connected to the R402 which is currently used for access to the peat production areas of the bog and the Bord na Móna 'tea centre', which is currently in use by employees. It is not proposed to use this access location for abnormal loads or general construction traffic. It will be necessary for a small number of vehicles to use this entrance to access the proposed borrow pit in order to begin those operations and also to implement the proposed demolition of the 'tea centre' building, the dismantling of the telecommunications mast and the dismantling of the Meteorlogical mast.. This entrance will also be available for the operational phase as the traffic volumes are very small and significantly less than the existing traffic associated with the peat production activities.

At the southern section of the site, to the east of the proposed southern substation there is a proposed internal roadway leading to the existing ash repository site. It is not proposed to use this access location for abnormal loads or general construction traffic. This access will be used during the operational phase of the project when traffic volumes will be limited. Use of this access road will be heavily dependent on the construction of the Option B substation.

The proposed layouts of the site entrances along local public roads are shown in Appendix 3-1 of the EIS. The site entrances and internal junctions, which were subject to autotrack assessments, are labelled as per the traffic and transport assessment in Section 13 of the EIS.

3.5.2 Turbine and Construction Materials Transport Route

It is proposed that the large wind turbine plant will be delivered via the M6 before turning south onto the N52 at Kilbeggan. The route follows the N52 south, bypassing Tullamore to the east before turning east on the R420. Approximately 6 kms east the route then turns northeast onto the R402 at the priority junction at Ballina Cross. The route then follows the R402 northeast for approximately 9 kms through the village of Ballinagar, turning due east at Daingean for approximately 10 kms. The site is then accessed via a right turn at the priority junction with the L1003 which provides access to the site by means of a new priority junction 430m southeast of the junction with the R402. The proposed route is shown on Figure 3.13. All deliveries of turbine components to the site will only be by way of the proposed transport route outlined in Figure 3.13.

Other construction materials, will be delivered to the site via the proposed haul route shown on Figure 3.14. The number of construction vehicles that will be generated during the construction phase of the proposed development are outlined as part of the traffic and transport assessment in Section 13.1 of this EIS.

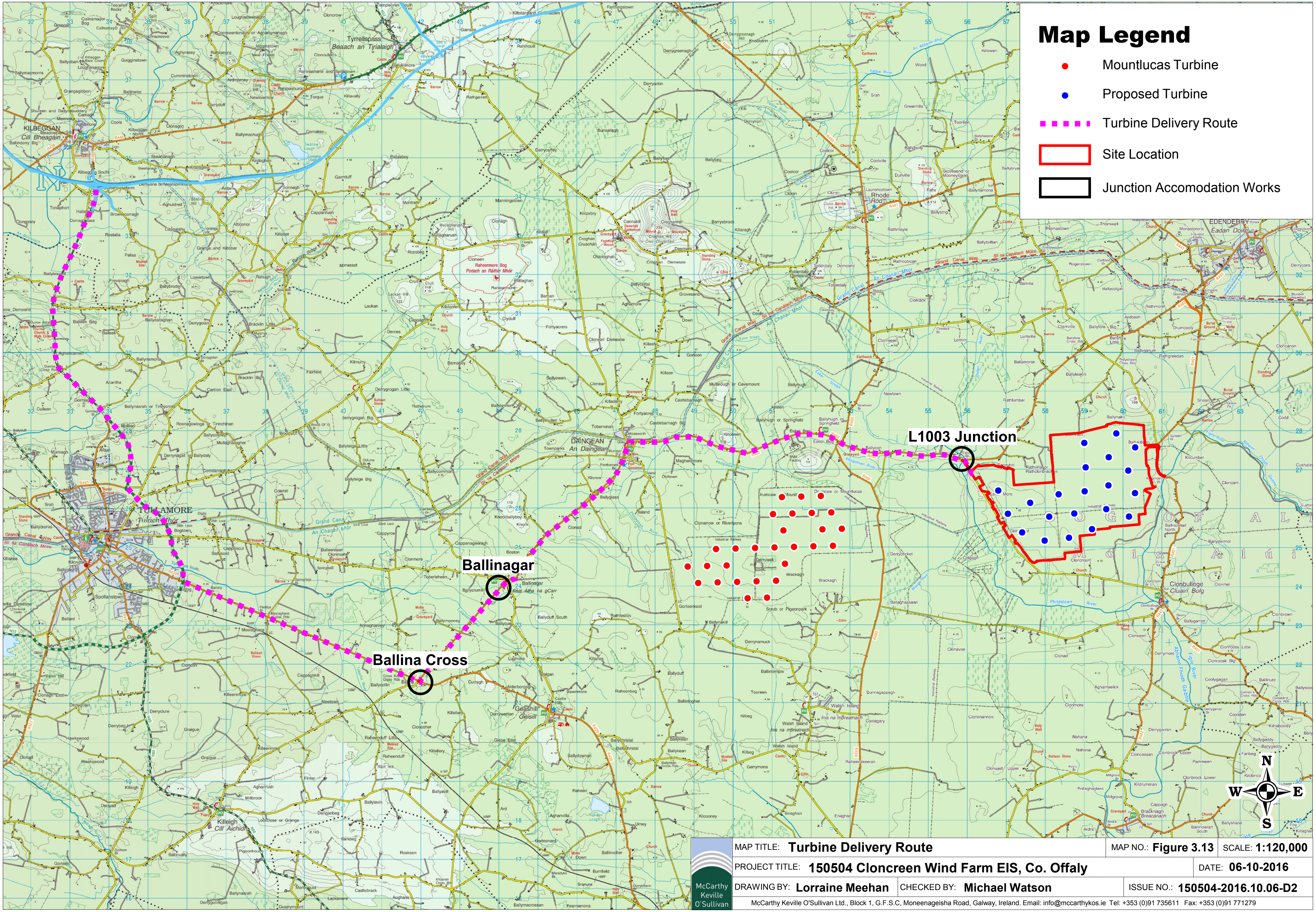
3.5.3 Traffic Management

A turbine with a maximum blade length of 65.5 metres has been used in assessing the traffic impact of the proposed development. The blade transporter for such a turbine blade would have a total vehicle length of 71.5 metres, including the blade which overhangs the back of the vehicle. The total length of the tower transporter is 46.7 metres with the axles located at the front and rear of the load with no overhang. The vehicles used to transport the nacelles will be similar to the tower transporter. All other vehicles requiring access to the site will be smaller than the design test vehicles. The turbine delivery vehicles have been modelled accurately in the Autotrack assessments for the site, as detailed in Section 13.1 of this EIS.

The need to transport a wind turbine blade measuring up to 65.5 metres on the public roads is not an everyday occurrence in the vicinity of the site of the proposed development. However, the procedures for transporting abnormal size loads on the country's roads are well established. Particularly as the turbine delivery route is the same as the one used for the existing Mountlucas wind farm with the exception of the final few kilometres to the Cloncreen wnd farm entracnce. While every operation to transport abnormal loads is different and requires careful consideration and planning, escort vehicles, traffic management plans, drive tests, road marshals and convoy escorts from the Garda Traffic Corps are all measures that are regularly employed to gets unusual loads from origin to destination. With over 2,800 MW of wind farms already built and operating in Ireland, transport challenges are something the wind energy industry and specialist transport sector has become particularly adept in finding solutions to.

A preliminary traffic management plan has been prepared as part of the traffic impact assessment set out in Section 13.1 of this EIS. Prior to the construction of the proposed development, a detailed traffic management plan will be prepared by the haulage company and submitted to Offaly County Council for approval. The plan will include:

- A delivery schedule.
- Details of temporary works or any other minor alteration identified.
- A dry run of the route using vehicles with similar dimensions.


Map Legend
Mountlucas Turbine
Proposed Turbine
Turbine Delivery Route
Site Location
Junction Accomodation Works
L1003 Junction
Ballinagar
Ballina Cross
TULLAMORE
DAINGEAN
Clonbullogue
Geashill
Killeigh
KILBEGGAN
EDENDERRY
Rhode
N
S
E
W
MAP TITLE: Turbine Delivery Route
MAP NO.: Figure 3.13
SCALE: 1:120,000
PROJECT TITLE: 150504 Cloncreen Wind Farm EIS, Co. Offaly
DATE: 06-10-2016
DRAWING BY: Lorraine Meehan
CHECKED BY: Michael Watson
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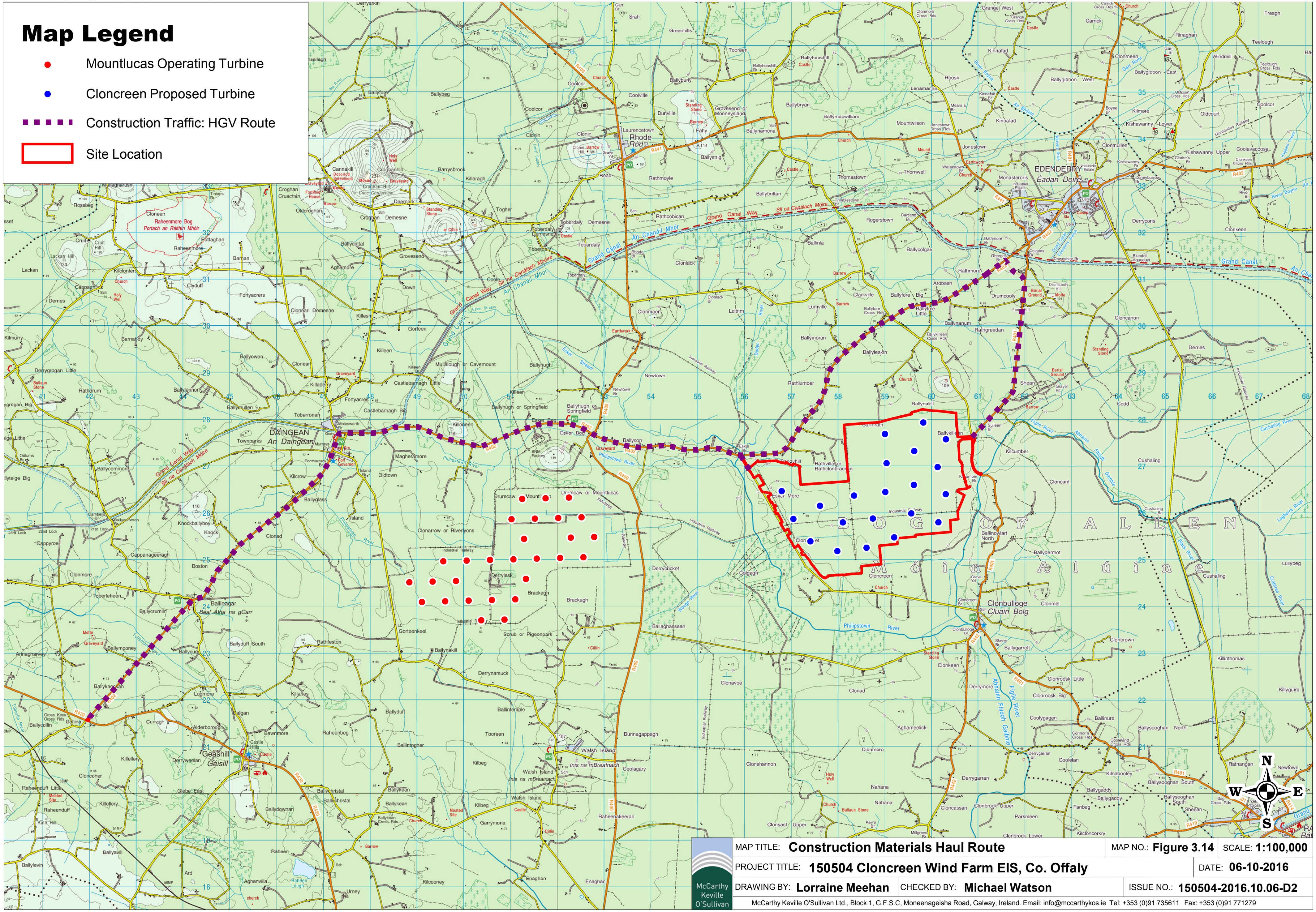
Map Legend

- Mountlucas Operating Turbine
- Cloncreen Proposed Turbine
- Construction Traffic: HGV Route
- Site Location



MAP TITLE: Construction Materials Haul Route	MAP NO.: Figure 3.14	SCALE: 1:100,000
PROJECT TITLE: 150504 Cloncreen Wind Farm EIS, Co. Offaly		DATE: 06-10-2016
DRAWING BY: Lorraine Meehan	CHECKED BY: Michael Watson	ISSUE NO.: 150504-2016.10.06-D2

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The deliveries of turbine components to the site will be made in convoys of three to five vehicles at a time, and mostly at night when roads are quietest. Convoys will be accompanied by escorts at the front and rear operating a "stop and go" system. Although the turbine delivery vehicles are large, they will not prevent other road users or emergency vehicles passing, should the need arise. The delivery escort vehicles will ensure the turbine transport is carried out in a safe and efficient manner with minimal delay or inconvenience for other road users.

It is not anticipated that any section of the local road network will be closed during transport of turbines, although there will be some delays to local traffic at pinch points. During these periods it may be necessary to operate local diversions for through traffic. All deliveries comprising abnormally large loads will be made outside the normal peak traffic periods to avoid disruption to work and school-related traffic.

Prior to the Traffic Management Plan being finalised, a full dry run of the transport operation along the proposed route will be completed using vehicles with attachments to simulate the dimensions of the wind turbine transportation vehicles. This dry run will inform the final traffic management plan. All turbine deliveries will be provided for in a transport management plan which will have to be prepared in advance of the construction stage, when the exact transport arrangements are known, delivery dates confirmed and escort proposals in place. Such a transport management plan is typically submitted to the Planning Authority for agreement in advance of any abnormal loads using the local roads, and will provide for all necessary safety measures, including a convoy and Garda escort as required, off-peak turning/reversing movements and any necessary safety controls.

3.6 Site Drainage

3.6.1 Introduction

The drainage design for the proposed wind farm development has been prepared by Hydro Environmental Services Ltd. (HES).

The protection of the watercourses within and surrounding the site, and downstream catchments that they feed is of utmost importance in considering the most appropriate drainage proposals for the site of the proposed development. There is an existing drainage system and surface water discharges from the site which is regulated by the Environmental Protection Agency (Licence Ref. P0501-01). The proposed development's drainage design has therefore been proposed specifically with the intention of having no negative impact on the water quality of the site and discharges from the site and its associated rivers and lakes, and consequently no impact on downstream catchments and ecological ecosystems.

No routes of any natural drainage features will be altered as part of the proposed development and turbine locations and associated new roadways were originally selected to avoid natural watercourses. There will be no direct discharges to any natural watercourses, with all drainage waters being dispersed as overland flows. All discharges from the proposed works areas will be made via settlement ponds, and over vegetation filters at a significant distance from streams and lakes respectively.

3.6.2 Existing Drainage Features

The topography of the development site is relatively flat with an elevation range of between 68 and 72 mOD (metres above Ordnance Datum). There are two slightly elevated mineral soil ridges at the site. One runs east west at the site compound, and the second is on the center of the eastern portion of the site, just south of the railway line, and it runs in a general north south direction. Along the majority of the site boundary a 1 to 2m high peat bank exists which is a remnant of the original bog. These perimeter peat banks create a boundary berm, forming a basin effect within the extraction area of the overall bog.

The surface of the cutover bog is drained by a network of east / west orientated peat drains that are typically spaced every 15 to 20m. These drains typically slope in both an easterly and westerly direction from the central north / south trending railway track line. Surface water outflows from the bog are located along the western, southern and eastern boundaries of the site and comprise both gravity and pumped outfalls. Other than the designated surface water outfalls, there are no other areas where runoff can leave the site.

Regionally the proposed wind farm development site, including the grid connection route options and haul route upgrades are located in the River Barrow surface water catchment within Hydrometric Area 14 of the South Eastern River Basin District.

On a more local scale the site is located in the Figile River surface water catchment. The Figile River flows in a southerly direction less than 0.5km to the east of the proposed site. The eastern section of the site drains directly to the Figile River via a number of outfall channels which are discussed further below in the site drainage section. The Philipstown River flows in a southerly direction approximately 0.5km to the west of the site prior to flowing in a more easterly direction to the south of the site and merging with the Figile River approximately 2km downstream of the site. The western section of the site drains to the Philipstown River via a number of channel outfalls which are also discussed further below.

Grid connection Option A exits on the area of the site that drains to the Figile River while grid connection Option B and the proposed haul route junction works drain to the Philipstown River.

3.6.3 Drainage Design Principles

Drainage water from any works areas of the wind farm site will not be directed to any natural watercourses within the site. Two distinct methods will be employed to manage drainage water within the site. The first method involves keeping clean water clean by avoiding disturbance to natural drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations and construction areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, to allow attenuation and settlement prior to controlled diffuse release.

The drainage design is intended to maximise erosion control, which is more effective than having to control sediment during high rainfall. Such a system also requires less maintenance. The area of exposed ground will be minimised. The drainage measures will prevent runoff from entering the works areas of the site from adjacent ground, to minimise the volume of sediment-laden water that has to be managed. Discoloured run-off from any construction area will be isolated from natural clean run-off.

3.6.4 References

The drainage design has been prepared based on experience of the project team of other wind farm sites in peat-dominated environments, and the number of best practice guidance documents referred to in the References section of the EIS.

3.6.5 Drainage Design

A preliminary drainage design for the proposed wind farm, incorporating all principles and measures outlined in this drainage design description, has been prepared, and is included in the drainage drawings in Appendix 3-1 to this EIS. The proposed wind farm drainage process flow is shown on Figure 3.15. The drainage design employs the various measures further described below.

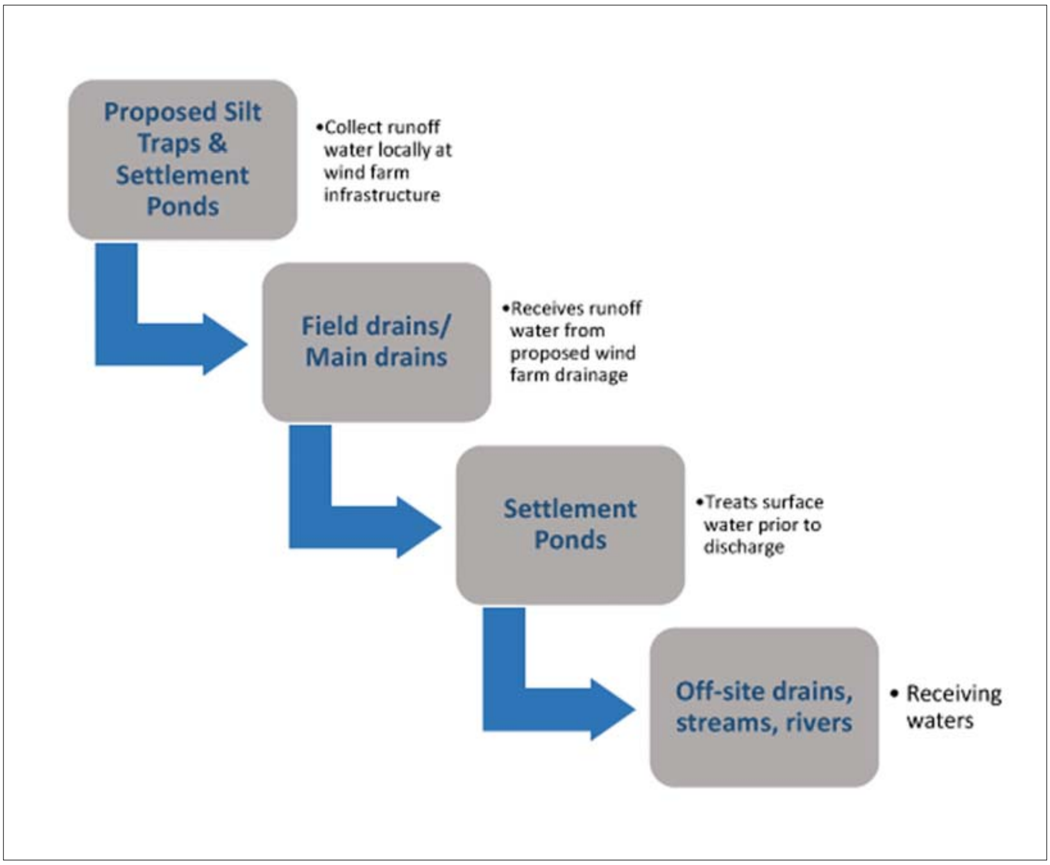


Figure 3.15 Proposed Wind Farm Drainage Process Flow

3.6.5.1 Interceptor Drains

Interceptor drains will be installed upgradient of any works areas to collect surface flow runoff and prevent it reaching excavations and construction areas of the site where it might otherwise have come into contact with exposed surfaces and picked up silt and sediment. The drains will be used to divert upslope runoff around the works area to a location where it can be redistributed over the ground surface as sheet flow. This will minimise the volume of potentially silty runoff to be managed within the construction area.

The interceptor drains will be installed in advance of any main construction works commencing. The material excavated to make the drain will be compacted on the downslope edge of the drain to form a diversion dike. On completion of the construction phase works, it is envisaged that the majority of the interceptor drains will be removed. At that stage, there will be no open excavations or large areas of exposed ground that are likely to give rise to large volumes of potentially silt-laden run off. Any areas in which works were carried out to construct roads, turbine bases or hardstands, will have been built up with large grade hardcore, which even when compacted in place, will retain sufficient void space to allow water infiltrate the subsurface of these constructed areas. It is not anticipated that roadways or other installed site infrastructure will intercept ground-conveyed surface water runoff to any significant extent that would result in scouring or over-topping or spill over. Where the drains are to be removed, they will be backfilled with the material from the diversion dike. Interceptor drains may have to be retained in certain locations, for example where roadways are to be installed on slopes, to prevent the roadways acting as conduits for water that might infiltrate the roadway sub-base. In these cases, interceptor drains would be maintained in localised areas along the roadway with culverts under the roadway, which would allow the intercepted water to be discharged to vegetation filters downgradient of the roadway. Similarly, in localised hollows where water is likely to be funnelled at greater concentrations than on broader slopes, interceptor drains and culverts may be left in situ following construction.

The velocity of flow in the interceptor will be controlled by check dams (see Section 3.6.5.3 below), which will be installed at regular intervals along the drains to ensure flow in the channel is non-erosive. On steeper sections where erosion risks are greater, a geotextile membrane will be added to the channel.

Interceptor drains will be installed horizontally across slopes to run in parallel with the natural contour line of the slope. Intercepted water will travel along the interceptor drains to areas downgradient of works areas, where the drain will terminate at a level spreader (see Section 3.6.5.4 below). Across the entire length of the interceptor drains, the design elevation of the water surface along the route of the drains will not be lower than the design elevation of the water surface in the outlet at the level spreader.

3.6.5.2 Collector Drains

Collector drains are shallow drains that will be used to intercept and collect run off from construction areas of the site during the construction phase. Drainage swales will remain in place to collect runoff from roads and hardstanding areas of the proposed development during the operational phase. A swale is an excavated drainage channel located along the downgradient perimeter of construction areas, used to collect and carry any sediment-laden runoff to a sediment-trapping facility and stabilised outlet. Swales are proven to be most effective when a dike is installed on the downhill side. They are similar in design to interceptor drains and collector drains described above.

Collector drains will be installed downgradient of any works areas to collect surface flow runoff where it might have come into contact with exposed surfaces and picked up silt and sediment. Swales will intercept the potentially silt-laden water from the excavations and construction areas of the site and prevent it reaching natural watercourses.

Collector drains will be installed in advance of any main construction works commencing. The material excavated to make the swale will be compacted on the downslope edge of the drain to form a diversion dike.

3.6.5.3 Check Dams

The velocity of flow in the interceptor drains and collector drains, particularly on sloped sections of the channel, will be controlled by check dams, which will be installed at regular intervals along the drains to ensure flow in the swale is non-erosive. Check dams will also be installed in some existing artificial drainage channels that will receive waters from works areas of the site.

Check dams will restrict flow velocity, minimise channel erosion and promote sedimentation behind the dam. The check dams will be installed as the interceptor drains are being excavated. Check dams may also be installed in some of the existing artificial drainage channels on the site, downstream of where drainage swales connect in.

The proposed check dams will be made up of straw bales or stone, or a combination of both depending on the size of the drainage swale it is being installed in. Where straw bales are to be used, they will be secured to the bottom of the drainage swale with stakes. Clean 4 to 6-inch stone will be built up on either side and over the straw bale to a maximum height of 600 mm over the bottom of the interceptor drain. In smaller channels, a stone check dam will be installed and pressed down into place in the bottom of the drainage swale with the bucket of an excavator.

The check dams will be installed at regular intervals along the interceptor drains to ensure the bottom elevation of the upper check dam is at the same level as the top elevation of the next down-gradient check dam in the drain. The centre of the check dam will be approximately 150 mm lower than the edges to allow excess water to overtop the dam in flood conditions rather than cause upstream flooding or scouring around the dams.

Check dams will not be used in any natural watercourses, only artificial drainage channels and interceptor drains. The check dams will be left in place at the end of the construction phase to limit erosive linear flow in the drainage swales during extreme rainfall events.

Check dams are designed to reduce velocity and control erosion and are not specifically designed or intended to trap sediment, although sediment is likely to build up. If necessary, any excess sediment build up behind the dams will be removed. For this reason, check dams will be inspected and maintained regularly to insure adequate performance. Maintenance checks will also ensure the center elevation of the dam remains lower than the sides of the dam.

3.6.5.4 Level Spreaders

A level spreader will be constructed at the end of each interceptor drain to convert concentrated flows in the drain, into diffuse sheet flow on areas of vegetated ground. The levels spreaders will be located downgradient of any proposed works areas in locations where they are not likely to contribute further to water ingress to construction areas of the site, or areas where they are not likely to give rise to peat stability issues.

The water carried in interceptor drains will not have come in contact with works areas of the site, and therefore should be free of silt and sediment. The level spreaders will distribute clean drainage water onto vegetated areas where the water will not be re-concentrated into a flow channel immediately below the point of discharge. The discharge point will be on level or only very gently sloping ground rather than on a steep slope so as to prevent erosion.

The slope in the channel leading into the spreader will be less than or equal to 1%. The slope downgradient of the spreader onto which the water will dissipate will have a grade of less than 6%. The availability of slopes with a grade of 6% or less will determine the locations of level spreaders. If a slope grade of less than 6% is not available in the immediate area downgradient of a works area at the end of a diversion drain, a piped slope drain will be used to transfer the water to a suitable location.

The spreader lip over which the water will spill will be made of a concrete kerb, wooden board, pipe, or other similar piece of material that can create a level edge similar in effect to a weir. The spreader will be level across the top and bottom to prevent channelised flow leaving the spreader or ponding occurring behind the spreader. The top of the spreader lip will be 150mm above the ground behind it. The length of the spreader will be a minimum of four metres and a maximum length of 25 metres, with the actual length of each spreader to be determined by the size of the contributing catchment, slope and ground conditions.

Clean four-inch stone can be placed on the outside of the spreader lip, and pressed into the ground mechanically to further dissipate the flow leaving the level spreader over a larger area.

3.6.5.5 Vegetation Filters

Vegetation filters are the existing vegetated areas of land that will be used to accept surface water runoff from upgradient areas. The selection of suitable areas to use as vegetation filters will be determined by the size of the contributing catchment, slope and ground conditions.

Vegetation filters will carry outflow from the level spreaders as overland sheet flow, removing any suspended solids and discharging to the groundwater system by diffuse infiltration.

Vegetation filters will not be used in isolation for waters that are likely to have higher silt loadings. In such cases, silt-bearing water will already have passed through stilling (settlement) ponds prior to diffuse discharge to the vegetation filters via a level spreader.

3.6.5.6 Stilling Ponds/Settlement Ponds

Stilling ponds will be used to attenuate runoff from works areas of the site during the construction phase, and will remain in place to attenuate runoff from roads and hardstanding areas of the proposed development during the operational phase. The purpose of the stilling ponds is to intercept runoff potentially laden with sediment and to reduce the amount of sediment leaving the disturbed area by reducing runoff velocity. Reducing runoff velocity will allow larger particles to settle out in the stilling ponds, before the run-off water is redistributed as diffuse sheet flow in filter strips downgradient of any works areas.

Stilling ponds will be excavated/constructed at each required location as two separate ponds in sequence, a primary pond and a secondary pond. The points at which water enters and exits the stilling ponds will be stabilised with rock aprons, which will trap sediment, dissipate the energy of the water flowing through the stilling pond system, and prevent erosion. The primary stilling pond will reduce the velocity of flows to less than 0.5 metres per second to allow settlement of silt to occur. Water will then pass from the primary pond to the secondary pond via another rock apron. The secondary stilling pond will reduce the velocity of flows to less than 0.3 metres per second. Water will flow out of the secondary stilling pond through a stone dam, partially wrapped in geo-textile membrane, which will control flow velocities and trap any sediment that has not settled out.

Water will flow by gravity through the stilling pond system. The stilling ponds will be sized according to the size of the area they will be receiving water from, but will be sufficiently large to accommodate peak flows storm events. The stilling ponds will be dimensioned so that the length to width ratio will be greater than 2:1, where the length is the distance between the inlet and the outlet. Where ground conditions allow, stilling ponds will be constructed in a wedge shape, with the inlet located at the narrow end of the wedge. Each stilling pond will be a minimum of 1-1.5 metres in depth. Deeper ponds will be used to minimise the excavation area needed for the required volume.

The embankment that forms the sloped sides of the stilling ponds will be stabilised with vegetated turves, which will have been removed during the excavation of the stilling ponds area. All material excavated during pond construction will be used locally for landscaping and berm construction around these ponds.

Stilling ponds will be located towards the end of swales, close to where the water will be reconverted to diffuse sheet flow. Upon exiting the stilling pond system, water will be immediately reconverted to diffuse flow via a fan-shaped rock apron if there is adequate space and ground conditions allow. Otherwise, a swale will be used to carry water exiting the stilling pond system to a level spreader to reconvert the flow to diffuse sheet flow.

A water level indicator such as a staff gauge will be installed in each stilling pond with marks to identify when sediment is at 10% of the stilling pond capacity. Sediment will be cleaned out of the still pond if it exceeds 10% of pond capacity. Stilling ponds will be inspected weekly and following rainfall events. Inlet and outlets will be checked for sediment accumulation and anything else that might interfere with flows.

3.6.5.7 Silt Bags

Dewatering silt bags allow the flow of water through them while trapping any silt or sediment suspended in the water. The silt bags provide a passive non-mechanical method of removing any remaining silt contained in the potentially silt-laden water collected from works areas within the site.

Dewatering silt bags are an additional drainage measure that can be used downgradient of the stilling ponds at the end of the drainage swale channels and will be located, wherever it is deemed appropriate, throughout the site. The water will flow, via a pipe, from the stilling ponds into the silt bag. The silt bag will allow the water to flow through the geotextile fabric and will trap any of the finer silt and sediment remaining in the water after it has gone through the previous drainage measures. The dewatering silt bags will ensure that there will be no loss of peaty silt into the stream.

The dewatering silt bag that will be used will be approximately 3 metres in width by 4.5 metres (see Plate 3.6 and Plate 3.7 below) in length and will be capable of trapping approximately four tonnes of silt. The dewatering silt bag, when full, will be removed from site by a waste contractor with the necessary waste collection permit, who will then transport the silt bag to an appropriate, fully licensed waste facility.

Plate 3.6 Silt Bag with water being pumped through

Plate 3.7 Silt bag under inspection

3.6.5.8 Silt Fences

Silt fences will be installed as an additional water protection measure around existing watercourses in certain locations, particularly where works are proposed within the 50-metre buffer zone of a stream.

Silt fences will be installed as single, double or a series of triple silt fences, depending on the space available and the anticipated sediment loading. The silt fence designs follow the technical guidance document *'Control of Water Pollution from Linear Construction Projects'* published by CIRIA (Ciria, No. C648, 1996). Up to three silt fences may be deployed in series.

The Stage 1 (Coarse) silt fence will consist of a geotextile fabric such as Terram 1000 attached by staples to fixed stakes. The Terram sheets will be folded in an L shape with one metre extending horizontally in towards the works area. This horizontal section will be buried at a distance of approximately 150mm beneath a clean stone surface. Terram 1000 is a permeable fabric through which water can pass, but through which sediment particles cannot. It does however, impede water flow and can lead to the backing up of water and sediment, which reduce its effectiveness.

The Stage 2 (Medium) silt fence will consist of straw bales, embedded approximately 100mm into the soil/ground and fixed in place with stakes. A geotextile fabric will be pegged and stapled to the straw bales and stakes.

The Stage 3 (Fine) silt fence will be similar to the Stage 1 fence, with the addition of a course sand and/or fine gravel at the base of the geotextile.

In the case of all three types of fence, the geotextile fabric will be embedded at least 150mm below the ground surface.

In a small number of locations around the proposed site where space between the works areas and watercourses may be limited, silt fence designs will be combined to increase their effectiveness. For example, a straw bale silt fence (Stage 2) may be double wrapped with geotextile fabric (Stage 1) and course sand/fine gravel added on the upgradient side (Stage 3). The most suitable type, number or combination of silt fences will be determined on a location specific basis for the various parts of the site. Although they may be indicated in the drainage designs shown in Appendix 3-1 to be just a single line, silt fences may be installed in series on the ground.

Site fences will be inspected regularly to ensure water is continuing to flow through the Terram, and the fence is not coming under strain from water backing up behind it.

3.6.6 Borrow Pit Drainage

The proposed borrow pit will extract sand and gravel deposits above the local groundwater table and therefore there is no potential to impact on local groundwater levels.

3.6.7 Cable Trench Drainage

Cable trenches are typically constructed in short controlled sections, thereby minimising the amount of ground disturbed at any one time, and minimising the potential for drainage runoff to pick up silt or suspended solids. Each short section of trench is excavated, ducting installed and bedded, and backfilled with the appropriate materials, before work on the next section commences. This operation normally occurs over a period of 2-4 hours.

To efficiently control drainage runoff from cable trench works areas, excavated material is stored on the up-gradient side of the trench and is temporarily sealed/smoothed over using the back of the excavator bucket. Should any rainfall cause runoff from the excavated material, the material is therefore collected and contained in the downgradient cable trench. Excess subsoil is removed from the cable trench works area immediately upon excavation, and in the case of the proposed development, would be transported to one of the on-site borrow pit storage areas or used for landscaping and reinstatements of other areas elsewhere on site.

3.6.8 Site and Drainage Management

3.6.8.1 Preparative Site Drainage Management

All materials and equipment necessary to implement the drainage measures outlined above, will be brought on-site in advance of any works commencing.

An adequate amount of straw bales, clean stone, terram, stakes, etc will be kept on site at all times to implement the drainage design measures as necessary. The drainage measures outlined in the above will be installed prior to, or at the same time as the works they are intended to drain.

3.6.8.2 Preemptive Site Drainage Management

The works programme for the groundworks part of the construction phase of the project will also take account of weather forecasts, and predicted rainfall in particular. Large excavations, large movements of overburden or large scale overburden or soil stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

3.6.8.3 Reactive Site Drainage Management

The final drainage design prepared for the proposed development prior to commencement of construction will have to provide for reactive management of drainage measures. The effectiveness of drainage measures designed to minimise runoff entering works areas and capture and treat silt-laden water from the works areas, will be monitored continuously by the environmental clerk of works or supervising hydrologist on-site. The environmental clerk of works or supervising hydrologist will respond to changing weather, ground or drainage conditions on the ground as the project proceeds, to ensure the effectiveness of the drainage design is maintained in so far as is possible. This may require the installation of additional check dams, interceptor drains or swales as deemed necessary on-site. The drainage design may have to be modified on the ground as necessary, and the modifications will draw on the various features outlined above in whatever combinations are deemed to be most appropriate to situation on the ground as a particular time.

In the event that works are giving rise to siltation of watercourses, the environmental clerk of works or supervising hydrologist will stop all works in the immediate area around where the siltation is evident. The source of the siltation will be identified and additional drainage measures such as those outlined above will be installed in advance of works recommencing.

3.6.9 Drainage Maintenance

An inspection and maintenance plan for the drainage system onsite will be prepared in advance of commencement of any works. Regular inspections of all installed drainage features will be necessary, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water at parts of the systems where it is not intended. The inspection of the drainage system will be the responsibility of the environmental clerk of works or the supervising hydrologist.

If necessary, any excess sediment build up behind check dams will be removed. For this reason, check dams will be inspected and maintained weekly during the construction phase of the project to insure adequate performance. Maintenance checks will also ensure the center elevation of the dam remains lower than the sides of the dam.

Check dams will also be inspected weekly during the construction phase of the project and following rainfall events to ensure the structure of the dam is still effective in controlling flow. Any scouring around the edges of the check dams or overtopping of the dam in normal flow conditions will be rectified by reinforcement of the check dam.

Drainage swales will be regularly inspected for evidence of erosion along the length of the swale. If any evidence of erosion is detected, additional check dams will be installed to limit the velocity of flow in the channel and reduce the likelihood of erosion occurring in the future.

A water level indicator such as a simple staff gauge or level marker will be installed in each silt trap with marks to identify when sediment is at 50% of the trap's capacity. Sediment will be cleaned out of the silt trap when it exceeds 50% of trap capacity. Silt traps will be inspected weekly during the construction phase of the project and following rainfall events. Inlet and outlets will be checked for sediment accumulation and anything else that might interfere with flows.

The frequency of drainage system inspections will be reduced following completion of the construction phase of the project. Weekly inspections during the construction phase will be reduced to monthly, bi-monthly and eventually quarterly inspections during the operational phase. The frequency will be increased or decreased depending on the effectiveness of the measures in place and the amount of remedial action required in any given period.

3.7 Construction Management

3.7.1 Construction Timing

It is estimated that the construction phase will take approximately 18 to 24 months from starting onsite to commissioning of the electrical system. The commencement of construction works where the removal of woody vegetation is required, or where works take place in sensitive breeding habitats (such as birch scrub and emergent wetland vegetation), will be scheduled to occur outside the bird nesting season (1st of March to 31st of August) to avoid any potentially significant effects on currently nesting birds. Construction may commence at any stage from September onwards to March, so that construction activities are ongoing by the time the next breeding bird season comes around, and can continue throughout the next breeding season.

3.7.2 Construction Sequencing

The construction phase can be broken down into three main phases, 1) civil engineering works: 12 months, 2) electrical works: 5 months, and 3) turbine erection and commissioning: 7 months. The main task items under each phase are outlined below.

Civil Engineering Works

- Install meteorological mast.
- Clear and hardcore area for temporary site offices. Install same.
- Construct new site roads and hard-standings and crane pads.
- Construct drainage ditches, culverts etc. integral to road construction.
- Construct two substation control buildings and groundworks for the substation compounds
- Excavate for turbine bases where required. Store soil/peat locally for backfilling and re-use. Place blinding concrete to turbine bases. Fix reinforcing steel and anchorage system for tower section. Construct shuttering. Fix any ducts etc. to be cast in. Pour concrete bases. Cure concrete. Remove shutters after 1-2 days.

Electrical Works

- Construct bases/plinths for transformer.
- Excavate trenches for site cables, lay cables and backfill. Provide ducts at road crossings.
- Erect external electrical equipment at substations
- Erect transformers at compound.
- Erect fencing at transformer compound.

Turbine Erection and Commissioning

- Erect towers, nacelles and blades.
- Backfill tower foundations and cover with suitable material.
- Complete electrical installation.
- Grid connection.
- Commission and test turbines.
- Complete site works, reinstate site.
- Remove temporary site offices. Provide any gates, landscaping, signs etc. which may be required.

The phasing and scheduling of the main construction task items are outlined in Figure 3.16 below, where 1st January 2019 has been selected as an arbitrary start date for construction activities.

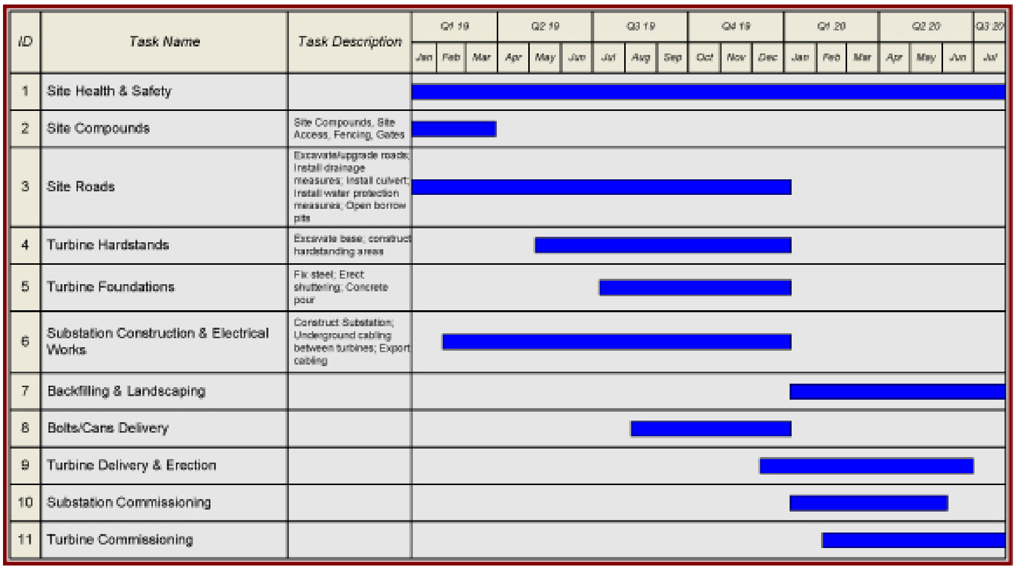


Figure 3.16 Indicative Construction Schedule

3.7.3 Construction Phase Monitoring and Oversight

The requirement for a Construction and Environmental Management Plan (CEMP) to be prepared in advance of any construction works commencing on any wind farm site and submitted for agreement to the Planning Authority is now well-established. The proposed procedures for the implementation of the mitigation measures outlined in such a CEMP and their effectiveness and completion is typically audited by way of a Construction and Environmental Management Plan Audit Report. The CEMP Audit Report effectively lists all mitigation measures prescribed in any of the planning documentation, all conditions attached to the grant of planning permission and any further mitigation measures proposed during the detailed design stage, and allows them to be audited on a systematic and regular basis. The first assessment is a simply Yes/No question, has the mitigation measure been employed on-site or not? Following confirmation that the mitigation measure has been implemented, the effectiveness of the mitigation measures has to be the subject of regular review and audit during the full construction stage of the project. If some remedial actions are needed to improve the effectiveness of the mitigation measure, then these are notified to the site staff immediately during the audit site visit, and in writing by way of the circulation of the audit report. Depending on the importance and urgency of rectifying the issue, the construction site manager is given a timeframe by when the remedial works need to be completed.

A Construction Environmental Management Plan (CEMP) has been prepared for the proposed development, and is included in Appendix 3-2 of this EIS. The CEMP includes details of drainage, peat and overburden management, waste management, and gives examples of how the above-mentioned Audit Report will function and be presented. It is intended that the CEMP would be updated prior to the commencement of the development, to include all mitigations measures, conditions and or alterations to the EIS and application documents that may emerge during the course of the planning process, and would be submitted to the Planning Authority for written approval.

The on-site construction staff will be responsible for implementing the mitigation measures specified in the EIS and compiled in the Audit Report. Their implementation will be overseen by supervising hydrogeologists, environmental scientists, ecologists or geotechnical engineers, depending on who is best placed to advise on the implementation. The system of auditing referred to above ensures that the mitigation measures are maintained for the duration of the construction phase, and into the operational phase where necessary. The Audit Reports are usually submitted to the Planning Authority as a condition of planning and will be proposed as part of the Environmental Management Plan and Audit System that that is typically proposed to and agreed with the Planning Authority in advance of construction works commencing.

3.8 Construction Methodologies

3.8.1 Turbine Foundations

Foundations for wind for wind turbines may be of the gravity, rock anchored and piled type. Trial pitting and/or windrow sampling has been carried out at each of the turbine base locations. Based on the geotechnical investigations to date the majority of the foundation at the proposed Cloncreen wind farm will be piled. Piling depths will depend on site conditions. These will be established by detailed post consent geotechnical investigations. The primary methodology that will be applied will be exploratory boreholes. Additional geotechnical investigations will be undertaken at each turbine location with associated sampling and laboratory testing. The exact dimensions of foundations will be determined by pre-construction structural design calculations incorporating appropriate factors of safety.

Each of the turbines to be erected on site will have a reinforced concrete base. Overburden will be stripped off the foundation area to a suitable formation using a 360° excavator, and will be placed across the site as close to the excavation as practical. A five-metre-wide working area will be required around each turbine base, with the sides of the excavated areas sloped sufficiently to ensure that slippage does not occur. Material excavated to create the working area will be stored locally for later reuse in backfilling the working area around the turbine foundation. The excavated material will be surrounded by silt fences to ensure sediment-laden run-off does not occur.

The formation material will have to be approved by an engineer as meeting the turbine manufacturer's requirements. In the case of gravity foundations, if the formation level is reached at a depth greater than the depth of the foundation, the ground level will have to be raised with clause 804 hardcore material and or lean mix concrete, compacted in 250 millimetres (mm) layers, with sufficient compacted effort (i.e. compacted with seven passes using 12 tonne roller). Drainage measures will be installed to protect the formation by forming an interceptor drain around the perimeter of the base which will outfall out at the lowest point level spreader or settlement pond. In the case of piled foundations the piling of typically 30-50 concrete piles to the required depth will be carried out. The piles will most likely be constructed by coring and inserting a steel sleeve which will be filled with reinforced concrete prior to sleeve removal. Where piling is carried out soil/peat will be excavated to a depth of up to 1m with a provision of a surrounding work area to allow placing of shuttering etc.

An embankment approximately 600 mm high will be constructed around the perimeter of each turbine base where required and a fence or berm will be erected to prevent construction traffic from driving into the excavated hole and to demarcate the working area. All necessary health and safety signage will be erected to warn of deep excavations etc. Access to and from excavated bases will be formed by excavating a pedestrian walkway to 1:12 grade.

There will be a minimum of 100 mm of blinding concrete laid on the formation material positioned using concrete skip and 360° excavator to protect ground formation and to give a safe working platform.

A 360° excavator with suitable approved lifting equipment will be used to unload reinforcing steel to required areas. The bottom matt of steel will be fixed prior to the tower cans, if used, being lifted into position. Steel cans, if used, will be lifted into position using a crane and approved lifting appliances and reinforcing steel will be positioned around cans in accordance with the turbine suppliers' requirements. The can will be levelled using the jacks at the base of the can. The top flange of the can will be checked to ensure it is level using a dumpy level. The remaining reinforcing steel will then be fixed and earthing material attached. The level of can will be checked again prior to the concrete pour and during the concrete pour.

Formwork to concrete bases will be propped/supported sufficiently so as to prevent failure. Concrete for bases will be poured using a concrete pump. After a period of time when the concrete has set sufficiently the top surface of the concrete surface is to be finished with a power float.

Once the base has sufficient curing time it will be filled with suitable fill up to existing ground level. The working area around the perimeter of the foundation will be backfilled with suitable material.

3.8.2 Site Roads and Crane Pad Areas

Site roads will be constructed to each turbine base and at each base a crane hard standing will be constructed to the turbine manufacturer's specifications. Tracked excavators will carry out excavation for roads with appropriate equipment attached. Material excavated to create the working area will be stored locally for later reuse in backfilling the working area around the turbine foundation. Any surplus excavated material will be spread as close to the excavation areas as practical as set out in the Peat Management Plan. A two to three-metre-wide working area will be required around each hard standing area, with the sides of the excavated areas sloped sufficiently to ensure that slippage does not occur.

When the formation layer has been reached, stone from the on-site borrow pit shall be placed to form the road foundation. In the event of large clay deposits being encountered in sections of road, a geotextile layer will be required at sub base level. The sub grade will be compacted with the use of a roller. The final wearing course will not be provided until all bases have been poured. This prevents damage to the wearing course due to stone and concrete trucks movements. The road will be upgraded prior to the arrival of the first turbine. All roads will be maintained for the duration of the project.

3.8.3 Grid Connection Cable Trench

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

- Option A: Construction of a 110 kV substation in the eastern section of the site. This substation will connect to the National Grid via an underground cable (approximately 1.7 kilometres in length) running from the substation to the existing 110 kV Cushaling substation at Edenderry Power Plant, located directly east of the proposed wind farm site. The proposed underground cable will be located on Bord na Móna lands and within the curtilage of the public road.

Or:

- Option B: Construction of a 110 kV substation in the southern section of the site. This substation will connect to the National Grid via a short section of overhead line (less than 0.1km) to the existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site.

Option A Construction Methodology

The underground cable required to facilitate grid connection will be laid beneath the surface of the site and/or public road using the following methodology:

- The area where excavations are planned will be surveyed, prior to the commencement of works, with a cable avoiding tool and all existing underground services will be identified.
- Two teams consisting of two tracked excavators, two dumpers and a tractor and stone cart with side-shoot will dig the trench for and lay approximately 300m of the underground cable ducting per day.
- Both teams will start approximately 150m apart with the team behind finishing at the starting point of the team ahead.

- The excavators will open a trench at the edge of the road surface, the trench will be a maximum of 600mm wide and 1,250mm deep.
- Clay plugs will be installed at 50m intervals to prevent the trench becoming a conduit for surface water runoff.
- Cable joint pits will be located at approximately 500m intervals, each joint pit will be approximately 2.6x8m in size and contain a communications chamber, an earth link box and a cable joint bay, all of which will be located in the road edge and accessible for cable pulling and future maintenance.
- The excavated material will be loaded into the dumpers to be transported to a designated temporary stockpiling area to be reused as backfilling material where appropriate.
- Once the trench has been excavated, a base layer of blinding will be installed by the tractor and cart and compacted by the excavators.
- The ducting along with marker strips will then be placed in the trench as per relevant specifications.
- Blinding will be installed to 75mm above the cable ducting and compacted.
- The remainder of the trench will be backfilled with granular material and compacted.
- The trench will be surfaced as per the road surface specifications of the national or local public road.

The typical cable trench details for the cable connection for Option A to Cushaling substation are shown on Plate 3.8 below.

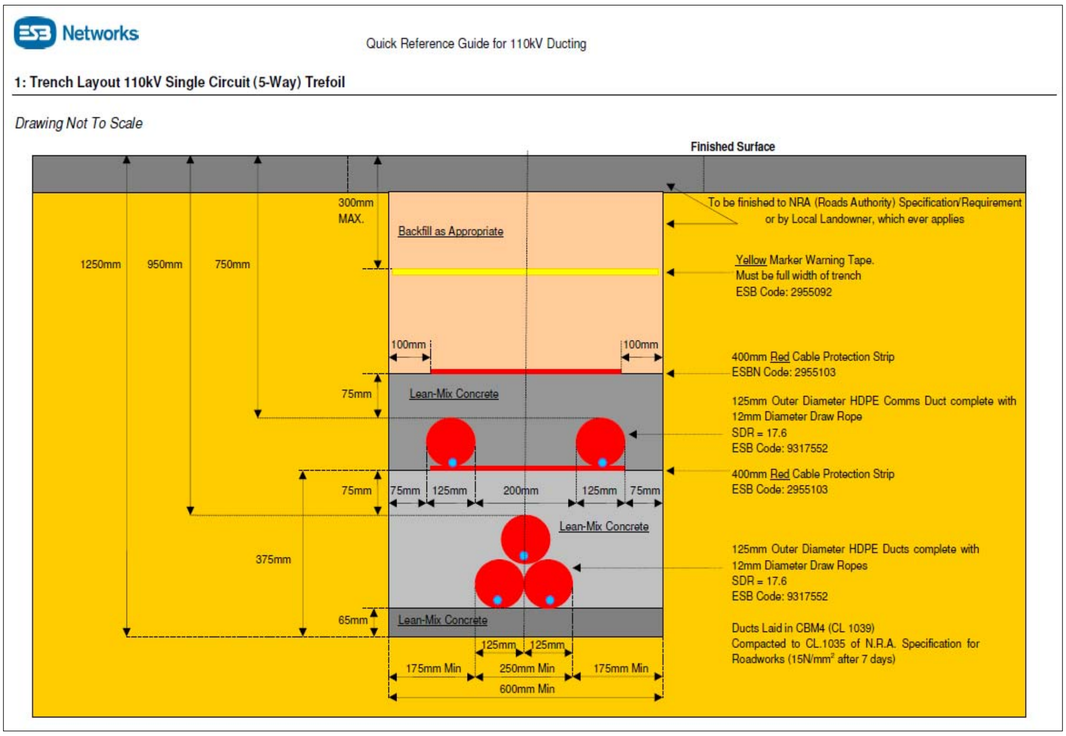


Plate 3.8: Trench layout 110kV Single Circuit

Option B Construction Methodology

The methodology for construction of the short section of overhead line will encompass the following:

- The existing 110kV overhead line will be modified to allow the line to turn into the new 110kV substation, this will involve the removal of one number double

pole set and the installation of two number turning angle masts and two number end masts within the substation area.
- Temporary access roads will be required from the substation road to the angle mast location to enable the delivery of stone and concrete required for the angle mast foundations.
- An outage of the existing Cushaling to Mountlucas overhead line will be sought and programed by Eirgrid's on the annual grid outage programme.
- The angle and end mast foundations will then be sheet piled, excavated, blinded, stoned up, prior to concrete shuttering and pouring of base and each angle mast leg.
- After completion of concrete pouring the ground surrounding the mast will be reinstated.
- After a sufficient concrete curing period the angle and end masts will be fully assembled on the ground before being lifted into place using a mobile crane.
- Crews will fix and bolt the masts in place and attach the lightning rod.
- Dead man stays will be installed to support the existing poleset's prior to the breaking overhead line at the location of the new anglemasts.
- The installation of 3no conductors and 2 no shield wires will then tie the existing overhead line into the new station at two points or bays.
- Bird diverters may also be installed on the new conductor as required.
- It is also common for a fiber optic cable which may wrapped around one of the conductors to be terminated into the new substation.

3.8.4 'Tea Centre' Demolition

There is a small single story building (c 8.5m x 8m) used by the peat production staff known as the 'tea centre' which will be demolished as it is located within the footprint of the proposed borrow pit. The demolition process will generally follow the sequencing shown on Table 3.7.

Table 3.7 Typical Demolition Sequencing

Demolition Sequence	General Description
Services Disconnection	Shut off ESB, Gas, drainage network etc.
Inventory of Hazardous Wastes	e.g. Grease & oils
Removal of furniture/Equipment	Plant & Equipment
Removal of hazardous materials	Drums of oil & grease
Removal of fixtures	Fixtures & fittings
Removal of timber	Floors, trusses, rafters
Demolition of Structures Shells	Manual or mechanical demolition
Removal of groundworks	Foundation, slabs and redundant drainage infrastructure.
Source segregation of material fractions	C&D waste recovery
Transport of materials to authorised facilities	Authorised Waste Collection Permit holders and Waste Facility or Licence holders

Prior to the commencement of any demolition at the site a full audit of waste material that will be generated will be carried out. A list of expected waste types that may be generated has been drawn up and the European Waste Catalogue Codes pertaining to each waste type is included in Table 3.8. The lists have been prepared following a visit to the proposed development site and inspection of the existing building.

Table 3.8 Expected waste types arising from the Demolition Phase

Materials type	Example	EWC Code
Cables	Electrical wiring	17 04 11
Concrete	Surfacing, flooring material	17 01 01
Glass	Windows	17 02 02
Metals	Steel roof coverings, window frames	17 04 07
Mixture of inert material	Sand, stones, plaster, rock	17 01 07
Plastic	PVC frames, electrical fittings	17 02 03
Soil & Stones	Overburden, soil, subsoil	17 05 04
Wood	Frames and doors,	17 02 01
Oils & Grease	Drums of oil & grease	13 01 11*

The majority of the waste generated by the demolition of the existing 'tea centre' will consist of concrete rubble and stones from the existing wall structure, floor and foundations. This material will be segregated from all other waste components and sent by an authorised waste collector to an authorised waste recovery facility. The remaining volume of waste material will not be large enough to warrant any further segregation therefore, all waste generated during the demolition of the building will be deposited into a single skip. This waste material will be transferred to a Materials Recovery Facility (MRF) by a fully licensed waste contractor where the waste will be sorted into individual waste streams for recycling, recovery or disposal. It is anticipated that this remaining material has no potential reuse in the construction phase of the proposed development.

3.8.5 Meterological Mast Disassembly

There is a 100m high meteorological mast on site which will be disassembled and removed from site as it will no longer be required due to the presence of the permanent meteorological mast on the western side of the site. The disassembly process will generally follow the sequencing shown on Table 3.9.

Table 3.9 Typical Dissasemply Sequencing

Demolition Sequence	General Description
Removal of Equipment	Equipment and monitors on the mast will be removed
Removal of hazardous materials	Electrical cabling, solar panels and other remaining electrical equipment
Removal of Mast Structure	Dissasemble Mast Structure
Removal of Groundworks	Ground anchors will either be dug up and removed or remain in situ
Source segregation of material fractions	C&D waste recovery
Transport of materials to authorised facilities	Authorised Waste Collection Permit holders and Waste Facility or Licence holders

3.8.6 Telecommunications Mast Disassembly

There is a 40m high telecommunications mast and associated radio equipment container on site which which will be disassembled and removed from site as it is located within the footprint of the proposed borrow pit. The disassembly process will generally follow the sequencing shown on Table 3.10.

Table 3.10 Typical Disassembly Sequencing

Disassembly Sequence	General Description
Services Disconnection	Shut off ESB.
Removal of Equipment	Plant & Equipment in the radio container removed
Removal of hazardous materials	Batteries & Printed Circuit Boards
Removal of antennae, dish's and aerials	Disconnect and remove each of the antennae, dish's and aerials
Removal of mast structure	Disassemble mast structure
Demolition of Structures Shells	Manual or mechanical demolition
Removal of groundworks	Foundation, slabs and redundant drainage infrastructure.
Source segregation of material fractions	C&D waste recovery
Transport of materials to authorised facilities	Authorised Waste Collection Permit holders and Waste Facility or Licence holders

3.9 Operation

The proposed wind farm development is expected to have a lifespan of approximately 25 - 30 years. During this period, on a day-to-day basis the wind turbines will operate automatically, responding by means of anemometry equipment and control systems to changes in wind speed and direction.

The wind turbines will be connected together and data relayed from the wind turbines to an off-site control centre. Each turbine will also be monitored off-site by the wind turbine supplier. The monitoring of turbine output, performance, wind speeds, and responses to any key alarms will be monitored at an off-site control centre 24-hours per day.

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

3.10 Decommissioning

The wind turbines proposed as part of the proposed development are expected to have a lifespan of approximately 30 years. Following the end of their useful life, the wind turbines may be replaced with a new set of machines, subject to planning permission being obtained, or the site may be decommissioned fully, with the exception of the electricity substation.

Upon decommission of the proposed wind farm, the wind turbines would be disassembled in reverse order to how they were erected. All above ground turbine components would be separated and removed off-site for recycling. Turbine foundations would remain in place underground and would be covered with earth and reseeded as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in significant environment nuisances such as noise, dust and/or vibration. Site roadways could be in use for other purposes other than the wind operation of the wind farm by the time the decommissioning of the project is to be considered, and therefore it may be more appropriate to leave the site roads in situ for future use. If it were to be confirmed that the roads were not required in the future for any other useful purpose, they could be removed.

The on-site electricity substations will not be removed at the end of the useful life of the wind farm project as they will form part of the national electricity network. By the time the decommissioning of the project is to be considered, the onsite substation will likely form an integral part of the local electricity network, with a number of supply connections and possibly some additional generation connection. Therefore, the substations will be retained as a permanent structure and will not be decommissioned.

4 HUMAN BEINGS

4.1 Introduction

This section of the Environmental Impact Statement (EIS) assesses the likely significant effects of the proposed development on human beings and has been completed in accordance with the guidance set out by the Environmental Protection Agency in *'Guidelines on Information to be contained in Environmental Impact Statements*' (EPA, 2000). Further information on the classification of effects used in this assessment is presented in Section 1.6.2 of this EIS.

One of the principle concerns in the development process is that people, as individuals or communities, should experience no diminution in their quality of life from the direct or indirect effects arising from the construction and operation of a development. Ultimately, all the effects of a development impinge on human beings, directly and indirectly, positively and negatively. The key issues examined in this section of the EIS include population, employment and economic activity, land-use, community facilities and services, tourism, health and safety, property values, shadow flicker and residential amenity.

4.2 Receiving Environment

4.2.1 Methodology

Information regarding human beings and general socio-economic data were sourced from the Central Statistics Office (CSO), the Offaly County Development Plan 2014 – 2020, Fáilte Ireland and any other literature pertinent to the area. The study included an examination of the population and employment characteristics of the area. This information was sourced from the most recent available census data (the Census of Ireland 2011; ahead of publication of the 2016 Census results), the Census of Agriculture 2010 and from the CSO website, www.cso.ie. Census information is divided into State, Provincial, County, Major Town and District Electoral Division (DED) level.

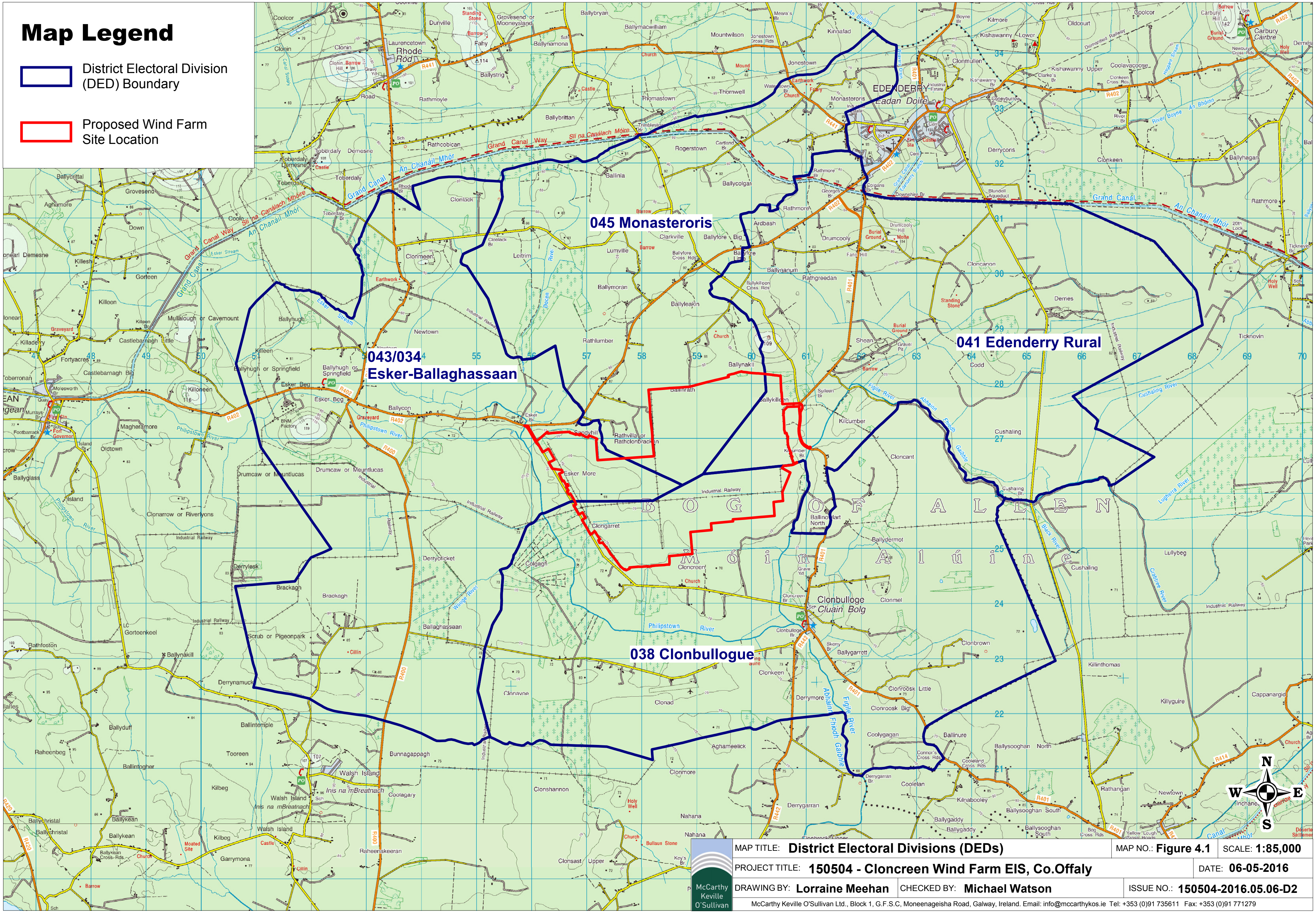
The site of the proposed development is located in the townlands of Cloncreen, Clongarret, Esker More, Rathvilla or Rathclonbracken, Ballinrath, Ballynakill, Ballykileen, Ballina, and Ballinagar, Co. Offaly. The site is located in eastern Co. Offaly, approximately 4.5 kilometres southwest of Edenderry. The villages of Clonbullogue and Rhode are located approximately 2.0 kilometres southeast and 7.0 kilometres northwest of the site, respectively.

In order to make inferences about the population and other statistics in the vicinity of the proposed development, the Study Area for the Human Beings section of this EIS was defined in terms of the District Electoral Divisions (DEDs). The site of the proposed development lies within the Monasteroris, Edenderry Rural, Clonbullogue and Esker/Ballaghassaan DEDs, as shown in Figure 4.1. The total combined DED area (Human Beings Study Area) has a population of 2,873 persons, and comprises of a total land area of 150.8 square kilometres. (Source: CSO Census of the Population 2011).

4.2.2 Population

4.2.2.1 Population Trends

In the four years between the 2006 and the 2011 Census, the population of Ireland increased by 8.2%. During this time, the population of Co. Offaly grew also by 8.2% to 76,687 persons. Other population statistics for the State, County and the Study Area



MAP TITLE: **District Electoral Divisions (DEDs)** | MAP NO.: **Figure 4.1** | SCALE: **1:85,000**

PROJECT TITLE: **150504 - Cloncreen Wind Farm EIS, Co.Offaly** | DATE: **06-05-2016**

DRAWING BY: **Lorraine Meehan** | CHECKED BY: **Michael Watson** | ISSUE NO.: **150504-2016.05.06-D2**

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(DEDs) have been obtained from the Central Statistics Office (CSO) and are presented in Table 4.1.

Table 4.1 Population 2006 – 2011 (Source: CSO)

Area	Population		% Population Change
	2006	2011	2006-2011
State	4,239,848	4,588,252	8.2%
Co. Offaly	70,868	76,687	8.2%
Study Area	2,504	2,873	14.7%

The data presented in Table 4.1 shows that the population of the Study Area increased by 14.7% between 2006 and 2011. This rate of population growth is higher than that recorded at State and County level from 2006 – 2011. When the population data is examined in closer detail, it shows that the rate of population change within the Study Area has been unevenly divided between the District Electoral Divisions (DEDs). The highest rate of population increase between 2006 and 2011 occurred within Monasteroris DED, which experienced a 23.1% population increase. In comparison, the population of Clonbullogue DED increased by just 5.1% during the same time period.

Of the four DEDs that make up the Study Area for this assessment (Human Beings Study Area), the highest population was recorded in Edenderry Rural DED, with 856 persons recorded during the 2011 Census, while Esker-Ballaghassaan DED had just 441 persons recorded during the 2011 Census.

4.2.2.2 Population Density

The population densities recorded within the State, Co. Offaly and the Study Area during the 2011 Census are shown in Table 4.2.

Table 4.2 Population Density in 2011 (Source: CSO)

Area	Population Density (Persons per square kilometre)
State	67.0
Co. Offaly	38.48
Study Area	19.05

The population density of the Study Area recorded during the 2011 Census was 19.05 persons per square kilometre. This figure is significantly lower than the national population density of 67 persons per square kilometre and the county population density of 38.48 persons per square kilometre.

Similar to the trends observed in population, the population density recorded across the Study Area varies between DEDs. Esker-Ballaghassaan DED has the lowest population density, at 10.48 persons per square kilometre, while Monasteroris DED has the highest population density, at 29.53 persons per square kilometre.

4.2.2.3 Household Statistics

The number of households and average household size recorded within the State, Co. Offaly and the Study Area during the 2006 and 2011 Censuses are shown in Table 4.3.

Table 4.3 Number of Households and Average Household Size 2002 – 2011 (Source: CSO)

Area	2006		2011	
	No. of Households	Avg. Size (persons)	No. of Households	Avg. Size (persons)
State	1,469,521	2.9	1,654,208	2.8
Co. Offaly	23,769	3.0	27,130	2.8
Study Area	359	3.1	405	2.9

In general, the figures in Table 4.3 show that while the number of households at State, County and Study Area level has continued to increase, the average number of people per household has decreased slightly, i.e. there are more households but less people per house. Average household size recorded within the Study Area during the 2006 and 2011 Censuses are in line with that observed at State and County level during the same time periods.

4.2.2.4 Age Structure

Table 4.4 presents the percentages of the State, Co. Offaly and Study Area population within different age groups as defined by the Central Statistics Office during the 2011 Census. This data is also displayed in Figure 4.2.

Table 4.4 Population per Age Category in 2011 (Source: CSO)

Area	Age Category				
	0 - 14	15 – 24	25 - 44	45 - 64	65 +
State	21.3%	12.6%	31.6%	22.7%	11.7%
Co. Offaly	23.4%	12.3%	29.6%	23.1%	11.6%
Study Area	24.4%	10.9%	28.6%	24.9%	11.1%

The proportion of the Study Area population within each age category is similar to those recorded at national and County level for most categories. Within the Study Area, the highest population percentage occurs within the 25-44 age category.

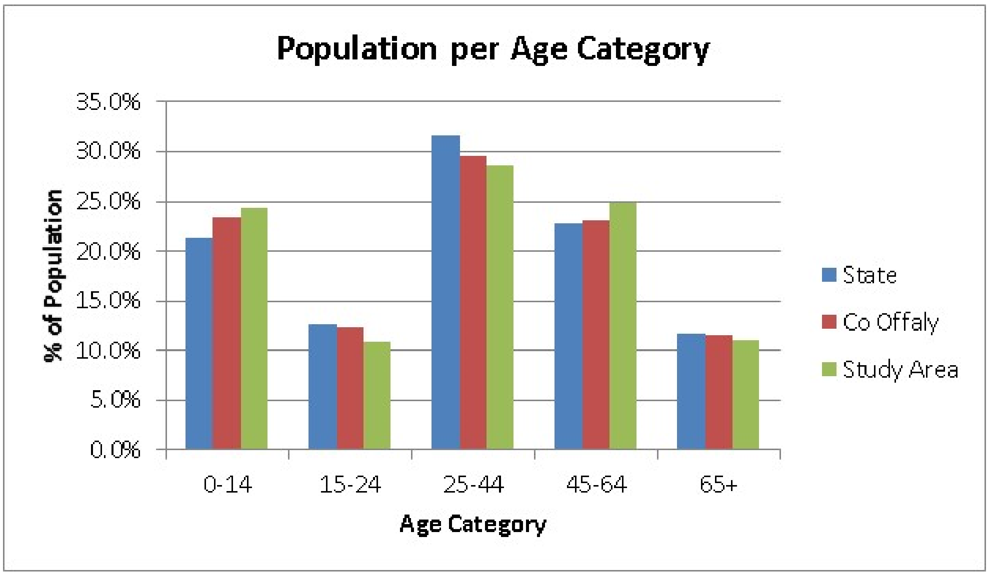


Figure 4.2 Population per Age Category in 2011 (Source: CSO)

4.2.3 Employment and Economic Activity

4.2.3.1 Economic Status of the Study Area

The labour force consists of those who are able to work, i.e. those who are aged 15+, out of full-time education and not performing duties that prevent them from working. In 2011, there were 2,232,203 persons in the labor force in Ireland. Table 4.5 shows the percentage of the total population aged 15+ who were in the labour force during the 2011 Census. This figure is further broken down into the percentages that were at work, seeking first time employment or unemployed. It also shows the percentage of the total population aged 15+ who were *not* in the labor force, i.e. those who were students, retired, unable to work or performing home duties.

Table 4.5 Economic Status of the Total Population Aged 15+ in 2011 (Source: CSO)

Status		State	Co. Offaly	Study Area
% of population aged 15+ who are in the labor force		**61.9%**	**61.0%**	**59.6%**
% of which are:	At work	81.0%	76.8%	80.1%
	First time job seeker	1.5%	1.7%	1.6%
	Unemployed	17.5%	21.5%	18.3%
% of population aged 15+ who are not in the labour force		**38.1%**	**39.0%**	**40.4%**
% of which are:	Student	29.7%	25.9%	23.5%
	Home duties	24.7%	28.9%	34.6%
	Retired	33.2%	31.8%	31.3%
	Unable to work	11.4%	12.8%	9.7%
	Other	1.0%	0.6%	0.9%

Overall, the principal economic status of those living in the Study Area is similar to that recorded at national and County level. The main difference is in the 'Home Duties' category which is higher than that at State and County level. Of those who were not in the labour force during the 2011 Census, the highest percentage of the Study Area population was in the 'Home duties' category, which is different to the figures recorded at national and County level that show 'retired' as the highest category.

4.2.3.2 Employment by Socio-Economic Group

Socio-economic grouping divides the population into categories depending on the level of skill or educational attainment required. The 'Higher Professional' category includes scientists, engineers, solicitors, town planners and psychologists. The 'Lower Professional' category includes teachers, lab technicians, nurses, journalists, actors and driving instructors. Skilled occupations are divided into manual skilled, such as bricklayers and building contractors; semi-skilled, e.g. roofers and gardeners; and unskilled, which includes construction labourers, refuse collectors and window cleaners. Figure 4.3 shows the percentages of those employed in each socio-economic group in the State, Co. Offaly and the Study Area during 2011.

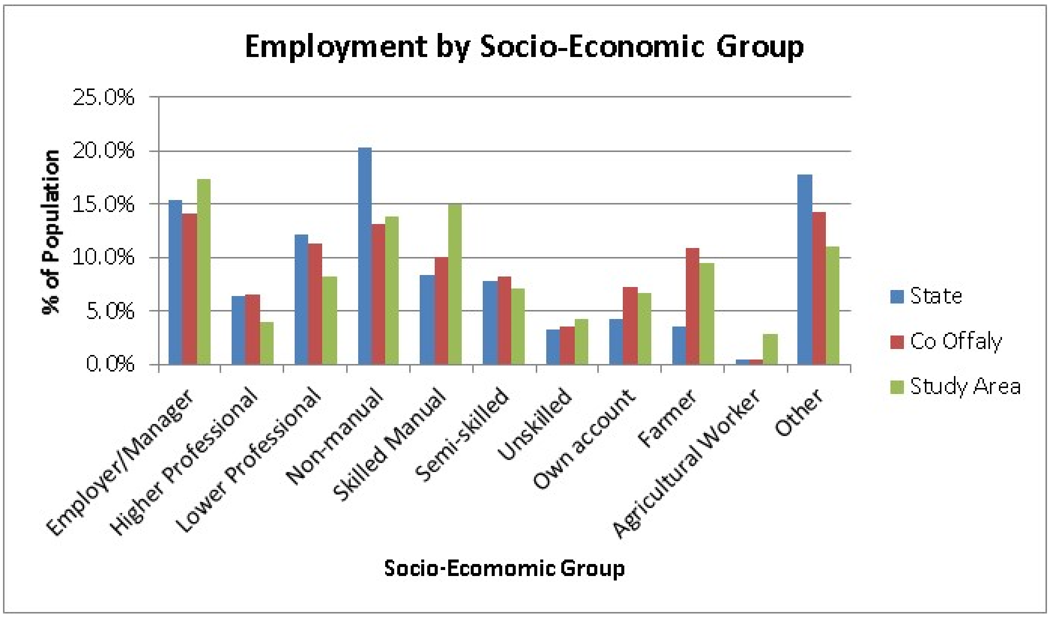


Figure 4.3 Employment by Socio-Economic Group in 2011 (Source: CSO)

The highest level of employment within the Study Area was recorded in the Employer/Manager category. Approximately 17.4% of those employed within the Study Area form part of this category, in comparison to 14.1% of the County population and 15.4% of the national population. After Employer/Manager, the next highest levels of employment within the Study Area are in the Skilled Manual and Non-manual categories. The categories in which the lowest percentage of the Study Area population was recorded are Agricultural Worker (2.9% of the Study Area population) and Higher Professional (3.9% of Study Area population).

The CSO figures for socio-economic grouping have a limitation of including the entire population, rather than just those who are in the labour force. It is likely that this is what gives rise to the high proportion of the population shown to be in the "Other" category in Figure 4.3.

4.2.3.3 The Value of Wind Energy to Ireland

4.2.3.3.1 Background

A report entitled *'The Value of Wind Energy to Ireland'* was commissioned by the Irish Wind Energy Association and published in March 2014 by Pőyry, an international consulting and engineering company. The study examines different future pathways for wind development in Ireland combining detailed market modelling by Pőyry with macroeconomic modelling by Cambridge Econometrics. It assesses the overall economic effect of planned wind development on energy prices and macroeconomic performance in Ireland.

4.2.3.3.2 Energy Targets

In 2007, the EU Department of Energy and Transport set a target of 16% for Ireland with regards to total energy consumption to come from renewable resources by 2020. Following this, the Irish Department of Environment, Heritage and Local Government increased the target for renewable energy's share of electricity consumption to 33%. This figure was further increased to 40% in late 2008, as part of the Government's strategy to make the green economy a core component of its recovery plan for Ireland. It is envisaged that wind energy will provide the largest source of renewable energy in achieving this target. Northern Ireland has adopted the same 40% renewables target for electricity and therefore significant growth in renewables across the Single Electricity Market (SEM) of the island of Ireland is expected ahead of 2020.

EU countries have also agreed on a new 2030 Framework for climate and energy, including EU-wide targets and policy objectives for the period between 2020 and 2030. These targets aim to help the EU achieve a more competitive, secure and sustainable energy system and to meet its long-term 2050 greenhouse gas reductions target. The specific targets include at least a 27% share of renewable energy consumption.

4.2.3.3.3 Employment Potential

As of September 2016, there were 3,083 Megawatts (MW) of wind energy capacity installed on the island in Ireland, the majority of this located in Counties Donegal, Cork and Kerry. Of the current installed wind power capacity, approximately 84 MW are installed in Co. Offaly, i.e. the Mountlucas wind farm.

The 2014 report by Pőyry states that meeting the 2020 renewables target will require the sustained installation of around 270 MW of new wind capacity annually. The associated annual investment of over €430 million would support 12,390 jobs during wind farm development and 920 jobs in the operation and maintenance sector by 2020. These figures translate to an estimated 5.74 direct jobs created per MW of wind capacity installed in the 'Domestic' scenario, i.e. delivering sufficient wind capacity to meet the Republic of Ireland and Northern Ireland renewables targets.

The report states that an increase in wind investment in the Republic of Ireland could create substantial benefits for associated industries, as well as increases in gross sector employment. Additional investment would lead to an increase in output and jobs in the planning and construction of new turbines, as well as permanent jobs in the operations and maintenance of these turbines.

4.2.3.4 Economic Value

Under the 'Domestic' scenario, as outlined above, the Irish wind energy industry has the potential to support €3.5 billion of direct investment, 1.2% of total Irish investment, and an additional €4.8 billion to 2030. Furthermore, Ireland currently has one of the highest energy import dependencies in Europe, importing 85% of its demand requirement. The development of indigenous wind generation reduces the reliance on fuel imports as electricity generated from fossil fuels are displaced from the merit order. Under the 'Domestic' scenario, the additional wind capacity deployed in this case would reduce reliance on imported energy sources with a 15% reduction in annual gas imports relative to a 'No Wind' development scenario in 2020 and 2030. The report states that this not only benefits security of supply but also creates a net transfer to the Irish economy, with the energy import bill falling by €282 million in 2020 and saving almost €671 million on expenditure on fuel imports per annum by 2030.

4.2.4 Land-use

The total area of farmland within the Study Area for the Human Beings assessment measures approximately 6,739 hectares or 44.7% of the Study Area, according to the CSO Census of Agriculture 2010. There are 177 farms located within the Study Area, with an average farm size of 38.1 hectares. This is slightly larger than the 36.5-hectare average farm size for Co. Offaly. Within the Study Area, farming employs 360 people, and the majority of farms are family-owned and run. Table 4.6 shows the breakdown of farmed lands within the wider DED Study Area used for this Section of the EIS. Pasture accounts for the largest proportion of farmland, followed by silage.

Table 4.6 Farm Size and Classification within the Study Area in 2010 (Source: CSO)

Characteristic	Value
Size of Study Area	15,080 hectares
Total Area Farmed within Study Area	6,739 hectares
Farmland as % of Study Area	44.7%
Breakdown of Farmed Land	Area (hectares)
Total Pasture	3,853 ha
Total Silage	1,711 ha
Grazing	192 ha
Total Hay	258 ha
Total Potatoes	1 ha
Total Cereals	568 ha
Total Crops	726 ha

4.2.5 Services

The proposed development site is located within the functional area of the Offaly County Development Plan 2014 - 2020. The nearest settlement to the proposed development site, is Clonbullogue, located on the R401 between Edenderry and Rathangan. The main services centre in the area is Edenderry, located approximately 4.5 kilometres northeast of the site.

4.2.5.1 Education

The primary schools located closest to the proposed development site are at Clonbullogue and Edenderry, located approximately 2.1 kilometres southeast and 5.1 kilometres northeast of the nearest proposed turbine locations, respectively. The secondary school located closest to the proposed development site is St. Mary's Secondary School, which lies approximately 5.4 kilometres northeast of the nearest proposed turbine location.

The third-level institution of Tallaght Institute of Technology is located approximately 46 kilometres east of the site.

4.2.5.2 Access and Public Transport

The proposed development site is accessed via the R402 and R401 Regional Roads and via local roads off the R401 and R402, which travel generally in north-south and northeast-southwest directions, east and northwest of the site respectively.

The site of the proposed development is not served by public transport. The nearest train station to the proposed development site is in Monasterevin, located approximately 14 kilometres south of the site. Also from Monasterevin, there are Bus Eireann connections to Dublin, Limerick and Cork, from which a most destinations may be reached.

4.2.5.3 Amenities and Community Facilities

Most of the amenities and community facilities, including GAA and other sports clubs, youth clubs and recreational areas, available in the area are located in Clonbullogue and the nearby settlements of Edenderry, Daingean and Rathangan. The church located closest to the proposed development site is in Clonbullogue.

There are a wide range of services available in the area. Retail and personal services are centered in Edenderry, and there are other shops and business located in

Clonbullogue, Daingean and Rathangan. Offaly County Council has a branch library at Edenderry.

The varied environment of this area of Co. Offaly provides many opportunities for walking and cycling. The Grand Canal Way walking route extends along some local roads and tracks in this part of the county. At its closest point, the route passes within 3.5 kilometres north of the subject site.

Mountlucas Wind Farm, located approximately four kilometres west of Cloncreen, features a seven-kilometre walkway/cycleway around the wind farm site, used for walking, cycling and running. It is generally accessible all year round, free of charge with onsite parking facilities. Free guided tours are also offered at Mountlucas by appointment. In 2015, there were approximately 13,500 visits to Mountlucas wind farm.

4.3 Tourism

4.3.1 Tourist Numbers and Revenue

Tourism is one of the major contributors to the national economy and is a significant source of full time and seasonal employment. During 2014 (the most recent period for which detailed figures are available), total tourism revenue generated in Ireland was approximately €6.6 billion, an increase of approximately 9.3% from the previous year. Overseas tourist visits to Ireland in 2014 grew by 6.2% to 7.1 million *('Tourism Facts 2014'*, Fáilte Ireland, September 2015).

Ireland is divided into seven tourism regions. Table 4.7 shows the total revenue and breakdown of overseas and domestic tourist numbers to each region in Ireland during 2014 (*'Tourism Facts 2014'*, Fáilte Ireland, September 2015).

Table 4.7 Overseas Tourists Revenue and Numbers 2014 (Source: Fáilte Ireland)

Region	Total Revenue (€m)	Total Number of Overseas Tourists (000s)
Dublin	€1,378.5 m	4,119
East & Midlands	€291 m	781
South-East	€205.6 m	870
South-West	€777.8 m	2,229
Shannon	€326.2 m	1,077
West	€434.4 m	1,442
North-West	€182.8 m	602
Total	€3,596.3 m	11,120

The East & Midlands region, in which the site of the proposed development is located, comprises Counties Kildare, Laois, Longford, Louth, Meath Wicklow, Westmeath and Offaly (east). This Region benefited from approximately 8.1% of the total number of overseas tourists to the country and approximately 7% of the total tourism income generated in Ireland in 2014.

Table 4.8 shows the breakdown of overseas tourist numbers to the East & Midlands Region during 2014 (the most recent regional data available) and the associated revenue generated. The regional data shows that Co. Wicklow had the highest tourism revenue and the highest number of overseas tourists within the Region during 2014. (Source: *'Regional Tourism Performance in 2014'*, Fáilte Ireland, 2016)

Table 4.8 Overseas Tourism to East & Midlands Region during 2014 (Source: Fáilte Ireland)

County	Revenue Generated by Overseas Tourists (€m)	No. of Overseas Tourists (000s)
Kildare	70	183
Laois	19	53
Longford	7	22
Louth	39	101
Meath	38	115
Wicklow	75	212
Offaly (east)	11	28
Westmeath	32	96

4.3.2 Tourist Attractions

The Grand Canal Way is a walking route running alongside the Grand Canal generally in an east-west direction from Dublin to Shannon Harbour, passing within 3.5 kilometres of the northern boundary of the proposed development site. Other tourist attractions located close to the proposed development site are the Grand Canal Adventure centre and the Irish Parachute Club, located approximately 9.5 kilometres west and 2.7 kilometres south of the nearest proposed turbine location respectively. The Grand Canal Adventure centre provides outdoor activities including kayaking, water zorbing, cycling and fishing.

4.3.3 Tourist Attitudes to Wind Farms

4.3.3.1 Fáilte Ireland Surveys

In 2007, Fáilte Ireland in association with the Northern Ireland Tourist Board carried out a survey of domestic and overseas holidaymakers to Ireland in order to determine their attitudes to wind farms. The purpose of the survey was to assess whether or not the development of wind farms impacts on the enjoyment of the Irish scenery by holidaymakers. The results of the survey were presented in the Fáilte Ireland Newsletter 2008/No.3 entitled *'Visitor Attitudes on the Environment: Wind Farms'*.

An updated survey was carried out by Millward Browne Landsdowne on behalf of Fáilte Ireland in 2012, in order to determine if the construction of wind farms in Ireland during the intervening period between 2007 and 2012 had resulted in any significant change in visitor attitudes. The results of the updated survey were presented in Fáilte Ireland Newsletter 2012/01: *'Visitor Attitudes on the Environment: Wind Farms'*. The 2012 surveys were undertaken with holidaymakers at various tourist offices and visitor attractions around the country, and a similar size and mix of domestic and overseas visitors was included. The 2012 survey was carried out in the Republic of Ireland only, therefore for accurate comparison the Northern Ireland data was stripped out of the 2007 survey results.

The main findings of the 2012 survey include:

- The 2012 research indicated an increase in the polarisation of opinion:
    - In 2007, the majority of visitors felt that wind farms had either no impact (49%) or a positive impact on the landscape (32%), whilst 17% felt it had a negative impact.
    - The 2012 research indicated increased positive (47%) and negative (30%) reactions, and less neutral responses (23%). The report does however point out *"It is notable that those interviewed who did not see*

a wind farm during their trip held more negative perceptions on wind farms to those that did".

- There has been an increase in the number of visitors who have seen at least one wind farm on their holiday, accompanied by a slight increase (from 45% in 2007 to 48% in 2012) in the number of visitors who felt that this had no impact on their sight-seeing experience. However, fewer now say they have a positive impact (down to 32% from 40%) and there is a slight increase in negative perceptions (from 15% in 2007 to 21% in 2012).

- As in 2007, the type of landscape in which a wind farm is sited can have a significant impact on attitudes. A greater relative negativity was expressed about potential wind farms on coastal landscapes (40%), followed by fertile farmland (37%) and mountain moorland (35%). Less than one in four were negatively disposed to the construction of wind farms on bogland (24%) or urban industrial land (21%).

- In 2012, 71% of visitors claimed 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. There was a slight increase from 21% to 24% in those who said it would impact negatively on their likelihood to visit again. Again however, the report notes:

  "Interestingly those who have not seen a wind farm on this visit have more negative opinions regarding the theoretical impact of a wind farm on their sightseeing compared to those who have actually seen one. This suggests there are some negative associations with wind farms that in reality do not materialise for those who have seen them."

Overall, the survey notes that given the scenario where more wind farms are to built in Ireland in the future, the most widely held view by survey respondents is that this will not impact on their likelihood to visit the area again, with a slightly greater majority saying that this would have a positive rather than a negative effect. Compared to 2007, the proportion citing a positive impact has declined (32% in 2012 compared to 40% in 2007) in favour of those who feel it would have no impact.

Further details regarding the general public perception of wind energy, including those living in the vicinity of a wind farm, are presented in Section 4.4 below.

4.3.3.2 Scottish Tourism Survey 2016

BiGGAR Economics undertook a study, entitled *'Wind Farms and Tourism Trends in Scotland'*, to understand the relationship, if any, that exists between the development of onshore wind energy and the sustainable tourism sector in Scotland. In recent years the onshore wind sector and sustainable tourism sector have grown significantly in Scotland. However, it could be argued that if there was any relationship between the growth of onshore wind energy and tourism, it would be at a more local level. This study therefore considered the evidence at a local authority level and in the immediate vicinity of constructed wind farms.

Eight local authorities had seen a faster increase in wind energy deployment than the Scottish average. Of these, five also saw a larger increase in sustainable tourism employment than the Scottish average, while only three saw less growth than the Scottish average. The analysis presented in this report shows that, at the Local Authority level, the development of onshore wind energy does not have a detrimental impact on the tourism sector. This found that in the majority of cases (66%) sustainable tourism employment performed better in areas surrounding wind farms than in the wider local authority area. There was no pattern emerging that would suggest that onshore wind farm development has had a detrimental impact on the tourism sector, even at the very local level.

Overall, the conclusion of this study is that published national statistics on employment in sustainable tourism demonstrate that there is no relationship between the development of onshore wind farms and tourism employment at the level of the Scottish economy, at local authority level, nor in the areas immediately surrounding wind farm development.

4.4 Public Perception of Wind Energy

4.4.1 Scotland and Ireland Survey

4.4.1.1 Background

A survey of the public perception of wind power in Scotland and Ireland was carried out in 2003/2004 by researchers at the School of Geography & Geosciences, University of St. Andrews, Fife and The Macaulay Institute, Aberdeen *('Green on Green: Public Perceptions of Wind Power in Scotland and Ireland'*, Journal of Environmental Planning and Management, November 2005). The aims of the study were to ascertain the extent to which people support or oppose wind power, to investigate the reasons for these attitudes and to establish how public attitudes relate to factors such as personal experience of operational wind farms and their proximity to them.

4.4.1.2 Study Area

Surveys were carried out at two localities in the Scottish Borders region, one surrounding an existing wind farm and one around a site at which a wind farm had received planning permission but had not yet been built. Surveys were also carried out in Ireland, at two sites in Counties Cork and Kerry, each of which has two wind farms in close proximity.

4.4.1.3 Findings

The survey of public attitudes at both the Scottish and Irish study sites concluded that large majorities of people are strongly in favour of their local wind farm, their personal experience having engendered positive attitudes. Attitudes towards the concept of wind energy were described as *"overwhelmingly positive"* at both study sites in Scotland, while the Irish survey results showed almost full support for renewable energy and 92% support for the development of wind energy in Ireland.

The results of the survey were found to agree with the findings of previous research, which show that positive attitudes to wind power increase through time and with proximity to wind farms. With regards to the NIMBY effect, the report states that where NIMBY-ism does occur, it is much more pronounced in relation to proposed than actual wind farms. The Scottish survey found that while positive attitudes towards wind power were observed among those living in proximity to both the proposed and existing wind farm sites, people around the proposed site were less convinced than those living in proximity to the existing site. Retrospective questioning regarding pre- and post-construction attitudes at the existing site found that attitudes remained unchanged for 65% of respondents. Of the 24% of people who altered their attitudes following experience of the wind farm, all but one became more positive. The report states:

> *"These results support earlier work which has found that opposition to wind farms arises in part from exaggerated perceptions of likely impact, and that the experience of living near a wind farm frequently dispels these fears. Prior to construction, locals typically expect the landscape impacts to be negative, whereas, once in operation, may people regard them as an attractive addition."*

The reasons that people gave for their positive attitude to the local wind farm were predominantly of a global kind, i.e. environmental protection and the promotion of renewable energy, together with opposition to a reliance on fossil fuels and nuclear power. Problems that are often cited as negative impacts of wind farms, such as interference with telecommunications and shadow flicker were not mentioned at either site. With regards to those who changed to a more positive attitude following construction of the wind farm, the reasons given were that the wind farm is *"not unattractive (62%), that there was no noise (15%), that community funding had been forthcoming (15%) and that it could be a tourist attraction (8%)"*.

The findings of the Irish survey reinforce those obtained at the Scottish sites with regards to the increase in positive attitudes to wind power through time and proximity to wind farms. The survey of public attitudes at the sites in Cork and Kerry found that the highest levels of support for wind power were recorded in the innermost study zone (0 – 5 kilometres from a point in between the pair of wind farms). The data also suggests that *"those who see the wind farms most often are most accepting of the visual impact"*. The report also states that a previous Irish survey found that most of those with direct experience of wind farms do not consider that they have had any adverse impact on the scenic beauty of the area, or on wildlife, tourism or property values. Overall, the study data reveals *"a clear pattern of public attitudes becoming significantly more positive following personal experience of operational wind farms"*.

With regards to wind farm size, the report notes that it is evident from this and previous research that wind farms with small numbers of large turbines are generally preferred to those with large numbers of smaller turbines.

4.4.1.4 Conclusions

The overall conclusions drawn from the survey findings and from the authors' review of previous studies show that local people become more favourable towards wind farms after construction, that the degree of acceptance increases with proximity to them, and that the NIMBY syndrome does not adequately explain variations in public attitudes due to the degree of subjectivity involved.

4.4.2 Sustainable Energy Ireland Survey

4.4.2.1 Background

The results of a national survey entitled *'Attitudes Towards the Development of Wind Farms in Ireland'* were published by the Sustainable Energy Authority of Ireland (SEAI) in 2003. A catchment area survey was also carried out by SEAI (formerly SEI) in order to focus specifically on people living with a wind farm in their locality or in areas where wind farms are planned.

4.4.2.2 Findings

The SEAI survey found that the overall attitude to wind farms is very positive, with 84% of respondents rating it positively or very positively. One percent rates it negatively and 14% had no opinion either way. Approximately two thirds of respondents (67%) were found to be positively disposed to having a wind farm in their locality. Where negative attitudes were voiced towards wind farms, the visual impact of the turbines on the landscape was the strongest influence. The report also notes however that the findings obtained within wind farm catchment areas showed that impact on the landscape is not a major concern for those living near an existing wind farm.

With regards to the economic and environmental effects of wind farm development, the national survey reveals that attitudes towards wind energy are influenced by a perception that wind is an attractive source of energy:

> *"Over 8 in 10 recognise wind as a non-polluting source of energy, while a similar number believe it can make a significant contribution to Ireland's energy requirements."*

The study reveals uncertainty among respondents with regards to the issues of noise levels, local benefits and the reliability or otherwise of wind power as an energy source. It goes on to state however that the finding that people who have seen wind farms rate these economic and environmental factors more favourably is a further indication that some experience of the structures tends to translate into positive attitudes towards wind energy.

Similar to the national survey, the surveys of those living within the vicinity of a wind farm also found that the findings are generally positive towards wind farms. Perceptions of the impact of the development on the locality were generally positive, with some three-quarters of interviewees believing it had impacted positively.

In areas where a wind farm development had been granted planning permission but was not yet under construction, three quarters of the interviewees expressed themselves in favour of the wind farm being built in their area. Four per cent were against the development. The reasons cited by those who expressed themselves in favour of the wind farm included the fact that wind energy is clean (78%), it would provide local jobs (44%), it would help develop the area (32%) and that it would add to the landscape (13%). Those with direct experience of a wind farm in the locality are generally impressed with it as an additional feature in the landscape. The report states:

> *"It is particularly encouraging that those with experience of wind turbines are most favourable to their development and that wind farms are not solely seen as good in theory, but are also seen as beneficial when they are actually built."*

Few of those living in proximity either to an existing wind farm or one for which permission has been granted believe that the development damages the locality, either in terms of damage to tourism potential or to wildlife. The survey found that there is a clear preference for larger turbines in smaller numbers over smaller turbines in larger numbers.

4.4.2.3 Conclusions

The main findings of the SEAI survey indicate that the overall attitude to wind farms is *"almost entirely positive"*. The study highlights that two-thirds of Irish adults are either very favourable or fairly favourable to having a wind farm built in their locality, with little evidence of a "Not In My Back Yard" (NIMBY) effect. The final section of the report states:

> *"The overwhelming indication from this study is that wind energy enjoys great support and, more specifically, that the development of wind farms is supported and welcomed. The single most powerful indicator of this is to be found among those living in proximity to an existing wind farm: over 60% would*

be in favour of a second wind farm or an extension of the existing one. This represents a strong vote in favour of wind farm developments — especially important since it is voiced by those who know from direct experience about the impact of such developments on their communities."

4.4.3 Local Consultation

As part of the public consultation undertaken during the design of the proposed development, a range of activities were undertaken including, public information evening, all occupied dwellings within two kilometres of the site were visited by representatives of Bord na Móna, public forum clinic, community engagement forum as well as the Mount Lucas Newsletter containing updates on the Cloncreen wind farm project.

Further details on the public consultation exercise are presented in Section 2.9.4 of this EIS.

4.5 Health Effects of Wind Farms

4.5.1 Health Effect Studies

While there are anecdotal reports of negative health effects on people who live very close to wind turbines, peer-reviewed research has generally not supported these statements. There is currently no published credible scientific evidence to positively link wind turbines with adverse health effects. The main publications supporting the view that there is no evidence of any direct link between wind turbines and health are summarised below.

1. ***'Wind Turbine Syndrome - An independent review of the state of knowledge about the alleged health condition'*, Expert Panel on behalf of Renewable UK, July 2010**

This report consists of three reviews carried out by independent experts to update and understand the available knowledge of the science relating to infrasound generated by wind turbines. This report was prepared following the publication of a book entitled *'Wind Turbine Syndrome'*, in 2009 by Dr. Pierpont, which received significant media attention at the time. The report discusses the methodology and assessment carried out in the 2009 publication and also assessed the impact of low-frequency noise from wind turbines on humans. The independent review found that:

- *"The scientific and epidemiological methodology and conclusions drawn (in the 2009 book) are fundamentally flawed;*
- *The scientific and audiological assumptions presented by Dr Pierpont relating infrasound to WTD are wrong; and*
- *Noise from Wind Turbines cannot contribute to the symptoms reported by Dr. Pierpoint's respondents by the mechanisms proposed."*

Accordingly, the consistent and scientifically robust conclusion remains that there is no evidence to demonstrate any significant health effects arising in humans arising from noise at the levels of that generated by wind turbines.

2. ***'Wind Turbine Sound and Health Effects - An Expert Panel Review'*, American Wind Energy Association and Canadian Wind Energy Association, December, 2009**

This expert panel undertook extensive review, analysis and discussion of the large body of peer-reviewed literature on sound and health effects in general, and on sound produced by wind turbines in particular. The panel assessed the plausible biological effects of exposure to wind turbine sound. Following review, analysis, and discussion of current knowledge, the panel reached consensus on the following conclusions:

- "*There is no evidence that the audible or sub-audible sounds emitted by wind turbines have any direct adverse physiological effects.*
- *The ground-borne vibrations from wind turbines are too weak to be detected by, or to affect, humans.*
- *The sounds emitted by wind turbines are not unique. There is no reason to believe, based on the levels and frequencies of the sounds and the panel's experience with sound exposures in occupational settings, that the sounds from wind turbines could plausibly have direct adverse health consequences*."

The report found, amongst other things, that:

- *"Wind Turbine Syndrome" symptoms are the same as those seen in the general population due to stresses of daily life. They include headaches, insomnia, anxiety, dizziness, etc.*
- *Low frequency and very low-frequency 'infrasound' produced by wind turbines are the same as those produced by vehicular traffic and home appliances, even by the beating of people's hearts. Such 'infrasounds' are not special and convey no risk factors;*
- *The power of suggestion, as conveyed by news media coverage of perceived 'wind-turbine sickness', might have triggered 'anticipatory fear' in those close to turbine installations."*

3. ***'A Rapid Review of the Evidence'*, Australian Government National Health and Medical Research Council (NHMRC) Wind Turbines & Health, July 2010**

The purpose of this paper was to review evidence from current literature on the issue of wind turbines and potential impacts on human health and, in particular, to validate the finding of the *'Wind Turbine Sound and Health Effects - An Expert Panel Review'* (see Item 2 above) that:

- *"There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*
- *There is currently no published scientific evidence to positively link wind turbines with adverse health effects.*
- *'This review of the available evidence, including journal articles, surveys, literature reviews and government reports, supports the statement that: There are no direct pathological effects from wind farms and that any potential impact on humans can be minimised by following existing planning guidelines."*

4. ***'Position Statement on Health and Wind Turbines'*, Climate and Health Alliance, (February 2012)**

The Climate and Health Alliance (CAHA) was established in August 2010 and is a coalition of health care stakeholders who wish to see the threat to human health from climate change and ecological degradation addressed through prompt policy action. In its Position Statement in February 2012, CAHA states that:

> *"To date, there is no credible peer reviewed scientific evidence that demonstrates a direct causal link between wind turbines and adverse health impacts in people living in proximity to them. There is no evidence for any adverse health effects from wind turbine shadow flicker or electromagnetic frequency. There is no evidence in the peer reviewed published scientific literature that suggests that there are any adverse health effects from infrasound (a component of low frequency sound) at the low levels that may be emitted by wind turbines."*

The Position Statement explores human perceptions of wind energy and notes that some people may be predisposed to some form of negative perception that itself may cause annoyance. It states that:

> *"Fear and anxious anticipation of potential negative impacts of wind farms can also contribute to stress responses, and result in physical and psychological stress symptoms... Local concerns about wind farms can be related to perceived threats from changes to their place and can be considered a form of "place-protection action", recognised in psychological research about the importance of place and people's sense of identity."*

CAHA notes the existence of "*misinformation about wind power*" and, in particular, states that:

> *"Some of the anxiety and concern in the community stems originally from a self-published book by an anti-wind farm activist in the United States which invented a syndrome, the so-called "wind turbine syndrome". This is not a recognised medical syndrome in any international index of disease, nor has this publication been subjected to peer review."*

CAHA notes that:

> *"Large scale commercial wind farms however have been in operation internationally for many decades, often in close proximity to thousands of people, and there has been no evidence of any significant rise in disease rates."*

This, it states, is in contrast to the health impacts of fossil fuel energy generation.

5. '*Wind Turbine Health Impact Study -Report of Independent Expert Panel'* – Massachusetts Departments of Environmental Protection and Public Health (2012)

An expert panel was established with the objective to, *inter alia*, evaluate information from peer-reviewed scientific studies, other reports, popular media and public comments and to assess the magnitude and frequency of any potential impacts and risks to human health associated with the design and operation of wind energy turbines. In its final report, the expert panel set out its conclusions under a number of headings, including noise and shadow flicker.

In relation to noise, the panel concluded that there was limited or no evidence to indicate any causal link between noise from wind turbines and health effects, including the following conclusions:

- *"There is no evidence for a set of health effects, from exposure to wind turbines that could be characterized as a "Wind Turbine Syndrome."*
- *The strongest epidemiological study suggests that there is not an association between noise from wind turbines and measures of psychological distress or mental health problems. There were two smaller, weaker, studies: one did note an association, one did not. Therefore, we conclude the weight of the evidence suggests no association between noise from wind turbines and measures of psychological distress or mental health problems.*
- *None of the limited epidemiological evidence reviewed suggests an association between noise from wind turbines and pain and stiffness, diabetes, high blood pressure, tinnitus, hearing impairment, cardiovascular disease, and headache/migraine."*

In relation to shadow flicker, the expert panel found the following:

- *"Scientific evidence suggests that shadow flicker does not pose a risk for eliciting seizures as a result of photic stimulation.*
- *There is limited scientific evidence of an association between annoyance from prolonged shadow flicker (exceeding 30 minutes per day) and potential transitory cognitive and physical health effects."*

6. **Wind Turbines and Health, A Critical Review of the Scientific Literature Massachusetts Inistute of Technology (Journal of Occupational and Environmental Medicine Vol. 56, Number 11, November 2014)**

This review assessed the peer-reviewed literature regarding evaluations of potential health effects among people living in the vicinity of wind turbines. The review posed a number of questions around the effect of turbines on human health, with the aim of determining if stress, annoyance or sleep disturbance occur as a result of living in proximity to wind turbines, and whether specific aspects of wind turbine noise have unique potential health effects. The review concluded the following with regard to the above questions:

- Measurements of low-frequency sound, infrasound, tonal sound emission, and amplitude-modulated sound show that infrasound is emitted by wind turbines. The levels of infrasound at customary distances to homes are typically well below audibility thresholds.
- No cohort or case–control studies were located in this updated review of the peer-reviewed literature. Nevertheless, among the cross-sectional studies of better quality, no clear or consistent association is seen between wind turbine noise and any reported disease or other indicator of harm to human health.
- Components of wind turbine sound, including infrasound and low frequency sound, have not been shown to present unique health risks to people living near wind turbines.
- Annoyance associated with living near wind turbines is a complex phenomenon related to personal factors. Noise from turbines plays a minor role in comparison with other factors in leading people to report annoyance in the context of wind turbines.

A further 25 reviews of the scientific evidence that universally conclude that exposure to wind farms and the sound emanating from wind farms does not trigger adverse health effects, was compiled in September 2015 by Professor Simon Chapman, of the School of Public Health and Sydney University Medical School, Australia, and is included as Appendix 4-1 of this EIS.

4.5.2 Turbine Safety

Turbines pose no threat to the health and safety of the general public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s *'Wind Energy Development Guidelines for Planning Authorities 2006'* state that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations. People or animals can safely walk up to the base of the turbines.

The DoEHLG Guidelines state that there is a very remote possibility of injury to people from flying fragments of ice or from a damaged blade. However, most blades are composite structures with no bolts or separate components and the danger is therefore minimised. The buildup of ice on turbines is unlikely to present problems. The wind turbines will be fitted with anti-vibration sensors, which will detect any imbalance caused by icing of the blades. The sensors will cause the turbine to wait until the blades have been de-iced prior to beginning operation.

Turbine blades are manufactured of glass reinforced plastic which will prevent any likelihood of an increase in lightning strikes within the site of the proposed development or the local area. Lightning protection conduits will be integral to the construction of the turbines. Lightning conduction cables, encased in protection conduits, will follow the electrical cable run, from the nacelle to the base of the turbine. The conduction cables will be earthed adjacent to the turbine base. The earthing system will be installed during the construction of the turbine foundations.

4.5.3 Electromagnetic Interference

The provision of underground electric cables of the capacity proposed is common practice throughout the country and installation to the required specification does not give rise to any specific health concerns.

The extremely low frequency (ELF) electric and magnetic fields (EMF) associated with the operation of the proposed cables fully comply with the international guidelines for ELF-EMF set by the International Commission on Non-Ionizing Radiation Protection (ICNIRP), a formal advisory agency to the World Health Organisation, as well as the EU guidelines for human exposure to EMF. Accordingly, there will be no operational impact on properties (residential or other uses) as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables.

The EirGrid document '*EMF & You: Information about Electric & Magnetic Fields and the electricity transmission system in Ireland'* (EirGrid, 2014) provides further practical information on EMF and is included as Appendix 4-2 of this EIS.

Further details on the potential impacts of electromagnetic interefence to telecommunications and aviation are presented in Section 13.2 of this EIS.

4.6 Property Values

The largest study of the impact of wind farms on property values has been carried out in the United States. *'The Impact of Wind Power Projects on Residential Property*

Values in the United States: A multi-Site Hedonic Analysis', December 2009, was carried out by the Lawrence Berkley National Laboratory (LBNL) for the U.S Department of Energy. This study collected data on almost 7,500 sales of single family homes situated within ten miles of 24 existing wind farms in nine different American states over a period of approximately ten years. The conclusions of the study are drawn from eight different pricing models including repeat sales and volume sales models. Each of the homes included in the study was visited to demonstrate the degree to which the wind facility was visible at the time of the sale, and the conclusions of the report state that *"The result is the most comprehensive and data rich analysis to date on the potential impacts of wind energy projects on nearby property values."*

The main conclusion of this study is as follows:

> *"Based on the data and analysis presented in this report, no evidence is found that home prices surrounding wind facilities are consistently, measurably, and significantly affected by either the view of wind facilities or the distance of the home to those facilities. Although the analysis cannot dismiss the possibility that individual or small numbers of homes have been or could be negatively impacted, if these impacts do exist, they are either too small and/or too infrequent to result in any widespread and consistent statistically observable impact*."

This study has been recently updated by LBNL who published a further paper entitled *"A Spatial Hedonic Analysis of the Effects of Wind Energy Facilities on Surrounding Property Values in the United States"*, in August 2013. This study analysed more than 50,000 home sales near 67 wind farms in 27 counties across nine U.S. states, yet was unable to uncover any impacts to nearby home property values. The homes were all within 10 miles of the wind energy facilities - about 1,100 homes were within 1 mile, with 331 within half a mile. The report is therefore based on a very large sample and represents an extremely robust assessment of the impacts of wind farm development on property prices. It concludes that:

> *"Across all model Specifications, we find no statistical evidence that home prices near wind turbines were affected in either the post-construction or post announcement/pre-construction periods."*

Both of these LBNL studies note that their results don't mean that there will never be a case of an individual home whose value goes down due to its proximity to a wind farm – however if these situations do exist, they're rare enough to be statistically insignificant. Therefore, although there have been claims of significant property value impacts near operating wind turbines that regularly surface in the press or in local communities, strong evidence to support those claims has failed to materialise in all of the major U.S. studies conducted thus far.

A further study was commissioned by RenewableUK and carried out by the Centre for Economics and Business Research (Cebr) in March 2014. Its main conclusions are:

- Overall the analysis found that the county-wide property market drives local house prices, not the presence or absence of wind farms.
- The econometric analysis established that construction of wind farms at the five sites examined across England and Wales has not had a detectable negative impact on house price growth within a five-kilometre radius of the sites.

Although there have been no empirical studies carried out in Ireland on the effects of wind farms on property prices, it is a reasonable assumption based on the available international literature that the provision of a wind farm at the proposed location would not impact on the property values in the area.

4.7 Shadow Flicker

4.7.1 Background

Shadow flicker is an effect that occurs when rotating wind turbine blades cast shadows over a window in a nearby property. Shadow flicker is an indoor phenomenon, which may be experienced by an occupant sitting in an enclosed room when sunlight reaching the window is momentarily interrupted by a shadow of a wind turbine's blade. Outside in the open, light reaches a viewer (person) from a much less focused source than it would through a window of an enclosed room (and is defined as Shadow Casting), and therefore shadow flicker assessments are typically undertaken for the nearby adjacent properties around a proposed wind farm site.

The frequency of occurrence and the strength of any potential shadow flicker effect can depend on several factors, each of which is described below.

1. Whether the sunlight is direct and unobstructed or diffused by clouds:
If the sun is not shining, shadow flicker cannot occur. Reduced visibility conditions such as clouds, haze, and fog greatly reduce the chance of shadow flicker occurring.

Cloud amounts are reported as the number of eights (okta) of the sky covered. Irish skies are completely covered by cloud for well over 50% of the time. The mean cloud amount for each hour is between five and six okta. This is due to our geographical position off the northwest of Europe, close to the path of Atlantic low pressure systems which tend to keep us in humid, cloudy airflows for much of the time. A study of mean cloud amounts at 12 stations over a 25-year period showed that the mean cloud amounts ware at their minimum in April and their maximum in July. Cloud amounts were less by night than by day, with the mean minimum occurring roughly between 2100 and 0100 GMT and the mean maximum between 1000 and 1500 GMT at most stations. *(Source: Met Éireann, www.met.ie)*

2. The presence of intervening obstructions between the turbine and the observer:
For shadow flicker to occur, the windows of a potentially affected property must have direct visibility of a wind turbine, with no physical obstructions such as buildings, trees and hedgerows, hills or other structures located on the intervening land between the window and the turbine.

Any obstacles such as trees or buildings located between a property and the wind turbine will reduce or eliminate the occurrence and/or intensity of the shadow flicker.

3. How high the sun is in the sky at a given time:
At distances of greater than approximately 500 metres between a turbine and a receptor, shadow flicker generally occurs only at sunrise or sunset when the shadow cast by the turbine is longer. At distances greater than ten rotor diameters from a turbine, the potential for shadow flicker is very low (*'Wind Energy Development Guidelines for Planning Authorities',* DoEHLG, 2006). Figure 4.4 illustrates the shadow cast by a turbine at various times during the day, where the red shading represents the area where shadow flicker may occur. When the sun is high in the sky, the length of the shadow cast by the turbine is significantly shorter.

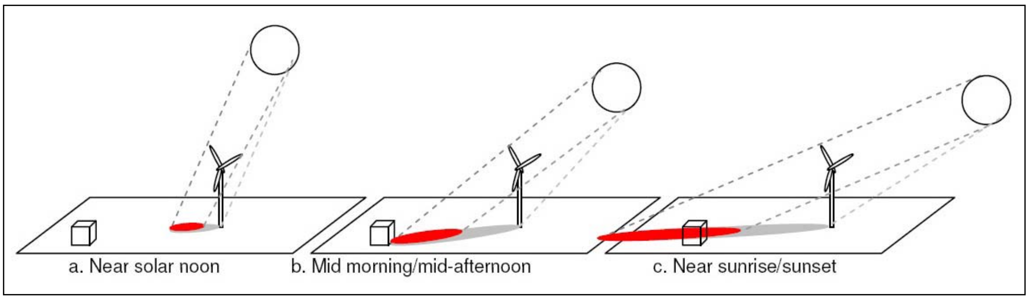


Figure 4.4 Shadow-prone Area as a Function of Time of Day (Source: Shadow Flicker Report, Helimax Energy, December 2008)

4. Distance and bearing, i.e. where the property is located relative to a turbine and the sun:

The further a property is from the turbine the less pronounced the effect will be. There are several reasons for this: there are fewer times when the sun is low enough to cast a long shadow; when the sun is low it is more likely to be obscured by either cloud on the horizon or intervening buildings and vegetation; and, the centre of the rotor's shadow passes more quickly over the land reducing the duration of the effect.

At distance, the turbine blades do not cover the sun but only partly mask it, substantially weakening the shadow. This effect occurs first with the shadow from the blade tip, the tips being thinner in section than the rest of the blade. The shadows from the tips extend the furthest and so only a very weak effect is observed at distance from the turbines. *(Source: Update of Shadow Flicker Evidence Base, UK Department of Energy and Climate Change, 2010)*

5. Property usage and occupancy:

Where shadow flicker is predicted to occur at a specific location, this does not imply that it will be witnessed. Potential occupants of a property may be sleeping or occupying a room on another side of the property that is not subject to shadow flicker, or completely absent from the location during the time of shadow flicker events. As shadow flicker usually occurs only when the sun is at a low angle in the sky, i.e. very early in the morning after sunrise or late in the evening before sunset, even if there is a bedroom on the side of the property affected, the shadow flicker may not be witnessed if curtains or blinds in the bedroom are closed.

6. Wind direction, i.e. position of the turbine blades:

The direction of wind turbine blades changes according to wind direction, as the turbine rotor turns to face the wind. In order to cast a shadow, the turbine blades have to be facing directly toward or away from the sun, so they are moving across the source of the light relative to the observer. This is demonstrated in Figure 4.5.

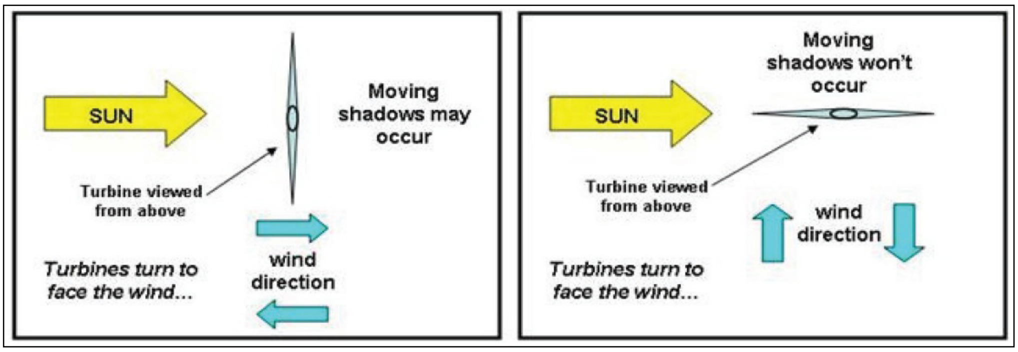


Figure 4.5 Turbine Blade Position and Shadow Flicker Effect (Source: Wind Fact Sheet: Shadow Flicker, Noise Environmental Power LLC)

7. Rotation of turbine blades:

Shadow flicker occurs only if there is sufficient wind for the turbine blades to be continually rotating. Wind turbines begin operating at a specific wind speed referred to as the 'cut-in speed', i.e. the speed at which the turbine produces a net power output, and they cease operating at a specific 'cut-out speed'. Therefore, even during the sunlight hours when shadow flicker has been predicted to occur, if the turbine blades are not turning due to insufficient wind speed, no shadow flicker will occur.

4.7.2 Guidance

The relevant Irish guidance for shadow flicker is derived from the '*Wind Energy Development Guidelines for Planning Authorities*' (Department of the Environment, Heritage and Local Government, 2006). 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 guidelines state that shadow flicker lasts only for a short period of time and occurs only during certain specific combined circumstances, as follows:

- the sun is shining and is at a low angle in the sky, i.e. just after dawn and before sunset, **and**
- the turbine is located directly between the sun and the affected property, **and**
- there is enough wind energy to ensure that the turbine blades are moving, **and**
- the turbine blades are positioned so as to cast a shadow on the receptor.

There are no properties located within 500 metres of a proposed turbine location. For the purposes of this assessment however, the recommended maximum guideline thresholds of 30 hours per year or 30 minutes per day have been applied to all occupied properties located within ten rotor diameters (i.e. 1.31 kilometres) of the proposed turbine locations.

4.7.2.1 Draft Guidance

The '*Wind Energy Development Guidelines for Planning Authorities*' (2006) are currently the subject of a targeted review. The proposed changes to the assessment of impacts associated with wind energy developments are outlined in the document *'Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review'* in relation to noise, proximity and shadow flicker (December, 2013). A consultation process in relation to this document is currently being undertaken. In advance of the updated Wind Energy Development Guidelines being finalised and published, the noise and shadow flicker predictions presented in this EIS therefore also consider the current consultation guidance with regard to the proposed development.

The Targeted Review document suggests that a condition be attached to all planning permissions for wind farms to ensure that there will be no shadow flicker at any existing dwelling or other existing affected property within ten rotor diameters of any wind turbine. It also suggests that a further condition be included which states that if shadow flicker does occur, then the necessary measures, such as turbine shut down during the associated time periods, will be taken by the wind energy developer or operator to eliminate the shadow flicker. The proposed development will be capable of meeting this condition if required, due to the use of turbine control software; further details are provided in Section 4 below on shadow flicker mitigation.

4.7.3 Shadow Flicker Prevention and Prediction Methodology

Shadow flicker occurs only under certain, combined circumstances, as detailed above. Where shadow flicker does occur, it is generally short-lived. The Department of the Environment, Heritage and Local Government (DoEHLG) guidelines state that careful site selection, design and planning, and good use of relevant software can help avoid the possibility of shadow flicker in the first instance, all of which have been employed at the site of the proposed development. Proper siting of wind turbines is key to reducing or eliminating shadow flicker.

The occurrence of shadow flicker can be precisely predicted using specialist computer software programmes specifically developed for the wind energy industry, such as WindFarm (ReSoft) or WindFarmer (DNV.GL) or AWS OpenWind. The computer modelling of the occurrence and magnitude of shadow flicker is made possible by the fact that the sun rises and sets in the same position in the sky on every day each year.

Any potential shadow flicker effect can be precisely modelled to give the start and end time (accurate to the second) of any incidence of shadow flicker, at any location, on any day or all days of the year when it might occur. Where a shadow flicker effect is predicted to occur, the total maximum daily and annual durations can be predicted, along with the total number of days. Any incidence of predicted shadow flicker can be attributed to a particular turbine or group of turbines to allow effective mitigation strategies to be planned and proposed if the model indicates that an exceedance of the shadow flicker guideline limit might occur, as detailed further below.

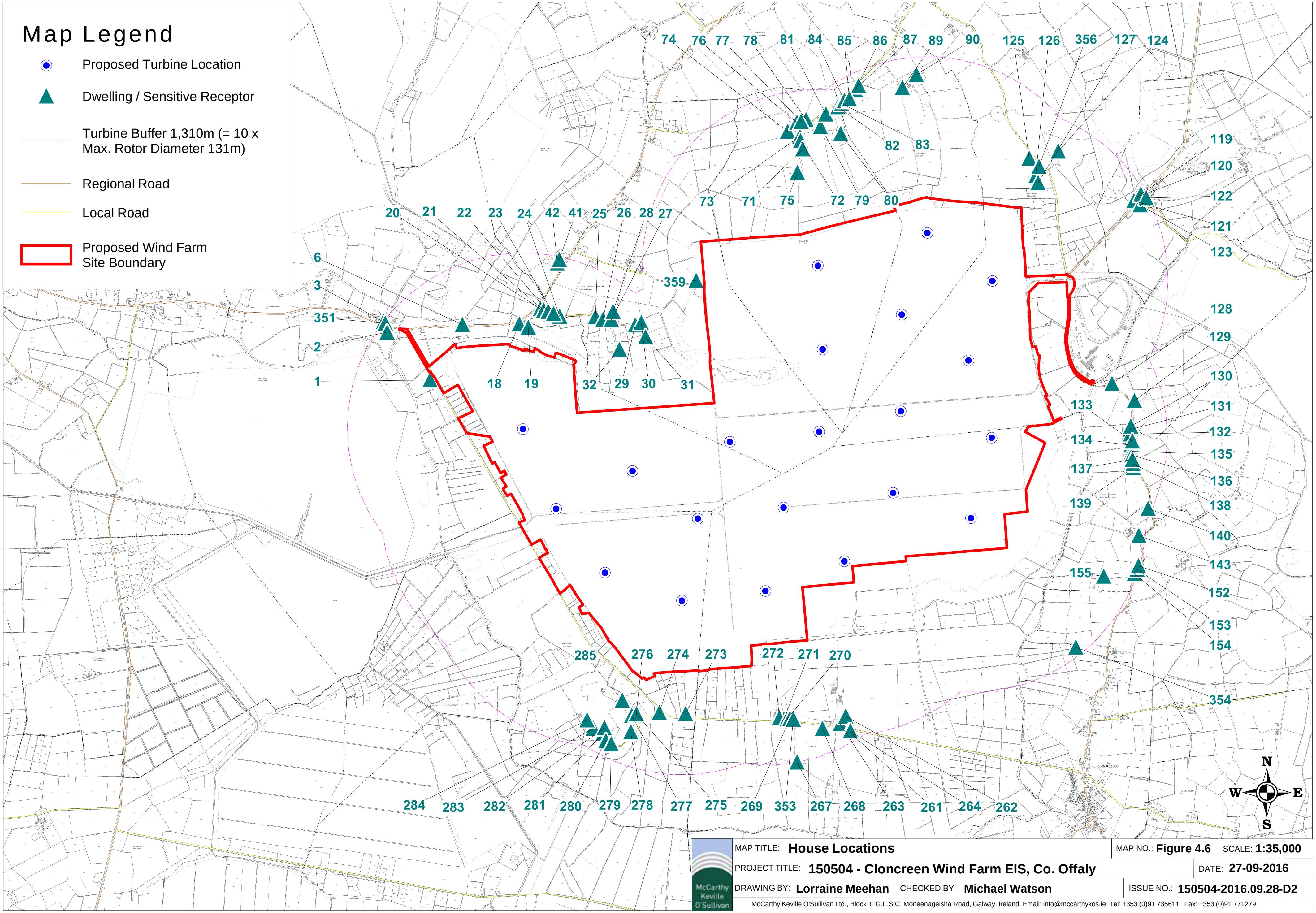
For the purposes of this shadow flicker assessment, the software package WindFarm Version 4.1.2.3 (ReSoft Ltd.) has been used to predict the level of shadow flicker associated with the proposed wind farm development. WindFarm is a commercially available software tool that enables developers to analyse, design and optimise proposed wind farms. It allows proposed turbine layouts to be optimised for maximum energy yield whilst taking account of environmental, planning and engineering constraints.

This shadow flicker assessment considers the 21 No. proposed turbines that make up the proposed Cloncreen wind farm development, and quantifies the potential shadow flicker effects that may arise from any of the turbines. The assessment then considers the potential cumulative shadow flicker effects which may be caused due to the proposed development in combination with other wind farm developments in the vicinity of the site.

4.7.4 Shadow Flicker Assessment Criteria

4.7.4.1 Study Area

A total of 95 no. properties have been identified in the vicinity of the site of the proposed development site up to a distance of ten rotor diameters from the proposed turbine locations, as shown on Figure 4.6. These houses were compiled from the list used for the original constraints mapping, and the identification numbers have remained the same for this study. The Grid Reference coordinates for each property are listed in Table 4.9. The distance to the nearest proposed turbine location from each property (P) is also listed.



MAP TITLE: **House Locations** | MAP NO.: **Figure 4.6** | SCALE: **1:35,000**

PROJECT TITLE: **150504 - Cloncreen Wind Farm EIS, Co. Offaly** | DATE: **27-09-2016**

DRAWING BY: **Lorraine Meehan** | CHECKED BY: **Michael Watson** | ISSUE NO.: **150504-2016.09.28-D2**

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Table 4.9 Property Locations

Property ID	Easting	Northing	Distance to Nearest Proposed Turbine (metres)
1	256105	226847	780
2	255783	227205	1240
3	255756	227283	1310
6	256347	227262	900
18	256772	227265	780
19	256840	227241	750
20	256930	227380	900
21	256954	227369	890
22	256988	227359	890
23	257028	227343	880
24	257075	227324	880
25	257342	227319	990
26	257399	227302	1010
27	257461	227299	1040
28	257474	227360	1100
29	257640	227258	1080
30	257685	227276	1100
31	257717	227169	1000
32*	257521	227077	910
41	257071	227748	1290
42	257057	227720	1260
71	258893	228574	870
72	258876	228637	930
73	258871	228670	970
74	258780	228707	1020
75*	258853	228399	700
76	258849	228774	1070
77	258880	228781	1080
78	258918	228794	1090
79	259024	228741	1030
80	259176	228689	980
81	259065	228835	1130
82	259155	228890	1150
83	259184	228915	1150
84	259205	228937	1160
85	259242	228948	1150
86	259288	229017	1190
87	259311	229048	1210
89	259638	229034	1090
90	259742	229131	1180
119	261421	228237	1280
120	261398	228219	1250
121	261369	228187	1210
122	261461	228210	1300
123	261416	228156	1240
124	260804	228559	1080

Property ID	Easting	Northing	Distance to Nearest Proposed Turbine (metres)
125	260586	228506	940
126	260636	228374	840
127	260653	228322	800
128	261206	226820	980
129	261373	226692	1100
130	261346	226502	1040
131	261342	226477	1030
132	261345	226442	1040
133	261358	226390	1050
134	261347	226360	1040
135	261354	226314	1050
136	261355	226285	1050
137	261358	226253	1060
138	261364	226220	1070
139	261366	226190	1080
140	261475	225886	1280
143	261406	225683	1260
152	261403	225456	1300
153	261394	225431	1300
154	261374	225399	1290
155	261143	225379	1080
261	259237	224219	1230
262	259214	224332	1120
263	259173	224275	1150
264	259249	224221	1230
267	258850	223989	1310
268	259040	224239	1120
269	258796	224313	980
270	258774	224311	980
271	258753	224312	970
272	258718	224320	960
273	258016	224351	850
274	257820	224359	860
275	257648	224348	920
276	257647	224336	930
277	257613	224337	940
278	257606	224214	1060
279	257460	224125	1200
280	257419	224148	1200
281	257399	224203	1160
282	257409	224246	1120
283	257326	224242	1170
284	257279	224303	1120
285	257543	224450	880
351	255770	227272	1290
353	258822	224308	990
354	260935	224849	1250

Property ID	Easting	Northing	Distance to Nearest Proposed Turbine (metres)
356	260660	228444	920
359	258095	227591	920

** Properties 32 and 75 are classed as Farmyard Buildings*

The properties listed in Table 4.9 above include properties that are currently unoccupied and dilapidated but that could be restored to a habitable condition. The study area was also the subject of a planning history search, to identify properties that may have been granted planning permission, but not yet been constructed. In any case where planning permission for a property has been granted, the property has been included in the list of properties in Table 4.9 above.

4.7.4.2 Turbine Type

This shadow flicker assessment assesses the potential shadow flicker from the proposed 21-turbine development and assesses the proposal in relation to the permitted development. The elevations and grid reference coordinates of the proposed 21 turbines are listed in Section 3 of this EIS.

Planning permission is being sought for a turbine size up to a maximum ground to blade tip height of 170 metres. The maximum potential rotor diameter will measure 131 metres. For the purposes of this assessment, a hub height of 104.5 metres and a rotor diameter of 131 metres was used, in order to present a worst case scenario.

While the turbine dimensions of a 131-metre rotor diameter and a 104.5-metre hub height have been used for the purposes of this assessment, the actual turbine to be installed on the site will be the subject of a competitive tender process, and could include turbines of a different rotor diameter and hub height configuration than considered as part of this assessment. Regardless of the make or model of the turbine eventually selected for installation on site, the potential shadow flicker impact it will give rise to will be no different than that predicted in this assessment. With the benefit of the mitigation measures outlined below, any turbine to be installed on-site will be able to comply with the DoEHLG guideline thresholds of 30 minutes per day or 30 hours per year. Any references to the turbine dimensions in the shadow flicker assessment must be considered in the context of the above, and should not be construed as meaning it predetermines the dimensions of any wind turbine that could be used on the site.

4.7.4.3 Assumptions and Limitations

At each property, shadow flicker calculations were carried out based on 4 no. notional windows facing north, east, south and west, labelled Windows 1, 2, 3 and 4 respectively. The degrees from north value for each window is:

- Window 1: 0 degrees from North
- Window 2: 90 degrees from North
- Window 3: 180 degrees from North
- Window 4: 270 degrees from North

Each window measures one-metre-high by one-metre-wide, and tilt angle is assumed to be zero. The centre height of each window is assumed to be two metres above ground level and no screening due to trees or other buildings or vegetation is assumed. It was not considered necessary or practical to measure the dimensions of every window on every property in the study area. While the actual size of a window will marginally influence the incidence and duration of any potential shadow flicker effect, with larger windows resulting in slightly longer shadow flicker durations, any additional incidences or durations or shadow flicker over and above those predicted in this assessment can be countered by extending the mitigation strategies outlined further below.

The use of computer models to predict the amount of shadow flicker that will occur is known to produce an over-estimate of possible impact, referred to as the *'worst-case impact'*, due to the following limitations:

- The sun is assumed to be shining during all daylight hours such that a noticeable shadow is cast. This will not occur in reality.
- The wind is always assumed to be within the operating range of the turbines such that the turbine rotor is turning at all times, thus enabling a periodic shadow flicker. Wind turbines only begin operating at a specific 'cut-in speed', and cease operating at a specific 'cut-out speed'. In periods where the wind is blowing at medium to high speeds, the probability of there being clear or partially clear skies where the sun is shining and could cast a shadow, is low.
- The wind turbines are assumed to be available to operate, i.e. turn, at all times. In reality, turbines may be switched off during maintenance or for other technical or environmental reasons.
- The turbine rotor is considered (as a sphere) to present its maximum aspect to observers in all directions. In reality, the wind direction and relative position of the turbine rotor would result in a changing aspect being presented by the turbine. The rotor will actually present as ellipses of varying sizes to observers from different directions. The time taken for the sun to pass across the sky behind a highly elliptical rotor aspect will be shorter than the modeled maximum aspect.

4.7.5 Shadow Flicker Assessment Results

4.7.5.1 Daily Shadow Flicker

The WindFarm computer software was used to model the predicted daily shadow flicker levels in significant detail, identifying the predicted daily start and end times, maximum daily duration and the individual turbines predicted to give rise to shadow flicker. The model results assume worst-case conditions, including:

- 100% sunshine during all daylight hours throughout the year,
- An absence of any screening (vegetation or other buildings),
- That the sun is behind the turbine blades,
- That the turbine blades are facing the property,
- That the windows of the property face directly towards the wind farm
- That the turbine blades are moving.

For ease of reference, the daily shadow flicker model results are summarised in Table 4.10 below. Table 4.10 details the maximum daily predicted shadow flicker, presening the worst-case scenario for the day of the year when the greatest duration of shadow flicker may be experienced. The predicted maximum daily shadow flicker levels are then considered in the context of the DoEHLG's guideline daily threshold of 30 minutes per day, in terms of whether there is any incidence of exceedance of the 30 minute per day threshold at each of the modelled properties. If there is a predicted exceedance of the 30 minute per day threshold at any property, the number of days the threshold will be exceeded are also detailed. If there is a predicted exceedance of the 30 minute per day threshold at any property, the turbines that contribute to the exceedance are also identified.

Finally, it is considered whether a shadow flicker mitigation strategy is required for each property. Mitigation strategies are deemed necessary for any property in exceedance of the daily shadow flicker threshold of 30 minutes per day, and are detailed in Section 4.7.6 below.

Table 4.10 Potential Daily Shadow Flicker (SF)

Property No.	Maximum Daily Shadow Flicker (Pre-Mitigation) from Proposed Turbines (hrs)	Any Exceedance of DoEHLG 30min/day Threshold?	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Giving Rise to Daily Shadow Flicker Threshold Exceedance	Mitigation Strategy Required?
1	0.68	Yes	37	1	Yes
2	0.46	No	0	N/A	No
3	0	No	0	N/A	No
6	0.54	Yes	31	1	Yes
18	0	No	0	N/A	No
19	0	No	0	N/A	No
20	0	No	0	N/A	No
21	0	No	0	N/A	No
22	0	No	0	N/A	No
23	0	No	0	N/A	No
24	0	No	0	N/A	No
25	0.5	No	0	N/A	No
26	0.51	Yes	25	1	Yes
27	0.98	Yes	69	1, 13	Yes
28	0.94	Yes	58	1, 13	Yes
29	0.91	Yes	48	1, 13	Yes
30	0.79	Yes	31	1, 13	Yes
31	0.71	Yes	57	1, 13	Yes
32	1.12	Yes	53	1, 13	No*
41	0	No	0	N/A	No
42	0	No	0	N/A	No
71	0.5	No	0	N/A	No
72	0.48	No	0	N/A	No
73	0.48	No	0	N/A	No
74	0.44	No	0	N/A	No
75	0.51	Yes	17	20, 21	No*
76	0.45	No	0	N/A	No
77	0.46	No	0	N/A	No
78	0.47	No	0	N/A	No
79	0.51	Yes	15	21	Yes
80	0.57	Yes	35	21	Yes
81	0.5	No	0	N/A	No
82	0.47	No	0	N/A	No
83	0.45	No	0	N/A	No
84	0.39	No	0	N/A	No
85	0.3	No	0	N/A	No

Property No.	Maximum Daily Shadow Flicker (Pre-Mitigation) from Proposed Turbines (hrs)	Any Exceedance of DoEHLG 30min/day Threshold?	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Giving Rise to Daily Shadow Flicker Threshold Exceedance	Mitigation Strategy Required?
86	0	No	0	N/A	No
87	0	No	0	N/A	No
89	0	No	0	N/A	No
90	0	No	0	N/A	No
119	0.44	No	0	N/A	No
120	0.45	No	0	N/A	No
121	0.46	No	0	N/A	No
122	0.43	No	0	N/A	No
123	0.45	No	0	N/A	No
124	0.49	No	0	N/A	No
125	0.59	Yes	30	21	Yes
126	0.59	Yes	26	17, 21	Yes
127	0.59	Yes	55	17, 21	Yes
128	0.55	Yes	23	8, 16	Yes
129	0.49	No	0	N/A	No
130	0.52	Yes	9	8	Yes
131	0.52	Yes	11	8	Yes
132	0.52	Yes	11	8	Yes
133	0.51	Yes	10	8	Yes
134	0.52	Yes	12	8	Yes
135	0.52	Yes	12	7, 8	Yes
136	0.52	Yes	10	7, 8	Yes
137	0.51	Yes	10	7, 8	Yes
138	0.51	Yes	8	7, 8	Yes
139	0.51	Yes	7	7, 8	Yes
140	0.45	No	0	N/A	No
143	0.44	No	0	N/A	No
152	0.43	No	0	N/A	No
153	0.43	No	0	N/A	No
154	0.44	No	0	N/A	No
155	0.52	Yes	19	7	Yes
261	0	No	0	N/A	No
262	0	No	0	N/A	No
263	0	No	0	N/A	No
264	0	No	0	N/A	No
267	0	No	0	N/A	No
268	0	No	0	N/A	No
269	0	No	0	N/A	No
270	0	No	0	N/A	No
271	0	No	0	N/A	No
272	0	No	0	N/A	No
273	0	No	0	N/A	No
274	0	No	0	N/A	No

Property No.	Maximum Daily Shadow Flicker (Pre-Mitigation) from Proposed Turbines (hrs)	Any Exceedance of DoEHLG 30min/day Threshold?	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Giving Rise to Daily Shadow Flicker Threshold Exceedance	Mitigation Strategy Required?
275	0	No	0	N/A	No
276	0	No	0	N/A	No
277	0	No	0	N/A	No
278	0	No	0	N/A	No
279	0	No	0	N/A	No
280	0	No	0	N/A	No
281	0	No	0	N/A	No
282	0	No	0	N/A	No
283	0	No	0	N/A	No
284	0	No	0	N/A	No
285	0	No	0	N/A	No
351	0.44	No	0	N/A	No
353	0	No	0	N/A	No
354	0	No	0	N/A	No
356	0.57	Yes	22	17, 21	Yes
359	0.59	Yes	36	19, 20	Yes

** Properties 32 and 75 are classed as Farmyard Buildings*

Of the 95 No. properties modelled, some level of shadow flicker is predicted to potentially occur at 56 properties, with a further 39 properties experiencing no shadow flicker as a result of the proposed development.

Of the 56 No. properties that may experience some shadow flicker in the worst-case scenario, only 29 of those properties may experience daily shadow flicker in excess of the DoEHLG guideline threshold of 30 minutes per day, P1, P6, P26-P32, P75, P79, P80, P125-P128, P130-P139, P155, P356 and P359. Two of these properties, P32 and P75 are derelict buildings now in use as farmyard buildings, therefore bringing the total number of potentially affected properties to 27. A shadow flicker mitigation strategy to control the level of daily shadow flicker experienced at the potentially affected properties is outlined in Section 4.7.6 below. This mitigation strategy outlines the method by which the exceedence at the relevant properties will be brought below 30 minutes per day.

The shadow flicker model used to predict the daily shadow flicker results assumes worst-case conditions, including 100% sunshine during all daylight hours throughout the year, an absence of any screening (vegetation or other buildings), that the sun is behind the turbine blades which are also facing the property, and that the turbine blades are always turning. In reality, the actual occurrence and incidence of shadow flicker is likely to be significantly less that that predicted in Table 4.10 above.

4.7.5.2 Annual Shadow Flicker

The WindFarm software was also used to model the predicted annual shadow flicker levels in significant detail, identifying the total annual duration and the total time each individual turbine is predicted to give rise to shadow flicker over the course of a year. The annual model results also assume worst-case conditions, including 100% sunshine during all daylight hours throughout the year, an absence of any screening (vegetation or other buildings), that the sun is behind the turbine blades which are also fully facing the property, and that the turbine blades are moving.

The DoEHLG Wind Energy Guidelines recommend that shadow flicker at dwellings within 500 metres of a proposed turbine location should not exceed a total of 30 hours per year. While there are no dwellings located within 500 metres of any proposed turbine location, this criterion has been applied to all properties located within 10 rotor diameters.

The total annual shadow flicker calculated for each property assumes 100% sunshine during daytime hours, as referred to above. However, weather data for this region shows that the sun shines on average for 29% of the daylight hours per year. This percentage is based on Met Eireann data recorded at Mullingar over the 30-year period from 1971 to 2000 (www.met.ie) as shown in Table 9.7 of Section 9 of this EIS. Table 4.11 therefore also lists the annual shadow flicker calculated for each property when the regional average of 29.2% sunshine is taken into account.

For ease of reference, the annual shadow flicker model results are summarised in Table 4.11 below. Table 4.11 details the maximum annual predicted shadow flicker. The predicted maximum annual shadow flicker levels are then reduced based on the 29.2% daylight hours per year long-term Met Eireann averages, to give a more accurate annual average shadow flicker prediction. Table 4.11 also outlines whether a shadow flicker mitigation strategy is required for each property to mitigate potential exceedances of the annual threshold figure. Mitigation strategies are detailed in Section 4.7.6 below and are deemed necessary for any property in exceedance of the daily shadow flicker threshold of 30 hours per year, after the annual sunshine reduction has been accounted for.

Table 4.11 Potential Total Annual Shadow Flicker

Property No.	Maximum Annual Shadow Flicker - Pre-Mitigation (hrs)	Adjusted (for sunshine) Annual Shadow Flicker – Pre-Mitigation (hrs)	Any Exceedance of DoEHLG 30hrs/year Threshold?	Mitigation Strategy Required?
1	30	8.76	No	No
2	16.1	4.70	No	No
3	0	0	No	No
6	26.2	7.65	No	No
18	0	0	No	No
19	0	0	No	No
20	0	0	No	No
21	0	0	No	No
22	0	0	No	No
23	0	0	No	No
24	0	0	No	No
25	22.5	6.57	No	No
26	28.7	8.38	No	No
27	62.2	18.16	No	No
28	51.9	15.15	No	No
29	56.1	16.38	No	No
30	49.1	14.33	No	No

Property No.	Maximum Annual Shadow Flicker - Pre-Mitigation (hrs)	Adjusted (for sunshine) Annual Shadow Flicker – Pre-Mitigation (hrs)	Any Exceedance of DoEHLG 30hrs/year Threshold?	Mitigation Strategy Required?
31	55	16.06	No	No
32	53.6	15.65	No	No*
41	0	0	No	No
42	0	0	No	No
71	18.3	5.34	No	No
72	18	5.25	No	No
73	18.1	5.28	No	No
74	15.4	4.49	No	No
75	31.9	9.31	No	No*
76	18.9	5.51	No	No
77	20.6	6.01	No	No
78	24	7.00	No	No
79	33.9	9.89	No	No
80	39.2	11.44	No	No
81	29.4	8.58	No	No
82	20.5	5.98	No	No
83	16.3	4.75	No	No
84	11.6	3.38	No	No
85	6.4	1.86	No	No
86	0	0	No	No
87	0	0	No	No
89	0	0	No	No
90	0	0	No	No
119	13.4	3.91	No	No
120	13.7	4.00	No	No
121	14.5	4.23	No	No
122	12.5	3.65	No	No
123	13.4	3.91	No	No
124	16.8	4.90	No	No
125	26.6	7.76	No	No
126	35.6	10.39	No	No
127	46.4	13.54	No	No
128	36.1	10.54	No	No
129	28.1	8.20	No	No
130	16.2	4.73	No	No
131	16.4	4.78	No	No
132	16.5	4.81	No	No
133	16.5	4.81	No	No
134	17.1	4.99	No	No
135	28.7	8.38	No	No
136	29	8.46	No	No
137	29	8.46	No	No
138	29.1	8.49	No	No

Property No.	Maximum Annual Shadow Flicker - Pre-Mitigation (hrs)	Adjusted (for sunshine) Annual Shadow Flicker – Pre-Mitigation (hrs)	Any Exceedance of DoEHLG 30hrs/year Threshold?	Mitigation Strategy Required?
139	29.4	8.58	No	No
140	18.9	5.51	No	No
143	12.1	3.53	No	No
152	13.4	3.91	No	No
153	13.8	4.02	No	No
154	14.7	4.29	No	No
155	27.2	7.94	No	No
261	0	0	No	No
262	0	0	No	No
263	0	0	No	No
264	0	0	No	No
267	0	0	No	No
268	0	0	No	No
269	0	0	No	No
270	0	0	No	No
271	0	0	No	No
272	0	0	No	No
273	0	0	No	No
274	0	0	No	No
275	0	0	No	No
276	0	0	No	No
277	0	0	No	No
278	0	0	No	No
279	0	0	No	No
280	0	0	No	No
281	0	0	No	No
282	0	0	No	No
283	0	0	No	No
284	0	0	No	No
285	0	0	No	No
351	16.2	4.73	No	No
353	0	0	No	No
354	0	0	No	No
356	23	6.71	No	No
359	40.3	11.76	No	No

** Properties 32 and 75 are classed as Farmyard Buildings*

Of the 95 no. properties modelled, the DoEHLG total annual guideline limit of 30 hours is predicted to be exceeded at 13 no. properties, P27-P32, P75, P79, P80, P126-P128, P359. Two of these properties, P32 and P75 are derelict buildings now in use as farmyard buildings as described above, therefore bringing the total number of potentially affected properties to 11. When the regional sunshine average of 29.2% is taken into account, i.e. the mean amount of sunshine hours throughout the year, the number of properties at which an exceedance of the 30-hour annual guideline limit is predicted is reduced to zero.

Mitigation measures in the form of a shadow flicker mitigation strategy would normally be applied to any property in exceedance of the annual shadow flicker threshold after the sunshine reduction has been accounted for, to reduce the daily level of shadow flicker at the affected properties below the guidelines level of 30 hours per year. In this instance, considering no property is in exceedance of the annual 30-hour threshold, no such shadow flicker mitigation strategy is deemed necessary. Should any situation arise after construction where a shadow flicker mitigation strategy is required, details of potential strategies are given in Section 4.7.6 below.

4.7.5.3 Cumulative Shadow Flicker

For the assessment of cumulative shadow flicker, any other existing, permitted or proposed wind farm would be considered where it had the potential to generate an in-combination shadow flicker effect with the proposed 21 Cloncreen turbines, on the 95 properties considered in this assessment.

The nearest wind turbines to the proposed development site are located within the Mountlucas wind farm, west of Cloncreen. The minimum distance between the Mountlucas operating turbines and the proposed Cloncreen turbines is 4.12 kilometres, therefore, there are no houses located within 10 rotor diameters of both wind farms, and thus no potential for cumulative shadow flicker. The minimum distance between the permitted Yellow River turbines and the proposed Cloncreen turbines is 9.2 kilometres, therefore, there is no potential for cumulative shadow flicker from this wind farm.

4.7.6 Shadow Flicker Mitigation Strategies

In cases where a property is predicted to experience shadow flicker in exceedance of the DoEHLG guideline limits of 30 minutes per day or 30 hours per year, a number of measures can be implemented to mitigate these effects and reduce the incidence and duration of potential shadow flicker below the recommended guidelines thresholds. Conditions are regularly attached to planning permission for wind farm projects requiring adherence to the DoEHLG guideline limits of 30 minutes per day or 30 hours per year and therefore such mitigation measures have been widely adopted through the wind energy industry.

Specific measures are generally not necessary to mitigate annual shadow flicker, as it has been established by long-term weather data that the sun shines on average for only 22-35% of daylight hours across Ireland over the course of a year. When the local sunshine data is applied to the worst-case model prediction figures, with proper project design, exceedances of the annual guideline limit of 30 hours per year are generally only likely at a small number of properties. Understandably, it is more likely that an exceedance of the daily guideline limit of 30 minutes would occur on a cloudless day with the sun shining, and so property-specific shadow flicker mitigation measures are better focused on reducing the daily shadow flicker durations below the guideline figure of 30 minutes per day.

There are three main mitigation strategies that can be employed to limit the incidence or duration of shadow flicker where necessary, each of which is now outlined and described below.

Screening Assessment

Where a property or property is predicted to be subject to some incidence of shadow flicker, the shadow flicker has been predicted on the basis of a "bare-earth" scenario, in the absence of any screening. In reality, the likelihood, incidence and duration of any potential shadow flicker may be significantly reduced or entirely eliminated due the presence of screening features in the immediate environs of the property. Such screening features could include small undulations in the local topography, built structures such as sheds, walls or other structures, and vegetation in the form of natural or planted trees, hedgerows or scrub. When such additional screening features are accounted for, the actual incidence and duration of any potential shadow flicker may be significantly reduced or entirely eliminated, negating the requirement for any further mitigation strategies as outlined below.

Screening Measures

In the absence of any screening features as described above, at any property where the shadow flicker generated by the proposed development exceeds the daily or annual guideline threshold and the owner(s) of the property would like the incidence of shadow flicker reduced, the operator of the wind farm will engage with the property owner to ensure the DoEHLG guideline threshold are not exceeded. The property owner will be asked to log the date, time and duration of shadow flicker events occurring on at least five different days. The provided log will be compared with the predicted occurrence of shadow flicker effects. In the unlikely event that there is a variance in the predicted and recorded incidence of shadow flicker, a visit will be carried out to verify the occurrence of shadow flicker at the residence. If an occurrence of shadow flicker is verified to be in exceedance of the guideline thresholds, a number of screening measures will be proposed to the property owner, including:

- Installation of appropriate window blinds or curtains in the affected rooms of the residence;
- Planting of screening vegetation;
- Other site-specific measures that might be agreeable to the affected party and may result in the desired mitigation.

If agreement can be reached on a set of appropriate measures, the necessary works to install the required mitigation would be implemented in cooperation with the property owner as soon as practically possible, with the full costs to be borne by the wind farm operator.

Should it not be possible for the parties to agree on a set of appropriate screening measures, turbine control measures will then be used to meet the guidelines thresholds, as described below.

Wind Turbine Control Measures

Modern wind turbines can be fitted with shadow flicker control units to allow the turbines to be controlled to prevent the occurrence or limit the duration of shadow flicker at properties surrounding the wind farm. The shadow flicker control units can be added to any required turbines, and are not cost prohibitive.

A shadow flicker control unit allow a wind farm's turbines to be programmed and controlled using the wind farm's SCADA control system to change a particular turbine's operating mode during certain conditions or times, or even turn the turbine off if necessary. This measure can be utilised at the site of the proposed development so as to prevent an exceedance of the guideline shadow flicker values at any property.

All predicted incidents of shadow flicker in excess of the daily or annual guidelines thresholds can be pre-programmed into the wind farm's control software. The wind farm's SCADA control system can be programmed to shut down any particular turbine at any particular time on any given day to ensure the daily or annual guidelines thresholds are not exceeded. Where such wind turbine control measures are to be utilised, they need only be implemented when the specific combined circumstances occur that are necessary to give rise to the shadow flicker effect in the first instance. Therefore, if the sun is not shining on a particular day that shadow flicker was predicted to occur at a nearby property, there would be no need to shut down the relevant turbines that would have given rise to the shadow flicker at the property. Similarly, if the wind speed was below the cut-in speed that caused the turbine rotor to rotate and give rise to a shadow flicker effect at a nearby property, there would be no need to shut down the relevant turbines that otherwise would have caused shadow flicker.

The atmospheric variables that determine whether shadow flicker will occur or not, are continuously monitored at the wind farm site and the data fed into the wind farm's SCADA control system. The strength of direct sunlight is measured by way of photo cells, and if the sunlight is of sufficient strength to cast a shadow, the shadow flicker control mechanisms come into effect. Wind speed and direction are measured by anemometers and wind vanes on each turbine and on the wind farm's met mast, and similarly, and if wind speed and direction is such that a shadow will be cast, the shadow flicker control mechanisms come into effect. This method of shadow flicker mitigation has been technically well-proven at wind farms in areas outside Ireland that experience significantly longer periods of direct sunlight.

4.8 Residential Amenity

Residential amenity relates to the human experience of one's home, derived from the general environment and atmosphere associated with the residence. The quality of residential amenity is influenced by a combination of factors, including site setting and local character, land-use activities in the area and the relative degree of peace and tranquillity experienced in the residence.

The proposed wind farm site is located on a site currently used for commercial peat extraction, therefore a certain level of activity and traffic movements are associated with the site, which will assist in the assimilation of the proposed development into the receiving environment. There are no properties located within 700 metres of a proposed turbine location.

When considering the amenity of residents in the context of a proposed wind farm, there are three main potential impacts of relevance: 1) Shadow Flicker, 2) Noise, and 3) Visual Amenity. Shadow flicker and noise are quantifiable aspects of residential amenity while visual amenity is more subjective. Detailed shadow flicker and noise modelling have been completed as part of this EIS (Section 4.7 above refers to shadow flicker modelling, Section 10 of the EIS addresses noise). A comprehensive landscape and visual impact assessment has also been carried out, as presented in Section 11 of this EIS. Impacts on human beings during the construction and operational phases of the proposed development are assessed in relation to each of these key issues and other environmental factors such as noise, traffic and dust; see Impacts in Section 4.9 below. The impact on residential amenity is then derived from an overall judgement of the combination of impacts due to shadow flicker, changes to land-use and visual amenity, noise, traffic, dust and general disturbance.

4.9 Likely and Significant Effect and Associated Mitigation Measures

4.9.1 'Do-Nothing' Scenario

If the proposed development were not to proceed, the existing uses for the site of commercial peat harvesting would continue until the peat is exhausted and then a rehabilitation plan implemented.

If the proposed development were not to proceed, the opportunity to capture an even greater part of Co. Offaly's valuable renewable energy resource would be lost, as would the opportunity to further contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources, increasing energy security of supply and the reduction of greenhouse gas emissions.

4.9.2 Construction Phase

4.9.2.1 Population

Those working on the construction phase of the proposed development will travel daily to the site from the wider area. It is estimated that a maximum of 120 staff members will be employed on the site at any one time during the six-month site preparation and groundworks stage of construction, reducing to a maximum of approximately 40 staff at any one time during the turbine construction stage. The construction phase will have no effect on the population of the Study Area in terms of changes to population trends or density, household size or age structure.

4.9.2.2 Health and Safety

The site specific Emergency Response Plan (ERP) will be developed prior to the construction of the facility and will include details on the response required and the responsibilities of all personnel in the event of an emergency. The ERP in terms of health and safety will require updating and submissions from the various contractors and suppliers on appointment as the proposed project progresses.

The Environmental Manager will be responsible for any corrective actions required as a result of an incident e.g. an investigative report, formulation of alternative construction methods or environmental sampling, and will advise the Main Contractor as appropriate.

Construction of the proposed development will necessitate the presence of a construction site. Construction sites and the machinery used on them pose a potential health and safety hazard to construction workers if site rules are not properly implemented. This will have a short-term potential significant negative effect.

Mitigation

During construction of the proposed development, all staff will be made aware of (through appropriate training and signage) and adhere to the Health & Safety Authority's *'Guidelines on the Procurement, Design and Management Requirements of the Safety, Health and Welfare at Work (Construction) Regulations 2006'*. This will encompass the use of all necessary Personal Protective Equipment and adherence to the site Health and Safety Plan. Appropriate health and safety signage will also be erected at locations around the site to ensure workers adhere to guidelines and regulations.

A 110 kv electricity line from the Cushaling substation traveses the site along the southern boundary. Appropriate warning measures including 'goalposts' will be used as appropriate to prevent contact with overheads lines.

Residual Effect
Short-term potential slight negative effect

4.9.2.3 Employment and Investment

The construction cost of the project will be in the region of €110 million, approximately 30% of which will relate to onsite works. The construction phase of the proposed development will last for approximately 18 months and during this time will employ up to 120 people. Where possible, the majority of construction workers and materials will be sourced locally, thereby helping to sustain employment in the construction trade. This will have a short-term significant positive effect.

The injection of money in the form of salaries and wages to those employed during the construction phase of the proposed project has the potential to result in an increase in household spending and demand for goods and services in the local area. This would result in local retailers and businesses experiencing a short-term positive effect on their cash flow. This will have a short-term slight positive indirect effect.

The proposed development will result in skilled jobs being available in the area, bringing specialist skills for both the construction and operational phases that could result in the transfer of these skills into the local workforce, thereby having a long-term positive effect on the local skills base. Up-skilling and training of local staff in the particular requirements of the wind energy industry is likely to lead to additional opportunities for those staff as additional wind farms are constructed in Ireland. Any such upskilling and training will have a long-term moderate positive indirect effect.

4.9.2.4 Land-use

The existing land-use of peat extraction will have ceased prior to construction. The site rehabilitation plan (see Section 5 of the EIS) incorporates the development of the wind farm. The required rehabilitation will commence once construction activities have been completed. This will have a temporary slight negative effect.

4.9.2.5 Noise

There will be an increase in noise levels in the vicinity of the proposed development site during the construction phase, as a result of heavy machinery and construction work. These effects will be short-term in duration. The noisiest construction activities associated with wind farm development are excavation, piling and pouring of the turbine bases, and the extraction of stone from the borrow pit. Excavation of a base can typically be completed in one to two days however, and the main concrete pours are usually conducted in one continuous pour, which is done within a matter of hours.

Construction noise at any given noise sensitive location will be variable throughout the construction project, depending on the activities underway and the distance from the main construction activities to the receiving properties. The potential noise effects that will occur during the construction phase of the proposed development are further described in Section 10 of this EIS. This will have a temporary slight negative effect.

Mitigation
Best practice measures for noise control will be adhered to onsite during the construction phase of the proposed development in order to mitigate the slight short-

term negative effect associated with this phase of the development. The measures will include:

- Sensitive location of equipment, taking account of local topography and natural screening.
- Working methods: construction noise will be controlled by prescribing that standard construction work will be restricted to the specified working hours. Any construction work carried out outside of these hours shall be restricted to activities that will not generate noise of a level that may cause a nuisance to local noise sensitive properties (e.g. dwelling houses). The phasing of works has also been designed with regard to avoidance of noise effects.
- Where possible, plant will be selected taking account of the characteristics of noise emissions from each item. All plant and machinery used on the site shall comply with E.U. and Irish legislation in relation to noise emissions. The timing of on- and off-site movements of plant near occupied properties will be controlled.
- Operation of plant: all construction operations shall comply with guidelines set out in British Standard documents *'BS 5338: Code of Practice for Noise Control on Construction and Demolition Sites'* and *'BS5228: Part 1: 1997: Noise & Vibration Control on Construction and Open Sites'*. The correct fitting and proper maintenance of silencers and/or enclosures, the avoidance of excessive and unnecessary revving of vehicle engines, and the parking of equipment in locations that avoid possible effects on noise-sensitive locations will be employed.
- Training and supervision of operatives in proper techniques to reduce site noise, and self-monitoring of noise levels, if appropriate.

Residual Effect
Short-term imperceptible negative effect

4.9.2.6 Dust

Potential dust emission sources during the construction phase of the proposed development include upgrading of existing access tracks and construction of new access roads, turbine foundations, internal road network, construction compounds and substations. These effects will not be significant and will be relatively short-term in duration. This will have a short-term slight negative effect.

Mitigation
It is anticipated that a significant volume of the aggregate material for the construction of roads and turbine bases will be sourced onsite; therefore, the need to transport this material to the site will be minimised. Any material sourced off site will be from local authorised quarry operators and will access the site using the haul route.

Truck wheels will be washed to remove mud and dirt before leaving the site. All plant and materials vehicles shall be stored in the dedicated compound area. Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and berming. Construction traffic will be restricted to defined routes and a speed limit will be implemented.

In periods of extended dry weather, dust suppression may be necessary along haul roads and around the borrow pit areas to ensure dust does not cause a nuisance. If necessary, water will be taken from the site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads and site compounds to prevent the generation of dust. Silty or oily water will not be used for dust suppression, because this would transfer the pollutants to the haul roads and generate polluted runoff or more dust. Water bowser movements will be carefully monitored by a suitably qualified and experienced person, as the application of too much water may lead to increased runoff.

Residual Effect
Short-term imperceptible negative effect

4.9.2.7 Traffic

A full Traffic and Transport assessment has been carried out by Alan Lipscombe Traffic and Transport Consultants, the results of which are presented in Section 13.1 of this EIS.

Turbines will be delivered to the site of the proposed development from the direction of Tullamore, Co. Offaly. The site will have one entrance for the purposes of turbine delivery, which is into the western side of the site via the R402 and the L1003 local road. This entrance will also be used for the majority of general construction traffic. The junction at the R402 and the local road and the local road itself for about 430 metres will require upgrade to accommodate the abnormal loads related to turbine delivery.

There is an existing entrance into the eastern side of the site via the R401 Regional road in the townland of Ballykilleen which is proposed for a portion of the general construction traffic and for during the operational phase. Minor upgrade works will be required to the eastern entrance in order to accommodate access and egress of construction vehicles.

During the turbine construction stage when general materials are delivered to the site, the delivery of construction materials will have a slight effect but will be temporary. During the days when the various components of wind turbine plant are delivered to the site by extended articulated vehicles, the effect of the delivery vehicles on traffic during these days will be significant but will be temporary; see Section 13.1 for further details. During the days when the concrete foundations are poured the effect on the surrounding road network will be moderate but will be temporary.

Mitigation
Aggregate materials for the construction of any additional site tracks will be primarily obtained from the proposed borrow pit on the site of the proposed development. This will significantly reduce the number of delivery vehicles required to access the site.

Turbine plant will be delivered to the site at night in order to reduce impacts on local traffic.

Residual Effect
Temporary slight negative effect

4.9.2.8 Tourism and Amenity

Temporary widening of the R402 road in Ballinagar village is required to accommodate the transport of turbines to the proposed wind farm. The temporary works will require the temporary removal of the existing footpath, vegetation and boundary wall that form part of the public park area. Further excavations will be required to allow the importation of suitable fill material to build the area back up to the existing road level. The extended area will then be stoned over to allow the traverse of the vehicles carrying the large components. The relevant areas of the public park will be closed to the public during the turbine delivery period. This temporary loss of amenity will have a moderate negative effect.

As there are no tourism or amenity attractions specifically pertaining to the wind farm site there are no effects associated with the construction phase of the proposed development at this location.

Mitigation
Once turbine deliveries are completed, the public park area will be fully reinstated and planted in accordance with the requirements of Offaly County Council.

Residual Effect
Temporary slight negative effect

4.9.2.9 Shadow Flicker

Shadow flicker, which occurs during certain conditions due to the movement of wind turbine blades, as described in Section 4.7 of this chapter of the EIS, occurs only during the operational phase of a wind energy development. There are therefore no shadow flicker effects associated with the construction phase of the proposed development.

4.9.2.10 Residential Amenity

The construction phase of the proposed development will give rise to some effects in terms of noise and vibration, dust, traffic and visual amenity, as described in the relevant chapters of this EIS and also addressed above in terms of effects on Human Beings. In the absence of any mitigation, the construction works could pose a significant to moderate short-term negative effect on residential amenity at properties located in the vincity of the proposed development site.

Mitigation
All mitigation as described in relation to noise and vibration, dust, traffic and visual amenity in this EIS will be implemented in order to reduce and avoid insofar as possible effects on residential amenity at properties located in the vicinity of the proposed development works, including along the proposed turbine and construction materials haul route.

Residual Effect
There will be a short-term slight negative effect on residential amenity in the vincinity of the proposed development site during construction works.

4.9.3 Operational Phase

4.9.3.1 Population

The operational phase of the proposed development will have no effect on the population of the Study Area with regards to changes to trends, population density, household size or age structure.

4.9.3.2 Health and Safety

The operational phase of the proposed development poses no significant threat for the health and safety of the general public. The Department of the Environment, Heritage and Local Government (DoEHLG)'s *'Wind Energy Development Guidelines for Planning Authorities 2006'* state that there are no specific safety considerations in relation to the operation of wind turbines. Fencing or other restrictions are not necessary for safety considerations. People or animals can safely walk up to the base of the turbines. The wind turbines will be fitted with anti-vibration sensors, which will detect any imbalance caused by icing of the blades. The sensors will cause the turbine to wait until the blades have been de-iced prior to beginning operation. Lightning protection conduits will be integral to the construction of the turbines. The provision of underground electric cables of the capacity proposed is common practice throughout the country and installation to the required specification does not give rise to any specific health concerns. Further details on turbine safety are presented in Section 4.5.2 above.

The site-specific Emergency Response Plan (ERP) will be developed prior to the construction of the facility and will include details on the response required and the responsibilities of all personnel in the event of an emergency.

The Environmental Manager will be responsible for any corrective actions required as a result of an incident e.g. an investigative report or environmental sampling, and will advise the wind farm operator as appropriate.

There will therefore be no effects on health and safety during the operational phase of the proposed development.

4.9.3.3 Employment and Investment

On a long-term scale, the proposed development will create up to six jobs during the operational phase relating to the maintenance and control of the wind farm, having a long-term slight positive effect.

4.9.3.4 Land-use

The footprint of the proposed development site, including turbines, roads etc., will occupy only a small percentage of the total Study Area defined for the purposes of this EIA. The main land-use of commercial peat harvesting will cease prior to the construction of the wind farm and a rehabilitation plan will be implemented as described in Section 5.4 of the EIS. Other land-uses within the wider area, will be unaffected by the proposed development. The design of the proposed development incorporates parking spaces at the site entrances, in order to accommodate use of the completed onsite roads for walking and cycling. Therefore, the proposed development will have moderate positive effect in terms of land-use.

4.9.3.5 Noise

A noise assessment of the operational phase of the proposed development has also been carried out through modelling of the development using noise prediction software, the results of which are presented in Section 10 of this EIS. The predicted noise levels for the proposed development have been compared with the existing background noise levels and the guidance levels for noise emissions from wind farms as set out by the Department of the Environment, Heritage and Local Government (DoEHLG).

It is predicted that noise levels associated with the proposed development will be within best practice noise criteria curves recommended in Irish guidance *'Planning Guidelines for Wind Farm Development 2006'*. While noise levels at low wind speeds will increase, the predicted levels are will remain low, albeit a new source of noise will be introduced into the soundscape.

In the event that exceedances of noise conditions arise, the curtailment of turbine operation can be implemented for the relevant turbines at the specified wind conditions in order to ensure noise levels are within the relevant noise criterion curves/planning conditions. Such curtailment can be applied using the wind farm SCADA system without undue impact on the wind farm operations. The wind farm's SCADA control system can change a particular turbine's operating mode during certain conditions or times, or even turn the turbine off if necessary.

As has been demonstrated in Section 10 of this EIS the relevant national guidance in relation to noise associated with wind turbines can be satisfied, and the predicted effect associated with the operational turbines is long term and not significant.

In relation to the proposed substation the associated effect is long term and not significant.

4.9.3.6 Traffic

During the operational phase the effect on the surrounding local highway network will be negligible given that there will only be a maximum of six staff members on site at any one time. Operation and maintenance activities will therefore have an imperceptible effect on local traffic.

4.9.3.7 Renewable Energy Production and Reduction in Greenhouse Gas Emissions

Emissions from energy production account for 23% of Ireland's greenhouse gas emissions, which is higher than the percentage produced by any other sector. The National Climate Change Strategy 2007 – 2012 states that electricity generation from renewable sources provides the most effective way of reducing the contribution of power generation to Ireland's greenhouse gas emissions.

The proposed development will offer significant benefits in terms of renewable energy production and reductions in greenhouse gas emissions. In this regard it will have a long-term significant positive effect.

4.9.3.8 Tourism and Amenity

The Department of the Environment, Heritage and Local Government's Wind Energy Development Guidelines for Planning Authorities 2006 state that *"the results of survey work indicate that tourism and wind energy can co-exist happily".*

Mountlucas Wind Farm is open for anybody who would like to explore the area. This wind farm received an estimated 15,000 visits in 2015. The visits comprised of guided tours of the site and visitors accessing the walkway/cycle way. Bord na Móna has created a 7 km public walkway-cycleway around the wind farm. This trackway is ideal for a number of activities including, bird watching, nature exploration, cycling, walking and running The walkway-cycleway is accessible all year round (except December 21st) during daylight hours – free of charge. This type of amenity use has been proven on wind farms on cutaway peatlands and will be considered for Cloncreen, as detailed in Section 3.4 of this EIS.

It is noteworthy that the Bord and Móna Ballycon bog lies between the Cloncreen wind farm site and the existing Mountlucas site. In 2006 a program of wetland enhancement work commenced at Ballycon Bog to establish a wetland habitat following the cessation of peat extraction. This area would be considered to form part of the portfolio of rehabilitated cutaway peatlands areas of high biodiversity with the Bord na Móna landbank. The Mountlucas Wind Farm is connected by rail line to Cloncreen that passes through the Ballycon bog. This connection creates the potential for further extension of the existing Mountlucas amenity walkway to Ballycon and also connection to the proposed walkway in Cloncreen. A potential connection between Mountlucas and

Cloncreen will be considered pending permission and construction of Cloncreen wind farm.

It is not considered that the proposed development would have an adverse effect on tourism infrastructure in the vicinity and taking proposals for recreational facilities at the site into consideration, the proposed development would have a long-term slight positive effect on tourism.

4.9.3.9 Shadow Flicker

The amount of shadow flicker that will occur at properties located within the area surrounding the proposed development site has been calculated using the WindFarm Version 4.1.2.3 software package. Some level of shadow flicker is predicted to occur at 56 of the 95 properties modelled for this assessment, assuming worst-case conditions. Of these 95 properties, the WindFarm model predicts that in the absence of appropriate mitigation measures, the DoEHLG guideline values for the total amount of shadow flicker to occur per day may be exceeded at 27 of these properties.

Of the 95 no. properties modelled for this assessment, the total annual guideline limit of 30 hours is predicted to be exceeded at 11 no. properties, assuming worst-case conditions. When the regional sunshine average figure of 29.2% is taken into account, the number of properties at which the annual guideline limit of 30 hours is predicted to be exceeded is reduced to zero.

Mitigation

Where necessary, a screening assessment, screening measures and/or wind turbine control measures will be employed to limit the incidence or duration of shadow flicker at the affected property. As the shadow flicker assessment is based on a "bare-earth" scenario, a screening assessment which accounts for features such as undulations in local topography, built structures such as sheds or walls, or vegetation, may find that there is no requirement for further mitigation strategies. In the absence of screening features as described above, a number of screening measures will be proposed to the property owner, including the installation of window blinds or curtains in affected rooms, planting of screening vegetation or other site specific measures agreeable to the affected party.

Should it not be possible for the parties to agree on a set of appropriate screening measures, turbine control measures will then be used to meet the guidelines thresholds, as described below. In order to demonstrate how the SCADA control system can be applied to switch off particular turbines at the relevant times and dates, Table 4.12 lists the 27 properties at which a shadow flicker mitigation strategy may be necessary to ensure the DoEHLG 30-minute per day shadow flicker threshold is not exceeded. In this case, the relevant turbine(s) would be programmed to switch off for the time required to reduce daily shadow flicker to a maximum of the guideline limit of 30 minutes. The SCADA control system would be utilised to control shadow flicker in the absence of being able to agree suitable screening measures with the relevant property owner. The mitigation strategy outlined in Table 4.12 below is based on the worst-case scenario. The details presented in Table 4.12 list the days per year and the turbines that could be programmed to switch off at specific times, in order to reduce daily shadow flicker to a maximum of 30 minutes.

Table 4.12 Shadow Flicker Mitigation Strategy – Turbine Numbers and Dates

Property No.	No. of Days 30min/day Threshold is Exceeded	Turbine(s) Producing Shadow Flicker	Days of Year When Mitigation May Be Required (Day No's)	Post-mitigation Maximum Daily Shadow Flicker (hrs:mins:sec)
1	37	1	46-63, 283-301	00:30:00
6	31	1	1-3, 7-8, 338-340, 344-366	00:30:00
26	25	1	1, 10-11, 336, 346-366	00:30:00
27	69	1, 13	1-24, 322-366	00:30:00
28	58	1, 13	1-19, 327-366	00:30:00
29	48	1, 13	1-24, 322-345, 366	00:30:00
30	31	1, 13	5-20, 327-341	00:30:00
31	57	1, 13	1-13, 16-27, 319-326, 328-331, 334-351, 362-366	00:30:00
79	15	21	16-23, 324-330	00:30:00
80	35	21	7-24, 323-339	00:30:00
125	30	21	29-43, 303-317	00:30:00
126	26	17, 21	46-58, 288-300	00:30:00
127	55	17, 21	1-2, 4-6, 51-63, 283-295, 340-342, 345-366	00:30:00
128	23	8, 16	52-61, 106-107, 238-239, 285-293	00:30:00
130	9	8	83-86, 259-263	00:30:00
131	11	8	85-89, 256-261	00:30:00
132	11	8	87-92, 253-258	00:30:00
133	10	8	92-96, 249-253	00:30:00
134	12	8	94-99, 246-251	00:30:00
135	12	7, 8	98-103, 242-247	00:30:00
136	10	7, 8	101-105, 240-244	00:30:00
137	10	7, 8	104-108, 237-241	00:30:00
138	8	7, 8	107-110, 235-238	00:30:00
139	7	7, 8	110-113, 232-235	00:30:00
155	19	7	130-138, 206-215	00:30:00
356	22	17, 21	41-51, 295-305	00:30:00
359	36	19, 20	47-51, 99-111, 235-247, 296-300	00:30:00

Where a shadow flicker mitigation strategy is to be implemented, it is likely that the control mechanisms would only have to be applied to one turbine to bring the duration of shadow flicker down to the 30-minute post-mitigation shadow flicker target.

Overall, the details presented in Table 4.12 demonstrate that using the turbine control system, it will be possible to reduce the level of shadow flicker at any affected property to below the daily guideline limit of 30 minutes, by programming the relevant turbines to switch off at the required dates and times.

Shadow flicker occurs only when the sun is shining. Therefore, if the sun is not shining, or sunlight levels are less than what would be required to cast a shadow, during the dates or times that a particular turbine has been programmed to switch off, there would be no requirement to switch that turbine off. When the mitigation measures are accounted for, there will be no significant residual effects from shadow flicker as a result of the proposed wind farm.

4.9.3.10 Interference with Communication Systems

Wind turbines, like all electrical equipment, produce electro-magnetic radiation and this can interfere with broadcast communications. This interference can be overcome by the installation of deflectors or repeaters (Department of the Environment, Heritage and Local Government, 2006). As part of the preparation of the EIS, MKO carried out an extensive scoping exercise, which included consultation with national and regional broadcasters and fixed and mobile phone operators. The details regarding the scoping exercise and a full list of consultees are provided in Section 2.9 of this EIS. Copies of scoping replies received are presented in Appendix 2-1 of the EIS.

A 40-metre telecommunications mast is currently located at Cloncreen bog. It is proposed to remove this mast as part of the proposed development. The mast is the property of Bord na Móna plc and if consent is granted for the project, Bord na Móna will enter into discussions with the current telecommunications operators with regard to the provision of an alternative location, an alternative methodology to meet the current operators' requirements or cessation of the service provision.

Further details regarding telecommunications are provided in Section 13.2, Material Assets. If further scoping responses are received, the comments of the consultees will be considered in the construction and operation of the proposed development, subject to the grant of planning permission. When mitigation measures are employed, there will be no effects on the operation of communication systems.

4.9.3.11 Residential Amenity

Potential effects on residential amenity during the operational phase of the proposed wind farm could arise primarily due to noise, shadow flicker or changes to visual amenity. Detailed noise and shadow flicker modelling has been carried out as part of this EIS, which shows that the proposed development will be capable of meeting all required guidelines in relation to noise and shadow flicker thresholds. Cognisance of potential revisions to the current guidelines has also been had, and in the event of lower thresholds for noise or shadow flicker being implemented, the appropriate mitigation measures can be used to meet the updated requirements.

The visual effect of the proposed development is addressed comprehensively in Section 10 of this EIS. The proposed development has been designed to maximise turbine separation distances to dwellings in the area, with no turbines located within 700 metres of a dwelling. Given this distance, and the level of existing screening in the area, the proposed development will have no significant effect on existing visual amenity at dwellings.

Mitigation

No turbines are proposed within 700 metres of any occupied dwellings. All mitigation as outlined under noise and vibration, dust, traffic, visual amenity and telecommunications in this EIS will be implemented in order to reduce insofar as possible effects on residential amenity at properties located in the vicinity of the proposed development works, including along the proposed turbine and construction materials haul route.

Residual Effect
The proposed development will have an imperceptible effect on residential amenity.

4.9.4 Cumulative Impact Assessment

For the assessment of cumulative impacts, any other existing, permitted or proposed developments (wind energy or otherwise) have been considered where they had the potential to generate an in-combination or cumulative effect with the proposed Cloncreen wind farm. Further information on the developments, plans and projects considered as part of the cumulative assessment are given in Section 2.10 of this EIS. The impacts with the potential to have cumulative effects on human beings, in particular noise, shadow flicker and visual effects are addressed in the relevant chapters.

4.9.4.1 Employment and Economic Activity

The permitted Yellow River wind farm is located within 20 kilometres of the proposed development site (minimum distance of 9.2 kilometres). The Yellow River and Cloncreen projects will contribute to short term employment during their construction stages and provide the potential for long-term employment resulting from maintenance operations. This results in a long-term significant positive effect.

Other projects as described in the cumulative assessment in Section 2.10.2 of this EIS also have the potential to provide employment in the short term.

4.9.4.2 Tourism

4.9.4.2.1 Recreation and Amenity

Designated sections, to be indentifed post-construction, of the internal road network at Cloncreen will be available for use as a public walkway-cycleway. This represents a positive cumulative effect in conjunction with the existing 7-kilometre public walkway-cycleway at Mountlucas wind farm.

The Bord na Móna Ballycon bog lies between the Cloncreen wind farm site and the existing Mountlucas site. In 2006 a program of wetland enhancement work commenced at Ballycon Bog to establish a wetland habitat following the cessation of peat extraction. The Mountlucas wind farm is connected by rail line to Cloncreen that passes through the Ballycon bog. This connection creates the potential for further extension of the existing Mountlucas amenity walkway to Ballycon and also connection to the proposed walkway in Cloncreen, thereby enhancing the potential positive cumulative effect.

4.9.4.2.2 Traffic

As stand alone projects or cumulatively, the construction phase of projects will have a short-term slight to moderate negative effect on tourism as nuisance from construction traffic is unavoidable.

Mitigation
Phased development will be employed to allow for construction traffic to be managed and to minimise the volume of construction traffic using the road network at any one time. The proposed phasing is set out in Chapter 3 and Chapter 13.

Residual Effect
Short term slight negative effect

4.9.4.3 Health and Safety

The proposed wind farm will have no effects in terms of health. There is no credible scientific evidence to link wind turbines with adverse health effects.

4.9.4.4 Property Values

There is no statistical evidence that home prices near wind turbines are affected post or pre construction periods after announcing development. A long-term imperceptible cumulative effect is anticipated.

4.9.4.5 Services

Potential cumulative effect through injection of money into local services though short and long-term employment and community gain fund. This is expected to be a long-term positive cumulative effect.

4.9.4.6 Shadow Flicker

As discussed in Section 4.7.5.3 above, no cumulative shadow flicker will occur at properties in the vicinity of the proposed wind farm.

4.9.4.7 Residential Amenity

In the unlikely event of all permitted and proposed projects as described in the cumulative assessment in Section 2.7 of this EIS being constructed at the same time, there is the potential for a resulting cumulative negative effect to occur on residential amenity.

Mitigation
No turbines are proposed within 700 metres of any occupied dwellings. All mitigation as outlined under noise and vibration, dust, traffic, visual amenity and telecommunications in this EIS will be implemented in order to reduce insofar as possible effects on residential amenity at properties located in the vicinity of the proposed development works, including along the proposed turbine and construction materials haul route. It is assumed also that all mitigation measures in relation to the other cumulative projects will also be implemented.

Residual Effect
The proposed development will have an imperceptible effect on residential amenity.

4.10 Conclusion

Following consideration of the residual effects (post-mitigation) it is noted that the proposed development will not result in any significant effects on Human Beings in the area surrounding the proposed development. Although some level of shadow flicker is predicted to occur at 56 no. of the 95 no. properties modelled for this assessment assuming worst-case conditions, the employment of suitable mitigation measures will ensure that there is no exceedance of the DoEHLG Wind Energy Guideline daily values at any of the properties. When the regional sunshine average figure of 29.2% is taken into account, the number of properties at which the annual guideline limit of 30 hours is predicted to be exceeded is zero. Provided that the proposed wind farm development is constructed and operated in accordance with the design, best practice and mitigation that is described within this application, significant effects on human beings are not anticipated at international, national or county scale.

5 FLORA AND FAUNA

5.1 Introduction

This chapter assesses the ecology of the receiving environment for the proposed Cloncreen Wind Farm development. This chapter does not include Ornithology, which is addressed in Chapter 6 of this EIS.

The ecology of the area surrounding the proposed development is first assessed in terms of habitats and species. The area over which the proposed development has the potential to result in effects (zone of influence) is then determined. Following this, the chapter identifies the Key Ecological Receptors within the zone of influence and accurately assesses the potential for effects thereon.

This chapter quantifies any potential effects relating to flora/fauna and KERs and identifies the measures required to avoid, reduce and mitigate likely significant effects. Identification of effects and prescribed mitigation has been derived following a collaborative approach working with a multi-disciplinary team including project engineers, ecologists, hydrologists and hydrogeologists. The results of ecological surveys have been utilised to inform the design of the proposed development, thereby minimising potential effects on sensitive habitats and species of conservation interest.

The assessment of the development site began with a desk study of available published data on sites designated for nature conservation, other ecologically sensitive sites, habitats and species of interest in the vicinity of the proposed development. A review of OSI mapping, online environmental web-mappers and ortho-photography was also undertaken. The baseline information obtained from the desk study was the first stage in defining a zone of influence of the proposed development.

Following the desk studies, including review of previously completed ecological surveys, multi-disciplinary ecological walkover surveys (As per Section 4.2 of *Ecological Survey Techniques for Protected Flora and Fauna during the Planning of National Schemes*' (NRA, 2009)) were conducted of the development site, grid connection and transport delivery route. A multi-disciplinary survey aims to undertake habitat assessment through classification, mapping and compilation of flora species lists and habitat suitability assessments for faunal species. The ecological surveys undertaken provided vital baseline information regarding the existing ecology of the study area.

In terms of definitions, a habitat is the environment in which an animal or plant lives, generally defined in terms of vegetation and physical structures. Habitats and species of ecological significance occurring/likely to occur within the zone of influence (ZOI) study area were classified as Key Ecological Receptors (KERs). A KER is defined as a site, habitat, ecological feature, assemblage, species or individual that occurs within the vicinity of a proposed development upon which effects are likely.

The ZOI has been determined by careful scientific analysis of the receiving environment within which the development is located. The ZOI includes the full extent of surface water catchments to their coastal outfalls, which include the designated sites which support connectivity with the development. Habitats and foraging routes remote from the development particularly for mammal species were all considered in the establishment of the ZOI. In this regard, the ZOI includes the development site, the grid connection route, the transport delivery route, European Sites (cSACs and SPAs), River Catchments, and Bat roost locations.

Throughout 2014, 2015 & 2016, a range of specialist ecological survey work has been undertaken to provide comprehensive information on all ecological aspects of the ZOI. These surveys include detailed analysis of potential protected habitats and species, aquatic assessment, Bat surveys, Mammal surveys including Otter and Badger and protected Flora surveys. The studies and survey work undertaken provide a comprehensive inventory of the flora and fauna of the study area.

Using the comprehensive assessment of the existing environment (baseline conditions), it has been possible to accurately predict the likely effects of the proposed development on the KERs and correctly assign an ecological significance to them.

Where detrimental effects have been identified, detailed and specific mitigations have been developed in accordance with the hierarchy of options suggested in the research for the European Commission publication, *'Managing Natura 2000 Sites - The provisions of Article 6 of the 'Habitats' Directive 92/43/EEC',* 2000. The adopted approach was - Avoid at source, reduce at source, abate on site, and finally abate at receptor. These measures have been incorporated into the proposed development as part of the avoidance and environmental protection strategy.

The information provided in this EIS chapter, accurately and comprehensively describes the baseline ecological environment; provides an accurate prediction of the likely ecological effects of the proposed development; prescribes mitigation as necessary; and, describes the residual ecological effects. The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate guidelines as fully described in the methodology section below.

5.1.1 Statement of Authority

Ecological baseline surveys undertaken in 2016, were conducted by McCarthy Keville O'Sullivan (MKO) ecologists; Pat Roberts B.Sc. (Env.) MCIEEM, John Hynes B.Sc. (Env.) M.Sc (Eco) GradCIEEM, Barry O'Loughlin B.Sc. (Env.) M.Sc (Eco) MCIEEM, Laoise Kelly B.Sc. (Env.) and Susan Doyle B.Sc. (Env.) M.Sc (Eco). All surveyors have relevant academic qualifications and are competent experts in undertaking habitat and ecological assessments to this level.

Inis Environmental Consultants and Malachy Walsh Environmental Consultants have undertaken bat surveys of the site. Ecofact Environmental Consultants have undertaken aquatic surveys of watercourses surrounding the development site. The Bord na Móna Ecology Team have also undertaken detailed habitat assessment of the mapping of pioneer vegetation communities, baseline ecological assessment and preparation of detailed cutaway bog rehabilitation plans for Cloncreen Bog. The above organisations have significant experience in undertaking habitat and ecological assessments to this level. The studies undertaken by the above has informed this EIS assessment.

This EIS chapter has been prepared by a competent expert, John Hynes, and reviewed by Pat Roberts (B.Sc. Environmental Science) who has over 10 years' experience in management and ecological assessment. Pat has supervised the majority of ecological assessments (300+) completed by the company, including more recently, over 200 assessments required in accordance with Article 6(3) of the Habitats Directive. He has worked on many large scale multi-disciplinary projects such as ecological and appropriate assessments of drainage and road scheme projects in the west and southwest.

John Hynes is a qualified Ecologist, with a B.Sc. in Environmental Science from NUI Galway (2010) and a Master's Degree in Applied Ecology, from University College Cork (2011) with four years' post-graduate experience. John's previous experience includes four years in private consultancy, concentrated mainly on aquatic and terrestrial projects for public sector authorities including water and wastewater supply schemes, arterial drainage schemes, national road schemes, wind farm developments, ecological assessments and habitat mapping. Prior to consultancy, John worked within Galway County Council on the Western River Basin District Project as a GIS Assistant/Assistant coordinator where he developed significant GIS and mapping skills. As part of his experience and education, John has developed excelled multidisciplinary field survey skills. John is a keen ornithologist and was a contributor to Birdwatch Ireland's Countryside Bird Survey and River Bird Survey (2013). John is also a contributor to the Bat Conservation Ireland BATLAS surveys.

5.1.2 Relevant Legislation

National Legislation

The Wildlife Acts of 1976-2012 are the Acts of the Oireachtas protecting wildlife (including game) and flora in the Republic of Ireland. The basic designation for wildlife in Ireland is the Natural Heritage Area (NHA). This is an area considered important for the habitats present or which holds species of plants and animals whose habitat needs protection. Under the Wildlife Amendment Act (2000), NHAs are legally protected from damage from the date they are formally proposed for designation.

In addition, there are proposed NHAs (pNHAs), which were published on a non-statutory basis in 1995, but have not since been statutorily proposed or designated. These sites are of significance for wildlife and habitats.

Prior to statutory designation, pNHAs are subject to limited protection, in the form of:

- Agri-environmental farm planning schemes
- Forest Service requirement for NPWS approval before they will pay afforestation grants on pNHA lands
- Recognition of the ecological value of pNHAs by Planning and Licencing Authorities.

Section 21 of the Wildlife Act, 1976 is set out in the Flora (Protection) Order, 2015, which supercedes orders made in 1980, 1987 and 1999. It is illegal to cut, uproot or damage the listed species in any way, or to offer them for sale. This prohibition extends to the taking or sale of seed. In addition, it is illegal to alter, damage or interfere in any way with their habitats. This protection applies wherever the plants are found and is not confined to sites designated for nature conservation.

Designated Sites of European Importance

The Habitats Directive, together with the Birds Directive forms the cornerstone of Europe's nature conservation policy. It is built around two pillars: the Natura 2000 network of protected sites and the strict system of species protection. The aim of the Habitats Directive is to contribute towards maintaining biodiversity throughout Member States through the conservation of natural habitats and wild flora and fauna. The Birds Directive seeks to protect all wild birds and their most important habitats across their entire natural range within the EU.

With the introduction of the EU Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC) (replaced with 2009/147/EC) which were transposed into Irish law as S.I. No. 94/1997 European Communities (Birds and Natural Habitats) Regulations 1997, the European Union formally recognised the significance of protecting rare and endangered species of flora and fauna, and also their habitats. The 1997 Regulations and their amendments were subsequently revised and consolidated in S.I. No. 477/2011- European Communities (Birds and Natural Habitats) Regulations 2011. This legislation requires the establishment and conservation of a network of sites of particular conservation value that are to be termed 'European Sites'.

Habitats Directive/Special Areas of Conservation

Articles 3 – 9 of the EU Habitats Directive (92/43/EEC) provide the EU legislative framework of protecting rare and endangered species of flora and fauna, and habitats. Annex I of the Directive lists habitat types whose conservation requires the designation of Special Areas of Conservation (SAC). Priority habitats, such as Turloughs, which are in danger of disappearing within the EU territory are also listed in Annex I. Annex II of the Directive lists animal and plant species (e.g. Marsh Fritillary, Atlantic Salmon, and Killarney Fern) whose conservation also requires the designation of SAC. Annex IV lists animal and plant species in need of strict protection such as Lesser Horseshoe Bat and Otter, and Annex V lists animal and plant species whose taking in the wild and exploitation may be subject to management measures. In Ireland, species listed under Annex V include Irish Hare, Common Frog and Pine Marten.

Species can be listed in more than one Annex, as is the case with Otter and Lesser Horseshoe Bat which are listed on both Annex II and Annex IV.

Birds Directive/Special Protection Areas

Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds (Birds Directive) has been substantially amended several times. In the interests of clarity and rationality the said Directive was codified in 2009 and is now cited as Directive 2009/147/EC. The Directive instructs Member States to take measures to maintain populations of all bird species naturally occurring in the wild state in the EU (Article 2). Such measures may include the maintenance and/or re-establishment of habitats in order to sustain these bird populations (Article 3).

A subset of bird species has been identified in the Directive and are listed in Annex I as requiring special conservation measures in relation to their habitats. These species have been listed on account of inter alia: their risk of extinction; vulnerability to specific changes in their habitat; and/or due to their relatively small population size or restricted distribution. Special Protection Areas (SPAs) are to be identified and classified for these Annex I listed species and for regularly occurring migratory species, paying particular attention to the protection of wetlands (Article 4).

Invasive Species Legislation

At an international level Ireland has signed up to a number of treaties and conventions, including the Convention on Biological Diversity. Such treaties and conventions require the Irish Government to address issues of invasive alien species. This has been implemented through the Wildlife Act 1976 and 2000 and further regulated through the European Communities (Birds and Natural Habitats) Regulations 2011 (SI 477 of 2011).

Regulations 49 and 50 of these regulations include legislative measures to deal with the dispersal and introduction of invasive alien species:

Regulation 49:

> '*a person shall be guilty of an offence if they: plant; disperse; allow or cause to disperse; spread or cause to grow the plant in the Republic of Ireland'. The list of species in the Third Schedule includes Japanese Knotweed, Giant Knotweed and their hybrid Bohemian Knotweed*.

Regulation 50:

> '*an offence to or intend to; import; buy; sell; breed; reproduce or propagate; offer or expose for sale; advertise; publish a price list; transport; and distribute any plant species or vector material listed in the Third Schedule*'.

Non-native species subject to restrictions under Regulations 49 and 50 are included in the third schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2011). The Third Schedule Invasive species include: Japanese Knotweed, Giant Hogweed, Giant Knotweed, Giant Rhubarb, Himalayan Balsam, Himalayan Knotweed, Bohemian Knotweed and Rhododendron.

5.1.3 Relevant Guidance

The assessment methodology is based primarily upon the National Road Authority (NRA)'s Guidelines for Assessment of Ecological Impacts of National Road Schemes Rev 2 (NRA, 2009) (referred to hereafter as the NRA Ecological Impact Assessment Guidelines), and the survey methodology is based on the NRA Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna on National Road Schemes (NRA, 2009).

In addition, regard was paid to the guidelines listed below in the preparation of this document to provide the scope, structure and content of the assessment. They are among the recognised guidance in Environmental Impact Assessment and National Road Scheme assessments.

- *Guidelines for Ecological Impact Assessment in the UK and Ireland. Terrestrial, Freshwater and Coastal* (CIEEM, 2016).
- *Advice Notes on Current Practice (in preparation of Environmental Impact Statements)* (Environmental Protection Agency (EPA), 2003).
- *Guidelines on the information to be contained in Environmental Impact Statements* (EPA, 2002).
- *Draft Revised guidelines on the information to be contained in Environmental Impact Statements* (EPA, 2015).
- *Environmental Impact Assessment of National Road Schemes –A Practical Guide* (NRA, 2009).
- *Guidelines for assessment of Ecological Impacts of National Road Schemes*, (NRA, 2009).
- *Environmental Assessment and Construction Guidelines* (NRA, 2006).

5.2 Methodology

This section describes the methodologies followed in the compilation of this EIS chapter. Recognised guidelines were followed in relation to every aspect of the scoping, survey and assessment.

5.2.1 Desk Study

The desk study undertaken for this assessment included a thorough review of the available ecological data including the following:

- Review of online web-mappers: National Parks and Wildlife Service (NPWS), Teagasc, EPA, Water Framework Directive (WFD), Geological Survey of Ireland (GSI), Inland Fisheries Ireland (IFI) & Irish Wetland Bird Survey I-WeBS.
- Review of the Bat Conservation Ireland (BCI) Private Database
- Review of the publically available National Biodiversity Data Centre (NBDC) web-mapper
- Inland Fisheries Ireland (IFI) Reports
- Records from the NPWS web-mapper and review of specially requested records from the NPWS Rare and Protected Species Database for the hectads which overlap with the study area.

5.2.2 Fieldwork

Field work in relation to habitats mammals, bats and aquatic surveys have been conducted for the Cloncreen site. These surveys were undertaken between 2013 and 2016. The methodologies for these surveys are outlined in the sections below.

In 2016 McCarthy Keville O'Sullivan completed a multidisciplinary survey of the development site. This bespoke survey was designed to provide comprehensive information on all ecological aspects of the ZOI and to provide the information required to complete a comprehensive assessment of potential effects on Flora and Fauna. It also provided a ground-truthing exercise in relation to the results of the field studies and desk studies that had previously been undertaken in relation to the Cloncreen site.

5.2.2.1 Ecological Surveys Bord na Móna (2015)

In 2015, Bord na Móna prepared an Ecological survey report for the Cloncreen site which is provided as Appendix 5-1 to this EIS. The report was informed by surveys undertaken in 2010 and 2015. Habitats within the Cloncreen site were identified in accordance with the Bord na Móna habitat classification scheme (Appendix 5-1). The surveys were multidisciplinary in nature and aimed to identify the habitats and species diversity of the site and to inform cutaway bog rehabilitation planning for the site.

5.2.2.2 Mammal Walkover Surveys (INIS Environmental Consultants)

Mammal walkover surveys were conducted by INIS Environmental Consultants in 2014 and 2015. The relevant extracts from the INIS Mammal Survey Report are provided in Appendix 5-2. The aim of the INIS survey was to determine a species list and general pattern of usage of the development site and adjacent habitats by non-volant mammals. A multi-disciplinary approach was taken, with five types of survey methods employed:

- Walked Transects Surveys
- Remote Camera Trapping Surveys
- Small Mammal Trapping Surveys
- Ink-pad Tunnel Surveys
- Hinterland Otter Survey

5.2.2.3 Bat Surveys

Prior to 2016, bat surveys have been conducted at the Cloncreen site by INIS Environmental Consultants and Malachy Walsh and Partners. A summary of the surveys undertaken is outlined below.

5.2.2.3.1 Bat Survey (INIS Environmental Consultants)

A baseline bat survey for a number of Bord na Móna sites was completed by INIS Environmental Consultants in 2013. Relevant extracts from the report which pertain to the Cloncreen site are provided in Appendix 5-3 (Annex 1) of this EIS. The Cloncreen site was included in the assessment and the site was surveyed using three methods:

- Hand held heterodyne bat detectors (Batbox Duet) used for bat activity transects
- Static recording using the ANABAT SD1
- Bat roost surveys within Bord na Móna land parcels and adjoining habitats.

Further details on the survey methodologies can be found in Appendix 5-3.

5.2.2.3.2 Bat Survey (Malachy Walsh and Partners)

Bat surveys were conducted during the 2015 survey season during the months of March, May, June, July, August and November. Three forms of survey design were implemented and included;

- Roost surveys (daytime visual search and bat activity surveys within the study area)
- Bat Activity surveys (bat transects), and
- Automated bat surveys.

Relevant extracts from the report which pertain to the Cloncreen site are provided in Appendix 5-3 (Annex 2) of this EIS.

5.2.2.4 Aquatic Surveys (Ecofact Environmental Consultants)

As part of a high level feasibility study, examining the potential for developing cutaway peat land and other adjacent lands in the east midlands area, Ecofact Environmental Consultants were commissioned to undertake aquatic surveys of watercourses within and in proximity to Bord na Móna sites. Surveys were conducted at 47 sampling locations. The Aquatic Survey Report provides an overview of the habitats and plants, fish, aquatic macroinvertebrates and biological and chemical water quality at each of the 47 sampling locations. A description of site location, physical characteristics, habitats, vegetation community, macroinvertebrate community, biological water quality, chemical water quality and species specific survey results are detailed on a site by site basis. Surveys were undertaken during the period July to November 2014. The relevant extracts from the Aquatic Survey Report are provided as Appendix 5-4 of this EIS.

None of the 47 aquatic sampling locations were located within the Cloncreen development site. However, water sampling location FW19 is located on the boundary of the Cloncreen development site, on a tributary of the Philipstown River. Sampling location FW20 is located on the Figile River which has downstream connectivity with the Cloncreen development site. Three additional sampling sites, FW15, FW16 and FW17 are located in proximity to the Cloncreen site but the watercourses have no hydrological connectivity with the development site.

5.2.2.5 Ecological Surveys 2016 (McCarthy Keville O'Sullivan)

5.2.2.5.1 Multi-disciplinary walkover survey (as per NRA Guidelines, 2009)

The ecology of the study area was first assessed in a desk study of ecological information that was pertinent to the development site including a review of previously completed ecological surveys as outlined above. This was followed by a multi-disciplinary ecological walkover survey of the study area which incorporated habitat mapping and evaluation. The walkover surveys were undertaken on the 28th and 29th of April, 10th of June 2016 and 28th of July 2016. The survey timing falls within the recognised optimum period for vegetation surveys/habitat mapping, i.e. April to September (Smith et al., 2011).

The previously completed habitat surveys were ground truthed and habitats were classified in accordance with the Heritage Council's *'Guide to Habitats in Ireland'* (Fossitt, 2000). Habitat mapping was undertaken with regard to guidance set out in '*Best Practice Guidance for Habitat Survey and Mapping*' (Smith *et al*., 2011). The Bord na Móna habitat map which was mapped in accordance with Bord na Móna habitat classification (developed specifically for Bord na Mona lands and utilising the Fossitt classification) was recast into the Fossitt classification during the ground truthing exercise.

Plant nomenclature for vascular plants follows '*New Flora of the British Isles*' (Stace, 2010), while mosses and liverworts nomenclature follows '*Mosses and Liverworts of Britain and Ireland - a field guide'* (British Bryological Society, 2010).

The walkover surveys were designed to detect the presence, or likely presence, of a range of protected species. The survey included identification of Badger setts and areas of suitable habitat, potential features likely to be of significance to Bats and additional habitat features for the full range of other protected species that are likely to occur in the vicinity of the route (e.g. Otter etc.).

Habitats considered to be of ecological significance and in particular having the potential to correspond to those listed in Annex I of the EU Habitats Directive 92/43/EEC were identified and classified as KERs.

The multi-disciplinary walkover surveys comprehensively covered the entire study area and based on the survey findings, further more detailed targeted surveys were carried out for habitats, features and locations of ecological significance. These surveys were carried out in accordance with NRA *Guidelines on Ecological Surveying Techniques for Protected Flora and Fauna* on National Road Schemes (NRA, 2009).

The locations of turbine bases, hardstanding areas, potential substations and grid connection routes, the site compounds, met mast, internal roads and borrow pits were subject to botanical assessment. The results of the assessment are provided in Appendix 5-5.

5.2.2.6 Faunal Surveys

Prior to conducting field surveys, a desk study of all literature pertinent to the potential faunal assemblage within the study area was undertaken. This included a review of available atlases and databases. Previously completed faunal survey reports, as outlined above, were reviewed. OSI mapping and ortho-photography was reviewed to determine the range of habitats with potential to support protected fauna within the study area including ecological connecting features in the landscape (e.g. hedgerows/treelines, woodland edge habitat and watercourses).

The NPWS were consulted regarding records of rare and protected species from the hectads which overlap with the current study area.

5.2.2.6.1 Otter Survey

Following a review of the previously completed ecological surveys and the results of the multi-disciplinary walkover survey; areas identified as providing potential habitat for Otter were subject to specialist targeted survey. The Otter survey of watercourses was conducted on the 10th of June 2016. The survey work was completed by John Hynes and Pat Roberts.

The Otter survey was conducted as per NRA (2009) guidelines (Ecological Surveying Techniques for Protected Flora and Fauna during the Planning of National Road Schemes). This involved a search for all Otter signs e.g. spraints, scat, prints, slides, trails, couches and holts. In addition to the width of the rivers/watercourses, a 10m riparian buffer (both banks) was considered to comprise part of the Otter habitat (NPWS 2009. Threat Response Plan: Otter (2009-2011). The dedicated Otter survey also followed the guidance as set out in NRA (2008) *'Guidelines for the Treatment of Otters Prior to the Construction of National Roads Schemes'*.

5.2.2.6.2 Badger Survey

Following a review of the previously completed ecological surveys; areas identified as providing potential habitat for Badger and previously identified sett locations were subject to specialist targeted survey. The Badger survey was conducted in order to determine the presence or absence of Badger signs within and outside (areas of identified suitable habitat) the development footprint and study area. This involved a search for all potential Badger signs as per NRA (2009) (latrines, badger paths and setts). Setts were classified as per the convention set out in NRA (2009) (i.e. Main, Annexe, Subsidiary, Outlier).

The Badger survey was conducted adhering to best practice guidance (NRA, 2009) and was cognisant of 'Guidelines for the Treatment of Badger Prior to the Construction of National Roads Schemes' (NRA, 2006a) in order to determine the presence of badger signs along and adjacent to the development footprint. Whilst the best time for undertaking Badger surveys is between November and April, when vegetation cover is reduced, the Badger survey conducted in June 2016 was not constrained by vegetation or season and a comprehensive survey was conducted.

The survey work was completed by John Hynes and Pat Roberts.

5.2.2.6.3 Bat Surveys

Following a review of the previously completed ecological surveys and the results of the multi-disciplinary walkover survey, areas identified as providing potential habitat for Bats and previously identified bat activity locations were subject to specialist targeted survey. The Bat Survey Report including detailed methodologies results and discussion is provided as Appendix 5-3 and is summarised below.

The overall aim of surveying at wind turbine/farm sites is to identify and assess the potential effects the proposed development is likely to have on local populations of bat species present on and around the site and hence on national bat populations (BCI 2012). Reference to the following best practice guidelines informed the design of the 2016 Bat surveys and the interpretation of results:

- Bat Conservation Ireland (2012) *Wind Turbine/Wind Farm Development Bat Survey Guidelines*
- Collins, J. (ed.) (2016). *Bat Surveys for Professional Ecologists: Good Practice Guidelines (3rd Edition)*. Bat Conservation Trust (BCT). Published after field survey work undertaken however informed the assessment.
- National Roads Authority (2006) *Guidelines for the treatment of bats during the construction of national road schemes*. National Roads Authority, Dublin, Ireland.

Night Time Detection Surveys, Fixed Point Detector Surveys & Potential Roost Surveys were conducted during the 2016 surveys. The Night Time Detection Surveys were conducted over five survey periods (i.e. a survey period related to a dusk and dawn survey) and the study area was divided and systematically surveyed by two survey teams. EM3 wildlife acoustic real time expansion bat detectors and Pettersen Ultrasound D200 heterodyne bat detectors were used by the surveyors to pick up the echolocation calls of any bats on the site.

In addition to the walked transect surveys, Song Meter SM3BAT bioacoustic static bat recording devices were deployed within the study area. These devices were positioned in contrasting areas (i.e. in areas of suitable habitat, identified from ortho-photography and field assessment, and open areas towards the center of the development site. The detectors were set to record from sunset to sunrise using the Solar Calculation Method (based on GPS location) which schedules recordings relative to sunrise and sunset times.

The data recorded were analysed using appropriate bat detection software (Wildlife Acoustics Kaleidoscope version 1.13). Echolocation signal characteristics (including signal shape, peak frequency of maximum energy, signal slope, pulse duration, start frequency, end frequency, pulse bandwidth, inter-pulse interval and power spectra) were compared to published signal characteristics for local bat species (Russ, 1999).

The structures and landscape features were examined in relation to bat suitability were graded in accordance with Table 4.1 of Collins, J (ed.), (2016). The grading protocol is divided into four Suitability Categories: High, Moderate, Low and Negligible.

Tables 5.1a and 5.1b below summarises the 2016 survey effort in relation to the Bat assessment of the proposed development.

Table 5.1a 2016 Bat Survey Transect Effort Summary

Date	Surveyor	Type	Sunset/Sunrise (hh:mm)	Start-Finish (hh:mm)	No. hours (hh:mm)
28th/29th April 2016	Pat Roberts	Dusk	20:53	20:30-23:30	03:00
		Dawn	05:56	04:30-06:00	01:30
26th/27th May 2016	John Hynes	Dusk	21:39	21:10-00:20	03:10
		Dawn	05:11	03:45-05:15	01:30
	Laoise Kelly	Dusk	21:39	21:10-00:20	03:10
		Dawn	05:11	03:45-05:15	01:30
30th June/1st July 2016	John Hynes	Dusk	21:59	21:28-23:40	02:12
		Dawn	05:06	02:50-05:00	02:10
28th/29th July 2016	John Hynes	Dusk	21:29	21:00-23:45	02:45
		Dawn	05:41	04:05-05:40	01:35
	Laoise Kelly	Dusk	21:29	21:00-23:35	02:35
		Dawn	05:41	04:00-05:40	01:40
23rd/24th August 2016	John Hynes	Dusk	20:37	20:10-23:10	03:00
		Dawn	06:25	05:00-06:35	01:35
	Laoise Kelly	Dusk	20:37	20:10-23:10	03:00
		Dawn	06:25	05:00-06:35	01:35
Total Survey Time (hh:mm)					**35:57**

Table 5.1b: Description of fixed point locations

ID	Survey Period	Grid Reference	Habitat Type
FP-1	28th April – 15th May 2016	258540, 224888	Bog woodland edge, adjacent to cutover bog.
FP-2	27th May – 15th June 2016	258540, 224888	Bog woodland edge, adjacent to cutover bog.
FP-3	27th May – 15th June 2016	258546, 226257	Open cutover bog
FP-4	28th July – 7th August 2016	257625, 225812	Cutover bog & scrub, adjacent to railway tracks

5.2.2.6.4 Additional Fauna

During the multi-disciplinary ecological walkover surveys the potential for the study area to support additional protected mammals such as Irish Hare, Pine Marten, Red Squirrel, Pygmy Shrew, Irish Stoat, Hedgehog, amphibians and additional fauna was assessed. The walkover survey was designed as a ground-truthing exercise to verify the findings of the previously completed mammal surveys.

5.2.2.7 Flora

Two nationally rare plant species, Basil Thyme (*Clinopodium acinos*) and Blue Fleabane (*Erigeron acer*) were recorded during the 2010 and 2015 habitat survey completed at the Cloncreen site by Bord na Móna.

Basil Thyme is listed on the Flora Protection Order 2015 and is also listed in the Irish Red Data Book (Curtis and McGough 1988). Blue Fleabane is listed in the Irish Red Data Book (Curtis and McGough 1988). Both species are not typical of bog habitat and are found along the railway tracks and hardstanding areas which were constructed, in the past, from material sourced from eskers or gravel pits.

Targeted surveys for Basil Thyme and Blue Fleabane were conducted in accordance with NRA 2009. The surveys were undertaken on the 27th of July 2016, during the fruiting/flowering season of Basil Thyme and Blue Fleabane which is July to August (Parnell and Curtis 2012).

Targeted 'look-see' searches were conducted, during which surveyors completed an exhaustive search of the habitat features likely to support the protected species. The survey aimed to confirm the presence of the protected species and to accurately map the location of the individuals/populations using a GPS. An estimate of population size and extent was derived.

5.2.2.8 Invasive Alien Species

During field surveys, a search for Invasive Alien Species (IAS) listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015) was conducted. Regulations 49 and 50 of these Regulations include legislative measures to deal with the dispersal and introduction of invasive alien species. Regulation 50 has not yet been commenced. IAS are also addressed by EU Regulation 1143/2014, which seeks to address the problem of invasive alien species in a comprehensive manner so as to protect native biodiversity and ecosystem services, as well as to minimise and mitigate the human health or economic impacts that these species can have.

5.2.3 Methodology for Assessment of Effects

5.2.3.1 Ecological Evaluation

Ecological evaluation and Effect assessment within this chapter follows a methodology that is set out in Chapter 3 of the *'Guidelines for Assessment of Ecological Impacts of National Roads Schemes'* (NRA, 2009). These guidelines set out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The guidelines provide a basis for determination of whether any particular site is of importance on the following scales:

- International
- National
- County
- Local Importance (Higher Value)
- Local Importance (Lower Value)

The NRA Ecological Impact Guidelines (2009) clearly sets out the criteria by which each geographic level of importance can be assigned. Locally Important (lower value) receptors contain habitats and species that are widespread and of low ecological significant and of any importance only in the local area. Internationally Important sites are either designated for conservation as part of the Natura 2000 Network (SAC or SPA) or provide the best examples of habitats or internationally important populations of protected flora and fauna.

All habitats and species within the development site were assigned a level of significance on the above basis and the ZOI and KERs were established and classified on this basis.

5.2.3.2 Assessment of Effects

Reference is made to the following parameters wherever appropriate when characterising effects:

- Magnitude relates to the quantum of effect, for example the number of individuals affected by an activity;
- Extent should also be predicted in a quantified manner and relates to the area over which the effect occurs;
- Duration is intended to refer to the time during which the effect is predicted to continue, until recovery or re-instatement;
- Reversibility should be addressed by identifying whether an effect is ecologically reversible either spontaneously or through specific action; and,
- Timing/frequency of effects in relation to important seasonal and/or life-cycle constraints should be evaluated. Similarly, the frequency with which activities (and associated effects) would take place can be an important determinant of the effect on receptors.

It is necessary to ensure that any assessment of effect takes account of construction and operational phases; direct, indirect and synergistic effects; and, those that are temporary, reversible and irreversible. The criteria for assessment of effect magnitude, type and significance are given in Table 5.2 and 5.3. The following terms are defined when quantifying duration: (EPA, 2002):

- Temporary – up to 1 year
- Short-term – 1 to 7 years
- Medium term – 7 to 15 years

- Long term – 15 to 60 years
- Permanent – over 60 years

Table 5.2 Criteria for assessing significance of effects based on (EPA, 2002)

Effect Magnitude	Definition
No change	No discernible change in the ecology of the affected feature
Imperceptible Effect	An effect capable of measurement but without noticeable consequences
Slight Effect	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
Moderate Effect	An effect that alters the character of the environment that is consistent with existing and emerging trends
Significant Effect	An effect which, by its character, its magnitude, duration or intensity alters a sensitive aspect of the environment
Profound Effect	An effect which obliterates sensitive characteristics

Table 5.3 Criteria for assessing effect quality based on (EPA, 2002)

Effect Type	Criteria
Positive	A change which improves the quality of the environment e.g. increasing species diversity, improving reproductive capacity of an ecosystem or removing nuisances
Neutral	A change which does not affect the quality of the environment
Negative	A change which reduces the quality of the environment e.g. lessening species diversity or reducing the reproductive capacity of an ecosystem

Once the potential effects are characterised, the significance of any such effects on the identified KERs will be determined following the NRA Guidelines (2009) and the *'Guidelines on the information to be contained in Environmental Impact Statements'* (EPA, 2002, as revised 2015 and currently in Draft form as at 29/04/2016).

The significance of any identified effects is determined following guidance set out in Section 3.4.4.3 of the guidelines (NRA, 2009) whereby effects are assigned significance empirically on the basis of an analysis of the factors which characterise them, irrespective of the value of the receptor. Significance is determined by effects on conservation status or integrity, regardless of geographical level at which these would be relevant.

If effects are not found to be significant at the highest geographical level at which the resource has been valued, they may be significant at a lower level and this is determined sequentially. Similarly, effects that do not affect the integrity of a site, may nevertheless affect the conservation status of a valuable constituent habitat or species, at a lower geographic scale. An equivalent approach has been applied to mitigation measures prescribed, which may have a significant beneficial effect, but at a higher or lower geographic scale than the receptor to which they have been applied.

5.2.3.3 Mitigation

The development has been designed to specifically avoid, reduce and minimise effects on all KERs. Where potential significant effects on KERs are predicted, mitigation has been prescribed to address such effects. In addition, mitigation has been employed to avoid, reduce, abate potential effects and in some cases it is predicted to result in an enhancement of the biodiversity value of an area.

Proposed best practice design and mitigation measures are specifically set out and are realistic in terms of cost and practicality. They have been subject to detailed design and will effectively address the effects on the identified KERs.

The potential effects of the proposed development were considered and assessed to ensure that all effects on KERs are adequately addressed and no significant residual effects are likely to remain following the implementation of mitigation measures / best practice.

5.2.3.4 Limitations

The information provided in this EIS chapter accurately and comprehensively describes the baseline ecological environment; provides an accurate prediction of the likely ecological effects of the proposed development; prescribes mitigation as necessary; and, describes the residual ecological effects. The specialist studies, analysis and reporting have been undertaken in accordance with the appropriate guidelines.

No limitations in the scope, scale or context of the assessment have been identified.

5.3 Description of the Baseline Environment

5.3.1 Scoping and Consultation

MKO undertook a scoping and consultation exercise during preparation of this EIS, as described in Section 2.9. Table 5.4 provides a list of the organisations consulted, with regard to Flora and Fauna, during the scoping process. Copies of all scoping responses are included in Appendix 2-1 of this EIS. The recommendations of the consultees have informed the EIS preparation process and the contents of this Flora and Fauna Chapter of the EIS.

Table 5.4 Scoping Response Summary

No.	Consultee	Response (to Scoping Document issued 10th September 2015)	Response (to Proposed Final Layout issued 22nd April 2016)
1	An Taisce	Email received 11/09/15	No response as of 30/09/16
2	Bat Conservation Ireland	No response as of 24/06/16	No response as of 30/09/16
3	BirdWatch Ireland	Email received 02/02/16	No response as of 30/09/16
4	Department of Agriculture, Food and the Marine	No response as of 30/09/16	No response as of 30/09/16
5	Department of Arts, Heritage and the Gaeltacht	Letter received 20/10/15	Email received 04/05/16. Letter received 14/06/16
6	Geological Survey of Ireland	No response as of 30/09/16	No response as of 30/09/16
7	Inland Fisheries Ireland	Letter received 18/09/15	No response as of 30/09/16

No.	Consultee	Response (to Scoping Document issued 10th September 2015)	Response (to Proposed Final Layout issued 22nd April 2016)
8	Irish Aviation Authority	Letter received 02/11/15	Email sent to Bord na Móna 30/06/16
9	Irish Environmental Network	Email received 14/09/15	No response as of 30/09/16
10	Irish Peatland Conservation Council	Letter received 29/09/15	No response as of 30/09/16
11	Irish Wildlife Trust	No response as of 30/09/16	No response as of 30/09/16
12	Kildare County Council Planning Section	Letter received 08/10/15	Letter received 03/05/16
13	Mr. Colm Malone, Local NPWS Ranger	Phone call with MKO Ecologist 13/01/16	-
14	Offaly County Council Planning Section / Roads Section / Environment Section / Heritage Officer	Letter received 16/10/15. Meetings held – see Section 2.9.3 in Chapter 2 of this EIS	Meetings held – see Section 2.9.3 of Chapter 2 of this EIS
15	South Eastern River Basin District	No response as of 30/09/16	No response as of 30/09/16
16	The Heritage Council	No response as of 30/09/16	No response as of 30/09/16

Table 5.5 below summarises the key scoping responses received in the relation to the Flora and Fauna of the study area. Table 2.3 of Chapter 2 presents the key points in relation the scoping responses received from all additional consultees, and notes where they have been addressed in this EIS. If further responses are received, the comments of the consultees will be considered in the construction and operation of the proposed development, subject to a grant of planning permission

Table 5.5 Review of Scoping Responses

No.	Consultee	Key Scoping Response Points	Comment
1	An Taisce	▪ Consultation for any proposal to be integrated with a peat-cutting cessation and restoration plan by Bord na Móna for all of its landholdings.	▪ Peat-cutting works are projected to cease at Cloncreen in 2018, prior to construction of the proposed development. All commercial extraction of peat for electricity production by Bord na Mona will cease in 2030.
2	BirdWatch Ireland	▪ See Item No. 10 below: Irish Whooper Swan Study Group consultation	▪ See Item No. 6 below: Irish Whooper Swan Study Group consultation
3	Department of Arts, Heritage and the Gaeltacht	▪ Ecological survey of the site required, including the route of any access roads, pipelines, cables etc., to survey habitats and species present. Any improvement or reinforcement works required for access and transport along the proposed haul route to also be subjected to ecological impact assessment.	▪ Ecological survey of site, including access roads, grid connection route and turbine haul route completed – See Chapter 5: Flora & Fauna, Chapter 6: Ornithology, Appropriate Assessment (AA) Screening Report, and Natura Impact Statement (NIS)
		▪ EIS to detail survey methodology, timing and results.	▪ Completed – See Sections 5.2 and 6.2
		▪ EIS to cover the whole project, including construction, operation and restoration / decommissioning phases.	▪ Completed – each phase is addressed throughout EIS
		▪ EIS to include Alternatives examined.	▪ Completed – See Section 2.8
		▪ Inland Fisheries Ireland (IFI) should be consulted.	▪ Completed – See Section 2.9.1
		▪ Baseline data on designated sites, habitats and species available online.	▪ Baseline data reviewed as part of desk study – See Section 5.3
		▪ Assess impacts, where applicable, with regard to: Natura 2000 sites, protected species and habitats, landscape features of major importance for wild flora and fauna, and biodiversity in general.	▪ Completed – See Section 5.4
		▪ EIS to assess cumulative impacts with other plans and projects, including non-wind farm projects.	▪ Completed – See Section 2.10 and cumulative impact section of each EIS chapter. Cumulative plans addressed in Natura Impact Statement
		▪ EIS to address the issue of invasive alien plant and animal species.	▪ Completed – See Section 5.4.3.6

		▪ EIS should provide an estimate of the length of hedgerow that will be lost, if any. Where trees or hedgerows have to be removed, there should be suitable planting of native species in mitigation. Where possible, hedgerows and trees should not be removed during the nesting season (i.e. March 1st to August 31st).	▪ Completed – See Section 5.4.3
		▪ Bat roosts may be present in trees, buildings and bridges. Bat roosts can only be destroyed under licence under the Wildlife Acts and a derogation under the Habitats Regulations, and such a licence would only be given if suitable mitigation measures were implemented. Where so-called bat friendly lighting is proposed as mitigation it should be proven to work as mitigation.	▪ No bat roosts are present on site, on grid connection route or on proposed turbine haul route – See Section 5.3.3.2
		▪ Any watercourse or wetland impacted on should be surveyed for the presence of protected species and species listed on Annexes II and IV of the Habitats Directive, such as Otter, Salmon, Lamprey, Freshwater Pearl Mussel, White-clawed Crayfish, Frogs, Newts and Kingfisher.	▪ Completed – See Section 5.3.3.2
		▪ Construction work should not impact on water quality, and measures should be detailed to prevent sediment and/or fuel runoff into watercourses.	▪ Noted – See Section 3.3.13.2 for measures to prevent sediment and/or fuel runoff into watercourses
		▪ If applicable the EIS should take account of the guidelines for Planning Authorities entitled *"The Planning System and Flood Risk Management"* (Department of the Environment, Heritage and Local Government, 2009).	▪ Completed – See Chapter 8 and Appendix 8-1 for Flood Risk Assessment
		▪ Ground and surface waters quality should be protected during construction and operation of the proposed development and if applicable the applicant should ensure that adequate sewage treatment facilities and water supplies are or will be in place prior to any development.	▪ Noted – See Section 3.6 for ground and surface water quality protection measures. See Sections 3.3.7 and 3.3.11 for sewage treatment and water supply proposals
		▪ Survey work should include 2 years of bird data. Survey methodologies should follow best practice and if necessary be modified to reflect the Irish situation. It is important that bird	▪ Noted – See Section 6.2 on bird survey methodology

		migration routes are considered as well as routes of birds travelling on a daily basis between roosting and feeding areas.	
		▪ A bat survey will be required.	▪ Completed – See Section 5.2.2.3
		▪ Complete project details including construction management plans (CMPs) need to be provided in order to allow an adequate EIS and appropriate assessment to be undertaken. The CMPs and other such plans must present adequate and effective mitigation, supported by scientific information and analysis, and be feasible within the physical constraints of the site.	▪ Completed – See Section 3: Description chapter and Construction & Environmental Management Plan in Appendix 3-2
		▪ If applicants are not in a position to decide the exact cable route location and details at time of application, then they need to consider the range of options that may be used in their assessment so that all issues are covered.	▪ Two potential grid connection options have been identified and are assessed in the EIS – See Section 5.3.3
		▪ EIS should identify any pre and post-construction monitoring which should be carried out. The applicant should not use any proposed post-construction monitoring as mitigation to supplement inadequate information in the assessment. Post-construction monitoring should include bird and bat strikes/fatalities including the impact on any such results of the removal of carcasses by scavengers. Monitoring results should be made available to the competent Authority and copied to this Department. A plan of action needs to be agreed at planning stage with the Planning Authority if the results in future show a significant mortality of birds and/or bat species.	▪ Noted – See Sections 5.5 and 6.8 on monitoring proposals
		▪ Should the exact height and rotor diameter of the turbines to be used not be known at EIS stage then the assessment of impacts must be applicable to a variety of turbine heights and rotor diameters which could be used. This should be made clear in EIS.	▪ Completed – See Section 3.3.1
		▪ In order to carry out the appropriate assessment screening, and/or prepare the Natura Impact Statement (NIS), information about the relevant Natura 2000 sites including their conservation objectives will need to be collected. Other	▪ Completed – See Section 2.9.1 regarding consultation, and accompanying Natura Impact Statement (NIS)

		relevant Local Authorities should be consulted to determine if there are any projects or plans which, in combination with this proposed development, could impact on any Natura 2000 sites.	
		▪ If proposed development is adjacent to a Natura 2000 site and involves landscaping or a garden, care should be taken to ensure that no terrestrial or aquatic invasive species are used which could impact negatively on these sites.	▪ Proposed development is not located adjacent to Natura 2000 site. No terrestrial or aquatic invasive species will be used in landscaping.
		▪ Where there are impacts on protected species and their habitats, resting or breeding places, licenses may be required under the Wildlife Acts or derogations under the Habitats Regulations. Should this survey work take place well before construction commences, it is recommended that an ecological survey of the development site should take place immediately prior to construction to ensure no significant change in the baseline ecological survey has occurred.	▪ Noted – See Section 5.5
		▪ Previous archaeological surveys of the bog should be examined.	▪ Completed – See Section 12.2.1
		▪ A new survey of the bog should be carried out. Survey work should be undertaken by an archaeologist working under the terms of an excavation licence.	▪ Noted – See Section 12.2.3 on survey methodology
		▪ Proposed site layout should be considered in light of the surveys.	▪ Noted – See Section 12.1.3
		▪ Implications of substations and grid connection for archaeological remains should be assessed.	▪ Completed – See Section 12.4.3.3
		▪ Archaeological mitigation should be suggested, to take place in advance of and/or during groundworks.	▪ Noted – See Sections 12.4.3 and 12.4.4
		▪ It is likely, that where material is to be preserved in situ, empirical measurement into the future of hydrology of the site will be required.	▪ Noted – See construction phase mitigation measures in Section 12.4.3
4	Inland Fisheries Ireland	▪ Smaller watercourses and the Bord na Móna drainage network have the potential to convey deleterious matter from construction works to the Philipstown and Figile Rivers. Systems should be put in place to ensure there shall be no discharge of suspended solids or any other deleterious matter	▪ Noted. Systems will be in place to prevent any material discharge of suspended solids or any other deleterious matter to watercourses during construction or operational phase or

		to watercourses during the construction / operational phase and landscaping works.	landscaping works – See Section 3.6 on Site Drainage.
		▪ All natural watercourses to be traversed during site development and road construction works should be effectively bridged prior to commencement. If temporary crossing structures are required, IFI approval will be necessary. Design and choice of temporary crossing structures must provide for passage of fish and macroinvertebrates, protection of important fish habitats, and prevent erosion and sedimentation.	▪ Noted. No new watercrossings are proposed as part of the development. One existing culvert will be extended at the western boundary of the site.
		▪ Access for angling on the Philipstown and Figile Rivers will be required; thus it would be helpful to identify proposed locations for construction and operational access.	Noted – See Section 3.5 on turbine haul route and site access locations. Access to the Philipstown and Figile Rivers will not be affected.
		▪ The crossing of important fisheries waters in relation to the grid connection should be addressed.	▪ No water crossings are required as part of grid connection works – See Section 3.3.9
		▪ Permanent crossing structures should not damage fish habitat or create blockages to fish and macroinvertebrate passage.	▪ Noted
		▪ OPW should be consulted at an early stage in the design process regarding flood risk management.	▪ Completed – See Section 2.9.1
		▪ Specific design recommendations are provided for bridges and culverts, and bank protection works.	▪ Noted – See Section 3.6.5
		▪ Guidelines provided on the timing of instream works.	▪ No instream works are required
		▪ Assess and critically review the soil type and structure at proposed turbine and access road locations.	▪ Completed – See Chapter 7 and Peat Stability Assessment in Appendix 7-1
		▪ Incorporate best practices into construction methods to minimise discharges of silt/suspended solids to waters. A comprehensive plan should be drawn up with specific measures to address the high potential for silt pollution of nearby watercourses during works on site.	▪ Completed – See Section 3.6
		▪ Natural flow paths should not be interrupted or diverted so as to give rise to or create potential for erosion.	▪ Noted. Natural flow paths will not be interrupted or diverted

		▪ Pre-cast concrete should be used whenever possible, to eliminate the risk to aquatic life. When cast-in-place concrete is required, all work must be done in the dry and isolated from any water that may enter the drainage network. Specific controlled and environmentally safe vehicle washout areas must be provided.	▪ Noted – See Section 3.3.13
		▪ All oils and fuels should be secured in secure bunded areas, and particular care and attention should be taken during refuelling and maintenance operations on plant and equipment. All plant and equipment should carry oil/fuel spill kits.	▪ Noted – See Section 3.3.13.2
		▪ Where site works involve discharges of drainage water to receiving rivers and streams, temporary oil interceptor facilities should be installed and maintained.	▪ Noted – See Section 3.6.5
		▪ No instream works on or with the potential to impact on fisheries waters shall be carried out with the written approval of IFI.	▪ Noted. No instream works are proposed
5	Irish Peatland Conservation Council	▪ Aerial image shows small remnant of intact raised bog habitat within proposed development area. Ensure this area fully classified and described in EIS.	▪ Area of intact raised bog habitat is outside the proposed development area – See habitat map with proposed development footprint in Section 5.3.3.1
		▪ There should be strong consultation links with the Bord na Móna Ecology team. Current and historical reports from the Ecology team should be reviewed and be included as part of the EIS.	▪ Completed – See Section 5.2.1
6	Irish Whooper Swan Study Group	▪ Direct consultation with MKO Ecology team; Study Group unaware of any significant historical swan flocks in the area; recommended contacting BirdWatch Ireland for latest I-WeBS data. ▪ BirdWatch Ireland sent list of sites on database that are either wholly or partially within Co. Offaly.	▪ Noted – See Section 6.2.1

5.3.2 Desk Study

5.3.2.1 Designated Sites in Relation to the Study Area

Using the GIS software, MapInfo (Version 10.0), designated sites within the potential zone of influence (15km buffer) of the proposed development were identified (as per DoEHLG (2010) *Appropriate Assessment of Plans and Projects in Ireland Guidance for Planning Authorities. Department of the Environment, Heritage and Local Government*). In addition, using the precautionary principle, designated Sites located outside the 15km buffer zone were also taken into account and assessed. However, potential for effect on designated sites located outside the 15km buffer zone was not identified. The designated sites in the zone of influence are listed below in Tables 5.6 and 5.7 and are displayed on Figure 5.1.

5.3.2.1.1 Nationally Designated Sites

The locations of the Nationally designated sites within the identified ZOI of the proposed development are displayed on Figure 5.1. The potential for the proposed development to results in adverse effects on these NHAs and pNHAs was considered and is presented in Table 5.6 below.

Table 5.6 Designated sites in the Zone of Influence

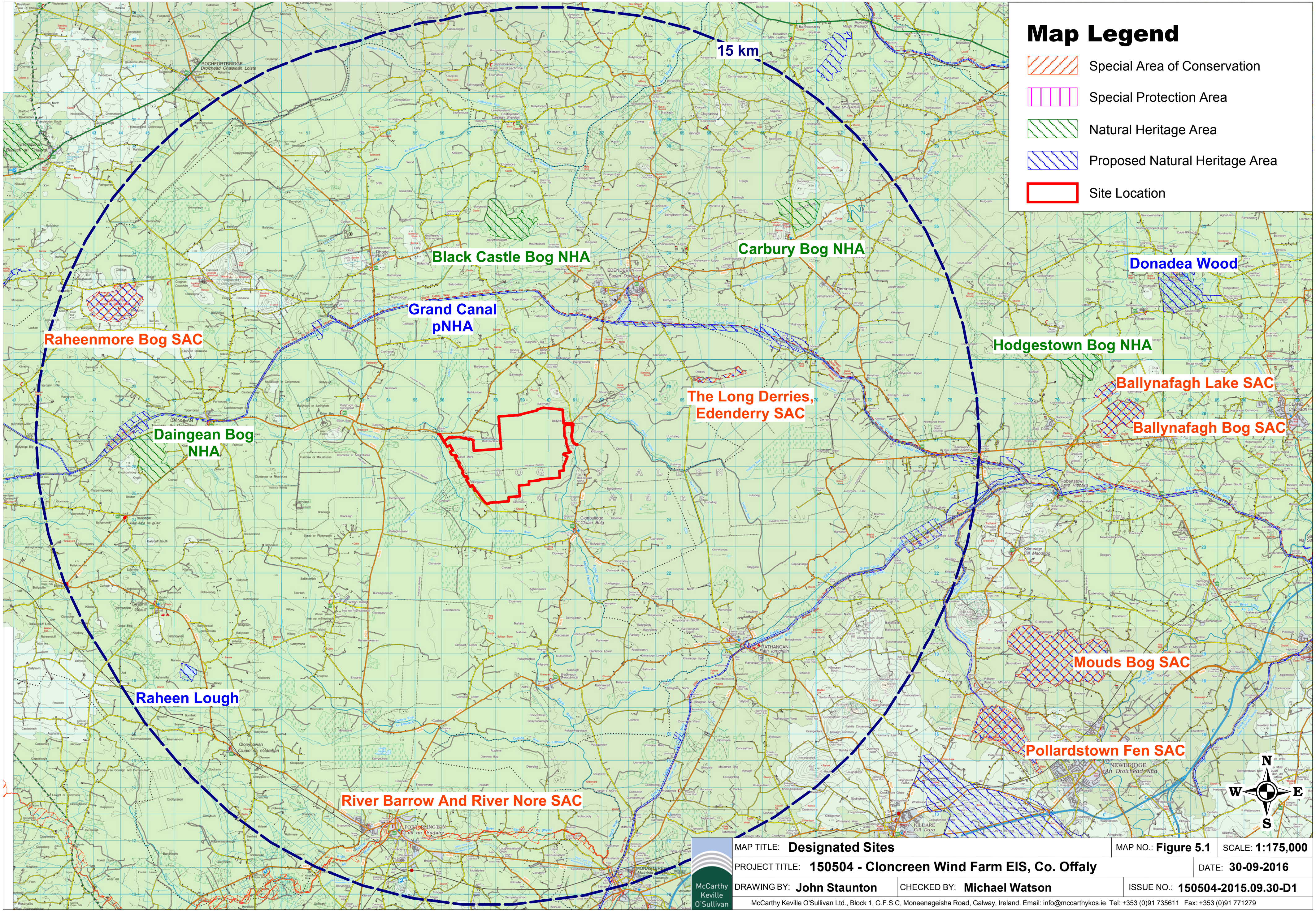
Designated site and code	Distance from proposed works (Km)	Pathway for Effect
Natural Heritage Area (NHA)		
Black Castle Bog NHA (000570)	6.3km North	No pathways by which the proposed development could affect these terrestrially based NHAs were identified during the assessment.
Daingean Bog NHA (002033)	9.9km West	
Carbury Bog NHA (001388)	10.9km North-east	
Proposed Natural Heritage Area (pNHA)		
Grand Canal pNHA (002104)	3.5km North	No pathways by which the proposed development could affect these pNHAs were identified during the assessment.
The Long Derries, Edenderry pNHA (000925)	4.9km East	
Raheen Lough pNHA (000917)	12.3km South-west	
Raheenmore Bog pNHA (000582)	12.3km North-west	

None of the NHAs or pNHAs within the ZOI were considered as KERs in their own right for the following reasons:

- Distance from the proposed development (nearest site 3.5km to the North)
- Nature of the conservation sites (e.g. terrestrial nature of habitats)
- There are no sites with hydrological connectivity which could potentially be effected (See Chapter 8 of the EIS).

5.3.2.1.2 European Sites

The locations of the European designated sites within the identified ZOI of the development are displayed on Figure 5.1. The potential for the proposed development to have an effect on these European sites was considered and is presented in Table 5.7 below.



MAP TITLE: **Designated Sites**		MAP NO.: **Figure 5.1**	SCALE: **1:175,000**
PROJECT TITLE: **150504 - Cloncreen Wind Farm EIS, Co. Offaly**			DATE: **30-09-2016**
DRAWING BY: **John Staunton**	CHECKED BY: **Michael Watson**	ISSUE NO.: **150504-2015.09.30-D1**	

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Table 5.7 Designated sites in the Zone of Influence

Designated site and code	Distance from proposed works (Km)	Effect Pathway
Special Area of Conservation (SAC)		
The Long Derries, Edenderry SAC (000925)	4.9km East	No pathways by which the proposed development could effect this SAC were identified during the assessment.
River Barrow and River Nore SAC (002162)	12.1km South (20km via surface water)	There is hydrological connectivity between the proposed development and the SAC. There is potential for effects in relation to emissions.
Raheenmore Bog SAC (000582)	12.3km North-west	No pathways by which the proposed development could effect this SAC were identified during the assessment.
Special Protection Area (SPA)		
There are no Special Protection Areas within 20km of the development site. Dedicated Bird Surveys have been conducted at the Cloncreen site and surrounding area in accordance with Scottish Natural Heritage Guidelines (SNH, 2014) during the following survey periods: ▪ Winter/non-breeding season of 2013/14 (Oct – Mar), ▪ Breeding season 2015 (Mar/Apr – Aug), ▪ Winter/non-breeding season of 2015/16 (Sept – Mar), and ▪ Breeding season of 2016 (April – August) A variety of field survey methodologies were utilised, having regard to the species composition and assemblages that were likely to occur within the study area: ▪ Initial Site Assessment ▪ Vantage Point (VP Surveys) ▪ Transect Surveys ▪ Adapted Brown and Shepard surveys ▪ Wetland Waterbird Counts and Waterbird Records Survey methods have been undertaken in line with best practice guidelines and provide coverage of the development site and surrounding environs. The results of the surveys provide detailed data to allow a robust assessment to be carried out. The nearest SPAs are Lough Ennell SPA, located 23.4 km to the north-west and Slieve Bloom Mountains SPA, located 23.7km to the south-west. The SCI species for Lough Ennell SPA are Pochard (*Aythya feria*), Tufted Duck (*Aythya fuligula*) and Coot (*Fulica atra*). None of these species were recorded within the Cloncreen development site during the dedicated bird surveys. Hen Harrier (*Circus cyaneus*) is the SCI species of Slieve Bloom Mountains SPA. The development site is outside the core (2km) and maximum (10km) foraging range of this species during the breeding season as per SNH (2013). Hen Harrier was only observed on four occasions within the Cloncreen study area: twice during the non-breeding (winter) season 2013/2014 and twice during the breeding season		

2016. Hen Harrier does not occur with regularity at the Cloncreen site and there are no winter roosts or breeding territories within or surrounding the study area. Hen Harrier is not dependent on the habitats of the study area for breeding, roosting, foraging or commuting purposes and significant effects on this species are not anticipated.

No significant records of migratory bird species were recorded within a 2-3km radius of the proposed development site during field surveys.

No SPAs are deemed to be in the Zone of Influence of the proposed windfarm development.

With regard to European Sites, a Screening assessment was carried out to provide An Bord Pleanála, with the information necessary to complete a Screening for Appropriate Assessment for the proposed development in compliance with Article 6(3) of the Habitats Directive. As part of this assessment, the potential for the proposed development to have an effect on any European sites in the ZOI was considered. The Screening for Appropriate Assessment concluded as follows:

> *"It cannot be excluded, in view of best scientific knowledge, on the basis of objective information that the proposed development, individually or in combination with other plans and projects, would have a significant effect on the following European Site, and as a result an appropriate assessment of the proposed development is required and a Natura Impact Statement shall be prepared in respect of the proposed development.*
>
> - *River Barrow and River Nore SAC (002162)"*

Taking a precautionary approach, the European Site has been included within the Zone of effect of the project in respect to an unmitigated release of emissions, thus the potential for significant effects on this European Site cannot be excluded at this stage of the assessment The potential for effects to occur in relation to the River Barrow and River Nore SAC (002162) have been considered as part of the Natura Impact Statement for the proposed development.

There will be no direct or indirect effects on The Long Derries, Edenderry SAC (000925) or Raheenmore Bog SAC (000582) given that the development site is located entirely outside the designated sites. The Long Derries, Edenderry SAC is designated for a terrestrial grassland habitat. The European site will not be affected by emissions or drainage effects from the operation and construction of the proposed development. No complete source-pathway-receptor chain was identified in relation to potential adverse effects. Consequently, effects on the European Site resulting from the proposed development can be excluded.

Hydrologically the development site and Raheenmore Bog SAC (000582) are not linked and the water regime governing this bog complex will not be affected by emissions or drainage effects from the operation and construction of the proposed development. No complete effect source-pathway-receptor chain was identified. Effects on the European Site resulting from the proposed development can be excluded.

5.3.2.2 Habitats Flora and Fauna

The following sections give an overview of the desk study sources consulted and results obtained during the desk study assessment.

5.3.2.2.1 NPWS Article 17 Datasets and Additional Habitat Databases

A review of the NPWS Habitat Directive - Article 17 datasets, Irish Semi-Natural Grassland Survey datasets, National Survey of Native Woodland datasets along with Long Established Woodland dataset was conducted on the 8th of June 2016, prior to undertaking the multi-disciplinary walkover survey. The datasets were downloaded and overlain on the proposed development study area.

None of the GIS datasets contain region or point data for the Cloncreen Study Area.

The Article 17 GIS point dataset for Alkaline Fen [7230] lists a number of fen complexes to the east of the Cloncreen Study Area (nearest record is Ballycon Fen, located 0.8km to the east). These are located on areas of former milled peat that have been out of production for some time and have naturally revegetated. It is noted that NPWS point dataset is based on a desk study only and field surveys have not been conducted to confirm the records. In addition, the precise location and extent of the fen habitats is not recorded.

The National Survey of Native Woodland datasets has no records for the Cloncreen study area but has records of non-Annex I Bog Woodland located approximately 3.5km to the north-west of the study area.

5.3.2.2.2 National Parks and Wildlife Service Protected Species Records

NPWS online records were searched to see if any rare or protected species of flora or fauna have been recorded from hectads N52 and N62. An information request was also sent to the NPWS requesting records from the Rare and Protected Species Database. Tables 5.8 - 5.10 list rare and protected species records obtained from NPWS.

Table 5.8 Records of European protected species NPWS for N52 and N62

Common Name	Scientific Name	Status
Otter	*Lutra lutra*	Annex II, IV, WA 1976-2012
Common Frog	*Rana temporaria*	Annex V, WA 1976-2012
White-clawed Crayfish	*Austropotamobius pallipes*	Annex II, WA 1976-2012
Marsh Fritillary	*Eurodryas aurinia*	Annex V, WA 1976-2012
Irish Hare	*Lepus timidus hibernicus*	Annex V, WA 1976-2012
Pine Martin	*Martes martes*	Annex V, WA 1976-2012

Table 5.9 Records of species protected under the Flora Protection Order 2015 and Red-listed Species

Common Name	Scientific Name	Status
Basil Thyme	*Clinopodium acinos*	Flora Protection Order
Blue Fleabane	*Erigeron acer*	Red List
Red Hemp-nettle	*Galeopsis angustifolia*	Flora Protection Order
Green-winged Orchid	*Orchis morio*	Red List
Alder Buckthorn	*Frangula alnus*	Red List

Table 5.10 Species protected under the Wildlife Acts 1976-2012), NPWS

Common Name	Scientific Name	Status
Badger	*Meles meles*	WA 1976/2012
Red Squirrel	*Sciuris vulgaris*	WA 1976/2012
Smooth Newt	*Triturus vulgaris*	WA 1976/2012
Hedgehog	*Erinaceus europaeus*	WA 1976/2012

5.3.2.2.3 *Pearl Mussel (Margaritifera margaritifera & Margaritifera durrovensis)*

The Freshwater Pearl Mussel and the Nore Freshwater Pearl Mussel are among the longest-living invertebrates. These species are under increasing pressure from a number of sources and are continuing to decline. Both species are now classified as Endangered on the IUCN Red List of Endangered Species and are listed under Annex II of the EU Habitats Directive. The Study area is located within the Margaritifera Sensitive Area *Barrow* which is classified as a *Catchment with previous records of Margaritifera, but current status unknown.* An information request was sent to the NPWS regarding the current distribution of Margaritifera Species within this catchment. The information provided by NPWS from the *Margaritifera records dataset 2015_v13* indicated that the nearest record for Pearl mussel is located greater than 75km (straight line distance) downstream of the EIS study area. The population of the Nore Freshwater Pearl Mussel for which the River Barrow and River Nore SAC is designated is located on the Nore river (NPWS 2013 & Conservation Objective Document) and has no connectivity to the proposed development as it is located in a separate surface water catchment.

5.3.2.2.4 *National Biodiversity Data Centre Data*

A search of the National Biodiversity Data Centre (NBDC) website was conducted with a focus on records of protected fauna recorded from hectads N52 and N62. The results of the database search are provided below in Table 5.11. Table 5.12 includes records non-native invasive species listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015).

Table 5.11 NBDC records for European protected species records for hectads G74 and G84

Common Name	Scientific Name	Conservation Status	Hectad
Basil Thyme	*Clinopodium acinos*	Flora Protection Order	N52, N62
Blue Fleabane	*Erigeron acer*	Red List	N52, N62
Alder Buckthorn	*Frangula alnus*	Red List	N52, N62
Common Frog	*Rana temporaria*	Annex V, Wildlife Acts	N52, N62
Marsh Fritillary	*Euphydryas aurinia*	Annex II	N62
Freshwater Crayfish	*Austropotamobius pallipes*	Annex II	G52, N62
Large White-moss	*Leucobryum glaucum*	Annex IV	N52, N62
Red Squirrel	*Sciuris vulgaris*	Wildlife Acts	N52, N62
Irish Hare	*Lepus timidus subsp. hibernicus*	Wildlife Acts	N52
West European Hedgehog	*Erinaceus europaeus*	Wildlife Acts	N52
Otter	*Lutra lutra*	Annex II, Wildlife Acts	N52
Pine Marten	*Martes martes*	Annex V, Wildlife Acts	N52
Badger	*Meles meles*	Wildlife Acts	N52
Irish Stoat	*Mustela ermine gibernica*	Wildlife Acts	N52
Smooth Newt	*Lissotriton vulgaris*	Wildlife Acts	N62

Common Name	Scientific Name	Conservation Status	Hectad
Daubenton's Bat	*Myotis daubentonii*	Annex IV, Wildlife Act 1979-2000	N62
Brown Long-eared Bat	*Plecotus auritus*	Annex IV, Wildlife Act 1979-2000	N62
Soprano Pipistrelle	*Pipistrellus pygmaeus*	Annex IV, Wildlife Act 1979-2000	N62

Annex I – Of EU Birds Directive, Annex II, Annex IV, Annex V – Of EU Habitats Directive, Wildlife Acts – Irish Wildlife Acts (1976, 2000).

Table 5.12 Third Schedule non-native invasive species records for hectad N52 and N62

Common Name	Scientific Name	Hectad
Japanese knotweed	*Fallopia japonica*	N62
Nuttall's Waterweed	*Elodea nuttallii*	N62
Canadian Waterweed	*Elodea canadensis*	N52

5.3.2.2.5 New Flora Atlas

A search was made in the *New Atlas of the British & Irish Flora* (Preston et al. 2002) to identify if any rare or protected plant species have been previously recorded from the hectads in which the proposed development is located i.e. (N62 and N52). The search targeted vascular plants that are listed in Annex II of the EU Habitats Directive, the Flora (Protection) Order (FPO) of 2015, and those listed in *The Irish Red Data Book* (Curtis and McGough 1988). The results of the Atlas search are provided in Table 5.13.

Table 5.13 Plant species of conservation concern recorded within hectads N62 & N52.

Common Name	Scientific Name	Hectad	Conservation Status
Red Hemp-nettle	*Galeopsis angustifolia*	N62	FPO, RL
Basil Thyme	*Clinopodium acinos*	N62	FPO
Green-winged Orchid	*Orchis morio*	N52, N62	RL
Blue Fleabane	*Erigeron acer*	N52, N62	RL
Corn Cockle	*Agrostemma githago*	N62	RL
Alder Buckthorn	*Frangula alnus*	N62	RL

RL – Red List, FPO – Flora Protection Order, Annex II – Of EU Habitats Directive

5.3.2.2.6 Bat Conservation Ireland Database

A search for records of bat activity and roosts within a 10km radius of the study area was conducted using the Bat Conservation Ireland database. A number of records have been recorded within 10km of the proposed works: roosts (5), transects (5), ad-hoc observations (11). The results of the database search are provided below in Table 5.14.

Table 5.14 BCI data 10km radius of Cloncreen Site

Survey Type	Hectad/ details	Species recorded	Survey	Bat Species Designation
Roost	Carbury, Clonsat; Co. Kildare	**Roost type**: Unknown **Species** Brown Long-eared Bat (Droppings)	A survey for bat roosts in Church of Ireland Churches	Annex IV
	Disused Church Rahan,	**Roost type**: Unknown	EIA survey – (Scott Cawley)	Annex IV

Survey Type	Hectad/ details	Species recorded	Survey	Bat Species Designation
	Edenderry Co Kildare	**Species** Unidentified Bat (Droppings)		
	Jonestown House, Edenderry, Co Offaly	**Roost type**: Unknown **Species** Unidentified Bat	Buildings At Risk Grant, The Heritage Council	Annex IV
	Morrissey Residence. Rhode, Co. Offaly	**Roost type**: Unknown **Species** Soprano Pipistrelle species	Bats in Houses Project	Annex IV
	Richard and Sarah Tyrell, Coolcor Carbury, Co. Kildare	**Roost type**: Unknown **Species** Brown Long-eared Bat (Droppings)	EIS Survey	Annex IV
Transect	5 No. Transects consisting of multiple individual surveys	Daubenton's Bat, Leisler's Bat, Soprano Pipistrelle, Common Pipistrelle, Unidentified bat	BC Ireland Car Based Bat Monitoring Scheme, All Ireland Daubenton's Bat Waterway Survey	Annex IV
Other Observation	11 No. observation from multiple surveys	Daubenton's Bat, Leisler's Bat, Soprano Pipistrelle, Common Pipistrelle, Unidentified Pipistrelle, Natterer's Bat, Brown Long-eared Bat	BATLAS 2010	Annex IV

5.3.2.2.7 EPA Water Quality Data

The EPA Envision map viewer was consulted on 8th of June 2016 regarding the water quality status of the Rivers which run to the east (Figile River) and west (Philipstown River) of the Study Area. There are no rivers within the study area and the minor watercourses that are present are deepened and straightened. The Biotic Index of Water Quality (BIWQ) was developed in Ireland by the Environmental Protection Agency (EPA). Q-values are assigned using a combination of habitat characteristics and structure of the macro-invertebrate community within the waterbody. Individual macro-invertebrate families are classified according to their sensitivity to organic pollution and the Q-value is assessed based primarily on their relative abundance within a sample. There are two sample stations on the Philipstown River; one located upstream (Esker Bridge) and one located downstream (Daingean) of the study area. Both sampling stations have been assigned Moderate Status (Q3-4).

There are two sampling stations of the Figile River. The Kilcumber Bridge sampling station is located to the east of the study area and has been assigned Moderate Status (Q3-4). The Figile Bridge, Clonbullogue, sampling station is located downstream of the study area and has been assigned Good Status (Q4).

River Basin Management Plans (RBMPs) have been published for all River Basin Districts in Ireland in accordance with the requirements of the Water Framework Directive. The online EPA Envision map viewer provides access to water quality information at individual waterbody level and at Water Management Unit level for all the River Basin Districts in Ireland. Waterbodies can relate to surface waters (these include rivers, lakes, estuaries [transitional waters] and coastal waters) or to groundwater. The WFD River Waterbody Status for the Figile and Philipstown River surrounding the development sites is Moderate; however, the status of the Figile River, downstream of Figile Bridge in Clonbullogue is assigned Good Status.

5.3.2.3 Conclusions of the Desk Study

The desk study revealed that there are no sites designated for nature conservation within a 3.5km radius of the proposed development.

There is potential surface water connectivity between the development site and The River Barrow and River Nore SAC (002162) which is located approximately 20km downstream via the Philipstown, Figile and Black Rivers. Freshwater pearl Mussel and the Nore Freshwater Pearl Mussel are Qualifying Interests of the SAC but the closest historic records for Freshwater Pearl Mussel is located greater than 75km (Straight line distance) downstream of the development site boundary. The Nore Freshwater pearl mussel population is located in the River Nore only (NPWS 2013); therefore, there is no connectivity in relation to this species.

A number of rare and protected habitats, flora and fauna have been recorded from the hectads in which the proposed development is located. The field survey will identify if any of the identified habitats, flora or fauna or additional ecological receptors occur within the study area.

5.3.3 Field Assessment

5.3.3.1 Habitats and Flora in the Existing Environment

5.3.3.1.1 Site Description (Habitats)

Cloncreen bog is situated approximately 4.5 km south west of Edenderry, Co. Offaly along the R401. Edenderry Power Plant is located immediately to the east of the site. Cloncreen bog is located within the Bord na Móna Derrygreenagh bog group, with Ballycon situated to the west and Ballydermot to the east of the site. This area was originally part of The Bog of Allen. Much of Cloncreen bog is in active peat production and is typical of a milled peat bog; divided up by drains, spaced approximately 15m apart, which separate long parallel production fields. Peat production is projected to cease on the site in 2018.

An ash repository is located in the south east corner of the site and is used to store ash from the nearby power station (EPA Licence No. W0049-02, Bord na Móna Energy Ltd.). A former Bord na Móna gravel pit is also present in the northern section of the site. The Cloncreen study area is dominated by Cutover Raised Bog (PB4). This is a variable habitat, or complex of habitats, that in the case of Cloncreen includes mosaics of bare peat and pioneer revegetated areas with secondary woodland, scrub, heath, fen/flush and grassland communities.

In 2015, Bord na Móna prepared an Ecological Survey Report for the Cloncreen site which is provided as Appendix 5-1.

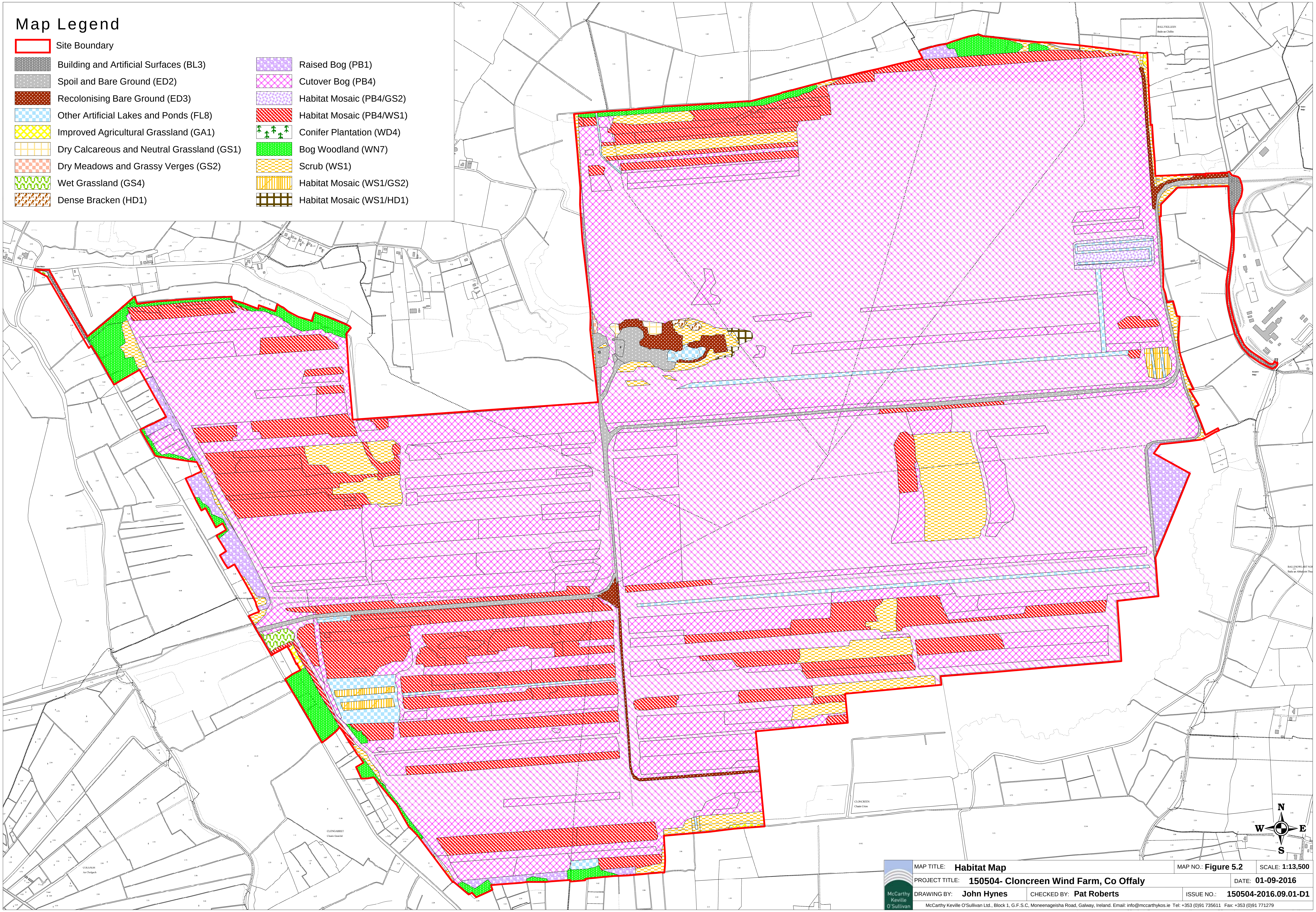
The sections below detail the findings of the Bord na Móna Survey and the multidisciplinary verification surveys undertaken by McCarthy Keville O'Sullivan in 2016. Habitats present within the study area were classified according to the guidelines set out in '*A Guide to Habitats in Ireland*' (Fossitt, 2000), as described above in Section 5.2.2. A habitat map (Figure 5.2) has been created to show the location and relative cover of the habitats recorded. Figures 5.3a and 5.3b show the habitats, with the proposed development footprints (options A &B) superimposed on them. In addition, the site has been mapped in detail as part of the Bord na Móna Ecological Survey (2015). The Bord na Móna map, Figure 5.4, provides detail on the habitats and pioneer vegetation communities which have begun to revegetate area of cutover bog within the Cloncreen site. The habitat map follows the Bord na Móna (Fossitt based) classification system.

The habitats recorded on the study area are listed in Table 5.15.

Table 5.15 Habitats within and adjacent to the wind farm site at Cloncreen, Co. Offaly

Habitat Name	Habitat Code	Area (ha)	% of Study Area
Dry Meadows and Grassy Verges	(GS2)	0.1	0.01
Conifer Plantation	(WD4)	0.12	0.01
Dense Bracken	(HD1)	0.29	0.03
Dry Calcareous and Neutral Grassland	(GS1)	0.51	0.05
Scrub/Dense Bracken Mosaic	(WS1/HD1)	0.54	0.05
Improved Agricultural Grassland	(GA1)	0.56	0.05
Wet Grassland	(GS4)	0.84	0.08
Buildings and Artificial Surfaces	(BL3)	2.17	0.22
Scrub/Dry meadows and grassy verges Mosaic	(WS1/GS2)	2.44	0.25
Cutover bog/Dry meadows and grassy verges Mosaic	(PB4/GS2)	3.18	0.33
Recolonising Bare Ground	(ED3)	5.78	0.60
Raised Bog	(PB1)	11.06	1.15
Spoil and bare ground	(ED2)	13.93	1.44
Other artificial lakes and ponds	(FL8)	14.24	1.48
Bog Woodland	(WN7)	16.61	1.72
Scrub	(WS1)	42.07	4.37
Cutover Bog/Scrub Mosaic	(PB4/WS1)	120.1	12.48
Cutover Bog	(PB4)	727.4	75.60
Dry Meadows and Grassy Verges	(GS2)	0.11	0.01

The Cloncreen study area is dominated by Cutover Raised Bog (PB4) (Plate 5.1). The edge of the study area is bordered by woodland habitats (Broadleaved and Conifer). Small scale turbary is practiced on bog remnants to the east, south and west. There are no rivers or large watercourses within the study area. There is a small stream/drain on the northern boundary. This flows through a Bord na Móna silt pond and then is culverted under the L1003 road and flows west into the Phillipstown River. This watercourse, labelled WC19 in the aquatic survey report, is described in greater



Map Legend
Site Boundary
Building and Artificial Surfaces (BL3)
Spoil and Bare Ground (ED2)
Recolonising Bare Ground (ED3)
Other Artificial Lakes and Ponds (FL8)
Improved Agricultural Grassland (GA1)
Dry Calcareous and Neutral Grassland (GS1)
Dry Meadows and Grassy Verges (GS2)
Wet Grassland (GS4)
Dense Bracken (HD1)
Raised Bog (PB1)
Cutover Bog (PB4)
Habitat Mosaic (PB4/GS2)
Habitat Mosaic (PB4/WS1)
Conifer Plantation (WD4)
Bog Woodland (WN7)
Scrub (WS1)
Habitat Mosaic (WS1/GS2)
Habitat Mosaic (WS1/HD1)
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MAP NO.: Figure 5.2
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DATE: 01-09-2016
DRAWING BY: John Hynes
CHECKED BY: Pat Roberts
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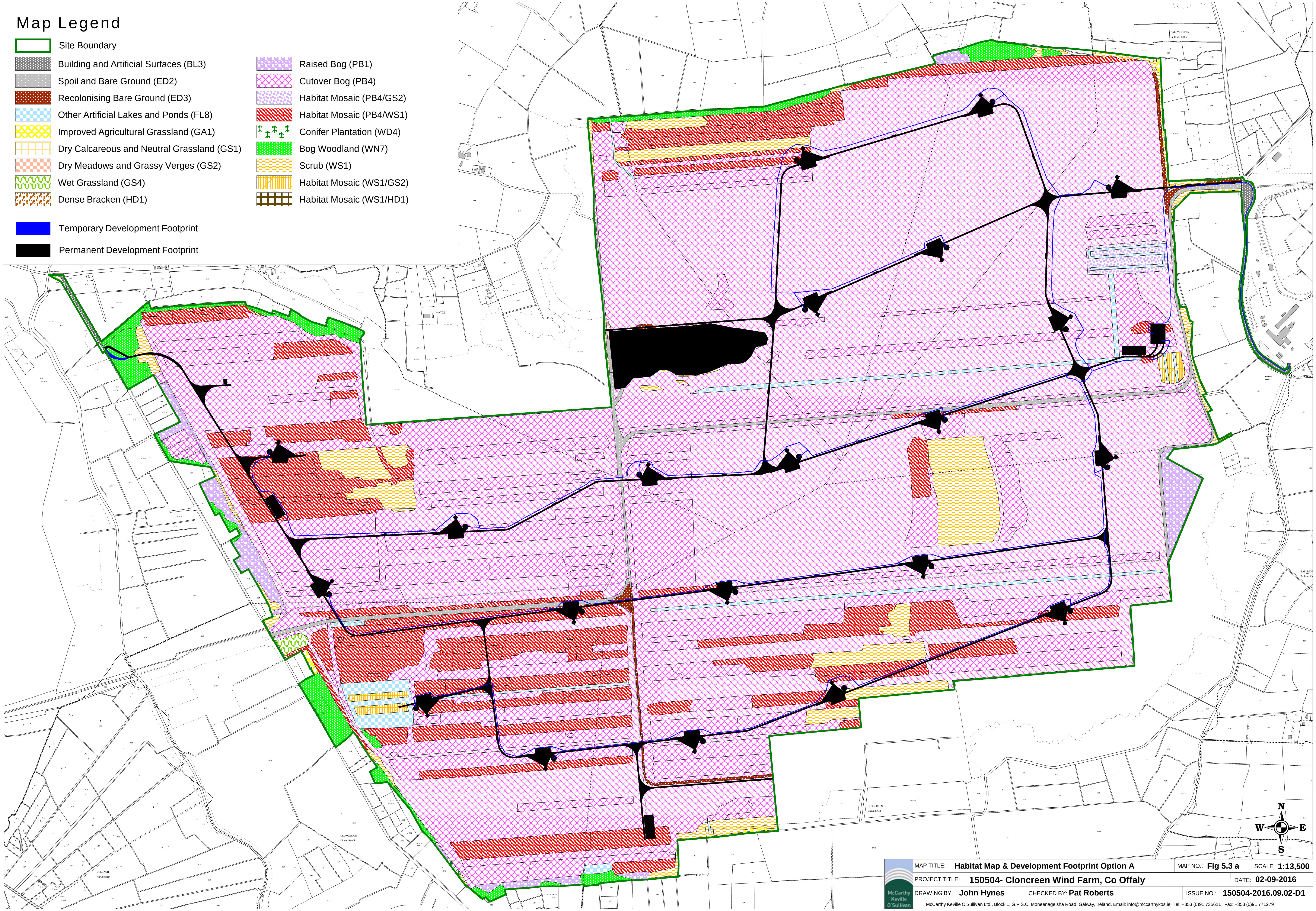
Map Legend
Site Boundary
Building and Artificial Surfaces (BL3)
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Wet Grassland (GS4)
Dense Bracken (HD1)
Raised Bog (PB1)
Cutover Bog (PB4)
Habitat Mosaic (PB4/GS2)
Habitat Mosaic (PB4/WS1)
Conifer Plantation (WD4)
Bog Woodland (WN7)
Scrub (WS1)
Habitat Mosaic (WS1/GS2)
Habitat Mosaic (WS1/HD1)
Temporary Development Footprint
Permanent Development Footprint
N
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MAP TITLE: Habitat Map & Development Footprint Option A
MAP NO.: Fig 5.3 a
SCALE: 1:13,500
PROJECT TITLE: 150504- Cloncreen Wind Farm, Co Offaly
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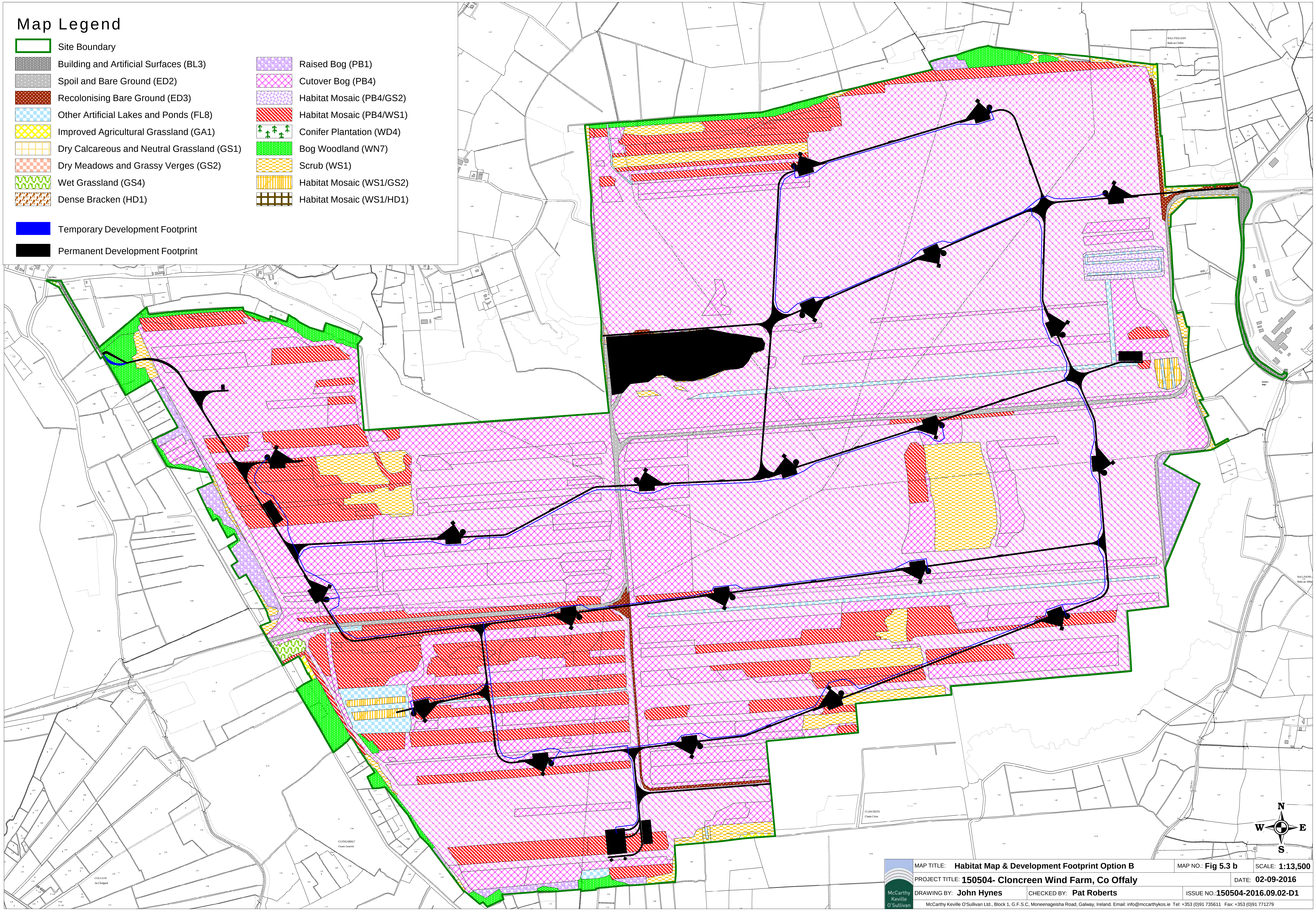

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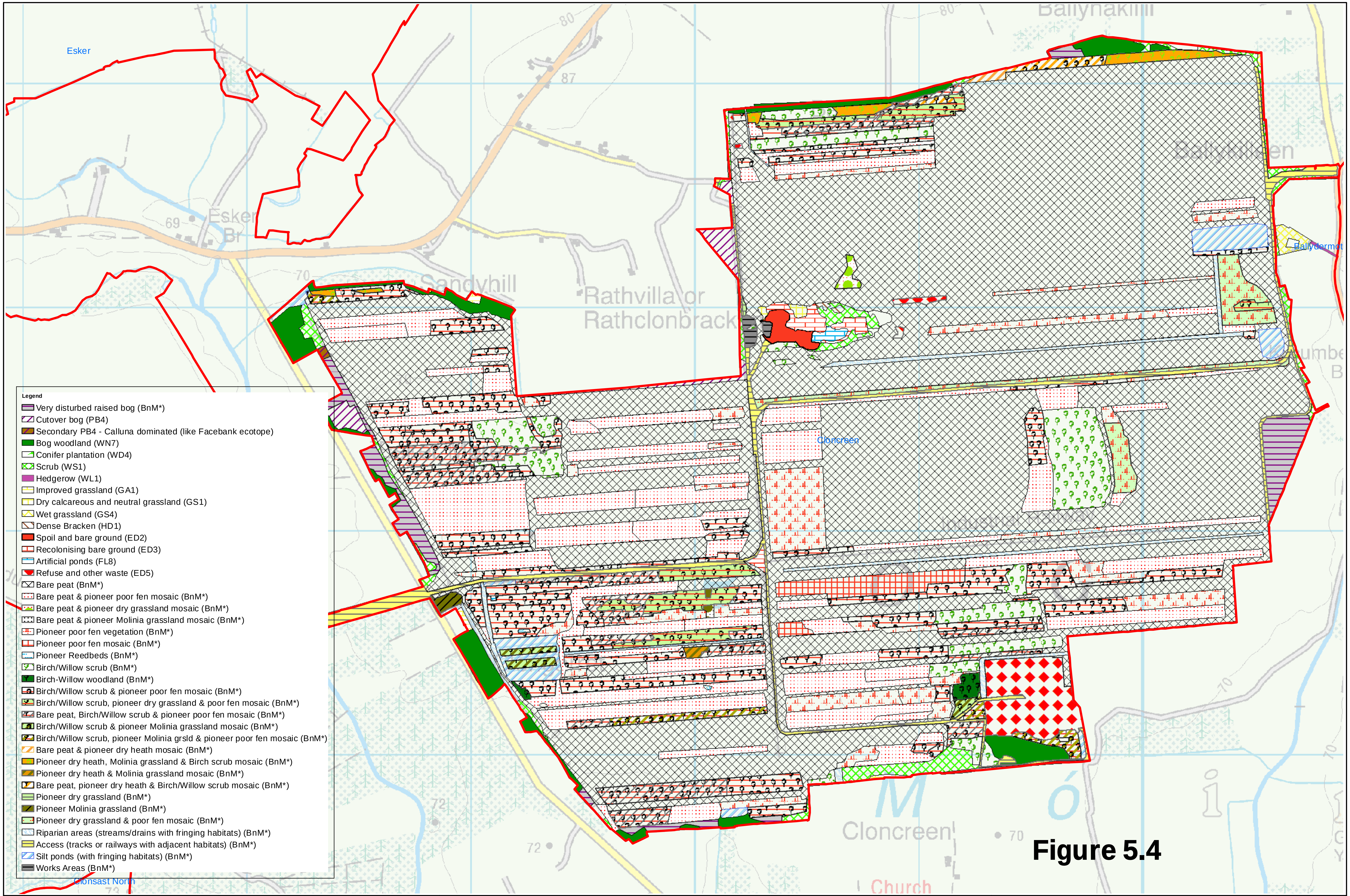

BORD NA MÓNA

Cloncreen 2015

Habitat map created by ground-truthing 2009 OSI aerial photos. BnM* - Habitat classification scheme based on BnM habitat classification scheme and refers to mainly pioneer communities developing on cutaway and production bog that are similar to more established habitats. Other habitats classified according to Fossit (2000).

Note: Draft maps for internal Bord na Mona use and discussion purposes only, should not be relied on as evidence of title, all queries regarding title status and boundaries should be referred to BnM Legal Dept.

Scale: 1:14,778

0 0.09 0.18 0.27 0.36 Kilometers

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OSi Permit No. EN 0035615

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Bog Group: Derrygreenagh

County: Offaly

Bog: Cloncreen

Created by: Ecology Team

22/06/2015

detail in Section 5.3.3.2.7 below. Silt ponds, which are typical of milled peat bogs, are present surrounding the site and the drains flow into these features. A former gravel pit is present within the site to the north east of the small existing building utilised as a 'Tea centre'. In addition, a large private gravel pit and pond area is located adjacent to the site to the North West. In order to facilitate the movement of milled peat and ash there are rail networks running through the study area.

The locations of turbine bases, hardstanding areas, haul route, potential substations, the site compounds, met mast and borrow pit were subject to botanical assessment. The results of the assessment are provided in Appendix 5-5.

For ease of description, Cloncreen can be divided into four main sections that are clearly divided by the Bord na Móna rail network.

North-Western Section
The majority of this area is no longer utilised for active peat production; however, peat milling activities have only ceased in recent years. There are significant areas of bare peat remaining along former milling fields and this is the dominant habitat present.

The majority of this cutover bog section is relatively dry but some sections of production fields become wet in the winter towards the mid –southern part of this section. Production fields towards the north-west have been out of production for some time. The oldest patches have developed open Birch (*Betula pubescens*) Scrub (WS1), generally forming a mosaic with pioneer Poor Fen (PF2) (Plate 5.2). Bog Cotton (*Eriophorum angustifolium*) and Marsh Arrowgrass (*Triglochin palustre*) are prominent in the pioneer fen areas. Additional species recorded from the mosaics include Silverweed (*Potentilla anserina*), Marsh Pennywort (*Hydrocotyle vulgaris*), Watermint (*Mentha aquatica*), Creeping Thistle (*Cirsium arvense*), Bent Grass (*Agrostis stolonifera*), Coltsfoot (*Tussilago farfara*), Dandelion (*Taraxacum officinale* agg.), Horsetail (*Equisetum* sp.), Catsear (*Hypocaris radicata*), Mousear (*Cerastium fontanum*), Mouse-ear Hawkweed (*Pilosella officinarum*) and Fireweed (*Chamerion angustifolium*). Species recorded from the narrow drainage ditches included Reed mace (*Typha latifolia*), Soft rush (*Juncus effusus*), Floating Sweet-grass (*Glyceria fluitans*), Reed Canary-grass (*Phalaris arundinacea*), Jointed Rush (*Juncus articulatus*) and Marsh Bedstraw (*Galium palustre*). In wetter areas, dense swards of Bog cotton are regenerating. Bryophytes are largely absent. Where dry ground conditions prevail, pioneer grassland communities have developed with Yorkshire Fog (*Holus lanatus*) dominant.

This section is fringed by Bog woodland and Birch scrub to the north and east. There are also some areas with active peat cutting by private individuals. Small patches of mature non-Annex I bog woodland (WN7) also occur (Plate 5.3). The woodlands are quite open and the ground cover is dominated by Bramble (*Rubus fruticosus* agg.), Purple Moor-grass (*Molinia caerulea*) and Bracken (*Pteridium aquilinum*). Other species present include Broad Buckler Fern (*Dryopteris dilatata*), Heather (*Calluna vulgaris*) and Gorse (*Ulex europaeus*). There are some narrow sections of Degraded raised bog (PB1), dominated by Ling Heather, along the margins. These areas are drained on all sides and are being colonised by Scrub (WS1) and pioneer Birch woodland (Plate 5.4).

North-Eastern Section
The majority of this section is in active peat production and dominated by bare peat.

A small inactive gravel pit (Rathvilla) is located in the northern section of the site (Plate 5.5). Rehabilitation works were carried out in the gravel pit in 2015. The gravel pit was located on a large glacial mound that was originally overlain by the bog. A large depression has now been created, partially filled with water, and is developing as a lake with a fringe of emergent vegetation (FS1) dominated by Reedmace. This is surrounded by banks of scrub (WS1), patches of Bracken (HH1), disturbed vegetation (ED3) and exposed gravel (ED2). Rehabilitation of the gravel pit focused on retaining features of biodiversity value (e.g. Sand-Martin nesting areas), contouring peat over-burden that was originally moved off the area back into part of the gravel pit basin, levelling spoil heaps and increasing site safety by creating berms around the lake and steep slopes (Bord na Móna 2014). Rehabilitation of the gravel pit has now been completed.

The Flora Protection Order species, Basil Thyme (*Clinopodium acinos*), and the Red listed species Blue Fleabane (*Erigeron acer*) occur in the borrow pit.

Areas out of active peat production to the north of the gravel pit are dominated by a regeneration mosaic of Bare peat, Birch woodland and pioneer Poor fen, similar to that described previously above.

A number of peat production fields along the northern boundary have not been harvested to the same extent as the surrounding fields and are at a higher elevation than the surrounding land. These areas are dominated by a mosaic of degraded and cutover bog, open Birch Scrub and dry grassland dominated by Purple Moor-grass. Dry grassland communities (GS2/GS1) dominated by Cocksfoot (*Dactylis glomerata*), Creeping Bent and Yorkshire Fog have developed on dry stockpiles of peat.

The eastern part of this section contains two groups of silt ponds which are classified as other artificial lakes and ponds (FL8). Relatively large drainage features (FW4) drain into the silt ponds (Plate 5.6).These silt ponds are surrounded by tall banks of peat spoil and spoil made up of glacial sub-soil. These banks are being colonised by ruderal vegetation. Older banks are dominated by rank grassland (GS2), dry grassland dominated by Purple Moor-grass, and Bracken (HD1. In areas, the ponds have a fringe of riparian and emergent aquatic vegetation with species like Pondweed (*Potamogeton natans*), Reedmace (*Typha latifolia*) and Water Horsetail *(Equisetum sp.)* present.

To the North and east, this section of Cloncreen is also surrounded by a narrow fringe of bog woodland (WN7), Birch scrub (WS1) and remnant Bog (PB1). The western side is located adjacent to active cutover bog that is being industrially harvested by a private company. The glacial mound also extends into this area and this has also been quarried by private development for gravel, which has left some deep gravel pits.

South-Eastern Section

Only small areas within this section are still in active peat production. Large areas which have been out of production for long periods of time have revegetated with pioneer Poor fen (PF2), Birch Scrub (WS1) and wet/dry grassland mosaics. This section is underlain with gravel. To the north, a raised area of glacial material has been exposed by peat extraction and has now developed as Birch Scrub. This area is almost entirely revegetated with Scrub (WS1) and Cutover Bog (PB4) (with pioneer Poor fen (PF2) vegetation). Large sections of bare peat area located to the eastern and western sides of this raised area and are still in active peat production. Along the eastern edge of the site an area of degraded Raised Bog (PB1) exists on an old section of cutaway. This area is dominated by Ling Heather (*Calluna vulgaris*) with scattered trees. The old drainage ditches have begun to fill in with *Sphagnum* in some sections.

An old disused rail line is located through the middle of this section and is completely revegetated with a mixture of Scrub (WS1), Heather and dry grassland dominated by Purple Moor-grass. This old railway line is at a higher elevation compared to the surrounding areas and contained some small areas of gravel where Basil Thyme and Blue Fleabane were located.

The southern half of this section was largely revegetated with a mixture Scrub (WS1) and pioneer Poor fen (PF2) vegetation apart from some areas that were still in active peat production. This section of the site is underlain by gravel.

An ash repository (EPA Licence No. W0049-02) has been developed on part of the cutaway, outside the Wind Farm Site Boundary towards the southern end of the site, to store ash from the nearby Edenderry power station. Cells for the collection of ash are still being developed. A mixture of habitats is found around this facility including Scrub (WS1) and Dry Meadows and Grassy verges (GS2). A section of Bog woodland (WN7) was located to the south of this facility. This Non-Annex I woodland was mature and was dominated by Birch with an understorey of Bramble and Purple Moorgrass.

South-Western Section

A relatively large section of the southern section of this area is in active peat production. Drains in this area are vegetated with plant species such as Soft Rush (*Juncus effusus*), Reedmace (*Typha latifolia*), Willow (*Salix* sp.) and Birch (*Betula pubescens*). In addition, occasional high fields are still in active peat production throughout the site.

Areas where harvesting has ceased, in the northern half of this section, are rapidly colonising with vegetation and habitats such as Scrub (WS1) and pioneer Poor Fen (PF2) are becoming well established. A series of silt ponds, which consist of a series of interconnected channels, are located close to the western boundary of the site. Few aquatic plants were present owing to the fact that these silt ponds appeared to have been cleared out regularly. In areas, the ponds have a fringe of riparian and emergent aquatic vegetation with species like Pondweed (*Potamogeton natans*), Reedmace (*Typha latifolia*), Common Reed (*Phragmites australis*) and Water Horsetail *(Equisetum sp.)* present.

These silt ponds are surrounded by tall banks of peat spoil and spoil made up of glacial sub-soil. These banks are colonized by a mosaic of Dry Meadows and Grassy Verges (GS2) and Scrub (WS1).

Pockets of non-Annex I bog Woodland (WN7) are located along the western boundary of the site. These sections of bog woodland were well developed and were dominated by Scot's Pine along with Birch, Oak, Rowan and Holly with a ground flora of Bramble, Male Fern, Bilberry (*Vaccinium myrtillus*), Purple Moorgrass and Herb Robert (*Geranium robertianum*).

The south of this section contained a small silt pond (FL8) and the most southerly production fields, classified as Cutover bog (PB4), were revegetating with Poor fen (PF2), Birch scrub (WS1) and dry grassland (GS2/GS1). Much of the peat fields that have recently come out of production are recolonizing with pioneer Poor fen (PF2) vegetation with Bog Cotton and Marsh Arrowgrass. The SW section is somewhat wetter than the rest of the site and is also underlain by shell marl.

Small sections of remnant raised bog are located along margins of the south of the section along with one area in the south west corner of the site. These areas of degraded raised bog are dry and were dominated by tall Heather (*Calluna vulgaris*). Trees such as Scot's Pine, Lodgepole Pine and Birch were also becoming established in these areas in large numbers.

Plate 5.1 Recently Milled peat field. (South section of site)

Plate 5.2 Bare peat which is revegetating with Scrub (WS1) and Pioneer poor fen (PF1) North-western section of site

Plate 5.3 Bog Woodland WN7 Non Annex I (North western site boundary)

Plate 5.4 Remnant Raised bog subject to scrub encroachment. (Western site boundary)

Plate 5.5 Old Gravel Pit, proposed to be extended as wind farm borrow pit

Plate 5.6 Large drainage feature located to the east of the site

Rail Lines

Rail lines run in east west and north south directions on the site, these lines connect Cloncreen Bog with other bogs, the adjacent ash repository and with Edenderry Power Station. The foundations for these rail lines were constructed of gravel from Rathvilla gravel pit. The development of rail lines using gravel from Rathvilla was a historic process that concluded in line with the cessation of activity at the gravel pit. The importation of calcareous gravel has created a habitat which is suited to calcicolus (lime-loving) species. The rail lines provide habitat for plant species such as Blue Fleabane (*Erigeron acer*) and Basil Thyme (*Clinopodium acinos*) and Wild Mignonette (*Reseda lutea*), which are naturally suited to sandy, gravely habitats such as eskers. Blue Fleabane and Basil Thyme are listed in the Irish Red Data Book (Curtis and McGough 1988) and their current status is endangered. Basil Thyme is also listed on the Flora Protection Order 2015.

Overall, rail lines on the site are in varying states ranging from operational rail lines on a daily basis to lines that have not been used for a number of years and were over grown with vegetation such as Bracken (HD1) and Dry Meadows and Grassy Verges (GS2).

5.3.3.1.2 Habitats on the Grid Connection Route

The planning application includes 2 No. substations and associated grid connections; however, only one substation and associated grid connection will ultimately be constructed. The proposed wind farm will connect to the grid via one of the following methods:

- **Option A**: construction of a 110 kV substation in the eastern section of site, to connect to existing 110 kV Cushaling substation at Edenderry Power Plant. Connection will be via underground cable approx 1.7km in length, located within Bord na Móna lands and curtilage of the public road.

Or

- **Option B**: construction of a 110 kV substation in southern section of site, to connect to existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site. Connection will be via two short sections of overhead line, (less than 0.1km).

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

<u>Option A Substation and Underground Grid Connection</u>
The proposed substation is located in the eastern section of the Cloncreen site. The proposed cable route is approximately 1.7km in length. The cable route will follow the route of the existing Bord na Móna rail network along the eastern boundary of the site for approximately 0.9km. It will then follow the route of the R401, for approximately 0.9km, to the Edenderry Power Station. The Bord na Móna rail track is classified as Spoil and Bare Ground (ED2). Habitat recorded adjacent to the railway track include Cutover Bog (PB4), Scrub (WS1), Dry Meadows and grassy verges (GS2) and Recolonising bare ground (ED3). The cables will be laid in the road/verge along the R401. The road carriageway is categorised as Buildings and artificial Surfaces (Bl3). The roadside verge is dominated by Dry Meadows and Grassy Verges (GS2). Staggered and fragmented Treelines (WL2) and Hedgerows (WL1) are present along the roadside verge and form the boundary between adjacent lands. Species recorded along the roadside verge include, Cocksfoot (*Dactylis glomerata*), False Oat grass (*Arrhenatherum elatius*), Bent Grass (*Agrostis stolonifera*), Ash (*Fraxinus excelsior*), Hawthorn (*Crataegus monogyna*), Elder (*Sambucas nigra*), Red Clover (*Trifolium pretense*), White Clover (*Trifolium repens*). Creeping Buttercup (*Ranunculus repens*), Hogweed (*Heracleum sphondylium*), Cow Parsley (*Anthriscus sylvestris*) and Knapweed (*Centaurea nigra*).

Flora Protection Order of Red listed flora were not recorded on the grid connection route.

Option B Substation and Overhead Grid Connection
Substation B will connect to the National Grid via two short sections of overhead line, (less than 0.1km in length), connecting to the existing 110 kV Thornsberry/Cushaling electricity transmission line located within the site. The substation is located in an area of Cutover bog (PB4) where there is little vegetation regeneration and continued active peat extraction.

5.3.3.1.3 Habitats at Locations of Junction Upgrades on Transport Route

Three junctions on the public road network along the turbine transport route to the proposed development require upgrade/temporary modification works, which will involve some minor habitat loss or temporary disturbance. These locations are shown in Figure 3.13 in Chapter 3 of the EIS. In addition, minor temporary works will also be required at 4 No. roundabouts along the N52 between the M6 motorway and Tullamore.

The location of the M6 Roundabout (Grid Ref: E233664, N234188), Ardan Roundabout (Grid Ref: E234480, N226510), Cappancur Roundabout (Grid Ref: E235600, N225271) and Cloncollog Roundabout (Grid Ref: E235890, N224130) along the transport route shall traverse the existing roundabout islands. Habitats at this location including Amenity Grassland and Flowerbeds and borders (BC4) will be disturbed temporarily. These habitats are of low ecological significance and will be reinstated.

The transport route accommodation works at Ballina Cross (Grid Ref: E241990, N221550) are small scale in nature. It is proposed to traverse an area dominated by Dry meadow and grassy verges (GS2) adjacent to the road verge. Species recorded from the grassland included Silverweed Creeping Thistle (*Cirsium arvense*), Wild Carrot (*Dacus carota*), Yorkshire Fog (*Holcus lanatus*) and False Oat Grass (*Arrhenatherum elatius*). There is no requirement for the removal of treeline or hedgerow at this location.

The transport route accommodation works at Ballinagar (Grid Ref: E244160, N224130) are small scale in nature and traverse the edge of an amenity parkland. Habitat recorded within the parkland included Amenity Grassland (GA2), Flowerbeds and borders (BC4) and Ornamental/non-native shrubs (WS3). There is the requirement to remove a number of semi mature ornamental trees including ornamental Maple (*Acer* sp), Ash (*Fraxinus escelsior*), Elm (*Elmus* sp.) and Birch (*Betula* sp.). The trees were visually assessed in relation to providing potential roost sites for bats but evidence of such features was not observed.

Accommodation works are required at the junction between the R402 and L1003. These works are to be located in a field of Wet Grassland (GS4). Approaching the western entrance, road upgrade works are required along the L1003. This will involve the cutback of trees for site lines. These works will involve the removal of semi-mature Birch and Ash. The woodland at the proposed western entrance is dry underfoot with dominant Birch (*Betula pubescens*) with some Grey Willow (*Salix cinerea*). The understorey is generally dominated by Bramble (*Rubus fruticosus agg.*) and Ferns (*Dryopteris sp.*) in many areas with Bracken (*Pteridium aquilinum*) in clearings. The woodland stands are relatively dry with many drainage ditches throughout. *Sphagnum* mosses were extremely rare. When considered according to the National Survey of Native Woodlands (Perrin, 2008), this woodland type corresponded closely with the *Rubus fruiticosus - Dryopteris dilatata* variant of the *Betula pubescens – Molinia caerulea* woodland group.

5.3.3.1.4 Botanical Species Present

A full list of the vascular plants recorded during the site visits is presented in Appendix 5-6 to this report. A total of 160 species of vascular plants were recorded within the study area.

The rail lines and existing borrow pit provide habitat for plant species such as Blue Fleabane (*Erigeron acer*) and Basil Thyme (*Clinopodium acinos*) which are naturally suited to sandy, gravely habitats such as eskers. Blue Fleabane and Basil Thyme are listed in the Irish Red Data Book (Curtis and McGough 1988) and their current status is endangered. Basil Thyme is also listed on the Flora Protection Order 2015.

Species listed in Annex II of the EU Habitats Directive or additional flora listed in the Flora (Protection) Order (2015) or red list of vascular plants (Curtis & McGough, 1988) were not recorded.

The results of botanical surveys to characterise the species and habitats present at the sites of the proposed turbine bases and additional infrastructure are shown in Appendix 5-5 to this report.

5.3.3.1.5 Targeted Flora Protection Order/Red List Species Surveys

Two nationally rare plant species, Basil Thyme (*Clinopodium acinos*) and Blue Fleabane (*Erigeron acer*) were recorded during the 2010 and 2015 habitat survey completed at the Cloncreen site by Bord na Móna.

Basil Thyme is listed on the Flora Protection Order 2015 and is also listed in the Irish Red Data Book (Curtis and McGough 1988). Blue Fleabane is listed in the Irish Red Data Book (Curtis and McGough 1988). The latter species are not typical of bog habitat and are found along the railway tracks through the site which were constructed, in the past, from material sourced from eskers or gravel pits. Both species were also previously recorded at the proposed borrow pit. The previous records for Blue Fleabane and Basil Thyme are displayed on Figure 5.5-a.

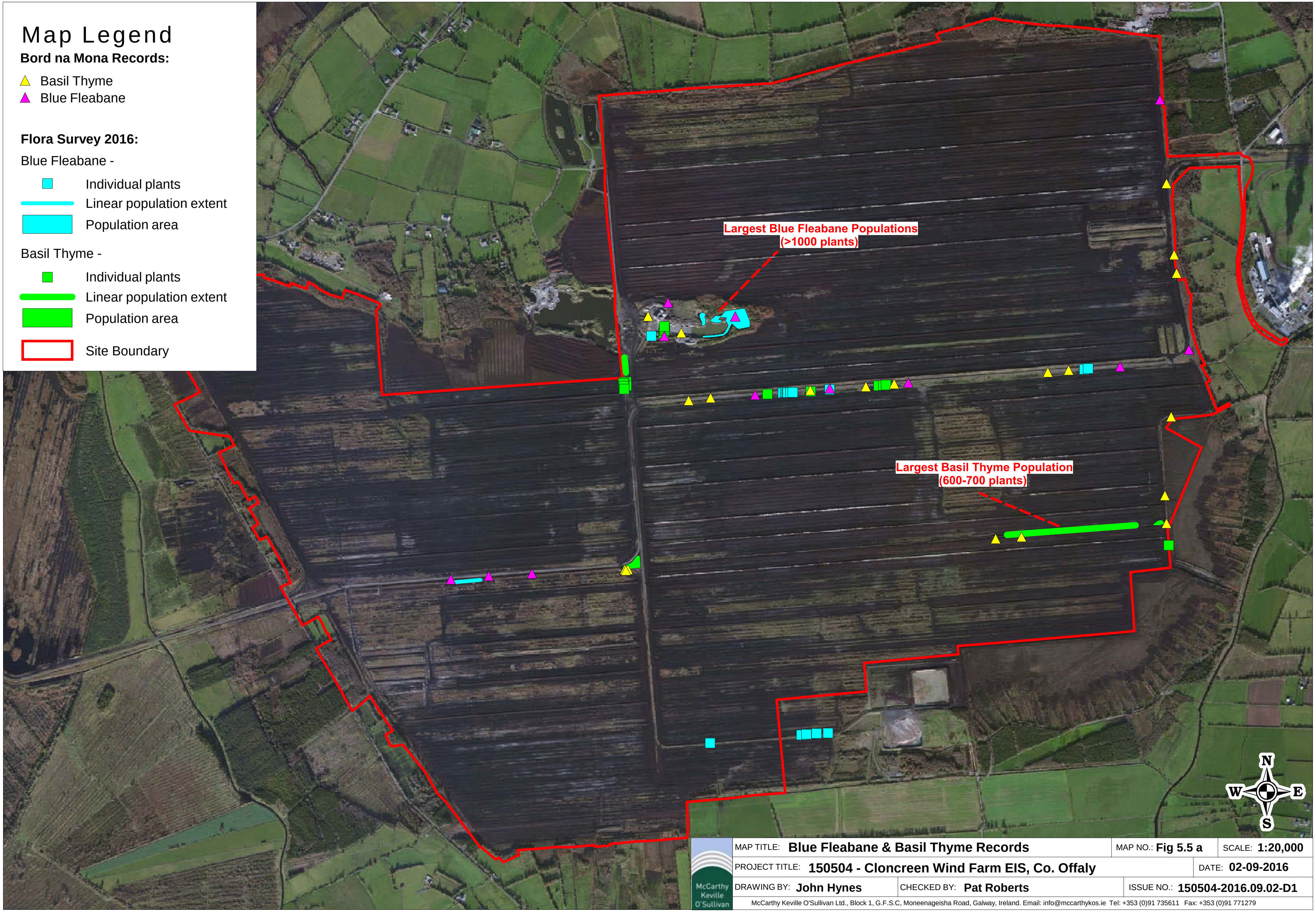
Targeted surveys for Basil Thyme and Blue Fleabane were conducted in accordance with NRA 2009. The surveys were undertaken on the 27th of July 2016, during the fruiting/flowering season of Basil Thyme and Blue Fleabane which is July to August (Parnell and Curtis 2012). The results of the field survey are displayed on Figure 5.5-a.

Figure 5.5-b shows the locations of Basil Thyme and Blue fleabane in relation to the proposed development footprint.

During the dedicated survey it was noted that the majority of the rail lines, in active use, had been sprayed with herbicide as part of routine maintenance. Where Basil Thyme and Blue fleabane were recorded on the treated railways they were found at the edges of the rail embankments outside the zone of herbicide application.

The largest concentration of Blue Fleabane was in the eastern section of the proposed borrow pit where in excess of 1000 plants were recorded. This area has not been disturbed recently.

The greatest population of Basil Thyme (600-700 plants) was recorded from a linear calcareous mound, approximately 670m in length, located in the south-eastern corner of the site.


Map Legend
Bord na Mona Records:
Basil Thyme
Blue Fleabane
Flora Survey 2016:
Blue Fleabane -
Individual plants
Linear population extent
Population area
Basil Thyme -
Individual plants
Linear population extent
Population area
Site Boundary
Largest Blue Fleabane Populations
(>1000 plants)
Largest Basil Thyme Population
(600-700 plants)
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MAP TITLE: Blue Fleabane & Basil Thyme Records
MAP NO.: Fig 5.5 a
SCALE: 1:20,000
PROJECT TITLE: 150504 - Cloncreen Wind Farm EIS, Co. Offaly
DATE: 02-09-2016
DRAWING BY: John Hynes
CHECKED BY: Pat Roberts
ISSUE NO.: 150504-2016.09.02-D1
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MAP TITLE: Blue Fleabane & Basil Thyme Records | MAP NO.: Fig 5.5 b | SCALE: 1:60,000

PROJECT TITLE: 150504 - Cloncreen Wind Farm EIS, Co. Offaly | DATE: 02-09-2016

DRAWING BY: John Hynes | CHECKED BY: Pat Roberts | ISSUE NO.: 150504-2016.09.02-D2

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A population of Blue fleabane of approximately 90-100 plants was recorded on the rail track immediately to the south of the tea center. A slightly smaller population (70-80 plants) was recorded from exposed gravel towards the center of the site.

Throughout the remainder of the site, Blue Fleabane and Basil Thyme were recorded in scattered locations and in low numbers.

5.3.3.1.6 Invasive Alien Species

During field surveys, a search for Invasive Alien Species (IAS) listed under the Third Schedule of the European Communities Regulations 2011 (S.I. 477 of 2015) was conducted. No third schedule species were recorded within the development sites or along the proposed transport and grid connection routes.

5.3.3.1.7 Significance of Flora

Ecological evaluation within this section follows a methodology that is set out in Chapter three of the 'Guidelines for Assessment of Ecological Impacts of National Roads Schemes' (NRA, 2009).

The rail lines and borrow pit provide habitat for plant for Blue Fleabane (*Erigeron acer*) and Basil Thyme (*Clinopodium acinos*). Blue Fleabane and Basil Thyme are listed in the Irish Red Data Book (Curtis and McGough 1988) and their current status is endangered. Basil Thyme is also listed on the Flora Protection Order 2015. The importance of these species within the study area is classified as ***Local Importance Higher Value*** on the basis or a regularly occurring populations assessed to be of importance at the local level.

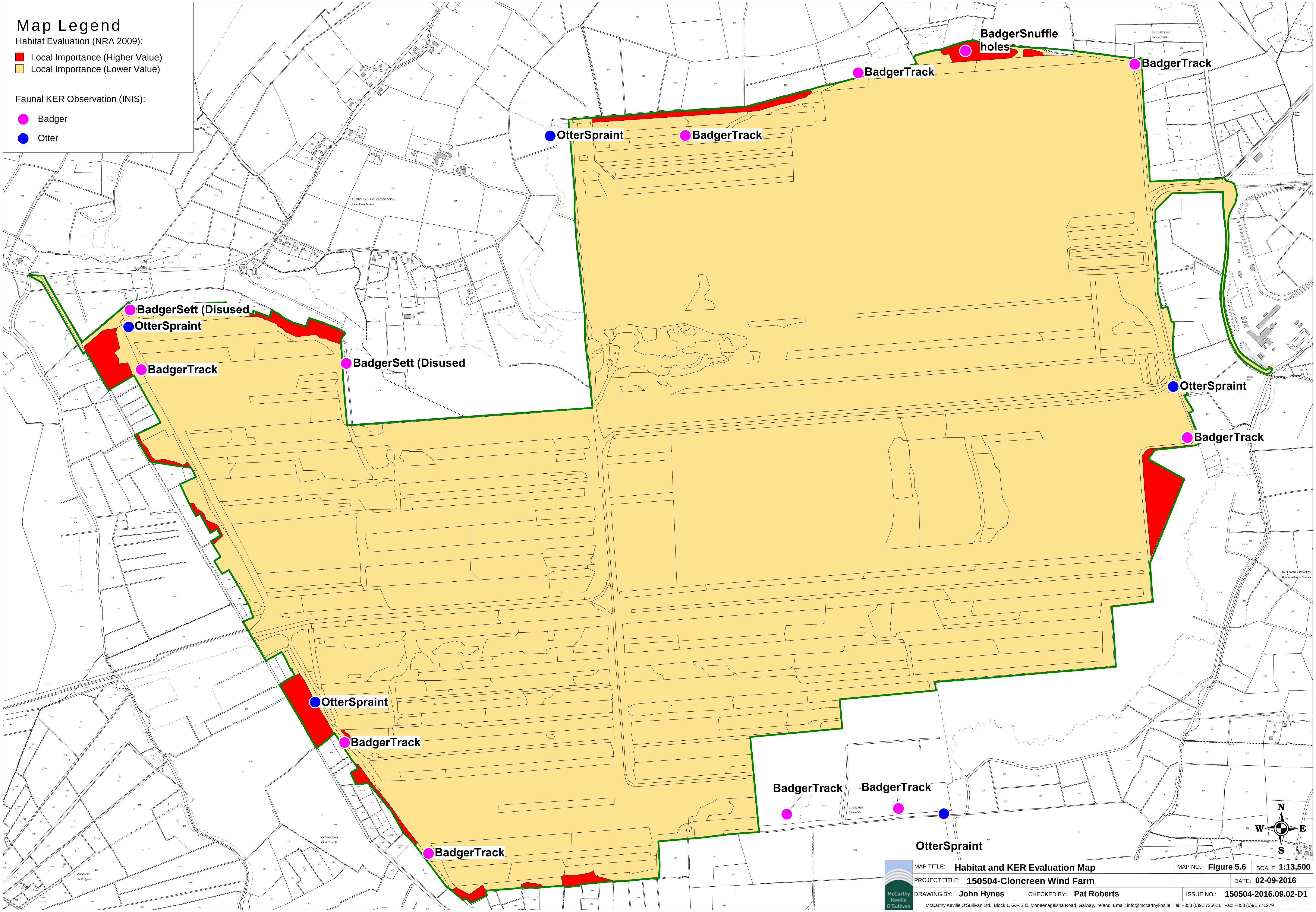
Additional flora of conservation concern was not recorded within the wind farm site or along the grid connection (Options A &B) or transport routes.

5.3.3.1.8 Significance of Habitats

Ecological evaluation within this section follows a methodology that is set out in Chapter three of the *'Guidelines for Assessment of Ecological Impacts of National Roads Schemes'* (NRA, 2009). Figure 5.6 displays the ecological significance of the habitats identified within the EIS study area.

Degraded raised bog (non-Annex I) occurs is scattered locations surrounding the EIS Study Area boundary. The largest extent of this habitat occurs to the south-east of the development site, outside the EIS Study area boundary. The degraded peatland does not conform to any of the Annex I raised bog habitat classifications. The habitat is not active and remnant areas are dried out and drained on all sides. Such areas are not capable of natural regeneration to active raised bog habitat. It is noted that the, structure, function and viability of the habitat is at risk from private peat extraction and scrub/woodland encroachment. The remnant degraded Raised Bog is assigned ***Local Importance (Higher Value)*** on the basis of containing semi-natural habitat types with high biodiversity in a local context.

Bog Woodland (WN7) is present in numerous locations surrounding the EIS study area boundary. Woodland stands were examined to investigate their potential to conform to the Annex I habitat 'Bog Woodland'. The woodland stands are dry underfoot with dominant Birch (*Betula pubescens*) with some Grey Willow (*Salix cinerea*). The understorey is generally dominated by Bramble (*Rubus fruticosus agg.*) and Ferns (*Dryopteris sp.*) in many areas with Bracken (*Pteridium aquilinum*) in clearings. The woodland stands are relatively dry with many drainage ditches throughout. *Sphagnum* mosses were extremely rare. When considered according to the National Survey of



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Native Woodlands (Perrin, 2008), this woodland type corresponded closely with the *Rubus fruiticosus - Dryopteris dilatata* variant of the *Betula pubescens – Molinia caerulea* woodland group. This habitat has no affinity with the Annex I Priority Habitat 'Bog Woodland'. The Bog woodland stands, none of which conform to Annex I status, are classified as being of ***Local Importance (higher value)*** on the basis of supporting semi-natural habitat types with high biodiversity and high degree of naturalness in a local context.

There are no large watercourses within the study area. The Philipstown River is located to the West and South and the Figile River is located to the East of the development site. A tributary of the Philipstown River, which is highly modified from its natural state, flows along the north eastern site boundary. These watercourses are assigned ***Local Importance (higher value)*** on the basis of supporting semi-natural habitat types with high biodiversity and high degree of naturalness in a local context. The watercourses also have potential as a habitat for a number of species that are listed on Annex II of the EU Habitats Directive (e.g. Otter, White-clawed Crayfish etc.).

Although there are habitats of ecological significance within the study area, the development footprint is dominated by habitats considered to be of low ecological value. Cutover Bog (PB4) is the dominant habitat and accounts for 74% of the study area. A mosaic of cutover bog and scrub accounts for 12% of the study area and Scrub (WS1) accounts for 4.6%. Spoil and bare ground ED2 which is the dominant habitat of the rail tracks, borrow pit and surrounding the tea centre accounts for approximately 2% for the study area. These habitats account for 90% of the EIS study area, are of local ecological significance and are assigned ***Local importance (lower value),*** as per the NRA 2009. Additional habitats including mosaics formed on cutover peat fields were also assigned ***Local importance (lower value)***.

Habitats encountered at the location of junction modifications on the proposed transport route and along the proposed grid connection route were of low ecological significance. The habitats encountered are common at the local, county and national level and are assigned ***Local importance (lower value),*** as per the NRA 2009.

Table 5.16 below provides a summary of the habitat importance valuation and identifies the habitats classified as Key Ecological Receptors.

Table 5.16 Summary of Habitat Significance

Common Name	Receptor Importance/Ecological Valuation (NRA Ecological Impact Assessment Guidelines, 2009)	KER Y/N
Degraded Raised Bog (PB1)	Local Importance (higher value)	Yes
Bog Woodland	Local Importance (higher value)	Yes
Philipstown River, Figile River and associated tributaries	Local Importance (higher value)	Yes
Additional habitats within the study area including transport route and grid connection route.	Local importance (lower value)	No

5.3.3.2 Fauna in the Existing Environment

5.3.3.2.1 Bat Survey (INIS Environmental Consultants)

A baseline bat survey for a number of Bord na Móna sites was completed by INIS Environmental Consultants in 2013. Relevant extracts from the report are provided in Appendix 5-3 (Annex 1) of this EIS. The Cloncreen site was included in the assessment and the site was surveyed using three methods:

- Hand held heterodyne bat detectors (Batbox Duet) used for bat activity transects
- Static recording using the ANABAT SD1
- Bat roost surveys within Bord na Móna land parcels and adjoining habitats

The following extract summarises the findings of the INIS survey, full detail on the survey results, discussion and conclusions are provided in Appendix 5-3.

"Five transects were designed at Cloncreen bog and these covered approximately 6 kilometres in distance. These were designed to survey open peat, scrub vegetation and well developed hedgerow habitat in the same bog. Eight bat contacts were recorded throughout the survey season with three species present: common pipistrelle Pipistrellus pipistrellus (n=5), myotis whiskered/Brandt's Myotis mystacinus/brandtii (n=7), leisler's Nyctalus leisleri (n=1). These results accounted for 1.3% of all bat records for this survey in both Bog Groups. All bat records were from the linear features of well-developed hedgerows at the north western side of this bog. Only a single common pipistrelle was recorded commuting, all other records were noted as foraging."

5.3.3.2.2 Bat Survey (Malachy Walsh and Partners)

Bat surveys were conducted during the 2015 survey season during the months of March, May, June, July, August and November. Three forms of survey design were implemented and included;

- Roost surveys (daytime visual search and bat activity surveys within the study area)
- Bat Activity surveys (bat transects), and
- Automated bat surveys

The following extract summarises the conclusions of the survey, further extracts are provided in Appendix 5-3 (Annex 2) of this EIS.

- *The following species were identified during secondary baseline bat surveys carried out at the Cloncreen Bog Site; Common pipistrelle, Soprano pipistrelle, Leisler's bat, Natterers bats, Daubenton's bat and Myotis species.*
- *Baseline bat surveys did not identify any large populations of bats using the Cloncreen Bog site.*
- *Overall the level of bat activity at the Cloncreen Bog site was low, with the majority of the bat activity occurring towards the vegetated fringes of the site.*
- *Automated bat surveys from height did not identify a high level of bat activity over the site at the Cloncreen Met Mast.*
- *The vegetated linear banks that cut through the bog site are used by foraging and commuting bats, albeit in low numbers.*
- *Bat activity decreased in the open cutover bogland habitat at the site. This altered habitat is by far the dominant habitat type at the study area.*
- *Within the Cloncreen bog site, there is little potential for roosting bats.*

- *The trees within the wooded areas that bound the Cloncreen Bog do not provide optimal conditions, to harbour bats.*
- *Previous bat roost surveys, and roost surveys carried out as part of this report, identified three bat roost sites in buildings, and one bat roost located in a bridge within 5km of the Cloncreen Bog site.*
- *No bat roosts were identified within the Cloncreen Bog site.*

5.3.3.2.3 McCarthy Keville O'Sullivan Bat Survey 2016

Transport Route

There is the requirement to remove a number of semi mature ornamental trees including ornamental Maple (*Acer* sp), Ash (*Fraxinus escelsior*), Elm (*Elmus* sp.) and Birch (*Betula* sp.) along the proposed transport route at Ballinagar (Grid Ref: 244160, 224130). The trees were visually assessed in relation to providing potential roost sites using a protocol set out in *Table 4.1 of Collins 2016*. The trees had no suitable features likely to be utilised as bat roosts and were assigned *Negligible Suitability*, as per table 4.1, in relation to their potential to support roosting bats.

Tree removal is also required along the local road L1003 and at the proposed western entrance of the site. The trees to be removed, semi-mature Ash (*Fraxinus excelsior*) and Birch (*Betula pubescens*), were visually assessed. The trees had no suitable features likely to be utilised as bat roosts and were assigned *Negligible Suitability*, as per table 4.1, in relation to their potential to support roosting bats.

Wind Farm Site

The one building within the site, the 'Tea Centre' (Grid Ref: 258224, 226887), was subject to a preliminary roost assessment (Collins, 2016). The exterior was inspected from ground level, with the aid of binoculars. The search included the ground, accessible windowsills, window panes, walls, eaves, slates, gutters, soffits, fascias, downspouts, lead flashing and the ridge beam. During inspections, surveyors searched for potential access points, roosting locations and any evidence of bats, including live and dead specimens, droppings, feeding remains, urine splashes, fur oil staining and noises. The 'Tea Centre' showed no evidence of bats and no potential access points. A previous bat emergence survey, carried out by Malachy Walsh and Partners in 2015, found no bats.

In total, 5 dusk and 5 dawn surveys, covering 35.95 hours were completed between April and August 2016. In total, 72 bat passes were recorded during manual transect surveys in 2016. Common pipistrelle was encountered most frequently, followed by Soprano pipistrelle. Unidentified Pipistrelle species, Leisler's bat, Brown Long-eared bat and unidentified bat species were recorded less frequently.

In total, 6263 bat passes were recorded during 69 nights of fixed point monitoring in 2016. Most of this activity was attributed to Common pipistrelle, followed by Soprano pipistrelle. Unidentified pipistrelles and Leisler's bat were recorded less frequently and Myotis sp. and Brown Long-eared bat recorded only rarely.

Bat activity was greatest at the edge habitat surveyed during deployments in April and May and was extremely low in the open cutover bog habitats installed in May and July. Bats appear to show a high fidelity to edge habitats for foraging and commuting. In addition, paired deployments at site edge and bog habitats over the same time period show a preference for edge habitat with no bats recorded in the open bog, where wind turbines will be situated.

Overall bat activity levels were shown to be very low and were largely concentrated away from proposed turbine locations around the fringes of the wind farm site.

The full bat survey report is provided in Appendix 5-3.

5.3.3.2.4 Non-volant Mammals

Mammal walkover surveys were conducted by INIS Environmental Consultants in 2014 and 2015. Relevant extracts for the INIS Mammal Survey Report are provided in Appendix 5-2. The following summarises the findings of the INIS Survey:

There were 34 individual records of mammal activity throughout Cloncreen Bog accounting for eight different species of mammal.

- Badger (13 records: sett, tracks and snuffle holes) (See Figure 5.6)
- Pine Marten (1 record: track)
- Otter (5 records: spraints) (See Figure 5.6)
- Red Squirrel (1 record: seen)
- Squirrel (2 record: foraged pine cones)
- Fallow Deer (3 records: tracks)
- Fox (7 records: tracks and scats)
- Wood Mouse (2 records: prints and small mammal trap)

Irish Hare occurs within the study area; however, their presence was not recorded on survey sheets due to their ubiquitous nature within the Study Area.

No active badger setts were recorded during the INIS survey. No Otter breeding or resting sites were recorded.

During the 2016 verification survey, undertaken by McCarthy Keville O'Sullivan, no additional non-volant mammal records were recorded. Badger setts locations, as identified by INIS were revisited and it was confirmed that the disused setts remained inactive. The proposed western access route to the site from the L1003 was surveyed from evidence of badger but no signs were found and no setts were recorded. No evidence of Otter was recorded during the 2016 survey.

Evidence of Pine marten, Red squirrel and Fallow Deer were not recorded during the 2016 verification survey. These species were not recorded with frequency within the study area during the 2014/2015 survey period. The recorded evidence does not suggest that the study area is utilised by populations of higher than local significance. Consequently, these species were not considered as KERS and further assessment was not deemed necessary. Wood mouse and Fox are not afforded statutory protection and are not considered as KERs.

5.3.3.2.5 Reptiles and Amphibians

Common Frog (*Rana temporaria*) was recorded in wet areas within the site (including in drains and pools and in bog habitats). The species is likely to breed within the study area. Common Lizard (*Zootoca vivipara*) and Smooth Newt (*Lissotriton vulgaris*), while not recorded during the site visits, are likely to occur within the study area.

It is considered that the proposed development will not result in a significant loss of suitable habitat for reptiles and amphibians. It is considered that suitable habitat is extremely widespread in the study area and beyond. No likely significant effects on these species are anticipated and therefore further survey/ assessment was not deemed necessary.

5.3.3.2.6 Aquatic Fauna

Bord Na Móna, Aquatic Ecological Surveys 2014

This survey, conducted by Ecofact Environmental Consultants in 2014 included biological sampling and chemical water quality assessments and was undertaken during the period July to November at 47 survey locations but only three sampling sites are pertinent to the current assessment. (See extracts from Ecofact report in Appendix 5-4).

Survey location FW16 is located upstream of the study area, on a tributary of the Philipstown River. Survey Location FW19 is located on a minor tributary of the Philipstown River that runs along the north western boundary of the study area. Sample location FW20 is located on the Figile River, downstream of the study area and confluence with the Philipstown River.

The report provides an overview of the habitats and plants, fish, aquatic macroinvertebrates and biological and chemical water quality at each of the survey locations. A description of site location, physical characteristics, habitats, vegetation community, macroinvertebrate community, biological water quality, chemical water quality and species specific survey results are detailed on a site by site basis. The species of conservation significance recorded during the baseline surveys are evaluated and discussed.

The following paragraphs summarise the results of the aquatic surveys undertaken at sample locations FW16, FW19 and FW20.

Site FW-16 was located on the 3rd order Esker River (EPA segment code 14_251) in the Barrow catchment. FW-16 was located in the townland of Esker, approximately 7.5km east of Daingean. This site was surveyed by electrofishing for 20 minutes. A total area of 60m^2 was surveyed. The fish species found were Stone Loach (N=28), Brown Trout (N=5), Dace (N=2) and Minnow (N=2). Crayfish were found to be present at Site FW-16. During the sweep sampling hatchling Crayfish (N=12), adult Crayfish (N=4) and juvenile Crayfish (N=3) were captured. During the hand searching survey juvenile crayfish (N=12) and crayfish hatchlings (N=6) were captured. A total of 100 cobble stone refuges were searched. Brook lamprey (N=1) was captured while biological sampling in a depth of over 1m. Biological water quality at this site was rated 'Q3-4, slightly polluted' using EPA freshwater biological monitoring criteria. This rating corresponds to WFD 'Moderate' status.

Site FW-19 was located on the 1st order Rathvilla/Rathclonbracken Stream (EPA segment code 14_1334) in the Barrow catchment. Site FW-19 was located in the townland of Sandyhill, approximately 8km east of Daingean. This site was surveyed by electrofishing for 5 minutes. A total area of 35m2 was surveyed. The only fish species found were Three-spined Stickleback (N=6) and Minnow (N=3). The site was sweep sampled and hand searched for crayfish. However, no crayfish were present. A juvenile lamprey survey was carried out however none were found. This location was deemed unsuitable with regard to the EPA Q determination scheme, with considerations for the absence of riffled habitat and suboptimal macroinvertebrate habitat.

Site FW-20 was located on the 4th order Figile River (EPA segment code 14_996) in the Barrow catchment. Site FW-20 was located in the Clonbullogue Village. This site was surveyed by electrofishing for 20 minutes. A total area of 50m^2 was surveyed. The fish species found were Roach (N=9) Dace (N=5), Stone Loach (N=5), Pike (N=4), Perch (N=2), Minnow (N=1), and Gudgeon (N=1). A Crayfish survey was conducted at site FW-20. During hand-searching of 100 refuges, 42 crayfish were found. Of those, 20 were crayfish hatchlings, 8 were juvenile and 14 were adults. During the 10 sweep samples 25 crayfish were caught with the following age distribution: crayfish hatchling (N=15), juvenile crayfish (N=5) and adult Crayfish (N=5). There was no juvenile lamprey habitat at this site and no lampreys were thought to occur. Using the EPA Q determination scheme, biological water quality at this site was rated 'Q3-4, slightly polluted', corresponding to WFD 'Moderate' status.

5.3.3.2.7 Freshwater Pearl Mussel (Margaritifera margaritifera)

The Study area is located within the Margaritifera Sensitive Area *Barrow* which is classified as a *Catchment with previous records of Margraitifera, but current status unknown.* An information request was sent to the NPWS regarding the current distribution of Margaritifera Species within this catchment. The information provided by NPWS from the *Margaritifera records dataset 2015_v13* indicated that the nearest record for Pearl mussel is located greater than 75km downstream of the EIS study area.

The aquatic survey, conducted by Ecofact Environmental Consultants 2015, included a Freshwater Pearl Mussel assessment;

> *"The potential for the Freshwater Pearl Mussel Margaritifera margaritifera to occur at each site was also assessed. Mussel surveys were undertaken at all sites where there was suitable habitat. FPM habitat suitability was assessed with reference to Conserving Natura 2000 Rivers Ecology Series No. 2 'Ecology of the Freshwater Pearl Mussel' (Skinner et al. (2003). It is noted that very few of the sites had any potential and only Anodonta sp. mussels were recorded during these surveys. "*

Additional, dedicated surveys for this species were not deemed necessary and this species was not included as a KER.

5.3.3.2.8 Terrestrial Invertebrates

Marsh Fritillary (*Euphydryas aurinia*)

The results of the desk study revealed that Marsh Fritillary has been recorded from hectad N62. The eastern portion of the study area is located within N62, consequently the potential for the study area to support Marsh Fritillary was considered.

Good quality Marsh Fritillary habitat is defined generally as having a moderate to high coverage of *Succisa pratensis* (more than 3 plants per m^2) growing in a low-growing unintensive sward with a height range of 10-25cm and low cover of invasive scrub (NPWS, 2013). Shorter and taller sward may also be occupied but these are considered to be less suitable and perhaps indicators of over and under grazing.

This habitat was searched for during the site surveys and was not found. Suitable habitat for Marsh Fritillary does not occur within development footprint or within the EIS study area boundary. This species is not included as a KER.

5.3.3.2.9 Significance of Fauna

The Ecological evaluation within this section follows a methodology that is set out in Chapter 3 of the *'Guidelines for Assessment of Ecological Impacts of National Roads Schemes'* (NRA, 2009).

Badger
Badger occur throughout the island of Ireland and are afforded protection under the Wildlife Acts, 1976-2012.Evidence of Badger activity was observed at 13 locations along the study area boundary (Figure 5.6):

- Two disused setts were recorded: Grid Ref: E256297, N227088 and E257201, N226864.
- Snuffle Holes Grid Ref: E259790, N228172.
- Ten mammal trails, in various locations along the study area boundary, which could potentially be utilised by badgers.

Evidence of badger was only recorded along the fringes of this site with no activity recorded from the center of the Cloncreen site.

No active setts or latrines were recorded within the development footprint or within the 150m derogation limit outside the footprint area. Badger as an Ecological Receptor has been assigned ***Local Importance (Higher value)*** on the basis that the habitats along the study area boundary are likely to be utilised by a regularly occurring badger population of Local Importance.

Irish Hare
Irish Hare are ubiquitous within the study area. Irish Hare as an Ecological Receptor has been assigned ***Local Importance (higher value)*** on the basis of being a resident population of species protected under the Wildlife Acts and Annex V of the EU Habitats Directive. Irish Hare is a native species (endemic sub-species), widely distributed and not considered threatened. There is an abundance of suitable habitat for this species within and surrounding the EIS study area. Significant effects are not anticipated and further assessment was not deemed necessary. This species is not classified as a KER.

Otter
Otter is listed under Annex II and Annex IV of the EU Habitats Directive and is also protected under the Irish Wildlife Acts 1976-2012 and is evaluated as being Near Threatened in the most recent Red Data list for mammals (Kingston, 2012). Otter signs, in the form of spraints, were observed at five locations along the study area boundary (Figure 5.6). Spraining sites was found in close association with large drainage ditches and silt ponds.

No Otter breeding sites or holts were observed. The watercourses in the study area offer potential foraging and commuting habitat for the species. While no Otter holts were identified in the study area it is likely that there are breeding holts located in the wider area. Whilst not providing optimum habitat for Otter it is considered likely that the smaller land drains located within the study area may be utilised, on occasion, as commuting corridors between larger watercourses. Otter as an Ecological Receptor has been assigned ***Local Importance (higher value)*** on the basis of being a resident population of species protected under the Wildlife Acts and Annex II and IV of the EU Habitats Directive.

Bats
All bat species in Ireland are protected under the Bonn Convention (1992), Bern Convention (1982) and the EU Habitats Directive (92/43/EEC). Additionally, in Ireland bat species are afforded further protection under the Birds and Natural Habitats Regulations (2011) and the Wildlife Acts 1976-2012. The following bat species were identified during the dedicated bat surveys undertaken at the Cloncreen site: Common Pipistrelle, Soprano Pipistrelle, Leisler's bat, Natterer's bats, Daubenton's bat and

Myotis species. The study area is not utilised by large populations of bats. Overall the level of bat activity at the Cloncreen Bog site was low, with the majority of the bat activity occurring towards the vegetated fringes of the site. Automated bat surveys from height did not identify a high level of bat activity over the site at the Cloncreen Met Mast. The vegetated linear banks and linear strips of scrub that cut through the bog site are used by foraging and commuting bats, albeit in low numbers. Bat activity decreased in the open cutover bog land habitat at the site. This altered habitat is by far the dominant habitat type at the study area. Within the Cloncreen bog site, there is little potential for roosting bats. The trees within the wooded areas that bound the Cloncreen Bog do not provide optimal conditions, to harbor bats and are assigned Low Suitability, as per Table 4.1 of Collins 2016.

There will be no net loss of bat foraging/roosting habitat associated with the proposed wind farm development including the grid connection (Options A & B) and proposed transport route. Vegetation to be removed at junction alteration locations does not have the potential to support roosting bats.

No bat roosts were identified within the Cloncreen Bog site.

Bats as an Ecological Receptor have been assigned ***Local Importance (higher value)*** on the basis of resident and/or locally occurring populations of Annex IV species under the EU Habitats Directive and protected under the Wildlife Acts, 1976-2012.

Table 5.17 below provides a summary of the faunal importance valuation and identifies the fauna classified as Key Ecological Receptors.

Table 5.17 Summary of Fauna Significance

Species	Conservation Status	Receptor Importance / Ecological Valuation (NRA 2009)	Rationale	KER Y/N?
Otter	Habitats Directive Annex II &IV species, Wildlife Acts 1976-2012	Local Importance (higher value)	Taking precautionary approach the receptor importance has been assigned based on a locally occurring population of species protected under the Habitat Directive and Wildlife Acts (recorded in borders of study area only)	Yes
Badger	Wildlife Acts 1976-2012	Local Importance (higher value)	Taking precautionary approach the receptor importance has been assigned based on a locally occurring population of species protected under the Wildlife Acts (recorded in borders of study area only)	Yes
Irish Hare	Habitats Directive Annex V species, Wildlife Acts 1976-2012	Local Importance (higher value)	Native species (endemic sub-species), widely distributed and not considered threatened. There is an abundance of suitable habitat for this	No

Species	Conservation Status	Receptor Importance / Ecological Valuation (NRA 2009)	Rationale	KER Y/N?
			species within and surrounding the EIS study area. Significant effects are not anticipated.	
Bat species	Habitats Directive Annex IV species, Wildlife Acts 1976-2012	Local Importance (higher value)	Resident and/or locally occurring populations of Annex IV species (Activity concentrated around fringes of study area)	Yes
Additional Fauna	Wildlife Acts 1976-2012	Local Importance (Lower value)	Populations of greater than local significance were not recorded	No

5.4 Likely and Significant Effects on Flora and Fauna

Ecological evaluation and assessment of effects within this chapter follows a methodology that is set out in Chapter 3 of the *'Guidelines for Assessment of Ecological Impacts of National Roads Schemes'* (NRA, 2009). These guidelines set out the context for the determination of value on a geographic basis with a hierarchy assigned in relation to the importance of any particular receptor. The assessment of effects also followings the guidance outlined in EPA 2002. (See section 5.1.3 for further details).

This assessment of effects is structured as follows:

- Assessment of 'Do nothing' Effect
- Assessment of effects relation to sites designated for nature conservation
- Assessment of effects in relation to receptors of Local Importance Lower Value
- Assessment of effects in relation to Key Ecological Receptors
- Summary of potential effects associated with proposed infrastructure

All elements of the proposed development have been considered in assessing effects on ecological receptors:

- Turbines (including Hardstanding areas)
- Borrow Pit
- Substation and Grid Connection (Options A &B)
- Other Infrastructure (Roads, Construction Compounds, Met Mast)
- Site entrances
- Junction Accommodation and road upgrade works

5.4.1 Do-Nothing Effect

The land that forms the study area is dominated by cutover raised bog which has been actively used for industrial peat extraction. Peat production has ceased in many areas of the site and the entire site is projected to be out of peat production by 2018. Following cessation of peat production, a Cutaway Bog Rehabilitation Plan, prepared by Bord na Móna, will be implemented on the site. The main objective of this rehabilitation plan is to stabilise the site after peat production through the re-vegetation of bare peat areas. Natural colonisation is encouraged. Active rehabilitation management to enhance re-vegetation in slowly vegetating areas will be carried out where required. Targeted management to create small wetland features and re-wet peat will also be carried out where possible. If the wind energy development goes ahead the rehabilitation plan will be revised.

If the wind energy development for which this EIS has been prepared does not go ahead, it is to be assumed that the character of the landscape and its uses will remain much as they are today, i.e. harvesting will continue until 2018 and after this period the cutaway bog will continue and develop typical cutaway habitats. Should the proposed wind energy development proceed, it is likely that the main land-use of the area will effectively remain as cutover/regenerating cutover bog, with wind energy generation being a land-use that is superimposed over the cutover bog during the lifetime of the proposed development.

5.4.2 Effects on Designated Areas

The proposed development does not traverse the boundaries of any European or Nationally designated sites important for nature conservation (Figure 5.1). There will be no direct effects on any designated site as a result of the construction, operation and decommissioning of the proposed development.
None of the Nationally designated sites within the ZOI were considered as KERs and effects are not anticipated for the following reasons:

- Distance from the proposed development (nearest site 3.5km)
- Nature of the conservation sites (e.g. terrestrial nature of habitats)
- Lack of any identifiable source~pathway~receptor chain for effects.

In relation to European Sites where it could not be excluded, on the basis of objective information, that the proposed development would have significant effects of a European site, a Natura Impact Statement (NIS) has been prepared which presents the data and information on the project and provides an analysis of the potential effects on the screened-in European Site, The River Barrow and River Nore SAC. The predicted indirect and residual effects on this European site are fully described in the NIS which will be submitted to the Planning Authority as part of the planning application.

The findings presented in the NIS are that the proposed development, by itself or in combination with other plans and projects, in light of best scientific knowledge in the field, will not adversely affect the integrity of the relevant European site and no reasonable scientific doubt remains as to the absence of such effects.

5.4.3 Effects on Receptors of Local Importance (Lower Value)

General effects on flora and fauna associated with the wind farm development are described in this section where they occur in areas that have not been identified as KERs. The majority of the EIS study has been identified as being of Local Importance (Lower Value) from an ecological perspective (Table 5.15 above).

5.4.3.1 Habitat Loss (Direct Effect)

5.4.3.1.1 Construction Phase

The proposed development does not traverse any European site and there will be no habitat loss within any European site associated within the proposed development.

The habitat loss will result from the construction of turbine bases and hardstands for the 21 wind turbines, the construction of the electrical substation/grid connection (Option A or B), borrow pit development and construction of new roads and tracks (including site entrances).

Habitats encountered at the location of junction modifications and road upgrade on the proposed transport route and along the proposed grid connection route were of low ecological significance. There will be small scale temporary habitat loss associated with these works.

Areas of habitat within the footprint of the proposed development are shown in Figures 5.3a and 5.3b and are described in Section 5.3 above. The areas of habitat that will be affected by the construction of the proposed development are shown in Table 5.18a and 5.18b below. These areas of habitat loss were calculated by overlaying the permanent and temporary development footprints, incorporating substation and grid connections options A & B respectively, on the habitat map and using the GIS application MapInfo to determine resulting habitat loss. The 21 turbine base sites and the proposed substation will be located within areas of cutover raised bog (PB4). Some of these areas have partially revegetated but cutover bog is still the primary habitat present.

It is proposed to excavate and extract construction material from the existing borrow pit within the site. The borrow pit was classified as Spoil and bared ground (ED2) as it is currently inactive.

<u>Footprint incorporating Substation and grid connection Option A</u>
The proposed development will have a permanent footprint of 39.6 hectares.and a temporary footprint of 3.9hectares. Table 5.18a provides detail on the extent of habitat lost in relation to the permanent and temporary development footprints.

<u>Footprint incorporating Substation and grid connection Option B</u>
The proposed development will have a permanent footprint of 40.07 hectares and a temporary footprint of 3.3 hectares. Table 5.18b provides detail on the extent of habitat lost in relation to the permanent and temporary development footprints.

The degree of effect in relation to habitat loss, in the absence of best practice, is assessed as **Permanent Slight Negative Effect**.

Best Practice incorporated into the project design
Best practice measures have been incorporated into the design of the project to minimise the potential for habitat loss. These measures are described in Section 5.5 below.

Residual Effect
The proposed works will not result in any significant habitat loss within the proposed development site. Habitat loss is restricted to habitats of Local importance and the proposed works will not result in the loss of habitats of County, National or International importance. No significant residual effects are anticipated.

5.4.3.1.2 Operational Phase

Significant effects are not anticipated during the operational phase of the development as there will be no additional loss of habitats associated with the operation of the wind farm.

Table 5.18a: Habitats affected by the total footprint (Option A) of the proposed development

Habitat	Area within site, ha	% of Study Area	Permanent Habitat Loss, ha	% of Habitat Type Permanently Lost within Study Area	Temporary Habitat Loss, ha	% of Habitat Type Temporarily Lost within Study Area	Total Area Affected, ha
Dry Meadows and Grassy Verges (GS2)	0.11	0.01	0.03	< 0.00	-	-	0.03
Conifer Plantation (WD4)	0.12	0.01	-	-	-	-	
Dense Bracken (HD1)	0.29	0.03	0.26	0.03	-	-	0.26
Dry Calcareous and Neutral Grassland (GS1)	0.51	0.05	0.49	0.05	-	-	0.49
Scrub/Dense Bracken Mosaic(WS1/HD1)	0.55	0.06	0.53	0.06	-	-	0.53
Improved Agricultural Grassland (GA1)	0.57	0.06	-	-	-	-	
Wet Grassland (GS4)	0.85	0.09	-	-	-	-	
Buildings and Artificial Surfaces (BL3)	2.17	0.23	0.01	< 0.00	0.19	0.02	0.20
Scrub/Dry meadows and grassy verges Mosaic(WS1/GS2)	2.44	0.25	0.02	< 0.00	0.01	< 0.00	0.03
Cutover bog/Dry meadows and grassy verges Mosaic(PB4/GS2)	3.19	0.33	-	-	< 0.00	< 0.00	< 0.00
Recolonising Bare Ground (ED3)	5.78	0.60	2.81	0.29	0.04	< 0.00	2.86
Raised Bog (PB1)	11.07	1.15	-	-	-	-	
Spoil and bare ground (ED2)	13.94	1.45	3.36	0.35	0.12	0.01	3.48
Other artificial lakes and ponds (FL8)	14.24	1.48	1.06	0.11	0.03	< 0.00	1.09
Bog Woodland (WN7)	16.62	1.73	0.11	0.01	0.08	0.01	0.20
Scrub (WS1)	42.07	4.37	2.97	0.31	0.03	< 0.00	3.00
Cutover Bog/Scrub Mosaic(PB4/WS1)	120.14	12.49	5.04	0.52	0.60	0.06	5.64
Cutover Bog (PB4)	727.41	75.61	23.07	2.40	2.74	0.28	25.81
		Total Permanent Habitat Loss	**39.767 ha**	**Total Temporary Habitat Loss**	**3.843 ha**	**Total area of habitat affected**	**43.611ha**

Table 5.18b Habitats affected by the footprint (Option B) of the proposed development

Habitat	Area within site, ha	% of Study Area	Permanent Habitat Loss, ha	% of Habitat Type Permanently Lost within Study Area	Temporary Habitat Loss, ha	% of Habitat Type Temporarily Lost within Study Area	Total Area Affected, ha
Dry Meadows and Grassy Verges (GS2)	0.11	0.01	0.03	< 0.00	-	-	0.03
Conifer Plantation (WD4)	0.12	0.01	-	-	-	-	
Dense Bracken (HD1)	0.29	0.03	0.26	0.03	-	-	0.26
Dry Calcareous and Neutral Grassland (GS1)	0.51	0.05	0.49	0.05	-	-	0.49
Scrub/Dense Bracken Mosaic(WS1/HD1)	0.55	0.06	0.53	0.06	-	-	0.53
Improved Agricultural Grassland (GA1)	0.57	0.06	-	-	-	-	
Wet Grassland (GS4)	0.85	0.09	-	-	-	-	
Buildings and Artificial Surfaces (BL3)	2.17	0.23	0.01	< 0.00	-	-	0.01
Scrub/Dry meadows and grassy verges Mosaic(WS1/GS2)	2.44	0.25	0.02	< 0.00	-	-	0.02
Cutover bog/Dry meadows and grassy verges Mosaic(PB4/GS2)	3.19	0.33	-	-	-	-	
Recolonising Bare Ground (ED3)	5.78	0.60	2.81	0.29	0.02	< 0.00	2.83
Raised Bog (PB1)	11.07	1.15	-	-	-	-	
Spoil and bare ground (ED2)	13.94	1.45	3.36	0.35	0.05	< 0.00	3.40
Other artificial lakes and ponds (FL8)	14.24	1.48	1.06	0.11	0.01	< 0.00	1.07
Bog Woodland (WN7)	16.62	1.73	0.11	0.01	0.08	0.01	0.20
Scrub (WS1)	42.07	4.37	2.97	0.31	-	-	2.97
Cutover Bog/Scrub Mosaic(PB4/WS1)	120.14	12.49	5.48	0.57	0.60	0.06	6.08
Cutover Bog (PB4)	727.41	75.61	23.10	2.40	2.44	0.25	25.54
		Total Permanent Habitat Loss	**40.236 ha**	**Total Temporary Habitat Loss**	**3.201ha**	**Total area of habitat affected**	**43.437ha**

5.4.3.2 Habitat Fragmentation (Direct Effect)

5.4.3.2.1 Construction Phase

The proposed development will inevitably result in some fragmentation as it bisects certain areas of habitat (Primarily cutover bog). Sensitive features such as woodlands and remnant degraded raised bog have been identified as KERs and potential effects on these areas are discussed in Section 5.4.4 below. The proposed development will result in the loss of 2.97 ha of scrub. The development will also include the loss of 6.0ha of scrub/cutover bog mosaic.

The degree of effect in relation to habitat fragmentation is assessed as **Permanent Slight Negative Effect**. The effect is classified as *slight* given the distinct lack of wildlife corridors, such as treelines, hedgerows and rivers in the study area. The proposed works will not result in any significant habitat fragmentation within the proposed development site during the construction phase and consequently no significant residual effects are anticipated.

5.4.3.2.2 Operational Phase

Significant effects are not anticipated during the operational phase of the development as there will be no additional habitat fragmentation associated with the operation of the Wind Farm

5.4.3.3 Run Off of Pollutants (Indirect Effect)

5.4.3.3.1 Construction phase

The construction of the development will involve earth moving and levelling operations which create the potential for pollution in various forms to run off the site and enter the surrounding environment. Chemicals used in construction including hydrocarbons and cement based products could potentially be washed off the site.

The degree of effect, in the absence of best practice, is assessed as **Temporary Moderate Negative Effect**.

Best Practice and Mitigation incorporated into the project design
Control measures for sediment run-off and hydrocarbon use are outlined in Section 3.6.5. The measures outlined will be employed during the construction process to reduce, remedy and avoid the negative effects outlined above.

Residual Effect
With best practice incorporated into the design, the potential for significant run off of pollutants from the site is greatly reduced. No significant residual effects are anticipated.

5.4.3.3.2 Operational Phase

There is the potential for suspended solids (silt, possibly containing soluble nutrients), nutrients washed from soil or pollutants from machinery/equipment present for maintenance works to be carried into surface waters by site drainage and storm water during the operational phase of the development via drainage from the site. The potential paths of effect are similar to those for the preparation and construction phase of the development.

The degree of effect, in the absence of best practice, is assessed as **Long-term Slight Negative Effect**

Best Practice and Mitigation incorporated into the project design
Control measures for sediment run-off and hydrocarbon use are outlined in Section 3.6.5. The measures outlined will be employed during the construction process to reduce, remedy and avoid the negative effects outlined above.

Residual Effect
With best practice incorporated into the design, the potential for significant run off of pollutants from the site is greatly reduced. No significant residual effects are anticipated.

5.4.3.4 Hydrological Effect on Habitats (Indirect Effect)

5.4.3.4.1 Construction Phase

The wind farm construction could potentially result in hydrological changes to the area surrounding the development due to drainage or local elevation of the water table (See Chapter 8 of EIS). This is not considered significant when applied to the habitats of Local Importance (Lower Value) that surround the proposed development footprint given that they are of low ecological significance and are unlikely to be adversely effected from hydrological change.

Given that no significant effects are anticipated there is no requirement for mitigation and therefore no residual effects are anticipated.

5.4.3.4.2 Operational Phase

The operational phase drainage system will be installed and constructed in conjunction with the existing bog drainage network The operation of the drainage system will potentially result in hydrological changes to the area surrounding the development due to drainage or local elevation of the water table (See Chapter 8 of EIS). This is not considered significant when applied to the habitats of Local Importance (Lower Value) that surround the proposed development footprint given that they are of low ecological significance and are unlikely to be adversely effected from hydrological change.

Given that no significant effects are anticipated there is no requirement for mitigation and therefore no residual effects are anticipated.

5.4.3.5 Displacement/Disturbance of Fauna (Indirect Effect)

5.4.3.5.1 Construction Phase

The wind farm development has the potential to result in habitat loss, disturbance and displacement to the fauna that reside within the EIS study, along the proposed grid connection route and at the locations requiring temporary modification works on the transport route.

Where fauna of particular ecological significance or potential habitat for such species was recorded, these were included as KERs and are described in the following sections. Effects on Mammals such as Pine Marten, Red Squirrel and Deer species are not considered likely to be of significance given the lack of evidence to suggest that the EIS study area provides important habitat for populations of local, county or national significance for these species. Consequently, these species are considered to be receptors of Local Importance (Lower Value) and are not considered to be KERs.

The degree of effect, in the absence of best practice, on faunal species is assessed as **Long-term Slight Negative Effect.**

Best Practice and Mitigation incorporated into the project design
Control measures for minimising disturbance and displacement of fauna are outlined in Section 5.5.

The measures outlined will be employed during the construction process to reduce, remedy and avoid the negative effects outlined above.

Residual Effect
With best practice incorporated into the design, the potential for significant effects in relation to disturbance/displacement of fauna is not anticipated.

5.4.3.5.2 Operational Phase

Significant effects are not anticipated during the operational phase of the development. Receptors of Local Importance (Lower Value) and are not considered to be KERs. Effects on species of Local Importance (Lower Value) are not considered to be of significance given the lack of evidence to suggest that EIS study area provides important habitat for populations of local, county or national significance for these species.

Residual Effect
With best practice incorporated into the design, the potential for significant effects in relation to disturbance/displacement of fauna is not anticipated.

5.4.3.6 Spread of Invasive Species

No invasive species were recorded on the site. However, the proposed works will involve the localised movement of peat and subsoil on the site and will create disturbed ground. Construction related activity has the potential to result in the introduction and establishment of problematic invasive plants.

A pre-construction survey for invasive species will be conducted. Should invasive species be recorded at works locations on the transport route, along the grid connection route or within the development footprint an Invasive Species Management Plan will be prepared prior to construction works commencing.

In the absence of appropriate best practice measures the effect associated with the spread of invasive species is assessed as a **Long Term Slight Negative Effect.**

Best Practice and Mitigation incorporated into the project design
The measures followed to avoid the spread of invasive alien species will follow guidelines issued by the National Roads Authority – *The Management of Noxious Weeds and Non-native Invasive Plant Species on National Roads* (NRA 2010).

A number of measures dealing with the potential spread and introduction of invasive species during construction works are outlined in Section 5.5.5 below.

Residual Effects
With the best practice measures outlined in Section 5.5.5 in place, the potential for the introduction and establishment of invasive alien plant species is not anticipated. **No Effect.**

5.4.3.6.1 Operational Phase

There are no Invasive species present at any of the proposed works locations associated with the Wind Farm development. Significant effects are not anticipated during the operational phase of the development given the implementation of the best practice measures outlined in Section 5.5.5

5.4.3.7 Decommissioning Phase

Long-term, slight positive effect is likely as turbines base areas are allow to regenerate naturally.

As described in Section 3.10 of this EIS, decommissioning of the proposed wind farm will involve disassembling the wind turbines in reverse order to how they were erected, separation of all above ground components for recycling off-site, covering of the turbine bases with earth and reseeding as appropriate. Leaving the turbine foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in significant environment nuisances such as noise, dust and/or vibration, as well as potential effects on water quality due to mobilisation of sediment due to excavations and damage to habitats due to ground works and vehicular movements. It is also proposed that site roads and the electricity substation will also be left in situ. As existing site roads will be used as the access routes for vehicles removing the individual turbine components and the disassembly of the turbines will occur on the hardstand of the turbine base, there is unlikely to be any effect on habitats surrounding the turbines resulting from the disassembly process. Post-disassembly the turbine base areas will be allowed to revegetate naturally.

Best Practice and Mitigation

None necessary given that no significant negative effects are anticipated.

Short-term, slight negative effect of decommissioning works on fauna

The site activity associated with the decommissioning works is likely to result in short-term disturbance to fauna resident in proximity to the turbine locations. Nuisance resulting from noise and human activity has the potential to deter fauna from using the areas surrounding turbines while they are being dismantled. However due to the fact that fauna are likely to be habituated to the operation of the wind turbines and maintenance works at these locations and the fact that the works will be short-term in nature, the effect is likely to be slight in nature. In addition, there will be adequate habitat within the wider area for fauna to disperse on a temporary basis.

Best Practice and Mitigation

None necessary given that no significant negative effects are anticipated.

Potential short-term negligible/neutral effect on water quality owing to exposed soil at decommissioned turbine base sites.

There is the potential for surface water run-off from exposed soil surfaces such as those that will initially cover over the decommissioned turbine bases to result in slight negative effects on water quality in local surface waters. However, in the case of the proposed development, the site drainage measures will still be in place and prevent any small amounts of silt-laden run-off; that might arise prior to consolidation of the surface, from entering the local surface waters network. Therefore, no effect on water quality is envisaged.

Best Practice and Mitigation

None necessary given that no significant negative effects are anticipated.

5.4.4 Effects on Key Ecological Receptors

5.4.4.1 Effects Identified in the Absence of Mitigation Measures

Effects on the key ecological receptors as defined in the preceding sections are described below in Table 5.19, below.

Table 5.19 Effect Characterisation for Key Ecological Receptors based on EPA (2002) and NRA (2009).

KER	Construction Phase Effects	Operational Phase Effects	Ecological Significance if Unmitigated
Degraded Raised Bog (Non-Annex I)	These bog remnants have are located along the margins of the Cloncreen site. It is noted that the, structure, function and viability of the habitat is at risk from private peat extraction and scrub/woodland encroachment. The degraded raised bog is assigned Local Importance (Higher Value) on the basis of containing semi-natural habitat types with high biodiversity in a **local** context. The proposed development has been designed to avoid any direct effects on this KER and given the extent of existing drainage and separation from the sensitive bog/heath habitats, indirect effects during construction are not anticipated.	No direct or indirect operational effects are anticipated on this KER.	Given that the development footprint is located over 100metres at closest from the sensitive habitats within the KER, effects associated with drainage are not anticipated. The proposed development is considered to be in line with existing practices; as the land in this area has been subject to significant drainage and as part of peat extraction works. In light of the above factors it is considered that the proposed development does not have the potential to result in significant effects on this KER either at the National, County or Local level.
Bog Woodland	Bog Woodland (WN7) is present in numerous locations surrounding the EIS study area boundary. The Bog woodland stands, none of which conform to Annex I status, are classified as being of *Local Importance (higher value)* on the basis of supporting semi-natural habitat types with high biodiversity and high degree of naturalness. The western access to the Cloncreen site will result in the direct loss of approximately 0.19 hectares of bog woodland. Indirect effects during construction are not anticipated.	No direct or indirect operational effects are anticipated on this KER.	The proposed development will result in a Permanent Slight Negative Effect at a local scale on approximately 0.19Hectares of bog woodland that is classified as being of Local Importance (Higher Value). This is a small fraction of the overall woodland in the area. It is a reversible effect. It is considered that the proposed development does not have the potential to result in significant effects on this KER either at the National, County or Local level.
Figile River, Philipstown River and associated tributaries	The Philipstown River is located to the West and South and the Figile River is located to the East of the development site. A tributary of the Philipstown River flows along the north eastern site boundary. These watercourses are assigned Local Importance (higher value) on the basis of supporting semi-	There will be no direct effects associated with the proposed development.	The potential for pollution of the watercourses during the construction phase, is considered to constitute a potential Short-term Moderate-Significant Negative Effect as it has the potential to alter a sensitive receptor over a short period of time

KER	Construction Phase Effects	Operational Phase Effects	Ecological Significance if Unmitigated
	natural habitat types with high biodiversity and high degree of naturalness. The watercourses also have potential as a habitat for a number of species that are listed on Annex II/IV of the EU Habitats Directive. There will be no direct effects associated with the proposed development. Indirect effects may include the run off of silt and other pollutants during the construction phase of the development from the construction site to the river.	Indirect effects may include the run off of silt and other pollutants during the operation phase of the development however significant effects are not anticipated.	and over a far wider area than the site itself. It is a reversible effect. The potential for pollution of the river during the operational phase, is considered to constitute a potential Long-term Slight - Moderate Negative Effect as it has the potential to alter a sensitive receptor over a long period of time and over a far wider area than the site itself. It is a reversible effect. The development has the potential to result in significant effects on this KER at the local level.
Otter	Otter signs, in the form of spraints, were observed at five locations along the study area boundary. Sprainting sites were found in close association with large drainage ditches and silt ponds. Sprainting sites were not from the interior/center of the development site. No Otter breeding sites or holts were observed. The watercourses in the study area offer potential foraging and commuting habitat for the species. While no Otter holts were identified in the study area it is likely that there are breeding holts located in the wider area. Whilst not providing optimum habitat for Otter it is considered likely that the smaller land drains located within the study area may be utilised, on occasion, as commuting corridors between larger watercourses. Otter as an Ecological Receptor has been assigned Local Importance (higher value). It is considered unlikely that there will be any direct effect on Otter as a result of the proposed development. Indirect effects may include barrier effect, disturbance and deterioration of habitat quality (water quality and loss of in-stream fishery habitat)	No direct effects are likely to be associated with the operation of the proposed development. Indirect effects may include, disturbance and deterioration of habitat quality (water quality and loss of in-stream fishery habitat)	No significant direct effects are anticipated on this species given the nature of the habitats within the development footprint and given that no rivers or streams will be altered. No Otter breeding or resting places were recorded within the EIS study area. The potential for habitat fragmentation is not anticipated given that alterations to watercourses likely to be used with regularity by Otters is not proposed. There is no evidence to suggest that the study area is utilised with frequency by a large Otter population and consequently significant disturbance/displacement effects are not anticipated. The potential for pollution of watercourses during the operational phase is considered to constitute a potential Long-term Slight - Moderate Negative Effect as it has the potential to reduce habitat quality over a long period of time and over a far wider area than the site itself. It is considered that effects could be reversible through appropriate design and mitigation.

KER	Construction Phase Effects	Operational Phase Effects	Ecological Significance if Unmitigated
			In light of the above factors it is considered that the proposed development does not have the potential to result in significant effects on this KER either at the National, County or Local level.
Badger	Evidence of Badger activity was observed at 13 locations along the study area boundary: ▪ Two disused setts were recorded: Grid Ref: E256297, N227088 and E257201, N226864. ▪ Snuffle Holes Grid Ref: E259790, N228172. ▪ Ten mammal trails, in various locations along the study area boundary, which could potentially be utilised by badgers. Evidence of badger was only recorded along the fringes of this site with no activity recorded from the center of the Cloncreen site. No active setts or latrines were recorded within the development footprint or within the 150m derogation limit outside the footprint area. Badger as an Ecological Receptor has been assigned Local Importance (Higher value). Direct effects on this KER are not anticipated. Indirect effects may include disturbance, however the development site is actively milled for peat and species in the area are likely to have habituated to human activity.	No direct effects are likely to be associated with the operation of the proposed development. Direct effects are not anticipated. Indirect effects may include disturbance, however the development site is actively milled for peat and species in the area are likely to have habituated to human activity.	No significant direct effects are anticipated on this species given the nature of the habitats within the development footprint and given that no breeding or resting places were recorded at the within the EIS study area. There is no evidence to suggest that the study area is utilised with frequency by a large Badger population and consequently significant disturbance/displacement effects are not anticipated. In light of the above factors it is considered that the proposed development does not have the potential to result in significant effects on this KER either at the National, County or Local level.
Bat species	The following bat species were identified during the dedicated bat surveys undertaken at the Cloncreen site: Common Pipistrelle, Soprano Pipistrelle, Leisler's bat, Natterer's bats, Daubenton's bat and Myotis species. The study area is not utilised by large populations of bats. Overall the level of bat activity at the Cloncreen Bog site was low, with the majority of the bat activity occurring towards the vegetated fringes of the site. Automated bat surveys from height did not identify a high level of bat activity over the site at the Cloncreen Met Mast. The vegetated linear banks and linear strips of scrub that cut through the bog site are used by foraging and commuting bats, albeit in low numbers. Bat activity decreased in the open	Direct Effects may include potential death by collision. Indirect effects may include disturbance.	No significant direct effects are anticipated during the construction phase given that no bat roosts are located within the development footprint. No upgrade works are required at potential roost sites along the grid connection or transport routes. Taking a precautionary approach, fragmentation of habitat and barrier effect are considered to constitute a potential Long Term Negligible Negative Effect associated with the construction phase.

KER	Construction Phase Effects	Operational Phase Effects	Ecological Significance if Unmitigated
	cutover bog (Bare peat) habitat at the site. This altered habitat is by far the dominant habitat type at the study area. Within the Cloncreen bog site, there is little potential for roosting bats. The trees within the wooded areas that bound the Cloncreen Bog do not provide optimal conditions, to harbor bats and are assigned Low Suitability, as per Table 4.1 of Collins 2016. Fragmentation of habitat and barrier effect are not anticipated to any significant degree given the extremely low levels of bat activity recorded within the study area and that there will be no significant disruption to potential foraging and commuting corridors for bats. There will be no loss of bat roosting habitat associated with the proposed grid connection, junction works or road upgrade to facilitate the proposed western entrance. Vegetation to be removed at junction alteration locations does not have the potential to support roosting bats. No bat roosts were identified within the Cloncreen Bog site. Bats as an Ecological Receptor have been assigned Local Importance (higher value). Direct Effects on Bats are not anticipated. Indirect effects may include fragmentation of habitat, barrier effect and disturbance.		During the operational phase, potential death by collision and disturbance are considered to be potential Long-term Negligible Negative Effects given the extremely low levels of bat activity recorded within the study area. In light of the above factors it is considered that the proposed development does not have the potential to result in significant effects on this KER either at the National, County or Local level.
Basil Thyme	The largest concentration of Basil Thyme was recorded from a linear calcareous mound, approximately 670m in length, located in the south-eastern corner of the site. A population of Basil Thyme of approximately 90-100 plants was recorded on the rail track immediately to the south of the tea center. A slightly smaller population (70-80 plants) was recorded from exposed gravel towards the center of the site. The population of this species in the development site was assigned ***Local Importance (higher value)***. Populations of this species will be directly affected upon during the construction phase of the development.	Direct or indirect effects on this species are not anticipated during the operational phase.	There is potential for direct effects on the habitat and populations of this species recorded within the development footprint. However, the development avoids the majority of the existing population within the study area. This effect is categorised as a Short-term Moderate Negative Effect during the construction phase In relation to area of suitable habitat for this species, the construction phase has the potential to result in a Long-term Positive Effect as

KER	Construction Phase Effects	Operational Phase Effects	Ecological Significance if Unmitigated
	Construction on site has the potential to have a positive effect on this species, given that construction activities shall result more gravel and sub-soil is exposed and disturbed, providing new habitat for this rare plant species. Indirect Effects are not anticipated.		construction activities will create new areas of suitable habitat within the development site which could potentially be colonised by Basil Thyme. Effects during the operation phase of the development are not anticipated. In light of the above, it is considered that the proposed development does not have the potential to result in significant effects on this KER either at the National or County level but does have the potential to result in effects at the Local Level.
Blue Fleabane	The largest concentration of Blue Fleabane was in the eastern section of the proposed borrow pit where in excess of 1000 plants were recorded. This area overlaps with the development footprint and will be directly affected upon during the construction phase. Elsewhere throughout the site this species occurred in low numbers and in scattered locations. The population of this species in the development site was assigned ***Local Importance (higher value)***. Construction on site has the potential to have a positive effect on this species, given that construction activities shall result more gravel and sub-soil is exposed and disturbed, providing new habitat for this rare plant species. Indirect Effects are not anticipated.	Direct or indirect effects on this species are not anticipated during the operational phase.	There is potential for direct effects on the habitat and populations of this species, recorded within the development footprint, during the construction phase of the development. This effect is categorised as a Short-term Moderate Negative Effect. In relation to area of suitable habitat for this species, the construction phase has the potential to result in a Long-term Positive Effect as construction activities will create new areas of suitable habitat within the development site which could potentially be colonised by Blue Fleabane. Effects during the operational phase of the development are not anticipated. In light of the above, it is considered that the proposed development does not have the potential to result in significant effects on this KER either at the National or County level but does have the potential to result in effects at the Local Level.

5.4.5 Cumulative Effects

5.4.5.1 Projects Considered in Cumulative Assessment

Assessment material for this cumulative assessment of effects was compiled on the relevant developments within the vicinity of the proposed development and was verified on the 12/10/2016. The material was gathered through a search of relevant online Planning Registers, reviews of relevant EIS documents, planning application details and planning drawings, and served to identify past and future projects, their activities and their environmental effects. The projects considered in relation to the potential for cumulative effects and for which all relevant data was reviewed (e.g. individual EISs, layouts, drawings etc.) include those listed below.

- Clonbullogue Ash Repository
- Edenderry Power Plant
- Peat Extraction: Allen Group
- Peat Extraction: Derrygreenagh Group
- Barrow BlueWay
- Grand Canal Blueway Shared Walking and Cycling Route
- Shean Site Infill
- Eastern and Midlands Regional Water Supply Project
- Clonin North Solar Farm
- Other Wind Farm Projects
- Mountlucas Wind Farm – Operating
- Yellow River Wind Farm – Permitted

Details for each project are presented in Section 2.9.2 of this EIS.

5.4.5.2 Results of Assessment of Cumulative Effects

Cloncreen Wind Farm Development

It is considered that the scale of the works and implementation of effective mitigation avoids all adverse effects on the Environment. There is no potential for cumulative effects arising in combination with any other or projects and therefore no potential for cumulative effects on the habitats flora and fauna of the existing Environment.

A number the developments listed above lie within the same surface water catchment as the proposed Cloncreen development, it is considered that the residual (mitigated) in-combination effect of the proposed development on surface water quality will be imperceptible/negligible. Therefore, there will be no significant cumulative effects of the development with other proposed projects on surface water quality.

The proposed grid connection options utilise areas of highly modified cutover bog which are currently subject to peat extraction and have little vegetation. There will be no loss of ecological sensitive habitats associated with these works and no significant ecological effects are anticipated. The grid connection will not give rise to cumulative effects when considered in combination with other projects.

Transport Route

Work include new access junctions, improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and construction access, including: temporary upgrade of R420/R402 junction, temporary road widening at 1 no. location on R402 in Ballinagar, upgrade of R402/L1003 junction, road upgrade along the L1003 and new construction phase site entrance, and upgrade of existing site entrance on R401. There will be no loss of ecological sensitive habitats associated with these works and no significant ecological effects are anticipated. The works will not give rise to cumulative effects when considered cumulatively with other projects.

Overall Conclusion
Based on the above, it can be objectively concluded in view of best scientific knowledge, on the basis of objective information that the proposed development, individually or cumulatively with other projects, will not have a significant adverse effect on the habitats, flora and fauna of the existing Environment.

5.5 Mitigation Measures

This section describes the measures that are in place to mitigate any potentially harmful or negative effects associated with the proposed development and the identified KERs as described in the preceding sections. General mitigation measures included within the design of the scheme are described first, with more specific measures to prevent or minimise effects on the individual receptors provided subsequently.

5.5.1 Mitigation by Avoidance

The proposed development has been designed to avoid ecologically sensitive areas and has been constraint led from the initial design phase.

The project design has followed the basic principles outlined below to eliminate the potential for ecological effects on KERs where possible and to minimise such effects where total elimination is not possible.

The development has been designed to avoid any direct, in-direct or residual adverse effects on European sites or other designated sites for nature conservation. In relation to European Sites where it could not be excluded, on the basis of objective information, that the proposed development would have significant effects (See AA Screening Report), a Natura Impact Statement has been prepared which presents the data and information on the project and on each site and provides an analysis of the potential effects on each site. The screened in European Site, The River Barrow and River Nore SAC, has been identified as a KER and the predicted and residual effects on this European site are fully described in the NIS. The findings presented in the NIS are that the proposed development, by itself or in combination with other plans and projects, in light of best scientific knowledge in the field, will not adversely affect the integrity of any European sites and no reasonable scientific doubt remains as to the absence of such effects.

The proposed development has also been designed to avoid effects on habitats that correspond to those that are listed on Annex I of the EU Habitats Directive outside of the European and Nationally designated sites. There will be no direct effects on Annex I habitats resulting from this development.

The proposed development has been designed to minimise direct or indirect effects on any habitats or species that were classified as being of National or Local Importance (Higher Value) in the design of the scheme

Through careful planning and design, direct or indirect effects on receptors of International, National & County importance have been avoided at the design stage. In addition, the proposed development layout minimises the potential for effects on receptors of Local Importance (Higher Value).

5.5.2 Construction and Environmental Management Plan (CEMP)

- A Construction and Environmental Management Plan (CEMP) has been prepared, and is included as Appendix 3-2 of this EIS. The CEMP will be in place prior to the start of the construction phase.
- Machinery and materials will either be parked/stored in the specified compound areas. Wherever possible, vehicles will be refuelled off-site. This will be the case for regular, road-going vehicles.
- For construction machinery that will be based on-site continuously, a limited amount of fuel will have to be stored on site.
- On-site refuelling of machinery will be carried out using a mobile double skinned fuel bowser.
- The fuel bowser, a double-axle custom-built refuelling trailer will be refilled off site, and will be towed around the site by a four-wheel drive jeep to where machinery is located. It is not practical for all vehicles to travel back to a single refuelling point, given the size of the cranes, excavators, etc. that will be used during the construction of the proposed wind farm. The jeep will also carry fuel absorbent material and pads in the event of any accidental spillages.
- The fuel bowser will be parked on a level area in the construction compound when not in use.
- Refuelling operations will be carried out only by designated trained and competent operatives.
- Mobile anti-pollution measures such as drip trays and fuel absorbent mats will be used during all refuelling operations.
- Materials excavated (e.g. peat, soil, gravel or rock) during construction of the turbine bases, electrical sub-station, or during construction of new roadways or the upgrading works on existing roadways will be reused within the site.
- Re-use of these materials within the site will occur under conditions where there is no possibility of the material becoming mobile in the environment and entering into either surface or ground waters.
- The CEMP also provides for the appointment of a Site Supervisor/Construction Manager and/or Environmental Manager to maintain responsibility for monitoring the works and Contractors/Sub-contractors from an environmental perspective. In addition, a Project Ecologist, Project Hydrologist and Project Geotechnical engineer will visit the site regularly and report to the Site Environmental Office. This structure will provide a "triple lock" review/interaction by external specialists during the construction phase.

5.5.3 Habitats Flora and Fauna

Where sections of woody vegetation are removed for the purposes of the junction and road upgrades, these will be replaced with suitable hedge/tree species which are common in the local context.

Even though works required for development are exempt from the conditions stipulated in the Wildlife Acts, the commencement of woody vegetation removal will be conducted outside the general bird breeding season which runs from the 1st of March to the 31st of August inclusive.

A pre-commencement mammal survey will be undertaken in order to identify any Otter holts or Badger setts within the works areas associated with the proposed development.

In accordance with best practice guidelines, a minimum of three years post-construction monitoring is recommended (BCI 2012a, Rodrigues et al. 2015). Post-construction bat activity surveys are recommended to be carried out in conjunction with fatality searches (BCI 2012a, Hundt 2012, Rodrigues 2015). A dusk and a dawn survey should be carried out on the night preceeding any bat fatality search. Activity surveys should comprise walked transects representative of all turbine locations and habitat features. The aim of post-construction activity surveys is to assess any changes in bat activity and habitat use on site and to provide context to fatality search results (See Appendix 5-3 for further details).

The proposed development footprint traverses populations of Basil Thyme and Blue Fleabane (See Figure 5.5-b) To compensate for this habitat loss, it is proposed to reinstate suitable calcareous habitat within the development site. Construction on site has the potential to actually enhance the conservation status of both species, as it will mean that more gravel and sub-soil is exposed and disturbed, providing new habitat for these rare plant species.

Basil Thyme is listed in the Flora Protection Order 2015, consequently it is an offence to take, alter or otherwise interfere with the habitat or environment of this plant without a Licence. Prior to works commencing in areas with identified populations of Basil Thyme a licence shall be sought under Wildlife Acts 1976-2012, Section-21 for the alteration and reinstatement of suitable habitat for this species.

The following methodology shall be employed in relation to the habitat reinstatement.

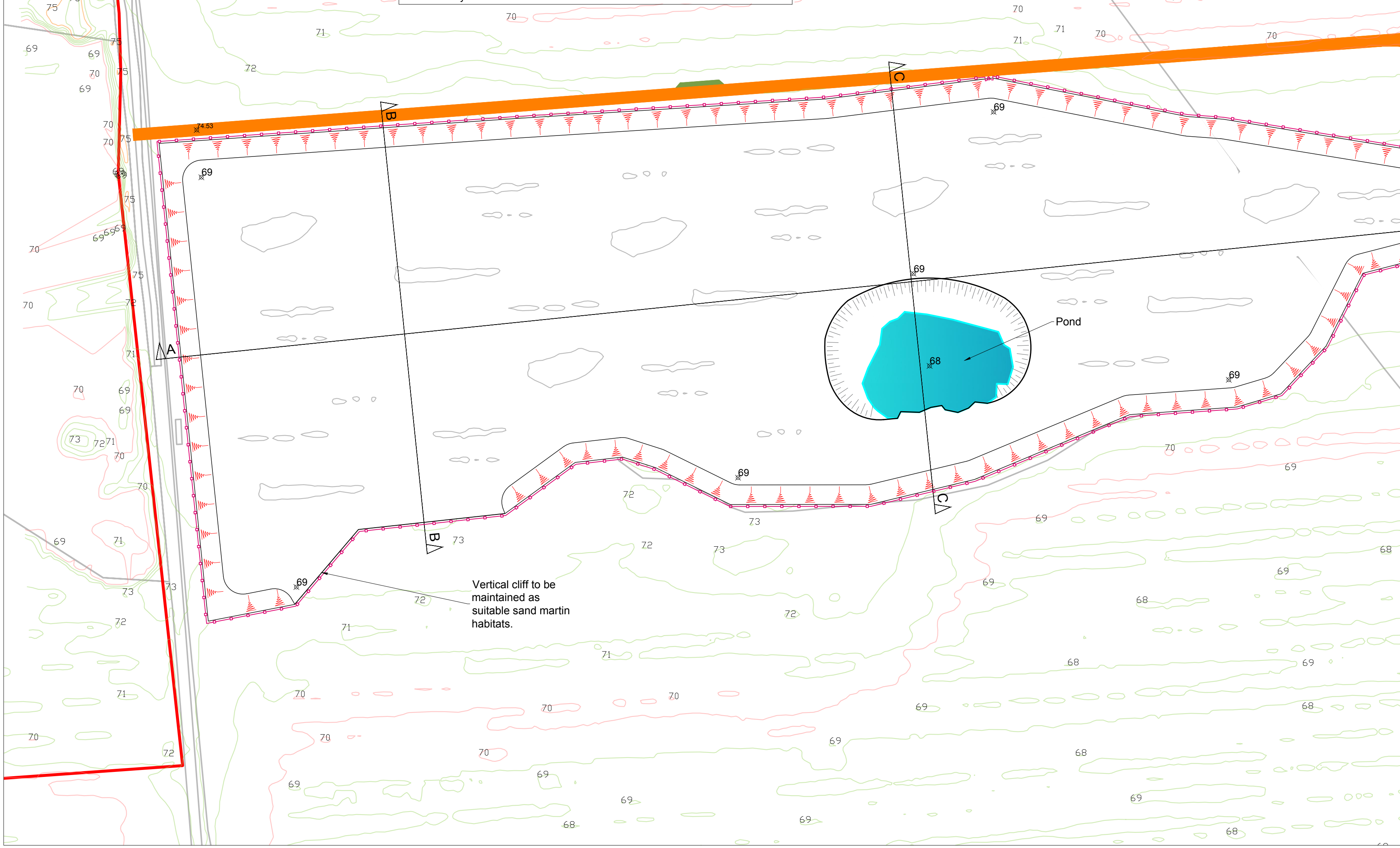
- Existing plants from the identified areas within the development footprint will be carefully excavated by hand with a shovel ensuring that the root system and surrounding rooting substrate remain intact. These plants will be moved to a prepared area with suitable substrate and habitat conditions for the calcicole species.
- Following the removal of the plants, the gravel/subsoil from identified areas within the development footprint shall be stripped and separately stored, covered and clearly marked within the development site boundary. The stockpile of the gravel/subsoil shall be temporarily fenced to avoid contamination or unnecessary disturbance.
- During reinstatement, a thin layer of the stripped gravel/subsoil, containing the residual floral seed bank, shall then be spread evenly over gravel substrate.
- These areas shall then be temporarily fenced off and allowed to regenerate naturally.
- Post regeneration the reinstated areas shall be subject to a management regime:
    1. No fertiliser or herbicide shall be applied.
    2. Potential Scrub encroachment will be monitored and appropriate measures adopted if required to manage any potential encroachment
    3. A monitoring programme shall be put in place and an annual assessment of Blue Fleabane and Basil Thyme populations shall be conducted by a suitably qualified ecologist to monitor the recovery and conservation status of these species.
    4. The annual assessment will be carried out for a period of three years. Following on from this the area will be routinely assessed as part of the program of habitat surveys carried out by the Bord na Mona Ecology team.

Figure 5.5-c presents a view of the proposed borrow pit following rehabilitation.

Rehabilitation Plan Notes 1:
Overburden present at existing borrow pit area (168,000m³) to be placed around the perimeter to creating graded slopes and placed across the entire base of borrow pit area to approx. 1m above water table (69mod). Following extraction of useable sand and gravel.

Rehabilitation Plan Notes 2:
Two nationally rare plant species, Basil Thyme (Clinopodium acinos) and Blue Fleabane (Erigeron acer) occur within the proposed borrow pit. Section 5.5.3 of the EIS outlines the proposed mitigation in relation to the preservation of living plants and rehabilitation of suitable habitat for the protected species. The methodology is summarised as follows:

- Existing plants from the identified areas within the development footprint will be carefully excavated by hand with a shovel ensuring that the root system and surrounding rooting substrate remain intact. These plants will be moved to a prepared area with suitable substrate and habitat conditions for the calcicole species.
- Following the removal of the plants, the grave/subsoil from identified areas within the development footprint shall be stripped and separately stored, covered and clearly marked within the development site boundary. the stockpile of the gravel/subsoil shall be temporarily fenced to avoid contamination or unnecessary disturbance.
- During reinstatement, a thin layer of the stripped gravel/subsoil, containing the residual floral seed bank, shall then be spread evenly over gravel substrate.
- These areas shall then be temporarily fenced off and allowed to regenerate naturally.



Drawing Legend

- Planning Application Boundary
- Proposed Road
- Passing Bay
- Minor Contour (1m Interval)
- Major Contour (70 MOD)
- Intermediate Contour (75 MOD)
- Gray Contour c0.5m
- Internal Cable Option A
- Internal Cable Option B
- Graded Slope
- Borrow Pit Fence or Berm

N

DRAWING TITLE:
Proposed Borrow Pit - Following Rehabilitation

PROJECT TITLE:
Cloncreen Wind Farm, Co. Offaly

DRAWING BY: Shane O Connor	CHECKED BY: Michael Watson
PROJECT No.: 150504	DRAWING No.: Figure 5.5c
SCALE: 1:2,000 @A3	DATE: 21.10.2016

OS SHEET No.: 3310, 3311, 3312, 3313, 3314, 3315, 3373, 3374, 3375, 3376, 3377, 3378, 3436, 3437, 3438, 3439, 3440, 3441, 3497, 3498, 3499, 3500, 3501, 3502

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5.5.4 Water Quality

Mitigation measures to protect local surface water quality are detailed in Section 3.6.5 (Description of the Proposed Development) and Chapter 8 (Hydrology & Hydrogeology) of this EIS. Further details are also provided in the CEMP in Appendix 3-2 of the EIS.

The NRA *Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes* and the Scottish Natural Heritage (SNH) *Good Practice During Wind Farm Construction* will also be considered.

5.5.5 Invasive Species

Due to the legislative requirements to control the spread of noxious weeds and non-native invasive plant species, it is important that any activities associated with the planning, construction and operation of wind farm developments comply with the requirements of the Wildlife Acts, 1976-2012. Regulations 49 and 50 of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2015) include legislative measures to deal with the dispersal and introduction of Invasive Alien Species (IAS), which are listed in the Third Schedule of the regulations.

Regulation 49 deals with the Prohibition on introduction and dispersal of certain species while Regulation 50 relates to Prohibition on dealing in and keeping certain species (Regulation 50 has not yet been commenced). Invasive species listed under the Third Schedule of the European Communities (Birds and Natural Habitats) Regulations 2011 (S.I. 477 of 2015).

The introduction and/or spread of invasive species such as Himalayan Balsam, Giant Rhubarb or Rhododendron for example, could result in the establishment of invasive alien species and this may have negative effects on the surrounding environs. Appropriate spread prevention measures have been incorporated into the design of the project.

Control Measures for the Management of Invasive Species

The following measures address potential effects associated with the construction phase of the project:

- Good construction site hygiene will be employed to prevent the introduction and spread of problematic invasive alien plant species (e.g. Himalayan Balsam, Japanese Knotweed etc.) by thoroughly washing vehicles prior to leaving any site.
- All plant and equipment employed on the construction site (e.g. excavator, footwear, etc.) will be thoroughly cleaned down using a power washer unit prior to arrival on site to prevent the spread of invasive plant species
- All washing must be undertaken in areas with no potential to result in the spread of invasive species. This process will be detailed in the contractor's method statement.
- Any soil and topsoil required on the site will be sourced from a stock that has been screened for the presence of any invasive species and where it is confirmed that none are present.
- All planting and landscaping associated with the proposed development shall avoid the use on invasive shrubs such as Rhododendron.

5.6 Residual Effects on Key Ecological Receptors (KERs)

The significance of any residual effects has been assessed by evaluating the likely effectiveness of the proposed mitigation in addressing the effects on integrity and conservation status of each of the key ecological receptors. See Table 5.20 below.

Table 5.20 Assessment of Scale and Significance of Residual Effects; based on the EPA (2002) and NRA (2009)

KER	Significance of Pre-Mitigation Effects	Ecological Significance following Mitigation
Degraded Raised Bog	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the National, County or Local level.	Given that the development footprint is located over 100metres at closest from the sensitive habitats within the KER, effects associated with drainage are not anticipated. The proposed development is considered to be in line with existing practices; as the land in this area has been subject to significant drainage and as part of peat extraction works. In light of the above factors it is considered that the proposed development does not have the potential to result in significant residual effects on this KER either at the National, County or Local level.
Bog Woodland	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the National or County level. The proposed development does have the potential to result in significant effects at the Local level.	The proposed development will result in the loss of approximately 0.19Hectares of non-Annex I bog woodland that is classified as being of Local Importance (Higher Value). This is a small fraction of the overall woodland in the area. It is considered that the proposed development does not have the potential to result in significant residual effects on this KER either at the County or National level.
Figile River, Philipstown River and associated tributaries	It is considered that the development does not have the potential to result in significant effects on this KER either at the National or County level. The proposed road development does have the potential to result in significant effects at the Local level.	Mitigation measures to protect local surface water quality are detailed in Chapters 3 (Description of the Proposed Development) and 8 (Hydrology & Hydrogeology) of this EIS. Further details are also provided in the CEMP in Appendix 3-2 of the EIS. With the above measures in place, it is considered that the proposed development does not have the potential to result in significant residual effects on this KER.
Otter	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the National, County or Local level.	No significant effects are anticipated on this species given the nature of the habitats within the development footprint and given that no breeding or resting places were recorded within the EIS study area. In addition there will be no alteration of rivers or streams. There is no evidence to suggest that the study area and particularly the development footprint, is utilised with frequency by Otter and consequently significant disturbance/displacement effects are not anticipated.

KER	Significance of Pre-Mitigation Effects	Ecological Significance following Mitigation
		Mitigation measures to protect local surface water quality are detailed Chapters 3 (Description of the Proposed Development) and 8 (Hydrology & Hydrogeology) of this EIS. Further details are also provided in the CEMP in Appendix 3-2 of the EIS. In light of the above factors it is considered that the proposed development does not have the potential to result in significant residual effects on this KER.
Badger	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the National, County or Local level.	No significant effects are anticipated on this species given the nature of the habitats within the development footprint and given that no active setts were recorded at the within the EIS study area. There is no evidence to suggest that the study area is utilised with frequency by Badgers and consequently significant disturbance/displacement effects are not anticipated. In light of the above factors it is considered that the proposed development does not have the potential to result in significant residual effects on this KER.
Bat species	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the National, County or Local level.	No significant effects are anticipated on bats given that no bat roosts are located within the development footprint. No upgrade works are required at roost sites along the grid connection or transport routes. Fragmentation of habitat, barrier effect, disturbance and collision risk are not considered to be significant effects given the extremely low levels of bat activity within the study area. In light of the above and taking cognisance of the prescribed mitigation, it is considered that the proposed development does not have the potential to result in significant residual effects on this KER
Basil Thyme	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the National, County or Local level.	There is potential for direct effects on the population of this species recorded within the proposed development footprint during the construction phase of the development. In relation to area of suitable habitat for this species, the construction phase has the potential to result in a Long-term Positive Effect as construction activities will create new areas of suitable habitat within the development site which could potentially be colonised by Basil Thyme. Effects during the operation phase of the development are not anticipated. A suit of mitigation measures in relation to the protection of protected flora are outlined in section 5.5.3.

KER	Significance of Pre-Mitigation Effects	Ecological Significance following Mitigation
		In light of the above and taking cognisance of the prescribed mitigation, it is considered that the proposed development does not have the potential to result in significant residual effects on this KER
Blue Fleabane	It is considered that the proposed development does not have the potential to result in significant effects on this KER at the National, County or Local level.	There is potential for direct effects on the population of this species recorded within the proposed borrow pit during the construction phase of the development. In relation to area of suitable habitat for this species, the construction phase has the potential to result in a Long-term Positive Effect as construction activities will create new areas of suitable habitat within the development site which could potentially be colonised by Blue Fleabane. Effects during the operation phase of the development are not anticipated. A suite of mitigation measures in relation to the protection of protected flora are outlined in section 5.5.3. In light of the above and taking cognisance of the prescribed mitigation, it is considered that the proposed development does not have the potential to result in significant residual effects on this KER

5.7 Conclusion

Following consideration of the residual effects (post mitigation) it is noted that the proposed development will not result in any significant effects on any of the identified KERs. No effects on receptors of International, National or County Importance were identified.

The potential for effects on the designated sites that were identified as KERs are fully described in the Natura Impact Statement that accompanies this application and this concludes that in view of best scientific knowledge and on the basis of objective information, the proposed development either individually or in combination with other plans or projects, is not likely to have significant effects on the European Sites that were assessed as part Appropriate Assessment process. No NHAs or pNHAs were identified as KERs and no potential pathway for effect on pNHAs was identified.

Other than the identified KERs, the ecological effects on floral and faunal receptors of Local Importance (Lower Value) are not considered to be significant in the Medium to Long term.

Provided that the proposed wind farm development is constructed and operated in accordance with the design, best practice and mitigation that is described within this application, significant effects on ecology are not anticipated at the international, national or county scales or on any of the identified KERs.

6 ORNITHOLOGY

6.1 Introduction

This chapter of the Environmental Impact Statement (EIS) assesses the likely significant effects that the proposed development may have on bird species. Firstly, a brief description of the proposed development is provided. This is followed by a comprehensive description of the methodologies that were followed in order to obtain the information necessary to complete a thorough assessment of the potential effects of the proposed development on bird species. The survey data is presented in full in the EIS Appendices, with a summary of the information presented within this chapter. An analysis of the results is then provided, which discusses the ecological significance of the birds recorded within the study area. The potential effects of the proposed development are then described in terms of the construction, operation and decommissioning phases of the development. An accurate prediction of the effects is derived following a thorough understanding of the nature of the proposed development along with a comprehensive knowledge of bird activity within the study area.

6.1.1 Background

The proposed development is described in full in Section 3 of this EIS. For the purposes of the planning application, the proposal comprises:

i. 21 No. wind turbines with an overall blade tip height of up to 170 metres and all associated hard-standing areas.
ii. 1 No. borrow pit.
iii. 1 No. permanent Anemometry Mast up to a height of 120 metres.
iv. Provision of new site access roads and associated drainage.
v. 1 no. 110 kV Electrical substation, which will be constructed at one of two possible locations on site: either Option A in Ballykilleen townland or Option B in Cloncreen townland. The electrical substation will have 2 no. control buildings, associated electrical plant and equipment, and waste water holding tank.
vi. 2 No. temporary construction compounds, one of which will be located in the townland of Esker More and the other at one of two possible locations: either Option A in Ballykilleen townland or Option B in Cloncreen townland.
vii. All associated underground electrical and communications cabling connecting the turbines to the proposed substation at either Ballykilleen or Cloncreen townland.
viii. All works associated with the connection of the proposed wind farm to the national electricity grid, which will be either to the existing Cushaling substation via underground cable (Option A) or to the existing Thornsberry/Cushaling 110 kV line via overhead line (Option B).
ix. Demolition of existing canteen 'tea centre' building.
x. Removal of existing telecommunications mast.
xi. Removal of existing meteorological mast.
xii. New access junctions, improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and construction access, including: temporary upgrade of R420/R402 junction, temporary road widening at 1 no. location on R402 in Ballinagar, upgrade of R402/L1003 junction, road upgrade along the L1003 and new construction phase site entrance, and upgrade of existing site entrance on R401.
xiii. All associated site development works.

The site of the proposed development measures 960 hectares. The proposed permanent footprint of the proposed development measures 40.1 hectares, which represents approximately 4% of the primary study area.

The planning application for the proposed wind farm includes all necessary connections to the electricity grid. All elements of the proposed project, including grid connection, have been assessed as part of this EIS. The planning application includes 2 No. substations and associated grid connections; however, only one substation and associated grid connection will ultimately be constructed. The proposed wind farm will connect to the national grid via one of the following methods:

- **Option A**: construction of a 110 kV substation in the eastern section of site, to connect to existing 110 kV Cushaling substation at Edenderry Power Plant. Connection will be via underground cable approx 1.7km in length, located within Bord na Móna lands and curtilage of the public road.

Or

- **Option B**: construction of a 110 kV substation in southern section of site, to connect to existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site. Connection will be via two short sections of overhead line, (less than 0.1km)

Both substations and grid connection options have been assessed as part of this EIS. All upgrades and improvements to sections of the public road network along the turbine delivery route have also been assessed.

6.1.2 Legislation and Policy Context

6.1.2.1 International Legislation and Guidance

The following international legislation has regard to protecting wildlife and habitat specifically bird communities and their habitats in an Irish Context:

- The EU Birds Directive (2009/147/EC of the European Parliament and of the Council of 30th November 2009 on the conservation of wild birds).
- The Habitats Directive (Directive 2009/147/EC, 92/43/EC on the Conservation of Natural Habitats and of Wild Fauna and Flora).
- Environmental Impact Assessment Directive (2011/92/EU)
- The International Convention on Wetlands of International Importance 1971.

The following strategy guidance documents published by Scottish Natural Heritage (SNH) have been applied in the assessment of the potential effects of wind energy projects on bird communities and their habitats in an Irish context:

- SNH (2014). *Recommended bird survey methods to inform impact assessment of onshore wind farms*. Scottish Natural Heritage.
- SNH (2010) *Avoidance rate information & guidance note: Use of avoidance rates in the SNH wind farm collision risk model*. Scottish Natural Heritage, Edinburgh, UK. http://www.snh.gov.uk/docs/B721137.pdf [accessed 08 Aug 2013].
- SNH (2013). *Assessing Connectivity with Special Protection Areas (SPAs)*. Scottish Natural Heritage.
- SNH (2012). *Assessing the Cumulative Impact of Onshore Wind Energy Developments*. Scottish Natural Heritage.

- SNH (2006). *Assessing Significance of Impacts from Onshore Windfarms on Birds Outwith Designated Sites*. Scottish Natural Heritage.
- SNH (2009). *Monitoring the impact of onshore wind farms on birds*. Scottish Natural Heritage.
- SNH (2000). *Wind farms and birds: calculating a theoretical collision risk assuming no avoidance action*. SNH Guidance Note.

6.1.2.2 National Legislation, Policy, Guidance and Action Plans

The following legislation and policy apply to bird communities in a national context:

- Irish Wildlife Act 1976 to 2012
- The European Communities (Birds and Natural Habitats) Regulations 2011 (transposes into law two Directives, EU Birds Directive and EU Habitats Directive)
- Planning and Development Acts 2000 - 2015

This assessment has been prepared with respect to the various planning policies and strategy guidance documents that apply on a national level outlined below:

- Planning and Development (Amendment) Act 2010 (number 30 of 2010) – amendment commenced 19/08/2010 (by S.I. No. 405 of 2010)
- Offaly County Council (2014). Offaly County Development Plan 2014-2020 Natura Impact Report. Offaly County Council, November 2014.
- Offaly County Council, (2014). *Wind Energy Strategy for County Offaly, Methodology Statement 2014. Offaly County Development Plan 2014-2020*. Offaly County Council, October 2014.
- DoEHLG (2013). *Guidelines for Planning Authorities and An Bord Pleanála on Carrying out Environmental Impact Assessment*. Department of the Environment, Community and Local Government.
- European Commission (2011). *Wind energy development and Natura 2000*. Guidance document.
- EPA (2003). *Advice notes on current practice (in the preparation of Environmental Impact Statements*. Environmental Protection Agency
- EPA (2002). *Guidelines on the information to be contained in Environmental Impact Statements*. Environmental Protection Agency.
- NRA (2009). *Guidelines for Assessment of Ecological Impacts of National Road Schemes (Revision 2)*. National Roads Authority.
- EPA (2015). *Draft revised guidelines on the information to be contained in Environmental Impact Statements*. Environmental Protection Agency.
- European Commission (2002). *Assessment of plans and projects significantly affecting Natura 2000 sites*.
- Percival, S.M. (2003). *Birds and wind farms in Ireland: A review of potential issues and impact assessment*. Ecological consultant report.
- BWI (2011). *Action Plan for Raised Bog Birds in Ireland 2011-2020*. BirdWatch Ireland, Kilcoole, Co. Wiclow.
- Bord na Móna (2010). *Biodiversity Action Plan 2016-2021.* Bord na Móna.
- Bord na Móna (2016). *Biodiversity Action Plan 2010-2015.* Bord na Móna.
- McGuinness, D., Muldoon, C., Tierney, N., Cummins, S., Murray, A., Egan, S. & Crowe, O. 2015. *Bird Sensitivity Mapping for Wind Energy Developments and Associated Infrastructure in the Republic of Ireland*. Guidance Document. Birdwatch Ireland.

6.1.3 Professional Competency of Authors

This ornithology chapter has been prepared by Mr. Barry O'Loughlin (BSc Environmental Science: National University of Ireland Galway, MSc Applied Ecology: University College Cork) with the assistance of Ms. Susan Doyle (BA Zoology: Trinity College Dublin. MSc Ecological Assessment: University College Cork) Ecologists with McCarthy Keville O'Sullivan Ltd. (MKO). Both are suitably qualified competent professional ecologists with extensive experience of completing avifaunal assessments. The majority of the field surveys undertaken in 2015 / 2016 was also carried out by these individuals. Input was also provided by Dr. Chris Peppiatt (Independent Ecologist) (BSc Botany, PhD) who has extensive experience of bird surveys, assessment and collision risk modelling. Bird survey data was also provided by Dr Brian Madden (PhD Eco), who completed bird surveys on the site from 2012 to 2015. Additional field surveyors that provided data during 2015 / 2016 include Mr. Tony Nagle (Independent Ecologist) (BSc Environmental Science, MSc Ecological Assessment: University College Cork). Mr. Alan Dunne (Independent Ecologist) (MSc Environmental Resource Management: University College Dublin). Mr. Donal Finch (Alan Lauder Consulting) (BSc Environmental Science: University College Dublin, MSc Biodiversity and Conservation: University of Leeds). Shane O'Neill (Certificate in Field Ecology University College Cork). Mr. Collin Gallagher (Alan Lauder Consulting) (BA Heritage Studies: Galway/Mayo Institute of Technology, MSc Ecological Economics: University of Edinburgh) all of whom are competent experts in bird surveying. This information has been referenced and considered as part of this assessment.

CVs for the authors of this report are provided in Appendix 6-1 of the EIS. All the above surveyors are competent and suitably qualified to complete the bird survey work, analysis and assessment of the likely effects that is included in this chapter.

6.2 Methodology

6.2.1 Desk Studies and Consultation

6.2.1.1 Desk Study

A comprehensive desk study was undertaken to search for any relevant information on the use of the study area by birds. Particular attention was paid to any information pertaining to either protected or vulnerable species such as those that are included on Annex I of the EU Birds Directive, the BoCCI Red and Amber Lists, migratory wildfowl and raptor species.

6.2.1.2 Consultation

Consultation was undertaken with the relevant statutory and non-statutory organisations as part of the EIS scoping to inform the current assessment.

- Development Applications Unit (DAU, Department of Arts, Heritage, Regional, Rural and Gaeltacht Affairs.
- National Parks & Wildlife Service
- Birdwatch Ireland
- Irish Raptor Study Group
- Irish Whooper Swan Study Group
- Irish Red Grouse Association

Section 2.9 of the EIS provides a full description of the scoping and consultation exercise undertaken by MKO, including a summary of all responses received. The relevant points in relation to the Flora & Fauna assessment, including birds, are also reiterated in Section 5.3.1 of Chapter 5. See also Section 6.3.1 below on additional specific consultation in relation to birds.

6.2.2 Field Surveys

This section of the report describes the criteria used for the selection of target species, the various field survey methodologies employed and survey rationale for the various survey methods employed. Field surveys were undertaken during the survey period October 2012 to August 2016. The data provided in this report is robust and allows clear, precise and definitive conclusions to be made on the avian receptors identified within the subject site. Field survey methodologies have been devised to survey for the various bird species composition and assemblages that occur within the study area.

The surveys were undertaken following published guidelines issued by Scottish Natural Heritage (SNH, 2014) during the following survey periods:

- Winter/non-breeding season of 2013/14 (Oct – Mar),
- Breeding season 2015 (Mar/Apr – Aug),
- Winter/non-breeding season of 2015/16 (Sept – Mar), and
- Breeding season of 2016 (Mar/April – Aug)

This is considered to be the core data that was used for the primary analysis of the results.

In addition, supplementary data is available from other transects and VP surveys that were carried out on the site during the winter season 2012/2013, breeding seasons of 2013 & 2014 and the winter of 2014/2015. Whilst the information gained from these surveys is valid ornithological data, the survey effort was not consistent with the guidelines issued by Scottish Natural Heritage (SNH, 2014) and therefore was not included as core data. It does however provide very useful and valid information about bird usage of the site and has been used as supplementary information in the assessment of the potential effects associated with the proposed wind farm on birds at this site. This additional information is provided in Appendix 6-2.

Furthermore, a single vantage point survey was undertaken on a monthly basis at a neighbouring Bórd na Mona site at Ballycon (between 600-900 metres to the west of the main study area) between September 2015 and May 2016 (refer to Figure 6.1). This site is a cutaway peatland that is currently under rehabilitation for biodiversity. An incidental record (source: Irish Birding) of Greenland White-fronted Goose (405 birds recorded in total) were observed at Ballycon and Coolagary (located south of Ballycon) on the 4th of April 2015. Birds were observed flying in a North-northwest direction over the general area (Ballycon and Coolagary) and settling in pond waters at Ballycon. Of this total amount, 100 birds were observed settling in pond waters at Ballycon from 09:05 to 10:15 Hrs. An additional flock of 95 birds flew in the same direction at 10:35 Hrs over Coolagary. Other flocks overflew the general area in the same direction (North-northwest). There were no records within or in the immediate proximity of the Cloncreen study area. Applying the precautionary approach, vantage point surveys at Ballycon were undertaken to establish whether this neighbouring site was regularly used by this species during the winter season 2015/16 and spring (2016) and autumn (2015) migration periods.

The various field survey methodologies have regard to the species composition and assemblages that occur within the study area and provide detailed data to allow a robust assessment be carried out. Survey methods have been undertaken in line with

MAP TITLE:	Ballycon Study Area (VP)	MAP NO.:	Figure 6.1	SCALE:	1:25,000
PROJECT TITLE:	150504 Cloncreen Wind Farm			DATE:	05-10-2016
DRAWING BY:	Stephen Corrigan	CHECKED BY:	Barry O'Loughlin	ISSUE NO.:	150504-2016.10.05-F

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best practice guidelines to provide detailed coverage of the study area and surrounding environs.

6.2.2.1 Target Species

The Scottish Natural Heritage (SNH) 2014 published guidance document *'Recommended bird survey methods to inform impact assessment of onshore wind farms'* states that *"the location and scale of the proposal, and sensitivity of the bird interest present will determine the target species and the duration of the survey period"*.

For the purposes of this assessment, a target species has been defined as any bird species susceptible to collision with an operating turbine. Previous studies have shown that bird groups most susceptible to collision risk with operating wind turbines are soaring birds of prey, waterbirds (including migratory waterfowl), waders and gulls (Powlesland, 2009). Particular consideration is also given to species that are either listed on Annex I of the EU Birds Directive or on the BoCCI Red List.

The bird taxa described above cover a large number of species that could potentially be target species. The number of potential target species is narrowed down by means of a review of desktop literature sources and existing datasets (e.g. National Biodiversity Data Centre, Irish Wetland Bird Surveys (IWeBS), National Parks and Wildlife Service, Bird Atlas records, International Swan Census surveys, etc.). The desk study provides details of species from the above taxa that are known to use or are likely to occur in the study area and particular attention is paid to these species during the field surveys. The field surveys are initially designed to survey for these species.

Following the completion of field surveys, it may be clear that a certain species that had been identified as a potential target species is not dependant on the site and therefore can be excluded from the list of target species. Similarly, field surveys may reveal that an additional species is dependent on the site and therefore must be added to the list of target species. It is at this time, following the completion of field surveys, that the final list of target species is set out and it is these species that are considered in the assessment of effects.

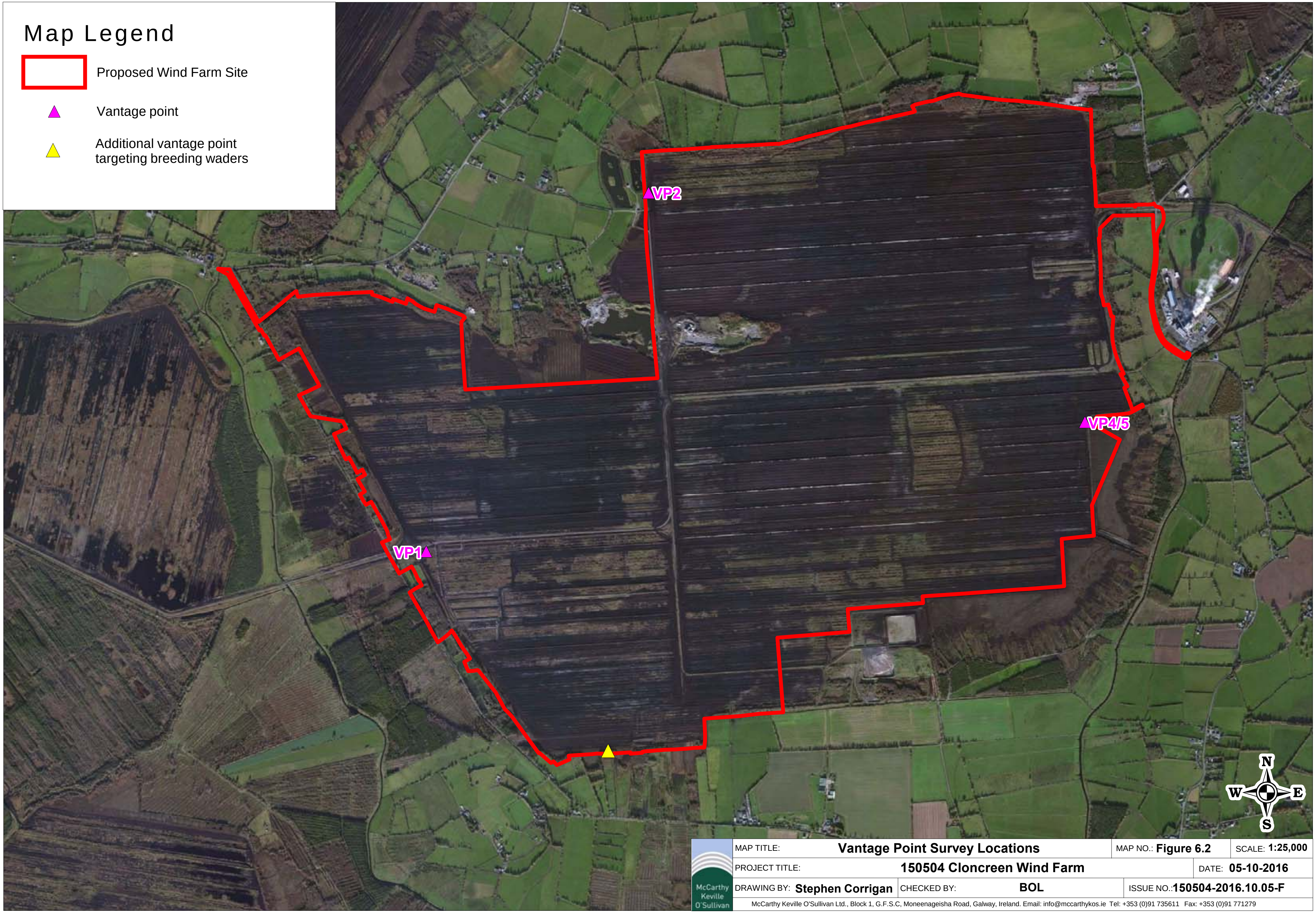
6.2.2.2 Initial Site Assessment

On the basis of the results of the desk study, consultation and initial reconnaissance site visits, a preliminary assessment of the importance of the site for bird species was made. This was primarily based on the proximity of any Special Protection Areas for birds (SPAs), IWeBs sites, waterbodies and an initial assessment of the value of the habitats for birds present in the study area. This initial assessment, together with the desk study, provided the baseline information about the site from which the scope and nature of the bird survey effort was derived.

6.2.2.3 Vantage Point (VP) Surveys

Dedicated vantage point watches were conducted from three fixed VP locations (VP1, VP2 & VP4/5) in line with survey methods and guidelines issued by Scottish Natural Heritage (SNH, 2014). An additional vantage point (VP6) was also used to detect target species in specific areas in the southern section of the site during the breeding seasons of 2015 & 2016. Survey effort undertaken for VP surveys (core data) is presented in Appendix 6-3, Table 1 to this report. This includes full details of dates, times, survey locations, survey duration and weather conditions for each survey. Figure 6.2 shows the location of the vantage points. VP surveys undertaken during the following periods:

- October 2013 to March 2014 (winter survey)



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- March/April to August 2015 (breeding survey)
- September 2015 to March 2016 (winter survey)
- March to August 2016 (breeding survey)

A minimum of 36 hours (129,600 seconds) of vantage point watch effort was undertaken at each VP during the survey periods outlined above. Vantage point watches were orientated around periods of dawn and dusk to coincide with times of dawn and dusk when bird activity is highest. The VPs selected are deemed adequate and have been devised to offer maximum views of the study area to allow a robust assessment be undertaken. VP surveys were undertaken on a monthly basis to provide adequate coverage of bird species distribution throughout different times of the year.

Watches were carried out during suitable weather conditions (SNH, 2014). The direction of flight, height (or altitude) of flight and the time/duration were taken into account for each sighting of target species observed during vantage point watches. The height estimates that were made by the observer during the survey were used to separate the observations into broad altitude groups, i.e. observations of birds flying at heights of less than ten metres, observations of birds flying at heights between ten and 25 metres, observations of birds flying between 25 and 175 metres and observations of birds that were flying at heights greater than 175 metres.

The predicted collision risk height band that was used in the current assessment (>25m, <175m) is considered to be conservative and in line with previous recommended height bands advocated by SNH (SNH, 2005). This guidance document has since been updated (SNH, 2014). SNH (2014) guidance states *'Flight heights should be classified into height bands, i.e. below the rotor- swept area, the rotor-swept area and above the rotor-swept area, allowing for observer error. Where there is doubt over the size of turbines to be used, further height bands to reflect the possible turbine sizes can be included'*.

A standard approach of using a height band of 25 metres as the minimum possible collision height has been employed in assessment of likely effects on birds for wind farm developments in Scotland. In the case of the turbine design at Cloncreen, the lowest possible point of the rotor swept area to ground will be 33.5 metres. It is important to note that there is an 8.5 metre difference from the 25 metre (>25m) predicted collision risk height incorporated in the current assessment compared to the actual height of the lowest point of the rotor swept zone at 33.5m (refer to Figure 6.3). Birds flying below 25 metres are considered to be flying well below the rotor swept zone and are not considered to be susceptible to collision risk with operating turbines within the study area.

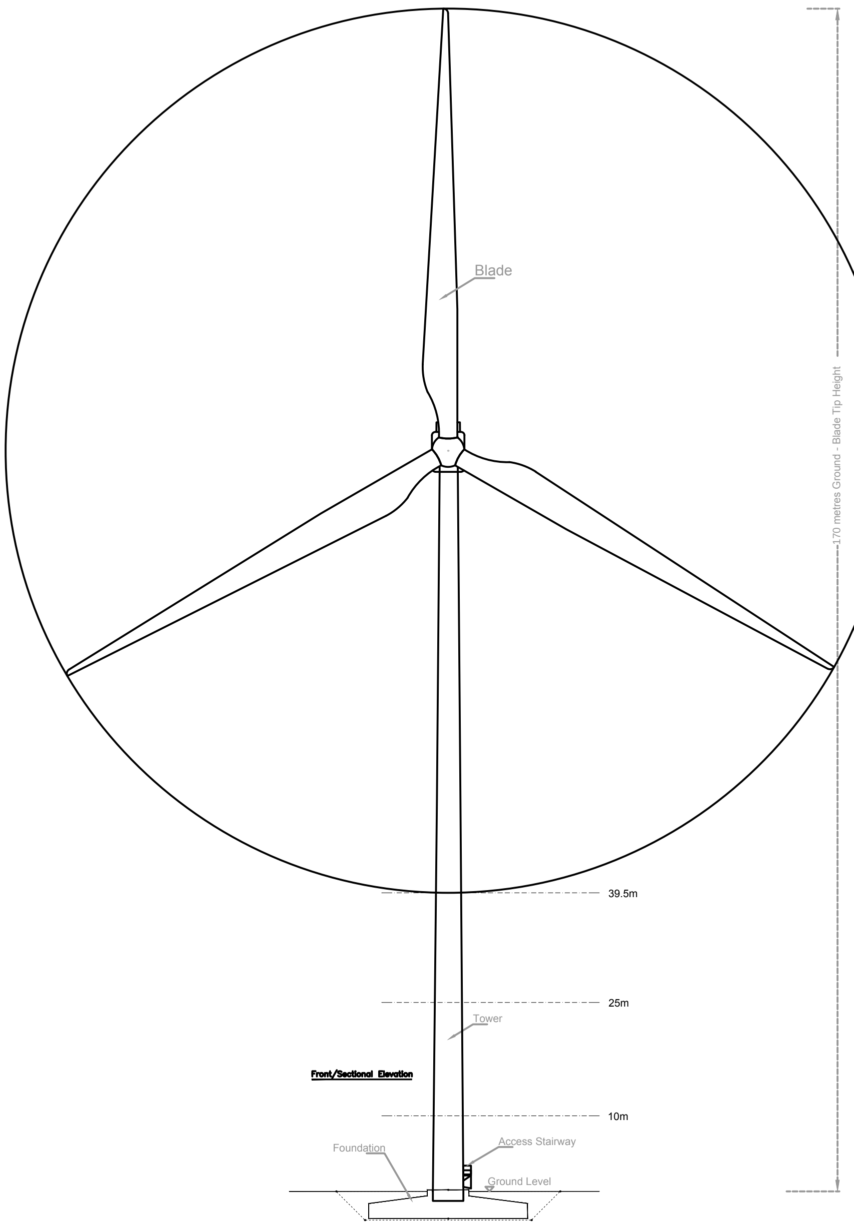
6.2.2.3.1 Viewshed Analysis

Viewshed analysis was carried out to inform coverage of the study area from fixed vantage point locations (VP1, VP2 & VP4/5). Viewsheds were calculated using Resoft Wind Farm ZTV (Zone of Theoretical Visibility) software in combination with Mapinfo Professional (Version 10.0) using a notional layer suspended at 25m, which represents the potential lowermost height passed through by the rotor blade tips used in the current assessment. While the relevance of being able to view as much of the site to ground level is acknowledged, the SNH guidance emphasises the importance of visibility of the 'collision risk volume' when the data is to be used to estimate the risk of collision with turbines by birds.

The GIS viewshed analysis involved testing each VP location for its visibility coverage by creating a view shed point two metres in height (to represent the height of observer)

Drawing Notes

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



DRAWING TITLE:

Wind Turbine Elevation & Plan

PROJECT TITLE:

Cloncreen Wind Farm, Co. Offaly

DRAWING BY: **Shane O Connor**	CHECKED BY: **Brian Keville**
PROJECT No.: **150504**	Figure No.: **6.3**
SCALE: **1 : 1,000 @ A4**	DATE: **27.06.2016**

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on a map using 10 metre contours terrain data. Using the ZTV software, a viewshed of 360 degrees was produced calculating an area 10 metres from ground level up to a 2km radius (refer to Figure 6.4). The resulting viewshed image was then cropped to 180 degrees to give the viewshed from each VP location in line with SNH (2014). A 500m buffer was applied to the outer most turbines of the proposed wind farm development in line with SNH (2014). The viewshed analysis offers maximum views of the study area with adequate coverage of the proposed turbine layout. As described above, the predicted collision risk height band that was used in the current assessment (>25m) is considered to be highly conservative and in line with previous recommended height bands advocated in SNH (2005) guidance documents.

6.2.2.4 Transect Surveys

Taking into account the nature of the habitats located within the study area (cutaway bog, scrub and surrounding farmland and successional woodland), a transect survey approach was employed to survey for the presence of wintering and breeding birds at the site of the proposed development, based broadly on methods described in Bibby et al., (2000).

Transect surveys were undertaken during the breeding season in April, May and June 2015. Aural and visual registrations were recorded as surveyors walked along transect routes. Passerines were also recorded during field surveys to inform the assessment of likely effects, particularly effects in relation to habitat loss. Figure 6.5 shows the transect route locations used during this survey period. The survey effort for this survey type is recorded in Appendix 6-3, Table 1.

Transect surveys were also undertaken during the winter season from November 2013 to February 2014, March 2015 and from September 2015 to March 2016. Transects undertaken during March 2016 were slightly modified and devised to encompass the different habitat complexes that occur within the study area. Winter transect surveys were modified to detect species composition within the site and are broadly based on survey methods issued by Bibby et al*.,* (2000). Figure 6.5 shows the transect routes used during this survey period. The survey effort is recorded in Appendix 6-3, Table 1.

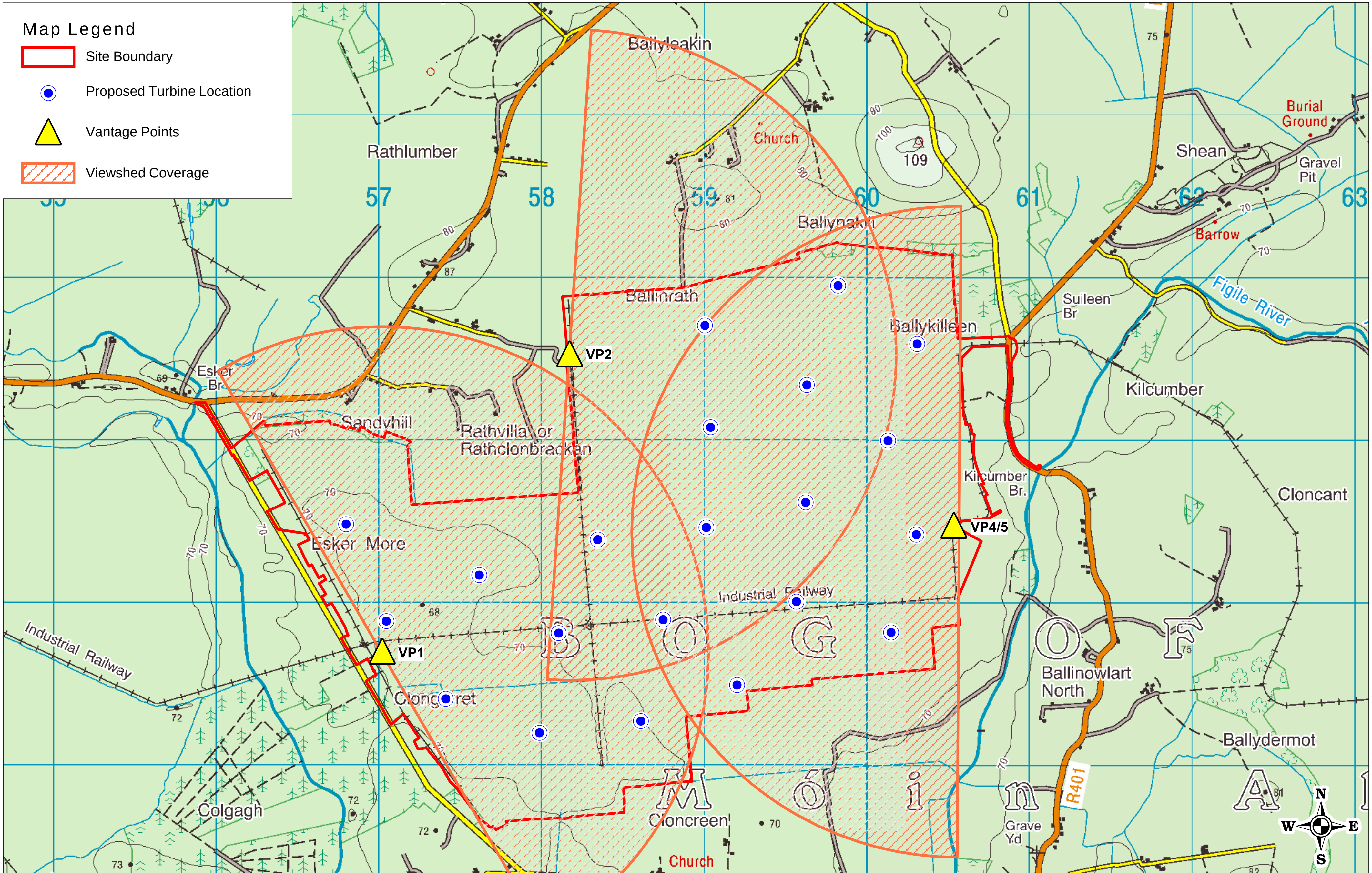
6.2.2.5 Adapted Brown & Shepherd Surveys/Quadrat surveys

Adapted Brown & Shepherd surveys (Brown & Shepherd, 1993, SNH, 2014) were conducted in April, May, June and July 2016 to survey for territories of breeding birds with particular emphasis on species likely to breed in open/moorland habitats such as waders, in particular Lapwing, Snipe, Ringed Plover etc. The survey effort for this survey type is recorded in Appendix 6-3, Table 1. Figure 6.6 shows the location of quadrats surveyed within areas of suitable habitat within and in the immediate environs of the proposed wind farm study area.

6.2.2.6 Breeding Raptor Surveys

Breeding raptor surveys (birds of prey/owls) were completed in April, May, June and July 2016. Appropriate survey methods for the species potentially present have been employed (Hardey et al., 2009) as recommended in SNH, 2014. Standard raptor survey methodologies are similar, but the distances covered outside the core survey area boundary during surveys will vary according to potential species present e.g. 2km survey distance for Peregrine, Kestrel, Sparrowhawk and Buzzard (the most likely raptors to occur in the vicinity of the proposed wind farm given the habitats present).

Therefore, the area of interest for breeding raptors corresponds to the proposed wind farm site itself and the lands within a 2km buffer zone of the study area boundary, as



MAP TITLE: Viewshed Analysis		MAP NO.: Figure 6.4	SCALE: 1:30,000
PROJECT TITLE: 150504 - Cloncreen Wind Farm EIS, Co. Offaly			DATE: 05-10-2016
DRAWING BY: Stephen Corrigan	CHECKED BY: BOL		ISSUE NO.: 150504-2016.10.05-D1

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MAP TITLE:	Transects Surveys Breeding & Winter Seasons	MAP NO.:	Figure 6.5	SCALE:	1:25,000
PROJECT TITLE:	150504 Cloncreen Wind Farm			DATE:	05-10-2016
DRAWING BY:	Stephen Corrigan	CHECKED BY:	BOL	ISSUE NO.:	150504-2016.10.05-F

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MAP TITLE: Brown & Shepherd 500m Quadrats		MAP NO.: Figure 6.6	SCALE: 1:25,000
PROJECT TITLE: 150504 Cloncreen Wind Farm			DATE: 05-10-2016
DRAWING BY: Stephen Corrigan	CHECKED BY: BOL		ISSUE NO.:150504-2016.10.05-F

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shown in Figure 6.7. Appendix 6-3, Table 1 provides details of the completed survey effort in April, May, June and July 2016.

6.2.2.7 Wetland Waterbird Counts and Waterbird Records

Wetland waterbird counts were undertaken at wetland sites within a 2-3 kilometre radius of the study area (see Figure 6.8) from September 2015 to May 2016. Counts were targeted at the principal rivers running through the area; the Philipstown River and the Figile River, with an emphasis on migratory waterfowl and suitable foraging pastures adjacent to the rivers. Records of numbers of wildfowl or wader species, presence of marked birds (leg-ringed or neck-collared), weather conditions and habitat types were noted during field surveys. Methodology derived following Gilbert et al. (1998) and Irish Wetland Bird Survey (IWeBS) census technique.

The survey effort undertaken for these wetland waterbird counts is provided in Appendix 6-3, Table 1 to this report.

Waterbird records at active and cutaway peat harvesting sites located within the Derrygreenagh and Ballydermot group of bogs were collated from the period winter season 2012/13 to the winter season 2015/2016. Records are documented in a number of unpublished reports submitted to Bord na Móna by Biosphere Environmental Services. These reports were used to identify areas of importance for various waterbird species in the wider environment of Cloncreen.

Core foraging ranges from night roosts for Whooper Swan are less than 5km while Greenland White-fronted Goose have cores ranges of 5-8km (SNH, 2013). Feeding and roosting areas used by Whooper Swans were identified up to a radius of 5km from the study area. The Derryarkin area was also included in this analysis, despite being a greater distance than 5km due to its high importance for Whooper Swan. Areas of importance to geese were identified up to an 8km radius of the study area and areas of significance for all other wintering and breeding waterbirds were identified within a 5km radius of the study area (see Figure 6.9).

6.2.3 Assessment Methodology

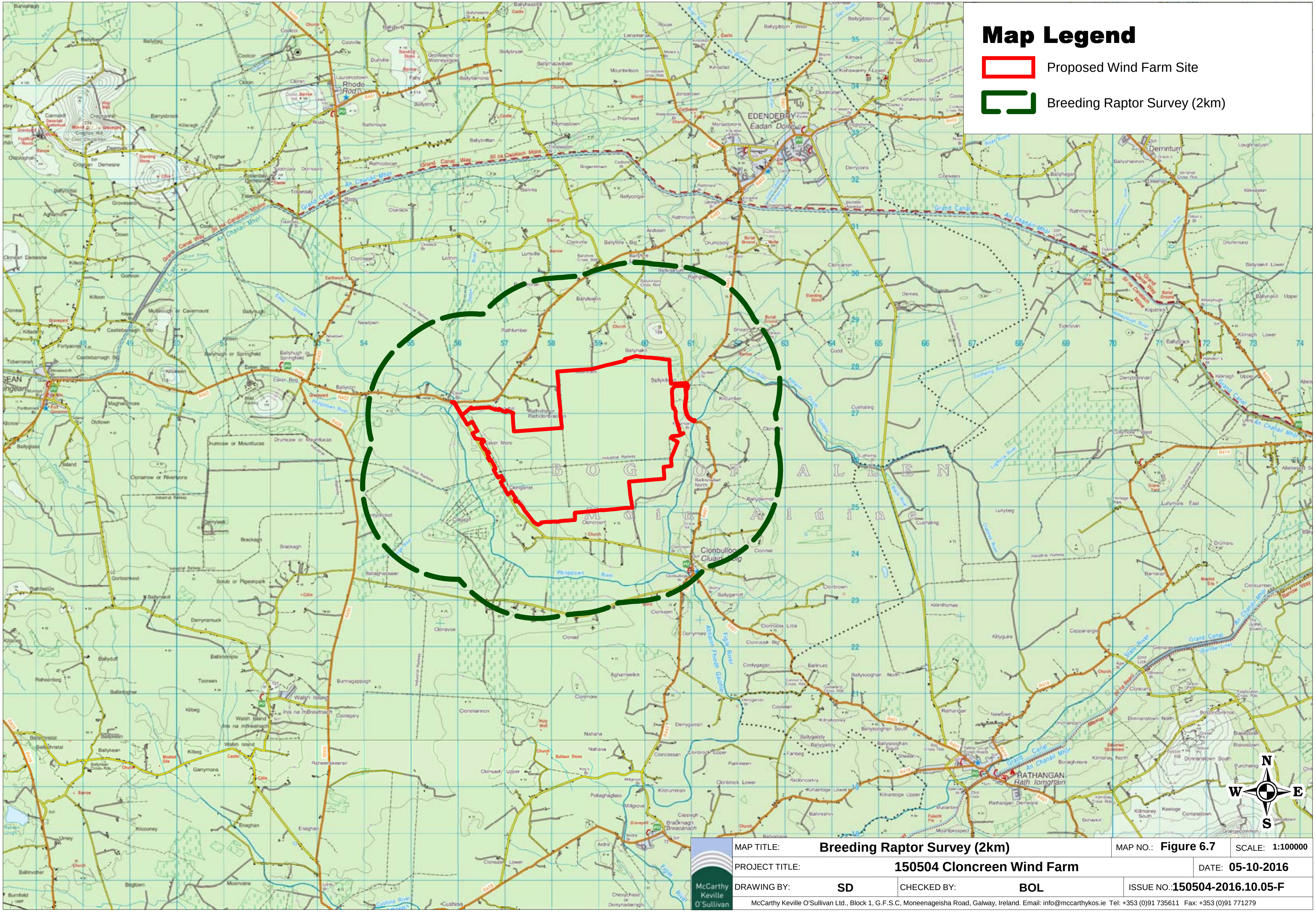
6.2.3.1 Evaluation Criteria

In order to assess the main ornithological receptors, an evaluation will be required. Avifauna receptors at the proposed development site were evaluated using criteria used in assessing the ecological importance of sites developed by the National Roads Authority on assessment of ecological impacts of National Road Schemes (NRA (2009)). The term 'receptor' is intended to refer to those that are judged to be of importance at a particular geographic scale (i.e. international, national, county and local (higher and lower value) importance. The selection of avifauna receptors for assessment of effects is based on NRA evaluation criteria (NRA, 2009).

Table 6.1 below presents criteria used in assessing the ecological importance of sites (in this case, importance of the site for birds).

Table 6.1 Criteria used in assessing the ecological importance of sites and selection of ecological/avifauna receptors

Ecological Valuation: Examples
International Importance: ▪ 'European Site' including Special Area of Conservation (SAC), Site of Community Importance (SCI), Special Protection Area (SPA) or proposed Special Area of Conservation.



MAP TITLE:	Breeding Raptor Survey (2km)		MAP NO.: Figure 6.7		SCALE: 1:100000
PROJECT TITLE:	150504 Cloncreen Wind Farm				DATE: 05-10-2016
DRAWING BY:	SD	CHECKED BY:	BOL	ISSUE NO.:	150504-2016.10.05-F

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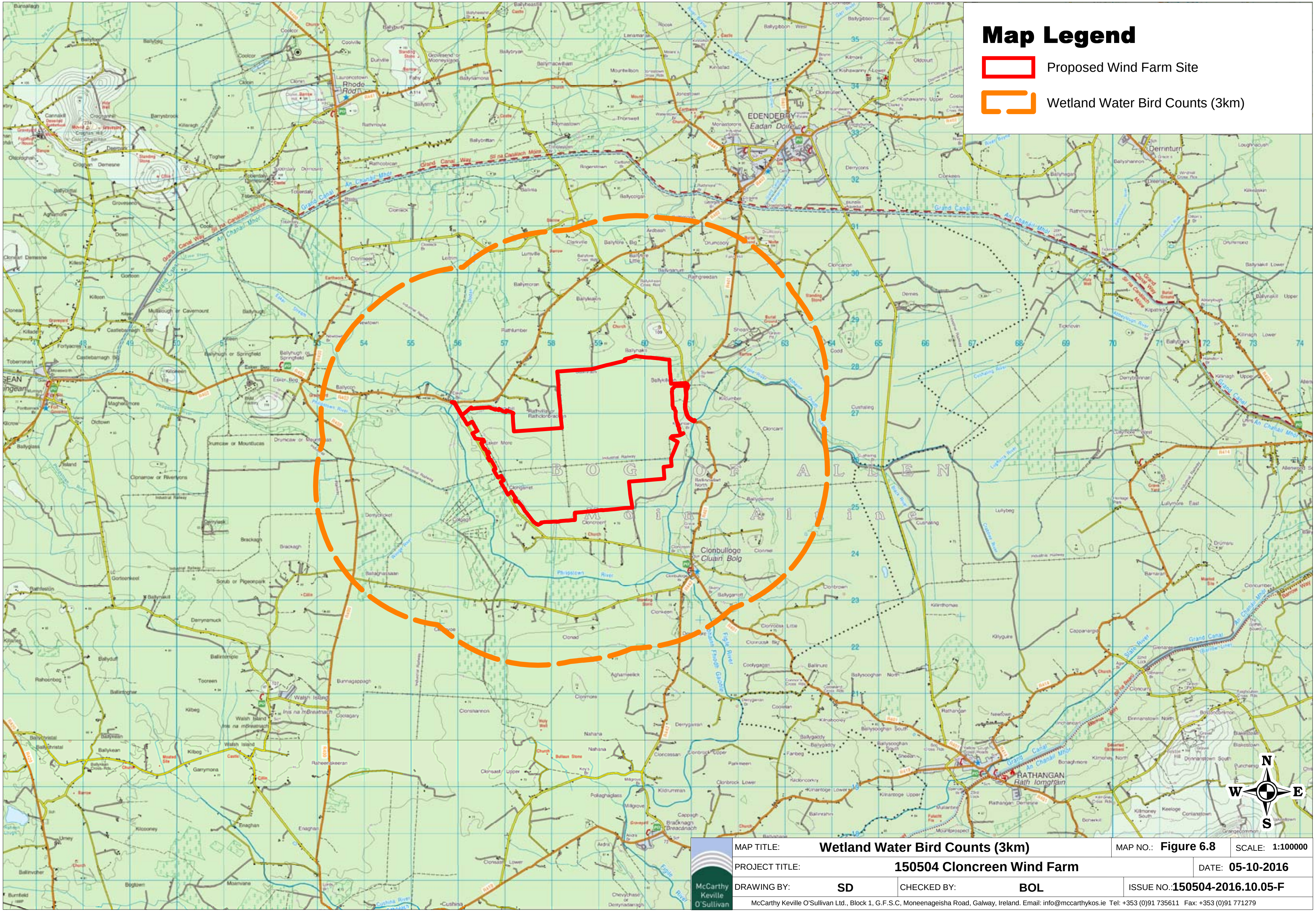

MAP TITLE:	Wetland Water Bird Counts (3km)	MAP NO.: Figure 6.8	SCALE: 1:100000
PROJECT TITLE:	150504 Cloncreen Wind Farm		DATE: 05-10-2016
DRAWING BY: SD	CHECKED BY: BOL		ISSUE NO.: 150504-2016.10.05-F

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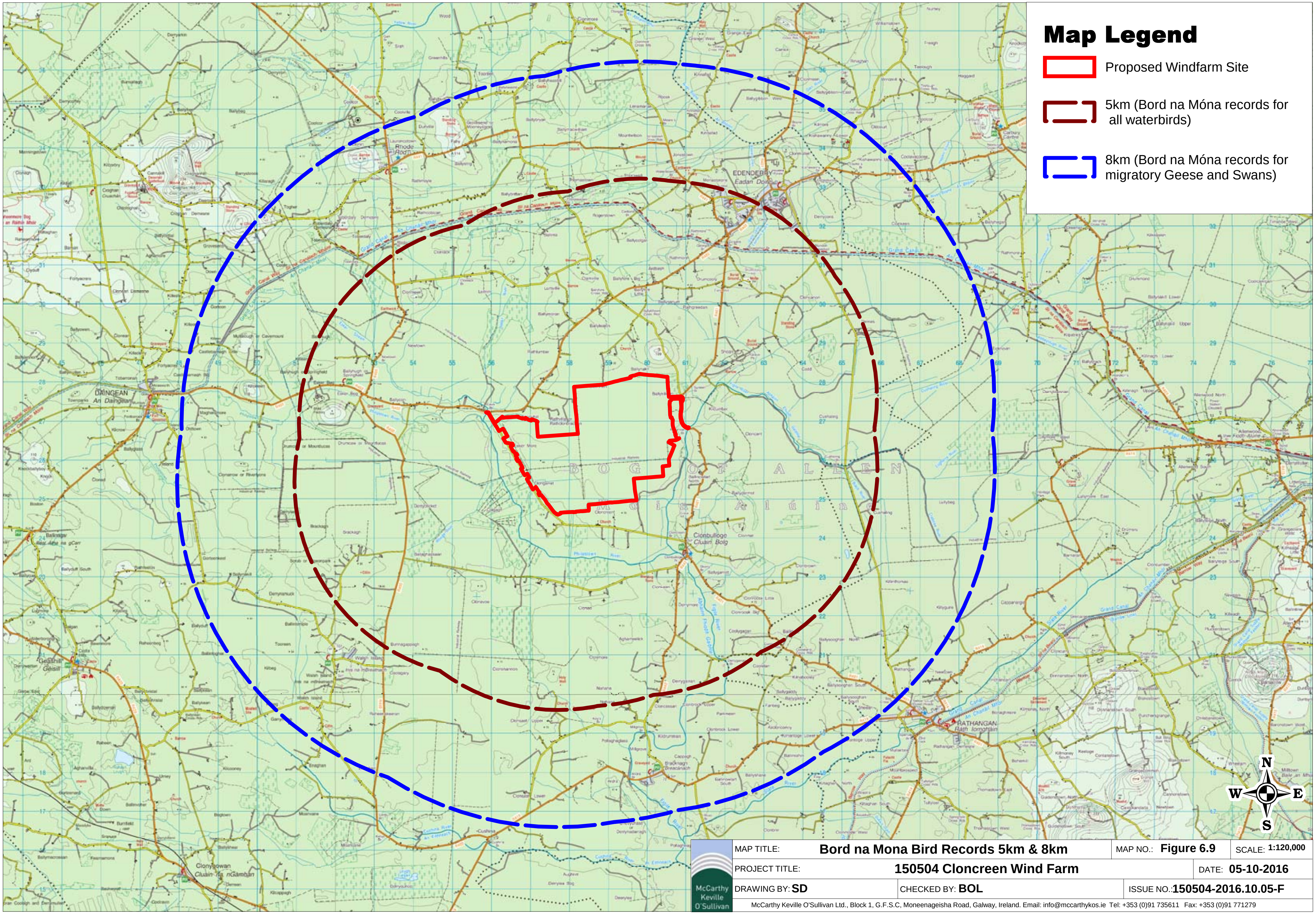

MAP TITLE:	Bord na Mona Bird Records 5km & 8km		MAP NO.: Figure 6.9		SCALE: 1:120,000
PROJECT TITLE:	150504 Cloncreen Wind Farm			DATE: 05-10-2016	
DRAWING BY: SD		CHECKED BY: BOL		ISSUE NO.:150504-2016.10.05-F	

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Ecological Valuation: Examples

- Proposed Special Protection Area (pSPA).
- Site that fulfils the criteria for designation as a 'European Site' (see Annex III of the Habitats Directive, as amended).
- Features essential to maintaining the coherence of the Natura 2000 Network.
- Site containing 'best examples' of the habitat types listed in Annex I of the Habitats Directive.
- Resident or regularly occurring populations (assessed to be important at the national level) of the following:
  - Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
  - Species of animal and plants listed in Annex II and/or IV of the Habitats Directive.
  - Ramsar Site (Convention on Wetlands of International Importance Especially Waterfowl Habitat 1971).
  - World Heritage Site (Convention for the Protection of World Cultural & Natural Heritage, 1972).
  - Biosphere Reserve (UNESCO Man & The Biosphere Programme).
  - Site hosting significant species populations under the Bonn Convention (Convention on the Conservation of Migratory Species of Wild Animals, 1979).
  - Site hosting significant populations under the Berne Convention (Convention on the Conservation of European Wildlife and Natural Habitats, 1979).
  - Biogenetic Reserve under the Council of Europe.
  - European Diploma Site under the Council of Europe.
  - Salmonid water designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988, (S.I. No. 293 of 1988).

National Importance:

- Site designated or proposed as a Natural Heritage Area (NHA).
- Statutory Nature Reserve.
- Refuge for Fauna and Flora protected under the Wildlife Acts.
- National Park.
- Undesignated site fulfilling the criteria for designation as a Natural Heritage Area (NHA); Statutory Nature Reserve; Refuge for Fauna and Flora protected under the Wildlife Act; and/or a National Park.
- Resident or regularly occurring populations (assessed to be important at the national level) of the following:
  - Species protected under the Wildlife Acts; and/or
  - Species listed on the relevant Red Data list
  - Site containing 'viable areas' of the habitat types listed in Annex I of the Habitats Directive.

County Importance:

- Area of Special Amenity.
- Area subject to a Tree Preservation Order
- Area of High Amenity, or equivalent, designated under the County Development Plan.
- Resident or regularly occurring populations (assessed to be important at the County level) of the following:
  - Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive;
  - Species of animal and plants listed in Annex II and/or IV of the Habitats Directive;
  - Species protected under the Wildlife Acts; and/or
  - Species listed on the relevant Red Data list.
- Site containing area or areas of the habitat types listed in Annex I of the Habitats Directive that do not fulfil the criteria for valuation as of International or National importance.

Ecological Valuation: Examples
▪ County important populations of species, or viable areas of semi-natural habitats or natural heritage features identified in the National or Local BAP, if this has been prepared ▪ Sites containing semi-natural habitat types with high biodiversity in a county context and a high degree of naturalness, or populations of species that are uncommon within the county. ▪ Sites containing habitats and species that are rare or are undergoing a decline in quality or extent at a national level.
Local Importance (higher value): ▪ Locally important populations of priority species or habitats or natural heritage features identified in the Local BAP, if this has been prepared; ▪ Resident or regularly occurring populations (assessed to be important at the Local level)[12] of the following: - Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; - Species of animal and plants listed in Annex II and/or IV of the Habitats Directive; - Species protected under the Wildlife Acts; and/or - Species listed on the relevant Red Data list. ▪ Sites containing semi-natural habitat types with high biodiversity in a local context and a high degree of naturalness, or populations of species that are uncommon in the locality; ▪ Sites or features containing common or lower value habitats, including naturalised species that are nevertheless essential in maintaining links and ecological corridors between features of higher ecological value.
Local Importance (lower value): ▪ Sites containing small areas of semi-natural habitat that are of some local importance for wildlife; ▪ Sites or features containing non-native species that are of some importance in maintaining habitat links.

Criteria outlined in Table 6.2 below has been developed by Percival (2003) (Irish Context) to assess sensitivity of a species which is defined as its ecological importance and nature conservation interest at the site being assessed. This is determined by a number of factors, including:

- whether the species is on Annex 1 of the EU Birds Directive
- whether the species is particularly ecologically sensitive: this includes large birds of prey and rare breeding birds (including divers, common scoter, hen harrier, golden eagle, red- necked phalarope, roseate tern and chough).
- whether the site contains species at nationally important numbers (>1% of Irish population)
- whether the site contains species at regionally important numbers (>1% of regional population, with the region usually taken as the county)
- whether the species is subject to special conservation measures, e.g. as red or amber species on the BirdWatch Ireland's (Colhoun and Cummins, 2013) list of Birds of Conservation Concern (BoCCI).

The sensitivity is further affected by any nature conservation designations in the area. The determination of sensitivity needs to take into account whether a species contributes to the overall objectives of the designation (including whether the species is notified as a qualifying feature of the site), and specifically for internationally important Special Protection Areas (SPA), it needs to consider whether the species contributes to the overall integrity of the site. Target species selected as 'avifauna receptors' have been evaluated in terms of their sensitivity (Percival, 2003). Where species were classified as KERS but do not correspond with the determining factor criteria set out below (i.e. green listed species) they were assigned a sensitivity of low on a precautionary basis.

Table 6.2 Evaluation of Sensitivity for Birds (Percival 2003)

Sensitivity	Determining Factor
Very High	Species that form the cited interest of SPA's and other statutorily protected nature conservation areas. Cited means mentioned in the citation text for the site as a species for which the site is designated.
High	Species that contribute to the integrity of an SPA but which are not cited as species for which the site is designated. Ecologically sensitive species including the following: divers, common scoter, hen harrier, golden eagle, red necked phalarope, roseate tern and chough. Species present in nationally important numbers (>1% Irish population)
Medium	Species on Annex 1 of the EU Birds Directive. Species present in regionally important numbers (>1% regional (county) population). Other species on BirdWatch Ireland's red list of Birds of Conservation Concern
Low	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern not covered above.

6.2.3.2 Assessment of Effect Type and Magnitude

Assessment of effects takes into account construction, operational and decommissioning effects with reference to the potential for direct, indirect and cumulative effects. The assessment also takes account of any residual effects that may persist following the implementation of any mitigation or best practice design. The characterisation of effects reflects the ecological structure and function upon which the key avifauna receptors depend. Detailed assessment of effects takes into account the magnitude of effects affecting populations.

This EIS uses the EPA (Environmental Protection Agency) classification of effects in order to describe the quality, significance, duration and type of effect – see Table 1.2 in Section 1.6.2 of Chapter 1 for terminology.

Effects on avifauna are to be assessed following published guidance by Percival (2003). Once key avian receptors have been selected and assigned an evaluation of importance or sensitivity, the significance of potential effects are rated as a product of both the magnitude of the predicted effect and the sensitivity if the key receptor affected. The magnitude of effect is based on probability of the likely effect occurring.

The criteria outlined in Table 6.3 below has been developed by Percival (2003) to determine the magnitude of potential effects on a species. Methodology for assessing sites outside of European Sites (i.e. SPAs) state '*the test of significance of an impact will be whether the wind farm impact is causing a significant change to the population,* *its range or distribution*' (Percival 2003). It is important to consider availability of alternative habitat elsewhere during this assessment.

Table 6.3 Determination of Magnitude Effects (Percival 2003)

Magnitude	Description
Very High	Total loss or very major alteration to key elements/ features of the baseline conditions such that the post development character/ composition/ attributes will be fundamentally changed and may be lost from the site altogether. *Guide: < 20% of population / habitat remains*
High	Major loss or major alteration to key elements/ features of the baseline (pre-development) conditions such that post development character/ composition/ attributes will be fundamentally changed. *Guide: 20-80% of population/ habitat lost*
Medium	Loss or alteration to one or more key elements/features of the baseline conditions such that post development character/composition/attributes of baseline will be partially changed. *Guide: 5-20% of population/ habitat lost*
Low	Minor shift away from baseline conditions. Change arising from the loss/alteration will be discernible but underlying character/composition/attributes of baseline condition will be similar to pre-development circumstances/patterns. *Guide: 1-5% of population/ habitat lost*
Negligible	Very slight change from baseline condition. Change barely distinguishable, approximating to the "no change" situation. *Guide: < 1% population/ habitat lost*

The significance of potential effects is assessed by cross tabulating the magnitude of effects and bird sensitivity to predict significance of each potential effect. Population status, distribution and trends of potentially affected species such as migratory winter birds should be taken into consideration when undertaking the assessment. Significant ratings are interpreted as follows, **very low** and **low** should not normally be of concern however normal design care should be undertaken to minimise effects, **medium** represents a potentially significant effect that requires careful individual assessment, while **very high** and **high** represents a highly significant effect on bird populations. A significance matrix table, combining magnitude and sensitivity to assess overall significance is presented in Table 6.4 below.

Table 6.4 Significance matrix: combining magnitude and sensitivity to assess significance (Percival 2003)

Significance		Sensitivity			
		Very High	High	Medium	Low
Magnitude	Very High	Very High	Very High	High	Medium
	High	Very High	Very High	Medium	Low
	Medium	Very High	High	Low	Very Low
	Low	Medium	Low	Low	Very Low
	Negligible	Low	Very Low	Very Low	Very Low

6.3 Desktop Review and Consultation

6.3.1 Consultation Response

A summary of the key consultation and scoping responses with the relevant consultees contacted are described in Table 6.5 below.

Table 6.5 List of organisations consulted during the preparation of the current assessment

Organisation	Response/Comments
National Parks and Wildlife service (NPWS)	Correspondence was undertaken with the NPWS ranger based in the local area, Mr. Colm Malone in January 2016 with regard to any ornithological records pertaining to the study area. Mr. Malone highlighted the following: ▪ Presence of a pair of breeding Peregrine Falcon (man-made nest box) at Edenderry power station, east of the study area. ▪ Whooper Swan at Derrygreenagh bog complex had declined at traditional areas during the winter season 2015/16, possibly due to heavy rainfall and flooding resulting in changes to foraging and roosting patterns. ▪ Not aware of any records for Greenland White-fronted Goose in the general area.
National Parks and Wildlife service (NPWS)	Correspondence was undertaken (October 2015) with Mr. Alyn Walsh, NPWS ranger based in Wexford, in relation to a record on www.irishbirding.com of 406 Greenland White-fronted Geese (GWFG) at Ballycon and Coolagary recorded on the 04/04/15. Ballycon occurs to the west of the Cloncreen study area. Mr. Walsh noted the following main point: ▪ GWFG record at Ballycon coincided with the Spring migration period. The flock size recorded at Ballycon was similar to those departing the Wexford Slobs on the 04/04/15 at 3am. Mr. Walsh noted that it is not unusual for flocks to drop down for short rest periods during migration and based on comparative figures, it is considered likely that the flock recorded at Ballycon are the same flock that departed the Wexford Slobs on the same date.
Development Applications Unit (DAU)	A response was received from the DAU on the 20th of October 2015 – see further details in Section 5.3.1 of Chapter 5. The response in relation to birds specifically set out the requirement for two years' bird surveying following best practice. The response requests that results for species are referenced back to the overall population and their dynamics and that bird migration, roosting and feeding routes also be considered.
Irish Whooper Swan Study Group/BirdWatch Ireland	The Irish Whooper Swan Study Group acknowledged receipt of email correspondence. As the organisation do not have recent survey records for this region, the communication was forwarded to Ms. Helen Boland, BirdWatch Ireland. Ms. Boland provided a list of IWeBS subsites within, or partially within, Co. Offaly. None of these sites fall within 5km and 8km of the study area, the known core foraging distances of Whooper Swan and Greenland White-fronted Goose (SNH, 2013).
Irish Raptor Study Group	No consultation response was received from the Irish Raptor Study Group.
Irish Red Grouse Association	No consultation response was received from the Irish Red Grouse Association.

6.3.2 Desktop Review

6.3.2.1 Designated Areas

6.3.2.1.1 European Sites

The Habitats Directive (together with the Birds Directive) forms the cornerstone of Europe's nature conservation policy. It is built around two pillars: the Natura 2000 network of protected sites and the strict system of species protection. All in all, the directive protects over 1,000 animal and plant species and over 200 "habitat types" (e.g. special types of forests, meadows, wetlands, etc.), which are of European importance.

With the introduction of the EU Habitats Directive (92/43/EEC) and Birds Directive (79/409/EEC) which were transposed into Irish law as S.I. No. 94/1997 *European Communities (Birds and Natural Habitats) Regulations* 1997, the European Union formally recognised the significance of protecting rare and endangered species of flora and fauna, and also, more importantly, their habitats. The 1997 Regulations and their amendments were subsequently revised and consolidated in S.I. No. 477/2011- *European Communities (Birds and Natural Habitats) Regulations* 2011. This legislation requires the establishment and conservation of a network of sites of particular conservation value that are to be termed 'European Sites'.

Special Protection Areas

Council Directive 79/409/EEC of 2 April 1979 on the conservation of wild birds (Birds Directive) has been substantially amended several times. In the interests of clarity and rationality the said Directive was codified in 2009 and is now cited as Directive 2009/147/EC. The Directive instructs Member States to take measures to maintain populations of all bird species naturally occurring in the wild state in the EU (**Article 2**). Such measures may include the maintenance and/or re-establishment of habitats in order to sustain these bird populations (**Article 3**).

A subset of bird species has been identified in the Directive and are listed in **Annex I** as requiring special conservation measures in relation to their habitats. These species have been listed on account of inter alia: their risk of extinction; vulnerability to specific changes in their habitat; and/or due to their relatively small population size or restricted distribution. **Special Protection Areas** (SPAs) are to be identified and classified for these Annex I listed species and for regularly occurring migratory species, paying particular attention to the protection of wetlands (**Article 4**).

Special Areas of Conservation

Articles 3 – 9 of the EU Habitats Directive (92/43/EEC) provide the EU legislative framework of protecting rare and endangered species of flora and fauna, and habitats. **Annex I** of the Directive lists habitat types whose conservation requires the designation of **Special Areas of Conservation** (SAC). Priority habitats, such as Turloughs, which are in danger of disappearing within the EU territory are also listed in Annex I. **Annex II** of the Directive lists animal and plant species (e.g. Marsh Fritillary, Atlantic Salmon, and Killarney Fern) whose conservation also requires the designation of **SAC. Annex IV** lists animal and plant species in need of strict protection such as Lesser Horseshoe Bat and Otter, and **Annex V** lists animal and plant species whose taking in the wild and exploitation may be subject to management measures. In Ireland, species listed under Annex V include Irish Hare, Common Frog and Pine Marten.

Species can be listed in more than one Annex, as is the case with Otter and Lesser Horseshoe Bat which are listed on both **Annex II** and **Annex IV**.

6.3.2.1.2 Nationally Designated Sites

Natural Heritage Areas (NHAs) and Proposed Natural Heritage Areas (pNHAs) are heritage sites that were designated for the protection of flora, fauna, habitats and geological sites under the Wildlife (Amendment) Act 2000. These sites do not form part of the Natura 2000 network and the AA process, or screening for same, does not apply to NHAs or pNHAs.

6.3.2.1.3 Identification of Designated Sites within the Likely Zone of Influence of the Study Area

The core ranges of the target species likely to be found using the study area, as per SNH (2013) was generally 3-5 kilometres. However, some species, such as geese, have core foraging ranges of up to 15km, whilst the Golden Plover may forage within an 11 kilometre range. Based on these core foraging ranges, using GIS software MapInfo (Version 10.0), designated sites within a radius of 15 kilometres of the proposed development were identified. Other designated sites outside this distance were considered for potential connectivity to the site (such as hydrological connectivity), however were not found to be within the likely zone of influence. The designated sites are listed below in Table 6.6 and displayed on Figure 6.10.

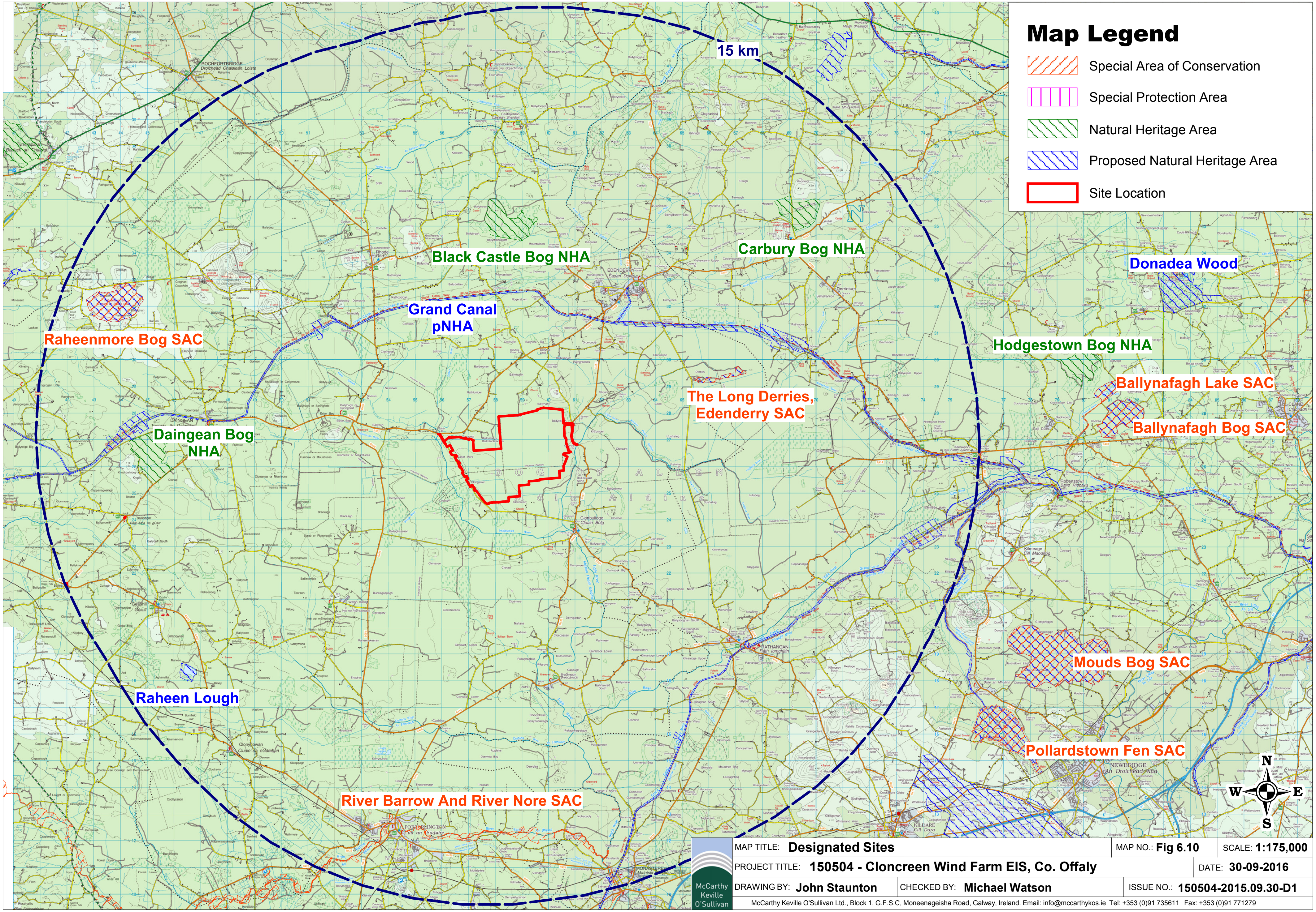
There are no Special Protection Areas (SPAs) within 15 kilometres of the proposed development site.

Table 6.6 Designated sites within 15 kilometres of proposed development

Designated site and code	Distance from proposed works (Kilometres)
Natural Heritage Area (NHA)	
Black Castle Bog NHA (000570)	6.3km North
Daingean Bog NHA (002033)	9.9km West
Carbury Bog NHA (001388)	10.9km North-east
Proposed Natural Heritage Area (pNHA)	
Grand Canal pNHA (002104)	3.5km North
The Long Derries, Edenderry pNHA	4.9km East
Raheen Lough pNHA (000917)	12.3km South-west
Raheenmore Bog pNHA (000582)	12.3km North-west
Special Areas of Conservation	
The Long Derries, Edenderry SAC (000925)	4.9km East
River Barrow and River Nore SAC (002161)	12.4km South
Raheenmore Bog SAC (000582)	12.6km North-east
Special Protection Areas	
There are no Special Protection Areas within 20km of the development site. The nearest SPAs are Lough Ennell SPA, located 23.4 km to the north-west and Slieve Bloom Mountains SPA, located 23.7km to the south-west. As per SNH 2013, the proposed windfarm site is beyond the core and maximum foraging ranges of the SCI species of Lough Ennell SPA and Slieve Bloom Mountains SPA. There will be **no impacts** on any Special Protection Areas associated with the proposed development.	

6.3.2.2 Breeding and Winter Bird Atlas Records

The principal published sources of information regarding the distribution of breeding birds in Ireland are '*Bird Atlas 2007-11: The breeding and wintering birds of Britain and Ireland*' (Balmer et al., 2013). Balmer et al. (2013) is the most recent comprehensive work on wintering and breeding birds in Ireland.



MAP TITLE: Designated Sites		MAP NO.: Fig 6.10	SCALE: 1:175,000
PROJECT TITLE: 150504 - Cloncreen Wind Farm EIS, Co. Offaly			DATE: 30-09-2016
DRAWING BY: John Staunton	CHECKED BY: Michael Watson	ISSUE NO.: 150504-2015.09.30-D1	

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The atlas provides data for breeding and wintering birds respectively in individual 10 kilometre-by-10 kilometre squares (also known as hectads). The study area lies within two hectads, N52 and N62. Table 6.7 presents a list of species found in the relevant hectads, which are recorded in the most recent breeding bird atlases and are also protected under the EU Birds Directive or listed on the Birds of Conservation Concern in Ireland (2013) (BoCCI) red list (Colhoun & Cummins, 2013). Birds listed under Annex I are offered special protection by the EU Birds Directive. Those listed on the BoCCI red list meet one or more of the following criteria:

- IUCN: Global conservation status (Critically Endangered (CE), Endangered (E) or Vulnerable (V), but not Near Threatened. These species are recognised as the highest priorities for action at a global scale and are thus priorities at an all-Ireland level.
- European conservation status. The conservation status of all European species was assessed most recently by Birdlife International (2004), one of the main changes in the revision being to include the IUCN criteria. These species are those of global conservation concern (including those classified as Near Threatened) and are Red-listed.
- The Irish breeding population has undergone significant historical decline since 1800.
- The Irish breeding population or range has declined by 50% or more in the thirteen years from 1998-2011 (BDp1) or the 25 years from 1980-2013 (BDp2).
- The Irish non-breeding population has undergone a significant decline of 50% in the last 25 years.
- The Irish breeding range has undergone a decline of 70% or more in the last 25 years.

It should be noted that breeding was not proven in all instances where birds were recorded during the breeding atlas surveys.

Table 6.7 Breeding Bird Atlas Data (Hectads N52 and N62)

Species Name	Breeding Atlas 07-11 hectad	Conservation Status
Dunlin (*Calidris alpine schinzii*)	N52*	BD, RL
Golden Plover (*Pluvialis apricaria*)	N52*	BD, RL
Hen Harrier (*Circus cyaneus*)	N52*, N62*	BD
Kingfisher (*Alcedo atthis*)	N52§, N62§	BD
Merlin (*Falco columbarius*)	N62*	BD
Peregrine (*Falco peregrinus*)	N52	BD
Whooper Swan (*Cygnus cygnus*)	N62*	BD
Grey Partridge (*Perdix perdix*)	N62§	RL
Grey Wagtail (*Motacilla cinerea*)	N62	RL
Herring Gull (*Larus argentatus*)	N52*	RL
Lapwing (*Vanellus vanellus*)	N52, N62	RL
Meadow Pipit (*Anthus pratensisi*)	N52#, N62§	RL
Redshank (*Tringa totanus*)	N62#	RL
Tufted Duck (*Aythya fuligula*)	N52§	RL
Woodcock (*Scolopax rusticol*)	N52§, N62#	RL
Yellowhammer (*Emberiza citrinella*)	N52# N62#	RL

BD = EU Birds Directive Annex I; RL = BoCCI Red List; §=Breeding possible, not confirmed; #= Breeding probable, not confirmed; * = Non-breeding

Seven species list in Annex I of the EU Birds Directive have been recorded within the relevant ten kilometre squares during surveys for the most recent breeding bird atlases. Table 6.8 outlines those species recorded in the relevant hectads during the most recent winter bid atlas studies that are also protected under the EU Birds Directive or mentioned on the Birds of Conservation Concern in Ireland (BoCCI) red list.

Table 6.8 Wintering Bird Atlas Data (Hectads N52 and N62)

Species Name	Wintering Bird Atlas 07-11 hectad	Conservation Status
Golden Plover (*Pluvialis apricaria*)	N52	BD, RL
Hen Harrier (*Circus cyaneus*)	N52, N62	BD
Merlin (*Falco columbarius*)	N62	BD
Peregrine (*Falco peregrinus*)	N52	BD
Whooper Swan (*Cygnus cygnus*)	N52, N62	BD
Barn Owl (*Tyto alba*)	N62	RL
Curlew (*Numenius arquata*)	N52	RL
Lapwing (*Vanellus vanellus*)	N52, N62	RL
Meadow Pipit (*Anthus pratensisi*)	N52, N62	RL
Woodcock (*Scolopax rusticol*)	N62	RL
Yellowhammer (*Emberiza citrinella*)	N62	RL

BD = EU Birds Directive Annex I; RL = BoCCI Red List

6.3.2.3 Whooper Swan International Census Records

The majority of Whooper Swans that over-winter in Ireland belong to the Icelandic breeding population. Flocks tend to arrive in Ireland in October (autumn migration) and depart in late March / Early April (spring migration). Large flocks concentrate in Lough Swilly (Co. Donegal) and move southwards from this geographic area. Swans migrate northwards towards Lough Swilly during Spring on return to breeding grounds in Iceland.

Whooper Swans are listed under Annex I of the EU Birds Directive (EU 79/409/EEC) and are an amber listed bird species of conservation concern in Ireland due to its unfavourable conservation status in Europe (Colhoun & Cummins, 2013).

Within Ireland, numbers of this species have increased at a mean rate of 2.6% annually since 2001 (Boland & Crowe, 2012), from 14,079 in 2005 (National Swan Census 2005) (Worden et al., 2009) to 14,981 in 2010 (National Swan Census 2010) (Boland et al., 2010). The island of Ireland now supports more than 50% of the flyway population of the Icelandic breeding population (Boland & Crowe, 2012; Hall et al., 2012). Of this most recent count, 10,452 birds were counted in the Republic of Ireland (Hall et al., 2012; Eionet, 2015). Despite some flux in the importance of specific overwintering sites, there has been no significant change in the number of internationally-important sites in Ireland (Boland et al., 2010).

The 2010 Swan Census (Boland et. al., 2010) was consulted regarding the Whooper Swan population in County Offaly. Based on the 2010 data the county population in January 2010 was 650 which represents an 11% decrease on the 2005 census data (total county population 734). There were 9 flocks of Whoopers identified as part of the census. Of the 650 specimens recorded 12.2% were juvenile birds and 51.5% were aged birds. Table 6.9 presents data for Whooper Swan populations and trends for the years 2005 and 2010.

Table 6.9 Count data from County Offaly obtained for the 2005 & 2010 International Swan Censuses. These sites do not occur within 15 km of the proposed development site.

Sub-site	2005	2010
Shannon Callows (Offaly, Galway, Roscommon, Tipperary & Westmeath combined)	432	364
Turraun Nature Reserve (Offaly)	141	No Data
Little Brosna Callows (Offaly, Tipperary)	No Data	279

6.3.2.4 Irish Wetland Bird Survey (IWeBS) Records

A data request form was sent to BirdWatch Ireland for IWeBS records of sites in Co.Offaly. The nearest IWeBS site, River Barrow (Monasterevin – Portarlington), occurs 9.5km south of the study area. Most of the larger IWeBS sites are divided into smaller count units, or subsites, to ensure thorough coverage, and to minimise duplication of counts. It should be noted counts in any one year may be unrepresentative due to gaps in coverage and/ or disturbance, or weather-induced effects on numbers and distribution. IWeBS records for River Barrow site are presented in Table 6.10 below.

Table 6.10 IWeBS records for River Barrow (Monasterevin – Portarlington) From 2007/08 to 2011/12

Species	1% National	1% International	07/08	08/09	09/10	10/11	11/12	Peak	Mean
Mute Swan	110	-	-	-	25	-	-	25	25
Whooper Swan	130	270	-	-	60	-	-	60	60

Note: Blank cells within columns which contain positive values for one or more species constitute zero for those species.

There are no Special Protection Areas (SPAs) within 15 kilometres of the proposed development site. The nearest SPA is Lough Ennell SPA, located 23.4 km to the north-west. Therefore, IWeBS data pertaining to SPAs were not reviewed as part of this assessment. No IWeBs sites occur within a 9.5 km radius of the Cloncreen study area. This takes into account the core foraging ranges for Greenland White-fronted Goose and Whooper Swan (SNH, 2013).

6.3.2.5 Previous Bird Surveys

Winter and breeding bird surveys were undertaken at a number of active and cutaway peat harvesting sites located within the Derrygreenagh and Ballydermot group of bogs. Surveys were undertaken during the winter seasons 2012/13, 2013/14, 2014/15 & 2015/16 and the breeding seasons 2013, 2014 & 2015 by Biosphere Environmental Services on behalf of Bord na Móna. The following provides a brief summary of the main findings of these unpublished reports. Relevant bird records compiled from the following reports are collated into Appendix 6-4, Table 1.

6.3.2.5.1 Winter Bird Survey February & March 2015: Cloncreen, Codd South & Ballydermot Bogs

A combination of vantage point watches and transect surveys, as well as general observations in the vicinity of the sites was completed for three peatland sites used for industrial peat extraction: Cloncreen, Codd South and Ballydermot. These surveys were focused on the following groups of birds or species:

- Waterfowl, particularly Whooper Swan
- Waders, particularly Lapwing and Golden Plover
- Hen Harrier, Merlin, Peregrine and other birds of prey
- Annex I species of the EU Birds Directive
- Red or Amber listed species as per the Birds of Conservation Concern in Ireland 2014-2019.

Based on these surveys, Cloncreen bog was considered to have limited potential for wintering birds and was assigned a rating of local Importance (higher value). Whooper Swan, Hen Harrier or Kingfisher, which have previously noted during field surveys (within and outside site), were not recorded during this survey. Peregrine utilise the site on occasion for perching or roosting. Lapwing and Golden Plover were recorded flying over the site but are not considered to be strongly associated with the site.

Codd South and Ballydermot are also categorised as local importance (higher value) for wintering birds based on the presence of roosting Golden Plover, Meadow Pipit and various Amber listed species. Hen Harrier was also recorded foraging on the site at Ballydermot located to the east.

6.3.2.5.2 Winter Bird Survey 2013-2014: Ballydermot & Derrygreenagh Bog Group

A study of wintering birds associated with Derrygreenagh and Ballydermot Bog Groups, which includes Cloncreen Bog, was carried out between October 2013 and March 2014. A combination of vantage point watches and transect walks, as well as focused surveys of wetland birds was completed. These surveys were focused on the following groups of birds or species:

- Waterfowl, particularly Whooper Swan
- Waders, particularly Lapwing and Golden Plover
- Hen Harrier, Merlin, Peregrine and other birds of prey
- Annex I species of the EU Birds Directive
- Red or Amber listed species as per the Birds of Conservation Concern in Ireland 2014-2019.

Based on previous studies in the area, a high frequency of survey for Whooper Swan was considered necessary. From October to March the movements of the main Whooper Swan population at Derrygreenagh sites were visited at weekly to fortnightly intervals over 3-4 hour periods. Dedicated dusk watches were undertaken for Hen Harrier to identify winter roost sites. A dedicated Red Grouse tape lure survey was also completed at Ticknevin, Daingean and Blackriver sites.

Cloncreen Bog was assessed as being of County Importance. This is based on numbers recorded during mid to late February 2014. The peak of 83 individuals was recorded on the 18th of February. The birds were recorded both feeding and roosting in this area of the site however were not regularly occurring. Hen Harrier was also observed foraging and perching on the site. Other target species recorded utilising the site include Peregrine, utilized the site regularly for perching, Lapwing, displaying on one occasion in March, Golden Plover, flying over the site on two occasions and Kingfisher, recorded once along a stream adjacent to the bog outside the study area. Other species recorded utilising the site included Mute Swan, Teal, Buzzard, Sparrowhawk, Kestrel, Snipe, Woodcock, Skylark, Meadow Pipit and Linnet. The importance of this site is largely due to the presence of the flooded area in the north of the site which is not a permanent feature. Further surveys at this site have, in the absence of the flooded area, not recorded Whooper Swan on the site.

Two sites were rated as National Importance, Cavemount and Derryarkin, based on the intensity of use of these sites by Whooper Swan. Four sites (including Cloncreen) were rated as County Importance based on the use of these sites by Whooper Swan, Hen Harrier or high numbers of wetland species. The remaining sites were categorised as Local Importance. Overall, this survey (in combination with a similar survey in 2012/13) concluded that the Derrygreenagh/Ballydermot group are of relatively low importance for wintering birds at national level.

6.3.2.5.3 Winter Bird Survey 2012-2013: Ballydermot & Derrygreenagh Bog Group

A baseline study of wintering birds associated with Derrygreenagh and Ballydermot Bog Groups, which includes Cloncreen Bog, was carried out between November 2012 and March 2013. A combination of vantage point watches and transect walks, as well as focused surveys for wetland birds was completed. These surveys were focused on the following groups of birds or species:

- Waterfowl, particularly Whooper Swan
- Waders, particularly Lapwing and Golden Plover
- Hen Harrier, Merlin, Peregrine and other birds of prey
- Annex I species of the EU Birds Directive
- Red or Amber listed species as per the Birds of Conservation Concern in Ireland 2014-2019.

At the commencement of the study, searches were made in areas surrounding the bog sites for potential wetland or grassland sites that could potentially support wintering waterbirds. This was based on the desk review, map details and general searches. Particular emphasis was placed on searches for feeding and/or roost sites for Whooper Swans. The search zone was generally within a 1-2 kilometre radius of the sites but was further where necessary. A focused survey for Hen Harrier was also carried out over suitable habitat for possible winter roosts.

This survey found Cloncreen Bog to have no significant potential for regularly occurring wintering birds of conservation importance. There was one flock of Golden Plover recorded flying over the study area on the 21st of April and no other target species were observed utilising the site or flying over the site. Therefore, the site was assessed as Local Importance (higher value)

During this survey period, only one site, Cavemount, was assessed as National Importance due to the population of Whooper Swan recorded at this site. All other sites were assessed as Local Importance (higher value).

6.3.2.5.4 Summer Bird Survey 2015: Cloncreen, Codd South & Ballydermot Bogs

A study of breeding birds was completed for three Bord na Móna bog sites between April and August 2015 using a combination of transect surveys, vantage point watches and focused searches for scarce species, particularly wetland birds. The surveys focused on the potential presence of the following groups of birds or species:

- Waders, mainly Lapwing, Ringed Plover and Snipe
- Other waterbirds, including Little Grebe, Teal and gull species
- Summering Merlin, Hen Harrier and other birds of prey
- Red Grouse
- Any other Annex I species of EU Birds Directive

- Any other Red or Amber listed species as per Birds of Conservation Concern in Ireland (BoCCI).

Cloncreen Bog was found to have low potential for breeding birds of conservation importance. Lapwing is the species of most conservation significance that breeds within the site. Woodcock were also recorded breeding on site. Peregrine which nest on a nearby power station fly over and perch occasionally on the site. A number of Amber listed species also occur on the site. Cloncreen Bog is assessed as Local Importance (higher value).

Codd South and Ballydermot were also assessed as having low potential for breeding birds and were categorised as Local Importance (higher value).

6.3.2.5.5 Summer Bird Survey 2014: Ballydermot & Derrygreenagh Bog Group

A study of breeding birds associated with Bord na Móna Derrygreenagh and Ballydermot Bog Group, including Cloncreen Bog, was completed between April and August 2014 using a combination of transect surveys, vantage point watches and focused searches for scarce species, particularly wetland birds. The surveys focused on the potential presence of the following groups of birds or species:

- Waders, mainly Lapwing, Ringed Plover and Snipe
- Other waterbirds, including Little Grebe, Teal and gull species
- Summering Merlin, Hen Harrier and other birds of prey
- Red Grouse
- Any other Annex I species of EU Birds Directive
- Any other Red or Amber listed species as per Birds of Conservation Concern in Ireland (BoCCI).

This study found Cloncreen Bog has low potential for breeding birds of high conservation importance. However, Lapwing, Woodcock and Meadow Pipit bred on the site during the survey period. Two displaying snipe were also recorded. Peregrine, which nests nearby was recorded hunting and flying over the site. Gravel pits within the site support a substantial Sand Martin colony and Swallow, Skylark and Linnet were recorded as breeding on the site. Lough Aisling adjacent to the northwest boundary of the site supports breeding Mute Swan. The site was categorized as Local Importance (higher value).

Derryarkin, Cavemount and Ballycon were assessed within this study as National Importance for the presence of breeding wetland birds and Black-headed Gulls. Six sites were assessed as being of county Importance for the presence of breeding wetland birds. Twenty-six sites were assessed as Local Importance (higher value) and a single site was assessed as Local Importance (lower value) due to the absence of breeding species of conservation interest and absence of suitable breeding bird habitat.

6.3.2.5.6 Summer Bird Survey 2013: Ballydermot & Derrygreenagh Bog Group

A study of breeding birds associated with Bord na Móna Derrygreenagh and Ballydermot Bog Group, including Cloncreen Bog, was completed between April and August 2013 using a combination of transect surveys, vantage point watches and focused searches for scarce species, particularly wetland birds. The surveys focused on the potential presence of the following groups of birds or species:

- Waders, mainly Lapwing, Ringed Plover and Snipe
- Other waterbirds, including Little Grebe, Teal and gull species

- Summering Merlin, Hen Harrier and other birds of prey
- Red Grouse
- Any other Annex I species of EU Birds Directive
- Any other Red or Amber listed species as per Birds of Conservation Concern in Ireland (BoCCI).

No significant wetland habitat for breeding waders or other wetland birds was identified at Cloncreen Bog. Gravel pits within the site support a substantial Sand Martin colony and Swallow, Skylark and Linnet were recorded as breeding on the site. Lough Aisling adjacent to the northwest boundary of the site supports breeding Mute Swan and Little Grebe. The site was categorized as Local Importance (lower value).

Three sites within this study were assessed as National Importance for the presence of breeding wetland birds and Black-headed Gulls. Six sites were assessed as being of county Importance for the presence of breeding wetland birds. Three sites were assessed as Local Importance (higher value) and the remaining sites were assessed as Local Importance (lower value) due to the absence of breeding species of conservation interest and absence of suitable breeding bird habitat.

6.3.2.5.7 Review of Whooper Swan Population Centred in Northeast County Offaly

This study focused on a population of Whooper Swans which frequently return to a number of peatland and grassland sites in and around the Derrygreenagh Bog Group in east Co. Offaly. The review assesses the size of the population over four winters 2012/13, 2013/14, 2014/15 & 2015/16, the use of the site and movement of birds between sites. This bog group includes Cloncreen, the study area of interest in this report. Derryarkin, Cavemount and Ballycon are the three remaining sites of interest investigated during the review.

The first significant record of Whooper Swan in the area identified during the review was recorded at Ballycon in 2010. Since this period there appears to be regular numbers of wintering Whooper Swan at Ballycon and Derryarkin. During the survey period, Whooper Swan were recorded on Cloncreen Bog during two winter seasons, 2013/14 and 2015/16. There are no permanent water bodies on this site and Whooper Swans appear to only use this site when it is subject to extensive flooding on the northern section of the site. The remaining three sites support more regularly occurring populations.

Based on the data available during the review process, it appears that Whooper Swan populations in the area are opportunistically using wetland habitats that have developed on cutaway sites and may be considered a transient event. Water levels in Cavemount are consistently high, and it is considered that Cavemount, Ballycon and Derryarkin will continue to have open water for some time. Remaining bogs in production in the Derrygreenagh group have less potential for significant wetland cutaway sites to develop and Whooper Swan usage of Cavemount, Ballycon and Derryarkin will likely persist in the short-medium term.

6.3.2.5.8 Birds on Cutaway Peatlands: Baseline Breeding Bird Population Survey (Copland, 2011)

This study established line transects on 10 cutaway bogs in the Midlands region to assess the bird assemblages utilising these sites. Surveys were undertaken between April and July and each site was walked at least twice. Five of the survey sites (Ballycon, Cavemount, Drumman, Timahoe, Ballybeg) fall within the Derrygreenagh Bog Group within which the study area of interest in this report, Cloncreen, also occurs. Ballycon is the closest of these to the study area, 0.2km west of the study area. A total of 62 species were recorded, 22 of which were confirmed breeding. Five red listed species (BoCCI) and 21 amber listed species were recorded during the transects. 33 species comprising 235 individuals were recorded at Ballycon including four waders (Ringed Plover, lapwing, Snipe and Redshank). The breeding bird assemblage at Ballycon is dominated by waders and wetland species (58.4%). The assemblage of breeding waders at this site was considered by the author as being of particular importance. The numbers of waders and wetlands species recorded at this site are unlikely to occur at Cloncreen due to the absence of permanent waterbodies which are present at Ballycon and the ongoing peat extraction. Given the time lapse since surveys were initially undertaken (2011), and in light of more recent surveys that have informed population trends at the various cutaway sites, records from this report are not included within Appendix 6-4, Table 1. The report is listed in the references section of this document.

6.3.2.6 Ad-hoc Records

A record for a flock of 406 Greenland White-fronted Goose from Ballycon and Coolagary was submitted to www.irishbirding.com. Ballycon wetland forms part of the Derrygreenagh Bog Group which includes Cloncreen Bog, the study area of interest in this report. Comments pertaining to this record are reproduced in the paragraph below:

> *"From 09.05 to 10:15 100 WFG settled on water at Ballycon N555260. Other skeins overflow the area headed NNW. At 10:35 95 WFG flying in the same direction seen at N540208 Coolagarry. Total number 406."*

Correspondence with Mr. Alyn Walsh, NPWS Ranger Co. Wexford, indicated that this is likely to be a flock on passage on spring migration returning to breeding grounds in Greenland from the Wexford Slobs (Section 6.3.1).

6.3.2.7 Planning Search

Assessment material for this cumulative assessment of effects was compiled on the relevant developments within the vicinity of the proposed development and was verified on the 12/10/2016. The material was gathered through a search of relevant online Planning Registers, reviews of relevant EIS documents, planning application details and planning drawings, and served to identify past and future projects, their activities and their environmental effects. The projects considered in relation to the potential for cumulative effects and for which all relevant data was reviewed (e.g. individual EISs, layouts, drawings etc.) include those listed below.

- Clonbullogue Ash Repository
- Edenderry Power Plant
- Peat Extraction: Allen Group
- Peat Extraction: Derrygreenagh Group
- Barrow BlueWay
- Grand Canal Blueway Shared Walking and Cycling Route
- Shean Site Infill
- Eastern and Midlands Regional Water Supply Project
- Clonin North Solar Farm
- Other Wind Farm Projects
- Mountlucas Wind Farm – Operating
- Yellow River Wind Farm – Permitted

Details for each project are presented in Section 2.9.2 of this EIS.

Details in relation to baseline avifauna records previously recorded at the permitted wind farm sites are further discussed in Section 6.6.4 (Cumulative Effects) of this report.

6.3.2.8 Wintering and Migratory Waterfowl Counts

SNH (2014) states '*It is known that geese are particularly sensitive to disturbance on roost sites. As such any known roost sites within 1km of the proposed wind farm should be surveyed fortnightly''*. A search for suitable roost habitat using ortho-base maps and ordnance survey maps of the study area was undertaken. Initial drive-by surveys along public roads also provided information on potential presence of suitable roost habitat within a 3km radius of the site. Suitable roost sites (i.e. ponds, rivers, lakes, reservoirs, etc.) deemed suitable to support wintering and migratory bird species were identified within a 3km radius of the study area and hinterland vantage point watches were conducted at these sites (Table 6.11) to detect any movement of wintering and migratory birds from these areas to the study area at Cloncreen. Special attention was also paid to areas of suitable foraging habitat including areas of improved agricultural grassland adjacent to the Figile River and Philipstown River.

Table 6.11 Suitable Wintering/Migratory Waterfowl Sites within 3km of the site

Site Name	Survey Location	Proximity to Site
Ballycon Bog	E 252230 N 226170	0.2km west
Cloncrane (adjacent to River Phillipstown)	E 258390 N223820	0.9km south
Lough Aisling	E 258060 N227650	70m west
Phillipstown River	E 257330 N 223690	1km south

6.3.3 Identification of Target Species

The Scottish Natural Heritage (SNH) 2014 published guidance document *'Recommended bird survey methods to inform impact assessment of onshore wind farms'* states that *'the location and scale of the proposal, and sensitivity of the bird interest present will determine the target species and the duration of the survey period'*. The SNH selects target species which are afforded a higher level of legislative protection. Special attention was paid to bird species listed on Annex I of the EU Birds Directive, red-listed Birds of Conservation Concern in Ireland (BoCCI) (Colhoun & Cummins, 2013) and Special Conservation Interests (SCIs) of Special Protection Areas (SPAs), where connectivity was established with designated areas. Offaly County Biodiversity Action Plan was also consulted for birds deemed to be of County importance.

For the purposes of this assessment, a target species is defined as any bird species susceptible to collision with an operating turbine. Previous studies have shown that bird groups most susceptible to collision risk with operating wind turbines are soaring birds of prey, waterbirds (including migratory waterfowl), waders and gulls (Powlesland, 2009).

Table 6.12 presents a list of all potential target species identified for surveys undertaken during the relevant survey period.

Table 6.12 Target species identified for bird surveys for the study area

Common Name	Latin Name	Rationale
Barn Owl	*Tyto alba*	Annex I, EU Birds Directive; Previously recorded within 10km square (N62).
Black-headed Gull	*Larus ridibundus*	BoCCI red-list.
Buzzard	*Buteo buteo*	Previously recorded within 10km square (N52, N62).
Coot	*Fulica atra*	Potential habitat on site.
Curlew	*Numenius arquata*	BoCCI Red List, Previously recorded within 10km square (N52) (Bird Atlas 2007-2011).
Golden Plover	*Pluvialis apricaria*	Annex I, EU Birds Directive; BoCCI Red List; Previously recorded within 10km square (N52) (Bird Atlas 2007-2011); suitable habitat in the wider hinterland.
Greenland White-fronted Goose	*Anser albifrons flavirostris*	Annex I, EU Birds Directive; previous records in region; suitable habitat in wider hinterland.
Grey Heron	*Ardea cinerea*	Suitable habitat on site.
Grey Partridge	*Perdix perdix*	BoCCI Red List, Previously recorded within 10km square (N62)
Hen Harrier	*Circus cyaneus*	Annex I, EU Birds Directive; Previously recorded within 10km square (N52, N62)
Herring Gull	*Larus argentatus*	BoCCI Red List; Previously recorded within 10km square (N52) (Bird Atlas 2007-2011);
Kestrel	*Falco tinnunculus*	Previously recorded within 10km square (N52, N62) (Bird Atlas 2007-2011);
Kingfisher	*Alcedo atthis*	Annex I, EU Birds Directive; BoCCI Red List; Previously recorded within 10km square (N52, N62) (Bird Atlas 2007-2011); suitable habitat in the wider hinterland.
Lapwing	*Vanellus vanellus*	BoCCI Red List; Previously recorded within 10km square (N52, N62) (Bird Atlas 2007-2011); suitable habitat in wider hinterland.
Lesser Black-backed Gull	*Larus fuscus*	Previously recorded within 10km square (N52, N62) (Bird Atlas 2007-2011)
Little Egret	*Egretta garzetta*	Annex I, EU Birds Directive; suitable habitat in the wider hinterland.
Little Grebe	*Tachybaptus ruficollis*	Suitable habitat in the wider hinterland.
Mallard	*Anas platyrhynchos*	Potential habitat on site.
Merlin	*Falco columbarius*	Annex I, EU Birds Directive; Previously recorded within 10km square (N62);
Moorhen	*Gallinula chloropus*	Suitable habitat in the wider hinterland.
Mute Swan	*Cygnus olor*	Potential habitat on site.
Peregrine Falcon	*Falco peregrinus*	Annex I, EU Birds Directive; Previously recorded within 10km square (N52);

Common Name	Latin Name	Rationale
Redshank	*Tringa totanus*	BoCCI Red List; Previously recorded within 10km square (N62) (Bird Atlas 2007-2011); suitable habitat in the wider hinterland.
Ringed Plover	*Charadrius hiaticula*	Previously recorded within 10km square (N52) (Bird Atlas 2007-2011)
Snipe	*Gallinago gallinago*	Suitable habitat on site.
Sparrowhawk	*Accipiter nisus*	Previously recorded within 10km square (N62) (Bird Atlas 2007-2011);
Teal	*Anas crecca*	Suitable habitat on site.
Whooper Swan	*Cygnus cygnus*	Annex I; Previously recorded within 10km square (N52, N62)
Wigeon	*Anas penelope*	Potential habitat on site.
Woodcock	*Scolopax rusticola*	BoCCI Red List; Previously recorded within 10km square (N52, N62) (Bird Atlas 2007-2011);
Yellowhammer	*Emberiza citrinella*	BoCCI Red List; Previously recorded within 10km square (N52, N52) (Bird Atlas 2007-2011)

6.4 Results and Discussion

6.4.1 Field Surveys

The findings of the field survey data for the winter seasons 2013/14 and 2015/16, breeding seasons 2015 & 2016 are described in this section of the report with full details of the survey data (including mapping) used to inform the results and discussion presented in Appendices 6-4 and 6-5. For ease of reference, the locations of these data within the relevant appendices are described in Table 6.13 below. It should be noted that a unique reference numbering system has been assigned for all target species observed in flight. The flight line maps have been attributed with a numbering system and should be read in conjunction with the corresponding flight line data.

It should also be noted that March marks the onset of the bird nesting season and the latter part of the winter bird survey season and duplicate records pertinent to this period have been provided in the data where the month overlaps with breeding and wintering seasons.

Table 6.13 Results of field survey data for the various survey methodologies employed at the subject site

Survey Data	Table No. & Appendix No.
Supplementary Data (Winter Season 2012/13 & Breeding Seasons 2013 & 2014)	Appendix 6-2; Table 1 & 2
Waterbird Records (Bord na Móna Sites) (5-8km radius)	Appendix 6-4; Table 1
Wetland Waterbird Counts	Appendix 6-5; Table 1
Vantage Point Survey Data (Flight Data)	Appendix 6-5; Table 2
Flight line Maps	Appendix 6-5; Figures 1 – 35
Wintering feeding/resting Sites (Maps)	Appendix 6-5; Figures 36 – 37
Breeding Bird Territories (Maps)	Appendix 6-5; Figures 38 - 43

Survey Data	Table No. & Appendix No.
Winter Transect Data	Appendix 6-5; Table 3
Breeding Transect Data	Appendix 6-5; Table 4
Adapted Brown & Shepherd Survey Data	Appendix 6-5; Table 5
Breeding Raptor Survey Data	Appendix 6-5; Table 6

Details of all bird species recorded within the study area during winter and breeding seasons are presented in Section 6.4.1.1 with information pertaining to the surveys of wetlands and waterbirds that were undertaken outside the site provided in Section 6.4.1.2.

A summary of the results that relate to the key target species identified within the study area is provided on a species by species basis in Section 6.4.1.3.

Supplementary data encompassing the winter seasons 2012/13 & 2014/15 and breeding seasons 2013 & 2014 was consulted to support the current assessment. Literature sources such as breeding and wintering bird data pertinent to Bord na Móna sites (Ballydermot & Derrygreenagh Bog Groups) in the wider surroundings were also consulted. This information is used and referred to (where relevant) in the identification of target species and in the discussion relating to each of the target species.

6.4.1.1 Bird Species Recorded on the Site

A comprehensive list of all bird species recorded within the study area is provided in Tables 6.14 and 6.15 below. Lists are divided into records during the breeding and wintering seasons.

Table 6.14 Summary of the bird species composition recorded within the study area during the winter survey seasons

Common Name	BoCCI Status; Annex I; EU Habitats Directive
Barn Swallow	Amber List
Blackcap	Green List
Blue Tit	Green List
Chaffinch	Green List
Coal Tit	Green List
Common Blackbird	Green List
Common Bullfinch	Green List
Common Buzzard	Green List
Common Chiffchaff	Green List
Common Cuckoo	Green List
Common Kestrel	Amber List
Common Linnet	Amber List
Common Moorhen	Green List
Common Pheasant	Green List
Common Raven	Green List
Common Snipe	Amber List
Common Whitethroat	Green List
Common Wood Pigeon	Green List
Dunnock	Green List
Eurasian Jackdaw	Green List
Eurasian Sparrowhawk	Amber List
Eurasian Teal	Green List

Common Name	BoCCI Status; Annex I; EU Habitats Directive
Eurasian Treecreeper	Green List
Eurasian Woodcock	Red List
European Golden Plover	Red List, Annex I, EU Birds Directive
European Goldfinch	Green List
European Greenfinch	Amber List
European Robin	Amber List
European Starling	Green List
Fieldfare	Green List
Goldcrest	Amber List
Great Tit	Green List
Grey Heron	Green List
Hen Harrier	Amber List; Annex I, EU Birds Directive
Hooded Crow	Green List
Jack Snipe	Green List
Jay	Green List
Lesser Black-backed Gull	Amber List
Lesser Redpoll	Green List
Linnet	Amber List
Long-eared Owl	Green List
Long-tailed Tit	Green List
Magpie	Green List
Mallard	Green List
Meadow Pipit	Red List
Mistle thrush	Amber List
Mute Swan	Amber List
Northern Lapwing	Red List
Northern Wheatear	Amber List
Peregrine Falcon	Green List; Annex I, EU Birds Directive
Pied Wagtail	Green List
Redwing	Green List
Reed Bunting	Green List
Ringed Plover	Green List
Rook	Green List
Sand Martin	Amber List
Sedge Warbler	Green List
Sky Lark	Amber List
Song Thrush	Green List
Stonechat	Amber List
Water Rail	Green List
Whooper Swan	Amber List; Annex I, EU Birds Directive
Willow Warbler	Green List
Winter Wren	Green List

There were just four BoCCI red-listed bird species of conservation concern recorded within the study area: Woodcock, Lapwing, Golden Plover and Meadow Pipit. Woodcock is red listed due to long term breeding population decline and contraction in breeding range. Lapwing has shown a decline of 89% since 1987 and the breeding population of Golden Plover is also in decline, whilst the wintering population has declined by over

50% in recent decades. Meadow Pipit is red listed due to short-term declines in the breeding population and is expected to return to favourable conservation status in the short-term. Give the wide distribution and range the species occupies, Meadow Pipit is not deemed to be a particularly vulnerable species (Colhoun & Cummins, 2013).

Winter migrants including Whooper Swan, Golden Plover, Lapwing, Redwing and Fieldfare were recorded during field surveys. Wintering flocks were not found to be restricted to the habitats of the study area with periodic usage of the habitats noted during periods of prolonged rainfall.

Annex I species recorded within the study area were Golden Plover, Whooper Swan, Peregrine Falcon and Hen Harrier. Peregrine Falcon and Hen Harrier were not found to be dependent on the habitats of the study area based on low observations recorded. Foraging habitat exists elsewhere in the wider surroundings to the west at the rehabilitation Bord na Móna site of Ballycon. The month of March marked the arrival of summer migrants such as Chiffchaff and Swallow.

Overall, species abundances recorded during winter months were found to be extremely low with little usage recorded. The habitats of the study area are limited in their potential to support significant numbers of wintering birds. Habitat homogeneity and the survey time of year appear to be important factors in the recorded species abundance and diversity within the proposed development site. The level of bird activity recorded at Cloncreen is on par with what would be expected from the habitats on site at that particular time of year. The species composition and assemblages are typical of regenerating habitats on cutaway sites.

Bird species recorded during the breeding season are summarised in Table 6.15 below.

Table 6.15 Summary of the bird species composition recorded within the study area during the breeding seasons 2015 & 2016

Species Name	Maximum Breeding Status in 2015 and 2016	BoCCI Status
Barn Swallow	Probable breeder	Amber Listed
Blackcap	Non-breeder	Green Listed
Blue Tit	Possible breeder	Green Listed
Chaffinch	Probable breeder	Green Listed
Coal Tit	Probable breeder	Green Listed
Common Blackbird	Confirmed breeder	Green Listed
Common Bullfinch	Probable breeder	Green Listed
Common Buzzard	Possible breeder	Green Listed
Common Chiffchaff	Possible breeder	Green Listed
Common Cuckoo	Possible breeder	Green Listed
Common Kestrel	Possible breeder	Amber Listed
Common Linnet	Probable breeder	Amber Listed
Common Moorhen	Non-breeder	Green Listed
Common Pheasant	Possible breeder	Green Listed
Common Raven	Non-breeder	Green Listed
Common Snipe	Probable breeder	Amber Listed
Common Whitethroat	Confirmed breeder	Green Listed
Common Wood Pigeon	Probable breeder	Green Listed
Dunnock	Possible breeder	Green Listed
Eurasian Sparrowhawk	Confirmed breeder	Amber Listed

Species Name	Maximum Breeding Status in 2015 and 2016	BoCCI Status
Eurasian Treecreeper	Possible breeder	Green Listed
Eurasian Woodcock	Possible breeder	Red Listed
European Goldfinch	Confirmed breeder	Green Listed
European Greenfinch	Non-breeder	Green Listed
European Robin	Probable breeder	Amber Listed
Goldcrest	Possible breeder	Amber Listed
Great Tit	Confirmed breeder	Green Listed
Grey Heron	Non-breeder	Green Listed
Hen Harrier	Non-breeder	Amber Listed, Annex I
Hooded Crow	Confirmed breeder	Green Listed
Jack Snipe	Possible breeder	Green Listed
Jackdaw	Non-breeder	Green Listed
Jay	Probable breeder	Green Listed
Lesser Black-backed Gull	Non-breeder	Amber Listed
Lesser Redpoll	Confirmed breeder	Green Listed
Long-eared Owl	Non-breeder	Green Listed
Long-tailed Tit	Possible breeder	Green Listed
Magpie	Probable breeder	Green Listed
Mallard	Probable breeder	Green Listed
Meadow Pipit	Confirmed breeder	Red Listed
Mistle thrush	Confirmed breeder	Amber Listed
Mute Swan	Non-breeder	Green Listed
Northern Lapwing	Confirmed breeder	Red Listed
Northern Wheatear	Possible breeder	Amber Listed
Peregrine Falcon	Non-breeder (also confirmed breeding offsite)	Green Listed, Annex I
Pied Wagtail	Possible breeder	Green Listed
Reed Bunting	Confirmed breeder	Green Listed
Ringed Plover	Confirmed	Green Listed
Rook	Non-breeder	Green Listed
Sand Martin	Confirmed breeder	Amber Listed
Sedge Warbler	Possible breeder	Green Listed
Sky Lark	Probable breeder	Amber Listed
Song Thrush	Possible breeder	Green Listed
Stonechat	Non-breeder	Amber Listed
Water Rail	Possible breeder	Amber Listed
Willow Warbler	Probable breeder	Green Listed
Winter Wren	Confirmed breeder	Green Listed

There were just three BoCCI breeding red-listed bird species of conservation concern recorded within the study area, Woodcock, Lapwing and Meadow Pipit. Woodcock was observed roding within the proposed development site. Given the wide distribution and range the species occupies, Meadow Pipit is not deemed to be susceptible to the proposed development. Lapwing was recorded breeding in the south-western section of the site (refer to Section 6.4.1.3.3 for further information).

Summer migrants recorded during field surveys included Chiffchaff, Cuckoo, Whitethroat, Sand Martin, Sedge Warbler and Willow Warbler. Numbers observed were recorded in relatively low numbers. Given the presence of suitable breeding habitat and breeding numbers in the wider surroundings, the local breeding population is not restricted to the habitats of the study area at Cloncreen. A Sand Martin colony (35 active nest entrances) was located in the northern part of the study area at proposed borrow pit area (spoil and bare ground (ED2)) (Grid Ref: N58505; 26851).

Peregrine Falcon and Hen Harrier, were the only Annex I bird species present during breeding bird surveys within the study area. Peregrine Falcon was identified breeding off-site. There was no evidence of breeding Hen Harrier.

Overall, the number of breeding birds of conservation concern recorded onsite were found to be low. Habitat homogeneity and the survey time of year appear to be important factors in the recorded species abundance and diversity within the proposed development site. The level of bird activity recorded at Cloncreen is on par with what would be expected from the habitats on site at that particular time of year. The majority of common passerines recorded during field surveys are restricted to the margins of the study area where conifer plantation, bog woodland, birch scrub and treelines dominate. The species composition and assemblages are typical of regenerating habitats on industrial cutaway sites.

A number of BoCCI amber listed species of conservation concern were recorded during both breeding season and winter field surveys. Species encountered during field surveys included: Swallow, Kestrel, Linnet, Snipe, Sparrowhawk, Robin, Goldcrest, Mistlethrush, Wheatear, Sand Martin, Skylark, Water Rail, Stonechat, Lesser Black-backed Gull and Hen Harrier. The majority of these species are common and widespread and suitable habitat is widespread in the wider surroundings. Water-rail was recorded on a single occasion during breeding transect surveys in March 2016. Vocal calls were recorded from a pair in an area comprising regenerating bog plant communities (sedges and reeds, *Eriophorum angustifolium*, *Carex rostrata* and *Typha latifoila*). The species was recorded in an area of permanent standing water deemed suitable for the species breeding requirements. However, there were no further observations or sightings of the species during the breeding season 2016. Lesser Black-backed Gull was observed commuting over the site, but was not considered to be using habitats within. Hen Harrier was also observed during the breeding season 2016, but no evidence of breeding behaviour was recorded.

6.4.1.2 Wetland and Waterbird Counts

No significant records of migratory geese and swans were recorded within a 2-3km radius of the proposed development site during field surveys. Special attention was paid to the Figile River, Philipstown River and Lough Aisling within a 2-3km radius of the study area. A flock of 1,200 Golden Plover (nationally important flock) were recorded in an area of improved agricultural grassland along with 16 Whooper Swan, 2 Mute Swan and 2 Greylag Geese in the townland of Cloncrane located approximately 0.7km south of the study area adjacent to the Philipstown River. There were no other records of significance recorded during wetland waterbird count surveys undertaken during the winter season 2015/16. The results of wetland waterbird counts are presented in Appendix 6-4, Table 1.

Following dedicated VP surveys undertaken at Ballycon (neighbouring site) from September 2015 to May 2016, covering an entire winter period and both spring and autumn migration periods, no migratory geese were recorded. The site supports low numbers of Whooper Swan, Lapwing, Golden Plover, Teal and Mallard with no nationally important flocks of these species recorded. A single Hen Harrier was recorded on this site on a number of occasions during the winter months but no roost site was identified at Ballycon.

6.4.1.3 Target Species

The potential target species were identified in the desk study (Section 6.3.3 above). Following the survey works undertaken, no additional target species were recorded. A number of those species that were identified as potential targets were not recorded on the site and therefore not brought forward target species. These include Barn Owl, Black-headed Gull, Coot, Curlew, Greenland White-fronted Goose, Grey Partridge, Herring Gull, Kingfisher, Little Egret, Merlin, Redshank, Wigeon and Yellowhammer. There were rare occurrences of additional species such as Teal, Moorhen and Little Grebe (recorded in very low numbers ranging from two to four individuals) recorded within the site during winter months. Based on low observations recorded, the species were not considered further as a target species.

Summaries of the relevant results pertaining to each of the target species that were recorded on the site is provided on a species by species basis in the following sections. The summary provides a brief discussion and evaluation of the significance of the results relating to each species.

6.4.1.3.1 Whooper Swan

Whooper Swan were recorded on 14 dates during the vantage point surveys undertaken in the winter seasons of 2013/14 and 2015/16. 36 VP watches were undertaken during this period and thus Whooper Swan were only recorded on 33% of these surveys. The maximum flock size was 83 with the average flock size being 27. This information is shown in graphic form on Figure 6.11.

Flight activity accounted for 0.08% of total watch time effort (refer to Figure 6.11). This represents an extremely low figure in terms of flight duration recorded within the study area. The majority of flight lines were recorded below predicted collision risk height (below 25m). Short internal flight lines were observed within the study area when flocks were observed foraging onsite. There were occasional records of Swans flying from roost locations at Ballycon (located to the west) to Cloncreen during dawn watches (see Appendix 6-5, Figure 1, 2, 3 & 4).

Flocks were observed commuting, feeding and temporarily roosting within the study area (see Appendix 6-5 Tables 2 & 3). Flocks of over the average of 14 birds were only recorded on four dates during the survey period. The first occasion was at the beginning of February 2014, the second was on the 18th February, the third was at the end of November/beginning of December 2015 and the fourth was on the 21st December 2015. These observations coincided with the presence of standing water on the site

Flocks were occasionally observed foraging onsite utilising areas of cutaway bog (feeding in areas of bare peat with revegetating *Eriophorum* communities) and temporary standing water at Location 'A' (refer to feeding/roosting distribution map; Appendix 6-5, Figure 36) and on one occasion at Locations 'B' & 'C' in low densities (11 & 5 individuals). There were rare occurrences of the species utilising areas of temporary standing water for roosting at Location 'A'. Numbers observed are well below nationally important estimates (150 individuals equates to national importance).

The presence of Whooper Swan recorded within the study area can be attributed to the exceptionally high levels of rainfall recorded during the winter seasons 2013/14 and 2015/16. The high water table provided temporary suitable conditions for swans to

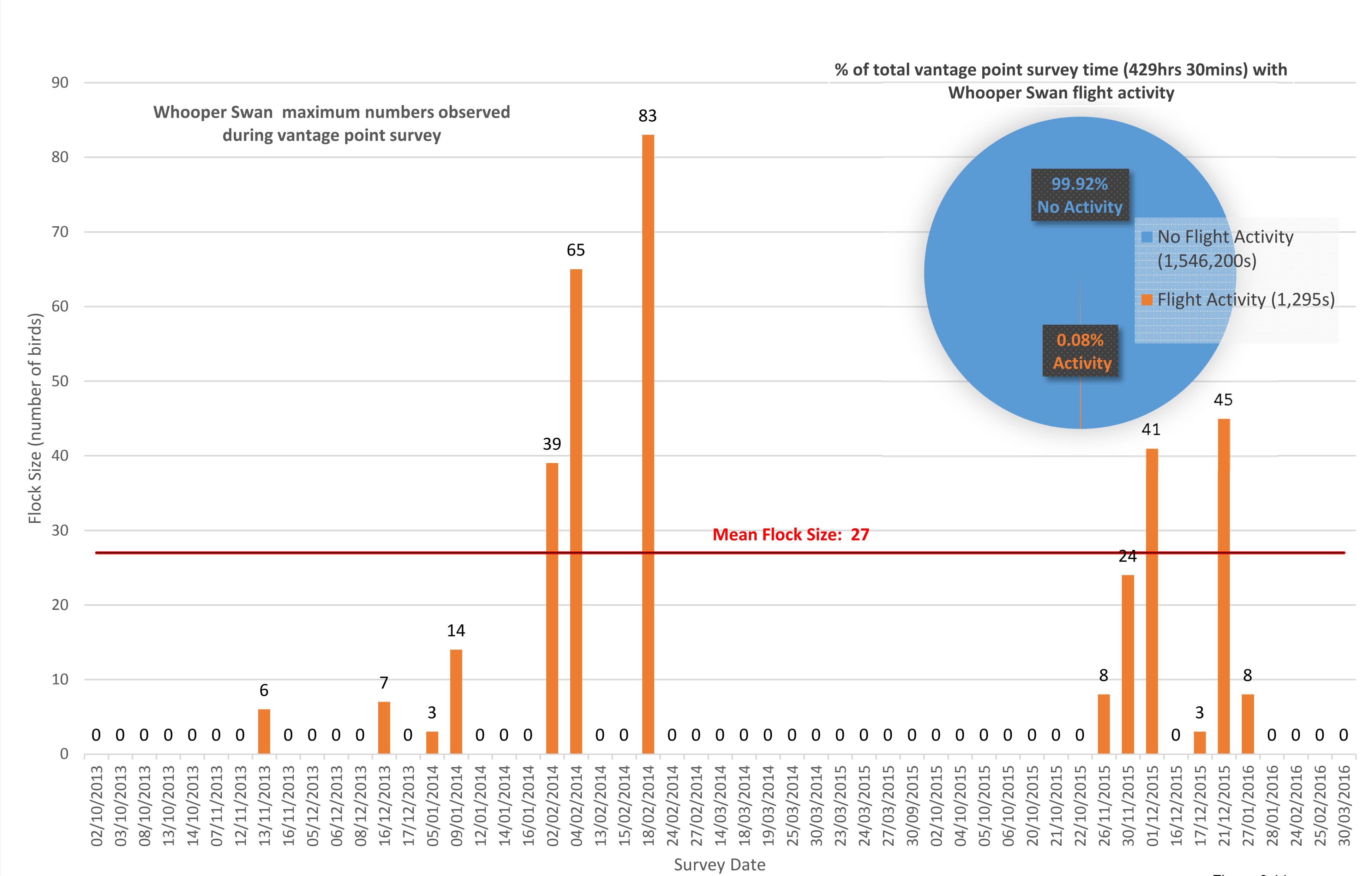

Whooper Swan maximum numbers observed during vantage point survey
% of total vantage point survey time (429hrs 30mins) with Whooper Swan flight activity
99.92% No Activity
0.08% Activity
No Flight Activity (1,546,200s)
Flight Activity (1,295s)
Mean Flock Size: 27
Flock Size (number of birds)
Survey Date

Figure 6.11

exploit the study area for feeding and roosting purposes. These findings are supported by supplementary surveys (refer to Appendix 6-2, Tables 1 & 2) undertaken during the winter seasons 2012/13 and 2013/14. Data during the winter seasons 2012/13 and 2013/14 reveal that Whooper Swans were entirely absent from the study area. Based on previous records from other Bord na Móna sites (refer to Appendix 6-4, Table 1), Whooper Swans were regularly recorded in relatively high numbers at Cavemount (nationally important flocks) and Derryarkin located approximately 4km and 7km north-west of Cloncreen respectively.

Flocks observed at Cloncreen are not deemed to be dependent on the habitats of the study area based on periodic usage during winter months, availability of optimal foraging and roost habitat in the wider surroundings and presence of regularly occurring populations concentrated at Derryarkin and Cavemount. The proposed development site does not occur on a regularly commuting flight path. The habitats of the study area are deemed to be sub-optimal for the roosting requirements of the species across the winter season. Swans were also recorded (to a lesser degree) at other industrial or cutaway peat harvesting sites in the wider surroundings including Esker, Ballycon, Clonsast North, Clonsast South, Ballybeg, Ballykeane, Blackriver Bog, Clonad and Cloncant Bog. The majority of the aforementioned sites form part of a large complex of sites of the Derrynagreenagh bog group (refer to Figure 6.12).

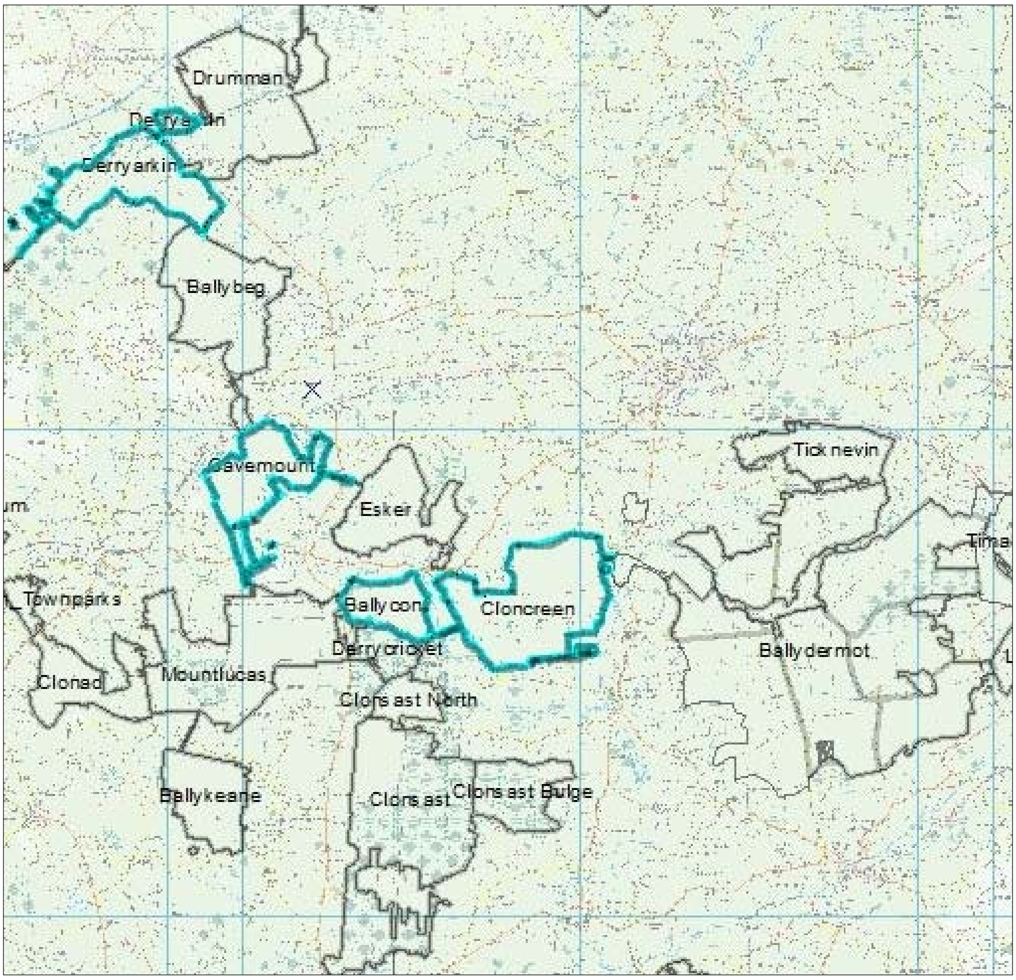


Figure 6.12 A section of the Derrynagreenagh Bog Complex outlining Cloncreen, Ballycon, Cavemount and Derryarkin

6.4.1.3.2 Golden Plover

Golden Plover were recorded within the study area during the non-breeding (winter) seasons 2013/14 and 2015/16 and Autumn migration season 2016. Observations and flight line data is presented in Appendix 6-5 Tables 2 & 3. Flocks were observed commuting, feeding and resting within the habitats of the study area during winter months. The number of birds present on site ranged from 1 to 250 individuals. The mean flock size was calculated to give a figure of 58 birds. A breakdown of flock size and % flight activity recorded within the study area is presented in Figure 6.13. There were rare occurrences (three occasions) of flocks resting on areas of bare peat within the site usually recorded in low densities (ranging 3 to 12 individuals) (see Appendix 6-5, Figure 37). Numbers recorded are well below nationally important estimates (1,200 birds equates to 1% of national importance). Flocks observed on passage were low (50 individuals in late March 2016).

Flight activity accounted for 0.15% of total watch time effort (refer to Figure 6.13). This represents an extremely low figure in terms of flight duration recorded within the study area. The majority of flight lines were recorded below predicted collision risk height (below 25m). Flight lines were largely concentrated in the northern and southern parts of the study area (refer to Appendix 6-5, Figures 5, 6 & 7). Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort across all seasons, the number of flight lines recorded is low. Larger flocks (numbers ranging 300 to 600 individuals) were recorded off-site in areas of improved agricultural grassland located to the south. Records of Golden Plover (1,200 individuals) were recorded off-site of the south and south-east during hinterland watches. Flocks observed at the Cloncreen are not dependent on the habitats of the study area based on occasional site usage, low level of flight activity recorded, low numbers of flock sizes and availability of alternative foraging and roost habitat in the wider surroundings.

6.4.1.3.3 Lapwing

Lapwing were recorded within the study area during the non-breeding (winter) seasons 2013/14 & 2015/16 and the breeding seasons 2015 & 2016. Observations and flight line data is presented in Appendix 6-5 Tables 2 - 5. The species was observed flying, breeding, resting and feeding within the habitats of the study area. The number of birds present onsite ranged from 1 to 150 individuals with the highest numbers recorded during winter months. The mean flock size was calculated to give a figure of 25 birds. A breakdown of flock size and % flight activity recorded within the study area is presented in Figure 6.14. Numbers recorded are well below nationally important estimates (1,100 birds equates to 1% of national importance). The majority of sightings were recorded during the breeding season 2015 & 2016 where breeding pairs were identified in areas of cutaway bog. There were six displaying pairs identified as 'probable breeders' in the western and south-western parts of the study area during the breeding season 2016 (refer to Appendix 6-5, Figure 10 & 38). No confirmed nest sites were identified during the breeding season 2016. Two confirmed nest sites were recorded in similar locations during the breeding season 2015.

Flight activity accounted for 0.09% of total watch time effort (refer to Figure 6.14). This represents an extremely low figure in terms of flight duration recorded within the study area. The majority of flight lines were recorded below predicted collision risk height (below 25m). Flight lines were largely concentrated in the northern and central parts of the study area (refer to Appendix 6-5, Figures 8, 9 & 10). Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort for individual survey seasons, activity was found to be low.

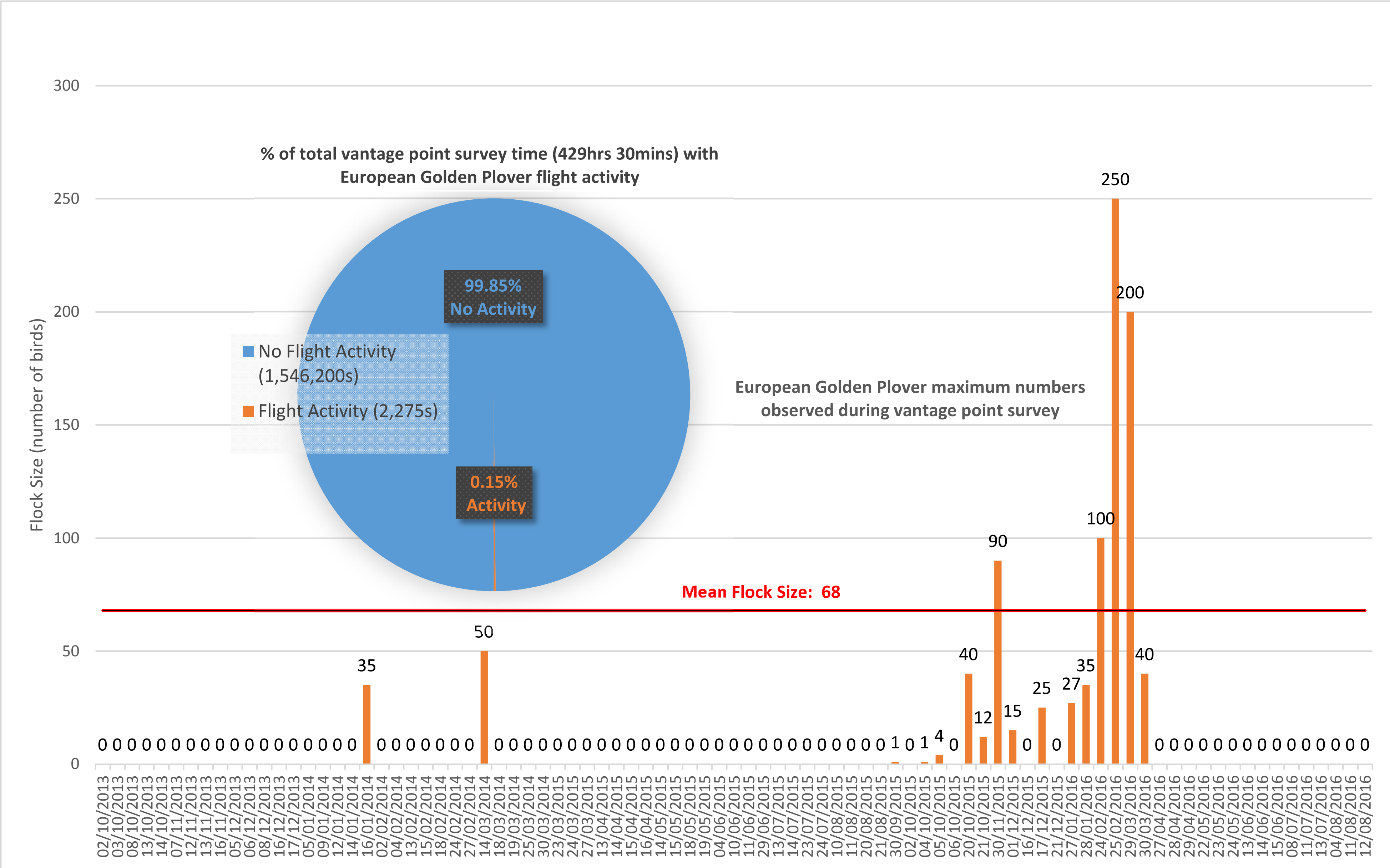

% of total vantage point survey time (429hrs 30mins) with European Golden Plover flight activity
99.85% No Activity
0.15% Activity
No Flight Activity (1,546,200s)
Flight Activity (2,275s)
European Golden Plover maximum numbers observed during vantage point survey
Mean Flock Size: 68
Flock Size (number of birds)
300
250
200
150
100
50
0
35
50
1
1
4
40
90
12
15
25
27
35
100
250
200
40
02/10/2013 03/10/2013 08/10/2013 13/10/2013 14/10/2013 07/11/2013 12/11/2013 13/11/2013 16/11/2013 05/12/2013 06/12/2013 08/12/2013 16/12/2013 17/12/2013 05/01/2014 09/01/2014 12/01/2014 14/01/2014 16/01/2014 02/02/2014 04/02/2014 13/02/2014 15/02/2014 18/02/2014 24/02/2014 27/02/2014 14/03/2014 18/03/2014 19/03/2014 25/03/2014 30/03/2014 23/03/2015 24/03/2015 27/03/2015 13/04/2015 14/04/2015 15/04/2015 16/04/2015 14/05/2015 15/05/2015 18/05/2015 19/05/2015 04/06/2015 10/06/2015 11/06/2015 29/06/2015 13/07/2015 14/07/2015 23/07/2015 24/07/2015 10/08/2015 11/08/2015 20/08/2015 21/08/2015 30/09/2015 02/10/2015 04/10/2015 05/10/2015 06/10/2015 20/10/2015 21/10/2015 30/11/2015 01/12/2015 16/12/2015 17/12/2015 21/12/2015 27/01/2016 28/01/2016 24/02/2016 25/02/2016 29/03/2016 30/03/2016 27/04/2016 28/04/2016 29/04/2016 22/05/2016 23/05/2016 24/05/2016 13/06/2016 14/06/2016 15/06/2016 08/07/2016 11/07/2016 13/07/2016 04/08/2016 11/08/2016 12/08/2016
Survey Date

Figure 6.13

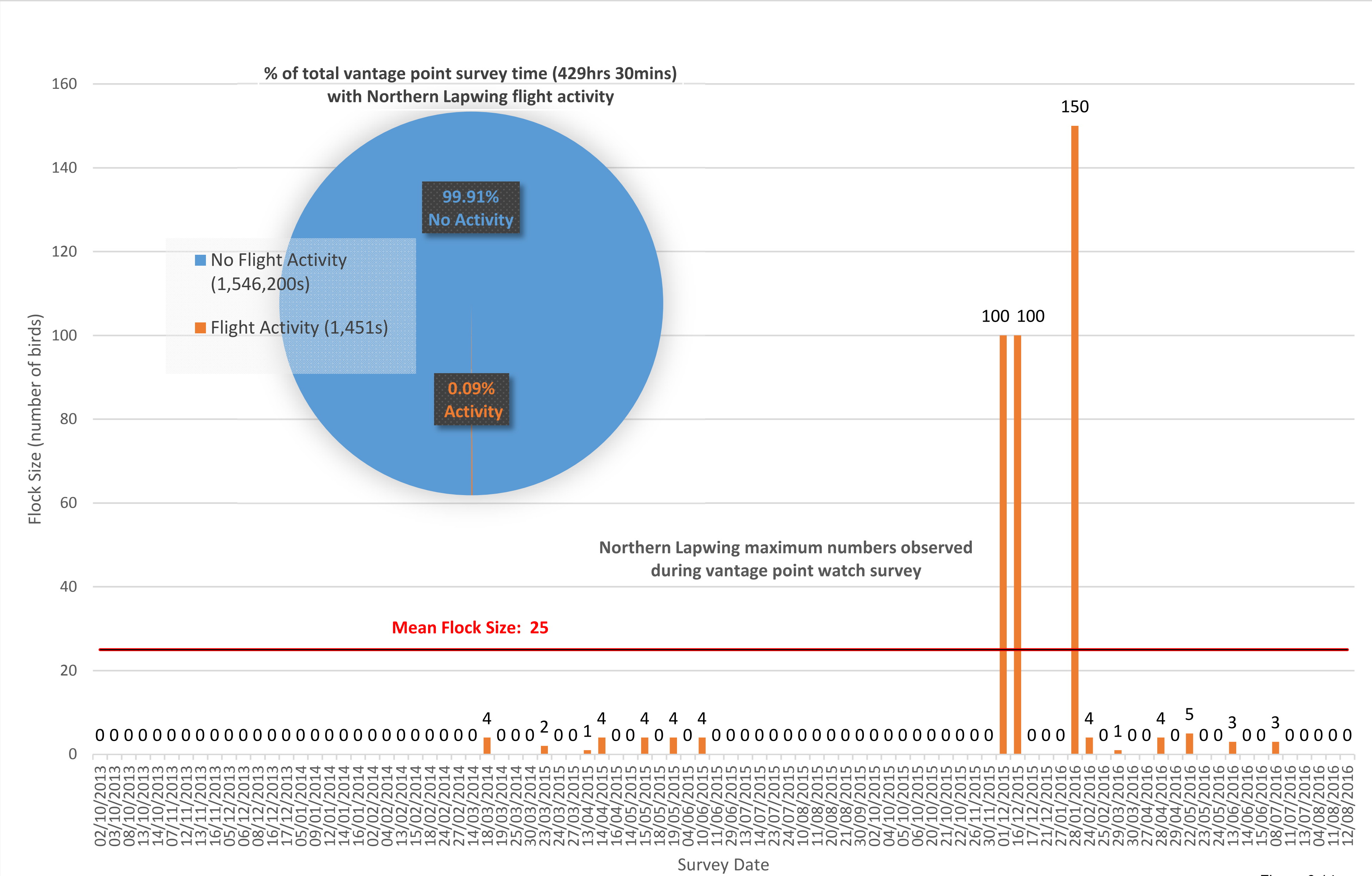

% of total vantage point survey time (429hrs 30mins)
with Northern Lapwing flight activity
99.91%
No Activity
0.09%
Activity
No Flight Activity (1,546,200s)
Flight Activity (1,451s)
Northern Lapwing maximum numbers observed
during vantage point watch survey
Mean Flock Size: 25
Flock Size (number of birds)
Survey Date
0
20
40
60
80
100
120
140
160
150
100
100
4
2
1
4
4
4
4
4
1
4
5
3
3
02/10/2013
03/10/2013
08/10/2013
13/10/2013
14/10/2013
07/11/2013
12/11/2013
13/11/2013
16/11/2013
05/12/2013
06/12/2013
08/12/2013
16/12/2013
17/12/2013
05/01/2014
09/01/2014
12/01/2014
14/01/2014
16/01/2014
02/02/2014
04/02/2014
13/02/2014
15/02/2014
18/02/2014
24/02/2014
27/02/2014
14/03/2014
18/03/2014
19/03/2014
25/03/2014
30/03/2014
23/03/2015
24/03/2015
27/03/2015
13/04/2015
14/04/2015
16/04/2015
14/05/2015
15/05/2015
18/05/2015
19/05/2015
04/06/2015
10/06/2015
11/06/2015
29/06/2015
13/07/2015
14/07/2015
23/07/2015
24/07/2015
10/08/2015
11/08/2015
20/08/2015
21/08/2015
30/09/2015
02/10/2015
04/10/2015
05/10/2015
06/10/2015
20/10/2015
21/10/2015
22/10/2015
26/11/2015
30/11/2015
01/12/2015
16/12/2015
17/12/2015
21/12/2015
27/01/2016
28/01/2016
24/02/2016
25/02/2016
29/03/2016
30/03/2016
27/04/2016
28/04/2016
29/04/2016
22/05/2016
23/05/2016
24/05/2016
13/06/2016
14/06/2016
15/06/2016
08/07/2016
11/07/2016
13/07/2016
04/08/2016
11/08/2016
12/08/2016

Figure 6.14

Unpublished reports for the Ballydermot & Derrygreenagh Bog Groups were consulted to determine breeding records (2013 & 2014) of the local population outside the study area (5-8km). From the most recent available information (refer to Appendix 6-4, Table 1), the findings of breeding data for 2013 and 2014 reveal that the local breeding population is predominantly increasing. Breeding activity was recorded in the following industrial cutaway sites outside the study area (5-8km radius) in 2014 and are summarised as follows (comparative figures for 2013 are given in brackets with percentage increase/decrease): Ballycon 9 (6) pairs (+33%), Cavemount 6 (9) (-33%), Clonsast North 3 (2) (+33%).

Given the presence of suitable breeding habitat and breeding numbers in the wider surroundings, the local breeding population is deemed to be increasing and not restricted to the habitats of the study area at Cloncreen. Much of the site is under peat production and the study area is limited in its potential to support significant breeding territories.

6.4.1.3.4 Ringed Plover

Ringed Plover were recorded within the study area during the breeding seasons 2015 & 2016 and the latter part of the winter season 2015/16 (March 2016). Observations and flight line data is presented in Appendix 6-5, Tables 2 - 5. The species was observed flying, breeding and resting within the habitats of the study area. The number of birds present onsite ranged from 1 to 3 individuals. The mean flock size was calculated to give a figure of 2 birds. A breakdown of flock size and percentage flight activity recorded within the study area is presented in Figure 6.15. Flight activity accounted for 0.02% of total watch time effort (refer to Figure 6.15). This represents an extremely low figure in terms of flight duration recorded within the study area. Flight activity was recorded below predicted collision risk height (below 25m). Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort, flight activity for winter and breeding seasons was found to be very low.

The majority of sightings were recorded during the breeding season 2015 & 2016 where breeding pairs were identified in areas of cutaway bog comprising regenerating bog sedges (i.e. *Eriophorum* sp. and *Carex* sp.). There were two pairs identified as 'confirmed breeders' located in the western and eastern sections of the study area during the breeding season 2016 (refer to Appendix 6-5, Figures 11, 12 & 39). A 'probable breeding pair' was identified in the south-western section of the study area during the breeding season 2015. Supplementary surveys undertaken in 2013 & 2014 did not detect any breeding records within the study area (refer to Appendix 6-2, Tables 1 & 2).

Breeding bird surveys for the Ballydermot & Derrygreenagh Bog Groups undertaken during the breeding seasons 2013 and 2014 recorded 'established breeding territories' at various Bord na Móna bogs in the wider study area (5-8km radius of Cloncreen) (refer to Appendix 6-4, Table 1). Breeding territories were recorded at Ballycon (3 pairs 2014), Cavemount (5 pairs in 2014) and Clonsast North (2 pairs in 2014). The results show that Ringed Plover is well established as a breeding bird in the Derrygreenagh group of bogs and will colonise sites where suitable conditions exist. Copland (2011) recorded Ringed Plover at Ballycon (4-5 pairs) and Cavemount (7 individuals). In a study of breeding waders on cutaway bogs in (west) County Offaly in 2002, Hudson et al. (2002) recorded Ringed Plover breeding at 4 out of 12 sites, with a total of 11 pairs. The number of breeding pairs recorded at Cloncreen was low (2 'probable pairs'). Given the presence of suitable breeding habitat and breeding numbers in the wider study area, the local breeding population is not restricted to the habitats of the study area at Cloncreen.

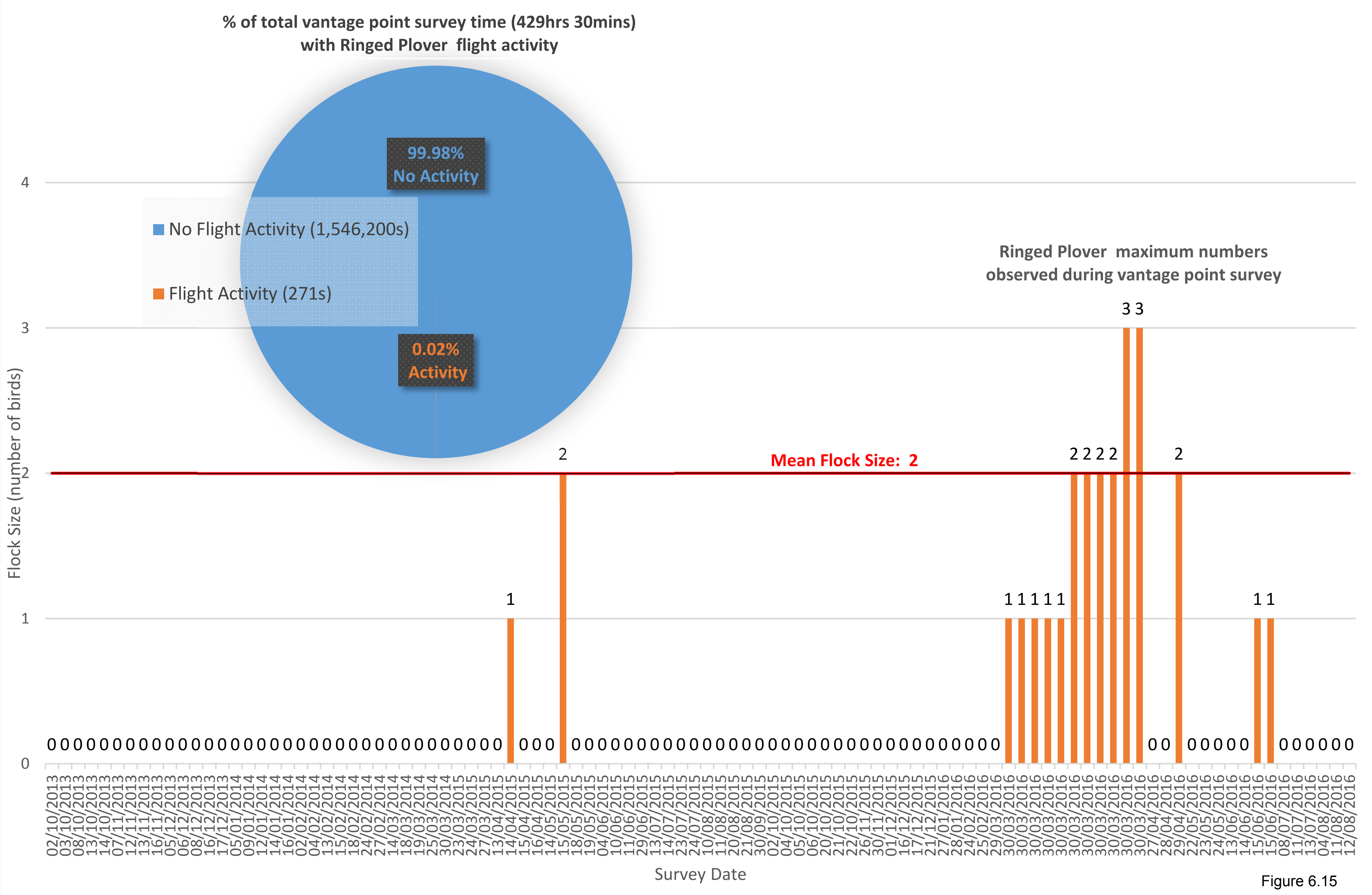

% of total vantage point survey time (429hrs 30mins) with Ringed Plover flight activity
99.98% No Activity
0.02% Activity
No Flight Activity (1,546,200s)
Flight Activity (271s)
Ringed Plover maximum numbers observed during vantage point survey
Mean Flock Size: 2
Flock Size (number of birds)
Survey Date

Figure 6.15

6.4.1.3.5 Snipe

Snipe was recorded within the study area during the non-breeding (winter) seasons 2013/14 & 2015/16 and the breeding seasons 2015 & 2016. Observations and flight line data is presented in Appendix 6-5, Tables 2 - 5. The species was observed flying, breeding, resting and feeding within the habitats of the study area. The number of birds present onsite ranged from 1 to 12 individuals with the highest numbers recorded during March 2015. The mean flock size was calculated to give a figure of 3 birds. A breakdown of flock size and % flight activity recorded within the study area is presented in Figure 6.16. Numbers recorded are well below internationally important estimates (20,000 birds equates to 1% of an internationally important flock).

Flight activity accounted for 0.06% of total watch time effort (refer to Figure 6.16). This represents an extremely low figure in terms of flight duration recorded within the study area. The majority of flight lines were recorded below predicted collision risk height (below 25m). Flight lines were largely concentrated in the western part of the study area (refer to Appendix 6-5, Figures 13, 14 & 15). Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort, flight activity across all seasons was found to be extremely low.

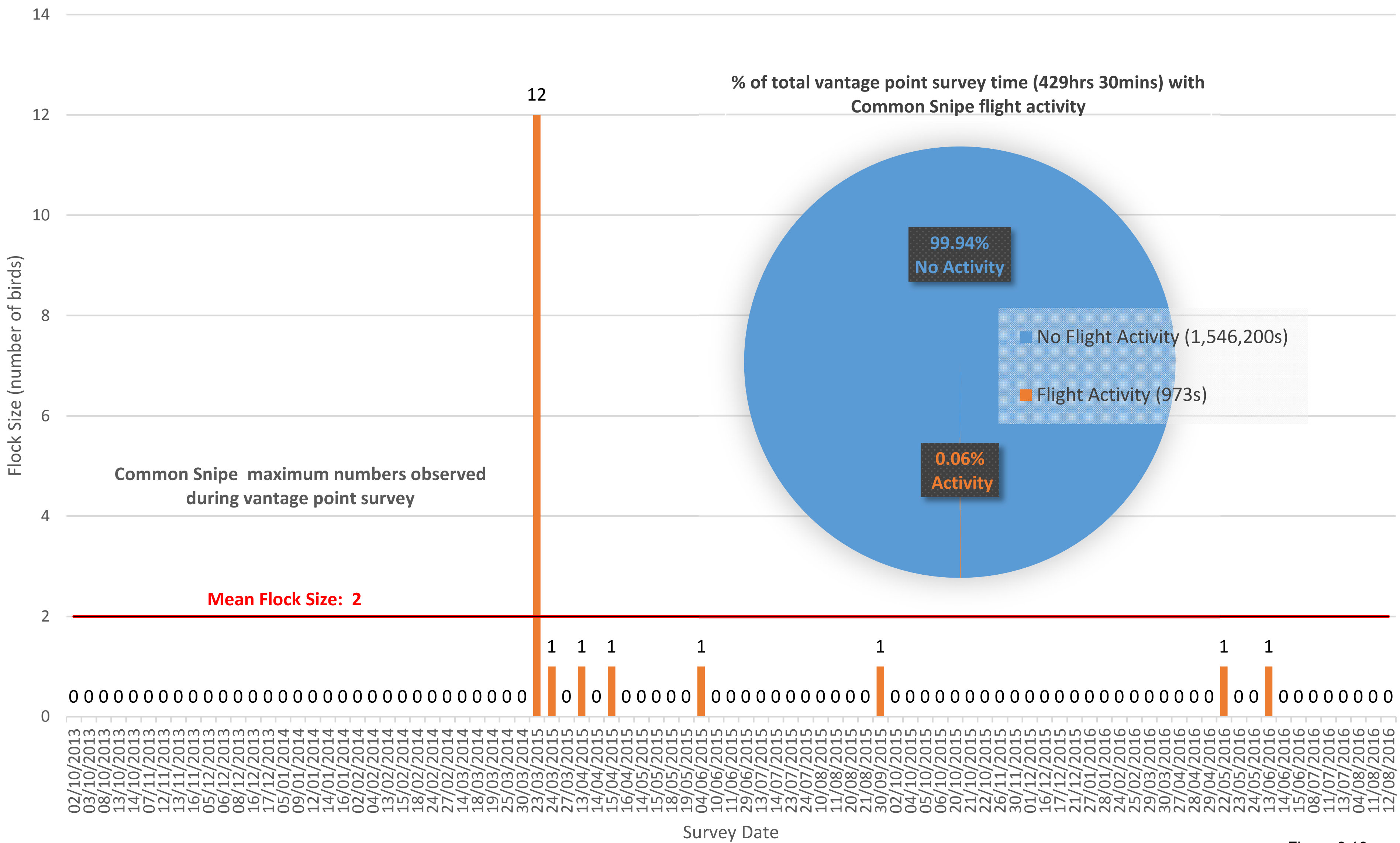
There were 2 pairs of Snipe identified as 'probable breeders' located in the western area during the breeding seasons 2015 & 2016 (refer to Appendix 6-5, Figures 14, 15 & 40). Breeding activity is usually established by recording displaying birds (probable breeding). Supplementary surveys undertaken in 2013 & 2014 recorded displaying birds (two 'probable breeding' pairs) within the study area. Based on the most recent breeding bird surveys undertaken in 2015 & 2016, breeding territories (2 'probable breeding pairs') are restricted to the western section of the study area.

Breeding bird surveys for the Ballydermot & Derrygreenagh Bog Groups undertaken during the breeding seasons 2013 and 2014 recorded breeding territories at various Bord na Móna bogs in the wider study area (5-8km radius of Cloncreen) (refer to Appendix 6-4, Table 1). Breeding was recorded at the following industrial cutaway sites in 2014 and are summarised as follows (comparative figures for 2013 are given in brackets with % increase/decrease): Ballycon 5 (5) pairs (no change), Cavemount 3 (3) (no change), Clonsast North 3 (3) (no change), Clonsast 1 (1) (no change), Ticknevin 3 (2) (+33%), Glashabaun South 1 (0) (+100%) and Ballydermot 3 (2) (+33%).

Based on these figures, Snipe is deemed to be a widespread and increasing breeding bird species in the wider surroundings. Copland (2011) recorded Snipe breeding at all of the following sites within 5-8km radius of the study area: Ballycon (5 individuals), Ballybeg (4 individuals) and Cavemount (2 individuals). Given the presence of suitable breeding habitat and breeding numbers in the wider study area, the local breeding population is not restricted to the habitats of the study area at Cloncreen. With the exception of revegetating bog plant communities in localised areas of cutaway bog, the majority of the habitats present onsite are deemed to be sub-optimal (bare peat) and unsuitable for the breeding requirements of the species with limited potential to support significant populations.

6.4.1.3.6 Woodcock

Woodcock was recorded within the study area during the breeding seasons 2015 & 2016. Observations and flight line data is presented in Appendix 6-5, Table 2. Due to their crepuscular habit, the species was largely recorded during dusk watches. Woodcock was occasionally observed flying over the study area while aural registrations of roding males were detected in areas of birch and willow scrub and areas of bare peat concentrated in the south-western and western sections of the study


% of total vantage point survey time (429hrs 30mins) with Common Snipe flight activity
99.94% No Activity
0.06% Activity
No Flight Activity (1,546,200s)
Flight Activity (973s)
Common Snipe maximum numbers observed during vantage point survey
Mean Flock Size: 2
Flock Size (number of birds)
Survey Date
14
12
10
8
6
4
2
0
02/10/2013
03/10/2013
08/10/2013
13/10/2013
14/10/2013
07/11/2013
12/11/2013
13/11/2013
16/11/2013
05/12/2013
06/12/2013
08/12/2013
16/12/2013
17/12/2013
05/01/2014
09/01/2014
12/01/2014
14/01/2014
16/01/2014
02/02/2014
04/02/2014
13/02/2014
15/02/2014
18/02/2014
24/02/2014
27/02/2014
14/03/2014
19/03/2014
25/03/2014
30/03/2014
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27/03/2015
13/04/2015
14/04/2015
15/04/2015
16/04/2015
14/05/2015
15/05/2015
18/05/2015
19/05/2015
04/06/2015
10/06/2015
11/06/2015
29/06/2015
13/07/2015
14/07/2015
23/07/2015
24/07/2015
10/08/2015
11/08/2015
20/08/2015
21/08/2015
30/09/2015
02/10/2015
04/10/2015
05/10/2015
06/10/2015
20/10/2015
21/10/2015
22/10/2015
26/11/2015
30/11/2015
01/12/2015
16/12/2015
17/12/2015
21/12/2015
27/01/2016
28/01/2016
24/02/2016
25/02/2016
29/03/2016
30/03/2016
27/04/2016
28/04/2016
29/04/2016
22/05/2016
23/05/2016
24/05/2016
13/06/2016
14/06/2016
15/06/2016
08/07/2016
11/07/2016
13/07/2016
04/08/2016
11/08/2016
12/08/2016

Figure 6.16

area (refer to Appendix 6-5 Figure 41). The number of birds present onsite ranged from 1 to 2 individuals.

Flight activity accounted for 0.01% of total watch time effort. The total Woodcock flight duration (seconds) is presented as a percentage of total vantage point watch time in Figure 6.17. The very small sector highlighted in orange represents an extremely low figure in terms of flight duration recorded within the study area. Flight lines (3 in total) were recorded below predicted collision risk height (below 25m) and concentrated in the western part of the study area (refer to Appendix 6-5, Figure 16). Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort, flight activity across all seasons was found to be extremely low.

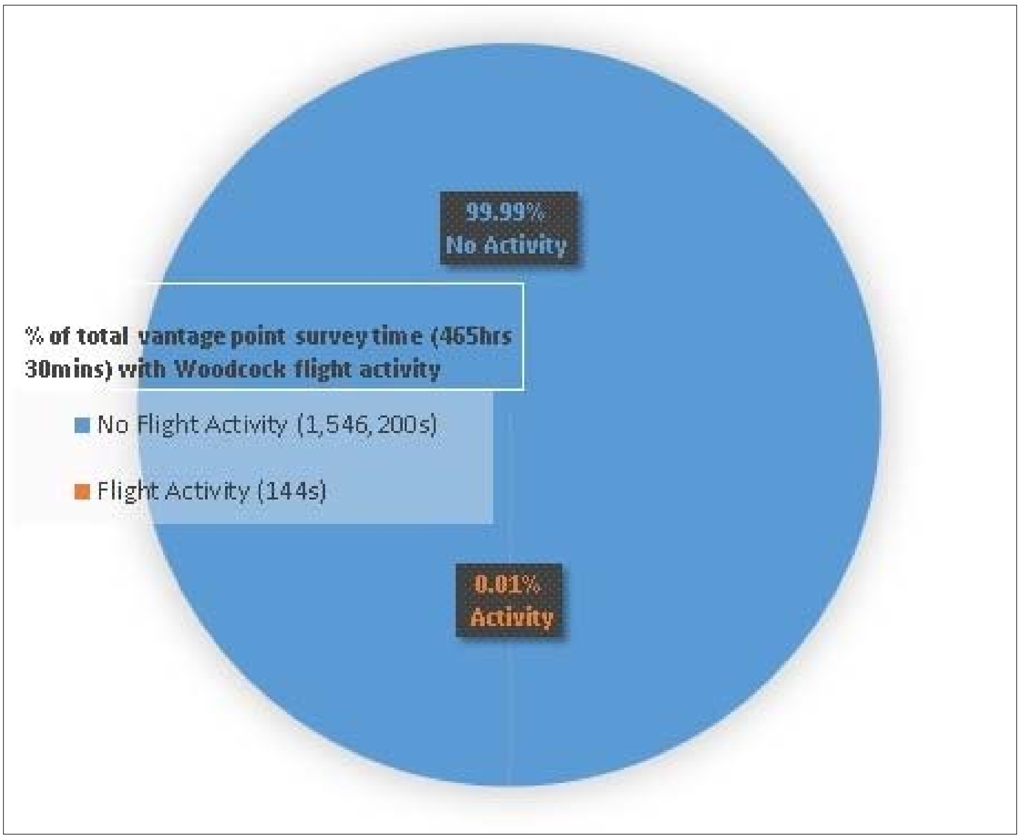


Figure 6.17 Woodcock Flight Activity

There were 2 'probable pairs' identified along the margins of the western boundary of the site during the breeding season 2016 (refer to Appendix 6-5, Figure 16). Similarly, a breeding pair was recorded along the south-western and western margins of the site during the breeding season 2015. Supplementary surveys undertaken in 2014 (refer to Appendix 6-2, Tables 1 & 2) reiterate the findings of surveys undertaken in 2015 & 2016 where a 'probable pair' were identified along the western boundary of the site. The species was previously recorded in industrial cutaway Bord na Móna sites in the wider surroundings (5-8km radius) at Clonsast, Clonsast North, Glashabaun South and Ballydermot (refer to Appendix 6-4, Table 1). Given the presence of suitable breeding habitat and breeding numbers in the wider surroundings, the local breeding population is not restricted to the habitats of the study area at Cloncreen. The majority of the habitats of the study area are deemed to be sub-optimal and unsuitable for the species with limited potential to support significant numbers.

6.4.1.3.7 Peregrine Falcon

Peregrine Falcon was observed utilising the habitats of the study area during wintering and breeding seasons (refer to Appendix 6- 5, Table 2 & 3 & 6 and Figures 17, 18, 19 & 20). A local pair were identified breeding at Edenderry Power Station to the east of the subject site and were occasionally observed perched on peat piles, bog stumps and the two masts on the site. A fully fledged juvenile was observed on the subject site with adult in July and August 2016.

A breakdown of flock size and % flight activity recorded within the study area is presented in Figure 6.18. Flight activity accounted for 0.14% of total watch time effort across all seasons (refer to Figure 6.18). This represents an extremely low figure in terms of flight duration recorded within the study area. Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort across all seasons, the number of flight lines recorded were low. This strongly suggests that the pair are not dependent on the habitats for all times of the season.

Given the open nature of the habitats onsite and dominance of bare peat, the majority of the study area is deemed to be unsuitable as key foraging grounds to the species. There is a wide availability of prey items (i.e. small mammals) associated with optimal hunting grounds in the wider surroundings (peatland habitats to the north located in the townland of Ballykilleen and Shean and to the east at Kilcumber and Cloncant). Peregrine is not a species whose dependency is restricted to the habitats of the study area at Cloncreen. There were records of the species flying over areas of improved agricultural grassland to the east and south of the study area during breeding raptor surveys in 2016 (Appendix 6-5, Table 6).

6.4.1.3.8 Hen Harrier

Hen Harrier was recorded within the study area on six occasions, twice during the non-breeding (winter) seasons 2013/14 (December and January) and four times during the breeding season 2016. Observations and flight line data is presented in Appendix 6-5, Table 2.

Observations comprised of an adult male (single individual) flying through the study area from the west and was observed perching on a wooden fence posts and hunting in the eastern part of the study area during the winter season. A ringtail was observed hunting in the study area during July and August 2016 (see Appendix 6-5, Figure 21). A breakdown of % flight activity recorded within the study area is presented in Figure 6.19 below. Flight activity accounted for 0.04% of total watch time effort (refer to the small sector highlighted in orange in Figure 6.19). This represents an extremely low figure in terms of flight duration recorded within the study area. Flight lines were recorded below predicted collision risk height. Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort across all seasons, the number of flight lines recorded is significantly low. No winter roosts occur within and to a 500m radius of the study area. In addition, no confirmed winter roosts were identified in the wider surroundings. The 10km hectads (N52 & N53) in which the study area overlaps occur outside the historical breeding range for the species (Ruddock et al. 2016). There were no records of Hen Harrier breeding within and up to a 2km radius of the study area during the breeding season 2016. The majority of the habitats within the Cloncreen study area are deemed to be sub-optimal (bare peat) and unsuitable for the ecological requirements of the species with limited potential to support significant populations as indicated by low observations recorded during field surveys.

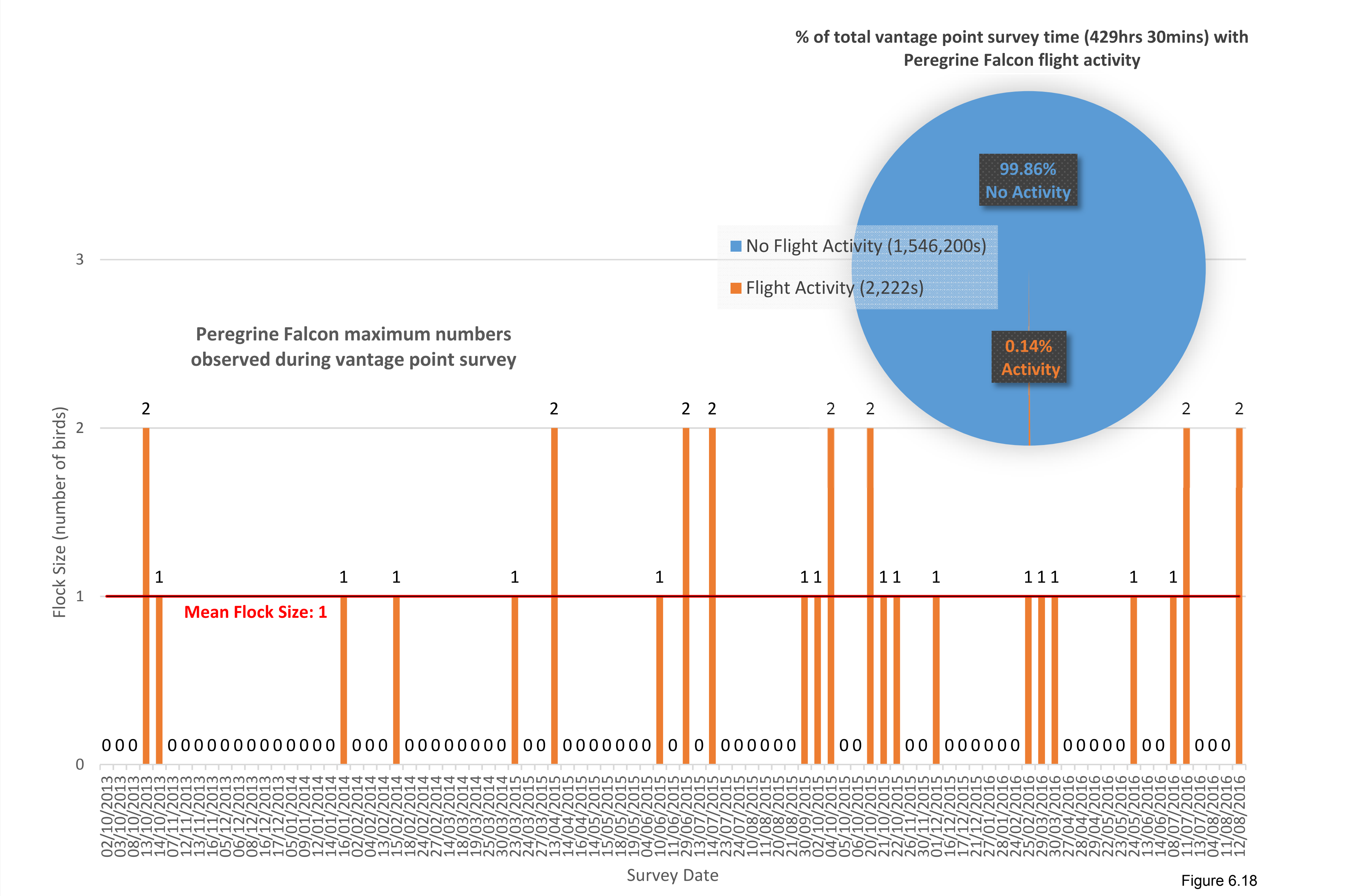

% of total vantage point survey time (429hrs 30mins) with Peregrine Falcon flight activity
99.86% No Activity
0.14% Activity
No Flight Activity (1,546,200s)
Flight Activity (2,222s)
Peregrine Falcon maximum numbers observed during vantage point survey
Mean Flock Size: 1
Flock Size (number of birds)
Survey Date

Figure 6.18

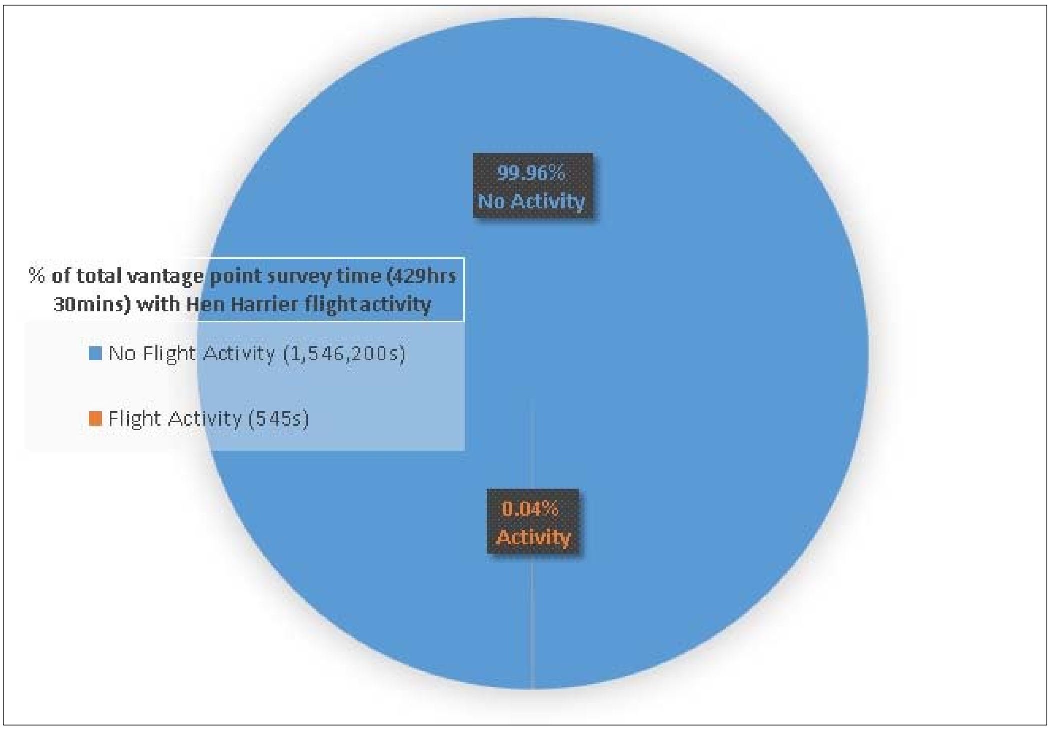


Figure 6.19 Hen Harrier Flight Activity

6.4.1.3.9 Mute Swan

Mute Swan were recorded within the study area on six occasions during the survey period (winter seasons 2013/14 & 2015/16; breeding season 2016). Observations and flight line data is presented in Appendix 6-5, Tables 2 - 4. Flocks were observed commuting and feeding within the habitats of the study area (see Appendix 6-5, Figure 22 and 23). The number of birds present onsite ranged from 1 to 4 individuals. The mean flock size was calculated to give a figure of 2 birds. A breakdown of flock size and % flight activity recorded within the study area is presented in Figure 6.20. Mute Swans were occasionally observed foraging onsite utilising areas of cutaway bog (feeding on bare peat and revegetating *Eriophorum sp.* communities) and temporary standing water concentrated in the western part of the study area. Numbers observed are well below nationally important estimates (90 individuals equates to national importance).

Flight activity accounted for 0.04% of total watch time effort (refer to Figure 6.20). This represents an extremely low figure in terms of flight duration recorded within the study area. In most cases, flight lines were recorded below predicted collision risk height (below 25m). Short internal flight lines were observed within the study area when flocks were observed foraging onsite. There were records of Swans flying from roost locations at Ballycon (located to the west) to Cloncreen during dawn watches. Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort across all seasons, the number of flight lines recorded is significantly low. Swans (1 pair) were detected breeding outside the site at Lough Aisling located west of VP2. The presence of Mute Swan recorded feeding within the study area during winter months can be attributed to the exceptionally high levels of rainfall recorded during the winter season 2015/16. The high water table provided temporary suitable conditions for swans to exploit the study area for feeding. These findings are supported by supplementary surveys (refer to Appendix 6-2, Tables 1 & 2) undertaken during the winter seasons 2012/13 and 2013/14. Data during the winter seasons 2012/13 and 2013/14 reveal that Mute Swan were absent from the study area.

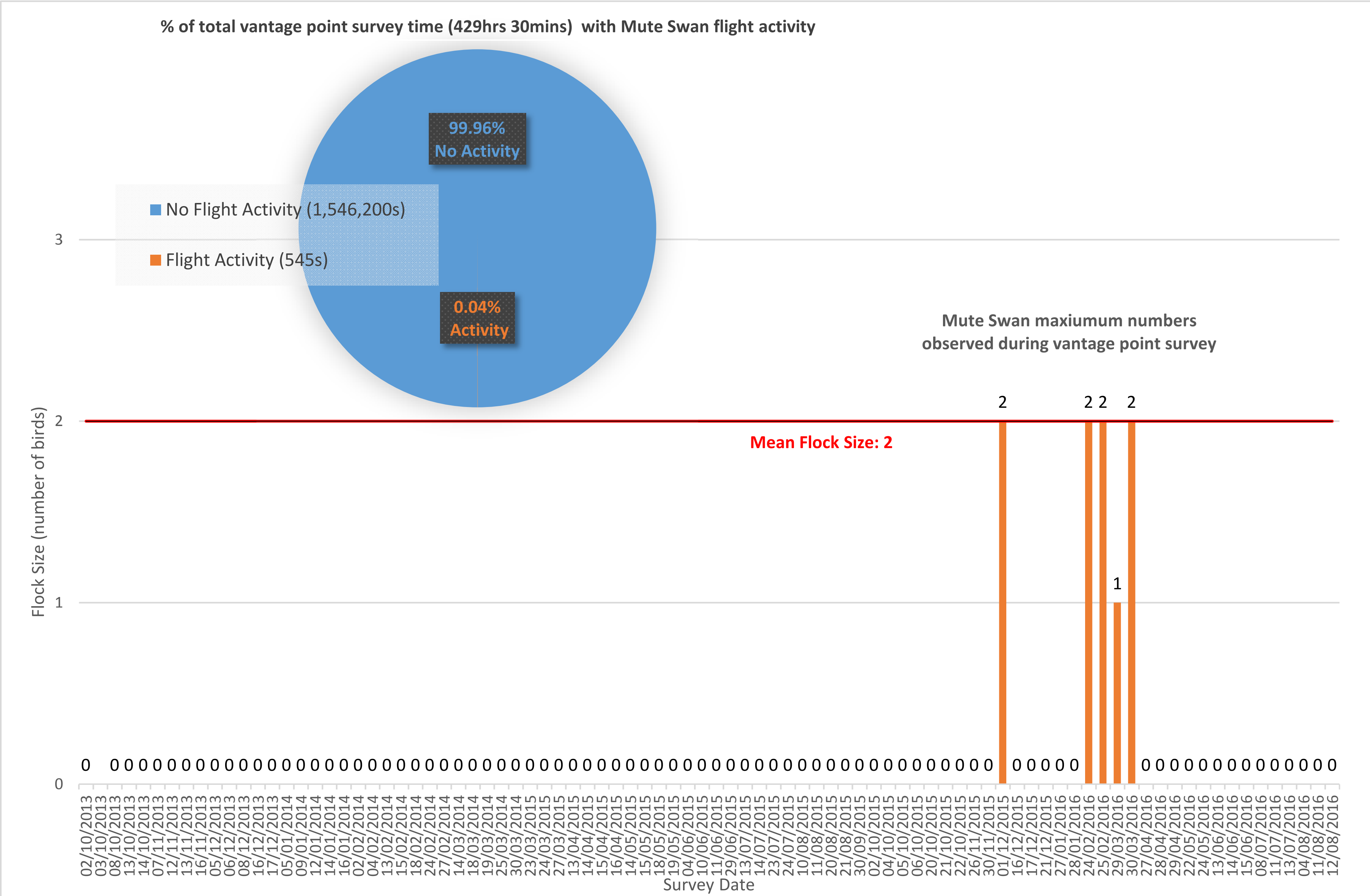

% of total vantage point survey time (429hrs 30mins) with Mute Swan flight activity
99.96% No Activity
0.04% Activity
No Flight Activity (1,546,200s)
Flight Activity (545s)
Mute Swan maxiumum numbers observed during vantage point survey
Mean Flock Size: 2
Flock Size (number of birds)
Survey Date

Figure 6.20

6.4.1.3.10 Grey Heron

Grey Heron were observed commuting and feeding/perching on various occasions during winter season 2013/14 & 2015/16 and breeding season 2016 (refer to Appendix 6-5, Tables 2 - 4). Numbers observed were recorded in low densities (1 to 2 individuals). The majority of observations comprised of single records commuting through the study area (see Appendix 6-5, Figure 24 & 25). Flight lines were largely recorded below predicted collision risk height (below 25m). The bird species was occasionally recorded foraging/perched onsite concentrated in areas of surface standing water and drainage ditches. Flight activity accounted for 0.11% of total watch time effort (refer to Figure 6.21). This represents an extremely low figure in terms of flight duration recorded within the study area. Flight lines were recorded below predicted collision risk height. Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort across all seasons, the number of flight lines recorded is low. Numbers observed are well below nationally important thresholds (25 individuals).

There were no breeding records or heronries recorded within a 500m buffer radius of the proposed development footprint. Given the presence of optimal foraging habitat in the wider surroundings (i.e. Ballycon), the foraging range of the species is not restricted to the habitats of the study area.

6.4.1.3.11 Mallard

Mallard was recorded within the study area during the winter survey seasons 2013/14 and 2015/16 and breeding season 2016 (refer Appendix 6-5, Tables 2 - 5). Numbers observed were recorded in low densities (1 to 6 individuals). Mallard were observed commuting over the study area and occasionally observed foraging onsite. The bird species was observed in areas of surface water ponding, drainage ditches and cutaway peat (see Appendix 6-5, Figure 26 & 27).

Flight activity accounted for 0.01% of total watch time effort (refer to Figure 6.22). This represents an extremely low figure in terms of flight duration recorded within the study area. In most cases, flight lines were recorded below predicted collision risk height (below 25m).

Mallard was recorded outside the study area utilising areas of improved agricultural grassland, artificial ponds and pools (including quarry ponds to the north and Lough Aisling). There was a single record of a 'probable breeding' pair recorded within the south-western part of the site (refer to Appendix 6-5, Table 5 and Figure 42). Suitable breeding habitat exists in the form of drainage ditches. Mallard is a BoCCI green-listed species of low conservation concern where the breeding range is stable and secure. Overall, the number of sightings observed was low and the species is not deemed to be dependent on the habitats of the study area given the wide availability of suitable alternative breeding and foraging habitat elsewhere in the wider surroundings (i.e. Esker, Ballycon, Codd, Clonsast, farmland, etc.).

6.4.1.3.12 Long-eared Owl

Long-eared Owl was recorded commuting on one occasion during breeding season 2016 (refer to Appendix 6-5, Table 2 and Figure 28). There were no further records of the species observed during the core survey period. The level of activity onsite was significantly low. No breeding territories were detected within and in the immediate surrounding environs of the study area.

Flight activity was below predicted collision risk height and accounted for 0.02% of total watch time effort (refer to small sector highlighted in orange in Figure 6.23 below). This represents an extremely low figure in terms of flight duration recorded within the

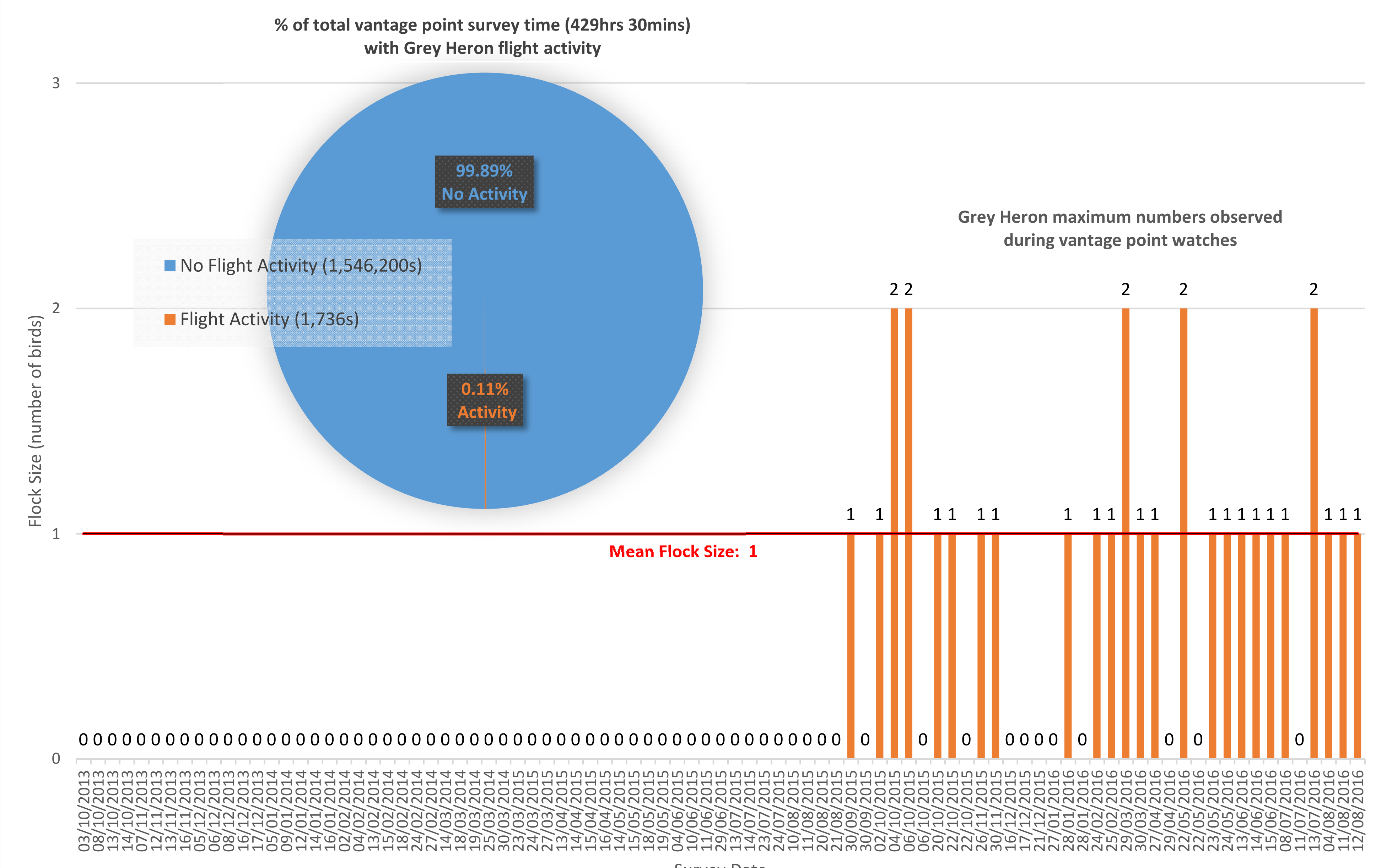

% of total vantage point survey time (429hrs 30mins) with Grey Heron flight activity
99.89% No Activity
0.11% Activity
No Flight Activity (1,546,200s)
Flight Activity (1,736s)
Grey Heron maximum numbers observed during vantage point watches
Flock Size (number of birds)
Mean Flock Size: 1
Survey Date

Figure 6.21

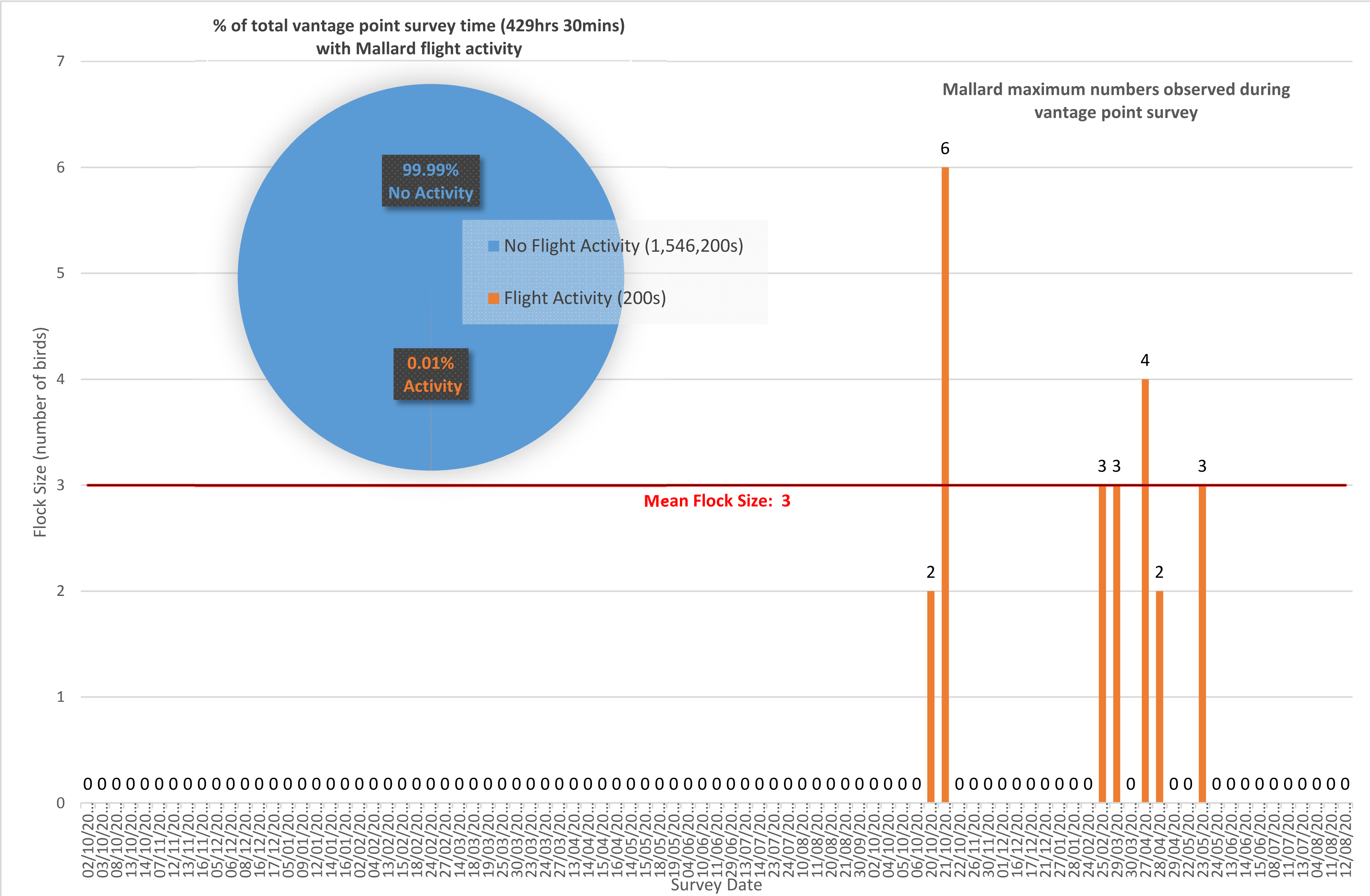

% of total vantage point survey time (429hrs 30mins) with Mallard flight activity
99.99% No Activity
0.01% Activity
No Flight Activity (1,546,200s)
Flight Activity (200s)
Mallard maximum numbers observed during vantage point survey
Mean Flock Size: 3
Flock Size (number of birds)
Survey Date

Figure 6.22

study area. The flight line was recorded below predicted collision risk height (below 25m). Given the low number of observations and survey effort undertaken, Long-eared Owl is not deemed to be dependent on the habitats of the study area.

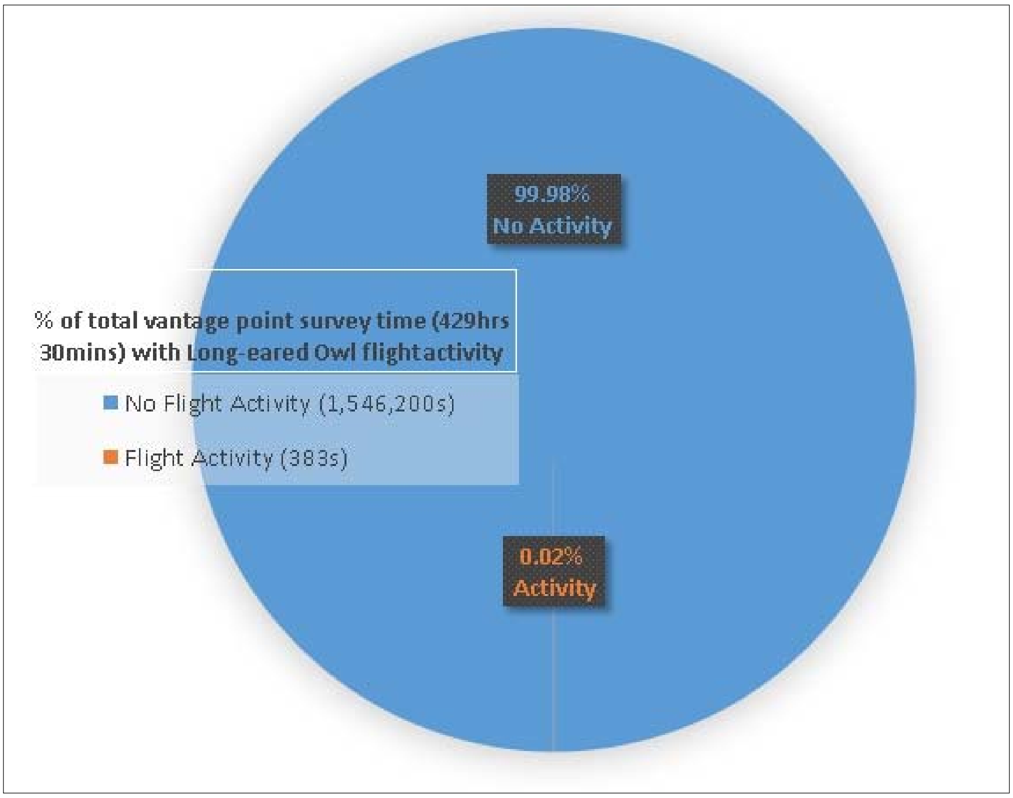


Figure 6.23 Long-eared Owl Flight Activity

6.4.1.3.13 Lesser Black-backed Gull

Lesser Black-backed Gull was recorded commuting on one occasion during winter season 2015/16 and one occasion during the breeding season 2016 (refer to Appendix 6-5, Table 5 and Figure 29). There were no further observations of the species. Flight activity was below collision risk height and accounted for less than 0.01% of total watch time effort. The level of activity was very low. Based on the low number of observations recorded, Lesser Black-backed Gull was not found to be dependent on the habitats of the study area.

6.4.1.3.14 Kestrel

Kestrel was recorded during the winter seasons 2013/14 and 2015/16 and the breeding seasons 2015 and 2016 (refer to Appendix 6-5 Tables 2 – 6). The majority of observations consisted of single bird records hunting, hovering and flying over study area. Flight lines were largely recorded below predicted collision risk height (below 25m). The highest concentration of flight lines was recorded in the northern part of the site over areas of cutaway bog and grassy verges and the south-eastern part of the study area over remnant sections of raised bog (see Appendix 6-5, Figures 30, 31 & 32).

Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort across all seasons, the number of flight lines recorded is low. Flight activity accounted for 1.01% of total watch time effort (refer to Figure 6.24). This represents an extremely low figure in terms of flight duration recorded within the study area.

While the species has been identified as a 'possible' breeder during May 2016 (refer to Appendix 6-5, Table 5), no confirmed nest sites were detected within the habitats of the

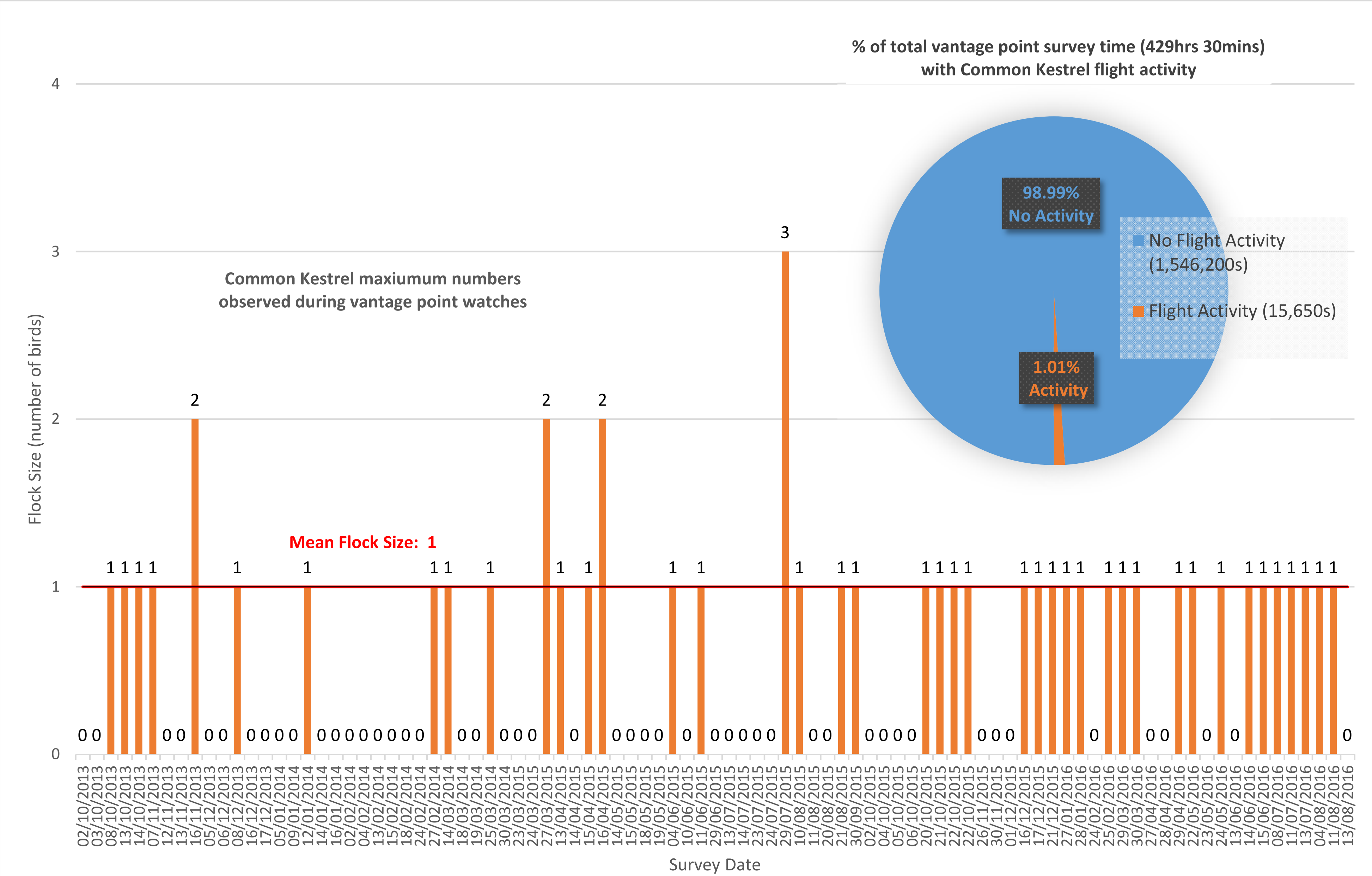

% of total vantage point survey time (429hrs 30mins) with Common Kestrel flight activity
98.99% No Activity
1.01% Activity
No Flight Activity (1,546,200s)
Flight Activity (15,650s)
Common Kestrel maxiumum numbers observed during vantage point watches
Mean Flock Size: 1
Flock Size (number of birds)
Survey Date

Figure 6.24

study area. Given the wide availability of prey items (i.e. small mammals) associated with optimal hunting grounds in the wider surroundings (Esker, Ballycon, Clonsast, etc.), Kestrel is not a species whose dependency is restricted to the habitats of the study area.

6.4.1.3.15 Sparrowhawk

Sparrowhawk was occasionally recorded during the winter seasons 2013/14 & 2015/16 and the breeding seasons 2015 and 2016 (refer to Appendix 6-5, Tables 2 – 4). The majority of observations consisted of birds in low densities (1 to 2 individuals) recorded hunting and flying along areas of bog woodland along the margins of the study area and areas of birch and willow scrub within the site. Flight lines were largely recorded below predicted collision risk height (below 25m). The highest concentration of flight lines was recorded in the northern part of the site over areas of cutaway bog and grassy verges and the south-eastern part of the study area over remnant sections of raised bog (see Appendix 6-5, Figure 33).

Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort across all seasons, the number of flight lines recorded is low. Flight activity accounted for 0.03% of total watch time effort (refer to Figure 6.25). This represents an extremely low figure in terms of flight duration recorded within the study area.

The species has been identified as a 'probable' breeder based on the presence of a pair exhibiting territorial behaviour during March 2015 and three fledged young recorded during July 2015. There were no 'confirmed' nest sites detected within the habitats of the study area during the survey period or breeding evidence in 2016. Given the wide availability of prey items (i.e. small mammals) associated with optimal hunting grounds in the wider surroundings (i.e. Esker, Ballycon, Codd, etc.), Sparrowhawk is not a species whose dependency is restricted to the habitats of the study area. The proposed development footprint avoids land take associated with breeding territories identified within the study area. With the exception of mature trees along the margins of the study area, the majority of the habitats present onsite are deemed to be sub-optimal (bare peat) and unsuitable for the ecological requirements of the species with limited potential to support significant populations.

6.4.1.3.16 Buzzard

Buzzard was recorded during the winter seasons 2013/14 & 2015/16 and the breeding seasons 2015 and 2016 (refer to Appendix 6-5, Tables 2 – 6). The majority of observations consisted of birds in low densities (1 to 2 individuals) recorded hunting, soaring and flying over the habitats of the study area. The highest concentration of flight lines was recorded along the eastern and northern parts of the site over areas of cutaway bog and remnant areas of raised bog. The cutover peat habitats that are abundant throughout the majority of the site were subject to low levels of activity/ (see Appendix 6-5, Figures 34 & 35). Flight lines were largely recorded below predicted collision risk height (below 25m).

Given a total of 429 hours and 30 minutes of dedicated vantage point watch effort across all seasons, the number of flight lines recorded is low. Flight activity accounted for 0.72% of total watch time effort (refer to Figure 6.26). This represents an extremely low figure in terms of flight duration recorded within the study area.

There were no 'confirmed' or 'probable' nest sites detected within the habitats of the study area during the survey period. Given the wide availability of prey items (i.e. small mammals) associated with optimal hunting grounds in the wider surroundings (i.e. Esker, Ballycon, Codd, etc.) together with suitable breeding habitat, Buzzard is not a

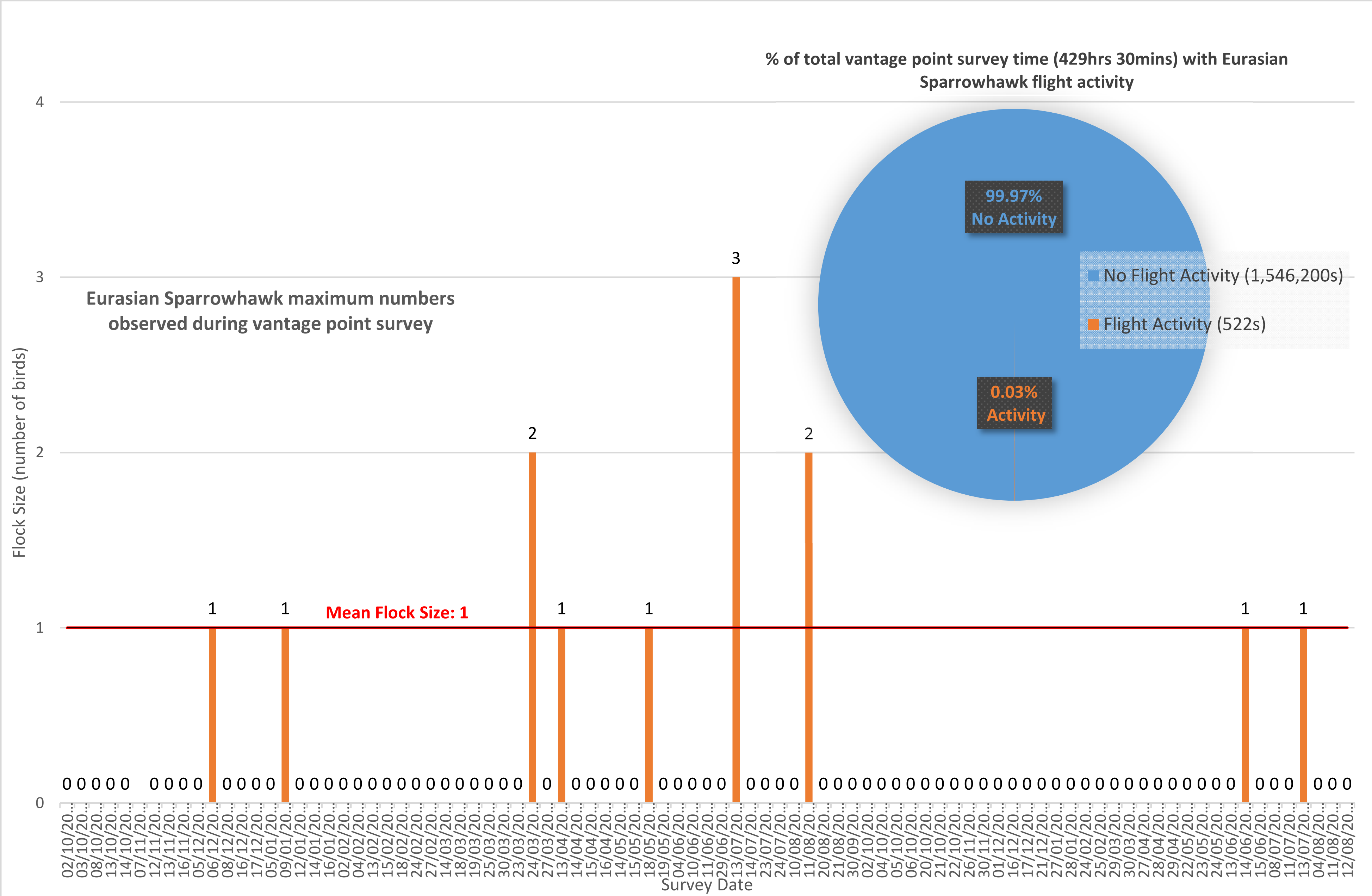

% of total vantage point survey time (429hrs 30mins) with Eurasian Sparrowhawk flight activity
99.97%
No Activity
0.03%
Activity
No Flight Activity (1,546,200s)
Flight Activity (522s)
Eurasian Sparrowhawk maximum numbers observed during vantage point survey
Mean Flock Size: 1
Flock Size (number of birds)
Survey Date

Figure 6.25

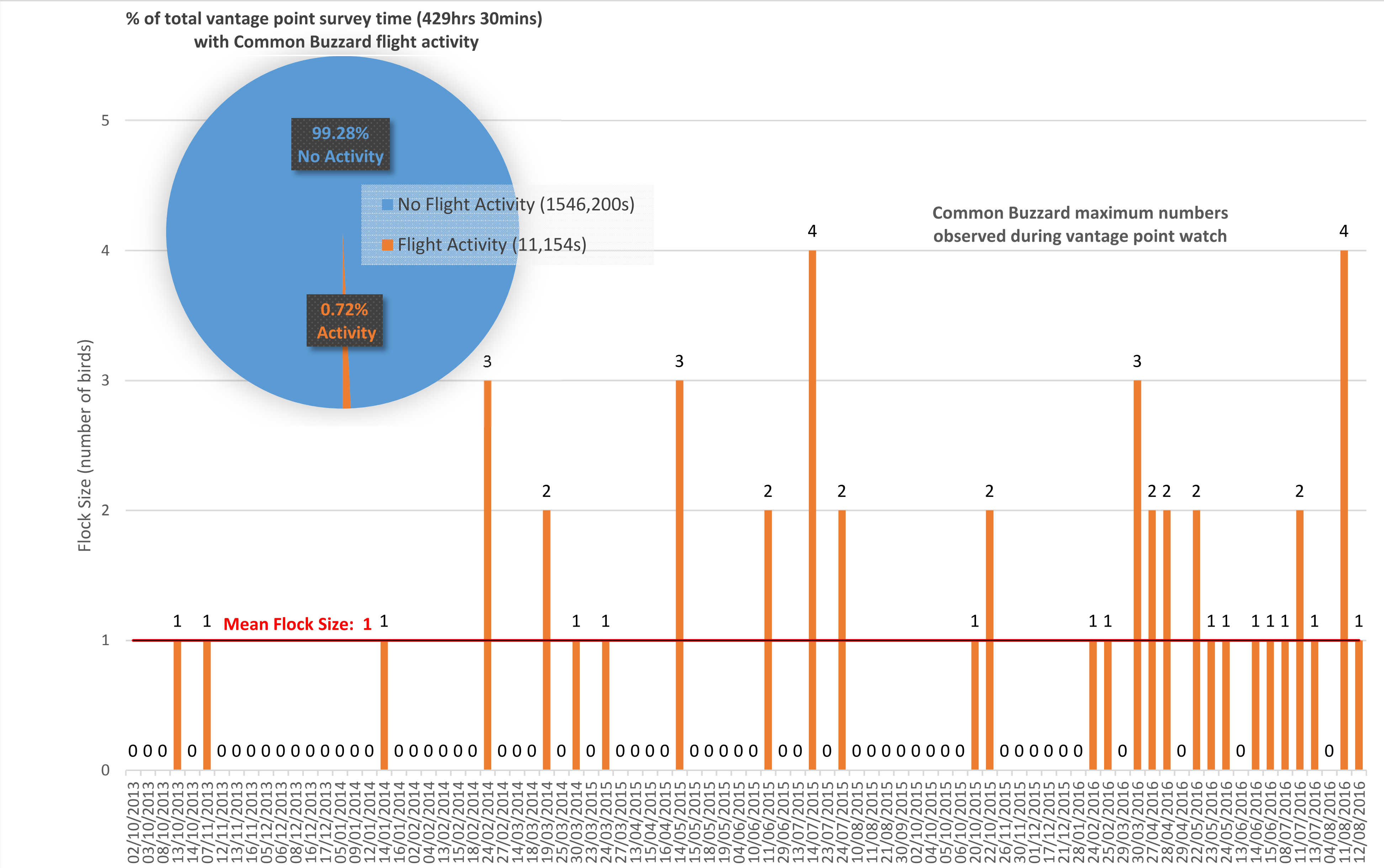

% of total vantage point survey time (429hrs 30mins) with Common Buzzard flight activity
99.28% No Activity
0.72% Activity
No Flight Activity (1546,200s)
Flight Activity (11,154s)
Common Buzzard maximum numbers observed during vantage point watch
Mean Flock Size: 1
Flock Size (number of birds)
Survey Date

Figure 6.26

species whose dependency is restricted to the habitats of the study area. With the exception of mature trees along the margins of the study area, the majority of the habitats present onsite are deemed to be sub-optimal (bare peat) and unsuitable for the ecological requirements of the species with limited potential to support significant populations.

6.4.1.3.17 Sand Martin

A sand martin colony (35 active nest entrances in 2015) was located in the northern part of the study area at the proposed borrow pit area (spoil and bare ground (ED2)) (Grid Ref: N58505; 26851) (refer to Appendix 6-5 Figure 43). The colony is deemed to be of high local importance for the local population in the area. It is proposed to extend the proposed borrow pit area for use as a borrow pit for the proposed development. There will be a temporary loss of habitat during the construction phase that will be mitigated by provision of alternative breeding habitat. It is expected that following construction, the borrow pit will serve as suitable nest habitat for the colony on return from wintering grounds.

6.5 Evaluation

6.5.1 Bird Sensitivity Mapping Tool

A Bird Sensitivity Mapping Tool for wind energy development was developed by BirdWatch Ireland and supported by the Department of Environment Community and Local Government, the Department of the Arts Heritage and the Gaeltacht, the Environmental Protection Agency, the Heritage Council, the Irish Environmental Network, the NTR Foundation, the Royal Society for the Protection of Birds, the Sustainable Energy Authority of Ireland, Éirgrid, Bórd Gáis, ESB Networks and Bórd na Móna. The project aims to support strategic planning of wind energy developments and provide a measured spatial indication of where protected birds are likely to be sensitive to wind energy developments. The mapping tool is accompanied by a guidance document which underpins the Bird Sensitivity Mapping Tool for Wind Energy Development which is now available as an online resource (McGuiness et al. (2015)). The criteria for estimating a zone of sensitivity ('low', 'medium', 'high' and 'highest') (Bird Sensitivity to Wind Energy Project) is based on a review of the behavioural, ecological and distributional data available for each species. Factors considered include (where available) collision risk, disturbance and core activity (McGuinness et al., 2015). The Mapping Tool also assesses species conservation status, vulnerability to collision and habitat preference to calculate a Species Sensitivity Score for 1km squares. The resultant map provides a depiction of bird sensitivity to wind energy infrastructure for 1km squares in the Republic of Ireland.

The Bird Sensitivity Mapping Tool for Wind Energy Development available on the National Biodiversity Database Centre Biodiversity MapViewer (http://maps.biodiversityireland.ie/#/Map) highlights the location of the study area at Cloncreen outside zones of sensitivity for bird species (McGuinness et al. 2015). The nearest sensitivity zone is 6.9km removed from the study area at Bracknagh located to the south and is classed as 'low' sensitivity for bird species.

6.5.2 Species Evaluation Criteria

6.5.2.1 Final list of Target Species

A list of potential target species was derived from desk based observations and is presented in the Desk Study. This informed the initial design of the survey. However, a number of species on this list were either not recorded during the site surveys or were recorded in such low numbers that they were not considered to be significant in the context of the development or the site. In addition, some species that had not previously been identified as target species, were recorded within the study area and were added to the list accordingly.

The species that were included on the original list but have been excluded, following review, are Barn Owl, Black-headed Gull, Coot, Curlew, Greenland White-fronted Goose, Grey Partridge, Herring Gull, Kingfisher, Little Egret, Merlin, Redshank, Wigeon, Yellowhammer and Little Grebe, as these species were not observed. Teal, Jack Snipe, Water Rail and Moorhen were observed within the study area, but are not included within the assessment due to insignificant observations (i.e. low numbers, not flying within the site, etc.).

Sand Martin was recorded as breeding species within the study area and is added to the final list of target species.

The final target species that were observed during field surveys undertaken at Cloncreen are listed are:

- Whooper Swan
- Golden Plover
- Lapwing
- Ringed Plover
- Snipe
- Woodcock
- Peregrine Falcon
- Hen Harrier
- Mute Swan
- Grey Heron
- Mallard
- Long-eared Owl
- Lesser Black-backed Gull
- Kestrel
- Sparrowhawk
- Buzzard
- Sand Martin

The significance of each species as it occurs on the site is presented in Table 6.16 below along with the rationale for its selection/exclusion as a Key Ecological Receptor.

Table 6.16 Avifauna Receptor Evaluation and Selection Criteria

Name	Conservation Status	NRA Evaluation (NRA, 2009)	NRA Criteria (Observation)	Key Receptor	Percival Sensitivity Evaluation (Percival, 2003)	Determining Factor (Percival, 2003)
Whooper Swan	Annex I, EU Birds Directive; BoCCI Amber List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; (Occasional flocks recorded during winter months (2013/14 & 2015/16), not regularly occurring.)	**Yes**	**Medium**	Species on Annex 1 of the EC Birds Directive; Other species on BirdWatch Ireland's red list of Birds of Conservation Concern.
Golden Plover	Annex I, EU Birds Directive; BoCCI Red List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list; Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive. (Wintering flocks recorded during winter months.)	**Yes**	**Medium**	Species on Annex 1 of the EC Birds Directive; Other species on BirdWatch Ireland's red list of Birds of Conservation Concern.
Lapwing	BoCCI Red List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species protected under the Wildlife Acts; and/or	**Yes**	**Medium**	Other species on BirdWatch Ireland's red list of Birds of Conservation Concern.

Name	Conservation Status	NRA Evaluation (NRA, 2009)	NRA Criteria (Observation)	Key Receptor	Percival Sensitivity Evaluation (Percival, 2003)	Determining Factor (Percival, 2003)
			Species listed on the relevant Red Data list. (Wintering and breeding (pairs) populations recorded within study area.)			
Ringed Plover	BoCCI Green List; Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species protected under the Wildlife Act. (Breeding territory recorded within study area.)	**Yes**	**Low**	(Precautionary approach followed) Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern.
Snipe	BoCCI Red List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species of animal listed in Annex II of the Habitats Directive; Species protected under the Wildlife Act. (Breeding territories recorded within study area.)	**Yes**	**Low**	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern.
Woodcock	BoCCI Red List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of	**Yes**	**Medium**	Other species on BirdWatch Ireland's red list of Birds of Conservation Concern

Name	Conservation Status	NRA Evaluation (NRA, 2009)	NRA Criteria (Observation)	Key Receptor	Percival Sensitivity Evaluation (Percival, 2003)	Determining Factor (Percival, 2003)
			the following: Species protected under the Wildlife Acts; and/or Species listed on the relevant Red Data list. (Presence of breeding pair and roding males.)			
Peregrine Falcon	Annex I, EU Birds Directive, Irish Wildlife Act & BoCCI Red List.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident t or regularly occurring population (assessed to be important at the Local level) of the following: Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; (Recorded hunting and foraging within study area.)	**Yes**	**Medium**	Species on Annex 1 of the EC Birds Directive.
Hen Harrier	Annex I, EU Birds Directive; BoCCI Amber List & Irish Wildlife Act.	**Locally Important (higher value)**	Species of bird, listed in Annex I and/or referred to in Article 4(2) of the Birds Directive; (Recorded on two occasions during winter months.)	**Yes**	**Medium** (no winter roost sites or breeding territories)	Species on Annex 1 of the EC Birds Directive.
Mute Swan	BoCCI Amber List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species protected under the Wildlife Acts; (Recorded in low numbers during winter months.)	**Yes**	**Low**	Any other species of conservation interest, including species on (Precautionary approach followed) BirdWatch Ireland's amber list of Birds of Conservation Concern.

Name	Conservation Status	NRA Evaluation (NRA, 2009)	NRA Criteria (Observation)	Key Receptor	Percival Sensitivity Evaluation (Percival, 2003)	Determining Factor (Percival, 2003)
Grey Heron	BoCCI Green List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species protected under the Wildlife Acts; (Recorded in low numbers during winter and breeding seasons.)	**Yes**	**Low**	(Precautionary approach followed) Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern.
Mallard	BoCCI Green List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species protected under the Wildlife Acts; (Recorded in low numbers during winter and breeding seasons.)	**Yes**	**Low**	(Precautionary approach followed) Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern.
Long-eared Owl	BoCCI Green List & Irish Wildlife Act.	**Locally Important (lower value value)**	(Recorded on one occasion only.)	**No**	**N/A**	**N/A**
Lesser Black-backed Gull	BoCCI amber List & Irish Wildlife Act.	**Locally Important (lower value value)**	(Recorded on one occasion only.)	**No**	**N/A**	**N/A**

Name	Conservation Status	NRA Evaluation (NRA, 2009)	NRA Criteria (Observation)	Key Receptor	Percival Sensitivity Evaluation (Percival, 2003)	Determining Factor (Percival, 2003)
Kestrel	BoCCI Amber List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species protected under the Wildlife Acts; (Recorded within the study area during winter and summer months.)	**Yes**	**Low**	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern.
Sparrowhawk	BoCCI Amber List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species protected under the Wildlife Acts; (Occasional records during winter and summer months.)	**Yes**	**Low**	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern.
Buzzard	BoCCI Green List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species protected under the Wildlife Acts; (Recorded within the study area during winter and breeding months.)	**Yes**	**Low**	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern.

Name	Conservation Status	NRA Evaluation (NRA, 2009)	NRA Criteria (Observation)	Key Receptor	Percival Sensitivity Evaluation (Percival, 2003)	Determining Factor (Percival, 2003)
Sand Martin	BoCCI Amber List & Irish Wildlife Act.	**Locally Important (higher value)**	Taking a precautionary approach the significance has been assigned based on a resident or regularly occurring population (assessed to be important at the Local level) of the following: Species protected under the Wildlife Acts; (Sand Martin colony recorded at the proposed borrow pit area (35 nest entrances recorded in 2015) (location of proposed borrow pit).	**Yes**	**Low**	Any other species of conservation interest, including species on BirdWatch Ireland's amber list of Birds of Conservation Concern.

6.6 Likely and Significant Effects

To determine the sensitivities of the key target species identified within the study area, the protective and conservation status of each species is considered as well as their susceptibility to effects from wind farms based on scientific published papers and current literature. Wind farms can have a number of effects on birds through habitat loss and fragmentation, disturbance displacement, mortalities due to collisions and barrier effects (Langston & Pullan (2013), Percival (2003) and European Commission (2011)). Appropriately sited and well-designed wind energy developments are not generally considered to be a threat to biodiversity (European Commission, 2011).

Sensitive project design has ensured that the proposed development is located outside sensitive areas designated areas for birds (i.e. SPAs, wildfowl reserves, etc.). This section incorporates the findings of the surveys undertaken at Cloncreen and assesses potential effects on avian receptors during the construction, operational and decommissioning phases of the proposed development. Effects have been assessed based on criteria outlined in Section 6.2.3 (Assessment Methodology).

In general, wind farm developments can have a number of direct and indirect/secondary effects on birds. These include

- Habitat Loss (construction and operational phase)
- Disturbance displacement (construction phase)
- Bird Collision (operational phase)
- Site avoidance and habitat loss due to displacement (operational phase)
- Disturbance (Operational phase)

6.6.1 Construction Phase

The likely potential significant effects on the avian receptors of the proposed development have been divided into two main types when considering the construction phase of the proposed development. These effects are associated with both the physical loss of habitat caused during the construction process and disturbance to birds within the vicinity of the construction works. The following effects are assessed during the construction phase of the proposed development: habitat loss and fragmentation, and disturbance displacement.

6.6.1.1 Habitat Loss and Fragmentation

The footprint of the proposed development will result in the inevitable loss of habitat where turbines, access tracks, electrical substation, temporary construction compound, anemometry mast and associated site works are proposed. It is expected that adjoining areas will be disturbed to a small extent during construction works. The magnitude of this effect can then be determined in relation to the proportion of each habitat available that will be lost, in the context of the wind farm development and the surrounding ranges of any key bird species present. The proposed development could result in the loss of nesting and/or foraging habitat for breeding and wintering birds. Habitat loss could arise as a result of the following activities associated with construction works: excavations, material stockpiling, peat side casting, vegetation clearance, tree removal, trimming operations, etc. potentially affecting birds during the nesting season. Material extraction from the borrow pit could also result in the loss of suitable habitat for breeding migrants (i.e. sand martin colonies). In general, birds such as common passerines are not considered to be significantly affected by wind farm developments (Percival, 2003). There are no European Sites within the identified zone of likely effects of the proposed wind farm and thus there will be no habitat loss in any European Site.

Potential effects may also arise should habitats become fragmented within the study area. Habitat fragmentation results in the division of large, continuous habitats into smaller, more isolated fragments (Andrén, 1994). Habitat fragmentation can lead to changes in patterns and distribution of habitats in the landscape and may alter foraging requirements, flight patterns and mobility. Alternatively, the construction of the wind farm may also benefit birds possibly as a result of the creation of suitable habitat in the form of disturbed ground (Gove et al., 2013) or through various enhancement measures. The methodology for assessing habitat loss on avian receptors follows guidance issued by Percival (2003) and EPA (2002) (refer to Section 6.2.3.1 and 6.2.3.2).

Tables 6.17 and 6.17a provide details in relation to a breakdown of habitat loss within the study area (depending on whether option A or B are chosen for the grifd connection). The principal habitat affected by the construction phase of the development will be cutaway bog varying from areas of bare peat to revegetating surfaces largely comprising Bog cotton (i.e. *Eriophorum angustifolium* and *Eriophorum vaginatum*) and Rush sp. (i.e. *Juncus effusus*).

Table 6.18 assesses the effects of habitat loss and fragmentation on the key avian receptors identified within the study area. A habitat map is available in Figure 5.5 of the Flora and Fauna Chapter (Chapter 5) of the EIS.

Table 6.17: Habitats affected by the footprint (Option A) of the proposed development

Habitat	Area within site, ha	% of Study Area	Permanent Habitat Loss, ha	% of Habitat Type Permanently Lost within Study Area	Temporary Habitat Loss, ha	% of Habitat Type Temporarily Lost within Study Area	Total Area Affected, ha
Dry Meadows and Grassy Verges (GS2)	0.11	0.01	0.03	< 0.00	-	-	0.03
Conifer Plantation (WD4)	0.12	0.01	-	-	-	-	
Dense Bracken (HD1)	0.29	0.03	0.26	0.03	-	-	0.26
Dry Calcareous and Neutral Grassland (GS1)	0.51	0.05	0.49	0.05	-	-	0.49
Scrub/Dense Bracken Mosaic(WS1/HD1)	0.55	0.06	0.53	0.06	-	-	0.53
Improved Agricultural Grassland (GA1)	0.57	0.06	-	-	-	-	
Wet Grassland (GS4)	0.85	0.09	-	-	-	-	
Buildings and Artificial Surfaces (BL3)	2.17	0.23	0.01	< 0.00	0.19	0.02	0.20
Scrub/Dry meadows and grassy verges Mosaic(WS1/GS2)	2.44	0.25	0.02	< 0.00	0.01	< 0.00	0.03
Cutover bog/Dry meadows and grassy verges Mosaic(PB4/GS2)	3.19	0.33	-	-	< 0.00	< 0.00	< 0.00
Recolonising Bare Ground (ED3)	5.78	0.60	2.81	0.29	0.04	< 0.00	2.86
Raised Bog (PB1)	11.07	1.15	-	-	-	-	
Spoil and bare ground (ED2)	13.94	1.45	3.36	0.35	0.12	0.01	3.48
Other artificial lakes and ponds (FL8)	14.24	1.48	1.06	0.11	0.03	< 0.00	1.09
Bog Woodland (WN7)	16.62	1.73	0.11	0.01	0.08	0.01	0.20
Scrub (WS1)	42.07	4.37	2.97	0.31	0.03	< 0.00	3.00
Cutover Bog/Scrub Mosaic(PB4/WS1)	120.14	12.49	5.04	0.52	0.60	0.06	5.64
Cutover Bog (PB4)	727.41	75.61	23.07	2.40	2.74	0.28	25.81
		Total Permanent Habitat Loss	**39.767 ha**	**Total Temporary Habitat Loss**	**3.843 ha**	**Total area of habitat affected**	**43.611ha**

Table 6.17a Habitats affected by the footprint (Option B) of the proposed development

Habitat	Area within site, ha	% of Study Area	Permanent Habitat Loss, ha	% of Habitat Type Permanently Lost within Study Area	Temporary Habitat Loss, ha	% of Habitat Type Temporarily Lost within Study Area	Total Area Affected, ha
Dry Meadows and Grassy Verges (GS2)	0.11	0.01	0.03	< 0.00	-	-	0.03
Conifer Plantation (WD4)	0.12	0.01	-	-	-	-	
Dense Bracken (HD1)	0.29	0.03	0.26	0.03	-	-	0.26
Dry Calcareous and Neutral Grassland (GS1)	0.51	0.05	0.49	0.05	-	-	0.49
Scrub/Dense Bracken Mosaic(WS1/HD1)	0.55	0.06	0.53	0.06	-	-	0.53
Improved Agricultural Grassland (GA1)	0.57	0.06	-	-	-	-	
Wet Grassland (GS4)	0.85	0.09	-	-	-	-	
Buildings and Artificial Surfaces (BL3)	2.17	0.23	0.01	< 0.00	-	-	0.01
Scrub/Dry meadows and grassy verges Mosaic(WS1/GS2)	2.44	0.25	0.02	< 0.00	-	-	0.02
Cutover bog/Dry meadows and grassy verges Mosaic(PB4/GS2)	3.19	0.33	-	-	-	-	
Recolonising Bare Ground (ED3)	5.78	0.60	2.81	0.29	0.02	< 0.00	2.83
Raised Bog (PB1)	11.07	1.15	-	-	-	-	
Spoil and bare ground (ED2)	13.94	1.45	3.36	0.35	0.05	< 0.00	3.40
Other artificial lakes and ponds (FL8)	14.24	1.48	1.06	0.11	0.01	< 0.00	1.07
Bog Woodland (WN7)	16.62	1.73	0.11	0.01	0.08	0.01	0.20
Scrub (WS1)	42.07	4.37	2.97	0.31	-	-	2.97
Cutover Bog/Scrub Mosaic(PB4/WS1)	120.14	12.49	5.48	0.57	0.60	0.06	6.08
Cutover Bog (PB4)	727.41	75.61	23.10	2.40	2.44	0.25	25.54
		Total Permanent Habitat Loss	**40.236 ha**	**Total Temporary Habitat Loss**	**3.201ha**	**Total area of habitat affected**	**43.437ha**

Table 6.18 Matrix for assessment of effects on Key Avifauna Receptors during Construction Phase (Habitat Loss and Fragmentation)

Key Receptor (Sensitivity)	Assessment (Habitat Loss and fragmentation)	Effect Significance (Habitat Loss and fragmentation)
Whooper Swan (Medium)	Loss of temporary foraging habitat where turbine/hardstand areas and access roads overlap with winter feeding habitat. Occasional records of the species feeding in areas of cutaway bog during the winter seasons 2013/14 and 2015/16. The average flock size recorded during winter months was 14 birds. Flocks of over the average of 14 birds were only recorded on four occasions during the survey period. Out of a combined total of 52 survey dates during the winter survey period (2013/14 & 2015/16), Whooper Swans were observed onsite 12 survey dates during vantage point watches and are not deemed to be regularly occurring. This pattern reflects the low feeding potential of the site during winter months. The species tends to alternate between feeding and roost sites throughout the winter period (Boland et al. 2010). The habitats of the study area are deemed to be sub-optimal for the foraging and roosting requirements of the species as indicated by their absence during winter seasons 2012/13 and 2014/15. Given the very low number of transits of commuting flocks flying over the site, together with temporary site usage and regularly occurring flocks of the population at Cavemount and Derryarkin, effects associated with habitat loss are deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium**, overall effect significance is **Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Golden Plover (Medium)	Occasional records during winter months. The average flock size recorded during winter months was 47 birds. Out of a combined total of 89 survey dates across all seasons, Golden Plover were observed onsite for 18 survey dates during vantage point watches and are not deemed to be a regularly occurring species. There were rare occurrences of the species recorded resting within the study area. Given the distribution of larger flocks recorded in the wider surroundings to the south, the species was not found to be dependent on the habitats of the study area for breeding, roosting and commuting purposes. Effects associated with habitat loss are deemed to be of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium**, overall effect significance is **Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Lapwing (Medium)	Construction of the proposed development will result in the loss of two breeding territories where turbine/hardstand areas and access roads are proposed. Both wintering and breeding Lapwing were recorded within the study area during the survey period. The average flock size recorded was 18 birds. Flocks of over the average of 18 birds were only recorded on two occasions during February 2015. The study area does not support significant populations of Lapwing during winter months. Displaying pairs were concentrated in the western and south-western parts of the study area. Habitat loss during construction works is deemed to be short-term in duration. Suitable alternative breeding habitat (bare peat and vegetated cutaway bog) exists in the wider surroundings with breeding population increases noted at Ballycon and Clonsast North. Following the cessation of industrial peat production operation, the site will colonise with sedges and grasses with suitable tracts of open peat for breeding Lapwing. This new configuration will provide optimal habitat for the species once more. However, irrespective of the proposed development, suitable breeding habitat for Lapwing will not persist within the study area after the scheduled cessation of peat production in 2019, as natural habitat succession will result in the revegetation of existing bare peat to suboptimal habitat. The presence of the wind farm is not expected to deter Lapwing from breeding within the study	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium**, overall effect significance is **Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).

Key Receptor (Sensitivity)	Assessment (Habitat Loss and fragmentation)	Effect Significance (Habitat Loss and fragmentation)
	area during the operational phase of the wind farm development. Langston et al. (2003) found that Lapwing nesting occurred slightly closer to turbines possibly as a result of the creation of preferred areas of shorter vegetation. Several studies of wind energy infrastructure and its effect on bird populations have found no discernible effect on populations of Lapwing, either through disturbance displacement or site avoidance (Pearce-Higgins et al. 2009). Pearce-Higgins et al., (2012) found no difference between wind energy effects during construction phase and operational phases (McGuinness et al. 2015). Given the short-term nature of construction works and the presence of suitable alternative habitat in the wider surroundings, land take in relation to suitable habitat is deemed to be short-term in duration. It is expected that breeding pairs will re-establish nest sites in the vicinity of the wind farm infrastructure following construction. Mitigation in terms of timing of works will be required to negate effects on the species during the breeding season.	
Ringed Plover (Low)	Recorded onsite during breeding seasons. The majority of sightings were recorded during 2016 with two 'confirmed' breeding pairs identified within the study area. The proposed development footprint will result in the small scale loss of potential breeding habitat in the eastern part of site. The species has a widespread breeding distribution in the wider study area at Ballycon, Cavemount and Clonsast North. Construction effects will be short-term in duration and it is expected that the species will utilise areas of bare peat once more following construction. However, irrespective of the proposed development, suitable breeding habitat for Ringed Plover will not persist within the study area following the scheduled cessation of peat production in 2018, as natural habitat succession will result in the revegetation of existing bare peat to suboptimal breeding habitat. Multiple nest opportunities occur in the wider area where successful breeding populations have established. Mitigation in terms of timing of works will be required to negate effects on the species during the breeding season. The species has a low conservation status listed on the BoCCI green list. The European population is secure and effect is assessed as being of **low concern**.	Magnitude effects is assessed as **Medium** (5-20% habitat lost), species sensitivity is **Low**, overall significance is **Very Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Snipe (Low)	Construction of the proposed development will result in the loss of a breeding territory where turbine/hardstand areas and access roads are proposed. Two 'probable' breeding pairs were identified during the most recent breeding season in 2016 concentrated in the western part of the study area. The number of breeding territories recorded onsite is low. Out of a combined total of 89 survey dates during the winter (2013/14 & 2015/16) and breeding (2015 & 2016) survey period, Snipe was observed onsite on 8 survey dates during vantage point watches. The species has a widespread breeding distribution throughout the country. Construction effects will be short-term in duration and it is expected that the species will utilise areas of suitable habitat once more following construction. As such, the effects are assessed as being of **low concern**. Mitigation in terms of timing of works will be required to negate effects on the species during the breeding season.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low** overall significance is **Very Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).

Key Receptor (Sensitivity)	Assessment (Habitat Loss and fragmentation)	Effect Significance (Habitat Loss and fragmentation)
Woodcock (Medium)	The proposed development footprint avoids the direct loss of breeding territories identified within the study area in 2016. The proposed development will result in the loss of suitable habitat in the form of birch and willow scrub in the southern section of the study area. The number of breeding territories recorded onsite is low (one probable breeding pair detected in 2016). Out of a combined total of 89 survey dates during the winter (2013/14 & 2015/16) and breeding (2015 & 2016) survey period, Woodcock was observed on 4 survey dates during vantage point watches. The species has a widespread breeding distribution in the wider study area at Clonsast, Clonsast North, Glashabaun South and Ballydermot (5-8km radius). Construction effects will be short-term in duration and suitable breeding habitat along the margins of the site will be retained where possible. Mitigation in terms of timing of works will be required to negate effects on the species during the breeding season.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium** overall significance is **Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Peregrine Falcon (Medium)	Land take associated with the proposed development will not result in the direct loss of nest sites within the study area as the species breeds off-site. Out of a combined total of 89 survey dates during the winter (2013/14 & 2015/16) and breeding (2015 & 2016) survey period, Peregrine was observed onsite on 24 survey dates during vantage point watches and is not a regularly occurring species given the availability of suitable foraging grounds to the north and east of Edenderry Power Station. Effects associated with habitat loss on the species are deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium,** overall significance is **Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Hen Harrier (Medium)	The species was observed on 4 occasions within the study area during winter and breeding months. The species is not dependent on the habitats of the study area for breeding, roosting, foraging and commuting purposes. Effects associated with habitat loss are deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium,** overall significance is **Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Mute Swan (Low)	There were rare occurrences of the species feeding and commuting over the habitats of the study and observed on 6 occasions within the study area. This pattern is reflected in the low number of flight lines recorded within the study area and the low feeding potential of the site for birds. The habitats of the study area are deemed to be sub-optimal for the foraging and roosting requirements of the species as indicated by their absence during winter seasons 2012/13 and 2014/15. Breeding pairs were recorded off-site. Given the very low number of transits of commuting flocks flying over the site, effects associated with habitat loss are deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low** overall significance is **Very Low** (Criteria: Percival, 2003).

Key Receptor (Sensitivity)	Assessment (Habitat Loss and fragmentation)	Effect Significance (Habitat Loss and fragmentation)
		Long-term Slight Negative Effect (Criteria: EPA, 2002).
Grey Heron (Low)	There were occasional occurrences of Grey Heron recorded in low numbers (1-2 individuals) foraging and commuting over the study area during the breeding seasons 2015 & 2016. The species has a low conservation status and has a widespread distribution throughout the country. Given the low number of transits recorded within the study area together with an absence of breeding territories, land take in relation to alternative habitat in the wider surroundings is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low** overall significance is **Very Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Mallard (Low)	There were occasional occurrences of Mallard recorded in low numbers commuting over the study area during the survey period. Out of a combined total of 89 survey dates across all seasons, Mallard was observed onsite for 7 survey dates during vantage point watches and is not deemed to be a regularly occurring species. The proposed development footprint avoids breeding territories (single territory) identified onsite. The species has a low conservation status with a widespread breeding population throughout the country. Given the short-term duration of construction works, land take in relation to alternative habitat in the wider surroundings is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low** overall significance is **Very Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Kestrel (Low)	Land take associated with the proposed development will not result in the direct loss of nest sites within the study area. No 'probable' or 'confirmed' breeding territories were identified during breeding seasons to suggest the species is strongly linked to the study area for breeding purposes. Out of a combined total of 89 survey dates during the winter (2013/14 & 2015/16) and breeding (2015 & 2016) survey period, Kestrel was observed on 39 survey dates during vantage point watches, usually comprising single individuals hunting and commuting over the site on occasion. Given the short-term duration of construction works, land take in relation to alternative habitat in the wider surroundings is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low** overall significance is **Very Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Sparrowhawk (Low)	Land take associated with the proposed development will not result in the direct loss of nest sites within the study area. No breeding territories were identified during the most recent breeding survey season undertaken in 2016. Out of a combined total of 89 survey dates during the winter (2013/14 & 2015/16) and breeding (2015 & 2016) survey period, Sparrowhawk was observed on 9 survey dates during vantage point watches and not deemed to be a regularly occurring species. These figures are reflected in the low number of flight lines recorded within the study area. Given	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low** overall significance is **Very Low** (Criteria: Percival, 2003).

Key Receptor (Sensitivity)	Assessment (Habitat Loss and fragmentation)	Effect Significance (Habitat Loss and fragmentation)
	the short-term duration of construction works, land take in relation to alternative habitat in the wider surroundings is assessed as being of **low concern.**	**Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Buzzard (Low)	Land take associated with the proposed development will not result in the direct loss of nest sites within the study area. No breeding territories were identified during the most recent breeding survey season undertaken in 2016. Out of a combined total of 89 survey dates during the winter (2013/14 & 2015/16) and breeding (2015 & 2016) survey period, Buzzard was observed on 32 survey dates during vantage point watches and not deemed to be a regularly occurring species. The species has a low conservation status and has a widespread distribution in the wider study area. Given the short-term duration of construction works, land take in relation to alternative habitat in the wider surroundings is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low** overall significance is **Very Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Sand Martin (Low)	It is proposed to use the rehabilitated gravel pit located in the northern section of the study area as a borrow pit for the proposed development. There will be a temporary loss of habitat during the construction phase where nest entrances will be lost due to material extraction. Mitigation in terms of timing of works and provision of alternative breeding habitat will be required to negate effects on the species during the breeding season. It is proposed that following wind farm construction, the borrow pit will be landscaped to meet the nesting preferences of the species in line with best practice guidance.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low** overall significance is **Very Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).

6.6.1.2 Disturbance Displacement

There is the potential for the construction phase of the development to disturb and/or displace bird species from using the immediate vicinity of the proposed development footprint through physical disturbance by plant machinery and contractors and noise emanating from site works. During the construction phase of the project, it is expected that the level of human activity on the site will be higher with further potential disturbance for avian receptors to utilise the site (Percival, 2003). Madders & Whitfield (2006) report disturbance effects as being short-term in duration. Displacement effects arising from construction related works may result in indirect habitat loss where birds becoming displaced from utilising the habitats of the study area.

In the case of the proposed wind farm development, construction disturbance displacement could arise as a result of the following: site excavations, material stockpiling, installation of cabling, excavation of borrow pit, vibration and noise effects, delivery routes, erection of turbines, placement of underground cabling, etc. Disturbance displacement effects may arise during the installation of the proposed grid connection associated with Route Option 'B'. Significant effects on bird populations in the wider area are not foreseen given the presence of traffic and movement of vehicular machinery along public roads on a daily basis.

Passerines are typically short-lived with high reproduction rates and are not generally considered to be particularly sensitive to wind farm effects (Langston et al., 2013). Predicted effects on passerines during construction phase is deemed to be a short-term imperceptible negative effect of low significance.

Table 6.19 below assesses effects associated with disturbance displacement in the context of the key avian receptors identified within the study area at Cloncreen.

Table 6.19 matrix for Assessment of likely effects on Key Avian Receptors during Construction Phase (Construction Disturbance Displacement)

Key Receptor (Sensitivity)	Assessment (Construction Disturbance Displacement)	Significance (Construction Disturbance Displacement)
Whooper Swan (Medium)	Potential exists for temporary disturbance displacement effects where turbines (T12) and access tracks are proposed in the western part of the site. The species was found to use the study area on a temporary basis during extreme wet weather conditions. Given the occasional presence of records onsite and distribution of regularly occurring flocks concentrated at Cavemount and Derryarkin, Whooper Swan was not found to be dependent on the habitats of the study area. The species tends to alternate between feeding and roost sites throughout the winter period (Boland et al. 2010). The presence of foraging flocks coincided with periods of very heavy rainfall and resulting creation of areas of temporary standing water within the site during the winter seasons 2013/14 and 2015/16. McGuinness et al. (2015) assigns a zone of sensitivity of 600m around occupied IWeBS sub-sites for the species. The nearest IWeBS site is over 9km from the study area. Rees (2012) documents displacement distances of 200-560m for swans. There are no regularly occurring populations of Whooper Swans within 600m of the proposed development footprint. In addition, the number of transits over the study area was low with no regularly recorded commuting flight lines. Effects associated with construction disturbance displacement are deemed to be of **low concern** based on temporary usage during winter months in extreme weather conditions.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium**, overall effect significance is **Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Golden Plover (Medium)	Potential exists for disturbance displacement effects on wintering flocks during the construction phase of the project. There is limited published studies assessing the effects of construction activities on wintering Golden Plover. Pearce-Higgins et al., (2012) found no significant effect on breeding Golden Plover during wind farm construction. Survey records reveal the presence of larger flocks in open fields over 800m to the south of the proposed development footprint. Hotker et al., (2006) reports that disturbance displacement is more of an issue for wintering Golden Plover depending on the availability of suitable alternative habitat. There is limited potential for the proposed works to result in permanent disturbance displacement effects during the construction phase given the low number of occasions the species was recorded onsite, absence of breeding records and short-term duration of construction works. Larger flocks were found to demonstrate a preference for areas of open pasture land to the south of the study area. Given the presence of alternative habitat in the wider surroundings (bare peat and improved pasture) and short-term duration of construction works, effects associated with construction disturbance displacement on the species is deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium**, overall effect significance is **Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Lapwing (Medium)	Potential exists for disturbance displacement effects on breeding and wintering Lapwing populations during the construction phase. The proposed works will result in disturbance displacement effects on breeding Lapwing pairs concentrated in the western and south-western parts of the study area where turbines (T2, T3, T4, T11 & T12) and access tracks are proposed. Following construction works, it is expected that Lapwing will re-establish breeding territories within the site during wind farm operation. The presence of the wind farm is not expected to deter Lapwing from breeding within the study during the operational phase of the wind farm development. Langston et al. (2003) found that Lapwing nesting occurred slightly closer to turbines possibly as a result of the creation of preferred areas of shorter vegetation. Several studies of wind energy infrastructure and its effect on	Magnitude effects is assessed as **Medium** (5-20% habitat loss), species sensitivity is **Medium**, and overall significance is **Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).

Key Receptor (Sensitivity)	Assessment (Construction Disturbance Displacement)	Significance (Construction Disturbance Displacement)
	bird populations have found no discernible effect on populations of Lapwing, either through disturbance displacement or site avoidance (Pearce-Higgins et all. 2009). Pearce-Higgins et al. (2009) found no significant relationship between distance to wind farms and changes on occurrence for breeding Lapwing. Given the presence of suitable alternative breeding habitat in the wider surroundings, together with increases in the local breeding population at Ballycon and Clonsast North, disturbance displacement effects during construction works are deemed to be short-term in duration. Mitigation in terms of timing of works will be required to negate effects on the species during the breeding season. The proposed turbines are sufficiently spaced apart (ca. 650m) that habituation is considered to be a likely scenario during wind farm operation. There is limited potential for disturbance displacement effects on wintering populations given the low number of occasions the species was recorded onsite. Given the presence of alternative habitat in the wider surroundings (bare peat and improved pasture) and short-term duration of construction works, effects associated with construction disturbance displacement on the species is deemed to be of **low concern**.	
Ringed Plover (Low)	Potential exists for short-term disturbance displacement effects during construction phase. The proposed development footprint will result in the loss of one of the breeding territories recorded in the eastern part of site. The species has a widespread breeding distribution in the wider study area at Ballycon, Cavemount and Clonsast North. Construction effects will be short-term in duration and it is expected that the species will re-establish breeding territories once more during wind farm operation. Mitigation in terms of timing of works will be required to negate effects on the species during the breeding season. The species has a low conservation status listed on the BoCCI green-list and the European population is secure. Overall effects are deemed to be of **low concern**.	Magnitude effects is assessed as **Medium** (5-20% population lost), species sensitivity is **Low**, overall significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Snipe (Low)	Construction of turbines and access tracks will result in one or more breeding territories being disturbed and displaced from the adjoining work areas in the short-term. The species has a widespread breeding distribution throughout the country and surrounding areas at Ballycon, Cavemount and Derryarkin. Construction effects will be short-term in duration and it is expected that the species will utilise areas of suitable habitat for nesting once more following construction. Mitigation in terms of timing of works will be required to negate effects on the species during the bird breeding season. Overall effects are deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low**, overall significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Woodcock (Medium)	There is potential for disturbance displacement effects where works are proposed in areas of suitable foraging habitat (birch and willow scrub) and in proximity to breeding territories (single territory identified in 2016). The species has a widespread breeding distribution in the wider study area at Clonsast, Clonsast North, Glashabaun South and Ballydermot. Construction effects will be short-term in duration and suitable habitat in the form of conifer plantation, birch woodland and deciduous woodland along the margins of the site will be retained where	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium**, overall significance is **Low** (Criteria: Percival, 2003).

Key Receptor (Sensitivity)	Assessment (Construction Disturbance Displacement)	Significance (Construction Disturbance Displacement)
	possible. Mitigation in terms of timing of works will be required to negate effects on the species during the breeding season. Overall effects are deemed to be of **low concern**.	**Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Peregrine Falcon (Medium)	There is potential for disturbance displacement effects of flight lines from areas of suitable foraging habitat. Peregrine was occasionally observed within the study area. Ruddock & Whitfield (2007) recommend applying a buffer of 400-600m around Peregrine nest sites in line with Petty (1998). The species breeds off-site at Edenderry Power Station located >600m from the nearest turbine location. Ruddock and Whitfield (2007) highlight Peregrine habituation to sources of disturbance as a likely scenario. The proposed construction works will not result in birds being displaced or altering flight activity based on occasional recorded usage within study area. Habitat loss as a result of displacement effects is deemed to be low given the limited availability of prey items for hunting raptors (bare peat). Effects associated with construction disturbance displacement in relation to suitable alternative habitat in the wider surroundings is deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium**, overall significance is **Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Hen Harrier (Medium)	Construction and human activities can cause abandonment of Hen Harrier roosts and nests (Ruddock & Whitfield, 2007). Ruddock & Whitfield (2007) recommends applying a 500m buffer around Hen Harrier nest sites (Ruddock & Whitfield, 2007). The 10km hectad squares (M52 & N62) in which the proposed development site overlaps occur outside the traditional breeding range for the species (Ruddock et al. 2016). No Hen Harrier nest sites were detected within a 2km radius of the study area. Given the low number of observations recorded onsite (two occasions), together with an absence of winter roosts and breeding territories, effects associated with construction disturbance displacement on the species is deemed to be **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium**, overall significance is **Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Mute Swan (Low)	Construction works could result in birds re-directing their flights away from the study area. Rees (2012) documents displacement distances of 200-560m for swans. There are no regularly occurring populations of Mute Swans within 600m of the proposed development footprint. Furthermore, the species breeds off-site. Given the low number of transits over the study area and absence of regularly recorded commuting flight lines, effects associated with construction disturbance displacement are deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low**, overall significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Grey Heron (Low)	Construction works could result in birds re-directing their flights away from the study area or disturbance to resident birds. However, there were no records of heronries or breeding birds recorded within the study area. The species has a low conservation status and a widespread distribution throughout the country. Given the short-term duration of construction works together with low densities recorded onsite (1 to 2 individuals), disturbance displacement effects in relation to alternative habitat is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low**, overall significance is **Very Low** (Criteria: Percival, 2003).

Key Receptor (Sensitivity)	Assessment (Construction Disturbance Displacement)	Significance (Construction Disturbance Displacement)
		Short-term Slight Negative Effect Criteria: EPA, 2002).
Mallard (Low)	Construction of turbines and access tracks will not result in significant disturbance displacement effects arising from adjoining work areas in the short-term. The species has a low conservation status and a widespread distribution throughout the country. It is expected that the species will utilise areas of suitable habitat for nesting once more following construction. Mitigation in terms of timing of works will be required to negate effects on the species during the bird breeding season. Given the short-term duration of construction works together with low densities recorded onsite (1 to 2 individuals), disturbance displacement effects in relation to alternative habitat is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low**, overall significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Kestrel (Low)	Construction works could result in birds re-directing their flights away from the study area or disturbance to resident birds. There were no breeding records recorded within the study area. The species has a widespread distribution throughout the country. Given the short-term duration of construction works together with low densities recorded onsite (1 to 2 individuals), disturbance displacement effects in relation to suitable alternative habitat in the wider surroundings is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), overall significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Sparrowhawk (Low)	Construction of turbines, access tracks and associated site works will not result in significant disturbance displacement effects from adjoining work areas in the short-term. No breeding territories were identified during the most recent breeding survey season undertaken in 2016. The species has a widespread breeding distribution throughout the country. Given the short-term duration of construction works together with the low number of observations recorded onsite, disturbance displacement effects in relation to suitable alternative habitat in the wider surroundings is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low**, overall significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Buzzard (Low)	Construction of turbines and access tracks will not result in significant disturbance displacement effects from adjoining work areas. No breeding territories were identified during the most recent breeding survey season undertaken in 2016. The species has a widespread breeding distribution in Co. Offaly. Given the short-term duration of construction works together with low bird densities (1 to 2 individuals), disturbance displacement effects in relation to suitable alternative habitat in the wider surroundings is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low**, overall significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).

Key Receptor (Sensitivity)	Assessment (Construction Disturbance Displacement)	Significance (Construction Disturbance Displacement)
Sand Martin (Low)	The proposed works will result in direct disturbance and destruction of the local sand martin population within the study area. There will be a temporary loss of habitat during the construction phase where nest entrances will be lost due to material extraction operations. Mitigation in terms of timing of works will be required to negate effects on the species during the breeding season. Further mitigation in terms of the provision of alternative breeding habitat (nest barrels) will also be required once construction works commence. It is proposed that following wind farm construction, the gravel pit will be landscaped to meet the nesting preferences of the species in line with best practice guidance. Alternative suitable habitat exists to the west of the Bord na Móna site at the location of the adjacent private gravel pit not currently used for extraction purposes.	Magnitude effects is assessed as **High** (20-80% habitat lost), species sensitivity is **Low**, overall significance is **Low** (Criteria: Percival, 2003). **Short-term Moderate Negative Effect** (Criteria: EPA, 2002).

6.6.2 Operational Phase

The likely potential significant effects on avian receptors of the proposed development have been divided into two main types when considering the operational phase of the proposed development. These effects are associated with mortalities due to collisions with operating turbines and disturbance displacement and barrier effects to birds during wind farm operation. The effects associated with habitat loss are considered under the assessment of effects during the construction phase (Section 6.6.1.1).

6.6.2.1 Collisions with Operating Turbines

Birds have been shown to be susceptible to collision risk with operating turbines. The rate of collisions has been shown by various studies to be dependent on the bird species, species abundances and frequencies, turbine height and design, geographic location, topography, etc. The level of collision risk depends on the site location and the species present as well as weather (i.e. fog conditions) and visibility factors (European Commission, 2011).

It has been suggested that collision risk is determined by bird weight, wing length, tail length and total bird length (Janss, 2000). Wing loading (ratio of body weight to wing area) and aspect ratio (ratio of wing span squared to wing area) are important as they influence flight type and collision risk. High wing loading is associated with low flight manoeuvrability which determines whether a bird can escape an encountered object fast enough to avoid collision (Marques et al., 2014). In general, larger birds (i.e. geese and swans) with poor manoeuvrability are at greater risk to collision with turbine structures (Drewitt & Langston, 2006). Significant collision mortality rates are particularly high in confined narrow corridors such as mountain passes used by migrating and local birds (European Commission, 2011). Farmland passerines are less likely to be collision victims than larger, less manoeuvrable species (Bright et al. 2009). In general, waterbirds will utilise natural features in the landscape such as natural watercourses when commuting between feeding and roost sites as opposed to mountainous and hilly terrain (Robinson et al., (2004). Studies of bird collisions at coastal wind farms in Blythe Harbour (North-east England) and Zeebrugge (Belgium) reported collision rates in excess of one bird per turbine per year, with most casualties at both sites being gulls (Percival, 2005).

Studies using radar-tracking at existing wind farms have shown that birds are generally able to avoid collisions with wind turbines and do not fly into them blindly (Percival, 2003). Through species specific avoidance behaviour birds are generally able to avoid collisions with wind turbines. Studies at upland sites in the UK have generally reported very low collision rates with some studies finding no collisions at all. Collision rates typically in range of only 1 in 1,000-10,000 bird flights through wind farms (Percival, 2003).

In the case of the proposed wind farm development at Cloncreen, collisions may arise should birds transiting the site collide with wind turbines during operational phase.

To determine the collision risk to target species identified within the study area, a **Collision Risk Model (CRM)** has been prepared. This modelling method has been developed by Band et al. (2007) to estimate the number of birds colliding with turbines over a period of time.

Collison risk was calculated using flight data that was recorded for the following avian receptors based on birds flying at collision risk height: Whooper Swan, Golden Plover, Lapwing, Snipe, Peregrine Falcon, Mute Swan, Grey Heron, Mallard, Kestrel, Sparrowhawk and Buzzard. The calculations differ from species to species, depending on the amount of recorded flight time in the collision zone, numbers of birds present, differing body lengths, wingspans and flight speeds, the time periods in a year when birds are present and the corresponding number of hours that the birds can be expected to be active. Various turbine and bird parameters are required to calculate the Collison Risk Model (CRM). These specifications and calculations are provided in Appendix 6-6.

A CRM calculation was not prepared for the following avian receptors as flights were not observed at collision risk height: Ringed Plover, Woodcock and Hen Harrier. The results of the CRM for avian receptors identified within the study area are presented in Table 6.20 below while collision assessment of target species is presented in Table 6.21.

Table 6.20 Predicted collision fatalities on key avian receptors identified within the Cloncreen study area

Species	Collision Risk/yr	No. Years per Collision	Collisions in 25 yrs	Avoidance factor (%)	Note
Whooper Swan	0.00169	591.37	0.04	98	Winter & passage (Oct-Mar)
Golden Plover *	0.71101	1.41	17.8	98	Winter & passage (Oct-Mar)
Lapwing *	0.09382	10.66	2.3	98	All year
Ringed Plover	-	-	-	98	No flight at collision height recorded.
Snipe †	0.00708	141.29	0.2	98	All year
Woodcock	-	-	-	98	No flight at collision height recorded.
Peregrine	0.00923	108.30	0.2	98	All year
Hen Harrier	-	-	-	99	No flight at collision height recorded.
Mute Swan	0.00636	157.36	0.16	98	All year
Grey Heron	0.00037	2699.06	0.009	98	All year
Mallard	0.00386	259.27	0.1	98	All year
Kestrel	0.14194	7.05	3.5	95	All year
Sparrowhawk	0.00546	183.07	0.1	98	All year
Buzzard	0.11957	8.36	3.0	98	All year
Sand Martin	-	-	-	-	Not considered collision risk species

*** Golden Plover and Lapwing assumed to be active for 12 hours per day in winter and 15 hours per day in summer to account for some nocturnal activity.**
† Snipe assumed to be active for 8 hours per day in winter and 15 hours per day in summer to account for crepuscular/nocturnal display flights.

Table 6.21 Matrix for Assessment of effects on Key Avian Receptors during Operational Phase (Collison Risk)

Key Receptor (Sensitivity)	Assessment (Collision Risk)	Significance (Collision Risk)
Whooper Swan (Medium)	Total flight duration spent within study area accounted for 0.08% of VP watch time effort. The majority of flight lines were recorded below predicted collision risk height (below 25m). Flights consisted of short internal flight lines between small areas of temporary standing water within study area. No regularly recorded commuting flight lines during winter months given periodic and temporary usage during winter months. The published avoidance rate issued by SNH for the species is 98%, indicating a high avoidance rate in regard to collision with operating turbines. The proposed development will not affect the local Whooper swan population present in the wider area. The proposed development site does not occur on a regularly commuting flight path where larger populations are concentrated between Bord na Móna sites at Cavemount, Derryarkin and Ballycon in the wider area. A review of the collisions of swans and geese with turbines at 46 European wind farms reported just 2 Whooper Swan casualties with operating wind farms (Rees, 2012). Most Whooper Swan flocks travel between 5 and 30m high between feeding and roost sites (McGuinness et al. 2015). Study area does not occur on a regularly used flight path between feeding and roost sites in the surroundings. The collision risk figures for Whooper Swan have been calculated to give a figure (for a 98% avoidance factor) of 0.00169 collisions per year (equivalent to approximately one collision every 591 years, or 0.04 collisions during a nominal 25-year wind farm lifespan). The number of collisions during the operational phase of the wind farm is predicted to be **negligible**.	Magnitude effects is assessed as **Negligible** (<1% population lost), species sensitivity is **Medium**, overall effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Imperceptible Negative Effect** (Criteria: EPA, 2002).
Golden Plover (Medium)	Total flight duration accounted for 0.14% of VP watch time effort. The majority of flight lines were recorded below predicted collision risk height (below 25m). Birds were recorded in flight on 16 out of 83 survey dates across all seasons and are not deemed to be regularly occurring. Collision studies undertaken in continental Europe show much lower collision records of Golden Plover than other species with few fatalities recorded (Hotker, 2006). Collision risk for waders is generally deemed to be low due to a relatively low cursory flight path, coupled with high flight manoeuvrability (McGuinness et al. 2015). Collision risk at Cloncreen is expected to be low given the low number of birds recorded during winter, autumn and spring migration periods. The published avoidance rate issued by SNH for Golden Plover is 98%, indicating a high collision avoidance rate with operating turbines. Collision risk fatality rates (extrapolated from the collision risk model) for Golden Plover have been calculated to give a figure (for a 98% avoidance factor) of 0.71101 collisions per annum (equivalent to approximately one collision every 1.41 years, or 17.8 collisions during a nominal 25-year wind farm lifespan). The predicted fatality rates are conservative. There is a 14.5m difference from the 25m (>25m) predicted collision risk height incorporated in the current assessment compared to the lowest possible point of the rotor swept zone at 39.5m. The number of collisions during the operational phase of the wind farm is expected to be lower than predicted figures extrapolated from the CRM.	Magnitude effects is assessed as **Low** (1-5% population lost), species sensitivity is **Medium**, overall effect significance is **Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).

Key Receptor (Sensitivity)	Assessment (Collision Risk)	Significance (Collision Risk)
	Collision risk on the species is predicted to be **low** and will not result in significant declines on the local population.	
Lapwing (Medium)	The majority of flight lines were recorded below predicted collision risk height (below 25m). Six 'probable' breeding territories identified in 2016. Territorial flight displays and commuting pairs were noted. A review of wind farm effect studies by Whitfield (2007) concluded that waders have relatively low susceptibility to collision (Bright et al., (2009). While flocks may fly over the study area on occasion, waders can react to the presence of turbines by either flying at higher altitudes or changing flight direction (Exo et al., 2003). The possibility that birds will habituate to wind farm structures has been suggested by Langston & Pullan (2003). It is expected that populations will habituate to the presence of turbines during wind farm operation. A default avoidance factor of 98% is used to calculate collision risk for Lapwing. The collision risk figures for Lapwing have been calculated to give a figure (for a 98% avoidance factor) of 0.09382 collisions per annum (equivalent to approximately one collision every 10.6 years, or 2.3 collisions during a nominal 25-year wind farm lifespan). The number of collisions during the operational phase of the wind farm is predicted to be **low** with no significant declines predicted on breeding and wintering birds.	Magnitude effects is assessed as **Low** (1-5% population lost), species sensitivity is **Medium**, overall effect significance is **Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Ringed Plover (Low)	Low numbers breeding onsite. Two 'probable' pairs identified during 2016. Low number of flight lines recorded within study area. The species is considered to be a low flier during the breeding season and not susceptible to effects associated with collision risk. A collision risk model has not been prepared as the species was only observed flying below predicted collision risk height (<25m). Collison risk is assessed as **low**.	Magnitude effects is assessed as **Low** (1-5% population lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Snipe (Low)	Displaying birds are considered to be most at risk of collision during breeding season. Low number of breeding territories within study area (two 'probable' pairs). Turbine height suggests that species mortality will not be significant. The number of documented fatalities in Europe was found to be low (Hotker et al., 2006). The collision risk figures for Snipe have been calculated to give a figure (98% avoidance factor (default) of 0.00708 collisions per year (equivalent to approximately one collision every 141 years, or 0.2 collisions during a nominal 25-year wind farm lifespan). The number of collisions during the operational phase of the wind farm is deemed to be **negligible**.	Magnitude effects is assessed as **Negligible** (<1% population lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Imperceptible Negative Effect** (Criteria: EPA, 2002).

Key Receptor (Sensitivity)	Assessment (Collision Risk)	Significance (Collision Risk)
Woodcock (Medium)	Low number of records within study area (1 breeding pair recorded). The species is crepuscular with roding males detected during dusk. Number of documented collisions is low with six fatalities reported from five European countries (Länderarbeitsgemeinschaft der Vogelschutzwarten, 2014). Birds typically display up to 30m above ground (below collision risk height at the subject site) (Hirons et al., 1982). A collision risk model has not been prepared as the species was only observed flying below predicted collision risk height (<25m). Collison risk on the species is predicted to be **low**.	Magnitude effects is assessed as **Low** (1-5% population lost), species sensitivity is **Medium, overall** effect significance is **Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Peregrine Falcon (Medium)	Occasional records of the species utilising the study area for commuting and hunting purposes. Breeds off-site to the east with suitable alternative habitat in the wider area to the north and east of Edenderry Power Station. The collision risk figures for Peregrine Falcon have been calculated to give a figure (98% avoidance factor (default) of 0.00923 collisions per year (equivalent to approximately one collision every 108 years, or 0.2 collisions during a nominal 25-year wind farm lifespan). The number of collisions during the operational phase of the wind farm is deemed to be **negligible**.	Magnitude effects is assessed as **Negligible** (<1% population lost), species sensitivity is **Medium,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Imperceptible Negative Effect** (Criteria: EPA, 2002).
Hen Harrier (Medium)	Recorded on a number of rare occasions. The species was not found to be dependent on the habitats of the study area. A collision risk model has not been prepared as the species was only observed flying below predicted collision risk height (<25m). Common flight height of Hen Harriers while feeding has been estimated at a mean of 10-20m above the ground (McGuinness et al., 2015). Previous studies highlight that 60-80% of Hen Harrier flight activity to be less than 2m (Whitfield & Madders, 2006). The height estimates and number of occasions observed onsite rule out the possibility of collision with operating turbines. Collison risk is assessed as **negligible**.	Magnitude effects is assessed as **Negligible** (<1% population lost), species sensitivity is **Medium,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Imperceptible Negative Effect** (Criteria: EPA, 2002).
Mute Swan (Low)	There were a low number of flight observations recorded within the study area during the study period. The collision risk figures for Mute Swan have been calculated to give a figure (98% avoidance factor (default)) of 0.00636 collisions per year (equivalent to approximately one collision every 157 years, or 0.16 collisions during a nominal 25-year wind farm lifespan). The number of collisions during the operational phase of the wind farm is deemed to be **negligible**.	Magnitude effects is assessed as **Negligible** (<1% population lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Imperceptible Negative Effect** (Criteria: EPA, 2002).
Grey Heron (Low)	Not found to be dependent on habitats of study area given widespread distribution. The species was observed in low densities commuting across the study area (1-2 individuals). The collision risk figures for Grey Heron have been calculated to give a figure (98% avoidance factor (default)) of 0.00037 collisions per year (equivalent to	Magnitude effects is assessed as **Negligible** (<1% population lost), species sensitivity is **Low,** overall

Key Receptor (Sensitivity)	Assessment (Collision Risk)	Significance (Collision Risk)
	approximately one collision every 2699 years, or 0.009 collisions during a nominal 25-year wind farm lifespan. The number of collisions during the operational phase of the wind farm is predicted to be **negligible**.	effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Imperceptible Negative Effect** (Criteria: EPA, 2002).
Mallard (Low)	Species has a widespread distribution throughout the country and has a low conservation status. Mallard was observed in low densities commuting across the study area. The collision risk figures for Mallard have been calculated to give a figure (98% avoidance factor (default)) of 0.00386 collisions per year (equivalent to approximately one collision every 259 years, or 0.1 collisions during a nominal 25-year wind farm lifespan). The number of collisions during the operational phase of the wind farm is deemed to be **negligible**.	Magnitude effects is assessed as **Negligible** (<1% population lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Imperceptible Negative Effect** (Criteria: EPA, 2002).
Kestrel (Low)	Species not found to be dependent on habitats of study area given absence of breeding territories recorded onsite. Suitable alternative habitat exists in the form of cutaway bog in the wider surroundings. The collision risk figures for Kestrel have been calculated to give a figure (95% avoidance factor (default)) of 0.14194 collisions per year (equivalent to approximately one collision every 7 years, or 3.5 collisions during a nominal 25-year wind farm lifespan). The number of collisions during the operational phase of the wind farm is deemed to be **Low**.	Magnitude effects is assessed as **Low** (1-5% population lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Slight Negative Effect** (Criteria: EPA, 2002).
Sparrowhawk (Low)	Low number of occasions recorded within study area. The collision risk figures for Sparrowhawk have been calculated to give a figure (98% avoidance factor (default)) of 0.00546 collisions per year (equivalent to approximately one collision every 183 years, or 0.1 collisions during a nominal 25-year wind farm lifespan). The number of collisions during the operational phase of the wind farm is deemed to be **negligible**.	Magnitude effects is assessed as **Negligible** (<1% population lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Imperceptible Negative Effect** (Criteria: EPA, 2002).
Buzzard (Low)	Low number of occasions recorded within study area. The collision risk figures for Buzzard have been calculated to give a figure (98% avoidance factor (default)) of 0.11957 collisions per year (equivalent to approximately one collision every 8.36 years, or 3 collisions during a nominal 25-year wind farm lifespan. The number of collisions during the operational phase of the wind farm is deemed to be **Low**.	Magnitude effects is assessed as **Low** (1-5% population lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003).

Key Receptor (Sensitivity)	Assessment (Collision Risk)	Significance (Collision Risk)
		Long-term Imperceptible Negative Effect (Criteria: EPA, 2002).
Sand Martin (Low)	Sand Martin is not a species susceptible to collision risk with operating turbines. The species is a low flyer and typically flies below collision risk height. In addition, the species has a high flight manoeuvrability which determines that the bird can escape an encountered object fast enough to avoid collision. Collison risk on the species is deemed to be **negligible**.	Magnitude effects is assessed as **Negligible** (<1% population lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Long-term Imperceptible Negative Effect** (Criteria: EPA, 2002).

6.6.2.2 Disturbance Displacement and Barrier Effect (Operational Phase)

Disturbance displacement (and avoidance) effects during wind farm operation could arise due to the presence of operating wind turbines that may deter some birds from using the site and surrounding environs (Percival, 2003). Disturbance effects could result in reduced resource use by birds (Gill et al. 1996). Disturbance can lead to displacement and exclusion from areas of suitable habitat around wind turbines effectively resulting in indirect habitat loss. The scale of deterrence, together with the availability of suitable alternative habitat that can accommodate displaced birds will determine whether the effect is significant or not (Langston & Pullan, 2003). There is an increasing amount of evidence that wind farms do not generally affect bird distribution (Powlesland, 2009). The most likely reason for this can be attributed to the fact that birds will avoid the vicinity of wind turbines where there is alternative feeding habitat in the area but will move closer when resources are limited (Powlesland, 2009 & Percival, 2003). Previous studies have detected nocturnal wintering birds flying between turbines during moonlight and parallel to turbines in complete darkness. Studies have found that local wintering birds will habituate to the presence of turbines and therefore avoid collision (Langston & Pullan, 2003). The proposed development site does not contain any ecological connecting features (in the form of natural watercourses) or waterbodies (lakes, reservoirs, ponds, etc.) to attract significant flocks of waterbirds to the study area.

Potential sources of disturbance and displacement during the operational phase as a result of the proposed development could include barrier effects associated with operating wind turbines (visual and noise disturbance), increased human activity associated with maintenance operations, traffic and road infrastructure, etc. The size and scale of wind farms involved will determine the magnitude of barrier effects. The barrier effect of wind farms arises where a large number of turbines that are densely clustered over a large area could potentially create a barrier to birds flying through the area. This can arise where one or more wind farms are distributed throughout a geographic area. The barrier effect can affect birds in two ways, the placement of turbines in the path of migration corridors (i.e. rivers and mountain passes) and the placement of turbines between feeding and roost sites. The main effect of barrier effects on birds during the operational phase could result in increased energy expenditure as a result of birds taking longer flight lines and re-directing flight lines away from the study area. Swans have shown macro and micro avoidance of turbines.

Displacement effects may occur but if there is alternative habitat to accommodate the displaced birds, the effect may be inconsequential (Percival, 2003). Percival (2003) reports that in some studies birds have been displaced by as much as 800m and up to 300m for breeding birds. There are no sensitive wildfowl refuges within an 800m radius of the study area to result in displacement effects on sensitive bird species from neighbouring sites. Areas within 800m of the proposed turbines mainly comprise cutaway industrial peat and improved agricultural grassland deemed to be of low ecological value for birds. The Bord na Móna cutaway site at Ballycon has attracted high numbers of waterbirds to the site since rehabilitation measures were implemented in 2006. The Ballycon site occurs outside 800m of the Cloncreen study area and therefore displacement effects are not foreseen on the bird interest. The level of bird interest detected during winter months and autumn and spring migration was found to be low. Significant disturbance displacement effects during wind farm operation are not anticipated given bird species distribution in the wider area.

The effects of disturbance displacement are expected to decrease over time as birds adjust to the new habitat configuration. This habituation may lead to alterations in foraging behaviour to adapt to a disturbed environment, which may contrast with that of a less perturbed habitat (Welty, 1987). It is expected that the local bird population will grow accustomed to the proposed development in the short-term. Table 6.22 assesses disturbance displacement on the key avifauna receptors identified within the study area.

Table 6.22 Matrix for Assessment of effects on Key Avian Receptors during Construction Phase (Operational Disturbance Displacement & Barrier Effect)

Key Receptor (Sensitivity)	Assessment (Disturbance Displacement & Barrier Effect)	Significance (Disturbance Displacement & Barrier Effect)
Whooper Swan (Medium)	Potential exists for possible disturbance displacement effects where turbines (T12) and access tracks are proposed in the western part of the site depending on availability of food resources. Fijn et al., (2012) & Rees (2012) report possible short-term displacement of up to 200-560m. Other studies report disturbance of up to 300m of wind farm sites (Percival, 2003). Literature sources suggest swans are likely to habituate to turbines over time (Fijn et al., (2012)). Given temporary site usage during winter months, and distribution of regularly occurring flocks concentrated at Cavemount, Derryarkin and Ballycon, the species will not be affected by disturbance displacement effects. There are no IWeBS sites/sub-sites or SPAs within a 5km radius of the study area deemed to be the core foraging distance range for the species (SNH, 2013). McGuinness et al. (2015) assigns a zone of sensitivity of 600m around occupied IWeBS sub-sites for the species. The nearest IWeBS site is over 9km from the study area. Displacement and avoidance effects will not result in increased energy expenditure should birds re-direct their flight lines to avoid large turbines. The number of transits over the study area was low with no regularly recorded commuting flight lines. Effects associated with operational disturbance displacement are deemed to be of **low concern** based on periodic usage during winter months. In general, waterbirds will utilise natural features in the landscape such as natural watercourses when commuting between feeding and roost sites (Robinson et al., 2004). There are no large watercourses in the vicinity of the study area considered suitable to link large flocks to the site. No flocks were observed commuting through the study area on passage during the Spring and Autumn migration. Given reported displacement distances for swans (200-560m) (Fijn et al., 2012), barrier effects are not anticipated as the study area is characterised by a flat open landscape that avoids restrictions on bird movements (i.e. natural barriers in the form of mountainous hilly terrain). Previous studies have shown birds adjusting their flight lines showing significant changes to their flightpath to avoid turbines, but flying in between rows of turbines (Rees, 2012). Langston & Pullan (2003) report nocturnal wintering birds flying between turbines during moonlight and flying parallel to turbines in complete darkness. Studies have found that local wintering birds will habituate to the presence of turbines and therefore avoid collision (Langston & Pullan, 2003). Overall, disturbance, displacement and barrier effects during wind farm operation are deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium, overall** effect significance is **Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Golden Plover (Medium)	Potential exists for disturbance displacement on wintering flocks from resting locations. There were low numbers recorded onsite, well below nationally important thresholds. Previous studies in relation to wind farm displacement disturbance on Golden Plover in the United Kingdom found no evidence for significant effects (Fielding & Haworth, 2010). Hotker et al. (2006) reports that following a review of 29 other studies, Golden Plover will approach wind turbines to an average distance of 175m in the non-breeding season (McGuinness et al. 2015). Signs of habituation have been shown in three of four studies reviewed for Golden Plover in the case of non-breeding birds (Hötker et al., 2004). The population recorded within the study area is restricted to wintering birds.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium,** overall effect significance is **Low** (Criteria: Percival, 2003).

Key Receptor (Sensitivity)	Assessment (Disturbance Displacement & Barrier Effect)	Significance (Disturbance Displacement & Barrier Effect)
	Larger flocks were concentrated in pasture land removed from the study area to the south. Displacement and avoidance effects will not result in increased energy expenditure should birds re-direct their flight lines to avoid large turbines on this basis. Langston & Pullan (2003) report nocturnal wintering birds flying between turbines during moonlight and flying parallel to turbines in complete darkness. Signs of habituation have been shown in three of four studies reviewed for Golden Plover in the case of non-breeding birds (Hötker et al., 2004). Barrier effects are not anticipated as the study area is characterised by an open landscape which does not restrict birds transiting in the wider area as opposed to natural barriers such as mountainous and hilly terrain. Given the low number of occasions birds were observed resting and flying onsite, together with higher populations in the wider surroundings and absence of significant flocks during spring and autumn migration, disturbance displacement and barrier effects during wind farm operation are deemed to be of **low concern**.	**Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Lapwing (Medium)	Potential exists for disturbance displacement effects on breeding and wintering Lapwing populations during the operational phase. The proposed works will result in disturbance displacement effects on breeding Lapwing concentrated in the western and south-western parts of the study area where turbines (T2, T3, T4, T11 & T12) and access tracks are proposed. Previous studies report Lapwing disturbance displacement of up to 108m from turbines (Hötker et al., 2006). The presence of the wind turbines and associated infrastructure is not expected to deter Lapwing from breeding within the study during wind farm operation. Langston et al. (2003) found that Lapwing nesting occurred slightly closer to turbines possibly as a result of the creation of preferred areas of shorter vegetation. Several studies have found no discernible effect on populations of Lapwing, either through disturbance displacement or site avoidance (Pearce-Higgins et all. 2009). Pearce-Higgins et al. (2009) found no significant relationship between distance to wind farms and changes on occurrence for breeding Lapwing. The proposed turbines are sufficiently spaced apart (ca. 650m) that habituation is considered to be a likely scenario. The proposed wind farm is located in an area characterised by open landscape with no significant regularly used flight lines recorded. Barrier effects are therefore not anticipated. Langston & Pullan (2003) report nocturnal wintering birds flying between turbines in periods of darkness. Given the low number of occasions birds were observed during winter, spring and autumn migration, disturbance displacement and barrier effects during wind farm operation are deemed to be of **low concern**. Furthermore, irrespective of the proposed development, suitable breeding habitat within the study area will not persist following the scheduled cessation of peat production in 2019, as the natural habitat succession will result in the revegetation of existing bare peat, providing unsuitable nesting conditions. Suitable alternative habitat occurs in the wider surroundings with favourable breeding success rates recorded at Ballycon and Clonsast North.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium,** overall effect significance is **Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).

Key Receptor (Sensitivity)	Assessment (Disturbance Displacement & Barrier Effect)	Significance (Disturbance Displacement & Barrier Effect)
Ringed Plover (Low)	The breeding distribution has been recorded in the wider study area at Ballycon, Cavemount and Clonsast North. It is expected that the species will re-establish breeding territories once more during wind farm operation. The species has a low conservation status listed on the BoCCI green-list and the European population is secure. The number of breeding territories recorded onsite was low. Also, irrespective of the proposed development, natural habitat succession of bare peat following the cessation of peat production in 2019 will ultimately result in revegetation and unsuitable nesting conditions for Ringed Plover. Disturbance displacement effects during wind farm operation are not anticipated and deemed to be of **low concern.** Recorded flight activity is below rotor blade height; the wind farm is unlikely to act as a barrier to a species such as Ringed Plover.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Snipe (Low)	Studies suggest significant declines in breeding densities during construction which may lead to declines post construction (Pearce-Higgins et al. 2012). Pearce-Higgins et al., (2012) report a 48% decline in abundance in the species within 500 metres of turbines. Low number of recorded breeding territories were recorded within study area. The proposed turbines are sufficiently spaced apart (ca. 650m) that habituation is considered to be a likely scenario. Disturbance displacement effects during wind farm operation are not anticipated. The majority of flight activity is below rotor blade height, the wind farm is unlikely to act as a barrier to the species given its widespread distribution in the wider surroundings and deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Woodcock (Medium)	There will be no requirement for land take of suitable foraging and breeding habitat during the operational phase. The Bord na Móna rehabilitation plan for Cloncreen aims to allow natural colonisation of birch and willow scrub following decommissioning of peat harvesting activities providing optimal habitat for this species. Given the distribution of the species in the wider study area (Clonsast, Clonsast North, Glashabaun South and Ballydermot), disturbance displacement effects are not anticipated. The species has a core foraging range from nest locations of up to 1km (Hoodless & Hirons, 2007). Displacement and avoidance effects will not result in increased energy expenditure should birds re-direct their flight lines to avoid large turbines. The number of transits recorded and observations of breeding (single territory) and wintering birds was low that barrier effects on the species are not anticipated and of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low,** overall effect significance is **Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Peregrine Falcon (Medium)	Potential exists for disturbance displacement from suitable foraging habitat during wind farm operation. Peregrine was only occasionally observed within the study area. Ruddock and Whitfield (2007) highlight Peregrine habituation to sources of disturbance as a likely scenario. Madders & Whitfield (2006) report that Peregrine exhibit low sensitivity to displacement effects in relation to operating wind turbines. Effects associated with disturbance displacement in relation to suitable alternative habitat in the wider surroundings (north and east of Edenderry Power Station) is deemed to be of **low concern**. Occasional observations recorded within study area suggests the species is not dependent on the study area throughout the year. The wind farm is therefore unlikely to act as a	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium,** overall effect significance is **Low** (Criteria: Percival, 2003).

Key Receptor (Sensitivity)	Assessment (Disturbance Displacement & Barrier Effect)	Significance (Disturbance Displacement & Barrier Effect)
	barrier effect given flight lines recorded outside the study area and suitable alternative habitat to the east and north of the Power Station.	**Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Hen Harrier (Medium)	Hen Harrier were only recorded on four occasions during the surveys that were undertaken and there were no records of breeding Hen Harrier either within or close to the site. Work carried out in 2006 and 2007 by Madden and Porter (2007) at the large existing wind farm at Derrybrien, Co. Galway, highlighted Hen Harriers foraging within 50 meters and, on occasion, within less than 10 meters of the turbine bases at this wind farm site. Given the very low number of occasions the species was recorded, disturbance displacement and barrier effects are deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Medium,** overall effect significance is **Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Mute Swan (Low)	Operating turbines could result in birds re-directing their flights away from the study area. Rees (2012) documents displacement distances of 200-560m for swans. There are no regularly occurring populations of Mute Swans within 600m of the proposed development footprint. Furthermore, the species breeds off-site. Given the low number of transits over the study area and absence of regularly recorded commuting flight lines, effects associated with disturbance displacement and barrier effects are deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Grey Heron (Low)	Operating turbines could result in birds re-directing their flights away from the study area or disturbance to resident birds. There were no records of heronries or breeding birds recorded within the study area. The species has a low conservation status and a widespread distribution throughout the country. Given the relatively low number of occasions and low densities recorded onsite (1 to 2 individuals), disturbance displacement and barrier effects in relation to alternative habitat is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).

Key Receptor (Sensitivity)	Assessment (Disturbance Displacement & Barrier Effect)	Significance (Disturbance Displacement & Barrier Effect)
Mallard (Low)	Operating turbines could result in birds re-directing their flights away from the study area or disturbance to resident birds. The species has a low conservation status and a widespread distribution throughout the country. Langston & Pullan (2003) reports no disturbance related effects on feeding and roosting Mallard following monitoring at an operating wind farm in the Netherlands. Given the relatively low number of occasions and low densities recorded onsite (1 to 2 individuals), disturbance displacement and barrier effects in relation to alternative habitat is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Kestrel (Low)	Disturbance displacement could result in birds re-directing their flights away from the study area. Maximum disturbance distances have been recorded to distances of up to 150m (Hotker et al., 2006). Studies investigating displacement effects on Common Kestrel at five European wind farm sites found that Kestrel exhibited low sensitivity to wind farm displacement (Madders & Whitfield, 2006).The species has a widespread distribution throughout the country. Given the absence of breeding territories and low densities recorded onsite (1 to 2 individuals), disturbance displacement effects in relation to suitable alternative habitat in the wider surroundings is assessed as being of **low concern.** Barrier effects are not foreseen given the relatively low number of flight lines concentrated over proposed turbine locations.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Sparrowhawk (Low)	Disturbance displacement could result in birds re-directing their flights away from the study area. Flight lines were not recorded in areas of proposed turbine locations. Overall activity found to be low. The species has a widespread breeding distribution throughout the country. Given the low number of observations recorded onsite, disturbance displacement and barrier effects in relation to suitable alternative habitat in the wider surroundings is assessed as being of **low concern.**	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).

Key Receptor (Sensitivity)	Assessment (Disturbance Displacement & Barrier Effect)	Significance (Disturbance Displacement & Barrier Effect)
Buzzard (Low)	Disturbance displacement could result in birds re-directing their flights away from the study area. Levels of turbine avoidance suggest breeding bird densities may be reduced within a 500m buffer of the turbines by 15–53% for Buzzard (Pearce-Higgins et al. (2009). There were no nest sites recorded within the study area or within 500m of proposed turbine locations. Flight lines were largely restricted to the margins of the site boundary and away from proposed turbine locations. Habituation to wind farm development have been reported by Hotker et al. (2006). Given the availability of suitable habitat in the wider surroundings together with a low number of observations recorded, disturbance, displacement and barrier effects on the species are deemed to be of **low concern**.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).
Sand Martin (Low)	The proposed works will not result in disturbance displacement effects. The proposed borrow pit is over ca. 300m from the nearest turbine. It is proposed that following wind farm construction, the location of the proposed borrow pit will be landscaped to meet the nesting preferences of the species in line with best practice guidance during wind farm operation.	Magnitude effects is assessed as **Low** (1-5% habitat lost), species sensitivity is **Low,** overall effect significance is **Very Low** (Criteria: Percival, 2003). **Short-term Slight Negative Effect** (Criteria: EPA, 2002).

6.6.2.3 Grid Connection and Transport Route

6.6.2.3.1 Grid Connection Option A: Substation and Underground Grid Connection

The proposed grid connection mainly utilises Bord na Móna land and local road infrastructure throughout its length. The grid connection will not necessitate the requirement to deviate off existing land/road infrastructure and will be underground thereby avoiding the potential for collision with commuting birds. Electricity cable ducting is proposed for the connection of a proposed substation within the proposed development site at Cloncreen and will terminate at the existing Cushaling substation that is adjacent to the Edenderry Power Station.

There are no tree removal works associated with either grid connection option.

6.6.2.3.2 Grid Connection Option B: Substation and Overhead Grid Connection

The proposed overhead grid connection will cross over an area of cutaway bog with little regeneration and re-establishment of vegetation communities. The habitat is deemed to be sub-optimal for foraging birds.

The proposed overhead grid connection associated with Substation Option B (refer to Chapter 3 for detailed description) will involve the installation of two small sections of overhead line (less than 0.1 kilometre in total length) to connect to the existing 110 kV Thornsberry/Cushaling overhead powerline, which traverses the southern section of the proposed development site. Potential for collision risk exists where commuting birds with poor manoeuvrability may utilise the area as a regular commuting route. It is accepted that species most susceptible to collision are those that lack agile flight and have 'high wing loading' (i.e. swans). The number of flight lines recorded in the vicinity of Grid Connection Option A were low. Given the presence of an existing 110 kV overhead line in this section of the site, and the small scale and size of the proposed connection, collision risk on birds transiting the study area is of low concern. It is expected that birds resident to the study area have already grown accustomed to the existing 110kV overhead powerline that collision risk is reduced.

The level of disturbance will be minor and it is foreseen that the effects associated with disturbance during construction will be minimal. Birds within the study area are thought to be sufficiently mobile so as to avoid collision with overhead lines.

A number of mitigation measures (including the use of bird diverters) have been drawn up and will be implemented to avoid collision risk on birds during the operational phase (refer to Section 6.7; Mitigation).

6.6.2.4 Turbine Transport Route

The proposed turbine haul route follows existing road infrastructure and only requires small scale road side modifications at a number of junction locations. There will be no requirement to deviate off existing road infrastructure onto areas of semi-natural habitat that could potentially support nesting birds throughout the majority of the route. There will be some requirement for tree felling and trimming operations at Ballinagar Park – see Description Chapter 3, Section 3.3.12 for further details. Deliveries will enter the site on the western boundary from the L1003 public road. A small area of Broadleaved Woodland will be removed to facilitate this access. Furthermore, some trees along the eastern side of the local roadway north and south of the proposed entrance will be removed to ensure adequate sightlines for traffic exiting the site. A number of small trees will be lost on the western side of the L1003 to facilitate road widening. An assessment of these habitats in summer 2016 concluded that removal of this vegetation will not constitute a significant effect to breeding birds, as the habitat is widespread in the general environment.

Vegetation removal and clearance will be undertaken outside the bird nesting season (1st of March to 31st of August) to minimise effects on breeding birds and so as not to cause undue disturbance.

6.6.3 Decommissioning Phase

During decommissioning there may be local disturbance to fauna on site. Birds may become temporarily displaced during site works. This will be a temporary to short-term effect and therefore is considered insignificant. Potential effects that may arise during decommissioning can include visual intrusion, noise, vibration, dust, pollution and the physical presence and movement of construction plant (equipment), and the presence of personnel associated with deconstruction and site security. Disturbance can lead to displacement and exclusion from areas of suitable habitat, which effectively amounts to reduction in quality or loss of habitat for birds, leading to reductions in bird density (Pearce-Higgins et al., 2009). Following dismantling of the turbines and removal off-site, direct positive effects are likely to result from the re-instatement of semi-natural habitat in the areas where site infrastructure will be removed. The timing of decommissioning works will be undertaken outside sensitive periods i.e. bird breeding season to avoid effects on nesting birds. Effects on avifauna receptors during the decommissioning phase are expected to be of a **temporary to short-term slight positive effect** of **low significance**.

6.6.4 Assessment of Cumulative Effects

Material for this assessment of cumulative effects was compiled on the relevant developments within the vicinity of the proposed development. The material was gathered through a search of relevant online Planning Registers, reviews of relevant EIS documents, planning application details and planning drawings, and served to identify past and future projects, their activities and their environmental effects. The projects considered in relation to the potential for cumulative effects and for which all relevant data was reviewed (e.g. individual EISs, layouts, drawings etc.) include those listed below.

6.6.4.1 Other Wind Farm Developments

A search was undertaken for wind energy planning applications for projects that may potentially result in cumulative effects with the proposed development at Cloncreen. The search was carried out to establish the nature and scale of developments in the local area and any previous ecological information relevant to birds (e.g. submitted as part of EIS) within the zone of influence of the study area. The operational and permitted wind farm developments identified within the zone of influence (15km as defined in Section 6.3.2.1.3) of the subject site are outlined in Table 6.23.

There is potential for cumulative effects on bird populations from multiple wind farm projects within local and regional areas by either reducing bird populations through collisions with operating turbines or disturbance and displacement or a barrier effect of populations from large areas of suitable habitat. Cumulative effects arising from two or more developments are usually restricted to 'additive effects' (i.e. multiple independent additive model). The effect of a single project that is insignificant may become significant when combined with other projects (European Commission, 2011). The assessment of Cumulative effects with other projects has been carried out in line with best practice guidance where applicable (SNH, 2012). Other wind farm projects are first discussed below and this is followed with an assessment of the current development in combination with other types of development that were identified during planning searches and investigations of ongoing activities within the zone of likely effect of the proposed development.

The following direct and indirect effects have been assessed in relation to cumulative effects with other projects

- Cumulative collision risk due to bird mortalities
- Cumulative disturbance and displacement (including site avoidance) and habitat loss
- Barrier Effect

Table 6.23 Cumulative effects with other wind farm developments in the wider surroundings

Wind Farm Development	Turbine No.	Operational Status	Distance from Subject Site
Mountlucas Wind Farm (Pl. Ref. 09/453, ABP PL19.237263)	28	Operating	4.2 kilometres west
Yellow River Wind Farm (ABP PL19.PA0032)	29	Permitted	8.7 kilometres north-west
Maighne Wind Farm (ABP PL09.PA0041)	47	Proposed	9 – 12 kilometres north-east, east and south-east

6.6.4.1.1 Cumulative Collision Risk

A review of baseline ornithological information recorded at other permitted wind farm developments in the wider surroundings was undertaken. There were rare occurrences of birds of high conservation concern recorded at the permitted wind farm of Mountlucas during February and June 2006. Notable raptors and waterbirds detected during field surveys included Mallard, Water-rail, Snipe, Sparrowhawk and Woodcock. Whooper Swans were observed off-site in low numbers (maximum flock size of 3 individuals). Species assemblages were recorded in low densities at the permitted wind farm site. The majority of summer migrants observed comprised of small passerines with low collision risk potential with operating turbines. Based on the low number of records and transits recorded at Mountlucas Wind Farm, cumulative effects with this wind farm development are assessed to be of **low concern**.

At Yellow River Wind Farm, 108 Whooper Swan were recorded at the site during winter bird surveys in winter 2013/14. Swans were found to use Derryarkin, in proximity to Yellow River, for feeding and roosting purposes. Other waterbirds and raptors observed included Golden Plover, Hen Harrier, Kestrel, Sparrowhawk and Snipe. Given the prescribed mitigation measures put in place in the project design (e.g. restrictions on site works during certain months of the year and hazard warning lights on certain turbine hubs), collision risk was not found to be significant for Whooper Swan or any other species. The permitted wind farm development is significantly removed from the Cloncreen study area and outside the core foraging ranges for Whooper Swan (5km (SNH, 2013)) that cumulative collision effects with this permitted wind farm development are not foreseen and are deemed to be of **low concern**.

At Maighne Wind Farm, waterbirds of high conservation concern such as Whooper Swan, Golden Plover and Lapwing were recorded during field surveys. The collision risk was considered low for Whooper Swan due to the low frequency of occurrence and the low numbers recorded onsite (maximum flock size was 6 birds). Similarly, the collision risk for Golden Plover was considered low as maximum flock size recorded on site was 438 birds, below the threshold for national importance. Other species recorded at Maighne Wind Farm with high collision risk potential were Lapwing and the raptors Peregrine, Kestrel, Buzzard and Hen Harrier. The overall collision risk significance for each of these species was of low concern. The permitted wind farm development is significantly removed from the Cloncreen study area (9-12km) and outside the core foraging ranges for Whooper Swan (5km (SNH, 2013)) that cumulative collision risks with this permitted wind farm development are not foreseen and are deemed to be of **low concern**.

Considering the distances of all three wind farm sites in relation to Cloncreen study area (4.2km, 8.7km & 9-12km respectively), no cumulative collision risk on any avian receptors including Whooper Swan are foreseen. The predicted number of collisions during the operational phase of Cloncreen Wind Farm have been assessed being of **low significance**. Furthemore, studies have found that local wintering birds will habituate to the presence of turbines and therefore avoid collision (Langston & Pullan, 2003). The turbine locations at the various wind farm sites are sufficiently spaced apart that no collision effects are foreseen on bird populations of the wider surrounding area. Given the occasional presence of Whooper Swans at Cloncreen, together with high avoidance factors of collisions with operating turbines (98%), cumulative collision mortality combined with other wind farm developments is deemed to be of **low concern**.

6.6.4.1.2 Cumulative Disturbance Displacement and Habitat Loss

Cumulative habitat loss may arise in two forms:

i. direct habitat loss associated with the development footprint (i.e. turbine bases, access roads, wind farm structures, etc.); and
ii. indirect habitat loss as a result of birds avoiding the site or being displaced due to operating turbines.

Direct habitat loss by the development of wind farm farms tend to be relatively small and tend not to be of major concern for birds outside European sites or sites of national and international importance for birds. The turbine locations at the various wind farm sites are sufficiently spaced apart that site avoidance and displacement effects on the species under consideration are deemed to be of low concern. As with Whooper Swans and Mute Swans feeding and roosting in Cloncreen, swans at Mountlucas were all found using an area of bog that was flooded at the time of bird surveys. At Mountlucas Wind Farm, the percentage habitat loss at the proposed development site accounted for 1.5%. Scrub habitat and its associated bird community within Mountlucas incurred the greatest effect. As scrub habitat was widely available in the surrounding landscape, the effect of the proposed development was considered to be of **low concern**. Similarly, at Yellow River Wind Farm, habitat loss was minimised to the turbine bases and access tracks only.

At Maighne Wind Farm, the overall significance of habitat loss for target species recorded at the site was "**low**" or "**very low**". The proposed development site will not result in displacement effects on regularly occurring birds at Ballycon. Comparable displacement effects can be drawn from Mountlucas Wind Farm. The operating wind farm occurs within 800m of the Bord na Móna Ballycon cutaway Site. The Ballycon site supports a regularly occurring waterbird population. Increases in waterbird numbers suggests that the permitted wind farm development at Mountlucas has not resulted in any displacement effects from birds utilising suitable habitat at Ballycon.

Cumulative disturbance displacement effects with other wind farm projects will not result in increased energy expenditure should birds re-direct their flight lines to avoid large turbines. The location of Mountlucas, Yellow River and Maighne wind farms are largely located outside the core foraging ranges for Whooper Swan and other species. Ample displacement habitat is available in the wider surroundings. Studies have found that birds will habituate to the presence of wind farm structures. In the case of Cloncreen, it is expected that local bird populations will habituate to the presence of the wind farm over time. As the proposed development site is sufficiently spaced apart from other wind energy projects, cumulative disturbance displacement effects on birds is not foreseen.

Given the wide availability of alternative suitable habitat (industrial cutaway bog, birch and willow scrub, etc.) elsewhere in the wider surroundings, cumulative effects associated with habitat loss and disturbance displacement effects with other projects is deemed to be **of low concern**. The total loss of temporary and permanent habitat within the study area together with other wind farm developments in relation to alternative habitat in the wider study area is deemed to be **of low concern**.

6.6.4.1.3 Barrier Effect

Open corridors are necessary to enable birds to migrate and commute between roosting, foraging and breeding sites. The barrier effect is often regarded as being of more concern to large flocks of migrating waterfowl than other bird species groups such as raptors. The European Commission (2011) guidance document highlights the potential risks associated with wind farms located along migration routes or flyways or regularly used flight lines between feeding areas and resting/breeding sites. No significant flocks of migratory wintering birds were regularly recorded commuting through the proposed development site at Cloncreen and Ballycon during VP surveys undertaken from October 2012 to June 2016 particularly during periods of autumn and spring migration. Whooper Swan flight lines were occasionally recorded during winter months but populations were largely restricted to sites in the wider surroundings including Cavemount and Derryarkin.

Percival (2001) makes a recommendation to space turbines greater than 200m apart to avoid inhibiting bird movements that could result in barrier effects. The turbines of the proposed development are spaced a minimum distance of 600m apart. Langston & Pullan (2003) report nocturnal wintering birds flying between turbines in moonlight conditions and flying parallel to turbines in complete darkness. Studies have found that local wintering birds will habituate to the presence of turbines and therefore avoid collision (Langston & Pullan, 2003). No regularly used commuting flight lines were observed passing through the proposed development site to suggest a link between feeding and roost sites within the wider surroundings. Hinterland surveys indicate that waterbird movements between Cloncreen and other wetlands were infrequent (with some movement between Cloncreen and the adjacent Ballycon). Total flight duration and flight activity within the study area was found to be low for all avian receptors identified.

The permitted and operating wind farm developments that occur within a 15km radius of the proposed wind farm development at Cloncreen are well spaced apart with the nearest permitted wind farm development located 4.2km west at Mountlucas. Mountlucas, Yellow River or Maighne were not found to support migratory birds on a regular basis. At Maighne Wind Farm, the overall significance of the barrier effect for all species recorded on site, including Whooper Swan, Golden Plover and Lapwing, was assessed as "low" or "very low".

There were no records of significant flocks of wintering birds commuting through the Cloncreen study area during periods of spring and autumn migration. There are no large natural watercourses in the immediate surroundings that could potentially support significant commuting flocks in the wider study area. In general, waterfowl commuting between feeding and roost sites tend to demonstrate a preference for flight paths associated along natural watercourses as opposed to crossings over mountainous and hilly terrain (Robinson et al. 2004). The low level of bird activity and flight lines recorded minimises any resulting increases in energy expenditure. Wintering waterbirds utilise the study area on occasion. Breeding territories were recorded in low numbers. Given the presence of sub-optimal habitat present onsite (industrial cutaway/cutaway bare peat), the subject site is limited in its potential to support significant bird populations to cause any barrier to movements of birds passing through the site. The distance between the wind farms will not result in any barrier to transit corridors used by birds or losses in increased energy expenditure. The potential barrier effect of the proposed development site together with other wind farm developments is deemed to be **of low significance.**

6.6.4.2 Other (Non-Wind Farm) Projects

Potential for cumulative effects with other projects such as mineral extraction, built development, overhead powerlines, telecommunications masts and recreational pressures were considered during the preparation of this assessment. This section has regard to published guidelines for in-combination effects issued by SNH (2012).

Other projects considered in relation to the potential for in-combination effects and for which all relevant data was reviewed are listed below. Details for each project are presented in Section 2.10.2 of the EIS:

- Clonbullogue Ash Repository
- Edenderry Power Plant
- Peat Extraction: Allen Group
- Peat Extraction: Derrygreenagh Group
- Barrow BlueWay
- Grand Canal Blueway Shared Walking and Cycling Route
- Eastern and Midlands Regional Water Supply Project

The above developments were included for assessment following the precautionary principle It is considered that the effects of the proposed wind farm are largely confined to the site itself with minimal effect on the wider area. This is achieved through informed project design and the employment of construction best practice measures.

The proposed wind farm development itself, in the absence of any mitigation, will only result in slight effects on any bird species during construction, operation or decommissioning (with the exception of Sand Martin – where local populations will be displaced and where specific mitigation is proposed). Any potential effects will be further reduced with the implementation of robust mitigation as described in the following sections.

The projects listed above will not exacerbate the effects of the proposed wind farm in relation to habitat loss, disturbance or collision risk. The wind farm development will not result in any effect on water quality in the surrounding watercourses or result in any other indirect off site effects on bird species or habitats.

It is therefore considered that there will be no significant negative cumulative effects resulting from the proposed Cloncreen development when assessed cumulatively with any of the operations listed above,

6.6.5 Do-Nothing Effect

The land that forms the study area is dominated by industrial cutaway peat which has been actively harvested. Peat production has ceased in many parts of the site and the entire site will be out of peat production by 2018. Following cessation of peat production, a Cutaway Bog Rehabilitation Plan, prepared by Bord na Móna, will be implemented on the site. This will include enhancement of habitat for remnant and pioneer vegetation communities.

If the wind energy development for which this EIS has been prepared does not go ahead, it is to be assumed that the character of the landscape and its landuse will remain much as they are today, i.e. harvesting will continue until 2018 and after this period the cutaway bog will continue to revegetate. Should the proposed wind energy development proceed, it is likely that the main land-use of the area will effectively remain as cutaway/regenerating cutaway bog, with wind energy generation being a land-use that is superimposed over the cutaway bog during the lifetime of the proposed development. The existing Cloncreen Rehabilitation Plan will be revised to take account of the wind farm development.

6.7 Mitigation Measures

This section describes the measures that are in place to mitigate any harmful or negative effects associated with the proposed development on avian receptors as described in the preceding sections. Mitigation measures aim to prevent or minimise likely significant effects on the individual receptors provided subsequently.

6.7.1 Mitigation at the Design Stage

The proposed development avoids ecologically sensitive areas and has been constraints led from the initial design phase. The project design has followed the basic principles outlined below to eliminate the potential for significant effects on avian receptors where possible and to minimise effects where relevant. The site design and layout deliberately avoids designated sites for nature conservation and is well removed from SPAs. This is in line with best practice measures outlined by the European Commission (2011) guidance document in regard to siting of wind farms in areas of low conflict zones for wildlife. Hard standing areas have been designed to the minimum size necessary to maximise areas of semi-natural habitat for birds (i.e. birch and willow scrub, poor fen etc.). The grid connection route options have been selected to utilise built infrastructure (i.e. roads) where possible. Cables have been placed underground in the case of Grid Connection Route Option A to avoid effects on roadside hedgerows and disturbance to nesting birds. Option B will involve less than 100m of overhead line before connecting into an existing powerline. It will not result in any effect on hedgerows or any disturbance to nesting birds.

To summarise, the following measures will be employed during the pre-construction phase that aim to avoid and reduce any likely significant effects on ecological receptors in the wider surroundings through careful planning and design:

- The footprint of the proposed development is restricted to habitats deemed to be of low ecological value. The proposed development avoids wildlife refuge sites such as lakes, ponds, rivers, large watercourses, etc. that may potentially support numbers of wintering waterfowl.

- The proposed development footprint avoids all forms of designated sites particularly SPAs and sites designated for wintering waterbirds.
- Cabling will be primarily underground thereby significantly reducing collision risk to birds during the operational phase of the project. If Substation and Grid Connection Option B are constructed, this would require the installation of less than 0.1 kilometre of overhead line to connect to the existing overhead line onsite, which has been assessed and will not result in significant effects on birds.
- The grid connection will be restricted to existing infrastructure and lands of low ecological sensitivity, thereby minimising disturbance to ground nesting birds in areas of semi-natural habitat adjacent to the grid route.

6.7.2 Mitigation During Construction, Operation and Decommissioning

The following mitigation measures will be employed and will ensure the minimisation of identified effects on birds during the construction, operational and decommissioning phases of the proposed development.

6.7.2.1 Construction Phase Mitigation

The aims and objectives of mitigation measures during the construction phase of the development are to ensure that the ornithological features identified within the core study area and buffers are safeguarded during construction so that any effects identified are reduced where possible. The following measures are proposed for the construction phase:

- The commencement of construction works where the removal of woody vegetation is required, or where works take place in sensitive breeding habitats (such as birch scrub and emergent wetland vegetation), will be scheduled to occur outside the bird nesting season (1st of March to 31st of August) to avoid any potentially significant effects on currently nesting birds. This is mitigation by avoidance of any potential for effects.
- The opening of the borrow pit will be scheduled to occur outside the bird nesting season (1st of March to 31st of August) to avoid any potentially significant effects on the existing Sand Martin colony within the gravel pit. The face of the borrow pit will be realigned to a gentle slope (less than 45°) during the winter season (September to February) to prevent the return of nesting Sand Martins in the following breeding season (following Hopkins (2001)). Alternative habitat using Sand Martin breeding barrels, as recommended by Hopkins (2001). Sand Martin barrels are constructed using a large barrel (e.g. a 10-gallon drum) placed on a stand 1.5-2m above ground level to prevent access by predators. The outside of the barrel is coated in rough sand to attract the attention of prospecting Sand Martin. The inside of the barrel is lined with waterproof paper and filled with a 15-to-1 mixture of sand and cement and allowed to dry. Once dry, nest entrance tunnels 13-15cm in diameter and 35-75cm long are bored out, sloping slightly upwards. The holes are filled with rough, dry sand to allow the Martins to dig a nest tunnel. As the current breeding colony is approximately 35 pairs, a total of 40 holes in the barrels will be suitable. The barrels must be completed before the commencement of the following breeding season (i.e. before the 1st of March). Barrels may be erected in a suitable location away from anthropogenic disturbance and machinery vibrations, and as close to water as possible. This is mitigation by avoidance of any potential for effects.
- The tunnels of the Sand Martin breeding barrels must be cleaned out and refilled in preparation for each breeding season (cleaning must take place

after the 31st of August and before the 1st of March). This is mitigation by avoidance of any potential for effects.
  - Construction operations will take place primarily during daylight hours to minimise disturbances to active nocturnal bird species/roosting birds. This measure is in line with best practice recommendations for mitigation measures in regard to birds and wind farms as recommended by the Royal Society for the Protection of Birds (Drewitt & Langston, 2006).
  - Appoint an Ecological Clerk of Works (ECoW) during the construction phase to:
    - Oversee management of ornithological and ecological issues during the construction period and advise on ornithological issues as they arise with a view to maintaining suitable habitat where possible (i.e. hedgerows, treelines, etc.).
    - Inform and educate on-site personnel of the ornithological and ecological sensitivities within the proposed development site.
    - Provide guidance to contractors to ensure legal compliance with respect to protected species onsite.
    - Liaise with officers of consenting authorities and other relevant bodies with regular updates in relation to construction progress.
- Presence of ECoW during vegetation clearance, earthworks and construction activities during the bird nesting season (if required).
- Undertake a pre-construction transect/walkover bird survey to ensure that significant effects on breeding birds will be avoided. This is mitigation by avoidance of any potential for effects.
- It is expected that following the construction phase, the borrow pit will once again serve as suitable nest habitat for the Sand Martin colony. When construction activity is complete, the face of the borrow pit will be realigned to a vertical face during the winter season (1st September to 28th February). Landscaping will be completed before the beginning of the following breeding season (i.e.1st of March) to allow prospecting Martins to excavate nests within the bank naturally. The breeding barrels may be removed during the winter season (1st September to 28th February) once the vertical face is complete.

6.7.2.2 Residual Effect (Construction Phase)

No effects of high significance were identified for the construction phase of the development.

Habitat Loss: There is predicted to be a **Long-term imperceptible negative effect** of **low significance** on common passerines through habitat loss associated with vegetation clearance and birch scrub removal. Following the implementation of the prescribed mitigation measures as set out above and timing of construction works in certain areas, no significant effects on key avian receptors are foreseen and habitat loss on the species is deemed to be of **Low Significance**.

Disturbance displacement: Following the implementation of the prescribed mitigation measures as set out above, disturbance related effects will be reduced as the timing of works that have been identified as having potential to affect breeding avian receptors will be scheduled to commence outside the bird breeding season. No significant effects were identified on the key avian receptors based on low levels of activity at the site the design of the scheme and the proposed mitigation measures. Given the wide availability of suitable habitat elsewhere in the wider surroundings, any potential effects resulting from land take of suitable avian habitat are deemed to be of **Low significance**.

6.7.2.3 Operational Phase Mitigation

The aims and objectives of mitigation measures during the operational phase of the development are to ensure that the ornithological features identified within the core study are safeguarded and that potential effects are reduced in significance where practical. The following measures are proposed for the operational phase:

- Bird boxes will be erected for common passerines (i.e. Goldfinch, Goldcrest, Robin, etc.) in areas of mixed broadleaved woodland to compensate for the loss of suitable nest habitat elsewhere within the site as a result of the development.
- Following construction, the face of the borrow pit will be realigned to a vertical face to provide suitable nesting opportunity for Sand Martin, following Hopkins (2001).
- Guy wires associated with meteorological masts will be equipped with line markers. Research shows that the attachment of line markers can reduce bird collisions on overhead lines by at least 50-60% (Jenkins et al., 2010; Barrientos et al., 2011; Martin, 2011; APLIC, 2012). This measure is employed to reduce any potential effect resulting from the installation of guy wires.
- Bird flight diverters will be installed on overhead line for Grid Connection Option B in line with best practice guidelines (Eirgrid, 2012). This is to minimise any potential for collision risk to insignificance.
- The Cloncreen rehabilitation plan will facilitate the development of additional birch scrub habitat and emergent wetland vegetation to enhance the ecological value of the site during the wind farm operation.

6.7.2.3.1 Residual Effect (Operational Phase)

No likely effects of significance were identified for the operational phase of the development. Birds are expected to habituate and grow accustomed to the presence of turbine structures and site infrastructure over a short period of time (1 – 2 seasons). The effects of disturbance displacement will decrease over time as birds adjust to the new habitat configuration. This habituation may lead to alterations in foraging behaviour to adapt to a disturbed environment, which may contrast with that of a less perturbed habitat (Welty, 1987). Given the wide availability of suitable habitat elsewhere in the wider surroundings, any potential effects resulting from land take of suitable avian habitat are deemed to be of **Low significance**.

6.7.2.4 Decommissioning Phase Mitigation and Residual Effect

Once electricity generation ceases, the decommissioning of a wind energy development may be undertaken. The effects of this on bird species are assessed below. Given that the proposed operation of the wind farm will be at least 25 years, decommissioning operations will take cognisance of best practice at that time. However, the following measures are proposed in line with current best practice.

- Commencement of decommissioning operations will be timed to avoid sensitive periods (i.e. bird nesting season 1st of March to 31st of August inclusive).
- Decommissioning operations will be undertaken during daylight hours to minimise disturbances to resident fauna during nocturnal periods.
- Any habitat re-instatement will include native species where possible to enhance bird diversity.

Following dismantling of the turbines and removal off-site, direct positive effects are likely to result from the re-instatement of semi-natural habitat in the areas where site infrastructure will be removed.

6.7.3 Summary of Effects

In summary, with the prescribed mitigation measures for birds in place, the proposed development will not result in **Significant residual effects** on bird populations of the study area. Considering the extent of habitat that will be affected and overall low dependency of birds on the site, it is predicted that the proposed development will result in effects of low significance and is assessed as having a **Long-term slight negative effect** of **low significance**.

6.8 Monitoring

A detailed post-construction Bird Monitoring Programme has been prepared for the operational phase of the proposed development and is presented in Appendix 6-6 The programme of works aims to monitor parameters associated with collision, displacement/barrier effects and habituation during the lifetime of the project. Surveys will be scheduled to coincide with Years 1, 2, 3, 5, 10 & 15 of the life time of the wind farm. Monitoring measures are broadly based on guidelines issued by the Scottish Natural Heritage (SNH, 2009). The following individual components are proposed:

- Breeding Bird Surveys (four visits).
- Vantage Point Surveys (with an emphasis on migratory waterfowl during the wintering survey period and spring/autumn migration).
- Targeted bird collision surveys (corpse searches) at turbine bases and overhead lines.
- Wintering and migratory waterfowl counts (August to May inclusive).

6.9 Statement of Significance

Given the findings as described within this assessment, it is considered that the potential effects of the proposed development upon birds will not be considered significant. Effects associated with habitat loss and fragmentation, disturbance, displacement, collision risk and cumulative effects have been assessed as a **Long-term slight negative effect** (EPA, 2002). Magnitude of potential effects for key avian receptors has been assessed as **negligible** to **low** significance while overall effect significance has been assessed as **very low** to **low** (Percival, 2003). The implementation of the prescribed mitigation measures will render any potential effects on avian receptors to **low significance**. In conclusion, no significant effects as a result of the proposed development are foreseen on key avian receptors of the study area.

7 SOILS AND GEOLOGY

7.1 Introduction

7.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by McCarthy Keville O'Sullivan (MKO) to carry out an assessment of the likely significant effects of a proposed 21 no. turbine wind farm, proposed borrow pit, haul route works and substation/grid connection route options (Option A – eastern substation and underground grid cable and Option B – southern substation and overhead grid connection) at Cloncreen, Co. Offaly on the soil and geological environment. The detailed project description is provided in Chapter 3.

This report provides a baseline assessment of the environmental setting of the proposed wind farm site, proposed borrow pit, haul route junction and road works and grid connection route options in terms of soils and geology and discusses the potential likely significant effects that the construction and operation of the proposed development will have. Where required, appropriate mitigation measures to limit any identified significant effects to soils and geology are recommended.

7.1.2 Relevant Legislation

The EIS is carried out in accordance with the follow legislation:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations and subsequent amendments (S.I. No. 84 of 1995, S.I. No. 351 of 1998, S.I. No. 93 of 1999; S.I. No. 450 of 2000; S.I No. 538 of 2001);
- The Planning and Development Acts, 2000-2015;
- Planning and Development Regulations 2001-2015
- S.I. No. 4 of 1995: The Heritage Act 1995, as amended; and
- Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment.

7.1.3 Relevant Guidance

The soils and geology section of this EIS is carried out in accordance with guidance contained in the following documents:

- Environmental Protection Agency (September 2015): *Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements)*;
- Environmental Protection Agency (September 2015): *Draft – Revised Guidelines on the Information to be Contained in Environmental Impact Statements;*
- Environmental Protection Agency (2003): *Advice Notes on Current Practice (in the Preparation on Environmental Impact Statements*);
- Environmental Protection Agency (2002): *Guidelines on the Information to be Contained in Environmental Impact Statements*;
- Institute of Geologists Ireland (2013): *Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements*; and,
- National Roads Authority (2005): *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*.

7.2 Schedule of Works

7.2.1 Desk Study

A desk study of the wind farm site, grid connection route options, third party lands and third party turbary lands, and the surrounding study area was largely completed in advance of undertaking the walkover survey and site investigations. The desk study involved collecting all the relevant geological data for the proposed development study area. This included consultation with the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - National Draft Bedrock Aquifer map;
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 15 (Geology of Galway - Offaly);
- Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets; and,
- General Soil Map of Ireland 2nd edition (www.epa.ie);

7.2.2 Baseline Mapping and Site Investigations

Geological mapping and a detailed walkover survey was undertaken by HES on 6th January 2016. Geotechnical ground investigations and a peat stability assessment were undertaken by Applied Ground Engineering Consultants AGEC Ltd during November and December 2015. Additional site investigations were undertaken by HES during April 2016.

In summary, site investigations to address the soil and geology section of the EIS included the following:

- A total of over 860 no. peat probe depths were carried out by AGEC Ltd and HES to determine the depth and geomorphology of the cutover peat at the site which includes the proposed grid connection route options;
- A borrow pit feasibility assessment by AGEC Ltd (December, 2015);
- Either window sampling or trial pits were undertaken at each turbine location, the proposed borrow pit and proposed substation Options A & B to investigate peat and mineral subsoil lithology;
- A geotechnical assessment of peat stability by AGEC Ltd (September, 2016);
- A total of 26 no. window sample points and 44 no. trial pits were undertaken across the site to investigate peat and mineral soil lithology;
- Logging of subsoil exposures; and,
- Mineral subsoils and peat were logged according to BS: 5930 and Von Post Scale respectively.

The Peat Stability Assessment report prepared by AGEC Ltd is included as Appendix 7-1 of this EIS. The Geotechnical Risk Register is presented in Appendix 7-2.

7.2.3 Impact Assessment Methodology

Using information from the desk study and data from the site investigation, an estimation of the importance of the soil and geological environment within the study area is assessed using the criteria set out in Table 7.1 (NRA, 2005).

Table 7.1 Estimation of Importance of Soil and Geology Criteria (NRA, 2005)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale. Degree or extent of soil contamination is significant on a national or regional scale. Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA). Large existing quarry or pit. Proven economically extractable mineral resource
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes. Geological feature of high value on a local scale (County Geological Site). Well drained and/or high fertility soils. Moderately sized existing quarry or pit. Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying site is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed Wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral Resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

The statutory criteria for the assessment of likely significant effects require that likely effects are described with respect to their extent, magnitude, type (*i.e.* negative, positive or neutral) probability, duration, frequency, reversibility, and transfrontier nature (if applicable). The descriptors used in this environmental impact statement are those set out in the EIA Directive; see glossary of effects in Chapter 1 of this EIS. In addition, the two impact characteristics proximity and probability are described for each impact and these are defined in Table 7.2.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of effects are related to examples of potential likely significant effects on the geology and morphology of the existing environment, as listed in Table 7.3.

Table 7.2 Additional Impact Characteristics

Impact Characteristic	Degree/ Nature	Description
Proximity	Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	Low	A low likelihood of occurrence of the impact.
	Medium	A medium likelihood of occurrence of the impact.
	High	A high likelihood of occurrence of the impact.

Table 7.3 Impact descriptors related to the receiving environment

Impact Characteristics		Potential Geological/Hydrological Impacts
Quality	Significance	
Negative only	Profound	Widespread permanent impact on: - The extent or morphology of a cSAC. - Regionally important aquifers. - Extents of floodplains. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Significant	Local or widespread time dependent impacts on: -The extent or morphology of a cSAC / ecologically important area. -A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). -Extent of floodplains. Widespread permanent impacts on the extent or morphology of a NHA/ecologically important area, Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.
Positive or Negative	Moderate	Local time dependent impacts on: - The extent or morphology of a cSAC / NHA / ecologically important area. - A minor hydrogeological feature. - Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends
Positive, Negative or Neutral	Slight	Local perceptible time dependent impacts not requiring mitigation.
Neutral	Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

7.3 Existing Environment

7.3.1 Site Description and Topography

Cloncreen Bog ("the site") which is a Bord na Móna peat harvesting bog is part of The Bog of Allen. The site is located approximately 2km to the northeast of the village of Clonbullogue and 4.5km southwest of Edenderry in County Offaly. The total site area is approximately 960ha (9.6km^2).

The Edenderry Power Station is located immediately to the east of the bog with an associated ash waste facility, located in the southeast of the proposed development site. A site compound relating to the peat harvesting works exists close to the main site entrance on the northwestern boundary of the site. The vast majority of the site comprises heavily drained cutover raised bog. A number of industrial railway lines intersect the site that services the adjacent bogs, the power station and ash repository.

The topography of the development site is relatively flat with an elevation range of between approximately 68 and 72mOD (metres above Ordnance Datum). Along the majority of the site boundary a 1 to 2m high peat bank exists which is a remnant of the original bog. These perimeter peat banks create a boundary berm, forming a basin effect within the extraction area of the overall bog.

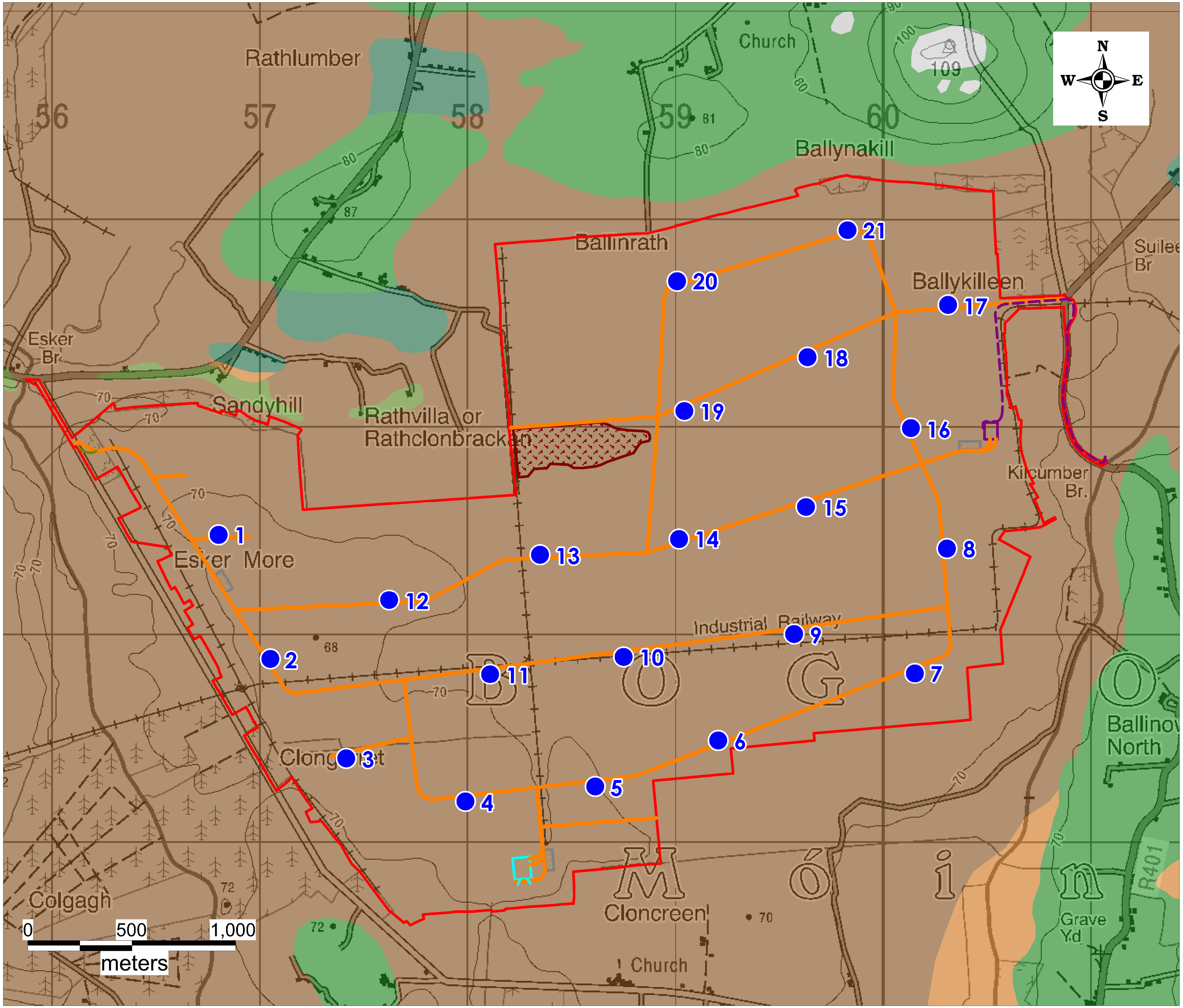
The surface of the cutover bog is drained by a network of east / west orientated drains that are typically spaced every 15 to 20m. These drains typically slope in both an easterly and westerly direction from the central north / south railway track line. Surface water outflows from the bog are predominately located along the western southern and eastern boundaries of the site and comprise both gravity and pumped outfalls. The drainage and hydrology of the site is described in detail in Chapter 8.

7.3.2 Soils and Subsoils – General

The published soils map (www.epa.ie) for the area shows that cutaway raised bog is exclusively mapped in the proposed development site. Other soil types mapped in the wider area outside of the site include surface water gleys/groundwater gleys (BminPD), peaty basic gleys (BminPDPT), shallow gleys (BminSP) and mineral alluvium (AlluvMIN). A map of the local subsoil cover is attached as Figure 7.1 (www.gsi.ie) and again this shows the site to be entirely covered by cutover peat.

Prior to the wind farm investigation work commencing all existing Bord na Móna peat depth data was collated and analysed. A total of no. 34,940 peat depth points were estimated using Lidar data. This was undertaken by subtracting the ground surface elevation from the established elevation of the underlying mineral subsoils (*i.e.* lacustrine clays or calcareous marl).

The locations of the peat depths are shown on Figure 7.2 and a peat depth distribution analysis is shown on Plate 7.1 below. The majority of the peat depths (~84.1 %) occur within the 0 – 2.0m range. Only ~16% of the estimated peat depths exceeded 2m, and these are largely located on the perimeter of the bog where no wind farm infrastructure is proposed.



Legend

- Proposed Site Boundary
- Proposed Road
- Proposed Turbine Location
- Proposed Substation A
- Proposed Substation B
- Proposed Grid Connection - Option A
- Proposed Grid Connection - Option B
- Construction Compound
- Proposed Borrow Pit
- Alluvium
- Cutover Bog
- Limestone Gravels
- Made Ground
- Rock at Surface
- Limestone Tills

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Title: Local Subsoils Map

Client: McCarthy Keville O'Sullivan

Job: Cloncreen WF

Project No: P1308-0

Figure No: 7.1

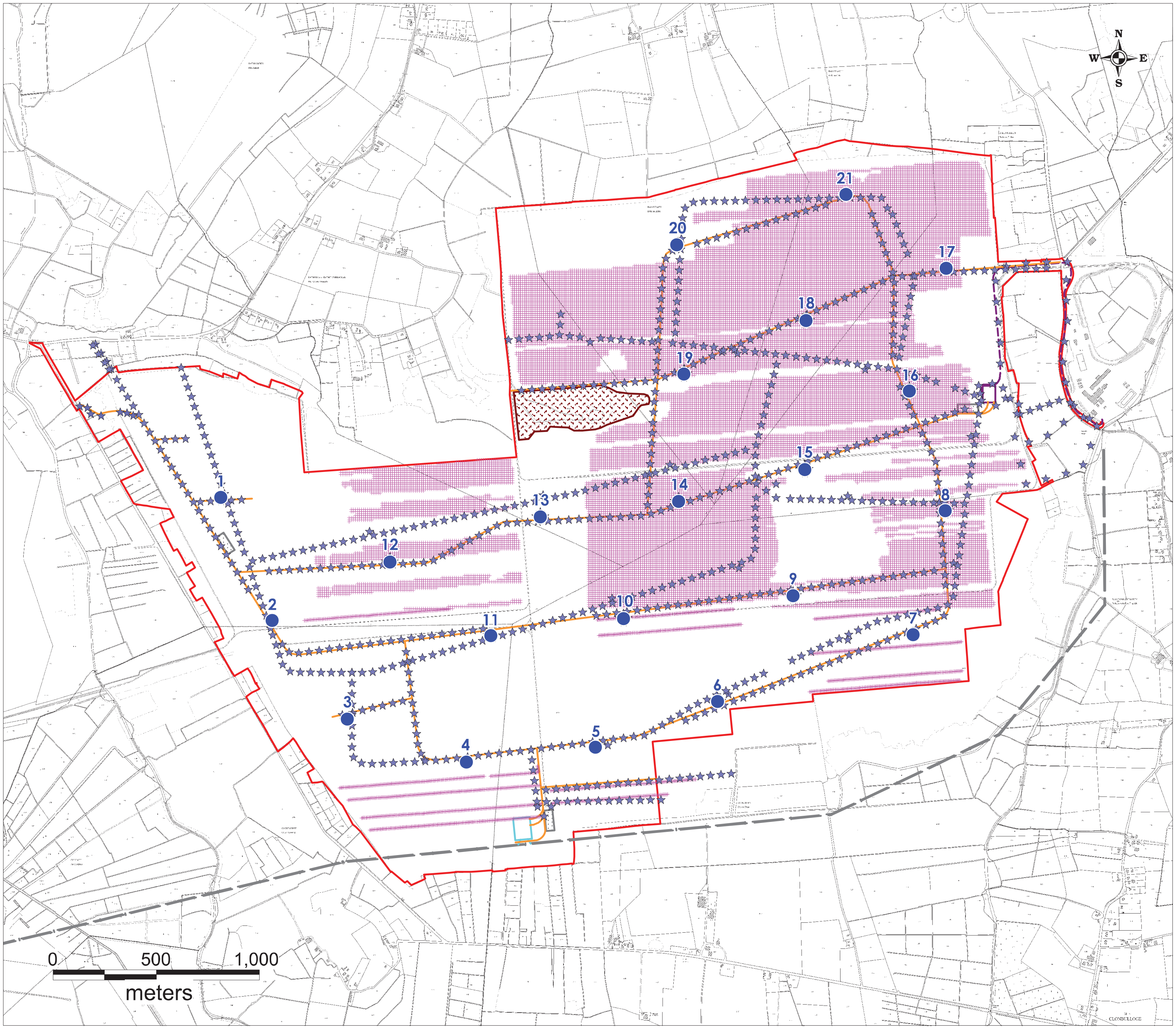
Sheet Size: A4

Drawing No: P1308-0-1215-701-A4-0A

Date: 27/09/2016

Scale: 1:25000

Drawn By: GD | Checked By: MG



Legend

- Proposed Site Boundary
- Proposed Road
- Proposed Turbine Location
- SI Peat Probe Location (860 no.)
- Lidar Inferred Peat Depth Location (34,940 no.)
- Proposed Substation A
- Proposed Substation B
- Proposed Grid Connection Option A
- Proposed Grid Connection Option B
- Construction Compound
- Proposed Borrow Pit
- Existing 110kV OHL

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Client: McCarthy Keville O'Sullivan

Job: Cloncreen WF, Co. Offaly

Title: All Peat Depths Location Map

Figure No: 7.2

Drawing No:P1308-0-0416-702-A3-0A

Sheet Size: A3	Project No: P1308-0
Scale: 1:25,000	Drawn By: GD
Date: 27/09/2016	Checked By: MG

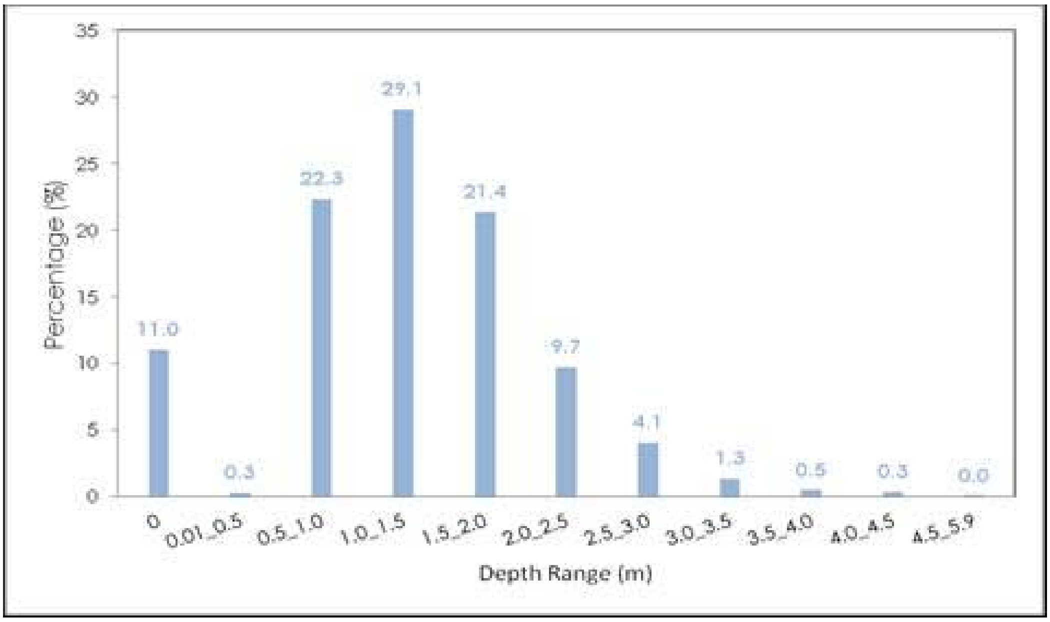


Plate: 7.1 Peat Depth Distribution Range for Bord na Móna Peat Depth Data

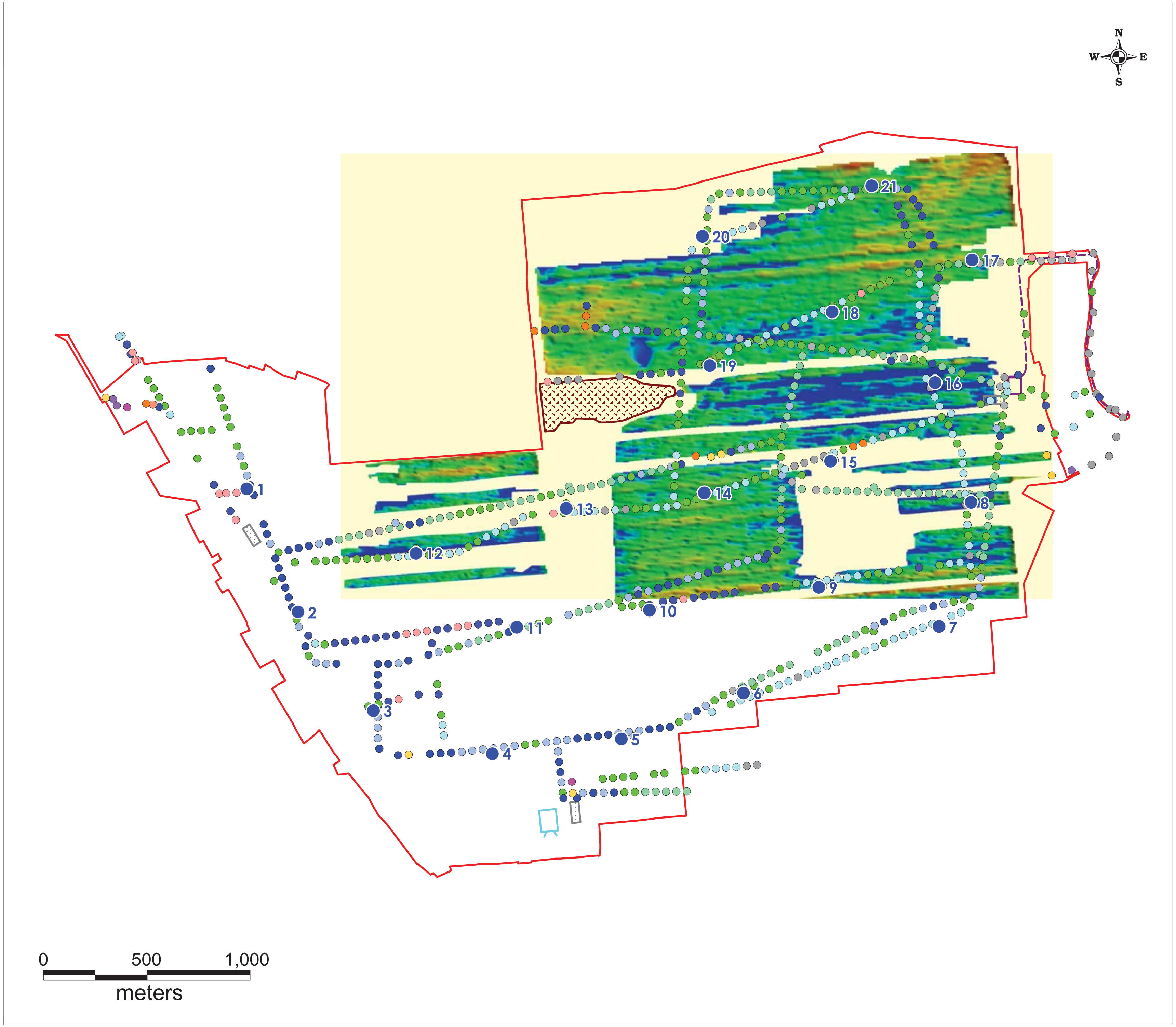
A total of approximately 860 no. peat probes were undertaken at the proposed development site as part of the wind farm investigations (summary peat depth maps are shown as Figure 7.2 and Figure 7.3). The peat probes were undertaken along the proposed development footprint of the wind farm (*i.e.* along proposed access roads, turbine locations, substations etc) and also along the proposed grid connection route Option A and Option B.

Overall peat depths recorded during the peat probing investigation ranged from 0 to 4.8m with an average of 1m. The peat depth range distribution plot for the proposed wind farm infrastructure areas and grid connection route options (refer to Plate 7.2) shows that the distribution with highest number of peat depth is the 0.01 to 0.5m range (28.6%). This was followed closely by the 0.5 to 1.0m range (24.7%). Of the total number of peat depth taken, 78% were below 1.5m with 84% being below 2.0m (*i.e.* similar to the larger dataset discussed above).

The peat depths recorded at proposed turbine locations T1 to T21 varied from 0 to 3.1m with an average of 1.1m (refer to Table 7.4 below). The majority of the peat depths at turbine locations were less than 1m. Peat depths recorded along the proposed access roads were typically less than 2.0 and locally up to 4.8, with an average of 0.84m. The peat depths along the proposed grid connection route Option A and Option B, are typically below 1m and locally up to 2m.

In order to investigate the peat and mineral subsoil lithology at the proposed turbine locations, substation Options A & B and the proposed borrow pit, a combination of trial pits and window sampling was undertaken. Shown on Table 7.4 below is a summary of the mineral subsoil lithology at the proposed development locations along with the investigation method used (*i.e.* window sampling or trial pit). The locations of the trial pits and window sample points are shown on Figure 7.4. Trial pits logs are included in Appendix 7-1 and window sample logs are included in Appendix 7-3.

Trial pits and window sampling undertaken at the proposed development locations typically encountered well drained, black/brown, firm pseudo-fibrous or fibrous PEAT that was sometimes amorphous.



Legend

- Proposed Site Boundary
- Proposed Turbine Location
- Proposed Substation A
- Proposed Substation B
- Proposed Grid Connection - Option A
- Proposed Grid Connection - Option B
- Construction Compound
- Proposed Borrow Pit

Peat Probe Depth Legend

- 0m
- 0 - 0.5m
- 0.5 - 1.0m
- 1.0 - 1.5m
- 1.5 - 2.0m
- 2.0 - 2.5m
- 2.5 - 3.0m
- 3.0 - 3.5m
- 3.5 - 4.0m
- 4.5 - 5m

BnM Peat Depth Legend (Lidar data)

4.4m
4.0m
3.5m
3.0m
2.5m
2.0m
1.5m
1.0m
0.5m
0.0m

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Client: McCarthy Keville O'Sullivan

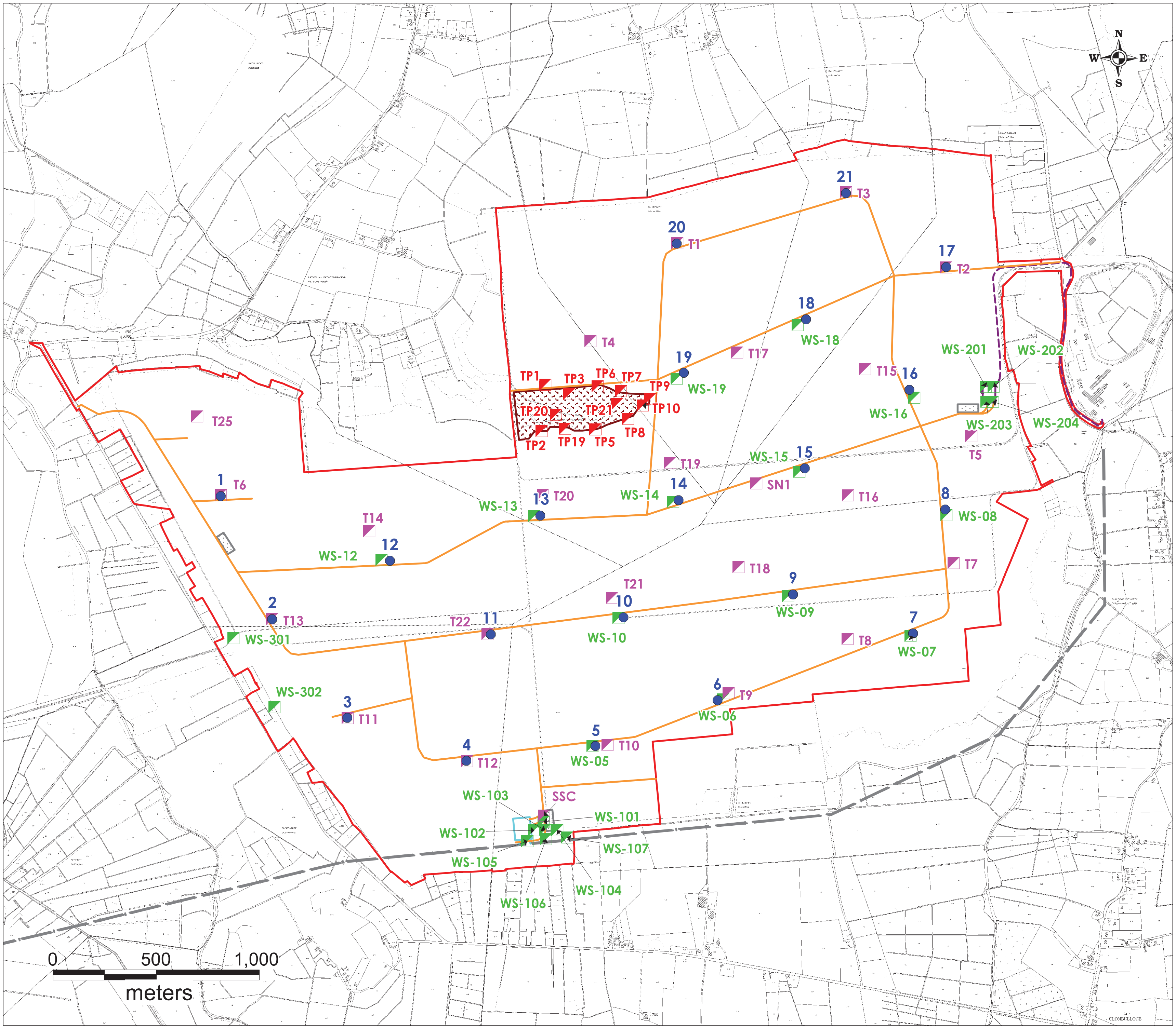
Job: Cloncreen WF, Co. Offaly

Title: Peat Depth Locations Map

Figure No: 7.3

Drawing No:P1308-0-0416-703-A3-0A

Sheet Size: A3	Project No: P1308-0
Scale: 1:25,000	Drawn By: GD
Date: 27/09/2016	Checked By: MG



Legend

- Proposed Site Boundary
- Proposed Road
- Proposed Turbine Location
- Borrow Pit Trial Pit Location (AGEC)
- Window Sample Location (HES)
- Trial Pit Location (AGEC)
- Proposed Substation A
- Proposed Substation B
- Proposed Grid Connection - Option A
- Proposed Grid Connection - Option B
- Construction Compound
- Proposed Borrow Pit
- Existing 110kV OHL

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Client: McCarthy Keville O'Sullivan	
Job: Cloncreen WF, Co. Offaly	
Title: Window Sample and Trial Pit Locations Map	
Figure No: 7.4	
Drawing No:P1308-0-0416-704-A3-0A	
Sheet Size: A3	Project No: P1308-0
Scale: 1:25,000	Drawn By: GD
Date: 27/09/2016	Checked By: MG

The mineral subsoil underlying the peat at the proposed turbine locations typically comprised shell marl, lacustrine deposits and glacial tills. Where the shell marl and lacustrine deposits are present they overlie the glacial tills. The lacustrine deposits comprised soft, grey laminated CLAY with these deposits having a thickness of just over 4m in places. The lacustrine deposits were also typically inter-bedded with lenses of silt and sand. Lacustrine deposits were found below the peat at turbine locations T5, T7, T8, T10, T13, T14 and T18. The peat at the remainder of the turbine locations were found to be underlain by glacial till deposits. Where the Lacustrine deposits are present, they were also found to be underlain by glacial tills. The glacial till deposits typically comprised SILT, SAND or GRAVEL dominated matrixes with varying proportions of minor constituents of clay, sand and gravel. Bedrock was not encountered at any of the proposed turbine locations. An Esker ridge is located on the north of the site in the area of the proposed borrow pit which is discussed below.

7.3.3 Soils and Subsoils – Substation (Option A and Option B)

The peat depths at the proposed substation Option A vary between 0 and 1.8m while peat depths at the proposed substation Option B vary between 1.8 and 2.2m.

The peat at the proposed substation Option A location was found to be underlain mainly by Lacustrine deposits which comprised mostly of soft laminated CLAY. The thickness of the Lacustrine clay in the area of substation Option A is between 0.32m and 2.75m. The Lacustrine clay was found to be underlain by medium dense silty SAND.

Likewise, the peat at the proposed substation Option B was also found to be underlain by Lacustrine deposits. However, the lacustrine deposits at this location comprised mainly of very soft shell Marl (calcareous mudstone) along with some CLAY. The thickness of the Lacustrine marl/clay in the area of the proposed substation Option B is between 0.25m and 3.75m. The Lacustrine marl/clay was found to be underlain by medium dense silty GRAVEL.

7.3.4 Soils and Subsoils – Proposed Borrow Pit

The peat depths in the unworked areas of the proposed borrow pit averaged at 1.7m. Sand and gravels are exposed in the western and eastern sections of the borrow pit area where extraction was previously undertaken. The proposed borrow pit is located along an esker ridge.

Trial pits (10 no.) were carried out within the unworked section of the esker deposit at the proposed borrow pit, and 2 no. trial pits were carried out within the existing extraction area. The general ground conditions comprised peat (in unworked sections) overlying local lacustrine deposits overlying glacial granular soils. The glacial deposits were typically described as sandy GRAVEL / gravelly SAND with cobbles and boulders. The glacial deposits have in the past been extracted from the proposed borrow pit area.

Details regarding proposed extraction volumes from the on-site borrow pit are shown in Section 7.4 below.

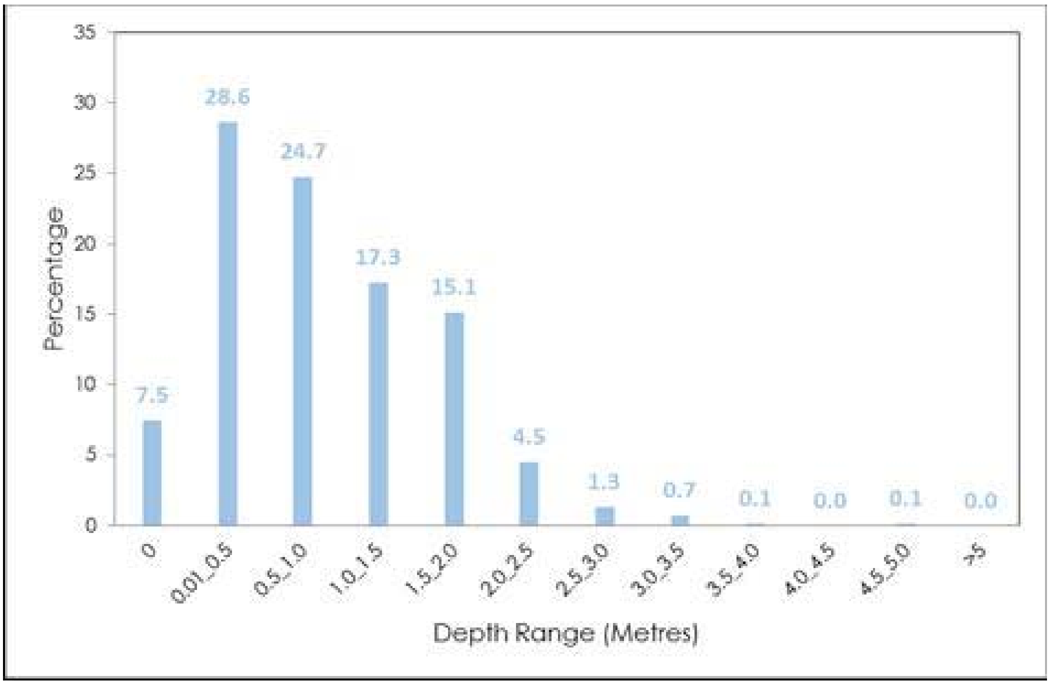


Plate: 7.2 Peat Depth Distribution Range for Proposed Infrastructure Footprint Area

Table 7.4 Summary of Peat Depths and Mineral Subsoil Lithology at Proposed Development Locations

Location	S.I. ID	Average Peat Depth (m)[1]	Summary of Underlying Mineral Subsoil Lithology
T1	TP-T6	2.7	Grey, soft to firm, slightly sandy, gravelly, SILT
T2	TP-T13	1.7	Slightly sandy, slightly gravelly SILT over sandy, GRAVEL
T3	TP-T11	1.7	Highly organic yellow soil over grey slightly clayey SILT
T4	TP-T12	0.7	Highly organic yellow soil over coarse SAND and clayey, slightly sandy, gravelly SILT
T5	WS-05	1.2	Soft, grey CLAY, with interbedded lenses of soft silt
T6	WS-06	0.2	Gravelly sandy SILT over silty GRAVEL
T7	WS-07	0.6	Soft, grey CLAY, with interbedded lenses of silt and fine sand
T8	WS-08	0	Soft grey CLAY over SAND
T9	WS-09	0.2	Gravelly, sandy SILT/CLAY over possible gravel
T10	WS-10	2.65	Soft, grey CLAY over gravelly sandy SILT
T11	TP-T22	0.7	Slightly clayey, slightly sandy SILT over sandy, gravelly SILT
T12	WS-12	0.3	Grey, fine SAND over CLAY over sandy gravelly SILT/CLAY
T13	WS-13	0.8	Soft, grey CLAY over sandy silty GRAVEL
T14	WS-14	0.65	Soft, grey CLAY over sandy silty GRAVEL
T15	WS-15	0.2	Grey, coarse SAND over sandy, silty GRAVEL

Location	S.I. ID	Average Peat Depth (m)[1]	Summary of Underlying Mineral Subsoil Lithology
T16	WS-16	0.3	Grey, fined grained SAND
T17	TP-T2	0.5	Grey, soft, sandy, SILT
T18	WS-18	0.4	Soft, gey CLAY over silty SAND
T19	WS-19	0.6	Soft, silty CLAY over sandy GRAVEL
T20	TP-T1	1.0	Grey, slightly sandy, gravelly, SILT
T21	TP-T3	0.8	Made Ground over grey, soft, slightly sandy, gravelly, SILT
Option A Substation	Footnote 2	0.8	Soft, grey CLAY and SILT over silty SAND
Option B Substation	Footnote 3	2.2	Marl and soft, grey CLAY over silty GRAVEL in places
Borrow Pit	Footnote 4	1.7	Sandy GRAVEL / gravelly SAND with cobbles and boulders

1. Average peat depth from peat stability investigation (AGEC, Sept 2016);
2. Based on 4 no. investigation locations (WS-201 to WS-204);
3. Based on 8 no. investigation locations (WS-101 to WS-107 & TP-SSC);
4. Based on 10 no. investigation locations (BP-TP-1 to BP-TP-3, BP-TP-5 to BP-TP-10 & BP-TP-19). These trial pits were completed in the unworked area of the existing borrow pit.

7.3.5 Bedrock Geology

Based on the GSI bedrock map the bedrock units underlying the proposed development site comprises Dinantian Pure Bedded Limestone (DPBL). There are no mapped faults intersecting the site, however a number of faults exist 1 – 2km to the southeast of the site. At Edenderry the Waulsortian mudbanks are set in a matrix of darker oolitic limestones known as the Edenderry Oolite formation. A bedrock geology map of the area is attached as Figure 7.5.

7.3.6 Geological Resource Importance

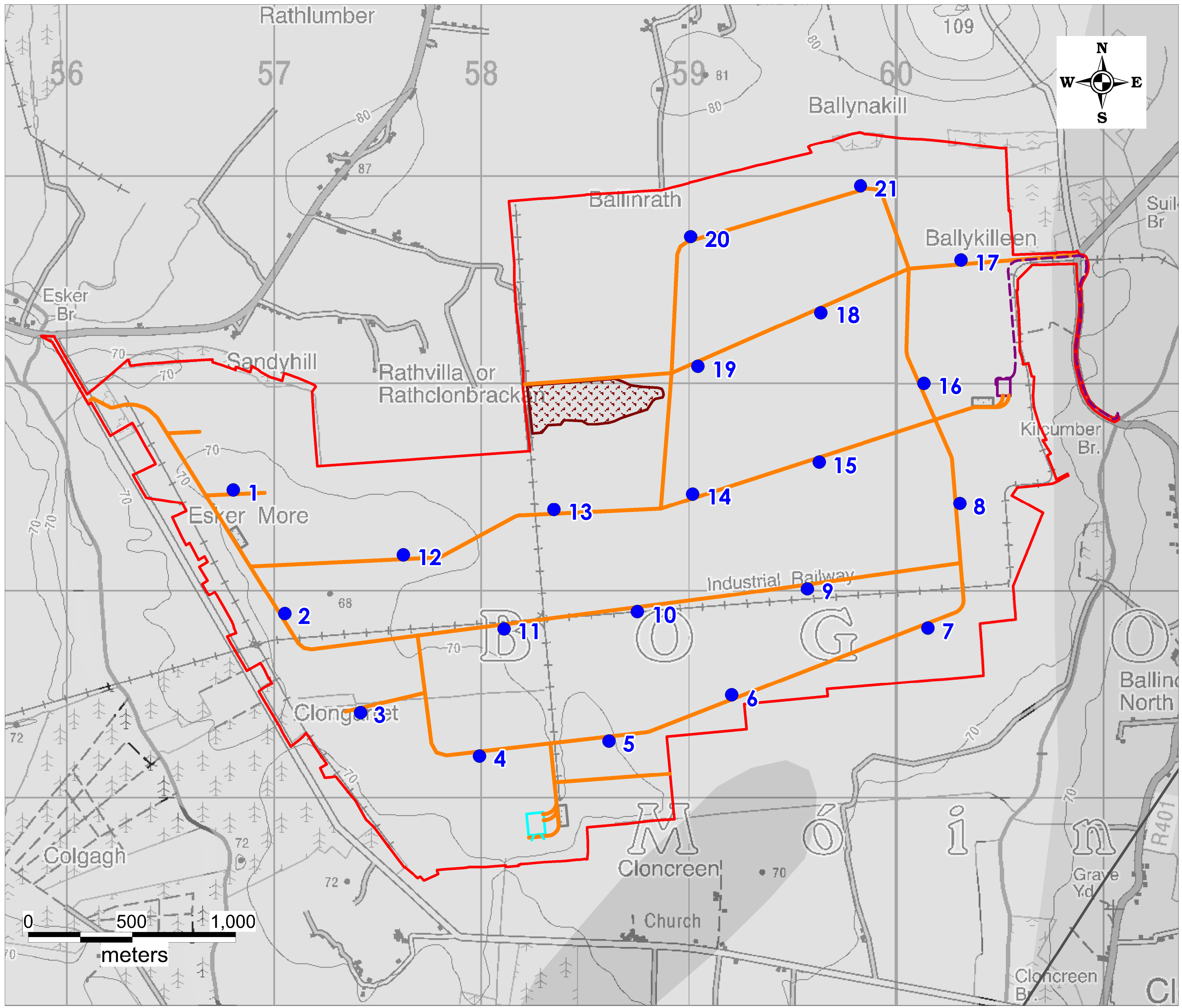
The limestone bedrock underlying the site could be classified as "Medium" importance. The bedrock could be used on a "sub-economic" local scale for construction purposes. The bedrock has not been used in the past at the site for this purpose.

The glacial subsoils (*i.e.* sands and gravels where present) could be classified as "Medium" importance. The glacial subsoils could be used on a "sub-economic" local scale for construction purposes. There is an existing sand and gravel pit at the proposed development site which was used in the past for on-site landscaping and railway embankments.

The overlying peat deposits at the site could be classified as "Low" importance as the peat is not designated in this area and is significantly degraded in most places at the site as a result of industrial peat production/extraction and drainage. Refer to Table 7.1 for definition of these criteria.

7.3.7 Geological Heritage and Designated Sites

There are no recorded Geological Heritage sites, mineral deposit sites or mining sites (current or historic) within the proposed development area. The proposed development is not located within any designated site.



Legend

- Proposed Site Boundary
- Proposed Turbine Location
- Proposed Road
- Proposed Substation A
- Proposed Substation B
- Proposed Grid Connection - Option A
- Proposed Grid Connection - Option B
- Construction Compound
- Proposed Borrow Pit
- Pure Bedded Limestone
- Upper Impure Limestone
- Mapped Faults

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Title: Local Bedrock Geology Map

Client: McCarthy Keville O'Sullivan

Job: Cloncreen WF

Project No: P1308-0

Figure No: 7.5

Sheet Size: A4

Drawing No: P1308-0-1215-705-A4-0A

Date: 27/09/2016

Scale: 1:25000

Drawn By: GD | Checked By: MG

7.3.8 Peat Stability Assessment

This section summarises the report on assessment of peat stability undertaken by AGEC Ltd (September, 2016) for the proposed 21 no. turbines and related infrastructure. The peat stability assessment report is included as Appendix 7-1 of this EIS.

The purpose of the peat stability assessment was to determine the stability *i.e.* Factor of Safety (FoS), of the peat slopes where construction is proposed during the development of the wind farm. This involved geotechnical assessments of each of the infrastructure locations and included peat depth measurements and in-situ shear strength testing. Slope inclinations at the main infrastructure locations range from 0 to 2 degrees, which is relatively flat.

The findings, which involved analysis of over 685 no. locations, showed that the site has an acceptable margin of safety and is suitable for the proposed wind farm development. The findings include recommendations and control measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety. The flat topography/nature of the terrain on site highlights the low risk of peat failure.

The hand vane results indicate undrained shear strengths in the range 12 to 70kPa, with an average value of about 37kPa. The strengths recorded would be typical of well drained peat as is present on the Cloncreen site.

Peat strength at sites of known peat failures (assuming undrained loading failure) are generally very low, for example the undrained shear strength at the Derrybrien failure (AGEC, 2004) as derived from essentially back-analysis, though some testing was carried out, was estimated at 2.5kPa. The recorded undrained strengths at the Cloncreen site are significantly greater than the lower bound values for Derrybrien indicating that there is no close correlation to the peat conditions at the Derrybrien site, and that there is significantly less likelihood of failure on the Cloncreen site.

The minimum required Factor of Safety (FoS) is 1.3 based on BS6031:1981: Code of Practice for Earthworks (BSI, 2009). The assigned probability of instability associated with a given FoS value is described in Table 7.5 below.

Table 7.5 Probability of instability Scale for Factor of Safety

Scale	Factor of Safety	Probability
1	1.30 or greater	Negligible/None
2	1.29 to 1.20	Unlikely
3	1.19 to 1.11	Likely
4	1.01 to 1.10	Probable
5	<1.0	Very Likely

7.3.8.1 Peat Stability Assessment Results

<u>Undrained Analysis</u>

The results of the undrained analysis for the peat are presented in Table 7.6 below (for the turbine locations).

The calculated FoS for load condition (1)[1] is in excess of 1.30 for each of the locations (over 685 no. locations) analysed with a range of FoS of 1.78 to in excess of 10, indicating

[1] No surcharge loading

a low risk of peat instability. The calculated FoS for load condition (2)[2] is in excess of 1.30 for each of the locations (over 685 no. locations) analysed with a range of FoS of 1.31 to in excess of 10, indicating a low risk of peat instability.

Drained Analysis
The results of the drained analysis for the peat are presented in Table 7.7 (for the turbine locations).

The calculated FoS for load condition (1) is in excess of 1.30 for each of the locations (over 685 no. locations) analysed with a range of FoS of 1.30 to in excess of 10 except for 2 no. locations where FoS's of 1.19 and 1.22 were calculated.

It should be noted that at the locations where the low FoS's were calculated, the slope angles were based on contour survey plans for site which give approximate values. Based on site data recorded during the walkover, it is likely that the slope angles derived from the contour survey plans overestimated the slope angle at these locations. Peat instability at these locations will not be an issue if the proposed control measures are put in place. Please refer to the AGEC report for full details of this assessment.

The calculated FoS for load condition (2) is in excess of 1.30 for each of the locations (over 685 no. locations) analysed with a range of FoS of 1.82 to in excess of 10, indicating a low risk of peat instability.

Table 7.6 Factor of Safety Results (undrained condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T1	256800	226488	6.14	4.53
T2	257048	225892	19.10	12.28
T3	257413	225414	8.19	5.55
T4	257989	225205	42.98	19.10
T5	258613	225277	11.47	6.88
T6	259204	225499	98.24	25.47
T7	260151	225822	28.65	15.63
T8	260306	226423	No Peat	
T9	259569	226011	68.77	22.92
T10	258749	225901	11.09	8.39
T11	258107	225818	21.50	9.56
T12	257619	226175	68.77	22.92
T13	258347	226393	11.47	6.88
T14	259015	226468	13.76	7.65
T15	259626	226622	38.23	11.86
T16	260132	227002	98.24	25.47
T17	260311	227596	14.34	7.82
T18	259633	227344	49.12	20.23
T19	259041	227084	34.38	17.19
T20	259006	227710	31.26	16.37
T21	259825	227955	34.38	17.19

[2] Surcharge of 10 kPa, equivalent to 1 m of stockpiled peat assumed as a worst case.

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
Substation Option A	260518	226977	5.47	3.52
Construction Compound 1	260416	226905	22.96	7.65
Substation Option B	258261	224874	6.26	4.30
Construction Compound 2	258388	224914	2.62	1.80
Construction Compound 3	256824	226258	22.92	13.75
Met Mast	256614	226783	24.58	10.12

Table 7.7 Factor of Safety Results (drained condition)

Turbine No./Waypoint	Easting	Northing	Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
T1	256800	226488	4.10	6.53
T2	257048	225892	12.73	17.73
T3	257413	225414	5.46	8.01
T4	257989	225205	28.65	27.58
T5	258613	225277	7.65	9.93
T6	259204	225499	65.49	36.77
T7	260151	225822	19.10	22.56
T8	260306	226423	No peat recorded	
T9	259569	226011	45.85	33.09
T10	258749	225901	7.39	12.11
T11	258107	225818	14.34	13.79
T12	257619	226175	45.85	33.09
T13	258347	226393	7.65	9.93
T14	259015	226468	9.17	11.03
T15	259626	226622	25.49	17.12
T16	260132	227002	65.49	36.77
T17	260311	227596	9.56	11.28
T18	259633	227344	32.75	29.20
T19	259041	227084	22.92	24.82
T20	259006	227710	20.84	23.64
T21	259825	227955	22.92	24.82
Substation Option A	260518	226977	3.65	5.07
Construction Compound 1	260416	226905	15.31	11.03
Substation Option B	258261	224874	4.17	6.21
Construction Compound 2	258388	224914	1.75	2.59
Construction Compound 3	256824	226258	15.28	19.86
Met Mast	256614	226783	16.38	14.60

In summary the findings of the peat assessment showed that the proposed Cloncreen wind farm site has an acceptable margin of safety and is suitable for the proposed wind farm development and proposed grid connection options. There is a low risk of peat failure at the site. The findings include recommendations and control measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety. The control measures are given in the AGEC Ltd peat stability assessment report to manage all risks associated with peat instability.

7.4 Characteristics of the Proposed Development

The proposed development will typically involve removal of peat and subsoils for access roads, internal access road networks, internal cable network, hardstanding emplacement, turbine foundations, substations, crane hardstands, compounds, met mast and the grid connection trench (Option A), or foundations for grid connection pylons (Option B). Aggregate for construction work will be sourced from 1 no. on-site proposed borrow pit and from suitable off site sources. There will be a minimal requirement for excavation work at the proposed haul route junction upgrades.

Estimated volumes of peat to be removed are shown in Table 7.8 below. The proposed volumes of granular construction material to be sourced from the on-site borrow pit and from suitable off-site sources are shown in Table 7.9 below.

In terms of peat handling and long term storage of excavated peat Bord na Móna has considerable experience in this area, both during peat production operations and during the rehabilitation processes associated with its cutaway bogs. This experience has shown that the most environmentally sensitive and stable way of handling and moving of excavated peat is its placement across the site and at locations as close as possible to the extraction areas.

Further details are provided in the Peat Management Plan (AGEC Ltd, September 2016) for the works which is included in Appendix 7-4.

Table 7.8 Summary of Estimated Peat Excavation Volumes

Development Component	Area (m^2) (approximate)	Peat Volume (m^3) Option A[1] (approximate)	Peat Volume (m^3) Option B[2] (approximate)
21 no. Turbines	Assumed a typical turbine foundation dig out (where applicable)	590	
21 no. Crane Hardstands	Plan area of triangular hardstand is c. 2,690m², plan area of rectangular hardstand is c. 1,816m², plan area of square hardstand is c. 225m²	98,770	
New Proposed Access Roads (includes lay-bys)	Total length of new proposed access road is c. 21.5km	213,385	
1 no. Site Entrance Construction Compounds	Plan area is c. 4,000m²	6,240	
Substation and construction compound (Option A)	Plan area of substation platform is c. 5,000m² and construction compound is c. 4,000m²	5,760	
Underground cable – Option A	c. 600 wide x 1200mm deep trench. Length of cable route is 18km (approx.)	13,920	

Development Component	Area (m^2) (approximate)	Peat Volume (m^3) Option A[1] (approximate)	Peat Volume (m^3) Option B[2] (approximate)
Substation and construction compound (Option B)	Plan area of substation platform is c. 8,500m^2 and construction compound is c. 4,000m^2		32,040
Underground cable – Option B	c. 600 wide x 1200mm deep trench. Length of cable route is 15km (approx.)		11,760
Met Mast	Assumed a 10 x 10m dig out for the met mast foundation	85	
Total		**338,750m^3 Option A**	**362,870m^3 Option B**

1 - Wind farm development with grid connection Option A, internal cabling Option A, and Substation Option A
2 - Wind farm development with grid connection Option B, internal cabling Option B, and Substation Option B

Table 7.9 Sources and Volumes of Construction Fill Material

Source	Construction Grade Fill Volume (m^3)		Higher Quality Final Surface Layer Fill (m^3)	
	Option A	Option B	Option A	Option B
Onsite Borrow Pit	320,000	320,000	-	-
Off-site Quarries	114,462	141,412	146,667	145,517

7.5 Likely Significant Effects & Mitigation Measures

7.5.1 Do-Nothing Scenario

Deepening of existing surface water drainage excavations may be carried out in areas of existing access roads and will be carried out in those areas of peat production that will be active up until the projected cessation of peat extraction in 2018. Localised 3rd party turbary peat cutting along the margins of the site will also continue. All "do nothing" effects will be localised and no significant effects are anticipated.

7.5.2 Worst Case Scenario

Excavation and relocation of peat and mineral subsoil which is a proposed part of the development works across the wind farm footprint. The "worst case scenario" will not have a significant effect on the local geological environment due to the scale and volume of the works, and the proposed mitigation to be implemented.

7.5.3 Likely Significant Effects and Mitigation Measures

The likely significant effects of the proposed development and mitigation measures that will be put in place to eliminate or reduce them are shown below.

7.5.3.1 Peat and Subsoil Excavation

Excavation of peat and subsoil will be required for construction of works for the installation of foundations for the access roads, turbine base/hardstand, grid cable connection trench (Option A grid connection to Cushaling substation) and foundations for grid connection Option B pylons, and internal cable network options (Option A and Option B). As presented in Table 7.8 the total excavation volumes for Option A is 348,125 m^3; and the total volumes for Option B is 363,605m^3.

Both options (entirety of Options A and B) will result in a permanent removal of peat and subsoil at excavation locations. Where possible excavated material will be used to reinstate cable trenches.

The granular soil at the site can be classified as of "Medium" importance, and the peat deposits at the site can be classified as of "Low" importance as the raised bog is already degraded by harvesting and drainage.

Mechanism: Extraction/excavation.
Receptor: Peat and subsoil.
Potential Impact: Negative, slight/moderate, direct, high probability, permanent effect on peat and subsoil.

7.5.3.1.1 Mitigation Measures/Effects Assessment

- Placement of turbines and associated infrastructure in areas with shallower peat where possible as provided by the site design/layout;
- The peat and subsoil which will be removed during the construction phase will be localised to the wind farm infrastructure turbine location and access roads;
- No turbines or related infrastructure will be constructed in any designated sites such as NHAs, SPAs or SACs; and so no soil/peat will be excavated from these sensitive locations. No turbines or related infrastructure will be constructed in areas of Annex 1 Habitat;
- A minimal volume of peat and subsoil will be removed to allow for infrastructural work to take place in comparison to the total volume present on the site due to optimisation of the layout by mitigation by design;
- Excavated peat will only be moved short distances from the point of excavation and will be used locally for landscaping; and,
- Construction of settlement ponds will be volume neutral, and excess material will be used locally to form pond bunds and surrounding landscaping.

7.5.3.1.2 Residual Effect

Negative, direct, slight, high probability, permanent effect on peat and subsoils.

7.5.3.1.3 Significance of Effects

No significant effects on soils and subsoils are anticipated.

7.5.3.2 Contamination of Soil by Leakages and Spillages and Alteration of Peat/Soil Geochemistry

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk. The accumulation of spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. Large spills or leaks have the potential to result in significant effects on the geological and water environment. However, small localised spills and leaks with no significant effects is the most likely scenario.

Pathway: Peat and subsoil pore space.
Receptor: Peat and subsoil.

Potential Impact: Negative, direct, slight, short term, medium probability effect on peat and subsoils.

7.5.3.2.1 Proposed Mitigation Measures

- Where possible refuelling and maintenance of construction vehicles or plant will take place off site;
- On site re-fuelling will be undertaken using a double skinned bowser with spill kits on the ready for accidental leakages or spillages;
- Fuels stored on site will be minimised. Storage areas where required will be bunded appropriately for the fuel storage volume for the time period of the construction and fitted with a storm drainage system and an appropriate oil interceptor;
- No refuelling will be permitted in the proposed borrow pit;
- The electrical control building will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- Where concrete is delivered on site, only the chute need be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be directed into a dedicated lined washout area. This lined area will be removed from site once construction phase is complete;
- An emergency plan for the construction phase to deal with accidental spillages will be contained within the Construction Environmental Management Plan (CEMP). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

7.5.3.2.2 Residual Effect

Negative, Imperceptible, direct, short term, low probability effect.

7.5.3.2.3 Significance of Effects

No significant effects on soils and subsoils are anticipated.

7.5.3.3 Erosion of Exposed Subsoils and Peat During Construction of Infrastructure

There is a high likelihood of erosion of peat during its excavation and relocation, however these effects will not be significant in terms of the local environment.

Mechanism: Vehicle movement, surface water and wind action.
Receptor: Peat and subsoil.
Potential Impact: Negative, direct, slight, high probability effect on peat and subsoils.

7.5.3.3.1 Proposed Mitigation Measures

Peat removed from turbine locations, substation location, temporary compounds, met mast and access roads will be used for landscaping close to the extraction area. Landscaping areas will be sealed and levelled using the back of an excavator bucket to prevent erosion. Where possible, the upper vegetative layer will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the stored peat within the peat storage areas. These measures will prevent erosion of stored peat in the short and long term. A full Peat Management Plan for the development is shown as Appendix 7-4.

7.5.3.3.2 Residual Effects

Negative, slight, direct, medium probability effect on peat and subsoils.

7.5.3.3.3 Significance of Effects

No significant effects on soils, subsoils or bedrock are anticipated.

7.5.3.4 Peat Instability and Failure

Peat instability or failure refers to a significant mass movement of a body of peat that would have a significant effect on the proposed wind farm development and the surrounding environment. The consequence of peat failure at the study area may result in:

- Death or injury to site personnel;
- Damage to machinery;
- Damage or loss of infrastructure;
- Drainage disrupted;
- Site works damaged or unstable;
- Contamination of watercourses, water supplies by particulates;
- Degradation of the peat environment.

Mechanism: Vehicle movement and excavations.
Receptor: Peat and subsoils.
Potential Impact: Direct, negative, significant, low probability effect on peat and subsoils.

The findings of the peat stability assessment as summarised in Section 7.3.8 above showed that the proposed Cloncreen wind farm site has an acceptable margin of safety and is suitable for the proposed wind farm development and proposed grid connection options. There is a low risk of peat failure at the site. The findings include recommendations and control measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

7.5.3.4.1 Mitigation Measures

The following general measures incorporated into the construction phase of the project will assist in the management of the risks for this site:

- Appointment of experienced and competent contractors;
- The site should be supervised by experienced and qualified personnel;
- Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a localised peat movement);
- Prevent undercutting of slopes and unsupported excavations by placement of appropriate batters;
- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground by ensuring these are placed on solid ground that has been assessed for specific loads;
- Set up, maintain and report findings from geotechnical monitoring systems (as defined in Section 10 of the Peat Management Plan, (AGEC 2016);
- Ensure construction method statements are developed and agreed in advance of construction as required by the Peat Stability Assessment (AGEC, 2016); and,
- Revise and amend the Risk Register as construction progresses to ensure all risks are managed and controlled throughout the construction phase.

Please refer to Appendix 7-1 for proposed turbine specific and road section mitigation measures.

7.5.3.4.2 Residual Effects

There are no significant residual effects anticipated on the soils and geological environment.

7.5.3.4.3 Significance of Effects

No significant effects on soils and subsoils are anticipated.

7.5.3.5 Potential Significant Effects of the Proposed Grid Connection Options

Excavation of peat and subsoil will be required for the construction of the underground grid connection cable trench (Option A), or pylon foundations for grid connection Option B. Either will result in a direct, permanent physical effect on peat and subsoil along the proposed cable route or below the pylons, via excavation and temporary movement/disturbance. However, the excavated peat and soil will be reinstated within the Option A trench where possible. Grid connection Option B is an overhead line, but will require excavation of peat and subsoils to form pylon foundations. This material will be moved and stored/landscaped as per the remainder of the earthworks across the site therefore no significant effects on peat and subsoil are anticipated.

Mechanism: Extraction.
Receptor: Peat and subsoil.
Potential Impact: Negative, direct, slight, high probability effect on peat and subsoils.

7.5.3.5.1 Proposed Mitigation Measures

No mitigation other than reinstatement is required in respect of Option A and Option B. The direct effect on peat and subsoils is an unavoidable but also acceptable effect on the soils and subsoils along the proposed grid connection cable route. The majority of the excavated peat and subsoils will be reinstated and therefore overall residual impact is neutral.

7.5.3.5.2 Residual Effect

Negative, slight, direct, high probability effect on peat and subsoils.

7.5.3.5.3 Significance of Effects

No significant effects on soils, subsoils or bedrock are anticipated as a result of the grid connection options.

7.5.3.6 Potential Significant Effect of the Proposed Borrow Pit

As discussed above it is estimated that up to 320,000m^3 (640,000 tonnes) of sand and gravel will be extracted locally from the proposed on-site borrow pit. This is an environmentally better option than an off-site source as it reduces construction traffic and therefore noise and air quality impacts can also be reduced.

No mitigation measures are required in respect of physical extraction of aggregate. Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section 7.5.3.2 above and these include not permitting refueling in the borrow pit area.

7.5.3.6.1 Significance of Effects

No significant effects on soils, subsoils or bedrock are anticipated as a result of the proposed borrow pit.

7.5.3.7 Potential Significant Effects of the Proposed Substation Option A and Option B

As presented in Table 7.8 above the estimated volume of peat to be excavated at substation Option A and Option B is 5,760m^3 and 32,040m^3 respectively. This is an unavoidable but acceptable consequence of the proposed development. The locations have been selected based on detailed geotechnical investigations and peat stability risk assessments.

Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section 7.5.3.2 above and measures dealing with soil erosion are dealt with in Section 7.5.3.3.

7.5.3.7.1 Significance of Effects

No significant effects on soils, subsoils or bedrock are anticipated as a result of the proposed substation options.

7.5.3.8 Potential Significant Effects of the Proposed Haul Route Junction Works

No significant excavation works will be required for the haul route works which will essentially involve widening an existing road junction on the northwest of the site. No significant impacts on soils and geology are anticipated. No mitigation is required in respect of soils and geology.

Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section 7.5.3.2 above and measures dealing with soil erosion are dealt with in Section 7.5.3.3.

7.5.3.8.1 Significance of Effects

No significant effects on soils, subsoils or bedrock are anticipated as a result of the proposed haul route junction works.

7.5.4 Operational Phase

No significant effects on soils/peat, subsoils or bedrock are anticipated during the operational phase of the wind farm as all earthworks and peat/soil/subsoil movements occur in the construction phase, with no earthworks occurring in the Operational Phase.

7.5.5 Decommissioning Phase

There will be no requirement for significant excavation of peat and subsoils during the decommissioning phase and therefore no significant effects are anticipated.

7.5.6 Cumulative Impacts

Due to the localised nature of the proposed construction earthworks which will be kept within the proposed development site boundary, there is no potential for significant cumulative effects in-combination with the other local developments as set out in Chapter 2. The construction of either grid connection Option A or Option B and the haul route junction works will only require relatively localised excavation works and therefore will not contribute to any significant cumulative effects on the soils and geology environment. Potential cumulative effects on the water environment are addressed in Chapter 8.

7.5.7 Conclusion

The proposed development will involve removal of peat and subsoils for access roads, internal road network, internal cable network, hardstanding emplacement, turbine foundations, substations, crane hardstands, compounds, met mast and the grid connection trench. Material for construction will be sourced from 1 no. proposed borrow pit. This will result in a permanent removal of peat and subsoil at most excavation locations.

Estimated volumes of peat to be excavated range between 338,750m^3 (Option A) and 362,870m^3 (Option B). Excavated peat will also be used for reinstatement and landscaping works as close to the extraction point as possible. The handling and storage of peat will be done in accordance with the Peat Management Plan (AGEC, 2016).

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

No significant effects on the soil and geology of the site will occur. A peat stability assessment undertaken for the site show that the risk of peat failure is designated trivial and tolerable and that the site has an acceptable margin of safety. A number of control measures are given in the AGEC Ltd peat stability assessment to manage all risks associated with peat instability.

7.5.8 Summary

No significant effects on the local soil and geology will occur as a result of the proposed development during the construction, operational or decommissioning phases. Mitigation measures are proposed to deal with potential minor effects. Due to the localised nature of the proposed construction works which will be kept within the proposed development site boundary, there is no potential for significant cumulative effects in-combination other local developments.

8 HYDROLOGY AND HYDROGEOLGOY

8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by McCarthy Keville O'Sullivan (MKOS) to carry out an assessment of the potential significant effects of a proposed 21 no. turbine wind farm, borrow pit, haul route junction works and its grid connection route options (Option A – underground cable, Option B overhead line) at Cloncreen, Co. Offaly on water aspects (hydrology and hydrogeology) of the receiving environment. The detailed project description is included in Chapter 3.

The objectives of the assessment are:

- Produce a baseline study of the existing water environment (surface water and groundwater) in the area of the proposed wind farm development and associated works;
- Identify any likely significant effects of the proposed development on surface water and groundwater during the construction phase, operational phase and decommissioning phase of the development;
- Identify mitigation measures to avoid, remediate or reduce likely significant negative effects and,
- Assess whether there are any likely significant residual effects and cumulative effects of the proposed development, its grid connection route and other local developments.

8.1.2 Relevant Legislation

The EIS is carried out in accordance with the follow Irish legislation:

- S.I. No. 349 of 1989: European Communities (Environmental Impact Assessment) Regulations, and subsequent Amendments (S.I. No. 84 of 1995, S.I. No. 352 of 1998, S.I. No. 93 of 1999, S.I. No. 450 of 2000 and S.I. No. 538 of 2001), S.I. No. 30 of 2000, the Planning and Development Act, and S.I. 600 of 2001 Planning and Development Regulations and subsequent Amendments. These instruments implement EU Directive 85/337/EEC (EIA Directive) and subsequent amendments, on the assessment of the effects of certain public and private projects on the environment;
- Planning and Development Acts 2000-2015;
- Planning and Development Regulations, 2001-2015;
- S.I. No. 94 of 1997: European Communities (Natural Habitats) Regulations, resulting from EU Directives 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (the Habitats Directive) and 79/409/EEC on the conservation of wild birds (the Birds Directive);
- S.I. No. 293 of 1988: Quality of Salmon Water Regulations, resulting from EU Directive 78/659/EEC on the Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life;
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC). Since 2000 water management in the EU has been directed by the Water Framework Directive (WFD). The key objectives of the

WFD are that all water bodies in member states achieve (or retain) at least 'good' status by 2015. Water bodies comprise both surface and groundwater bodies, and the achievement of 'Good' status for these depends also on the achievement of 'good' status by dependent ecosystems. Phases of characterisation, risk assessment, monitoring and the design of programmes of measures to achieve the objectives of the WFD have either been completed or are ongoing. In 2015 it will fully replace a number of existing water related directives, which are successively being repealed, while implementation of other Directives (such as the Habitats Directive 92/43/EEC) will form part of the achievement of implementation of the objectives of the WFD;

- S.I. No. 41 of 1999: Protection of Groundwater Regulations, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);
- S.I. No. 249 of 1989: Quality of Surface Water Intended for Abstraction (Drinking Water), resulting from EU Directive 75/440/EEC concerning the quality required of surface water intended for the abstraction of drinking water in the Member States (repealed by 2000/60/EC in 2007);
- S.I. No. 439 of 2000: Quality of Water intended for Human Consumption Regulations and S.I. No. 278 of 2007 European Communities (Drinking Water No. 2) Regulations, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the Drinking Water Directive) and WFD 2000/60/EC (the Water Framework Directive);
- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010; and,
- S.I. No. 296 of 2009: European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009.

8.1.3 Relevant Guidance

The water section of the EIS is carried out in accordance with guidance contained in the following:

- *Environmental Protection Agency (September 2015): Draft - Advice Notes on Current Practice (in the preparation on Environmental Impact Statements);*
- *Environmental Protection Agency (September 2015): Draft – Revised Guidelines on the Information to be Contained in Environmental Impact Statements;*
- *Environmental Protection Agency (2003): Advice Notes on Current Practice (in the preparation on Environmental Impact Statements);*
- *Environmental Protection Agency (2002): Guidelines on the Information to be Contained in Environmental Impact Statements;*
- *Institute of Geologists Ireland (2013): Guidelines for Preparation of Soils, Geology & Hydrogeology Chapters in Environmental Impact Statements;*
- *National Roads Authority (2005): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;*
- *Department of Environment, Heritage & Local Government (2006): Wind Farm Development Guidelines for Planning Authorities;*
- *Forestry Commission (2004): Forests and Water Guidelines, Fourth Edition. Publ. Forestry Commission, Edinburgh;*
- *Coillte (2009): Forest Operations & Water Protection Guidelines;*
- *Forest Services (Draft) Forestry and Freshwater Pearl Mussel Requirements – Site Assessment and Mitigation Measures;*

- *Forest Service (2000): Forestry and Water Quality Guidelines. Forest Service, DAF, Johnstown Castle Estate, Co. Wexford;*
- *COFORD (2004): Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads;*
- *Eastern Regional Fisheries Board (not dated): Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites;*
- *Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010);*
- *PPG1 - General Guide to Prevention of Pollution (UK Guidance Note);*
- *PPG5 – Works or Maintenance in or Near Watercourses (UK Guidance Note);*
- *CIRIA (Construction Industry Research and Information Association) 2006: Guidance on 'Control of Water Pollution from Linear Construction Projects' (CIRIA Report No. C648, 2006); and,*
- *CIRIA 2006: Control of Water Pollution from Construction Sites - Guidance for Consultants and Contractors. CIRIA C532. London, 2006.*

8.2 Methodology

8.2.1 Desk Study

A desk study of the proposed development site, third party land and third party turbary lands, and surrounding area was largely completed prior to the undertaking of field mapping and walkover assessments. The desk study involved collecting all relevant geological, hydrological, hydrogeological and meteorological data for the study area. This included consultation with the following:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - National Draft Bedrock Aquifer map;
- Geological Survey of Ireland - Groundwater Database (www.gsi.ie);
- Met Eireann Meteorological Databases (www.met.ie);
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directive "WaterMaps" Map Viewer (www.wfdireland.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 15 (Geology of Galway - Offaly); Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland - Groundwater Body Characterisation Reports;
- OPW Indicative Flood Maps (www.floodmaps.ie);
- Environmental Protection Agency – "Hydrotool" Map Viewer (www.epa.ie);
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie); and,
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).

8.2.2 Site Investigations

A hydrological walkover survey, including detailed drainage mapping and baseline monitoring/sampling, was undertaken by HES on 6th January 2016. Additional site investigations to assess the geological and hydrogeological regime were undertaken by HES during April 2016.

In summary, assessments to address the hydrology and hydrogeology section of the EIS included the following:

- Walkover surveys and hydrological mapping of the proposed site, grid connection route, haul route works and the surrounding area were undertaken whereby water flow directions and drainage patterns were recorded;
- A preliminary flood risk assessment for the proposed development footprint area;
- A total of over 860 no. peat probes were undertaken by AGEC Ltd and HES to determine the thickness and geomorphology of the blanket peat overlying the site;
- Either window sampling or trial pits were undertaken at each turbine location, proposed borrow pit and proposed substation Options A & B to investigate peat and mineral subsoil lithology;
- Piezometers were installed at the substation sites to allow water level monitoring. The piezometers were screened in the mineral soil stratum. Seasonal water level monitoring was completed;
- Field hydrochemistry measurements (electrical conductivity, pH and temperature) were taken to determine the origin and nature of surface water flows;
- A total of 7 no. surface water samples were undertaken to determine the baseline water quality of the primary surface waters originating from the proposed site. This was undertaken to complement the existing BnM surface water quality monitoring data which is also presented below in this chapter; and;
- On-going surface water quality monitoring by Bord na Móna as part of their IPC Licence.

8.2.3 Impact Assessment Methodology

Please refer to Chapter 1 of the EIS for details on the impact assessment methodology (EPA, 2002 & 2003). In addition to the above methodology, the sensitivity of the water environment receptors was assessed on completion of the desk study and baseline study. Levels of sensitivity which are defined in Table 8.1 are then used to assess the potential effects that the proposed development may have on the local baseline water environment (*i.e.* water receptors).

Table 8.1 Receptor Sensitivity Criteria (Adapted from www.sepa.org.uk)

Sensitivity of Receptor	
Not sensitive	Receptor is of low environmental importance (*e.g.* surface water quality classified by EPA as A3 waters or seriously polluted), fish sporadically present or restricted). Heavily engineered or artificially modified and may dry up during summer months. Environmental equilibrium is stable and is resilient to changes which are considerably greater than natural fluctuations, without detriment to its present character. No abstractions for public or private water supplies. GSI groundwater vulnerability "Low" – "Medium" classification and "Poor" aquifer importance.
Sensitive	Receptor is of medium environmental importance or of regional value. Surface water quality classified by EPA as A2. Salmonid species may be present and may be locally important for fisheries. Abstractions for private water supplies. Environmental equilibrium copes well with all natural fluctuations but cannot absorb some changes greater than this without altering part of its present character. GSI groundwater vulnerability "High" classification and "Locally" important aquifer.

Sensitivity of Receptor	
Very sensitive	Receptor is of high environmental importance or of national or international value *i.e.* NHA or SAC. Surface water quality classified by EPA as A1 and salmonid spawning grounds present. Abstractions for public drinking water supply. GSI groundwater vulnerability "Extreme" classification and "Regionally" important aquifer

8.3 Receiving Environment

8.3.1 Site Description and Topography

Cloncreen Bog ("the site") which is a Bord na Móna peat harvesting bog is part of The Bog of Allen. The site is located approximately 2km to the northwest of the village of Clonbullogue and 4.5km southwest of Edenderry in County Offaly. The total site area is approximately 960ha (9.6km^2).

The Edenderry Power Station is located immediately to the east of the bog with an associated ash waste facility, located in the southeast of the proposed development site. A site compound relating to the peat harvesting works and a rehabilitated sand and gravel borrow pit exists close to the existing main site entrance on the northwestern boundary of the site. The vast majority of the site comprises heavily drained cutover raised bog. A number of industrial railway lines intersect the site that services the power station and ash repository.

The topography of the development site is relatively flat with an elevation range of between approximately 68 and 72 mOD (metres above Ordnance Datum). There are two slightly elevated mineral soil ridges at the site. One runs east west at the site compound, and the second is on the centre of the eastern portion of the site, just south of the railway line, and it runs in a general north south direction. Along the majority of the site boundary a 1 to 2m high peat bank exists which is a remnant of the original bog. These perimeter peat banks create a boundary berm, forming a basin effect within the extraction area of the overall bog.

The surface of the cutover bog is drained by a network of east / west orientated peat drains that are typically spaced every 15 to 20m. These drains typically slope in both an easterly and westerly direction from the central north / south trending railway track line. Surface water outflows from the bog are located along the western, southern and eastern boundaries of the site and comprise both gravity and pumped outfalls. Other than the designated surface water outfalls, there are no other areas where runoff can leave the site.

8.3.2 Water Balance

Long term rainfall and evaporation data was sourced from Met Éireann. The 30-year annual average rainfall recorded at Edenderry 4.5km northeast of the proposed development site, are presented in Table 8.2.

Table 8.2 Local Average long-term Rainfall Data (mm)

Station		X-Coord		Y-Coord		Ht (MAOD)		Opened		Closed		
Edenderry		262,700		262,700		85		1951		N/A		
Jan	Feb	Mar	Apr	May	Jun	July	Aug	Sept	Oct	Nov	Dec	Total
82	59	63	56	64	63	58	78	73	83	77	84	840

The closest synoptic station where the average potential evapotranspiration (PE) is recorded is at Mullingar, approximately ~28km northwest of the site. The long term average PE for this station is 448mm/yr. This value is used as a best estimate of the site PE. Actual Evaporation (AE) at the site is estimated as 425mm/yr (which is 0.95 × PE).

The effective rainfall (ER) represents the water available for runoff and groundwater recharge. The ER for the site is calculated as follows:

Effective rainfall (ER) = AAR – AE
= 840mm/yr – 425mm/yr
ER = 415mm/yr

Based on groundwater recharge coefficient estimates from the GSI (www.gsi.ie) an estimate of 18mm/year average annual recharge is given for basin peat in this area (recharge coefficient of ~4%). This means that the hydrology of the site is characterised by very high surface water runoff rates and very low groundwater recharge rates. Therefore, conservative annual recharge and runoff rates for the site are estimated to be 18mm/yr and 397mm/yr respectively.

8.3.3 Regional and Local Hydrology

Regionally the proposed wind farm development site, including the grid connection route options and haul route upgrades are located in the River Barrow surface water catchment within Hydrometric Area 14 of the South Eastern River Basin District. A regional hydrology map is shown as Figure 8.1.

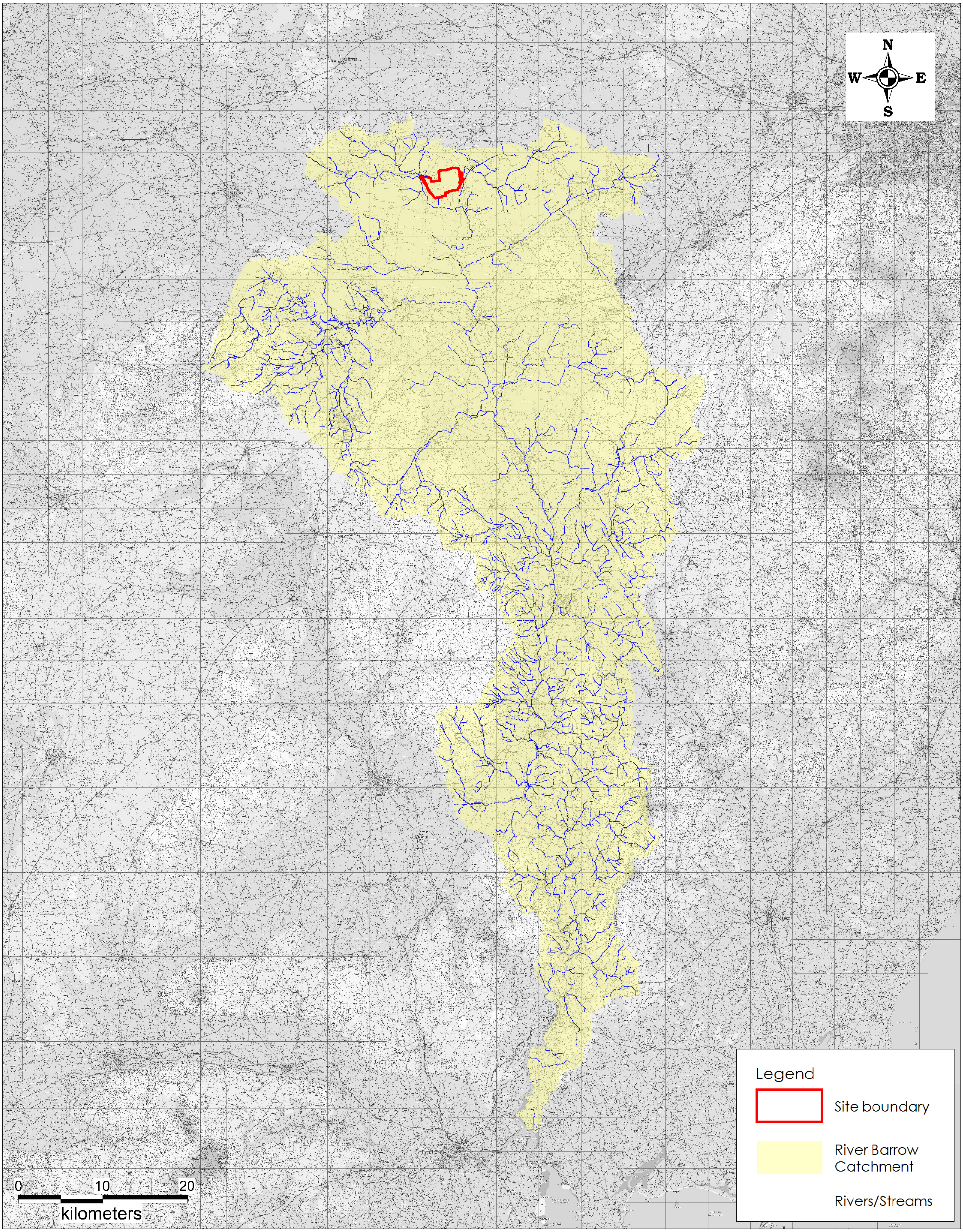
On a more local scale the site is located in the Figile River surface water catchment. The Figile River flows in a southerly direction less than 0.5km to the east of the proposed site. The eastern section of the site drains directly to the Figile River via a number of outfall channels which are discussed further below in the site drainage section. The Philipstown River flows in a southerly direction approximately 0.5km to the west of the site prior to flowing in a more easterly direction to the south of the site and merging with the Figile River approximately 2km downstream of the site. The western section of the site drains to the Philipstown River via a number of channel outfalls which are also discussed further below.

Grid connection Option A exits on the area of the site that drains to the Figile River while grid connection Option B and the proposed haul route junction works drain to the Philipstown River.

A local hydrology map is shown as Figure 8.2.

8.3.4 Site Drainage

The surface of the cutover bog is drained by a network of parallel east / west orientated drains that are typically spaced every 15 to 20m. The parallel running bog surface drains are approximately 1 - 1.5m deep and in most areas they intercept the mineral subsoil underlying the peat. These bog surface drains slope in both an easterly and westerly direction from the central north / south trending railway line. Surface water outflows from the bog are located along the western, southern and eastern boundaries of the site and comprise both gravity and pumped outfalls. Surface water draining/pumped from the site is routed via large settlement ponds prior to discharge to off-site drainage channels which flow into the local rivers (*i.e.* Figile River and the Philipstown River). A flow diagram of the existing drainage system is shown in Plate 8A below.



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Sheet Size: A4	Job: Cloncreen WF
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Scale: 1:500000	Project No: P1308-0
Drawn By: GD Checked By: MG	Drawing No: P1308-0-0916-801-A4-0A

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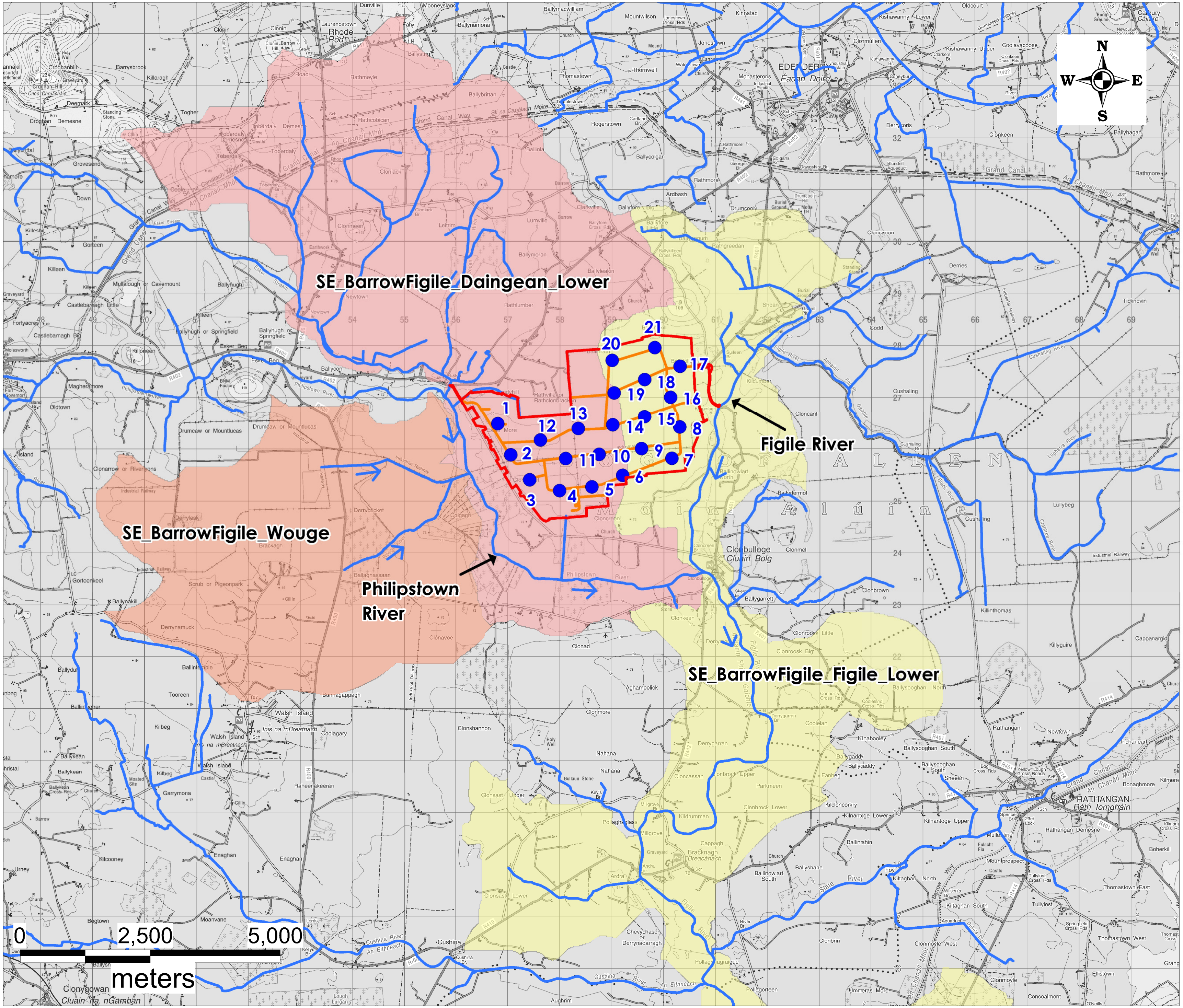

Legend

Site boundary

Proposed road

Rivers/Streams

Flow Direction

Proposed Turbine Location

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Title: Local Hydrology Map

Client: McCarthy Keville O'Sullivan

Job: Cloncreen WF

Project No: P1308-0

Figure No: 8.2

Sheet Size: A4

Drawing No: P1308-0-1215-802-A4-0A

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Drawn By: GB

Checked By: MG

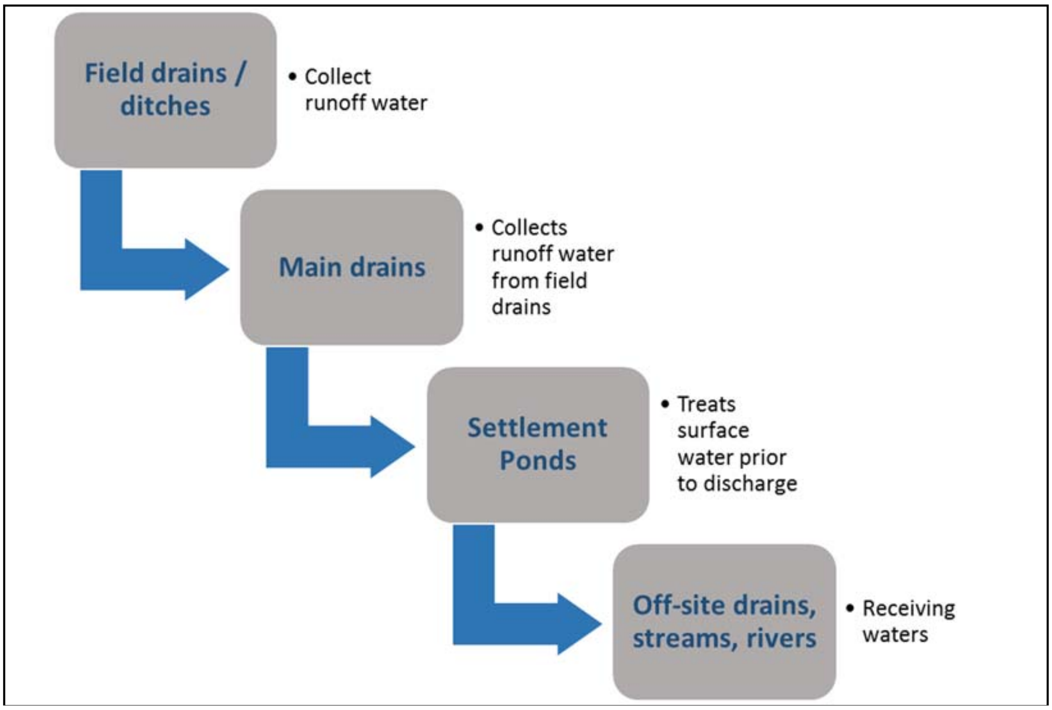


Plate 8A Existing Drainage System

The western section (*i.e.* west of the north/south trending railway line) and southwestern section of the site drain to 3 no. gravity outfalls and 1 no. pumped outfall. Gravity outfall SW-34 is located at the northwestern corner of the site, gravity outfall SW-33 is located on the western boundary and gravity outfall SW-32 is located on the southwestern boundary of the site. These three outfalls have large settlement ponds in place for treatment of surface water runoff from the bog (refer to Photograph 8.1 below for example). The settlement ponds at these outfall locations discharge into off-site drains which flow towards the Philipstown River. A pumped outfall is also located on the southwestern section of the site (*i.e.* at the southern end of the central north / south trending railway line). This pumping station is sometimes used as an alternative to outfall SW-32. The pumping station discharges into a drain which flows in an easterly direction towards the Figile River (refer to Photograph 8.2 below).

Photograph 8.1: Settlement Pond at Outfall SW-33

Photograph 8.2: Western Pumped Outfall

The majority of the western section of the site north of the east/west trending railway line drains to the outfall SW-33. The northwestern section of the site drains to outfall SW-34. Normally and in non-flood conditions, the southwestern section of the site drains to outfall SW-32. However as stated above, a pumping station is now in place that pumps water into a drainage channel that flows in a easterly direction along the southern boundary of the site.

The eastern section of the site also drains to 2 no. gravity outfalls and 1 no. pumped outfall. The north-eastern section of the site drains to pumped outfall SW-35 while the eastern and south-eastern sections of the site drain to gravity outfalls SW-37 and SW-37A respectively. SW-35 and SW-37 discharge into an off-site drain that discharges into the Figile River to the east of the site. SW-37A discharges into a separate off-site drain that discharges into the Figile River approximately 0.8km further downstream.

The two pumping stations are float operated, and these control the delivery from the electrical pumps. Both are rated to pump approximately 15mm of rainfall in 1 hour.

A site drainage map is shown as Figure 8.3 and a site sub-catchment map is shown as Figure 8.4.

8.3.5 Flood Risk Assessment Overview

This section presents an overview of the flood risk assessment undertaken for the proposed development. The full flood risk assessment report for the proposed Cloncreen Wind Farm is provided as Appendix 8-1.

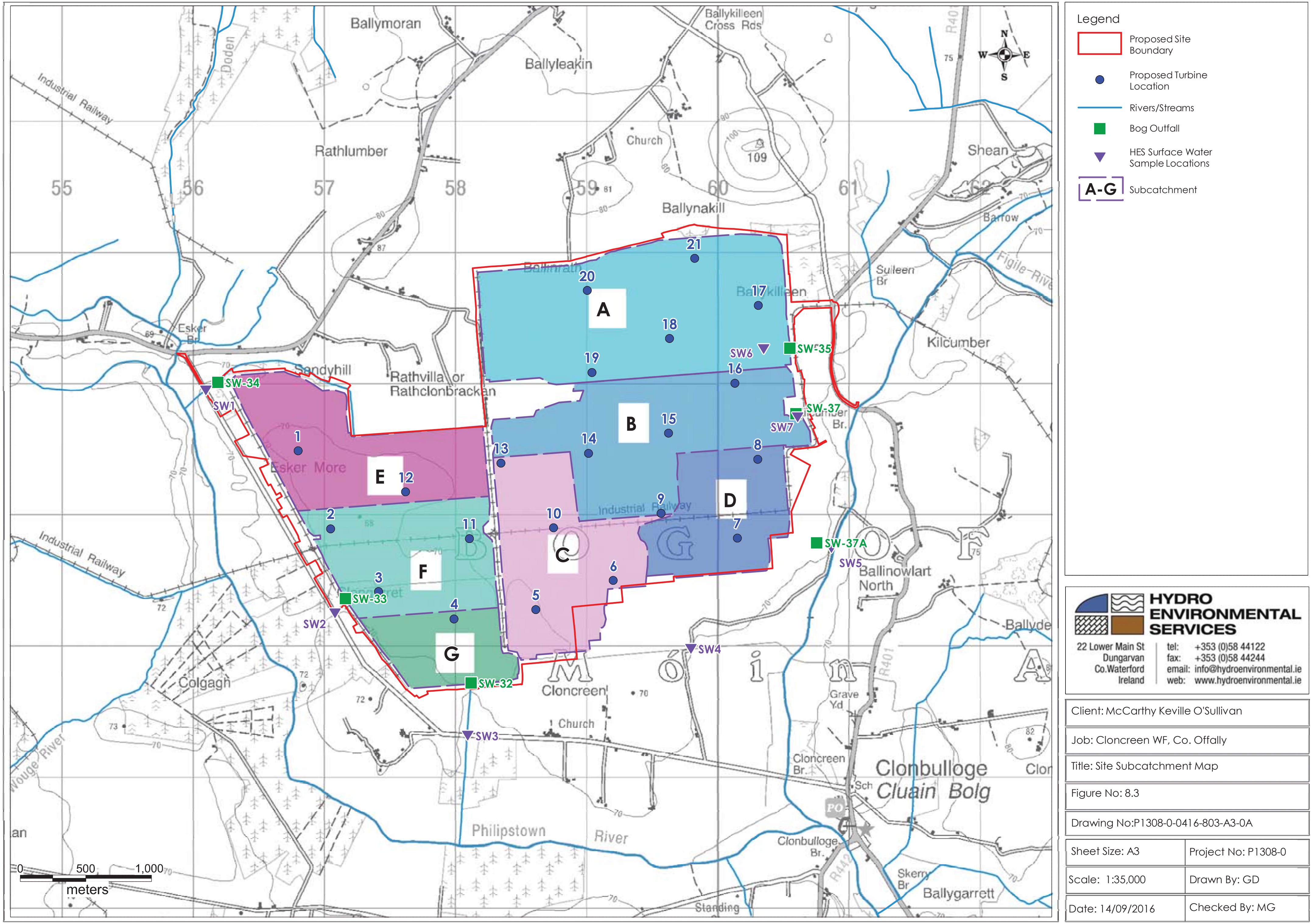
To identify those areas as being at risk of flooding, OPW's indicative river and coastal flood map (www.floodmaps.ie), CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.cfram.ie) and historical mapping (*i.e.* 6" and 25" base maps) were consulted.

No recurring flood incidents within the site boundary were identified from OPW's indicative river and coastal flood map. Several recurring flooding incidences are mapped to the east and west of the site on the Figile River and the Philipstown River respectively.

Identifiable map text on local available historical 6" or 25" mapping for the study area identify lands that are "liable to flood" along the Philipstown River and the Figile River outside of the site boundary.

There are no areas within the site or downstream of it mapped as "Benefiting Lands". Benefiting lands are defined as a dataset prepared by the Office of Public Works identifying land that might benefit from the implementation of Arterial (Major) Drainage Schemes (under the Arterial Drainage Act 1945) and indicating areas of land subject to flooding or poor drainage.

The PFRA mapping (www.cfram.ie) shows the extents of the indicative 1 in 100-year flood zone which relates to fluvial (*i.e.* river) flood events (refer to Plate 8B below). The vast majority of the proposed development site is located outside of the 1 in 100-year flood zone (Flood Zone A) with the exception of a section on the north-western corner of the site and a section on the southwestern corner of the site. These mapped fluvial flood zones within the site occur at the locations feeding into outfalls SW-34 and SW32. These areas are also the lowest lying areas of the site. All proposed turbine locations and the access roads are outside of the fluvial indicative 1 in 100-year flood zone. The extent of the mapped flood zones east and southeast of SW-34 is not possible given the topography.



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Client: McCarthy Keville O'Sullivan	
Job: Cloncreen WF, Co. Offaly	
Title: Site Subcatchment Map	
Figure No: 8.3	
Drawing No:P1308-0-0416-803-A3-0A	
Sheet Size: A3	Project No: P1308-0
Scale: 1:35,000	Drawn By: GD
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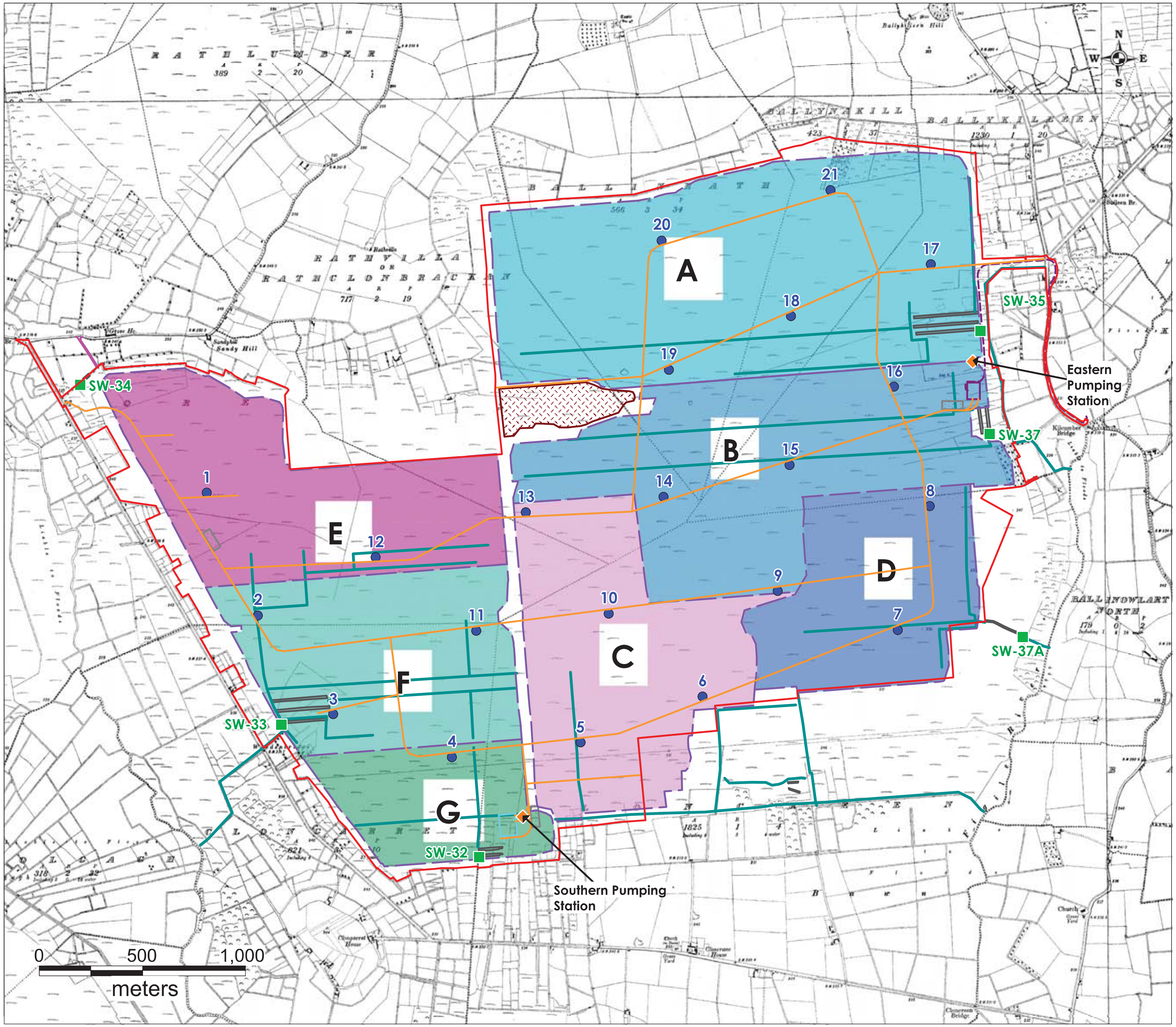

Legend

- Proposed Site Boundary
- Proposed Road
- Proposed Turbine Location
- Proposed Substation A
- Proposed Substation B
- Proposed Grid Connection - Option A
- Proposed Grid Connection - Option A
- Construction Compound
- Proposed Borrow Pit
- Settlement Ponds
- Bog Outfall
- Main Drains
- Pumping Station
- A-G Subcatchments

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Client: McCarthy Keville O'Sullivan

Job: Cloncreen WF, Co. Offaly

Title: Site Drainage Map

Figure No: 8.4

Drawing No:P1308-0-0416-804-A3-0A

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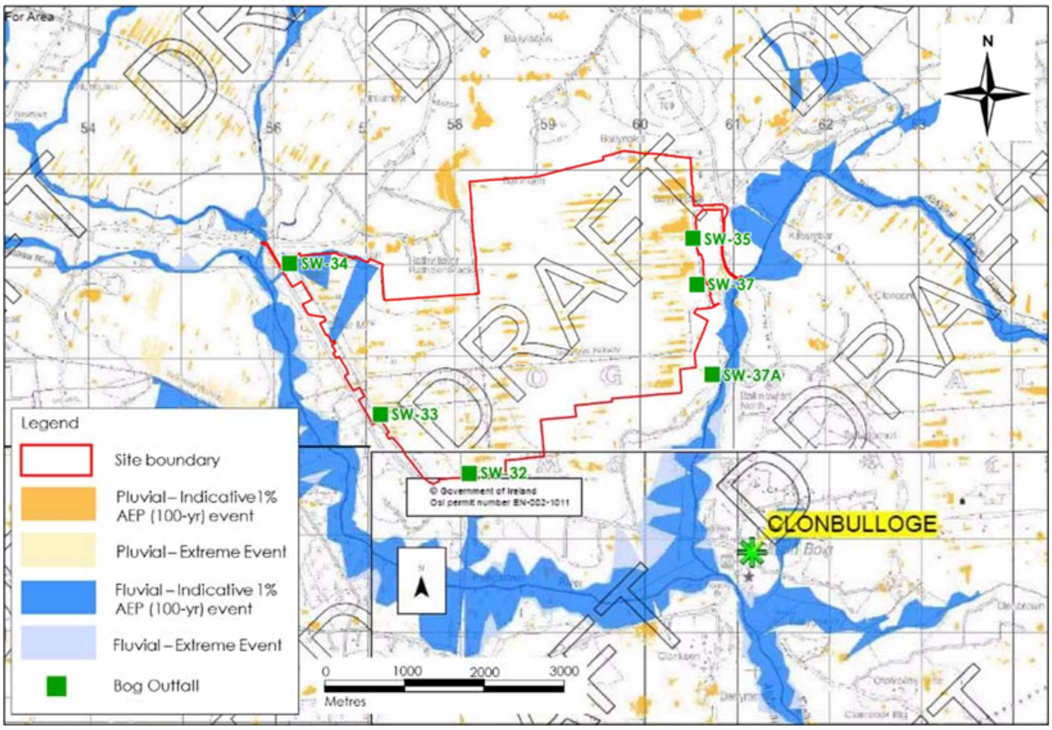


Plate 8B: PFRA Indicative Flood Zone Map

Also shown on the PFRA mapping is the indicative extent of pluvial flooding (*i.e.* flooding from rainfall ponding). As shown in Plate 8B, pluvial flooding appears to occur along the main drainage channels within the site and this is as result of surface water runoff backing up in the drainage routes when the capacity of the outfalls is exceeded. The site visit undertaken on 6th January 2016 was undertaken after a period of prolonged heavy rainfall/storms and therefore the site was observed in very wet conditions. Proposed turbine locations that were noted to be significantly affected by pluvial flooding on that day included T2 and T4 on the west of the site.

Where complete, the CFRAMS OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the PFRAM maps. CFRAM fluvial mapping has been completed in the proposed area.

The proposed development site is not identified on the CFRAM flooding fluvial extent mapping, dated February 2015 as either in Flood Zone A or B. Therefore, according to CFRAMs the proposed development is located in Zone C, where the probability of flooding is low. This suggests that the site is suitable for the proposed development in terms of flood risk. The fluvial flood zones areas indicated on the CFRAM mapping are shown on Plate 8C below.

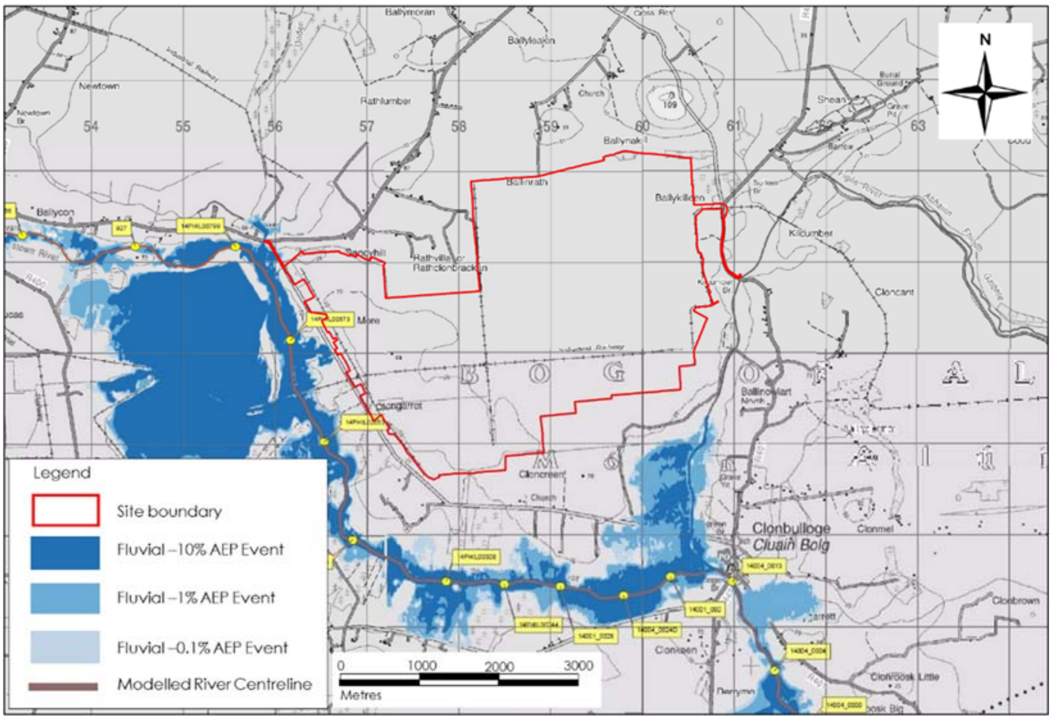


Plate 8C: CFRAMS Fluvial Flood Zone Mapping

With regards to the proposed development site, it will for the large part remain fluvial flood free, but on very rare occasions there is a risk of inundation from pluvial flooding. Surface water discharges from the site are attenuated, and will be slowed down below greenfield runoff rates. Where pumping is used, pumping stations are rated for low discharge volumes in the order of 15mm per hour.

Surface water will be held on site behind, access tracks, in shallow wet ecological areas, in low lying areas, in silt traps, in settlement ponds, and upstream of pumping stations.

Given the large area of the site (960Ha), it has a large capacity to store water following rainfall events, even if storage is only a couple of centimetres in depth.

Overall, during the wind farm phase of development for the site, surface water is more likely to be held on site due to new proposed attenuation measures, and this will have a positive impact on downstream flooding events. This is discussed further below in Section 8.3.17 where a surface water runoff assessment is undertaken.

No part of the proposed infrastructure will flood, and all access roads, and turbine bases will be designed to be above known pluvial flood levels.

8.3.6 Surface Water Quality

Q-rating status data for EPA monitoring points on the Philipstown River and the Figile River are shown on Table 8.3 below. Most recent data available (2004 to present) show that the Q-rating for the Philipstown River and the Figile River is Moderate to Good Status in the vicinity of the proposed site.

Table 8.3 EPA Water Quality Monitoring Q-Rating Values

Water body	EPA Location Description	Easting	Northing	EPA Q-Rating Status
Philipstown River	Esker Bridge	255857	227234	Q3 - Q4 Moderate
Philipstown River	Esker Bridge N	255755	227031	Q3 - Q4 Moderate
Philipstown River	Derrygarron	261970	220892	Q4 Good
Figile River	Kilcumber Bridge	261055	226836	Q3 - Q4 Moderate
Figile River	Figile Bridge	261021	223500	Q4 Good
Figile River	Daingean	259875	223347	Q3 - Q4 Moderate

Field hydrochemistry measurements of electrical conductivity (µS/cm), pH (pH units) and temperature (°C) were taken within surface watercourses downstream of the Cloncreen bog outfalls (refer to Table 8.4 and Figure 8.3 for locations). The monitoring was undertaken after a period of very wet weather and as a result outfalls and drains were observed in medium to high flow conditions. The results are listed (along with the surface water feature type) in Table 8.4. With the exception of monitoring location SW6, the watercourses monitored were typically drains into which the bog outfalls discharged into. Monitoring location SW6 was taken at the pumped outfall on the east of the site (*i.e.* SW35).

Electrical conductivity (EC) values at the monitoring location ranged between 245 and 425µS/cm. This indicates that a considerable quantity of groundwater is mixing with the surface water runoff from the surface of Cloncreen bog. This is likely to be the case considering the penetration of the field drains into the mineral soil across the site. The source of the groundwater is most likely to be from the mineral subsoils that underlie the peat in this area. The mineral subsoils are likely to have become more exposed in places as a result of peat cutting and installation of drainage channel that extend below the peat layer and into the mineral soil.

The pH values were generally slightly acidic with some values just exceeding neutral. Slightly acidic pH values of surface waters would be typical of peatland environments due to the decomposition of peat. It would appear that the groundwater component in the drains on the day of monitoring was not sufficiently alkaline to raise the pH above 7.0 at most of the locations. During dryer periods slightly higher pH measurements would be expected.

Table 8.4 Field Parameters - Summary of Surface Water Chemistry Measurements.

Location ID	Easting	Northing	EC (µS/cm)	pH	Temp °C	Drainage Feature
SW1	256095	226955	280	6.9	5.3	Drain d/s of outfall SW-34
SW2	257080	225256	245	5.8	5.7	Drain d/s of outfall SW-33
SW3	258093	224323	269	5.7	5.3	Drain d/s of outfall SW-32
SW4	259796	224984	285	7.1	5.1	Drain d/s of Pump 1 outfall

Location ID	Easting	Northing	EC (µS/cm)	pH	Temp °C	Drainage Feature
SW5	260868	225753	361	6.8	5.2	Drain d/s of outfall SW-37A
SW6	260350	227270	425	6.9	5.3	Pumped outfall SW-35
SW7	260610	226750	385	6.8	5.2	Drain d/s of outfall SW-37

Surface water samples were also taken in the watercourses downstream of the bog outfalls at the locations identified in Table 8.4 above. The locations of the sampling points are shown on Figure 8.3.

Results of the laboratory analysis are shown alongside relevant water quality regulations in Tables 8.5 and 8.6 below. In addition, Environmental Objectives Surface Water Regulations (S.I. 272 of 2009) are shown in Table 8.7. Original laboratory reports are attached as Appendix 8-2.

Table 8.5 Analytical Results of HES Surface Water Samples (SW1-Sw4)

Parameter	EC DIRECTIVES			Sample ID			
	2006/44/EC		EC DW Regs 2007	SW1	SW2	SW3	SW4
	Salmonid	Cyprinid					
Total Suspended Solids (mg/L)	≤ 25 (O)	≤ 25 (O)	-	<2	7	5	11
Ammonia N (mg/L)	≤0.04	≤0.02	0.3	0.098	0.463	0.248	0.249
Nitrite NO_2 (mg/L)	≤ 0.01	≤ 0.03	0.5	<0.002	0.01	0.01	0.014
Ortho-Phosphate – P (mg/L)	-	-	-	<0.006	0.012	0.104	0.01
Nitrate - NO_3 (mg/L)	-	-	50	11.5	6.8	8.10	9.3
Total Phosphate (mg/L)	-	-		0.042	<0.021	0.12	0.043
Chloride (mg/L)	-	-	250	18.78	7.79	11	10.26
BOD	≤ 3	≤ 6	-	<2	<2	<2	<2

Table 8.6 Analytical Results of Surface Water Samples (Sw5 – SW7)

Parameter	EC DIRECTIVES			Sample ID		
	2006/44/EC		EC DW Regs 2007	SW5	SW6	SW7
	Salmonid	Cyprinid				
Total Suspended Solids (mg/L)	≤ 25 (O)	≤ 25 (O)	-	20	23	34
Ammonia N (mg/L)	≤0.04	≤0.02	0.3	0.552	1.82	0.468
Nitrite NO_2 (mg/L)	≤ 0.01	≤ 0.03	0.5	0.011	0.018	0.061
Ortho-Phosphate – P (mg/L)	-	-	-	0.032	0.013	<0.006
Nitrate - NO_3 (mg/L)	-	-	50	6.2	8.9	29.59
Total Phosphate (mg/L)	-	-		0.193	0.038	0.032
Chloride (mg/L)	-	-	250	9.33	14.87	12.15
BOD	≤ 3	≤ 6	-	<2	<2	<2

Total suspended solids (TSS) ranged between <2 and 34mg/L. With the exception of samples SW7 all other results for TSS are below the Freshwater Fish Directive (2006/44/EC) for both Salmonid and Cyprinid waters.

Ammonia N ranged between 0.098 and 1.82mg/L, which is above the Freshwater Fish Directive (2006/44/EC) limit for both Salmonid waters and Cyprinid waters. The presence of elevated ammonia is due to natural decomposition of peat.

BOD was less than 2mg/L in all samples, which is below the Freshwater Fish Directive (2006/44/EC) for both Salmonid and Cyprinid waters.

Nitrite ranged between <0.002 and 0.061mg/L and results were typically low which is what would be expected in a peatland environment. In comparison to the Freshwater Fish Directive (2006/44/EC) for Salmonid and Cyprinid waters there were four and one exceedances respectively.

Nitrate ranged between 6.2 and 29.5mg/L and with the exception of SW7 results were typically low which is what would be expected in a peatland environment. SW7 was taken in a drain that borders grassland land immediately to the east of the site and therefore the source of the nitrate is likely to be related to local landspreading.

Table 8.7 Chemical Conditions Supporting Biological Elements*

Parameter	Threshold Values (mg/L)
BOD	High status ≤ 1.3 (mean)
	Good status ≤ 1.5 mean
Ammonia-N	High status ≤ 0.04 (mean)
	Good status ≤0.065 (mean)

Parameter	Threshold Values (mg/L)
Ortho-phosphate	High status ≤0.025 (mean)
	High status ≤0.025 (mean) Good status ≤0.035 (mean)

** Environmental Objectives Surface Water Regulations (S.I. 272 of 2009)*

In comparison to the Environmental Objectives Surface Water Regulations (S.I. 272 of 2009), all results for ammonia N exceeded both the "Good Status" and "High Status" threshold values.

In relation to ortho-phosphate all samples with the exception of SW3 were at least within the "Good Status". Five of the seven samples were within the "High Status" threshold (*i.e.* SW1, SW2, SW4, SW6 and SW7). BOD was reported as less than 2mg/L which is likely to indicate at least "Good Status".

8.3.7 Cloncreen Bog Outfall Water Quality Monitoring

As part of the IPC licensing for the peat harvesting operation (P0503-01) surface water quality monitoring data for runoff from the Cloncreen bog is available for six outflow locations from the bog. As discussed above these are referred to as SW32, SW33, SW34, SW35, SW37 and SW37A. Summary data for 2013 and 2014 is shown in Table 8.8 to 8.13.

For suspended solids, average values at most monitoring locations were well below the Freshwater Fish Directive (2006/44/EC) for both Salmonid and Cyprinid waters (25mg/L). Slightly higher average values were recorded at monitoring locations SW35 and SW37 and this is mainly due to sporadic high peaks in suspended solids rather than overall higher levels.

Average ammonia values for the monitoring locations typically exceeded the Freshwater Fish Directive (2006/44/EC) limit for both Salmonid waters and Cyprinid waters. The presence of elevated ammonia is due to natural decomposition of peat within the bog.

Average nitrate and nitrite values were typically low which is what you would expect from an environment dominated by peat. The average BOD at all monitoring locations was less than 2mg/L which is typical of a low nutrient environment such as peatland. Similarly, total phosphorus was typically low at the monitoring locations with the exception of SW37. The average total phosphorus value at SW37 was 0.275mg/L which would be considered high for surface water runoff from a peatland environment and this is possibly related to local agricultural activity as indicated above.

Table 8.8 Surface Water Monitoring Location SW32 – Summary Data for 2013 / 2014

Parameter	No. of Samples	Max (mg/L)	Min (mg/L)	Average (mg/L)
Suspended Solids	4	<5	<5	<5
BOD	4	<2	<2	<2
Ammonia (NH3)	4	0.48	0.03	0.25
Nitrate (N)	4	3.2	0.42	1.3
Nitrite (N)	4	0.04	<0.02	<0.02
Total Phosphorus	4	<0.05	<0.05	<0.05

Table 8.9 Surface Water Monitoring Location SW33 – Summary Data for 2013 / 2014

Parameter	No. of Samples	Max (mg/L)	Min (mg/L)	Average (mg/L)
Suspended Solids	4	29	5	12.25
BOD	4	3	<2	<2
Ammonia (NH3)	4	2	0.03	0.78
Nitrate (N)	4	2.7	0.85	1.91
Nitrite (N)	4	0.06	0.02	0.04
Total Phosphorus	4	0.05	<0.05	<0.05

Table 8.10 Surface Water Monitoring Location SW34 – Summary Data for 2013 / 2014

Parameter	No. of Samples	Max (mg/L)	Min (mg/L)	Average (mg/L)
Suspended Solids	4	16	5	9
BOD	4	<2	<2	<2
Ammonia (NH3)	4	1.5	0.39	0.86
Nitrate (N)	4	2.8	0.52	1.49
Nitrite (N)	4	0.04	0.02	0.03
Total Phosphorus	4	<0.05	<0.05	<0.05

Table 8.11 Surface Water Monitoring Location SW35 – Summary Data for 2013 / 2014

Parameter	No. of Samples	Max (mg/L)	Min (mg/L)	Average (mg/L)
Suspended Solids	4	45	5	20.25
BOD	4	<2	<2	<2
Ammonia (NH3)	4	4.2	1.3	2.23
Nitrate (N)	4	3.3	0.92	2.33
Nitrite (N)	4	0.16	0.03	0.09
Total Phosphorus	4	0.12	0.05	0.08

Table 8.12 Surface Water Monitoring Location SW37 – Summary Data for 2013 / 2014

Parameter	No. of Samples	Max (mg/L)	Min (mg/L)	Average (mg/L)
Suspended Solids	4	41	5	19.5
BOD	4	<2	<2	<2
Ammonia (NH3)	4	3.5	0.25	1.52
Nitrate (N)	4	3	1.9	2.35
Nitrite (N)	4	0.3	0.03	0.13
Total Phosphorus	4	0.86	0.05	0.28

Table 8.13 Surface Water Monitoring Location SW37A – Summary Data for 2013 / 2014

Parameter	No. of Samples	Max (mg/L)	Min (mg/L)	Average (mg/L)
Suspended Solids	4	19	5	10.5
BOD	4	<2	<2	<2
Ammonia (NH3)	4	1.5	0.12	0.86
Nitrate (N)	4	3.7	0.4	1.56
Nitrite (N)	4	0.07	0.03	0.06
Total Phosphorus	4	0.06	<0.05	<0.05

Surface water quality monitoring data for outfall SW-33 for the year 2015 are shown in Table 8.14 to Table 8.16 below (each successive table relates to different parameters starting with TSS in Table 8.14). Outfall SW-33 is the main outfall on the west of the site. Total Suspended solids (TSS) were monitored daily while ammonia and phosphorus were monitored typically 4 times monthly.

All values for suspended solids were below 5mg/L. Ammonia N and total phosphorus monitoring (Tables 8.15 and 8.16 below) was undertaken less frequently (4 -5 times month) during this period and results are generally typically for runoff from a peatland environment (*i.e.* low phosphorus and slightly elevated ammonia).

Table 8.14 Surface Water Monitoring Location SW33 – 2015 Total Suspended Solid Results

Month	No. of Samples	Max (mg/L)	Min (mg/L)	Average (mg/L)
Jan	31	<5	<5	<5
Feb	28	<5	<5	<5
Mar	31	<5	<5	<5
Apr	30	<5	<5	<5
May	31	<5	10	<5
June	8	<5	7	<5

Table 8.15 Surface Water Monitoring Location SW33 – 2015 Ammonia Results

Month	No. of Samples	Max (mg/L)	Min (mg/L)	Average (mg/L)
Jan	4	1.1	0.72	0.84
Feb	4	1	0.71	0.9
Mar	5	0.75	0.56	0.66
Apr	4	0.66	0.2	0.45
May	4	0.72	0.33	0.46
June	2	0.33	0.21	0.27

Table 8.16 Surface Water Monitoring Location SW33 – 2015 Total Phosphorus Results

Month	No. of Samples	Max (mg/L)	Min (mg/L)	Average (mg/L)
Jan	4	<0.05	<0.05	<0.05
Feb	4	<0.05	<0.05	<0.05
Mar	5	<0.05	<0.05	<0.05
Apr	4	0.06	<0.05	<0.05

Month	No. of Samples	Max (mg/L)	Min (mg/L)	Average (mg/L)
May	4	0.49	<0.05	<0.05
June	2	<0.05	<0.05	<0.05

8.3.8 Hydrogeology

The Dinantian pure bedded limestones which are mapped to underlie the proposed development site are classified by the GSI (www.gsi.ie) as a Locally Important Aquifer - Bedrock which is Generally Moderately Productive (Lm). As this is pure limestone a relatively high permeability could be expected along weathered fractures and faults. However, the available evidence for this bedrock type in this area suggests that this is not always the case and this is because bedding is often poorly developed by weathering (GSI, 2004). The limestone bedrock in the area of Cloncreen is covered by a substantial thickness of lacustrine and glacial deposits which in turn is overlain by cutaway peat. The glacial deposits will likely provide the dominant potential pathway for groundwater movement in the proposed development site especially where sands and gravels are present.

As discussed in Chapter 7 (Soils and Geology) the mineral subsoil underlying the peat at the proposed turbine locations comprised predominately SILT with varying proportions of minor constituent's clay and sand and gravel. Sand and gravel deposits are present on the northern section of the site in the area of the proposed borrow pit. Based on exposures at the proposed borrow pit and data from the trial pit investigation, the glacial deposits are at least partially saturated beneath the peat. Groundwater seepages were noted in the majority of the trial pits at depth ranging between approximately 2 and 3 metres below ground level (mbgl) with resting groundwater levels (*i.e.* static) above the base of the peat of shown in Table 8.17 below which shows water level monitoring for piezometers installed at the site.

Regional groundwater levels below the bog are expected to be high, or close to base of peat level. There is strong evidence of groundwater drainage into the field drains (*i.e.* from elevated EC readings discussed at Section 8.3.6), and this drainage likely controls any sub-artesian groundwater levels that occur below the bog.

Due to the presence of the overlying peat (which results in minimal recharge) and the bulk low permeability of the SILT deposits, groundwater movement through the glacial till is likely to be relatively slow unless higher permeability sands and gravels are present. Recharge is likely to be limited to the higher ground to the north of the site where the peat is thin or absent. The groundwater flow direction in the area of Cloncreen bog is likely to be towards the Philipstown River and Figile River channels.

Table 8.17 Groundwater Level Monitoring Data

Location	WL mbgl (21/04/2016)	WL mbgl (26/04/2016)	WL mbgl (25/05/2016)	Peat Depth (m)	Summary Subsoil Lithology
WS-13[1]	0.24	0.39	0.41	0.67	Lacustrine Clay over silty GRAVEL
WS-103[2]	-	0.29	0.20	0.58	Shell Marl over silty GRAVEL
WS-202[3]	-	0.14	0.03	0.34	Lacustrine Clay over silty SAND
WS-204[3]	-	0.17	0.22	0.35	Lacustrine Clay over silty SAND

Notes: 1 – Turbine Location T13, 2 – Substation Option B, 3 – Substation Option A, mbgl – metres below ground level

8.3.9 Groundwater Vulnerability

The vulnerability rating of the bedrock aquifer underlying site is classified as "Low" to "Moderate" and this is consistent with the presence of basin peat underlain by a substantial depth of lacustrine SILT and glacial deposits.

This means there is a low potential for groundwater dispersion and movement within the aquifer, therefore surface water bodies such as drains and streams are more vulnerable than groundwater at this site.

8.3.10 Groundwater Hydrochemistry

There are no groundwater quality data for the proposed wind farm site and groundwater sampling would generally not be undertaken for this type of development in terms of EIS reporting, as groundwater quality impacts would not be anticipated.

Based on data from GSI publication Calcareous/Non calcareous classification of bedrock in the Republic of Ireland (WFD, 2004), the groundwater in areas of pure limestone is very hard with total hardness values in excess of 350 mg/l (as $CaCO_3$) and electrical conductivity values ranging 590-634 µS/cm, indicating that the groundwater has a calcium bicarbonate hydrochemical signature.

8.3.11 Water Framework Directive Water Body Status & Objectives

The South Eastern River Basin District (SERBD) Management Plan was adopted by all local authorities in the SERBD prior to 30th of April 2010, as stipulated in the European Communities (Water Policy) Regulations 2003 (S.I. 722 of 2003 as amended). The SERBD Management Plan (2009 – 2015) objectives, which will be integrated into the design of the proposed wind farm development, include the following:

- Prevent deterioration and maintain a high status where it already exists;
- Protect, enhance and restore all waters with aim to achieve at least good status by 2015;
- Ensure waters in protected areas meet requirements; and,
- Progressively reduce chemical pollution.

Our understanding of these objectives is that surface waters, regardless of whether they have 'Poor' or 'High' status, should be treated the same in terms of the level of protection and mitigation measures employed, *i.e.* there should be no negative change in status at all.

Strict mitigation measures in relation to maintaining a high quality of surface water runoff from the development and groundwater protection will ensure that the status of both surface water and groundwater bodies in the vicinity of the site will be at least maintained (see below for WFD water body status and objectives) regardless of their existing status.

8.3.12 Groundwater Body Status

Local Groundwater Body (GWB) and Surface water Body (SWB) status reports are available for download from (www.wfdireland.ie).

The Rhode GWB (IE_SE_G_116) underlies the development site. This GWB is assigned 'Good Status', which is defined based on the quantitative status and chemical status of the GWB.

8.3.13 Surface Water Body Status

A summary of the WFD status and risk result of Surface Water Bodies (SWBs) in which development is proposed (or immediately upstream of) are shown in Table 8.18 below.

The western half of the site is located in the Daingean Lower SWB (IE_SE_14_239) and the eastern half is located in the Figile Lower SWB (IE_SE_14_998). The Daingean Lower SWB and the Figile Lower SWB have an overall status of "Poor" and "Moderate" respectively. The risks mainly relate to channelization and diffuse sources of pollution.

Poor construction and water management practices during wind farm construction have the potential to impact on local surface water quality. Mitigation measures (as detailed below) will ensure that surface runoff from the developed areas of the site will be of a high quality and will therefore not impact on the status of downstream surface water bodies.

Table 8.18 Summary WFD Information for Surface Water Bodies

Water Body	General Physico-Chemical Status	Overall Ecological Status	Overall Status	Overall Risk Result	Overall Objective
Dangean Lower	N/A	Poor	Poor	1b	Restore 2021
Figile Lower	N/A	Moderate	Moderate	1a	Restore 2021

8.3.14 Designated Sites and Habitats

Designated sites include National Heritage Areas (NHAs), Proposed National Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs). The proposed wind farm development site is not located within any designated conservation site.

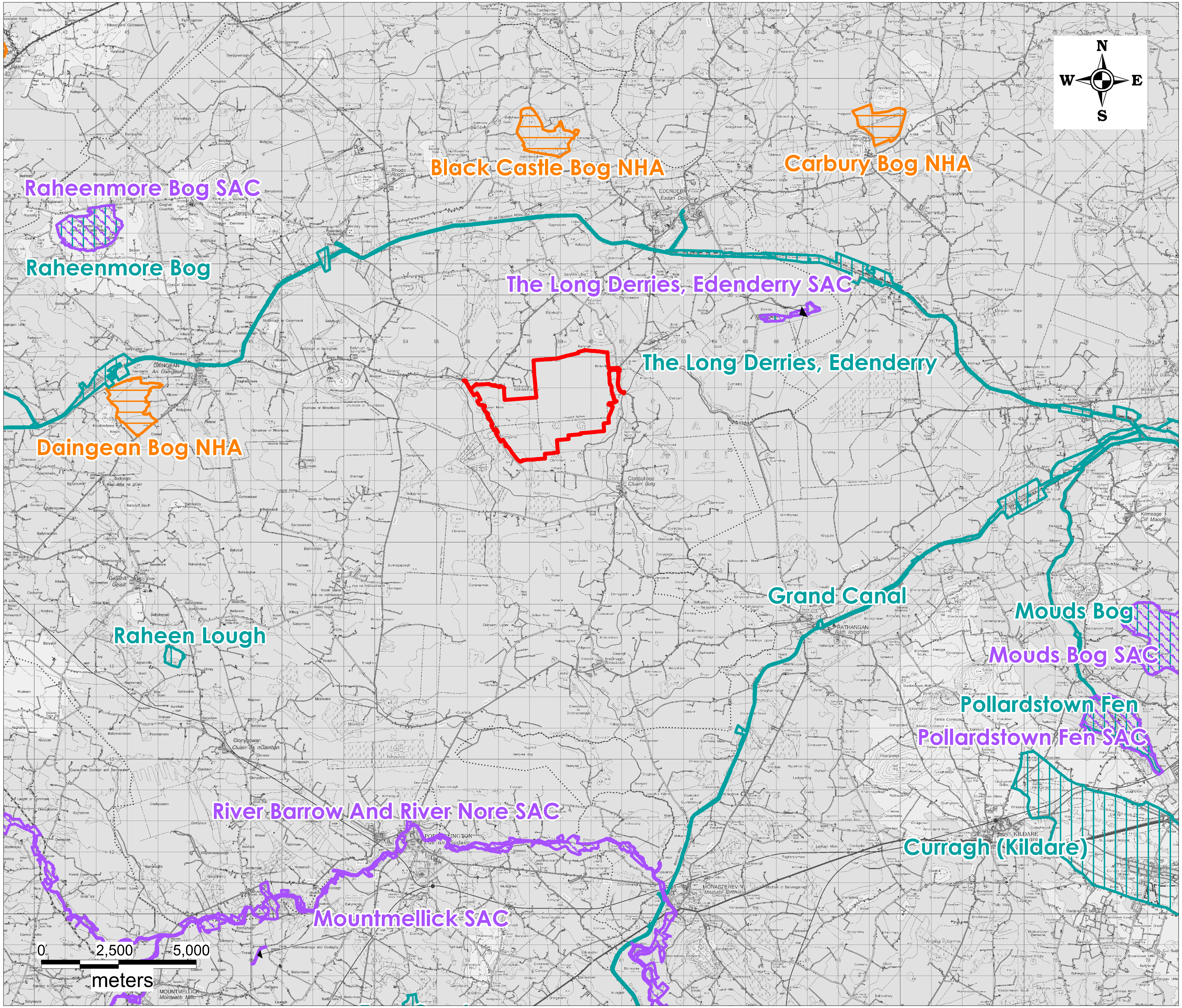
Designated sites in proximity to the proposed development site are listed below and show in Figure 8.5.

- The Long Derries, Edenderry cSAC and pNHA (Site Code: 000925) exists ~3km northeast of the proposed development site.
- Black Castle Bog NHA (Site Code: 000570) exists ~6.6km north of the proposed development site.
- Daingean Bog NHA (Site Code: 002033) exists ~10km west of the proposed development site.
- The Grand Canal pNHA (Site Code: 002104) exists ~3.5km north of the proposed development site.

The proposed development site is not hydrologically connected to any of the above listed designated sites.

As stated in Section 8.3.3 above, the proposed development site is located in the River Barrow regional surface water catchment. The River Barrow is a designated SAC (*i.e.* River Barrow and River Nore SAC) and it exists approximately 20km downstream of the site.

The likely significant effects on European sites are assessed in the AA Screening Report and NIS for the project.



Legend:

- Proposed Site Boundary
- Streams/Rivers
- cSAC
- SPA
- NHA
- pNHA

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Title: Designated Sites Map

Client: McCarthy Keville O'Sullivan

Job: Cloncreen WF

Project No: P1308-0

Figure No: 8.5

Sheet Size: A4

Drawing No: P1308-0-1215-805-A4-00A

Date: 14/09/2016

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8.3.15 Water Resources

Clonbullogue Public Water Supply (PWS) spring source and its groundwater protection zone (Zone of Contribution or ZOC) exist approximately 1km to the southeast of the proposed development site. The recharge area to the spring is mapped to be till deposits that exist to the northeast of the source location. The proposed development site is not located in the groundwater protection zone to this source. It is also worth noting that the ZOC to the spring exists to the east of the Figile River and therefore the Figile River channel creates a hydraulic boundary between the proposed development site and the area of the ZOC. Groundwater flow within the glacial deposits beneath the proposed development site is therefore expected to discharge into the Figile River rather than continue on towards the Clonbullogue PWS spring and ZOC. The location of the ZOC is shown on Figure 8.6.

A search of private well locations (wells with location accuracy of 1 – 50m were only sought) was undertaken using the GSI well database (www.gsi.ie). No wells with an accuracy of 1 – 50m were mapped in the area of the proposed development site. All the wells mapped in the area of the site are mapped only to an accuracy of 1km and therefore assessing potential impacts on these wells cannot be undertaken in any reliable manner.

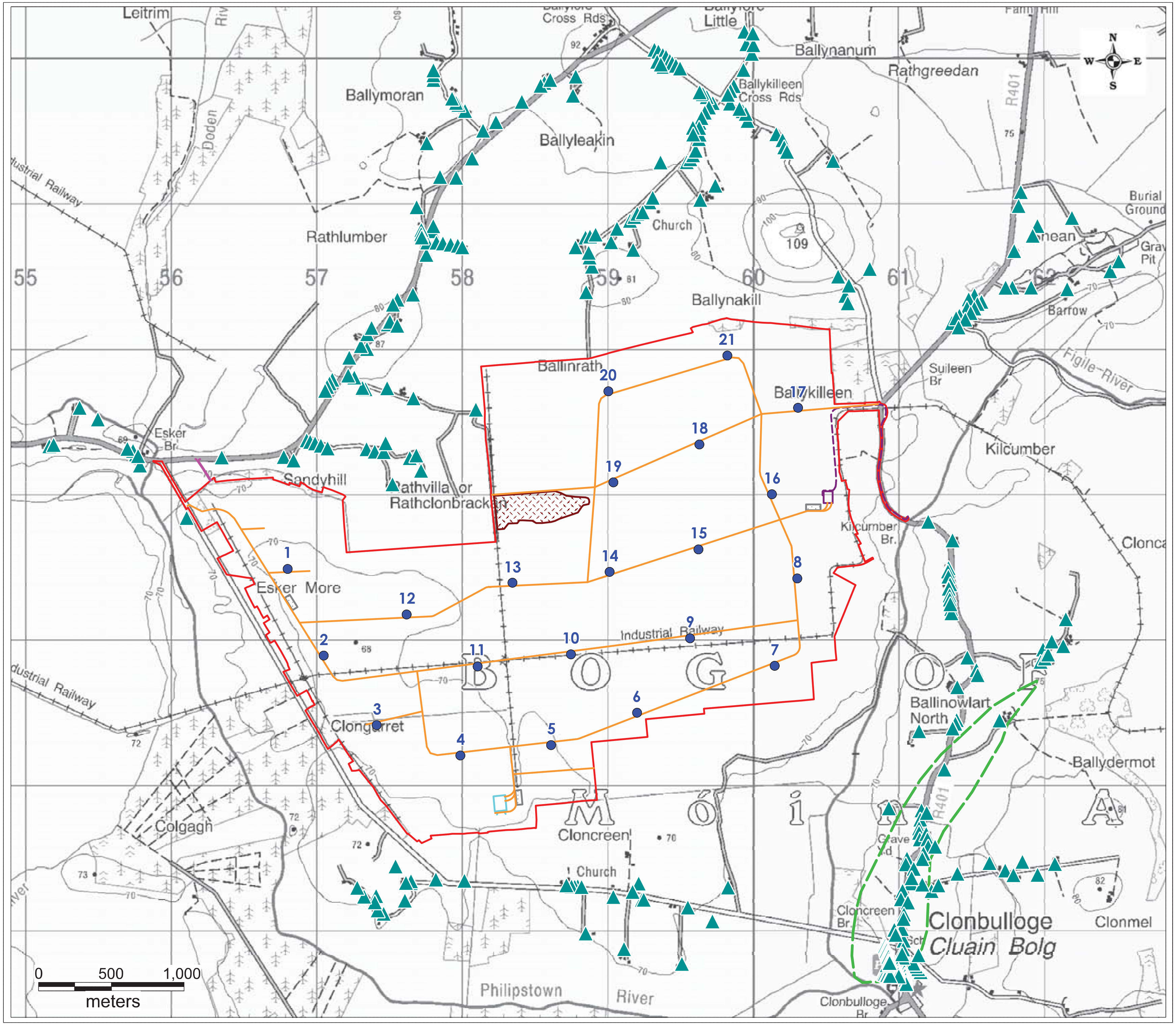
To overcome the poor accuracy problem of the GSI mapped wells it is assumed that every private dwelling in the area has a well supply and this impact assessment approach is described further below. This is very unlikely to be the case given a public water supply is present locally at Clonbullogue.

A stated in Section 8.3.8 above, the groundwater flow in the mineral soil deposits (silts, sands and gravels) beneath the peat at the proposed development site is expected to discharge into the Philipstown River and the Figile River which flow to the west/south and east of the site respectively. Therefore, groundwater flow on the west and south of the site is expected to be in a south-westerly and southerly direction respectively towards the Philipstown River. The groundwater flow direction on the east of the site is expected to be in an easterly / south-easterly direction towards the Figile River.

Using this conceptual model of groundwater flow, dwellings that are potentially located down-gradient of the proposed development footprint are identified and an impact assessment for these actual and potential well locations is undertaken.

As shown on Figure 8.6, there are no private dwellings down-gradient of the site to the west / southwest and therefore there is no potential for impact. The dwellings on the east of the site all exists to the east of the Figile River channel and therefore no groundwater flow [originating from the below site] is expected to reach these dwelling locations due to the hydraulic boundary effect created by the Figile River channel (*i.e.* shallow groundwater will discharge into the river rather than pass under it).

The private dwellings to the south of the site are potentially down-gradient of the proposed development as these dwellings exists between the proposed development site and the Philipstown River channel (discharge point of groundwater from the proposed development site). The closest proposed infrastructure up-gradient of the dwellings to the south along with the setback distance are shown in Table 8.19 below. An impact assessment for potential wells at these dwelling locations is undertaken in Section 8.4 below.



Legend

- Proposed Site Boundary
- Proposed Road
- Proposed Turbine Location
- Dwelling
- Proposed Substation A
- Proposed Substation B
- Proposed grid Connection Option A
- Proposed Grid Connection Option B
- Construction Compound
- Proposed Borrow Pit
- Zone of Contribution to Clonbullogge Public Water Supply

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Client: McCarthy Keville O'Sullivan	
Job: Cloncreen WF, Co. Offaly	
Title: Local Dwelling Map	
Figure No: 8.6	
Drawing No:P1308-0-0416-806-A3-0A	
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Scale: 1:35,000	Drawn By: GD
Date: 27/09/2016	Checked By: MG

Table 8.19 Potential Private Wells Down-gradient of the Development Footprint

Development Footprint Location [(1)]	Distance from Closest Private Dwelling (m) [(2)]
T3	970
T4	850
T5	960
T6	1,300
Substation Option B	645

Notes:

1. *Distance from closest turbine, site compound, borrow pit or substation (i.e. mineral soil excavation). Access roads and the grid connection cable trench are not considered a potential risk due to the shallow nature of these works. The distances listed above are from the nearest wind farm infrastructure within the same ground water catchment as the dwelling.*
2. *Each dwelling is assumed to have an on-site private groundwater well.*

8.3.16 Receptor Sensitivity

Due to the nature of wind farm developments, being near surface construction activities, impacts on groundwater are generally negligible and surface water is generally the main sensitive receptor assessed during impact assessments. The primary risk to groundwater at the site would be from cementitious materials, hydrocarbon spillage and leakages. These are common potential impacts on all construction sites (such as road works and industrial sites). All potential contamination sources are to be carefully managed at the site during the construction, operational and decommissioning phases of the development and mitigation measures are proposed below to deal with these potential minor impacts.

Based on criteria set out in Table 8.1 above, the Locally Important Aquifer can be classed as Sensitive to pollution. The majority of the site however is covered in cutover peat which in turn is underlain by silt dominated glacial deposits and these layers act as a protective cover to the underlying bedrock aquifer. The glacial deposits are not mapped as an aquifer but they are likely to be used locally as a water supply and therefore they can also be classed as Sensitive to pollution. However, due to the presence of the peat, and upwelling groundwater in the field drains, any contaminants which may be accidently released on-site are more likely to travel to nearby streams within surface runoff.

Comprehensive surface water mitigation and controls are outlined below to ensure protection of all downstream receiving waters. Mitigation measures will ensure that surface runoff from the developed areas of the site will be of a high quality and will therefore not impact on the quality of downstream surface water bodies. Any introduced drainage works at the site will mimic the existing drainage regime thereby avoiding changes to flow volumes leaving the site via the existing outfalls.

8.3.17 Assessment of Changes in Site Runoff Volumes

This section undertakes a water balance assessment and surface water runoff assessment for the proposed development. The water balance is undertaken for the site without considering the proposed surface water attenuation measures. The objective of the water balance assessment is to demonstrate that due to the naturally high runoff rates (and low groundwater recharge rates) there will be no significant potential for changes in the surface water runoff/recharge regime at the site. The runoff assessment then demonstrates how the proposed wind farm surface water drainage and attenuation measures will reduce surface water runoff due to increased storage and slower runoff rates, compared to an active peat production bog.

The water balance is undertaken for baseline characterisation purposes along with an assessment of potential runoff changes as a result of the proposed development footprint before drainage mitigation measures are put in. The rainfall depths used in the water balance, are long term monthly averages, are not used in the design of the sustainable drainage system for the wind farm. As outlined in Section 8.4.2.2 below the peak runoff generated by a 1 in 100 return event (*i.e.* the peak runoff for various event durations) will be used for design purposes.

The water balance calculations are carried out for the month with the highest average recorded rainfall minus evapotranspiration, for the current baseline site conditions (Table 8.21). It represents therefore, the long term average wettest monthly scenario in terms of volumes of surface water runoff from the site pre-wind farm development. The surface water runoff co-efficient for the site is estimated to be 96% based on GSI estimates.

The highest long term average monthly rainfall recorded at Edenderry occurred in December, at 84mm. The average monthly evapotranspiration for the synoptic station at Mullingar over the same period in December was 2.7mm. The water balance indicates that a conservative estimate of surface water runoff for the site during the highest rainfall month is 751,168m^3/month or 24,232m^3/day for the proposed development site.

Table 8.20 Water Balance and Baseline Runoff Estimates for Wettest Month (December)

Water Balance Component	Depth (m)
Average December Rainfall (R)	0.084
Average December Potential Evapotranspiration (PE)	0.0027
Average December Actual Evapotranspiration (AE = PE x 0.95)	0.0025
Effective Rainfall December (ER = R - AE)	0.0815
Recharge (4% of ER)	0.0032
Runoff (96% of ER)	0.0783

Table 8.21 Baseline Runoff for the Site

Study Area	Approx. Area (ha)	Baseline Runoff per month (m^3) [1]	Baseline Runoff per day (m^3) [1]
Development Site	960	751,168	24,232

Note: of wettest month, i.e. December

Table 8.22 Water Balance and Estimated Development Runoff Volumes

Development and Substation A or B	Site Baseline Runoff/month (m^3)	Baseline Runoff/day (m^3)	Permanent Hardstanding Area (m^2)	Hardstanding Area 100% Runoff (m^3)	Hardstanding Area 96% Runoff (m^3)	Net Increase/month (m^3)	Net Increase/day (m^3)	% Increase from Baseline Conditions (m3)
Option A	751,168	24,232	396,000	32,274	30,983	1,291	41.6	0.172
Option B	751,168	24,232	401,000	32,682	31,374	1,307	42.2	0.174

Note: Development with either substation Option A or Option B

There is a slight difference in the footprint area of substation Option A and Option B and therefore the water balance is completed for the wind farm development for the two options. The emplacement of the proposed permanent development footprint (which also includes either substation Option A or Option B proposals), as described in Chapter 3 of the EIS (assuming emplacement of impermeable materials as a worst case scenario) could result in an average total site increase in surface water runoff of approximately 1,300m^3/month as shown above in Table 8.22. The above table completes a water balance for the wind farm development for both substation options.

This represents a potential increase of approximately 0.17% in the average daily/monthly volume of runoff from the site area in comparison to the baseline pre-development site runoff conditions. This is a very small increase in average runoff and results from the naturally high surface water runoff rates and the relatively small area of the site being developed, the proposed total permanent development footprint being approximately 40ha (with substation Option A – 39.6ha, and substation Option B – 40.1ha), representing ~4% of the total study area of 960ha.

The additional volume is low due to the fact that the runoff potential from the site is naturally high (96% of effective rainfall leaves the site as runoff). Also, the calculation assumes that all hardstanding areas will be impermeable which will not be the case as access tracks will be constructed of permeable stone aggregate). The increase in runoff from the proposed development will therefore be negligible. This is even before mitigation measures will be put in place. Therefore, there will be no risk of exacerbated flooding down-gradient of the site.

As stated in Section 8.3.4 above there are existing surface water control measures at the bog which comprise field drains, main drains and settlement ponds. All these existing drainage measures offer surface water attenuation during rainfall events. However, as the part of the proposed wind farm drainage (which is outlined further in Section 8.3.18 and Section 8.3.19 below) it is proposed that runoff from the proposed infrastructure will be collected locally in new proposed silt traps, settlement ponds at hardstand and turbine base areas and wetland areas prior to release into the existing wider bog drainage network. The new proposed wind farm drainage measures will then in effect create significant additional attenuation to what is already present at the site. The net effect of this will be a reduction in the overall runoff coefficient of the bog as demonstrated by the use of the Rational Method in Table 8.23 below. Based on a conservative reduction in the runoff coefficient from 0.85 to 0.7 for the overall site, there would a potential 16.8% reduction in runoff rates from the site. This assessment demonstrates that there will be no risk of exacerbated flooding down-gradient of the site as a result of the proposed wind farm development. The proposed development will in effect retain water within the bog for longer periods.

Table 8.23 Surface Water Runoff Assessment for Proposed Wind Farm Drainage

Site Area	C[1]	Area (m^2)	Rc[2]	Rainfall Intensity (mm/hr)	Runoff Rate (m^3/s)	Total Site Runoff Rate (m^3/s)
Without Wind Farm Drainage Control						
Undeveloped Area	2.78	9200000	0.85	11	10.7	11.3
Development Footprint	2.78	400000	0.95	11	0.5	
With Wind Farm Drainage Control						
Undeveloped Area	2.78	9200000	0.7	11	8.8	9.4
Development Footprint	2.78	400000	0.95	11	0.5	
Estimated Potential Reduction in Site Runoff Rate						16.8%

Notes: 1 – Constant, 2- Runoff Coefficient

8.3.18 Development Interaction with the Existing Bog Drainage Network

The proposed wind farm drainage will not significantly alter the existing drainage regime at the site. Moreover, the proposed drainage system will be fully integrated into the existing established bog drainage system.

Existing field drains and main drains will be routed under/around access tracks using culverts as required.

Runoff from access tracks, turbine bases, and developed areas (construction compounds, sub-stations, met mast) will be collected and treated in local (proposed) silt traps and settlement ponds and then discharged to existing peat field drains. From there this water will flow towards the site boundaries in field drains and main drains) and be treated further in the existing main settlement ponds prior to discharge from the site.

One of the proposed ecological aspects of the drainage design is to re-wet the site in small areas, where possible, to create wet areas as such wetland features which are good for overall site biodiversity. Ponding would occur in these areas to a very shallow depth, and only intermittently following heavy rainfall. No large open bodies of water are proposed, and where intermittent ponding occur these will be broken up into small areas using small linear peat berms.

8.3.19 Proposed Drainage Management

Runoff control and drainage management are key elements in terms of mitigation against impacts on surface water bodies. Two distinct methods will be employed to manage drainage water within the proposed development. The first method involves 'keeping clean water clean' by avoiding disturbance to existing established drainage features, minimising any works in or around artificial drainage features, and diverting clean surface water flow around excavations, construction areas and temporary storage areas. The second method involves collecting any drainage waters from works areas within the site that might carry silt or sediment, and nutrients, to route them towards new proposed silt traps and settlement ponds (or stilling ponds) prior to controlled diffuse release into the existing field drainage network. There will be no direct discharges to any existing natural watercourse.

During the construction phase all runoff from works areas (*i.e.* dirty water) will be attenuated and treated to a high quality prior to being released. A detailed set of drainage plans showing the layout of the proposed wind farm drainage design elements is shown in Appendix 3-1 of the EIS. A process flow diagram of the proposed wind farm drainage is shown in Plate 8D below.

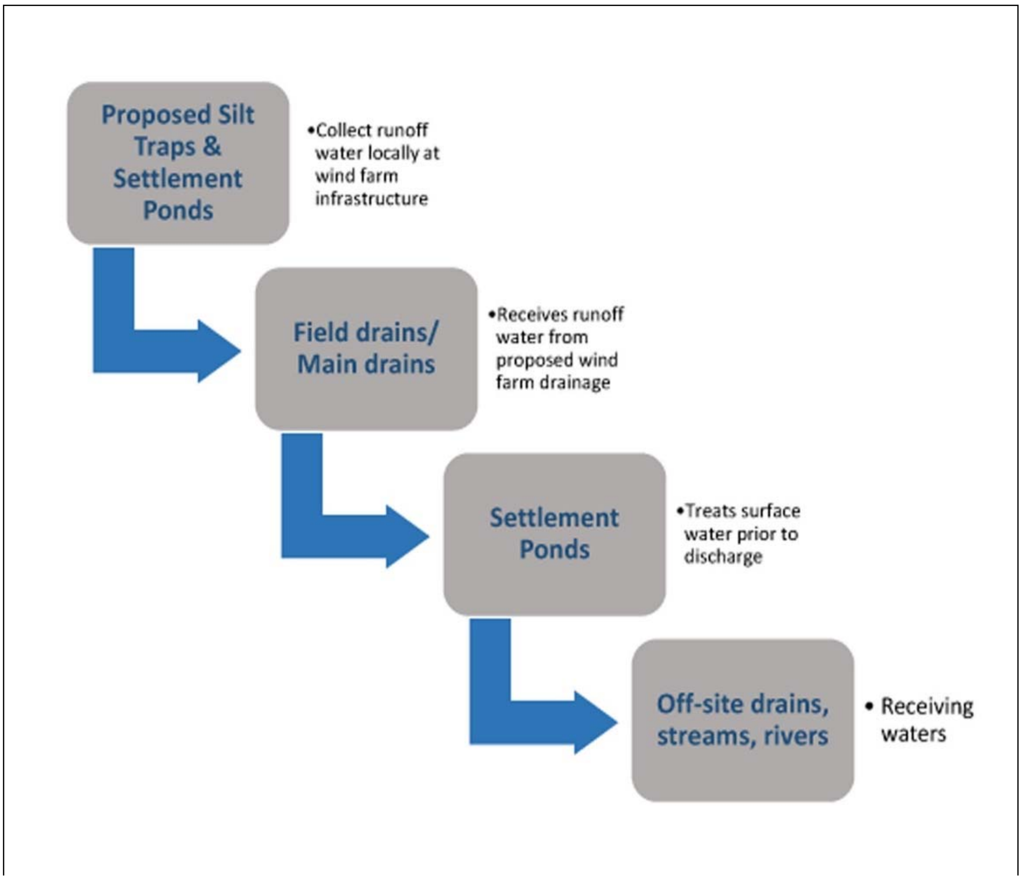
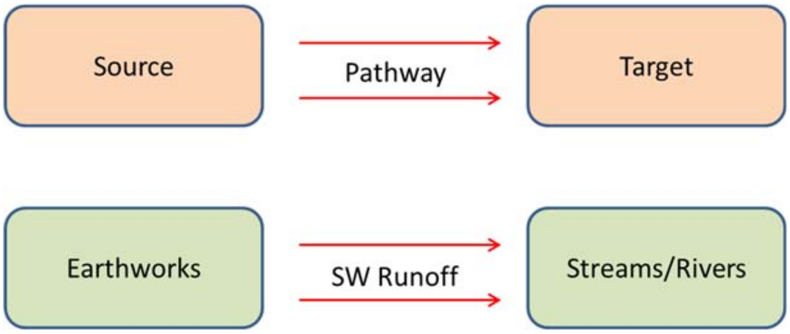


Plate 8D: Proposed Wind Farm Drainage Process Flow Diagram

8.4 Likely Significant Effects and Mitigation Measures

8.4.1 Overview of Impact Assessment Process

The conventional source-pathway-target model (see below, top) was applied to assess potential significant effects on downstream environmental (water) receptors (see below, bottom as an example) as a result of the proposed wind farm development, and associated works.



Where potential significant effects are identified, the classification of impacts in the assessment follows the descriptors provided in the Glossary of Impacts contained in the following guidance documents produced by the Environmental Protection Agency (EPA):

- *Advice Notes on Current Practice in the Preparation of Environmental Impact Statements* (EPA, 2003); and,

- *Guidelines on the Information to be contained in Environmental Impact Statements* (EPA, 2002).

The description process clearly and consistently identifies the key aspects of any potential impact source, namely its character, magnitude, duration, likelihood and whether it is of a direct or indirect nature.

In order to provide an understanding of the stepwise impact assessment process applied below (Section 8.4.2 and 8.4.3), we have firstly presented below a summary guide that defines the steps (1 to 7) taken in each element of the impact assessment process. The guide also provides definitions and descriptions of the assessment process and shows how the source-pathway-target model and the EPA impact descriptors are combined.

Using this defined approach, this impact assessment process is then applied to all wind farm construction, operation and decommissioning activities which have the potential to generate a source of significant adverse effect on the geological and hydrological/ hydrogeological (including water quality) environments.

Step 1	Identification and Description of Potential Impact Source This section presents and describes the activity that brings about the potential significant effects or the potential source of pollution. The significance of effects is briefly described.	
Step 2	Pathway / Mechanism:	The route by which a potential source of impact can transfer or migrate to an identified receptor. In terms of wind farm developments and associated works, surface water and groundwater flows are the primary pathways, or for example, excavation or soil erosion are physical mechanisms by which a potential significant effect is generated.
Step 3	Receptor:	A receptor is a part of the natural environment which could potentially be impacted upon, *e.g.* human health, plant / animal species, aquatic habitats, soils/geology, water resources, water sources. The potential significant effect can only arise as a result of a source and pathway being present.
Step 4	Pre-mitigation Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential significant effect before mitigation is put in place.
Step 5	Proposed Mitigation Measures:	Control measures that will be put in place to prevent or reduce all identified significant adverse effects. In relation to wind farm developments, these measures are generally provided in two types: (1) mitigation by avoidance, and (2) mitigation by engineering design.
Step 6	Post Mitigation Residual Impact:	Impact descriptors which describe the magnitude, likelihood, duration and direct or indirect nature of the potential significant effect after mitigation is put in place.

Step 7	Significance of Effects:	Describes the likely significant post mitigation effects of the identified potential impact source on the receiving environment.

8.4.2 Construction Phase Potential Effects

8.4.2.1 Earthworks (Turbine bases, hardstanding areas, access roads, substations, new site entrance / haul route upgrade and grid connection routes) Resulting in Suspended Solids Entrainment in Surface Waters

Construction phase activities including access road construction, turbine base/hardstanding construction, substation construction and grid connection cable trench excavations will require earthworks resulting in excavation of peat and mineral subsoil where present. Potential sources of sediment laden water include:

- Drainage and seepage water resulting from road and turbine base excavation;
- Stockpiled excavated material providing a point source of exposed sediment;
- Construction of the grid connection cable trench resulting in entrainment of sediment from the excavations during construction; and,
- Erosion of sediment from emplaced site drainage channels.

These activities can result in the release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream surface water bodies. Potential effects could be significant if not mitigated against.

Pathways: Drainage and surface water discharge routes.
Receptors: Down-gradient rivers and dependant ecosystems.

Pre-Mitigation Effects
Indirect, negative, significant, temporary, medium probability effect.

Proposed Mitigation Measures
There are no natural watercourses present within the site and therefore there will be no requirement to avoid any streams or rivers as would normally be required on say an upland wind farm site. All the local streams and rivers are located at significant distances off-site.

Mitigation by Design:
Presented below are temporary and construction drainage control measures that will be utilised during the construction phase of the wind farm. As stated above there is an existing established drainage network at the site which comprises field drains, main drains and settlement ponds. The measures outlined below will be used in conjunction with the existing drainage network to ensure protection of rivers and streams downstream of the proposed development site.

- Source controls:
    - Interceptor drains, vee-drains, diversion drains, flume pipes, erosion and velocity control measures such as use of sand bags, oyster bags filled with gravel, filter fabrics, and other equivalent systems.
    - Small working areas, covering stockpiles, weathering off stockpiles, cessation of works in certain areas or other equivalent measures.
- In-Line controls:

  - Interceptor drains, vee-drains, oversized swales, erosion and velocity control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt bags, silt fences, sedimats, filter fabrics, and collection sumps, temporary sumps/attenuation lagoons, sediment traps, pumping systems, settlement ponds, temporary pumping chambers, or other equivalent systems.
- Treatment systems:
  - Temporary sumps and attenuation ponds, temporary storage lagoons, silt traps, settlement ponds, and proprietary settlement systems such as Siltbuster, and/or other equivalent systems.

There is an extensive network of field drains already existing at the site, and these will be integrated and enhanced as required and used within the wind farm development drainage system. The key elements being the upgrading and improvements to water treatment systems, such as in-line controls and treatment systems, including silt traps, and settlement ponds.

The main elements of interaction with existing field drains/main drains will be as follows:

- Apart from interceptor drains, which will convey clean runoff water to the downstream field drainage system there will be no direct discharge (without treatment for sediment reduction via silt traps/settlement ponds) of runoff from the proposed wind farm drainage into the existing site drainage network where possible. This will reduce the potential for any increased risk of downstream flooding or sediment transport/erosion;
- Temporary silt traps will be placed in the existing drains downstream of construction works, and these will be diverted into proposed interceptor drains, or culverted under/across the works area;
- During the operational phase of the wind farm runoff from individual turbine hardstanding areas will not be discharged directly into the existing drain network but discharged locally at each turbine location through settlement ponds which outfall to a field drain;
- Velocity and silt control measures such as check dams, sand bags, oyster bags, straw bales, flow limiters, weirs, baffles, silt fences will be used during the construction works; and,
- Existing culverts will be lengthened where necessary to facilitate construction of wind farm access tracks/roads.

Water Treatment Train:
If the discharge water from construction areas fails to be of a high-quality then a filtration treatment system (such as a 'siltbuster' or equivalent treatment train (sequence of water treatment processes) will be used to filter and treat all surface discharge water collected in the dirty water drainage system. This will apply for all of the construction phase.

Silt Fences:
Silt fences will be emplaced within drains down-gradient of all construction areas. Silt fences are effective at removing heavy settleable solids. This will act to prevent entry to the existing drainage network of sand and gravel sized sediment, released from excavation of mineral sub-soils of glacial and glacio-fluvial origin, and entrained in surface water runoff. Inspection and maintenance of these structures during construction phase is critical to their functioning to stated purpose. They will remain in place throughout the entire construction phase.

Silt Bags:
Silt bags will be used where small to medium volumes of water need to be pumped from excavations. As water is pumped through the bag, most of the sediment is retained by the geotextile fabric allowing filtered water to pass through.

Pre-emptive Site Drainage Management:
The works schedule for the construction stage of the development will also take account of weather forecasts, and predicted rainfall in particular. Large excavations and movements of peat/subsoil or peat stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.

The following forecasting systems are available and will be used on a daily basis at the site to direct proposed construction activities:

- **General Forecasts:** Available on a national, regional and county level from the Met Eireann website (www.met.ie/forecasts). These provide general information on weather patterns including rainfall, wind speed and direction but do not provide any quantitative rainfall estimates;
- MeteoAlarm: Alerts to the possible occurrence of severe weather for the next 2 days. Less useful than general forecasts as only available on a provincial scale;
- 3-hour Rainfall Maps: Forecast quantitative rainfall amounts for the next 3 hours but does not account for possible heavy localised events;
- Rainfall Radar Images: Images covering the entire country are freely available from the Met Eireann website (www.met.ie/latest/rainfall_radar.asp). The images are a composite of radar data from Shannon and Dublin airports and give a picture of current rainfall extent and intensity. Images show a quantitative measure of recent rainfall. A 3-hour record is given and is updated every 15 minutes. Radar images are not predictive; and,
- Consultancy Service: Met Eireann provide a 24-hour telephone consultancy service. The forecaster will provide interpretation of weather data and give the best available forecast for the area of interest.

Using the safe threshold rainfall values will allow work to be safely controlled (from a water quality perspective) in the event of forecasting of an impending high rainfall intensity event.

Works should be suspended if forecasting suggests any of the following is likely to occur:

- >10 mm/hr (*i.e.* high intensity local rainfall events);
- >25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
- >half monthly average rainfall in any 7 days.

Prior to works being suspended the following drainage control measures should be completed:

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and,
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

Management of Runoff from Peat and Subsoil Storage Areas:
It is proposed that excavated peat will be used for landscaping close to its original extraction point. During the initial placement of peat and subsoil, silt fences, straw bales and biodegradable geogrids will be used to control surface water runoff from the storage areas. 'Siltbuster' treatment trains will be employed if necessary.

Timing of Site Construction Works:
Construction of the site drainage system will only be carried out during periods of low rainfall, and therefore minimum runoff rates. This will minimise the risk of entrainment of suspended sediment in surface water runoff, and transport via this pathway to surface watercourses.

Monitoring:
An inspection and maintenance plan for the on-site drainage system will be prepared in advance of commencement of any construction works. Regular inspections of all installed wind farm drainage systems will be undertaken, especially after heavy rainfall, to check for blockages, and ensure there is no build-up of standing water in parts of the systems where it is not intended.

Any excess build-up of silt levels at dams, the settlement ponds, or any other drainage features that may decrease the effectiveness of the drainage feature, will be removed.

During the construction phase field testing and laboratory analysis of a range of parameters with relevant regulatory limits and EQSs should be undertaken for each primary watercourse, and specifically following heavy rainfall events (*i.e.* weekly, monthly and event based). The monitoring will be completed at the locations and for the parameters already specified in the IPC Licence for the works (P0503-01). A monitoring plan is outlined in the preliminary CEMP attached as Appendix 3-2 to the EIS.

Residual Effects
Negative, indirect, imperceptible, temporary, low probability effect

Significance of Effects
No significant effects on the surface water quality are anticipated.

8.4.2.2 Potential Impacts on Groundwater Levels during Excavation Works & from Proposed Borrow Pit

Dewatering of borrow pits (which is not proposed) and other deep excavations (*i.e.* turbine bases) have the potential to impact on local groundwater levels. However, groundwater level impacts are not anticipated to be significant due the local hydrogeological regime (*i.e.* high water table below the bog, and significant distances to any potential off site receptors such as wells or natural rivers/streams) which comprises relatively low permeability glacial deposits. Also, the sands and gravels for extraction at the proposed borrow pit are above the local groundwater table.

Pathway: Groundwater flow paths.
Receptor: Groundwater levels.

Pre-Mitigation Effect
Direct, negligible, slight, short term, low probability effect

Impact Assessment / Mitigation Measures
The proposed borrow pit will extract sand and gravel deposits above the local groundwater table and therefore there is no potential to impact on local groundwater levels.

Relevant environmental management guidelines from the EPA quarry 2006 guidance document – "*Environmental Management in the Extractive Industry*" in relation to groundwater issues will be implemented during the construction phase.

The installation of turbine bases in the underlying glacial deposits is likely to require some temporary dewatering arrangements. However, due to the dominance of relatively low permeability SILT subsoils the impacts on groundwater levels will be localized to the excavation and only for a temporary basis during the construction work.

The proposed underground cable (grid connection Option A) trench depth will only be approximately 1.2 m in depth and therefore no impacts on the local groundwater table or flows are anticipated. Grid connection Option B comprises overhead lines and therefore there is no potential for groundwater level or flow impacts.

No groundwater impacts at haul route junction upgrade works are anticipated, as these works are all occurring at ground level, and will not intercept the groundwater table.

Residual Effects
No residual effects are anticipated.

Significance of Effects
No significant effects on groundwater levels are anticipated.

8.4.2.3 Excavation Dewatering and Potential Impacts on Surface Water Quality

Groundwater seepages will likely occur in turbine base excavations and this will create additional volumes of water to be treated by the drainage management system. Groundwater inflows will be more significant where lenses of sand and gravel are intercepted in excavations.

Inflows will likely require management and treatment to reduce suspended sediments. No contaminated land was noted at the site and therefore pollution issues are anticipated in this respect.

Pathway: Overland flow and site drainage network.
Receptor: Down-gradient surface water bodies.

Pre-Mitigation Effects
Indirect, negative, significant, temporary, low probability effects to surface water quality.

Proposed Mitigation Measures
Mitigation by Design:
Management of excavation seepages and subsequent treatment prior to discharge into the existing field drainage network will be undertaken as follows:

- Appropriate interceptor drainage, to prevent upslope surface runoff from entering excavations will be put in place;
- If required, pumping of excavation inflows will prevent build-up of water in the excavation;

- The interceptor drainage will be discharged to the existing field drainage system or onto the bog surface;
- The pumped water will be discharged via silt bags/silt traps adjacent to excavation areas, or via specialist treatment systems such as a Siltbuster unit if required;
- There will be no direct discharge to the existing drainage network and therefore no risk of hydraulic loading or contamination will occur;
- Daily monitoring of excavations by a suitably qualified person will occur during the construction phase. If high levels of seepage inflow occur, excavation work should immediately be stopped and a geotechnical assessment undertaken; and,
- A mobile 'Siltbuster' or equivalent specialist treatment system will be available on-site for emergencies in order to treat sediment polluted waters from settlement ponds or excavations should they occur. Siltbusters are mobile silt traps that can remove fine particles from water using a proven technology and hydraulic design in a rugged unit. The mobile units are specifically designed for use on construction-sites.

Residual Effects
Indirect, negligible, temporary, low probability effects on local surface waters.

Significance of Effects
No significant effects on the surface water quality are anticipated.

8.4.2.4 Potential Release of Hydrocarbons during Construction and Storage

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. It is also a nutrient supply for adapted micro-organisms, which can rapidly deplete dissolved oxygen in waters, resulting in death of aquatic organisms.

Pathway: Groundwater flowpaths and site drainage network.
Receptor: Groundwater and surface water.

Pre-Mitigation Effects
Indirect, negative, slight, short term, medium probability effect to local groundwater quality.
Indirect, negative, significant, short term, low probability effect to surface water quality.

Proposed Mitigation Measures:
Mitigation by Design:

- On site re-fuelling of machinery will be carried out using a mobile double skinned fuel bowser. The fuel bowser, a double-axel custom-built refuelling trailer will be re-filled off site, and will be towed around the site by a 4x4 jeep to where machinery is located. The 4x4 jeep will also carry fuel absorbent material and pads in the event of any accidental spillages. The fuel bowser will be parked on a level area in the construction compound when not in use and only designated trained and competent operatives will be authorised to refuel plant on site. Mobile measures such as drip trays and fuel absorbent mats will be used during all refuelling operations;
- There will be no refuelling permitted in the proposed borrow pit area;

- Fuels stored on site will be minimised. Any storage areas will be bunded appropriately for the fuel storage volume for the time period of the construction;
- The electrical control building should be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used should be regularly inspected for leaks and fitness for purpose; and,
- An emergency plan for the construction phase to deal with accidental spillages will be contained within Environmental Management Plan. Spill kits will be available to deal with accidental spillages.

Residual Effect
Indirect, negative, imperceptible, temporary, low probability effect on groundwater and surface water.

Significance of Effects
No significant effects on surface water or groundwater quality are anticipated.

8.4.2.5 Groundwater and Surface Water Contamination from Wastewater Disposal

Release of effluent from domestic wastewater treatment systems has the potential to impact on groundwater and surface waters if site conditions are not suitable for an on-site percolation unit.

Pathway: Groundwater flowpaths and site drainage network.
Receptor: Down-gradient well supplies, groundwater quality and surface water quality.

Pre mitigation Effect
Indirect, negative, significant, temporary, low probability effect to surface water quality.
Indirect, negative, slight, temporary, low probability effect to local groundwater.

Proposed Mitigation Measures
Mitigation by Avoidance:

- A self-contained port-a-loo with an integrated waste holding tank will be used at each of the site compounds, maintained by the providing contractor, and removed from site on completion of the construction works;
- Water supply for the site office and other sanitation will be brought to site and removed after use from the site to be discharged at a suitable off-site treatment location; and,
- No water will be sourced on the site, or discharged to the site.

Residual Effect
No effect

Significance of Effects
No significant effects on surface water or groundwater quality are anticipated.

8.4.2.6 Release of Cement-Based Products

Concrete and other cement-based products are highly alkaline and corrosive and can have significant negative impacts on water quality. They generate very fine, highly alkaline silt (pH 11.5) that can physically damage fish by burning their skin and blocking their gills. A pH range of ≥ 6 ≤ 9 is set in S.I. No. 293 of 1988 Quality of Salmonid Water Regulations, with artificial variations not in excess of ± 0.5 of a pH unit. Entry of cement based products into the site drainage system, into surface water runoff, and hence to surface watercourses or directly into watercourses represents a risk to the aquatic environment. Peat ecosystems are dependent on low pH hydrochemistry. They are extremely sensitive to introduction of high pH alkaline waters into the system. Delivery of wet concrete on site and washing out of transport and placement machinery are the activities most likely to generate a risk of cement based pollution.

Pathway: Site drainage network.
Receptor: Surface water and peat water hydrochemistry.

Pre-Mitigation Effect
Indirect, negative, moderate, short term, medium probability effect to surface water.

Proposed Mitigation Measures
Mitigation by Avoidance:

- No batching of wet-cement products will occur on site. Ready-mixed supply of wet concrete products and where possible, emplacement of pre-cast elements, will take place;
- Where possible pre-cast elements for culverts and concrete works will be used;
- No washing out of any plant used in concrete transport or concreting operations will be allowed on-site;
- Where concrete is delivered on site, only the chute need be cleaned, using the smallest volume of water possible. No discharge of cement contaminated waters to the construction phase drainage system or directly to any artificial drain or watercourse will be allowed. Chute cleaning water is to be directed into a dedicated lined washout area. This lined area will be removed from site once construction phase is complete;
- Use weather forecasting to plan dry days for pouring concrete; and,
- Ensure pour site is free of standing water and plastic covers will be ready in case of sudden rainfall event.

Residual Effect
Negative, Indirect, imperceptible, short term, low probability impact.

Significance of Effects
No significant effects on surface water quality are anticipated.

8.4.2.7 Potential Impacts on Hydrologically Connected Designated Sites

The proposed wind farm development site is not located within any designated conservation site. As stated in Section 8.3.3 above, the proposed development site is located in the River Barrow regional catchment. The River Barrow is a designated SAC (*i.e.* River Barrow and River Nore SAC) and it exists approximately 20km downstream of the site. No significant effects on the River Barrow and River Nore SAC are anticipated and this is due to the existing and proposed on-site drainage control measures in addition to the significant downstream distance of this designated site.

A Natura Impact Statement (NIS) has been prepared, and will be submitted with the planning application for the proposed development. The NIS concludes that the proposed development, by itself or in combination with other plans and projects will not adversely affect the integrity of any designated European Site.

Pathway: Surface water flowpaths.
Receptor: Down-gradient water quality and designated sites.

Pre-Mitigation Effect
Indirect, negative, negligible, temporary, low probability effect.

Proposed Mitigation Measures
The proposed mitigation measures for protection of surface water quality which will include the existing bog drainage controls (*i.e.* existing field drains, main drains and settlement ponds) and proposed wind farm drainage control measures (*i.e.* interceptor drains, collector drains, swales, silt traps, and settlement ponds) will ensure that the quality of runoff from proposed development areas will be very high.

As stated in Impact Section 8.4.2.1 above, there could potentially be an "*imperceptible, temporary, low probability effect*" on local streams and rivers but this would be very localised and over a very short time period (*i.e.* hours). Therefore, significant indirect effects on designated sites is not anticipated. No direct impacts on designated sites can occur due to their considerable separation from the site boundary.

Residual Effects
No residual effects on designated sites are anticipated.

Significance of Effects
No significant impacts on designated sites are anticipated.

8.4.2.8 Potential Impacts on Local Groundwater Well Supplies

As stated in Section 8.3.15 above, the private dwellings to the south of the site are potentially down-gradient of the proposed development as these dwellings exist between the proposed development site and the Philipstown River (discharge point of groundwater from the proposed development site). The proposed infrastructure up-gradient of the dwellings to the south along with the setback distance is shown in Table 8.18 above. The closest proposed infrastructure to these dwellings is substation B which has a setback distance of approximately 645m. The closest proposed turbine is approximately 850m away. The haul route junction works will only require shallow earthworks and there will be no potential to impact on local wells.

Pathway: Groundwater flowpaths.
Receptor: Groundwater Supplies.
Pre-Mitigation Effect
Indirect, negative, imperceptible, short term, low probability effect.

Impact Assessment
The risk to any potential well source on the south of the site from potential contaminant release within any excavation at this distance is negligible. Due to the relatively low bulk permeability of mineral soils beneath the peat (*i.e.* predominately silts and clays with some interbedded gravels), the low recharge characteristics (due to the overlying peat) and the low groundwater gradients (flat topography), groundwater travel times are expected to be very slow. The relatively low permeability and the diffuse nature of groundwater flow in the mineral soils would mean that a pollutant would take months/years to travel this distance as demonstrated below by means of the Darcy mean velocity equation:

$$q = k.i$$

$$v = q/ ne$$

$$T = L / v$$

where:
q = specific discharge (m/day)
k = permeability m/day (a value of 1m/day for low permeability subsoils is used).
ne = porosity (a value of 0.025 is used for silts/clays).
i =slope of the water table in the subsoil can be estimated from on topography (a value of 0.005 is used down-gradient of substation B (70mOD -65mOD)/1000m = 0.005).
v = Darcy velocity (m/day).
L = Distance (metres).
T = Time of travel (days)

Based on a groundwater flow velocity of 0.2m/day, the time of travel (ToT) for a potential pollutant to flow from the development location to the dwelling house would be in the order of 9 years. During this time any discharge would be assimilated and attenuated by natural groundwater flow, and diluted by rainfall recharge. Also any entrained sediment would be filtered within the low permeability subsoils.Therefore the risk posed to potential well sources at this distance from potential spills and leaks from excavations is negligible.

In addition, there are proposed mitigation measures (outlined above at Sections 8.4.2.4 and 8.4.2.6) that will minimise and prevent potential groundwater contamination from hydrocarbons and other chemicals.

Residual Effects
No residual effects on groundwater supplies are anticipated either in terms of quality or quantity.

Significance of Effects
No significant impacts on potential groundwater supplies are anticipated.

8.4.3 Operational Phase Effects

8.4.3.1 Progressive Replacement of Natural Surface with Lower Permeability Surfaces

Progressive replacement of the bare peat or partially vegetated surface with impermeable surfaces could potentially result in an increase in the proportion of surface water runoff reaching the surface water drainage network. In reality, the access roads will have a higher permeability than the underlying peat. However, it was conservatively assumed in the assessment (Section 8.3.17) that the proposed access roads are impermeable.

The footprint comprises turbine bases and hardstandings, access roads, substation (Option A or Option B) and site compounds. During storm rainfall events, additional runoff coupled with increased velocity of flow could increase hydraulic loading, resulting in erosion of watercourses and impact on aquatic ecosystems.

Pathway: Site drainage network.
Receptor: Surface waters and dependent ecosystems.

Pre-Mitigation Effect
Direct, negative, moderate, permanent, moderate probability effect.

Impact Assessment
The emplacement of the proposed permanent development footprint (which includes either substation Option A or Option B), could result in an average total site increase in surface water runoff of approximately 1,300m^3/month This represents a potential increase of approximately 0.17% in the average daily/monthly volume of runoff from the site area in comparison to the baseline pre-development site runoff conditions. This is a very small increase in average runoff and results from the naturally high surface water runoff rates and the relatively small area of the site being developed, the proposed total permanent development footprint being approximately 40ha (Option A – 39.6ha, Option B – 40.1ha), representing ~4% of the total study area of 960ha.

The increase in runoff from the proposed development will therefore be negligible. This is even before mitigation measures will be put in place. Therefore, there will be no risk of exacerbated flooding down-gradient of the site.

However, as the part of the proposed wind farm drainage it is proposed that runoff from the proposed infrastructure will be collected locally in new proposed silt traps, settlement ponds and biodiversity wetland areas prior to release into the existing drainage network. The new proposed wind farm drainage measures will then in effect create significant additional attenuation to that which is already present at the site.

Based on a conservative reduction in the runoff coefficient from 0.85 to 0.7 for the overall site, there would a potential 16.8% reduction in runoff volumes from the site. This assessment demonstrates that there will be no risk of exacerbated flooding down-gradient of the site as a result of the proposed wind farm development. The proposed development will in effect retain water within the bog for longer periods.

Proposed Mitigation Measures
Mitigation by Design:
The operational phase drainage system will be installed and constructed in conjunction with the existing bog drainage network and will include the following:

- Interceptor drains will be installed up-gradient of all proposed infrastructure to collect clean surface runoff, in order to minimise the amount of runoff reaching areas where suspended sediment could become entrained. It will then be directed existing downstream field drains;
- Collectors drains will be used to gather runoff from access roads and turbine hardstanding areas of the site, likely to have entrained suspended sediment, and channel it to new local settlement ponds for sediment settling, and these will then outfall to existing field drains;
- Check dams will be used along sections of access road drains to intercept silts at source. Check dams will be constructed from a 4/40mm non-friable crushed rock;
- Small wetland areas will be constructed throughout the site and these will have the capacity to attenuate water during heavy rainfall events; and,
- Finally, all surface water runoff from the development will have to pass through the settlement ponds at the bog outfall locations prior to final discharge from the site.

Residual Effect
Negative, direct, negligible, long term, moderate probability effect.

Significance of Effects
No significant effects on surface water quality or quantity are anticipated.

8.4.3.2 Impacts of the Proposed Grid Connection Options A and B

If grid connection Option A is chosen (underground cable), the cable trench will be backfilled, reinstated and reseeded over and therefore poor quality runoff from exposed soil will not be an issue once the route is reinstated. Therefore, there will be no potential to impact on surface water quality from sediment input during the operational phase. Other potential contaminants such as hydrocarbons will not be present during the operational phase and therefore no impacts are anticipated. Due to the shallow nature of the trench there will be no potential to impact on the local groundwater flow regime. No mitigation is required.

Grid connection Option B comprises an overhead line and therefore no impacts on surface waters or groundwater are anticipated during the operational phase if this option is chosen. No mitigation is required.

8.4.4 Decommissioning Phase

It is anticipated that the likely decommissioning phase impacts will be similar to construction phase impacts but the overall potential for impact will be much lower, as less excavation/earthworks will be undertaken during the decommissioning phase.

As in the construction phase, temporary surface runoff control measures will again be put in place during decommissioning works. The drainage system will remain operational during the decommissioning phase and will serve to treat any sediment laden surface water run-off due to a renewed disturbance of soils. Re-vegetation will be monitored. No significant residual effects on the water environment are anticipated during the decommissioning phase.

8.4.5 Do-Nothing Scenario

If the proposed development were not to proceed, the existing uses for the site of commercial peat harvesting would continue until the peat is exhausted and then a rehabilitation plan implemented.

Downstream water quality and flood risk would continue to be protected by the existing on site drainage system, and the likely effects of the do nothing scenario would be neutral.

8.4.6 Worst-Case Scenario

Contamination of local watercourses during the construction and operational phases, which in turn could affect the ecology and quality of the downstream water bodies such as the Philipstown River and the Figile River. Also, potentially localised groundwater contamination may occur as described in Sections 8.4.2.4 and 8.4.2.6. However, mitigation measures will be put in place to prevent these from occurring as described in Sections 8.4.2.4 and 8.4.2.6.

8.4.7 Cumulative Impacts

Potential for cumulative in-combination effects with other consented and / or operational projects such as peat extraction [on other bogs within the catchment], built development, overhead powerlines, telecommunications masts, renewable wind energy strategies, grid connections and recreational pressures were also considered during the preparation of this assessment.

Other projects considered in relation to the potential for in-combination effects and for which all relevant data was reviewed include the following:

- Clonbullogue Ash Repository
- Edenderry Power Plant
- Peat Extraction: Allen Group
- Peat Extraction: Derrygreenagh Group
- Barrow Blueway
- Grand Canal Blueway Shared Walking and Cycling Route
- Eastern and Midlands Regional Water Supply Project
- Clonin North Solar development
- Shean Site Infill

Details for each project are presented and the methodology by which these projects were chosen in Chapter 2 of the EIS.

Following a review of the respective planning applications for each project, no potential for cumulative effects with the projects (listed above) on the local hydrology (water quality & flow) of the study area are foreseen for the reasons outlined below.

Section 8.4.2 above concludes that there will be no significant hydrological impacts associated with the proposed wind farm development and therefore the potential for cumulative impacts with other projects is considered negligible on this basis. The potential for hydrological cumulative effects will largely relate to water quality (suspended sediments) rather than effects on surface water flows as runoff from the site will actually be reduced due to the proposed drainage measures.

Clonbullogue Ash Respository and Edenderry Power Plant have no potential to affect water quality in terms of sediment input to surface waters and therefore there is no potential for cumulative effects. The Barrow Blueway and the Grand Canal Blueway Shared Walking and Cycling Route both follow existing routes and paths and therefore the potential for these developments to contribute to water quality effects and contribute to cumulative effects will be negligible. Any proposed stream / river crossings in relation to Eastern and Midlands Regional Water Supply Project delivery route will be undertaken in accordance with best practice watercourse crossing methods and therefore the potential to contribute to cumulative effects will be negligible. Solar farms (such Clonin North Solar development) can be constructed with minimal ground disturbance and therefore the potential to contribute to cumulative effects will be also negligible.

In respect of the peat extraction operations (Allen Group and Derrygreenagh Group), they operate under strict IPPC licences and they have been operating in the region for years without resulting in significant effects on local hydrology. The peat extraction at the Cloncreen bog will have ceased prior to the construction of the wind farm which will have an overall positive effect in terms of potential cumulative effects as the potential for silt release from the operational bog is then eliminated.

In terms of hydrological cumulative impacts arising from the proposed wind farm infrastructure and the grid connection route Option A (UGC) or Option B (OHL) no significant effects are anticipated and this is due to the proposed short distances of both options (UGC - ~1.7km, OHL - ~0.1km in total). Also Option B is an overhead line and therefore there will be minimal ground disturbance and therefore the potential for water quality effects is negligible. In relation to both Option A and Option B any potential runoff from the works will be contained within the site drainage network and treated prior to discharge. The potential for either grid connection Option A or Option B to contribute to surface water quality impacts is negligible.

A hydrological cumulative impact assessment with regard to the internal wind farm infrastructure of other wind farm developments within a 20km radius of the proposed development site within the River Barrow catchment was also undertaken. The wind farm developments assessed are listed in Table 8.24 below and are shown on Figure 8.7.

Table 8.24: Wind Farm Developments in the River Barrow catchment within a 20km radius of the site

Catchment Area	Wind Farm	Status	Potential No. of Turbines in Catchment
River Barrow	Yellow River	Permitted (29 no.)	0
	Mountlucas	Operating (28 no.)	28
Potential Total			**28**

The total number of turbines that could potentially be operating inside a 20km radius of Cloncreen within the River Barrow catchment, including the proposed Cloncreen Wind Farm 21 no. turbines is 49.

The catchment area of the River Barrow within a 20km radius of the site is ~750km^2 and therefore if all 49 no. turbines are constructed this equates to one turbine for approximately every ~15km^2 which is considered imperceptible in terms of potential cumulative hydrological effects as the combined footprint area of the developments will be negligible compared to the area of the catchment itself. In addition, it should be noted that 28 of the 41 possible turbines (*i.e.* ~68%) are already operational and therefore these developments are not anticipated to contribute to any cumulative hydrological effects as construction is complete.

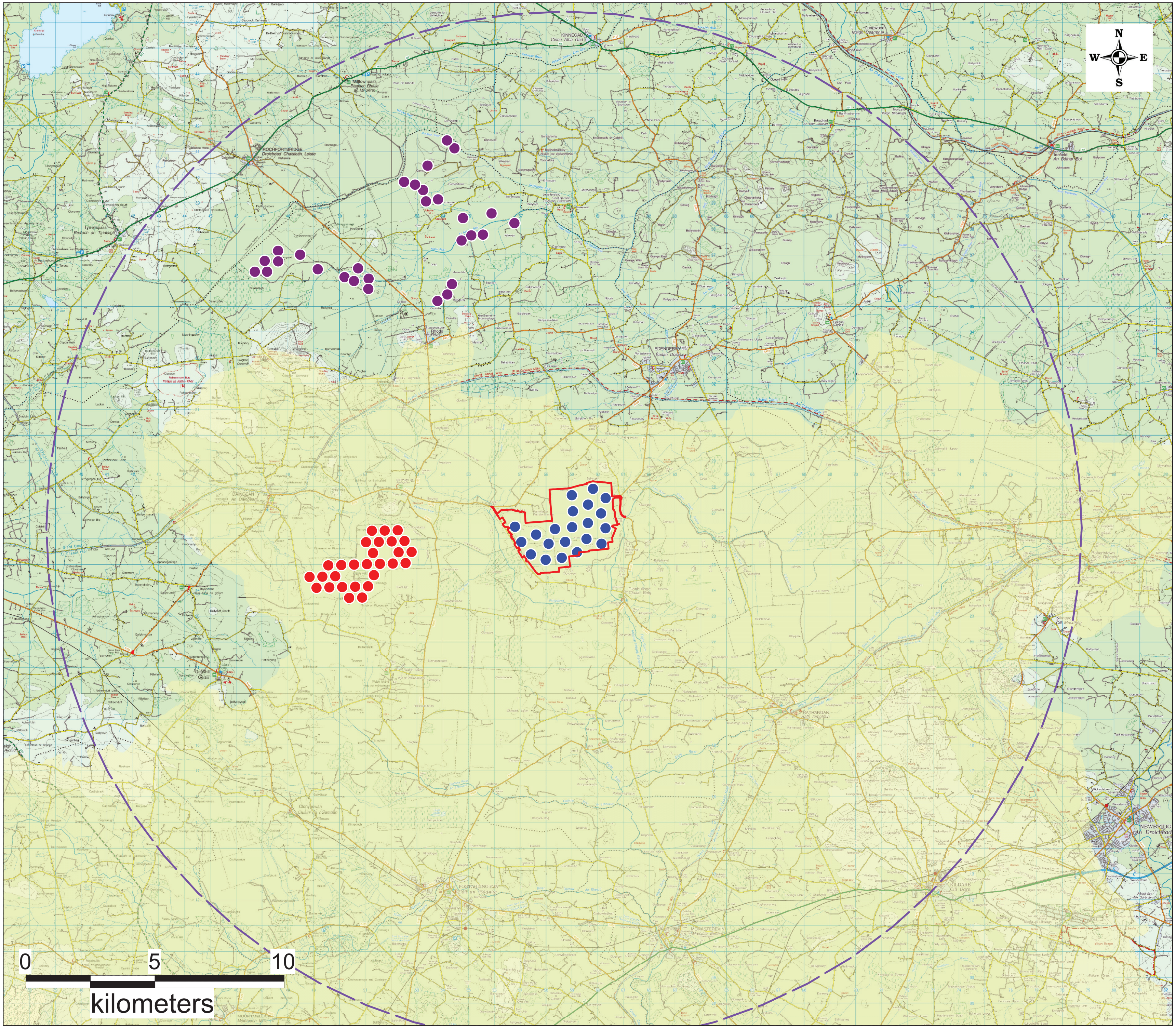
Implementation of the proposed wind farm drainage mitigation (in addition with the existing established bog drainage network) will ensure there will be no cumulative significant effects on the water environment from the proposed development, the proposed grid connection options, other wind farm developments and non-wind farm developments within the River Barrow catchment.

8.4.8 Conclusion

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

Surface water drainage measures, pollution control and other preventative measures have been incorporated into the project design to minimise significant adverse effects on water quality and downstream designated sites.

The surface water drainage plan will be the principal means of significantly reducing sediment runoff arising from construction activities and to control runoff rates. The drainage plan involves collecting any drainage waters from works areas within the site that might carry silt or sediment, and nutrients, to route them towards new proposed silt traps and settlement ponds (or stilling ponds) prior to controlled diffuse release into the existing field drainage network. There will be no direct discharges to any



Legend

Proposed Site Boundary

Cloncreen Turbine Location: (Proposed)

Mountlucas Turbine Location: (Operating)

Yellow River Turbine Location: (Permitted)

20km Site Buffer

River Barrow Catchment

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Client: McCarthy Keville O'Sullivan	
Job: Cloncreen WF	
Title: Cumulative Impact Map	
Figure No: 8.7	
Drawing No: P1308-0-0916-807-A3-0A	
Sheet Size: A3	Project No: P1308-0
Scale: 1:200,000	Drawn By: GD
Date: 27/09/2016	Checked By: MG

existing natural watercourse from the wind farm construction, operation or decommissioning works.

The new proposed wind farm drainage measures will in effect create significant additional attenuation to what is already present at the site. The net effect of this will be a reduction in the overall runoff from the bog. The proposed development will in effect retain water within the bog for longer periods and therefore there will be no risk of downstream flooding.

Preventative pollution measures also include fuel and concrete management and a waste management plan which will be incorporated into the Construction and Environmental Management Plan.
Overall the proposal presents no significant effects to surface water (quality or flows) and groundwater (quality or quantity) provided the proposed mitigation measures are implemented.

No significant cumulative effects on any of the regional surface water catchment or groundwater bodies are anticipated from the proposed Cloncreen wind farm (including haul route and new site entrance), its associated grid connection options and other local developments.

9 AIR AND CLIMATE

9.1 Air Quality

9.1.1 Background

The proposed wind farm site is located in eastern Co. Offaly, approximately 4.5 kilometres southwest of Edenderry, at its nearest point. The villages of Clonbullogue and Rhode are located approximately 2.0 kilometres southeast and 7.0 kilometres northwest of the site boundary respectively.

Cloncreen is a single peat production bog unit within the Bord na Móna Derrygreenagh peat production bog group. The land-use/activities within and adjacent to the proposed development site comprise a mix of active peat extraction (IPC Licence No. P503-01), bare cutaway peat, re-vegetation of bare peat, an EPA-licenced ash repository (Licence No. W0049-02) and wind measurement (a single 100-metre meteorological mast). There is a former rehabilited gravel pit (now inactive) located in the north central section of the site, which it is proposed to extend as part of the proposed development. There are also a number of Bord na Móna rail lines that pass through the bog facilitating the transportation of milled peat and ash.

Land-use in the surrounding landscape comprises a mix of agricultural land, forestry, cutaway peatlands and energy production. The main existing significant energy infrastructure in the local area is Edenderry Power Plant, located directly east of the Cloncreen site, associated grid infrastructure in the form of 110 kV pylons network (and in particular the Thornsberry/Cushaling line, which crossed the proposed development site), and the operational Mountlucas wind farm, located approximately 4.0 kilometres to the west of the site. Mountlucas comprises 28 no. turbines, with a total power output of 84 Megawatts (MW), and has been in operation since 2014. Clonbullogue aerodrome is located approximately 2.3 kilometres south of the Cloncreen site boundary.

Due to the non-industrial nature of the proposed development and the general character of the surrounding environment, air quality sampling was deemed to be unnecessary for this EIS. Although the site is located close to Edenderry Power Plant, it is expected that air quality in the existing environment locally is good. Edenderry Power Plant is operated by Edenderry Power Ltd. under IPC Licence No. P0482-04 issued by the Environmental Protection Agency (EPA), therefore all emissions from this site are strictly controlled and monitored.

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

9.1.2 Air Quality Standards

In 1996, the Air Quality Framework Directive (96/62/EC) was published. This Directive was transposed into Irish law by the Environmental Protection Agency Act 1992 (Ambient Air Quality Assessment and Management) Regulations 1999. The Directive was followed by four Daughter Directives, which set out limit values for specific pollutants:

- The first Daughter Directive (1999/30/EC) addresses sulphur dioxide, oxides of nitrogen, particulate matter and lead.
- The second Daughter Directive (2000/69/EC) addresses carbon monoxide and benzene. The first two Daughter Directives were transposed into Irish law by the Air Quality Standards Regulations 2002 (SI No. 271 of 2002).
- A third Daughter Directive, Council Directive (2002/3/EC) relating to ozone was published in 2002 and was transposed into Irish law by the Ozone in Ambient Air Regulations 2004 (SI No. 53 of 2004).
- The fourth Daughter Directive, published in 2007, relates to polyaromatic hydrocarbons (PAHs), arsenic, nickel, cadmium and mercury in ambient air.

The Air Quality Framework Directive and the first three Daughter Directives have been replaced by the Clean Air for Europe (CAFE) Directive (Directive 2008/50/EC on ambient air quality), which encompasses the following elements:

- The merging of most of the existing legislation into a single Directive (except for the Fourth Daughter Directive) with no change to existing air quality objectives.
- New air quality objectives for $PM_{2.5}$ (fine particles) including the limit value and exposure concentration reduction target.
- The possibility to discount natural sources of pollution when assessing compliance against limit values.
- The possibility for time extensions of three years (for particulate matter PM_{10}) or up to five years (nitrogen dioxide, benzene) for complying with limit values, based on conditions and the assessment by the European Commission.

Table 9.1 below sets out the limit values of the CAFE Directive, as derived from the Air Quality Framework Daughter Directives. Limit values are presented in micrograms per cubic metre ($\mu g/m^3$) and parts per billion (ppb). The notation PM_{10} is used to describe particulate matter or particles of ten micrometres or less in aerodynamic diameter. $PM_{2.5}$ represents particles measuring less than 2.5 micrometres in aerodynamic diameter.

The CAFE Directive was transposed in to Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011). These Regulations supersede the Air Quality Standards Regulations 2002 (S.I. No. 271 of 2002), the Ozone in Ambient Air Regulations 2004 (S.I. No. 53 of 2004) and the Ambient Air Quality Assessment and Management Regulations 1999 (S.I. No. 33 of 1999).

Table 9.1 Limit values of Directive 2008/50/EC, 1999/30/EC and 2000/69/EC (Source: EPA)

Pollutant	Limit Value Objective	Averaging Period	Limit Value (μg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Sulphur dioxide (SO_2)	Protection of Human Health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year	1st Jan 2005
Sulphur dioxide (SO_2)	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year	1st Jan 2005

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m3)	Limit Value (ppb)	Basis of Application of Limit Value	Attainment Date
Sulphur dioxide (SO_2)	Protection of vegetation	Calendar year	20	7.5	Annual mean	19th Jul 2001
Sulphur dioxide (SO_2)	Protection of vegetation	1st Oct to 31st Mar	20	7.5	Winter mean	19th Jul 2001
Nitrogen dioxide (NO_2)	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year	1st Jan 2010
Nitrogen dioxide (NO_2)	Protection of human health	Calendar year	40	21	Annual mean	1st Jan 2010
Nitrogen monoxide (NO) and nitrogen dioxide (NO_2)	Protection of ecosystems	Calendar year	30	16	Annual mean	19th Jul 2001
Particulate matter 10 (PM_{10})	Protection of human health	24 hours	50	-	Not to be exceeded more than 35 times in a calendar year	1st Jan 2005
Particulate matter 2.5 ($PM_{2.5}$)	Protection of human health	Calendar year	40	-	Annual mean	1st Jan 2005
Particulate matter 2.5 ($PM_{2.5}$) Stage 1	Protection of human health	Calendar year	25	-	Annual mean	1st Jan 2015
Particulate matter 2.5 ($PM_{2.5}$) Stage 2	Protection of human health	Calendar year	20	-	Annual mean	1st Jan 2020
Lead (Pb)	Protection of human health	Calendar year	0.5	-	Annual mean	1st Jan 2005
Carbon Monoxide (CO)	Protection of human health	8 hours	10,000	8,620	-	1st Jan 2005
Benzene (C_6H_6)	Protection of human health	Calendar Year	5	1.5	-	1st Jan 2010

The Ozone Daughter Directive 2002/3/EC is different from the other Daughter Directives in that it sets target values and long-term objectives for ozone rather than limit values. Table 9.2 presents the limit and target values for ozone.

Table 9.2 Target values for Ozone Defined in Directive 2008/50/EC

Objective	Parameter	Target Value for 2010	Target Value for 2020
Protection of human health	Maximum daily 8-hour mean	120 mg/m^3 not to be exceeded more than 25 days per calendar year averaged over 3 years	120 mg/m^3
Protection of vegetation	AOT_{40} calculated from 1 hour values from May to July	18,000 mg/m^3.h averaged over 5 years	6,000 mg/m^3.h
Information Threshold	1-hour average	180 mg/m^3	-
Alert Threshold	1-hour average	240 mg/m^3	-

AOT_{40} is a measure of the overall exposure of plants to ozone. It is the sum of the excess hourly concentrations greater than 80 µg/m^3 and is expressed as µg/m^3 hours.

9.1.3 Air Quality Zones

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

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

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

9.1.4 Existing Air Quality

The EPA publishes Air Monitoring Station Reports for monitoring locations in all four Air Quality Zones. The ambient air quality monitoring carried out closest to the proposed development site is at Newbridge, Co, Kildare, located approximately 24 kilometres southeast of the proposed development site. EPA air quality data is available for Newbridge in the report *'Ambient Air Monitoring at Newbridge, Co. Kildare 1st October 2009 – 24th May 2010'*, as detailed below. This monitoring location lies within Zone C. Lower measurement values for all air quality parameters would be expected for the proposed development site as it lies in a rural location, within Zone D.

9.1.4.1 Sulphur Dioxide (SO_2)

Sulphur dioxide data for the 2009/2010 monitoring period in Newbridge is presented in Table 9.3. Neither the hourly limit value nor lower assessment threshold set out in the CAFE Directive were exceeded during the monitoring period.

Table 9.3 Sulphur Dioxide Data Newbridge October 2009 to May 2010

Parameter	Measurement
No. of hours	5,635
No. of measured values	5,193
Percentage Coverage	92.2%
Maximum hourly value	31.9 µg/m^3
98 percentile for hourly values	8.8 µg/m^3
Mean hourly value	2.9 µg/m^3
Maximum 24-hour mean	7.7 µg/m^3
98 percentile for 24-hour mean	7.0 µg/m^3

9.1.4.2 Particulate Matter (PM_{10})

Particulate matter (PM_{10}) data for the 2009/2010 monitoring period in Newbridge is presented in Table 9.4. The 24-hour limit value for the protection of human health (50 µg/m$_3$) was exceeded 2 times during the measurement period. The upper assessment threshold was exceeded on ten days and the lower assessment threshold was exceeded on 37 days. The CAFE Directive stipulates that these assessment thresholds should not be exceeded more than 35 times in a calendar year. The mean of the daily values during the measurement period is below the annual limit value for the protection of human health (40 µg/m$_3$).

Table 9.4 Particulate Matter (PM10) Data Newbridge October 2009 to May 2010

Parameter	Measurement
No. of days	236
No. of measured values	197
Percentage Coverage	83.5%
Maximum daily value	74.3 µg/m3
Mean daily value	17.3 µg/m3

9.1.4.3 Nitrogen Dioxide (NO_2)

Nitrogen dioxide and oxides of nitrogen data for the 2009/2010 monitoring period in Newbridge are presented in Table 9.5. One hourly mean NO_2 value was above the lower assessment threshold. The CAFE Directive stipulates that this threshold should not be exceeded more than 18 times in a calendar year. The mean hourly NO_2 value during the measurement period was below the annual lower assessment threshold for the protection of human health, which is 26 µg/m^3. The lower threshold of mean annual NO_x concentration for the protection of vegetation and natural ecosystems was exceeded. However, this assessment criterion is not applicable to the monitoring location of Newbridge as it is an urban environment. This value can be expected to be lower at the site of the proposed development due to its location in Zone D.

Table 9.5 Nitrogen Dioxide and Oxides of Nitrogen Data Newbridge October 2009 to May 2010

Parameter	Measurement
No. of hours	5,200
No. of measured values	5,177
Percentage Coverage	99.6%
Maximum hourly value (NO2)	104.3 µg/m^3
99.7 percentile for hourly values (NO2)	78.3 µg/m^3
Mean hourly value (NO2)	15.4 µg/m^3
Mean hourly value (NOx)	24.8 µg/m^3 NO2

9.1.4.4 Carbon Monoxide (CO)

Carbon monoxide data for the 2009/2010 monitoring period in Newbridge is presented in Table 9.6. The mean hourly concentration of carbon monoxide recorded was 0.4 mg/m^3. On no occasions were values in excess of the 10 mg/m^3 limit value set out in the CAFE Directive recorded.

Table 9.6 Carbon Monoxide Data Newbridge October 2009 to May 2010

Hourly Values	Result
No. of hours	5,484
No. of measured values	5,315
Percentage Coverage	96.9%
Maximum hourly value	2.2 mg/m^3
98 percentile for hourly values	1.2 mg/m^3
Mean hourly value	0.4 mg/m^3
Maximum 8-hour mean	1.87 mg/m^3
98 percentile for 8-hour mean	1.09 mg/m^3

9.1.4.5 Dust

There are no statutory limits for dust deposition in Ireland. However, EPA guidance suggests that a deposition of 10 mg/m^2/hour can generally be considered as posing a soiling nuisance. This equates to 240 mg/m^2/day. The EPA recommends a maximum daily deposition level of 350 mg/m^2/day when measured according to the TA Luft Standard 2002.

9.1.5 Likely Significant Effects and Associated Mitigation Measures

9.1.5.1 'Do-Nothing' Effect

If the proposed development were not to proceed, the opportunity to reduce emissions of carbon dioxide, oxides of nitrogen (NO_x), and sulphur dioxide (SO_2) to the atmosphere would be lost due to the continued dependence on electricity derived from fossil fuel, rather than renewable energy sources such as the proposed wind farm. This would result in an indirect negative effect on air quality.

9.1.5.2 Construction Phase

9.1.5.2.1 Exhaust Emissions

Turbines and Other Infrastructure

The construction of turbine bases and hardstands, compound and parking areas and the anemometry mast base, demolition of the existing 'tea centre' building and removal of the existing onsite telecommunications mast and wind mast will require the operation of construction vehicles and plant on site. Exhaust emissions associated with vehicles and plant will arise as a result of the construction and demolition activities. This potential effect will not be significant, and will be restricted to the duration of the construction phase and localised to works locations. Therefore, this is a short-term slight negative effect. Mitigation measures to reduce this effect are presented below.

Borrow Pit

Extension of the existing onsite borrow pit will also require the use of construction machinery and plant, thereby giving rise to exhaust emissions. This is also a short-term slight negative effect, which will be reduced through use of the best practice mitigation measures as presented below.

Substation and Grid Connection
The planning application encompasses two options in relation to substations and grid connection:

- **Option A**: construction of a 110 kV substation in the eastern section of site, to connect to existing 110 kV Cushaling substation at Edenderry Power Plant. Connection will be via underground cable approx 1.7km in length, located within Bord na Móna lands and curtilage of the public road.

Or

- **Option B**: construction of a 110 kV substation in southern section of site, to connect to existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site. Connection will be via two short sections of overhead line, (less than 0.1km)

Both options have been assessed as part of this EIS, however only one substation and associated grid connection will ultimately be constructed. The construction of either substation and associated grid connection will require the use of construction machinery, thereby giving rise to exhaust emissions. This is a short-term slight negative effect, which will be reduced through use of the best practice mitigation measures as presented below.

Junction Accommodation Works
The junction accommodation works along the proposed turbine haul route will encompass temporary upgrade works at 4 No. roundabouts on the National road network and 3 No. junctions on the Regional road network. The use of construction vehicles at these locations will give rise to exhaust emissions, creating a short-term slight negative effect in terms of air quality.

The transport of turbines and construction materials to the site, which will occur on specified routes only (see Section 3.5 of the EIS), will also give rise to exhaust emissions associated with the transport vehicles. This constitutes a slight negative effect in terms of air quality. Mitigation measures in relation to exhaust emissions are presented below.

Mitigation
- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.
- Turbines and construction materials will be transported to the site on specified routes only unless otherwise agreed with the Planning Authority.
- A significant proportion of the aggregate materials for the construction of the proposed wind farm will be obtained from the borrow pit on the site of the proposed development. This will significantly reduce the number of delivery vehicles accessing the site, thereby reducing the amount of emissions associated with vehicle movements.

Residual Effect
Short-term Imperceptible Negative Effect

9.1.5.2.2 Dust Emissions

Turbines and Other Infrastructure

The construction of turbine bases and hardstands, temporary compound and parking areas and the anemometry mast base, and demolition of the existing 'tea centre' building, will give rise to dust emissions during the construction phase. This potential effect will not be significant and will be restricted to the duration of the construction phase. Therefore, this is a short-term slight negative effect. Dust suppression mitigation measures to reduce this effect are presented below.

Borrow Pit

Expansion of the existing onsite borrow pit and the extraction of material from this location will give rise to localised dust emissions. This is a short-term moderate negative effect. Mitigation measures to reduce this effect are presented below.

Substation and Grid Connection

The planning application encompasses two options in relation to substations and grid connection, as described below. Only one substation and associated grid connection will ultimately be constructed, as described above.

Option A will encompass the construction of a substation in the eastern section of the site and the laying of 1.7 kilometres of underground cable within Bord na Móna lands and in the curtilage of the public road, to connection to Cushaling substation at Edenderry Power Plant. The construction of this substation and grid connection will give rise to localised dust emissions during their construction. This is a short-term slight negative effect. Mitigation measures to reduce this effect are presented below.

Option B will entail the construction of a substation in the southern section of the site and a short section of overhead line to connect to the existing 110 kV line through the site. The construction of this substation and grid connection will give rise to localised dust emission during their construction. This is a short-term slight negative effect. Mitigation measures to reduce this effect are presented below.

Junction Accommodation Works

Temporary upgrade works along the turbine haul route, and the transport of turbines and construction materials to the proposed wind farm site, will also give rise to some localised dust emissions during periods of dry weather. This is a short-term slight negative effect. Mitigation measures to reduce this effect are presented below.

Mitigation

- Sporadic wetting of loose stone surface will be carried out during the construction phase to minimise movement of dust particles to the air. In periods of extended dry weather, dust suppression may be necessary along haul roads and around the borrow pit area to ensure dust does not cause a nuisance. If necessary, water will be taken from stilling ponds in the site's drainage system, and will be pumped into a bowser or water spreader to dampen down haul roads, borrow pit and site compounds to prevent the generation of dust. Water bowser movements will be carefully monitored to avoid, insofar as reasonably possible, increased runoff.
- All plant and materials vehicles shall be stored in dedicated compound areas [on site].
- Areas of excavation will be kept to a minimum, and stockpiling will be minimised by coordinating excavation, spreading and compaction.

- Turbines and construction materials will be transported to the site on specified haul routes only.
- The agreed haul route roads adjacent to the site will be regularly inspected for cleanliness, and cleaned as necessary.
- The transport of construction materials to the site that have significant potential to cause dust, will be undertaken in tarpaulin or similar covered vehicles where necessary.
- A Construction and Environmental Management Plan (CEMP) will be in place throughout the construction phase (see Appendix 3-2). The CEMP includes dust suppression measures.
- Monitoring of dust levels will be carried out throughout the duration of the construction phase to monitor the effectiveness of the dust suppression measures. Baseline figures for dust will be established prior to the construction phase. The TA Luft (German Government '*Technical Instructions on Air Quality*') provides a guideline acceptable value of 350 mg/m^2/day for the deposition of non-hazardous dusts. This value shall not generally be exceeded beyond the site boundary.

Residual Effect
Short-term Imperceptible Negative Effect

9.1.5.3 Operational Phase

9.1.5.3.1 Exhaust Emissions

Exhaust emissions associated with the operational phase of the proposed development will arise from machinery and vehicles that are intermittently required onsite for maintenance. This will give rise to a long-term imperceptible effect.

Mitigation
Any vehicles or plant brought onsite during the operational phase will be maintained in good operational order, thereby minimising any emissions that arise.

9.1.5.3.2 Air Quality

The proposed wind farm, by providing an alternative to electricity derived from coal, oil or gas-fired power stations, will result in emission savings of carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide SO_2. Exposure to chemicals such as SO_2 and NO_x are thought to be harmful to human health. The production of renewable energy from the proposed development will have a long-term significant positive effect on air quality.

9.2 Climate

9.2.1 Climate Change and Greenhouse Gases

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

9.2.1.1 Greenhouse Gas Emission Targets

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

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

9.2.1.1.1 Doha Amendment to the Kyoto Protocol

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

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

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

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

9.2.1.1.2 COP21 Paris Agreement

COP21 was the 21st session of the Conference of the Parties (COP) to the United Nations Convention. Every year since 1995, the COP has gathered the 196 Parties (195 countries and the European Union) that have ratified the Convention in a different country, to evaluate its implementation and negotiate new commitments. COP21 was organised by the United Nations in Paris and held from 30th November to 12th December 2015.

COP21 closed on 12th December 2015 with the adoption of the first international climate agreement (concluded by 195 countries and applicable to all). The twelve-page text, made up of a preamble and 29 articles, provides for a limitation of the temperature rise to below 2°C and even to tend towards 1.5°C. It is flexible and takes into account the needs and capacities of each country. It is balanced as regards adaptation and mitigation, and durable, with a periodical ratcheting-up of ambitions.

9.2.1.1.3 Emissions Projections

In 2016, the EPA published an update on Ireland's Greenhouse Gas Emission Projections to 2020. Ireland's target is to achieve a 20% reduction of non-Emissions

Trading Scheme (non-ETS) sector emissions, i.e. agriculture, transport, residential, commercial, non-energy intensive industry and waste, on 2005 levels, with annual binding limits set for each year over the period 2013 – 2020.

Greenhouse gas emissions are projected to 2020 using two scenarios; 'With Measures' and 'With Additional Measures'. The 'With Measures' scenario assumes that no additional policies and measures, beyond those already in place by the end of 2014 are implemented. The 'With Additional Measures' scenario assumes implementation of the 'With Measures' scenario in addition to full achievement of Government renewable and energy efficiency targets for 2020, as set out in the National Renewable Energy Action Plan and the National Energy Efficiency Action Plan.

The EPA Emission Projections Update notes the following key trends:

- Ireland's non-Emissions Trading Scheme (ETS) emissions are projected to be 6% and 11% below 2005 levels in 2020 under the 'With Measures' and 'With Additional Measures' scenarios, respectively. The target for Ireland is a 20% reduction.
- Ireland is projected to exceed its annual binding limits in 2016 and 2017 under both scenarios, 'With Measures' and 'With Additional Measures'.
- Over the period 2013 – 2020, Ireland is projected to cumulatively exceed its compliance obligations by 12 Mt CO_2 (metric tonnes of Carbon Dioxide) equivalent under the 'With Measures' scenario and 3 Mt CO_2 equivalent under the 'With Additional Measures' scenario.

The EPA report states that *"Failure to meet 2020 renewable and energy efficiency targets will result in Ireland's emission levels moving even further from its emission reduction targets"*. The report also concludes:

- *The latest projections estimate that by 2020 non-ETS emissions will be at best 11% below 2005 levels compared to the 20% reduction target. Emission trends from agriculture and transport are key determinants in meeting targets, however emissions from both sectors are projected to increase in the period to 2020.*
- *It is clear that Ireland faces significant challenges in meeting emission reduction targets for 2020 and beyond. ('Greenhouse Gas Emission Projections to 2020 – An Update'*, EPA, 2016)

9.2.2 Climate and Weather in the Existing Environment

Ireland has a temperate, oceanic climate, resulting in mild winters and cool summers. The Met Éireann weather station at Mullingar, Co. Westmeath, is the nearest weather and climate monitoring station to the proposed development site that has meteorological data recorded for the 30-year period from 1971 - 2000. The monitoring station is located approximately 30 kilometres northwest of the site. Meteorological data recorded at Mullingar over the 30-year period from 1971 - 2000 is shown in Table 9.7 overleaf. The wettest months are October and December, and April is usually the driest. July is the warmest month with a mean daily temperature of 19.2° Celsius.

Table 9.7 Data from Met Éireann Weather Station at Mullingar, 1971 to 2000: Monthly and Annual Mean and Extreme Values

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
TEMPERATURE (degrees Celsius)													
Mean daily max	7.2	7.7	9.6	11.8	14.7	17.2	19.2	18.9	16.5	13	9.6	7.8	12.8
Mean daily min	1.4	1.5	2.7	3.8	6.1	8.8	11	10.5	8.6	6.2	3.1	2.2	5.5
Mean temperature	4.3	4.6	6.1	7.8	10.4	13	15.1	14.7	12.5	9.6	6.3	5	9.1
Absolute max.	13.8	15.4	16.8	22.6	25	28.8	29.7	28.9	25	21.6	17.3	14.6	29.7
Absolute Min.	-14.9	-6.7	-6	-4.2	-2.6	0.2	3.8	2.1	0	-4.4	-6.9	-12.4	-14.9
Mean No. of Days With Air Frost	10	8.2	5.8	3.2	0.5	0	0	0	0	1.5	6.7	8.3	44.3
Mean No. of Days With Ground Frost	17.7	15.1	13.6	10.8	5	0.8	0	0.1	1.7	5.9	13.1	15.1	99
RELATIVE HUMIDITY (%)													
Mean at 0900UTC	91	90.1	88.1	82.5	78.6	79.5	82.1	84.9	87.7	89.9	91.7	91.6	86.5
Mean at 1500UTC	84.1	78.9	73.5	68.4	67.4	69.2	70.3	70.6	72.7	77.4	82.7	86.4	75.1
SUNSHINE (hours)													
Mean daily duration	1.7	2.2	3	4.7	5.6	5.1	4.7	4.5	3.8	3	2.1	1.4	3.5
Greatest daily duration	8.1	9.5	10.9	13.6	15.4	16	15.6	14.4	11.7	10.1	8.6	7.3	16
Mean no. of days with no sun	11.3	7.9	5.4	2.9	2.2	1.9	2	2.2	3.7	5.8	8.8	11.9	66.1
RAINFALL (mm)													
Mean monthly total	87.2	68.6	70.6	57.8	58.9	63.5	58.8	75.5	79.4	93.6	81.7	90.8	886.4
Greatest daily total	26	24.7	29.5	27.6	27.2	52.9	26.6	58.2	42.1	48.8	43.7	38.8	58.2
Mean num. of days with >= 0.2mm	19	16	18	14	14	14	15	16	16	18	17	18	195
Mean num. of days with >= 1.0mm	14	12	14	11	11	10	10	12	12	13	13	14	146
Mean num. of days with >= 5.0mm	6	5	5	4	4	4	3	5	5	6	6	6	59
WIND (knots)													
Mean monthly speed	9.7	9.7	9.7	8.1	7.6	7.1	6.9	6.7	7.2	8	8.3	9	8.2
Max. gust	76	71	60	56	58	52	48	50	51	59	62	73	76
Max. mean 10-minute speed	45	36	39	34	36	26	27	28	32	36	32	39	45
Mean num. of days with gales	0.5	0.3	0.2	0	0.1	0	0	0	0	0.1	0	0.2	1.4
WEATHER (mean no. of days with...)													
Snow or sleet	5.9	4.8	3.8	2	0.2	0	0	0	0	0	0.8	3.1	20.5
Snow lying at 0900UTC	2.9	1.2	0.7	0.2.	0	0	0	0	0	0	0.1	1	6.1
Hail	0.6	0.8	2.6	1.9	1.9	0.4	0	0.2	0.2	0.5	0.5	0.3	9.5
Thunder	0.1	0.1	0.3	0.2	0.8	0.9	1.3	0.7	0.1	0.2	0.2	0.1	4.9
Fog	4.7	3.9	2.8	2.7	2.4	1.8	2.4	4.6	4.9	4.6	5.3	5.2	45.3

9.2.3 Calculating Carbon Losses and Savings from the Proposed Development

9.2.3.1 Background

Carbon dioxide (CO_2) emissions occur naturally in addition to being released with the burning of fossil fuels. All organic material is composed of carbon, which is released as CO_2 when the material decomposes. Organic material acts as a store of carbon. Peatland habitats are significant stores of organic carbon. The vegetation on a peat bog slowly absorbs CO_2 from the atmosphere when it is active and converts it to organic carbon. When the vegetation dies, in the acidic waterlogged conditions of bogs and peatlands, the organic material does not decompose fully and the organic carbon is retained in the accumulating mass of the peatland.

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

9.2.3.2 Calculating Carbon Losses and Savings

Bord Na Móna developed a methodology based on their extensive experience for calculating carbon losses and savings from the proposed wind farm development. This was used to assess the effects of the proposed wind farm in terms of potential carbon losses and savings taking into account peat removal, drainage and site restoration. The methodology reflects the specific nature of the cutaway peat lands upon which the project is proposed to be located.

The completed worksheet including the assumptions used in the model is provided as Appendix 9-1 to this EIS. The peat losses are based on the volume of peat disturbed and redistributed, and takes a 'worst case' approach, by assuming that the in situ peat had been rewetted and therefore had zero net emissions, and the redistributed peat has high emissions associated with rushes and birch/willow scrub habitat type.

The model calculates the total carbon emissions associated with the proposed wind farm development including manufacturing of the turbine technology, transport, construction of the development and carbon losses due to peatland disturbance.

The model also calculates the carbon savings associated with the proposed wind farm development against three comparators:

i. The average fossil emissions on the Irish Grid – based on the SEM Reference mid-merit plant
ii. The EU Fossil Fuel Comparator (a measure of the fossil intensity across the European market)
iii. A displaced 'Load Following' combined cycle gas turbine plant.

The expected and maximum, worst-case scenario CO_2 losses due to the proposed wind farm development are summarised in Table 9.8 and the total savings against the three comparators listed above are summarised in Table 9.9.

Table 9.8 CO_2 losses from the proposed development

Origin of Losses	CO2 Losses (tonnes CO2 equivalent)
Losses due to turbine lifecycle (e.g. manufacture, construction, decommissioning)	100,133.1
Losses due to Additional Cycling Emissions	64,884.8
Losses from peat land disturbance emissions	26,466.0
Total	**191,483.9**

The peat losses are based on the volume of peat disturbed and redistributed, and takes a 'worst case' approach as described above.

Table 9.9 Wind Farm Lifetime savings

Comparator	CO2 Savings (tonnes CO2 equivalent)	Payback (years)
SEM Mid-Merit Plant	3,727,454	1.54
EU Fossil Fuel Comparator (FFC)	3,352,456	1.71
'Load Following' Combined Cycle Gas Turbine Plant	1,976,037	2.91

Based on the Bord Na Móna model calculations as presented above, 191,483.9 tonnes of CO_2 will be lost to the atmosphere due to changes in the peat environment, changes in the cycling of mid-merit gas-fired generation units and due to the construction, operation and decommissioning of the proposed development. This represents a fraction of the total amount of carbon dioxide emissions that will be offset by the proposed wind farm project as set out in Table 9.9. The volume of CO_2 that will be lost to the atmosphere will be offset by the proposed development between 1.54 and 2.91 years of operation, depending on the fuel source to which it is compared.

9.2.4 Likely Significant Effects and Associated Mitigation Measures

9.2.4.1 'Do-Nothing' Effect

If the proposed development were not to proceed, the opportunity to significantly reduce emissions of greenhouse gas emissions, including carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide (SO_2), to the atmosphere would be lost. The opportunity to contribute to Ireland's commitments under the Kyoto Protocol would also be lost.

9.2.4.2 Construction Phase

9.2.4.2.1 Greenhouse Gas Emissions

Turbines and Other Infrastructure

The construction of turbine bases and hardstands, compound and parking areas and the anemometry mast base, demolition of the existing 'tea centre' building and removal of the existing onsite telecommunications mast and met mast will require the operation of construction vehicles and plant on site. Greenhouse gas emissions, e.g. carbon dioxide (CO_2), associated with vehicles and plant will arise as a result of the construction and demolition activities. This potential effect will be slight only, given the insignificant quantity of greenhouse gases that will be emitted, and will be restricted to the duration of the construction phase. Therefore, this is a short-term slight negative effect. Mitigation measures to reduce this effect are presented below.

Borrow Pit
Extension of the existing onsite borrow pit will also require the use of construction machinery and plant, thereby giving rise to greenhouse gas emissions. This is also a short-term slight negative effect, which will be reduced through use of the best practice mitigation measures as presented below.

Substation and Grid Connection
The planning application encompasses two options in relation to substations and grid connection, as described above. The construction of either substation and associated grid connection will require the use of construction machinery, thereby giving rise to greenhouse emissions. This is a short-term slight negative effect, which will be reduced through use of the best practice mitigation measures as presented below.

Junction Accommodation Works
The junction accommodation works along the proposed turbine haul route will encompass temporary upgrade works at 4 No. roundabouts on the National road network and 5 No. junctions on the Regional road network. The use of construction vehicles at these locations will give rise to greenhouse gas emissions, creating a short-term slight negative effect in terms of air quality.

The transport of turbines and construction materials to the site, which will occur on specified routes only (see Section 3.5 of the EIS), will also give rise to greenhouse gas emissions associated with the transport vehicles. This constitutes a slight negative effect in terms of air quality. Mitigation measures in relation to greenhouse gas emissions are presented below.

Mitigation
- All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.
- Turbines and construction materials will be transported to the site on specified routes only unless otherwise agreed with the Planning Authority.
- A significant proportion of aggregate materials for the construction of the proposed wind farm will be obtained from the borrow pit on the site of the proposed development. This will significantly reduce the number of delivery vehicles accessing the site, thereby reducing the amount of emissions associated with vehicle movements.

Residual Effect
Short-term Imperceptible Negative Effect on Climate as a result of greenhouse gas emissions

9.2.4.3 Operational Phase

9.2.4.3.1 Greenhouse Gas Emissions
The proposed development will generate energy from a renewable source. This energy generated will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a positive effect on climate. As detailed in Table 9.9 above, the proposed development will displace carbon dioxide from fossil fuel-based electricity generation, over the proposed 30-year lifespan of the proposed wind farm. The proposed project will assist in reducing carbon dioxide (CO_2) emissions that would otherwise arise if the same energy that the proposed wind farm will generate were otherwise to be generated by conventional fossil fuel plants. This is a long-term significant positive effect.

Some potential long-term slight negative effects that may occur during the operational phase of the proposed development are the release of small amounts of carbon dioxide to the atmosphere due to the potential alteration to the drainage of the site and the removal of carbon fixing vegetation. These effects will be slight and will be nullified by the quantity of carbon dioxide that will be displaced by the proposed development.

Residual Effect
Long-term Moderate Positive Effect on Climate as a result of reduced greenhouse gas emissions

9.3 Cumulative Assessment

Potential cumulative effects on air quality and climate between the proposed wind farm development and other wind farm and infrastructure developments in the vicinity were also considered as part of this assessment. The developments considered as part of the cumulative effect assessment include operating, permitted and proposed wind farms and all other major infrastructure projects, yet to be constructed, within 20 kilometres of the proposed development site. These projects are described in Section 2.10.2 of this EIS.

The nature of the proposed development is such that, once operational, it will have a long-term, moderate, positive effect on the air quality and climate. Taking into account that the same positive effects are and will be replicated by the other operating, permitted and proposed wind farm developments listed above, by providing an alternative to electricity derived from coal, oil or gas-fired power stations, which will result in emission savings of carbon dioxide (CO_2), oxides of nitrogen (NO_x), and sulphur dioxide SO_2, there will be an even greater cumulative long-term, significant positive effect on air quality and climate.

During the construction phase of the proposed development and other developments, within 20 kilometres of the proposed development site, that are yet to be constructed, there will be minor emissions from construction plant and machinery and potential dust emissions associated with the construction activities. However, once the mitigation proposals, as outlined in Section 9.1.5.2 are implemented during the construction phase of the proposed development, there will be no cumulative effect on air and climate.

There will be no net carbon dioxide (CO_2) emissions from operation of the proposed wind farm. Emissions of carbon dioxide (CO_2), oxides of nitrogen (NO_x), sulphur dioxide (SO_2) or dust emissions during the operational phase of the proposed development will be minimal, relating to the use of operation and maintenance vehicles onsite, and therefore there will be no measureable cumulative effect with other developments on air quality and climate.

10 NOISE AND VIBRATION

10.1 Introduction

This chapter of the EIS describes the assessment undertaken of the likely significant noise and vibration effects of the proposed Cloncreen wind farm development on local residential amenity. The development consists of the following:

i. 21 No. wind turbines with an overall blade tip height of up to 170 metres and all associated hard-standing areas.
ii. 1 No. borrow pit.
iii. 1 No. permanent Anemometry Mast up to a height of 120 metres.
iv. Provision of new site access roads and associated drainage.
v. 1 no. 110 kV Electrical substation, which will be constructed at one of two possible locations on site: either Option A in Ballykilleen townland or Option B in Cloncreen townland. The electrical substation will have 2 no. control buildings, associated electrical plant and equipment, and waste water holding tank.
vi. 2 No. temporary construction compounds, one of which will be located in the townland of Esker More and the other at one of two possible locations: either Option A in Ballykilleen townland or Option B in Cloncreen townland.
vii. All associated underground electrical and communications cabling connecting the turbines to the proposed substation at either Ballykilleen or Cloncreen townland.
viii. All works associated with the connection of the proposed wind farm to the national electricity grid, which will be either to the existing Cushaling substation via underground cable (Option A) or to the existing Thornsberry/Cushaling 110 kV line via overhead line (Option B).
ix. Demolition of existing canteen 'tea centre' building.
x. Removal of existing telecommunications mast.
xi. Removal of existing meteorological mast.
xii. New access junctions, improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and construction access, including: temporary upgrade of R420/R402 junction, temporary road widening at 1 no. location on R402 in Ballinagar, upgrade of R402/L1003 junction, road upgrade along the L1003 and new construction phase site entrance, and upgrade of existing site entrance on R401.
xiii. All associated site development works.

Baseline noise levels have been measured at locations representative of the nearest noise sensitive properties. Noise predictions have been prepared for construction and wind turbine operation activities in relation to the nearest properties to the proposed development.

Following assessment of the study area around the proposed wind farm site, an appraisal of cumulative effects that considers other wind energy developments in the area is considered necessary due to the presence of an existing operational site at Mountlucas wind farm which is located some 4 km west of Cloncreen. This cumulative assessment has been considered here.

The methodology adopted for this noise appraisal is as follows:

- Review of appropriate guidance, planning conditions applicable to other sites and specification of suitable construction and operational noise / vibration criteria;
- Characterisation of the receiving noise and vibration environment;
- Characterisation of the proposed development;
- Prediction of the noise and vibration effect associated with the proposed development, and;
- Evaluation of noise and vibration effects.

For a glossary of terms used in this chapter please refer to Appendix 10-1.

10.1.1 Statement of Authority

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

Dermot Blunnie
Dermot Blunnie (Acoustic Consultant) holds a MSc in Applied Acoustics and has completed the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control. He is also an associate member of the IOA. He has extensive knowledge in aspects of environmental surveying, modeling and impact assessment, particularly for wind energy developments.

10.2 Fundamentals of Acoustics

A sound wave travelling through the air is a regular disturbance of the atmospheric pressure. These pressure fluctuations are detected by the human ear, producing the sensation of hearing. In order to take account of the vast range of pressure levels that can be detected by the ear, it is convenient to measure sound in terms of a logarithmic ratio of sound pressures. These values are expressed as Sound Pressure Levels (SPL) in decibels (dB).

The audible range of sounds expressed in terms of Sound Pressure Levels is 0dB (for the threshold of hearing) to 120dB (for the threshold of pain). In general, a subjective impression of doubling of loudness corresponds to a tenfold increase in sound energy which conveniently equates to a 10dB increase in SPL. It should be noted that a doubling in sound energy (such as may be caused by a doubling of traffic flows) increases the SPL by 3dB.

The frequency of sound is the rate at which a sound wave oscillates, and is expressed in Hertz (Hz). The sensitivity of the human ear to different frequencies in the audible range is not uniform. For example, hearing sensitivity decreases markedly as frequency falls below 250Hz. In order to rank the SPL of various noise sources, the measured level has to be adjusted to give comparatively more weight to the frequencies that are readily detected by the human ear. Several weighting mechanisms have been proposed but the 'A-weighting' system has been found to provide one of the best correlations with perceived loudness. SPL's measured using 'A-weighting' are expressed in terms of dB(A).

An indication of the level of some common sounds on the dB(A) scale is presented in Figure 10.1, which shows a quiet bedroom at around 35 dB(A), a nearby noisy HGV at 90 dB(A) and a pneumatic drill at about 100 dB(A).

There are two quite distinct types of noise source within a wind turbine. The mechanical noise produced by the gearbox, generator and other parts of the drive train; and the aerodynamic noise produced by the passage of the blades through the air. Since the early 1990s there has been a significant reduction in the mechanical noise generated by wind turbines. It is now, usually less than, or of a similar level to the aerodynamic noise. Aerodynamic noise from wind turbines is generally unobtrusive; it is broad-band in nature and in this respect is similar to, for example, the noise of wind in trees.

Well-designed wind farms should be located so that increases in ambient noise levels around noise-sensitive developments are kept to acceptable levels with relation to existing background noise. This will normally be achieved through good design of the turbines and through allowing sufficient distance between the turbines and any existing noise-sensitive development so that noise from the turbines will not normally be significant. Noise levels from turbines are generally low and, under most operating conditions, it is likely that turbine noise would be masked by wind-generated background noise.

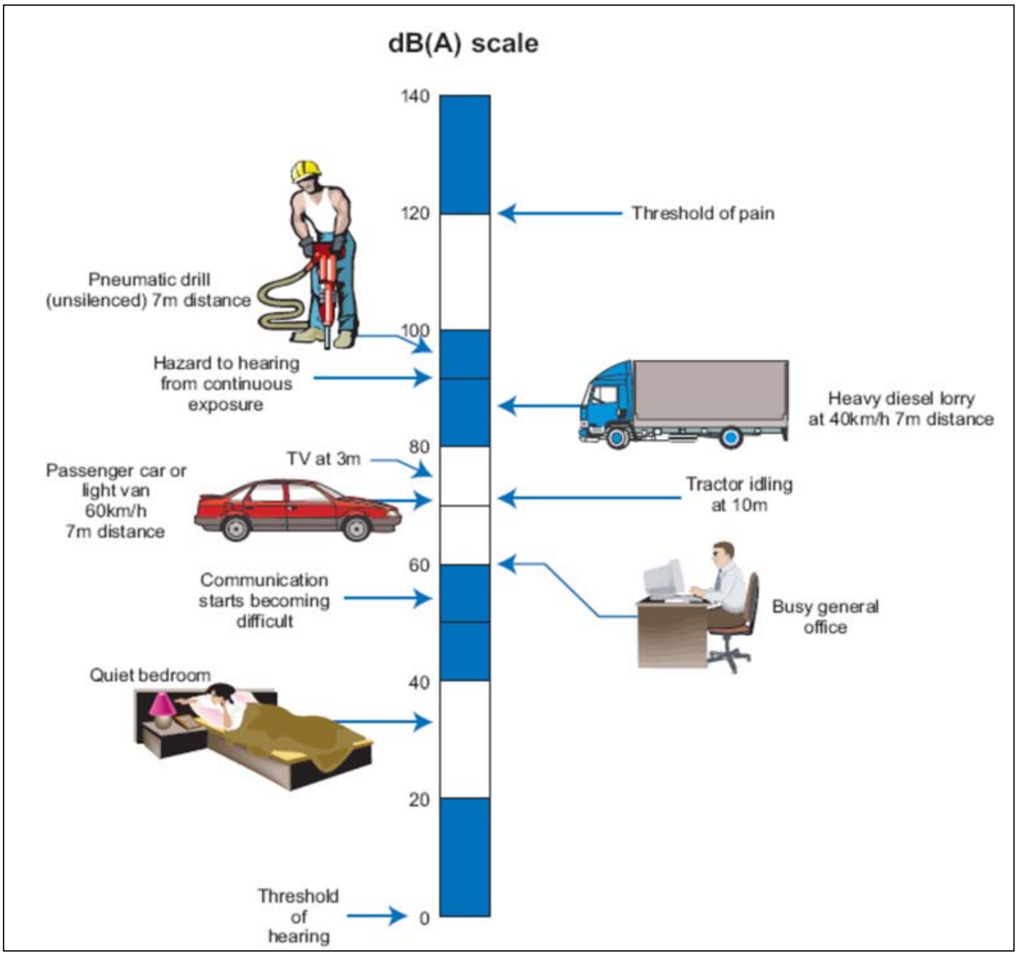


Figure 10.1 The level of typical common sounds on the dB(A) scale (NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes, 2004)

10.3 Guidance Documents and Adopted Criteria

The following sections review best practice guidance that is commonly adopted in relation to developments such as the one under consideration here.

10.3.1 Construction Phase

10.3.1.1 Noise

There is no published statutory Irish guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. Local authorities normally control construction activities by imposing limits on the hours of operation and may consider noise limits at their discretion.

In the absence of specific noise limits, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the British Standard *British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.*

The approach adopted here calls for the designation of a noise sensitive location into a specific category (A, B or C) based on existing ambient noise levels in the absence of construction noise. This then sets a threshold noise value that, if exceeded, indicates a significant noise impact is associated with the construction activities.

Table 10.1 sets out the values which, when exceeded, signify a significant effect at the facades of residential receptors as recommended by BS 5228 – 1. These levels relate to construction noise only.

Table 10.1 Example Threshold of Significant Effect at Dwellings

Assessment category and threshold value period ($L_{Aeq,T}$)	Threshold value, in decibels (dB)		
	Category A Note A	Category B Note B	Category C Note C
Night-time (23:00 to 07:00hrs)	45	50	55
Evenings and weekends Note D	55	60	65
Daytime (07:00 – 19:00hrs) and Saturdays (07:00 – 13:00hrs)	65	70	75

Note A Category A: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are less than these values.
Note B Category B: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are the same as category A values.
Note C Category C: threshold values to use when ambient noise levels (when rounded to the nearest 5dB) are higher than category A values.
Note D 19:00 – 23:00 weekdays, 13:00 – 23:00 Saturdays and 07:00 – 23:00 Sundays.

It should be noted that this assessment method is only valid for residential properties. The following method should be followed:

For the appropriate period (e.g. daytime) the ambient noise level is determined and rounded to the nearest 5dB. In this instance, with the rural nature of the site, all properties in the vicinity of the development have ambient noise levels in the range of 45 to 55 dB L_{Aeq}. Therefore, all properties will be afforded a Category A designation.

See Section 10.4.2 for the detailed assessment in relation to this site. If the specific construction noise level exceeds the appropriate category value (e.g. 65dB $L_{Aeq,1hr}$ during daytime periods) then a significant effect is deemed to occur.

10.3.1.2 Vibration

Vibration standards come in two varieties: those dealing with human comfort and those dealing with cosmetic or structural damage to buildings. For the purpose of this development, the range of relevant criteria used for building protection is expressed in terms of Peak Particle Velocity (PPV) in mm/s.

Guidance relevant to acceptable vibration within buildings is contained in the following documents:

- *BS 7385 – "Evaluation and measurement for vibration in buildings – Part 2: Guide to damage levels from groundborne vibration" (1993)*; and
- *BS 5228 – "Code of practice for noise and vibration control on construction and open sites – Part 2: Vibration" (2009).*

BS 7385 states that there should typically be no cosmetic damage if transient vibration does not exceed 15 mm/s at low frequencies rising to 20 mm/s at 15 Hz and 50 mm/s at 40 Hz and above. These guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings.

BS 5228 recommends that, for soundly constructed residential property and similar structures that are generally in good repair, a threshold for minor or cosmetic (i.e. non-structural) damage should be taken as a peak particle velocity of 15 mm/s for transient vibration at frequencies below 15 Hz and 20 mm/s at frequencies above than 15 Hz. Below these vibration magnitudes minor damage is unlikely, although where there is existing damage these limits may be reduced by up to 50%. In addition, where continuous vibration is such that resonances are excited within structures the limits discussed above may need to be reduced by 50%.

The NRA document *Guidelines for the Treatment of Noise and Vibration in National Road Schemes* also contains information on the permissible construction vibration levels during the construction phase as shown in Table 10.2.

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of:

Table 10.2 Allowable Vibration at Properties

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

10.3.2 Operational Phase

10.3.2.1 Noise

The noise assessment summarised in the following sections has been based on guidance in relation to acceptable levels of noise from wind farms as contained in the document *"Wind Energy Development Guidelines for Planning Authorities"* published by the Department of the Environment, Heritage and Local Government. These guidelines are in turn based on detailed recommendations set out in the Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication *"The Assessment and Rating of Noise from Wind Farms*" (1996). The ETSU document has been used to supplement the guidance contained within the *"Wind Energy Development Guidelines for Planning Authorities"* publication where necessary. Planning permissions and decisions issued by An Bord Pleanála and / or the local authority in relation to wind energy sites in the wider area have also been reviewed here.

"Wind Energy Development Guidelines for Planning Authorities"

Section 5.6 of the *"Planning Guidelines"* published by the Department of the Environment, Heritage and Local Government (2006) outlines the appropriate noise criteria in relation wind farm developments.

The following extracts from this document should be considered:

> *"An appropriate balance must be achieved between power generation and noise impact."*

While this comment is noted it should be stated that the *"Planning Guidelines"* give no specific advice in relation to what constitutes an '*appropriate balance*'. In the absence of this, guidance will be taken from alternative and appropriate publications.

> *"In the case of wind energy development, a noise sensitive location includes any occupied house, hostel, health building or place of worship and may include areas of particular scenic quality or special recreational importance. Noise limits should apply only to those areas frequently used for relaxation of activities for which a quiet environment is highly desirable. Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed."*

As can be seen from the calculations presented later in this document the various issues identified in this extract have been incorporated into our assessment.

> *"Any existing turbines should not be considered as part of the prevailing background noise."*

The Mountlucas wind farm is currently operating approximately 4.2 kilometres west of the proposed development site, at its nearest point. The emissions from this site will be given due consideration as part of this assessment.

> *"In general, a lower fixed limit of 45dB(A) or a maximum increase of 5dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours."*

This represents the commonly adopted daytime noise criterion curve in relation to wind farm developments. However, an important caveat should be noted as detailed in the following extract.

> *"However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global developments. Instead, in low noise environments where background noise is less than 30dB(A), it is recommended that the daytime level of the* $L_{A90,\,10min}$ *of*

> *the wind energy development be limited to an absolute level within the range of 35 – 40dB(A)."*

In relation to night time periods the following guidance is given:

> *"A fixed limit of 43dB(A) will protect sleep inside properties during the night."*

Note again this limit is defined in terms of the $L_{A90,10min}$ parameter. This represents the commonly adopted night time noise criterion curve in relation to wind farm developments.

Reviewing the baseline noise data contained in this assessment and in order to provide a robust approach it is proposed to adopt a lower daytime threshold of 40dB $L_{A90,10mn}$ in this instance. This considers the baseline noise levels measured in the area and on-going developments in terms of Irish guidance on the issue of wind turbine noise.

A level of 40dB(A) has been adopted in relation to low noise areas. This is considered appropriate in light of the following:

- The EPA document *'Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)'* proposes a daytime noise criterion of 45dB(A) in 'areas of low background noise'. The proposed lower threshold here is 5dB more stringent than this level.

- Proposed changes to the assessment of noise effects associated with on-shore wind energy developments are outlined in the Department of Environment, Community & Local Government (DECLG) document '*Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review in relation to Noise, Proximity and Shadow Flicker'* (December 11th 2013). A noise limit of 40dB $L_{A90,10min}$ attributable to one or more wind turbines, is proposed therein in order to restrict noise from wind turbines at noise sensitive properties.

- It should be reiterated that the 2006 *'Wind Energy Development Guidelines'* calls for *"An appropriate balance must be achieved between power generation and noise impact."* Based on a review of other national guidance in relation to acceptable noise levels in areas of low background noise it is considered that the criteria adopted as part of this assessment are robust.

In addition, the An Bord Pleanála (ABP) planning permission in relation to the nearby Mountlucas wind farm development (Ref: PL19.237263) states the following planning condition in relation to noise:

9. (1) During the operational period, noise levels resulting from the operation of the wind turbines and the fixed anemometry mast, when measured at the nearest inhabited house, shall not exceed 43dBA (15 minutes Leq). All sound measurement shall be carried out in accordance with ISO Recommendation R 1996 "Assessment of Noise with respect of Community Response" as amended by ISO Recommendations R 1996 1.

The stated limit of 43dB $L_{Aeq,15min}$ in the relevant planning condition is equivalent to a level of 41dB $L_{A90,10min}$. Therefore, the proposed lower threshold of 40dB $L_{A90,10min}$ is considered robust in terms of conditions placed on other developments in the area.

In summary the following criteria are proposed:

- 40dB $L_{A90,10min}$ for quiet daytime environments of less than 30dB $L_{A90,10min}$;
- 45dB $L_{A90,10min}$ for daytime environments greater than 30dB $L_{A90,10min}$ or a maximum increase of 5dB(A) above background noise (whichever is higher), and;
- 43dB $L_{A90,10min}$ for night time periods.

Based on the baseline noise monitoring carried out and reviewed in this assessment day and night time noise criteria curves have been derived for the development. Again, it should be noted that the lowest baseline noise levels monitored at the various monitoring locations have been used in this process in order to adopt a worst-case approach in the derivation of the noise criteria curves.

Future Potential Guidance Changes

Proposed changes to the assessment of noise impacts associated with on-shore wind energy developments are outlined in the Department of Environment, Community & Local Government (DECLG) document *Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review in relation to Noise, Proximity and Shadow Flicker (December 11th 2013).* A consultation process in relation to the document is currently being undertaken by DECLG.

In essence the consultation document proposes the following amendments in terms of noise criteria applied to wind energy developments:

Proposed Approach	▪ A noise limit of 40dB $L_{A90,10min}$ attributable to one or more wind turbines, should be applied in order to restrict noise from wind turbines at noise sensitive properties. ▪ This limit is an outdoor limit, which should not be exceeded at noise sensitive properties at any wind speed within the operational range of any turbine (i.e. from cut-in until maximum rated power level is reached). ▪ The limit will apply irrespective of time of day or night. ▪ No noise limit is proposed at the properties of landowners with a financial interest in proposed projects.

In order to inform the current discussion, the noise predictions presented in this review have also been considered in light of the consultation guidance.

"The Assessment and Rating of Noise from Wind Farms – ETSU-R-97"

As stated previously the core of the noise guidance contained within the "*Planning Guidelines on Wind Energy"* guidance document is based on the ETSU publication "*The Assessment and Rating of Noise from Wind Farms*".

Current best practice calls for the control of wind turbine noise by the application of noise limits at the nearest noise sensitive properties. It is considered that absolute noise levels applied at all wind speeds are not suited to wind turbine developments and therefore best practice is to adopt noise limits relative to background noise levels in the vicinity of the noise sensitive locations. Therefore, one critical aspect of the noise assessment of wind energy proposals relates to the identification of baseline noise levels through on site noise surveys. At a minimum continuous baseline noise monitoring should be carried out at the nearest noise sensitive locations for typically a two-week period and should capture a representative sample of wind speeds in the area (i.e. cut in speeds to wind speed of rated sound power of the proposed turbine).

Background noise measurements (i.e. $L_{A90,10min}$) should be carried out in light of guidance contained within ISO 1996: 2007: Acoustics – *Description, measurement and assessment of Environmental Noise*" and related to wind speed measurements that are collated at the site of the wind turbine development itself. Regression analysis is then applied to this data set to derive background noise levels at various wind speeds, and from this, the appropriate day and night time noise criterion curves can be established.

Noise emissions associated with the wind turbine units themselves are predicted in accordance with *ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation* (1996). This is a noise prediction standard that considers noise attenuation offered, amongst others, by distance, ground absorption, directivity and atmospheric absorption. Noise predictions and contours are typically prepared for various wind speeds and the predicted levels are compared against the relevant noise criterion curve to demonstrate compliance with the guidance contained within the ETSU-R-97 documentation. Where noise predictions indicate that reductions in noise emissions are required in order to satisfy any adopted criteria consideration can be given to site lay out, detailed downwind analysis and various modes of 'low noise' operation that are typically offered by modern wind turbine units.

10.3.2.2 Special Characteristics

Infrasound/Low Frequency Noise

Low Frequency Noise is noise that is dominated by frequency components less than approximately 200Hz whereas Infrasound is typically described as sound at frequencies below 20Hz.

In relation to Infrasound, the following extract from *'EPA document Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3)'* is noted here:

> *"There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20 Hz. This was a prominent feature of passive yaw "downwind" turbines where the blades were positioned downwind of the tower which resulted in a characteristic "thump" as each blade passed through the wake caused by the turbine tower. With modern active yaw turbines (i.e. the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature."*

A modern active yaw turbine is proposed for this development.

With respect to infrasonic noise levels below the hearing threshold, the World Health Organisation (WHO) document *"Community Noise"* has stated that:

> *"There is no reliable evidence that infrasounds below the hearing threshold produce physiological or psychological effects"*

In 2010, the UK Health Protection Agency published a report entitled *"Health Effects of Exposure to Ultrasound and Infrasound, Report of the independent Advisory Group on Non-ionising Radiation"*. The exposures considered in the report related to medical applications and general environmental exposure. The report notes:

> *"Infrasound is widespread in modern society, being generated by cars, trains and aircraft, and by industrial machinery, pumps, compressors and low speed*

> *fans. Under these circumstances, infrasound is usually accompanied by the generation of audible, low frequency noise. Natural sources of infrasound include thunderstorms and fluctuations in atmospheric pressure, wind and waves, and volcanoes; running and swimming also generate changes in air pressure at infrasonic frequencies.*
>
> *For infrasound, aural pain and damage can occur at exposures above about 140 dB, the threshold depending on the frequency. The best-established responses occur following acute exposures at intensities great enough to be heard and may possibly lead to a decrease in wakefulness. The available evidence is inadequate to draw firm conclusions about potential health effects associated with exposure at the levels normally experienced in the environment, especially the effects of long-term exposures. The available data do not suggest that exposure to infrasound below the hearing threshold levels is capable of causing adverse effects."*

The UK Institute of Acoustics Bulletin in March 2009 included a statement of agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments (IAO JS2009). The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. On the subject of infrasound, the article notes:

> *"Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.*
>
> *Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low-frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view.*
>
> *A Portuguese group has been researching 'Vibro-acoustic Disease' (VAD) for about 25 years. Their research initially focused on aircraft technicians who were exposed to very high overall noise levels, typically over 120 dB. A range of health problems has been described for the technicians which the researchers linked to high levels of low frequency noise exposure. However other research has not confirmed this. Wind farms expose people to sound pressure levels orders of magnitude less than the noise levels to which the aircraft technicians were exposed. The Portuguese VAD group has not produced evidence to support their new hypothesis that infrasound and low frequency noise from wind turbines causes similar health effects to those experienced by the aircraft technicians."*

In the unlikely event that an issue on low frequency noise is associated with the proposed development, it is recommended that an appropriate detailed investigation be undertaken. Internal measurements are recommended and due consideration should be given to the guidance contained in Appendix VI "Low Frequency Noise" of the

EPA document *"Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)"* which are in-turn based on the threshold values outlined in the Salford University document *"Procedure for the assessment of low frequency noise complaints"*, Revision 1, December 2011.

If low frequency noise issues are identified, appropriate mitigation measures, including site curtailment under conditions (i.e. wind direction/speed) that give rise to the issue will be implemented through the turbine control system associated with the development.

The noise criteria outlined in ETSU-R-97 account for the fact that wind turbines exhibit a characteristic noise that is described using the term 'blade swish'. The DTI Report – *'The Measurement of Low Frequency Noise at Three UK Windfarms'*, concluded the following:

> *"The common cause of complaints associated with noise at all three wind farms is not associated with low frequency noise, but is the audible modulation of the aerodynamic noise, especially at night".*

It goes on to suggest, *"It may be appropriate to re-visit the issue of aerodynamic modulation and the means by which it should be assessed"*. The potential issue of aerodynamic modulation (or Amplitude Modulation) is discussed in more detail in the following section.

Amplitude Modulation
This section has been prepared with a view to reviewing the following:

- Discussion of the principles of Amplitude Modulation (AM) in terms of the *'current thinking'* as to the causes of the issue and the conditions in which the issue is more likely to occur.
- Discussion on the issue in terms of perceived impacts and issues experienced across Ireland and the UK including commentary on the frequency/regularity of the issue.
- Review of current consultation processes in relation to the issue of 'Other' AM (OAM), and;
- Discussion on typical mitigation measures that may be considered in terms of the management of OAM should the issue occur.

Definition of Amplitude Modulation
In the context of this assessment, AM is defined in the IoA Noise Working Group (Wind Turbine Noise) document *Amplitude Modulation Working Group Final Report – A Method for Rating Amplitude Modulation in Wind Turbine Noise (Aug 2016)*, as:

> *"periodic fluctuations in the level of broadband noise from a wind turbine (or wind turbines), the frequency of the fluctuations being the blade passing frequency (bpf) of the turbine rotor, as observed outdoors at residential distances in free-field conditions."*

It should be noted that current study and research is mainly focused on the measurement and assessment of the AM characteristics presented by current large wind turbines with 3-bladed rotors rotating at speeds up to about 20 rpm such as the unit being considered for the proposed site.

Current research into a proposed metric is intended to be applied to external measurements of noise experienced at 'residential distances', i.e. separation distances between large wind turbines and dwellings in the UK & Northern Ireland being typically 500 metres or greater. The measurements are made outdoors for consistency with other procedures for measuring wind turbine noise.

In this first instance it is appropriate to define AM. It is now generally accepted that there are two mechanisms causing amplitude modulation:

- 'Normal' AM (blade swish), and;
- 'Other' AM.

In both cases, the result is a regular fluctuation in amplitude at the Blade Passing Frequency (BPF) of the wind turbine blades (the rate at which the blades of the turbine pass a fixed point). For a three-bladed turbine rotating at 20 rpm, this equates to a modulation frequency of 1 Hz.

'Normal' AM — An observer at ground level close to a wind turbine will experience 'blade swish' because of the directional characteristics of the noise radiated from the trailing edge of the blades as it rotates towards and then away from the observer.

This effect is reduced for an observer on or close to the turbine axis, and therefore would not generally be expected to be significant at typical separation distances, at least on relatively level sites.

The RenewableUK AM project (RenewableUK 2013) has coined the term 'normal' AM (NAM) for this inherent characteristic of wind turbine noise, which has long been recognized and was discussed in ETSU-R-97 in 1996.

'Other' AM — In some cases AM is observed at large distances from a wind turbine (or turbines). The sound is generally heard as a periodic 'thumping' or 'whoomphing' at relatively low frequencies.

On sites where it has been reported, occurrences appear to be occasional, although they can persist for several hours under some conditions, dependent on atmospheric factors, including wind speed and direction.

It was proposed in the RenewableUK 2013 study that the fundamental cause of this type of AM is transient stall conditions occurring as the blades rotate, giving rise to the periodic thumping at the blade passing frequency.

Transient stall represents a fundamentally different mechanism from blade swish and can be heard at relatively large distances, primarily downwind of the rotor blade.

The RenewableUK AM report adopted the term 'Other AM' (OAM) for this characteristic. The terms 'enhanced' or 'excess' AM (EAM) have been used by others, although such definitions do not distinguish between the source mechanisms and presuppose a 'normal' level of

AM, presumably relating back to blade swish as described in ETSU-R-97.

Causes of Amplitude Modulation

Of the potential OAM 'source' effects, the prime candidate is transient separation of airflow from each blade ('stall'). The turbine blades operate at an 'angle of attack' (determined by a combination of the incoming air velocity and the velocity from rotation). Above a given angle of attack (mainly determined by the air velocity and the blade profile), the air flow over the upper (suction) surface of the blade may detach, resulting in the generation of a region of turbulent air on a region of the blade surface (stall) and a loss of lift.

The noise generated by the interaction of the turbulent air in the stalled region with the blade surface will result in increased noise (compared with the un-stalled, attached-flow case). In consequence, stall occurring over a small area of each turbine blade in one part of the blade's rotation only (for example as it passes over the top of its path) will result in cyclic increases in noise level (and therefore OAM).

Stall noise also has a lower characteristic frequency than noise from an un-stalled blade and, importantly, it will also exhibit different directivity. Based on a model developed as part of RenewableUK work, this change in directivity in particular is predicted to result in significant modulation levels in downwind directions, which is consistent with observations of OAM made to date.

Downwind directions are those in which the highest overall levels of turbine noise are generally experienced in the far-field of the turbines. This results from a combination of source directivity and propagation effects and would explain the different characteristics and impact of OAM when compared to NAM.

The RenewableUK research concludes that whether or not a wind turbine on a particular site will exhibit OAM is dependent on a large number of complex factors, including:

- the local atmospheric conditions (particularly variation in wind speed and direction over the area of the rotor disk);
- local topography (which may influence rotor inlet flows in different wind directions), and;
- the design of the turbine blades and the way they are controlled.

It is not therefore possible to be prescriptive as to whether any particular site or wind farm design is more or less likely to give rise to OAM being generated. This is considered likely to be due to a combination of site and installation-specific factors, including meteorology.

Where a wind turbine installation exhibits OAM, it is then natural to consider how it can be assessed in terms of annoyance, and, in the event that the assessment shows that OAM requires to be mitigated, how this can be achieved.

Human Response

In some cases, AM is observed at large distances from a wind turbine (or turbines). The sound is generally heard as a periodic 'thumping' or 'whoomphing' at relatively low frequencies.

The RenewableUK research discusses "How People Respond to Amplitude-Modulated Wind Turbine Noise". This has been reviewed in the following paragraphs.

As part of the RenewableUK work an extensive series of listening tests, under controlled laboratory conditions, were commissioned in order to establish if and how noise with a modulating character can be more annoying than steady noise of the same measured level.

The core approach of the testing consisted of simulated recordings, based on an analysis of actual field recordings, and with a wide range of input parameters, being played back to a range of subjects of different ages and sensitivity but of normal hearing.

The frequency spectra and levels of sounds were simulated to attempt to represent the varying characteristics of AM as it might be perceived in a rural residential external setting. Subjects were asked to rate the noise in two ways:

- on an absolute annoyance rating, and;
- with a rating relative to un-modulated noise, with the presence in some cases of background noise with a spectrum and character representative of a rural garden.

The work found the following:

- Responses were not significantly affected by:
  - the frequency content of the modulated noise;
  - the modulation waveform, and;
  - or the presence of limited amounts of wind-disturbed vegetation noise.
- Annoyance ratings were significantly related to:
  - to the frequency (rate) of the modulation;
  - the overall A-weighted level (or loudness) of the test sound, and;
  - the modulation depth.

In terms of annoyance ratings, these were correlated with the mean noise level and a range of metrics defining the degree of modulation. This showed that annoyance increases slightly with modulation depth. It was noted that the mean overall noise levels were shown to dominate the annoyance rating.

Frequency of Occurrence of AM

It should be noted that AM is associated with wind turbine operations but it should also be noted that is a rare event associated with a limited number of wind farms. That is to say while it can occur it is the exception rather than the rule.

Salford University / DEFRA / CLG and BERR prepared a research study in order to investigate the issue of aerodynamic modulation associated with wind turbine noise. The results were reviewed and published in the report *'Research into Aerodynamic Modulation of Wind Turbine Noise'*.

The broad conclusions of this report were that aerodynamic modulation was only considered to be an issue at four, and a possible issue at a further eight, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the 4 sites where aerodynamic modulation was confirmed as an issue, it was considered that conditions associated with aerodynamic modulation is likely to occur between about 7 and 15% of the time.

RenewableUK states the following:

Page 68 Module F — *"even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent."*

It also states:

Page 6 Module F — *"It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months."*

This review states: *"There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed."*

Possible Mitigation Measures

If the issue of AM were to occur in relation to the proposed site, it is appropriate to consider what practically can be done to address the issue. Again, the latest research in relation to this issues in presented in the RenewableUK work.

As previously *stated "there is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the sites' general characteristics or on the known characteristics of the wind turbines to be installed."*

The RenewableUK work concludes that:

> *"In the immediate term, the only guaranteed solution to mitigate OAM if it occurs in practice on particular site is the cessation of operation of offending turbines during those conditions under which OAM is found to occur."*

In terms of future developments, the following is stated:

> *"Given the characteristics of the partial stall mechanism identified, the effective mitigation of OAM in practice will require the future involvement and close cooperation of wind turbine manufacturers, and possibly involve detailed measurements that focus on better understanding the surface pressure distributions on the turbine blades themselves, particularly as the stall point is approached. Simple analysis methods have been developed to assist in identifying the most likely relevant conditions. It is believed that with such cooperation, methods will be capable of being developed for avoiding local stall conditions.*
>
> *Such methods may involve software 'fixes' that seek to modify the logic of the control system algorithms, perhaps even through the application of more advanced cyclical pitch control. More fundamental, physical design changes may also prove worthwhile, such as innovative blade designs or the addition of blade vortex generators which may delay the onset of stall. Such methods*

would be likely to only have a limited or negligible impact on the generating capacity of the turbines."

Ongoing Research

Research and guidance in the area is ongoing with recent publications being issued by Renewable UK and most recently by the Institute of Acoustics (IoA) Amplitude Modulation Working Group (AMWG).

The IoA group have issued a final report "*A Method for Rating Amplitude Modulation in Wind Turbine Noise*". This document puts forward the 'Reference Method' to be used to reliably identify the presence of amplitude modulated wind turbine noise. It is proposed that this Reference Method will be used in order to determine the presence of amplitude modulated wind turbine noise.

In terms of a rating methodology for AM, the "*A Method for Rating Amplitude Modulation in Wind Turbine Noise*" report states *"there is currently no generally agreed rating methodology for wind turbine AM. New Zealand Standard NZS 6808: 2010 provided a penalty mechanism but noted that there was no objective test available. Authorities in Australia and Finland have published some guidance on rating methodologies and associated limits, although these are either unvalidated or in draft form. In the UK, planning conditions intended to address AM have been imposed on a small number of wind farms to develop a scheme of assessment. These conditions have been based either on the time series method adopted at Den Brook, which has been the subject of much debate and legal challenge, or the frequency domain method proposed by RenewableUK (RenewableUK, 2013). However, in virtually all cases, planning officers and inspectors, in granting wind farm planning permission, have declined to impose an AM condition; as either they have considered that the need for such a condition had not been demonstrated, or that there was no robust scientific basis for framing such a condition, or both. In a number of cases, a condition requiring a scheme for assessing AM to be agreed with the local planning authority has been imposed; this form of condition relies on the premise that an appropriate method of assessing AM will be available within the development timescale."*

In this event that the presence of amplitude modulated wind turbine noise is confirmed it is proposed to use the guidance in the *Proceedings of Instiute of Acosutics* paper '*A review of Research into Human Reposne to the Amplitude Modulated Componet of Wind Turbine Noise and Development of a Planning Control Method for Implementation in the UK*'[1] be used to rate the issue and to apply the appropriate corrections/ratings.

10.4 Receiving Environment

This stage of the assessment was to determine typical background noise levels in the vicinity of the noise sensitive locations in closest proximity to the development site. This was done through installing unattended sound level meters at five representative locations in the surrounding area for approximately a two-week period. Note that no significant sources of vibration were noted at any of the survey locations. The Mountlucas wind farm was not noted to have a significant effect on the noise environment at any of the noise monitoring locations considered here.

10.4.1 Choice of Measurement Locations

The noise monitoring locations were identified by preparing a preliminary noise contour at an early stage of the assessment. Any locations that fell inside the predicted

[1] Proceedings of the Institute of Acoustics, Vol. 38. Pt. 1. 2016

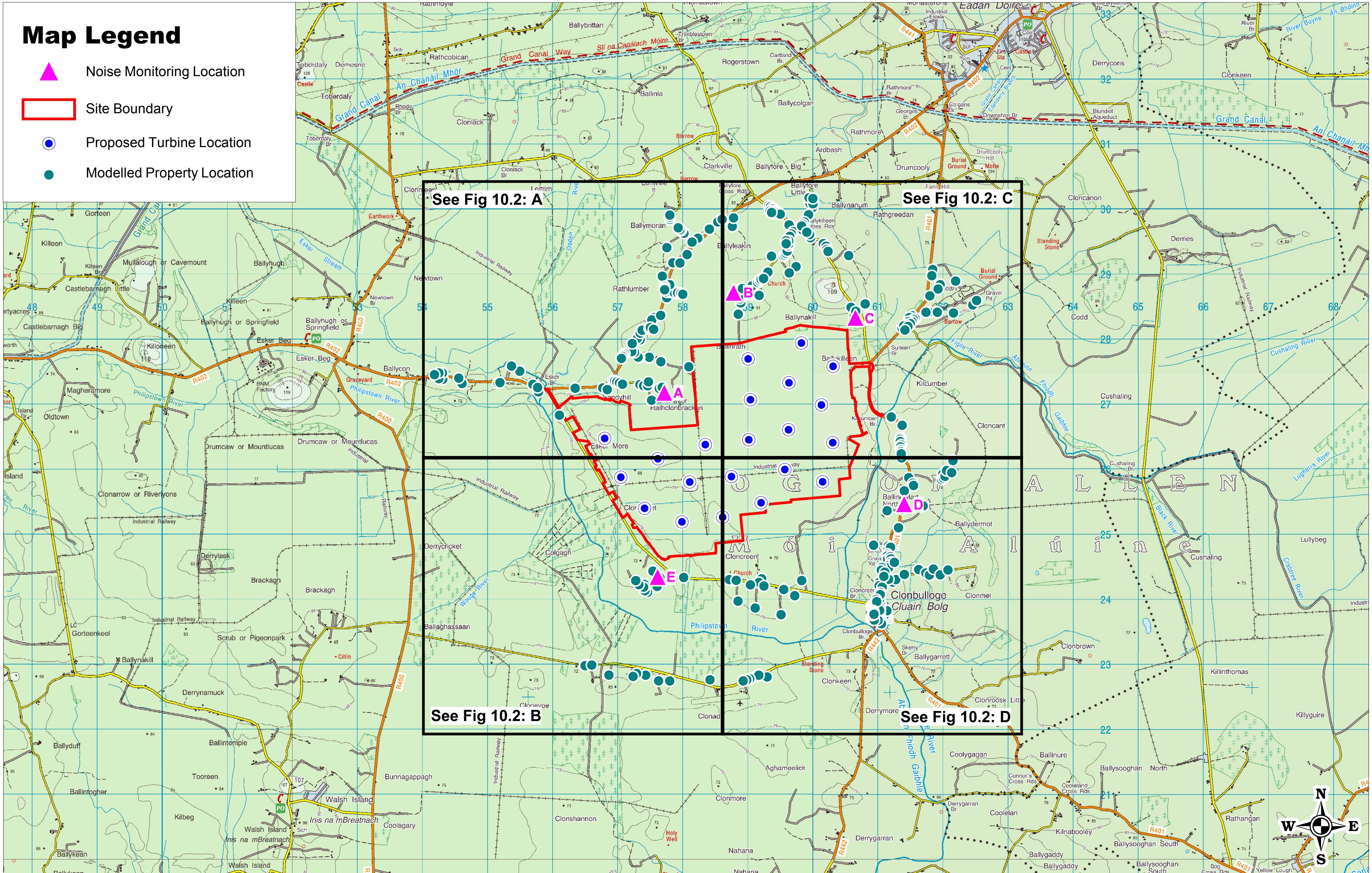
35dB $L_{A90,10min}$ noise contour were considered for noise monitoring. The selection of monitoring locations was supplemented by reviewing aerial images of the study area and other online sources of information (e.g. Google Earth).

The selected locations for the noise monitoring are outlined in the following sections and are identified in Figure 10.2 (including Figures 10.2 A, B, C and D). Plates 10.1, 102, 10.3, 10.4 and 10.5 illustrate the installed noise monitoring kits at the locations identified in Figure 10.2. Co-ordinates for the locations are detailed in Table 10.3.

Table 10.3 Noise Measurement Coordinates

Location	Coordinates	
	Easting	Northing
A (H31)	257,717	227,169
B (H74)	258,780	228,707
C (H127)	260,653	228,322
D (H153)	261,394	225,431
E (H276)	257,647	224,336

Significant noise sources in this area were noted to be local and distant traffic movements, activity in and around the residences, wind generated noise from local foliage and other typical anthropogenic sources typically found in such rural settings.



MAP TITLE: Noise Monitoring & House Locations: Key Plan | MAP NO.: Fig 10.2 | SCALE: 1:75,000

PROJECT TITLE: 150504 Cloncreen Wind Farm EIS, Co. Offaly | DATE: 05-10-2016

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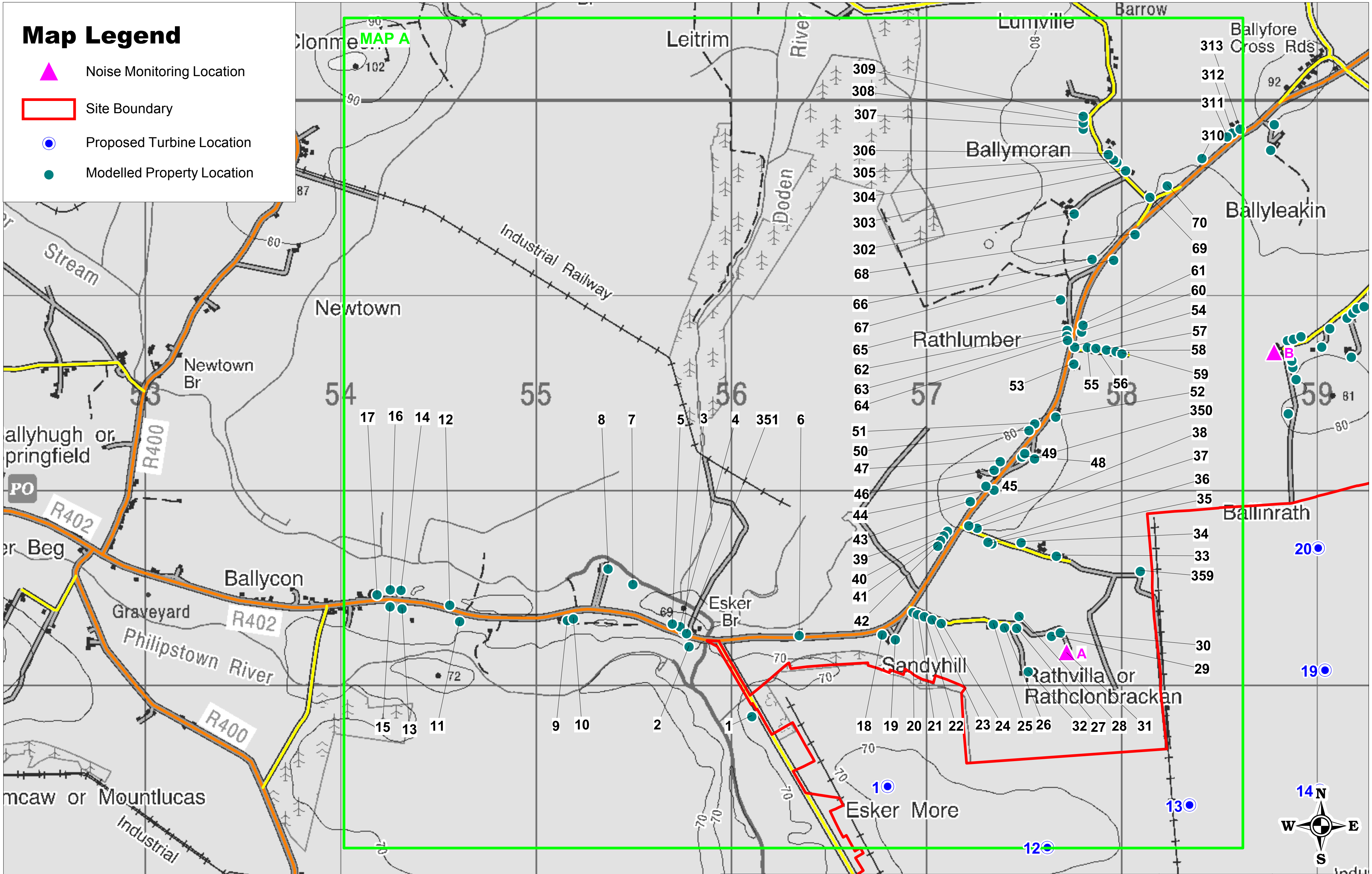

MAP TITLE: Noise Monitoring & House Locations: Map A | MAP NO.: Fig 10.2 A | SCALE: 1:25,000

PROJECT TITLE: 150504 Cloncreen Wind Farm EIS, Co. Offaly | DATE: 05-10-2016

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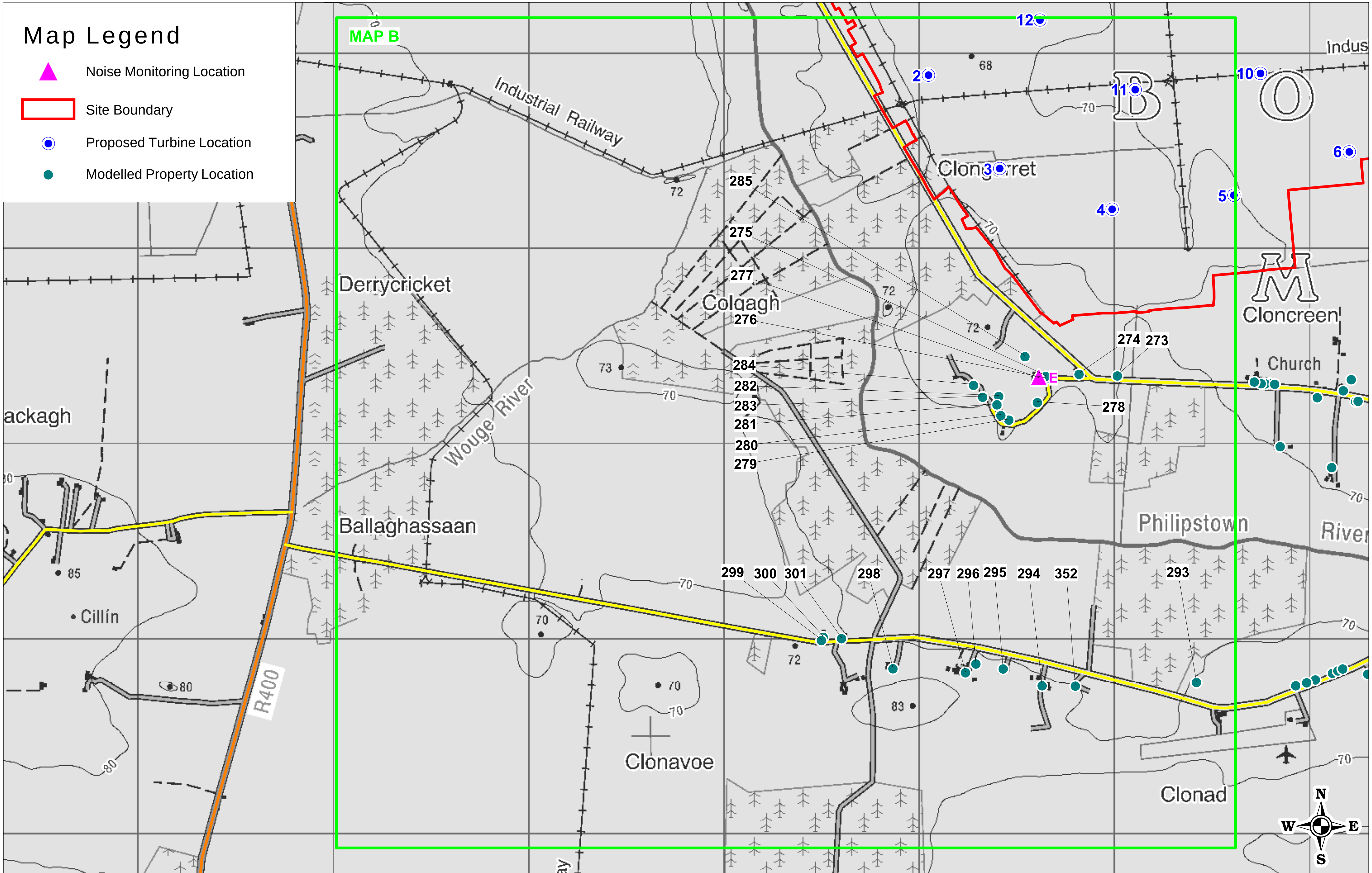

MAP TITLE:	Noise Monitoring & House Locations: Map B
MAP NO.:	Fig 10.2 B
SCALE:	1:25,000
PROJECT TITLE:	150504 Cloncreen Wind Farm EIS, Co. Offaly
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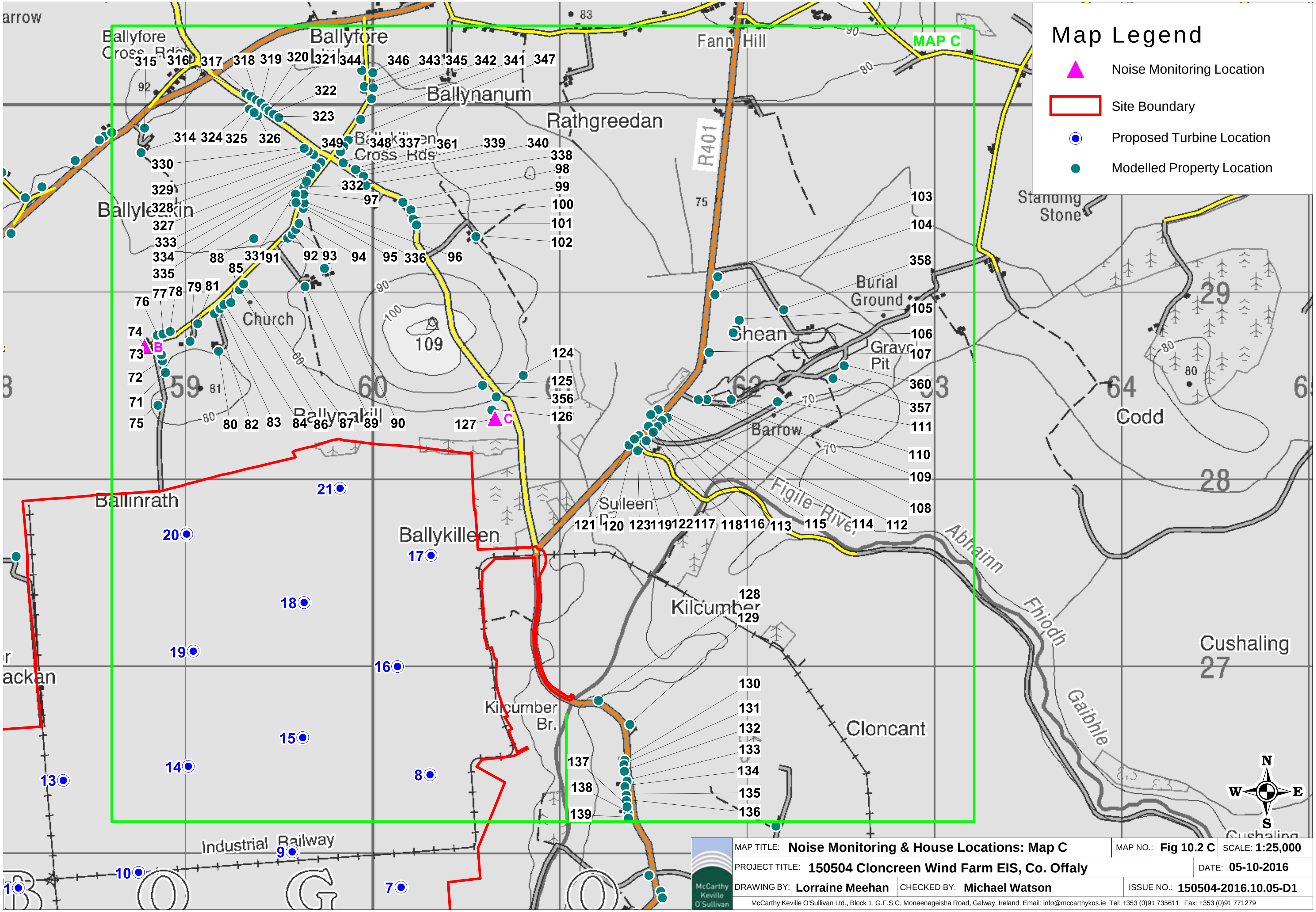

MAP TITLE: Noise Monitoring & House Locations: Map C	MAP NO.: Fig 10.2 C
SCALE: 1:25,000	
PROJECT TITLE: 150504 Cloncreen Wind Farm EIS, Co. Offaly	DATE: 05-10-2016
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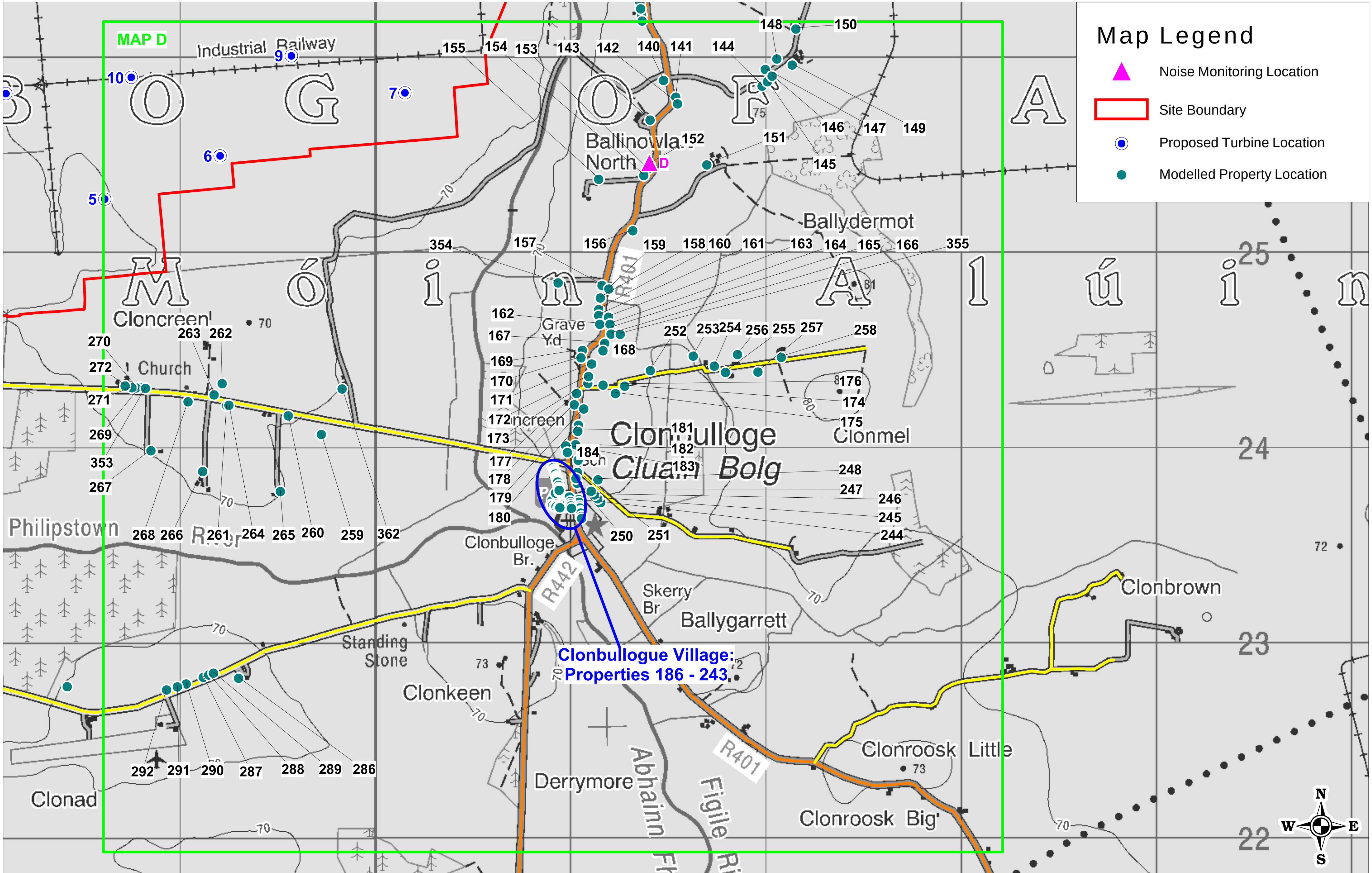

MAP TITLE: **Noise Monitoring & House Locations: Map D** | MAP NO.: **Fig 10.2 D** | SCALE: **1:25,000**

PROJECT TITLE: **150504 Cloncreen Wind Farm EIS, Co. Offaly** | DATE: **05-10-2016**

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Plate 10.1 Noise Monitoring Location A

Plate 10.2 Noise Monitoring Location B

Plate 10.3 Noise Monitoring Location C

Plate 10.4 Noise Monitoring Location D

Plate 10.5 Noise Monitoring Location E

10.4.2 Measurement Periods

Noise measurements were conducted at relevant monitoring locations over the following periods:

Table 10.4 Noise Measurement Periods

Location	Start Date	End Date
A (H31)	1st March 2016 – 13:30hrs	16th March 2016 – 10:50hrs
B (H74)	1st March 2016 – 14:20hrs	16th March 2016 – 10:30hrs
C (H127)	1st March 2016 – 14:40hrs	16th March 2016 – 10:00hrs
D (H153)	1st March 2016 – 13:50hrs	16th March 2016 – 10:50hrs
E (H276)	1st March 2016 – 14:30hrs	16th March 2016 – 11:10hrs

A sufficient variety of wind speed and weather conditions were encountered over the survey periods in question.

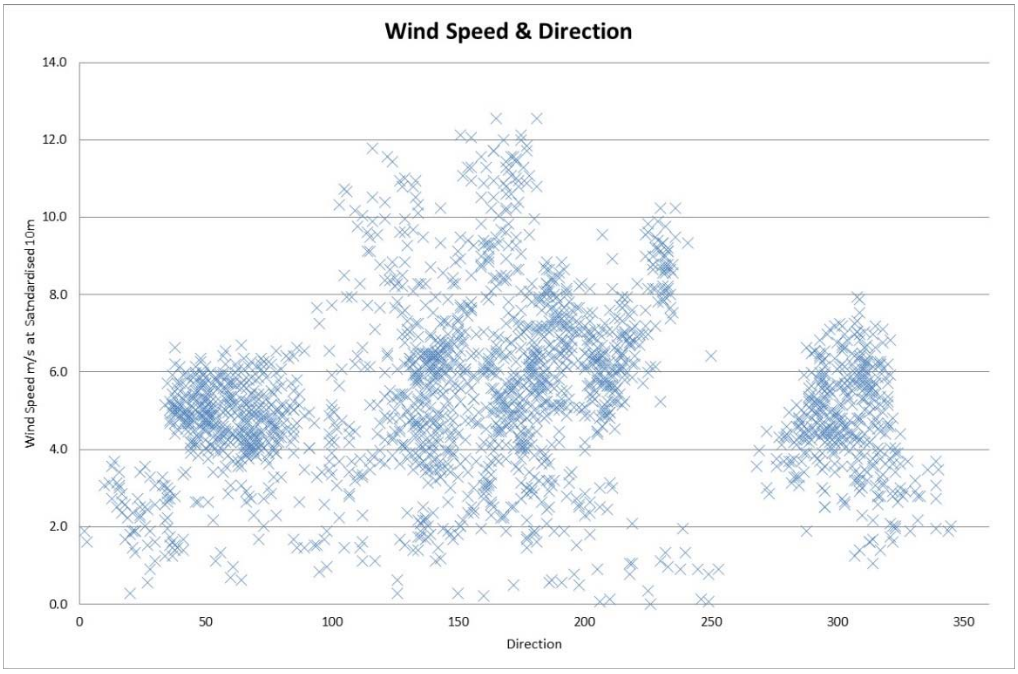


Figure 10.3 Distribution of Wind Speeds & Direction during Survey Period

10.4.3 Personnel and Instrumentation

AWN Consulting installed and removed the noise monitors at all locations. The following instrumentation was used at the various locations:

Table 10.5 Instrumentation

Location	Equipment	Serial Number	Calibration Drift
A (H31)	Brüel & Kjær Type 2238	2638292	+0.2
B (H74)	Brüel & Kjær Type 2238	2562813	+0.1
C (H127)	Brüel & Kjær Type 2238	2684495	+0.1
D (H153)	Brüel & Kjær Type 2238	2562663	+0.1
E (H276)	Brüel & Kjær Type 2238	2654428	+0.3
Calibrator	Brüel & Kjær Type 4231	2460007	N/A

Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær type 4231 Sound Level Calibrator where appropriate. Relevant calibration certificates are presented in Appendix 10-2.

Rain fall was monitored using a Texas Instruments (TR525T) rain gauge with 0.2mm tipping bucket and data logger that was placed at Location D (H153). The rain gauge allows the identification of periods of rain fall in order that they can be removed from the noise monitoring data sets, in line with best practice, when calculating the prevailing background noise levels at the various locations.

Wind speed measurements were obtained from an on-site met mast at the location marked on Figure 10.4.

10.4.4 Procedure

Measurements were conducted at the five locations over the survey periods. Sample periods for the noise measurements were 10 minutes during both the daytime and night-time periods. The results were saved to the instrument memory for later analysis. Survey personnel noted potential primary noise sources contributing to noise build-up during the installation and removal of the sound level meters from site (e.g. identified significant noise sources in the area such as local traffic or farm yard activities). $L_{Aeq,10min}$ and $L_{A90,10min}$ parameters were measured in this instance.

10.4.5 Consideration of Wind Shear

As part of a robust wind farm noise assessment due consideration should be given to the issue of wind shear. The issue of wind shear has been considered following relevant guidance as outlined in the IoA document *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise.* This presents the following equations in relation to the derivation of a standardised wind speed at 10m above ground level:

Equation A
Shear Exponent Profile: this uses the following equation:

$$U = U_{ref} \times (H \div H_{ref})^{m}$$

Where:

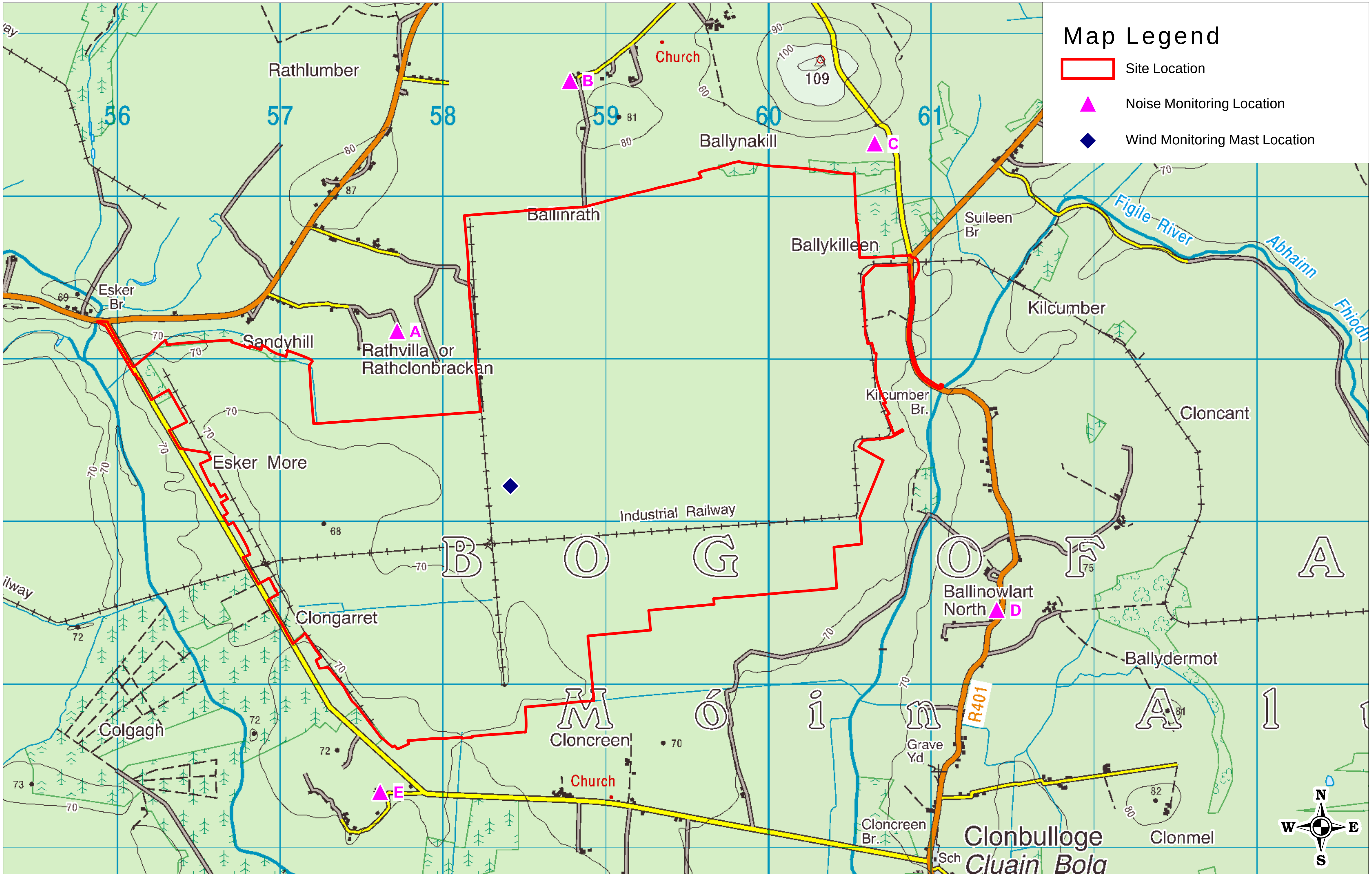
U	calculated wind speed.
U_{ref}	measured wind speed.
H	height at which the wind speed will be calculated.
H_{ref}	height at which the wind speed is measured.
m	shear exponent.

Equation B
Roughness Length Shear Profile: this uses the following equation:

$$U_1 = U_2 \times [(\ln(H_1 \div z))/ (\ln(H_2 \div z))]$$

Where:

H_1	The height of the wind speed to be calculated (10m)
H_2	The height of the measured wind speed.
U_1	The wind speed to be calculated.
U_2	The measured wind speed.
z	The roughness length.



MAP TITLE: Wind Monitoring Mast Location	MAP NO.: Figure 10.4 — SCALE: 1:30,000
PROJECT TITLE: 150504 - Cloncreen WF, Co. Offaly	DATE: 11-09-2016
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Note: A roughness length of 0.05m is used to standardise hub height wind speeds to 10m height in the IEC 61400-11:2003 standard, regardless of what the actual roughness length seen on a site may have been. This 'normalisation' procedure was adopted for comparability between test results for different turbines.

A data set from the met mast was available for the duration of the baseline noise survey undertaken here. This data set was used to perform a calculation of the shear exponent found between the highest two wind speed measurements for every ten-minute period. The shear exponents calculated for every ten-minute period were then used to calculate the hub height wind speed from that measured at the relevant hub height proposed here, using equation B. Equation A was then used to calculate a ten-metre height wind speed from the hub height wind speed every ten minutes, assuming the reference roughness length of 0.05 m.

10.4.6 Results

The results of the background noise monitoring programme are extensive in nature. The raw data sets are not included in this document but are available on request along with the measured and derived[2] wind speeds for the survey period.

The following sections present an overview and statistical analysis of the noise monitoring data obtained from the survey programme at each location for day (07:00 to 23:00hrs) and night time periods (23:00 to 07:00hrs).

The ETSU document outlines the rationale as to why the use of the L_{A90} parameter for the assessment of wind turbine sites is preferred over the L_{Aeq} parameter. These should be noted in the view of the L_{Aeq} data sets presented and commented upon in this report. It states the following:

> *"experience in the field when performing such measurements indicates that short, transitory noise events can significantly change the L_{Aeq}. These events are not related to the noise emitted by the wind farm. These transitory noise events can be sources such as low flying aircraft, bird song, animal noises, cars, wind effects on microphone, etc.*
>
> *Measurements performed in rural areas indicate that the ambient L_{Aeq} noise levels may be 5 – 25dB(A) above the L_{90} background levels due to these transitory events. Therefore, when performing noise measurements for the assessment of compliance with planning conditions or obligations, confusion can occur due to the L_{Aeq} being significantly higher than the L_{90} background noise level due to noise sources not associated with the wind farm.*
>
> *The Noise Working Group is agreed that the $L_{A90(10\ minutes)}$ descriptor should be used for both the background noise and the wind farm noise and that when setting limits, it should be borne in mind that the $L_{A90(10\ minutes)}$ from the wind farm is likely to be 1.5 – 2.5dB(A) less than the L_{Aeq} measured over the same period".*

---

2 Derived to a level of 10m above ground based on guidance contained within Institute of Acoustics Acoustic Bulletin Technical Contribution "*Prediction and Assessment of Wind Turbine Noise – Agreement about Relevant Factors for Noise Assessment for Wind Energy Projects*" (dated March/April 2009)

10.4.6.1 Location A (H31)

10.4.6.1.1 Daytime Period

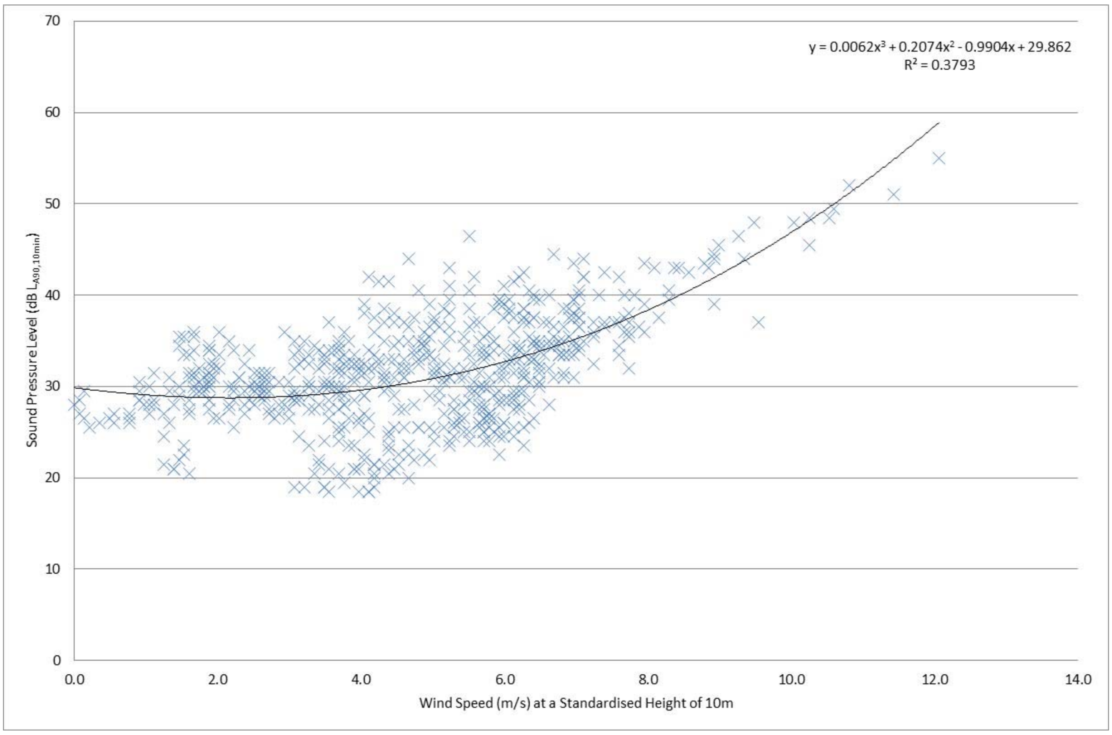


Figure 10.5 Daytime Regression Analysis – Location A

10.4.6.1.2 Night Period

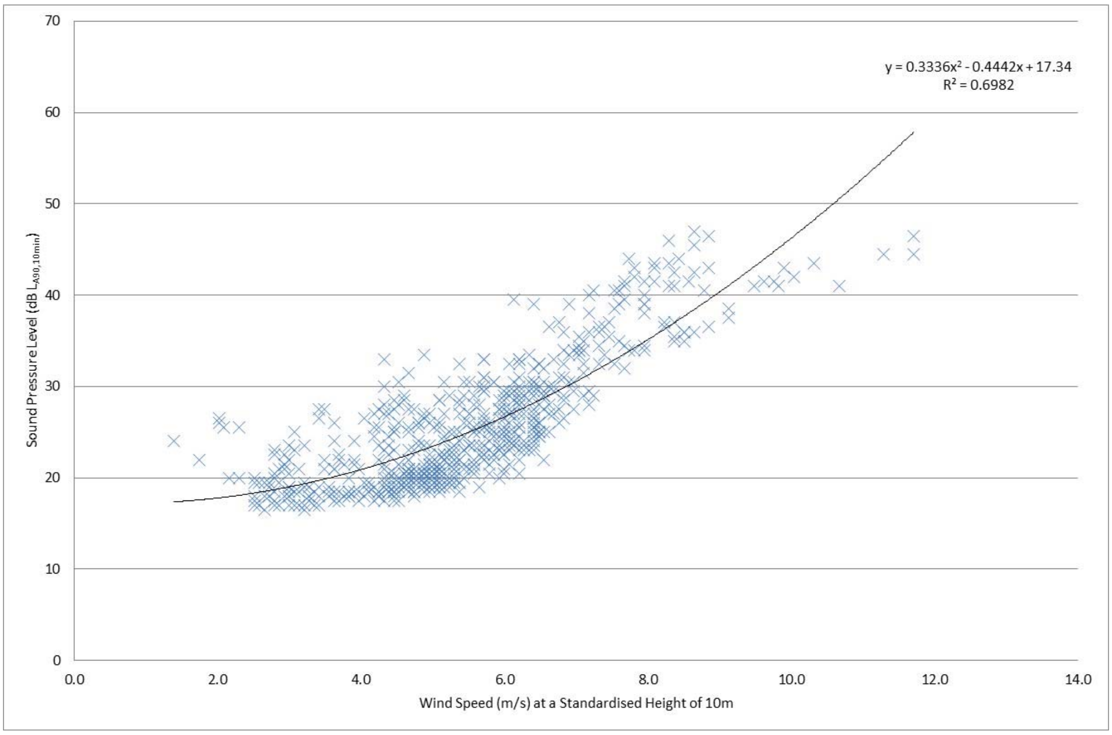


Figure 10.6 Night Regression Analysis – Location A

10.4.6.2 Location B (H74)

10.4.6.2.1 Daytime Period

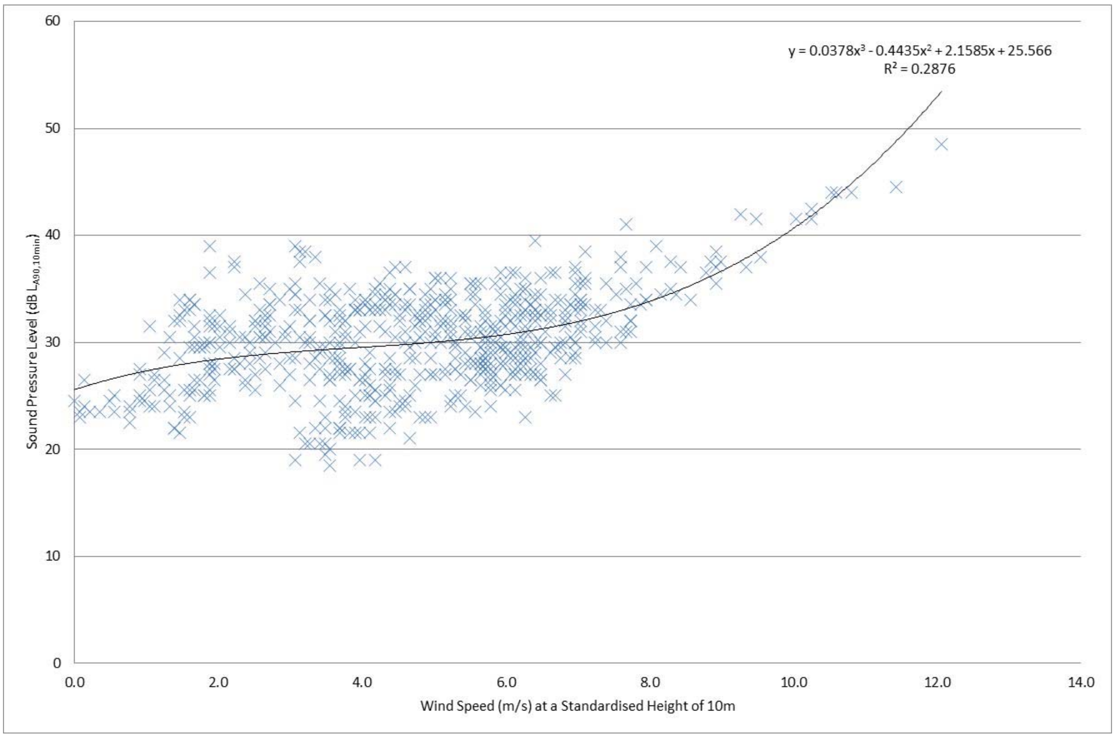


Figure 10.7 Daytime Regression Analysis – Location B

10.4.6.2.2 Night Period

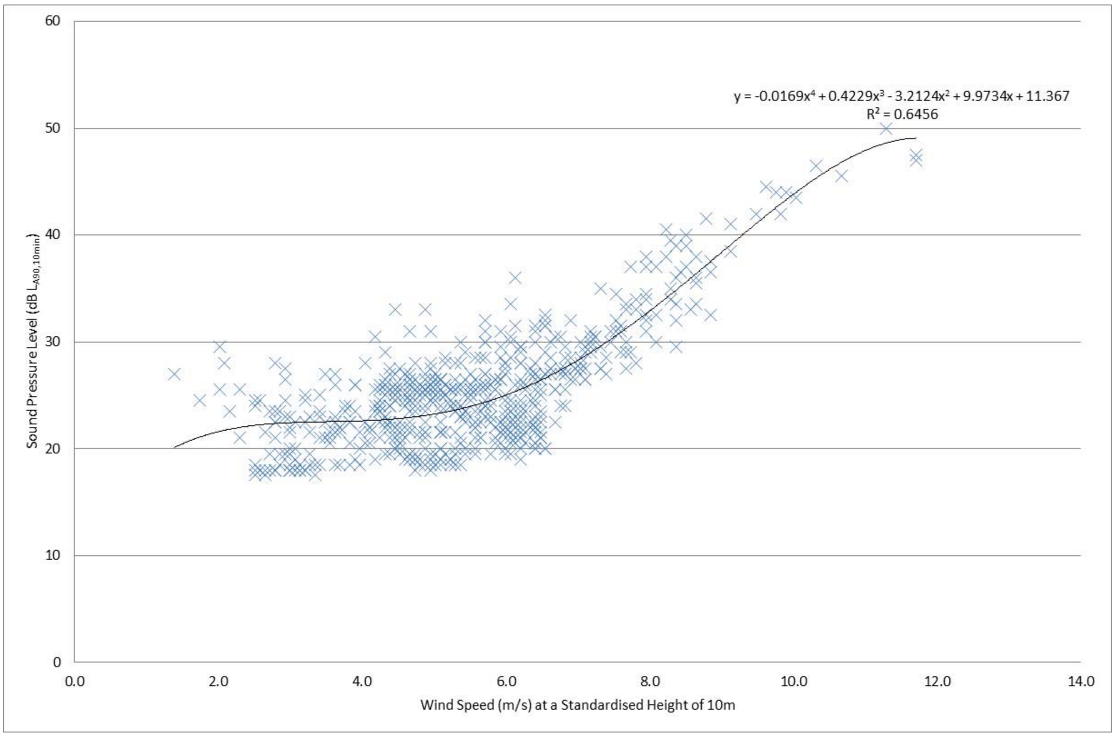


Figure 10.8 Night Regression Analysis – Location B

10.4.6.3 Location C (H127)

10.4.6.3.1 Daytime Period

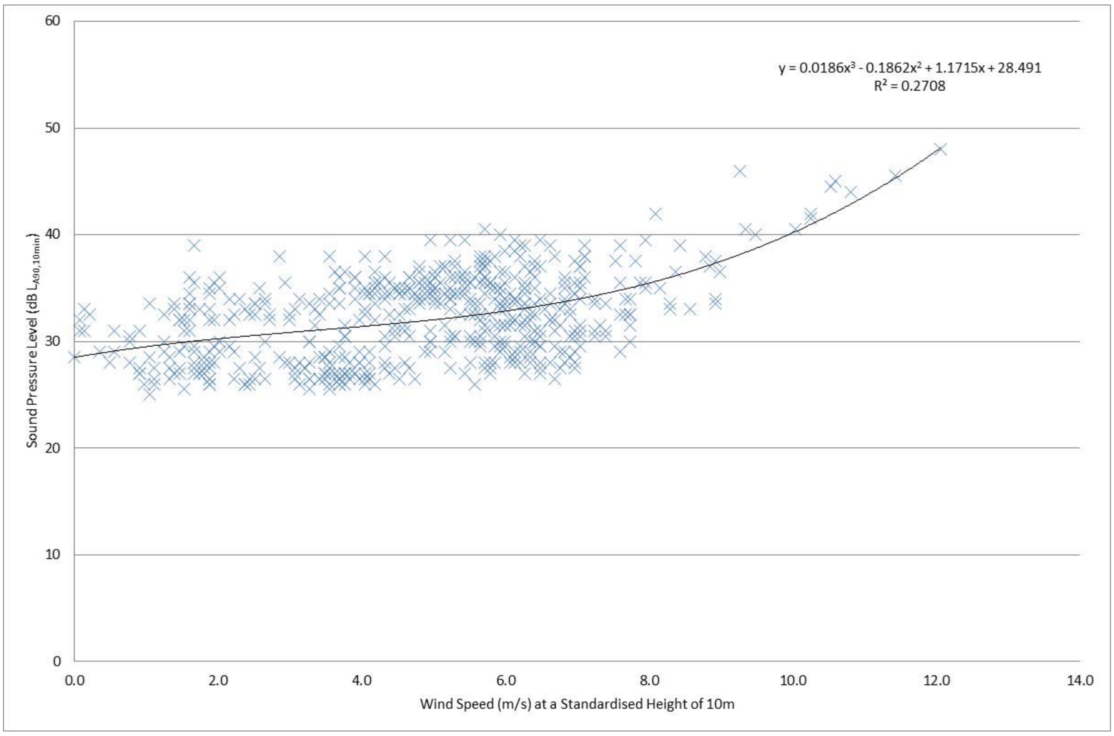


Figure 10.9 Daytime Regression Analysis – Location C

10.4.6.3.2 Night Period

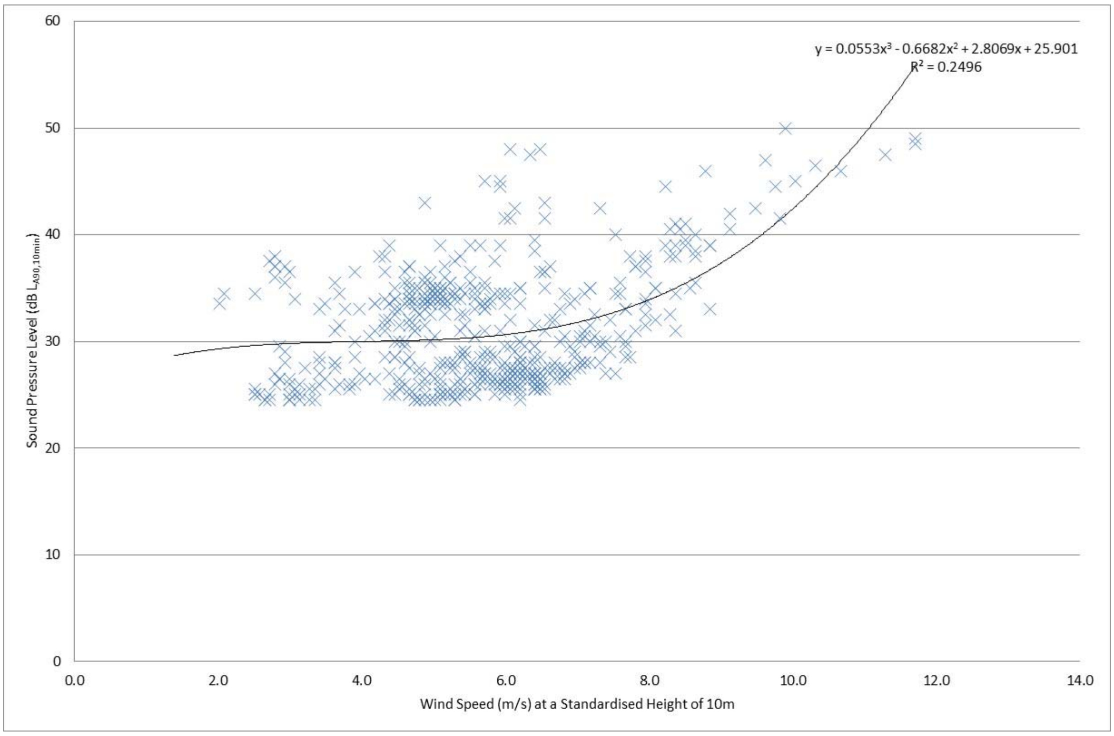


Figure 10.10 Night Regression Analysis – Location C

10.4.6.4 Location D (H153)

10.4.6.4.1 Daytime Period

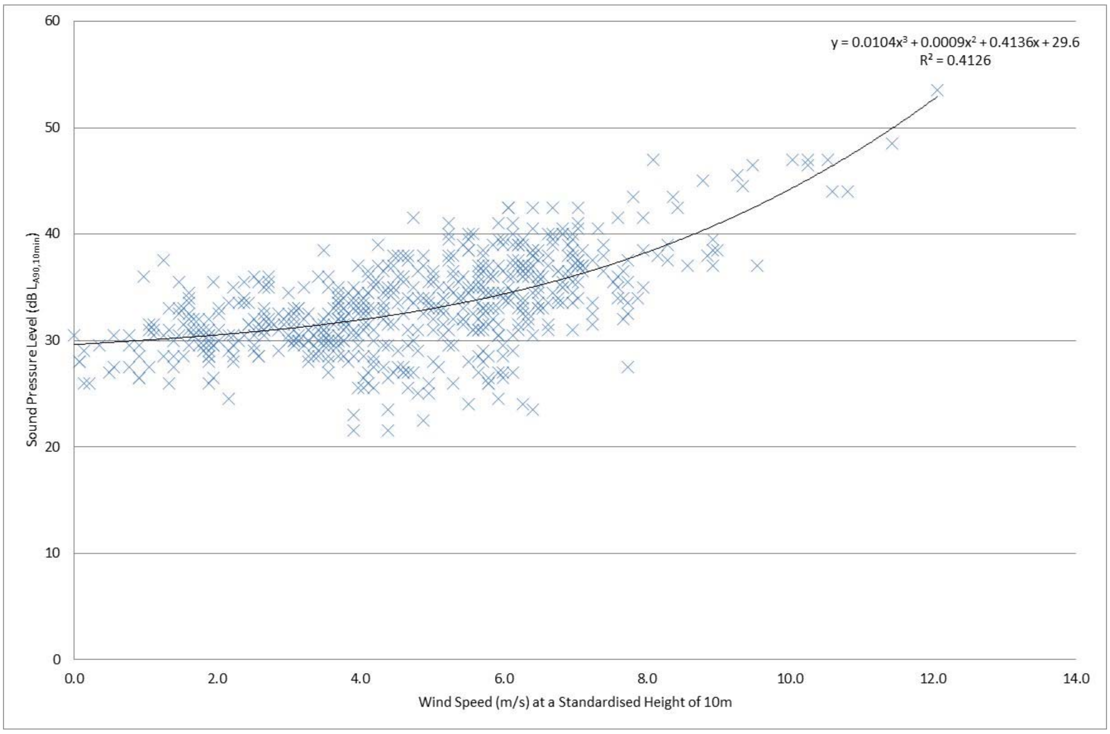


Figure 10.11 Daytime Regression Analysis – Location D

10.4.6.4.2 Night Period

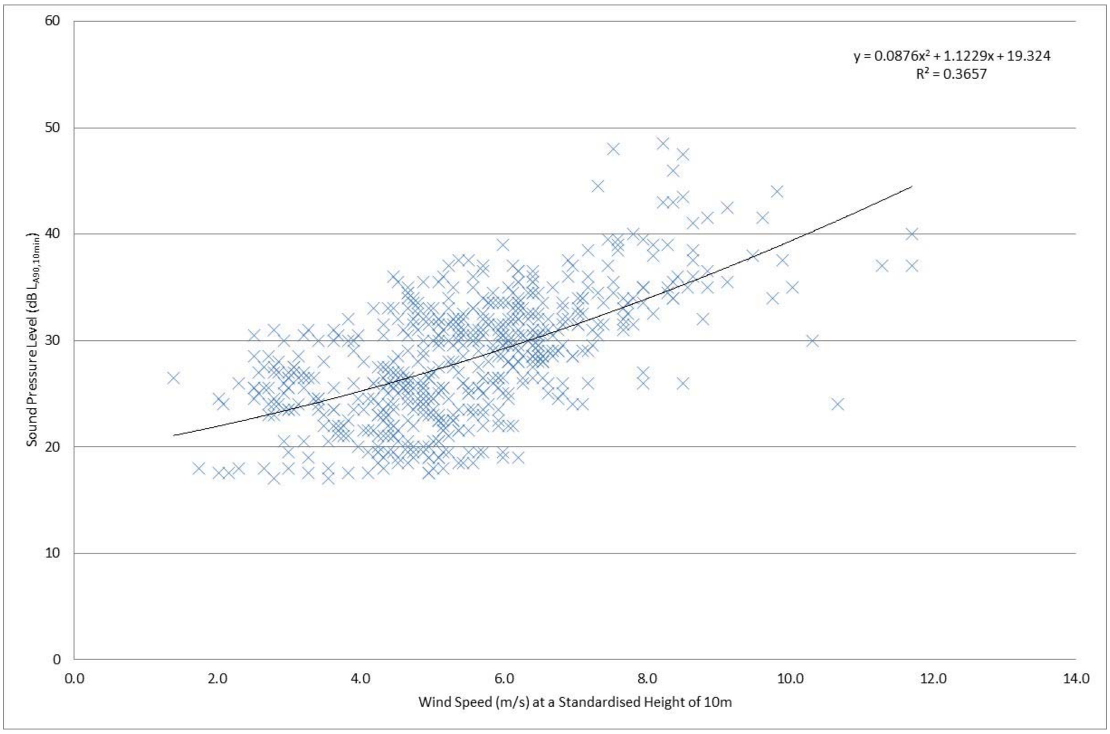


Figure 10.12 Night Regression Analysis – Location D

10.4.6.5 Location E (H276)

10.4.6.5.1 Daytime Period

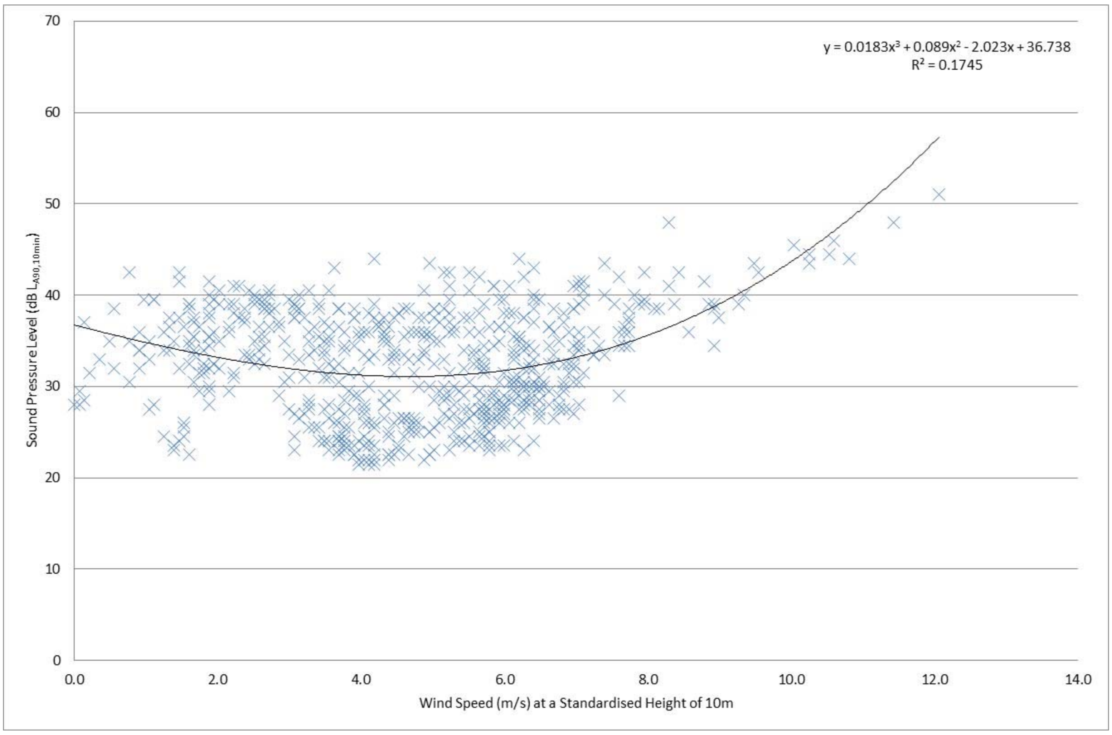


Figure 10.13 Daytime Regression Analysis – Location E

10.4.6.5.2 Night Period

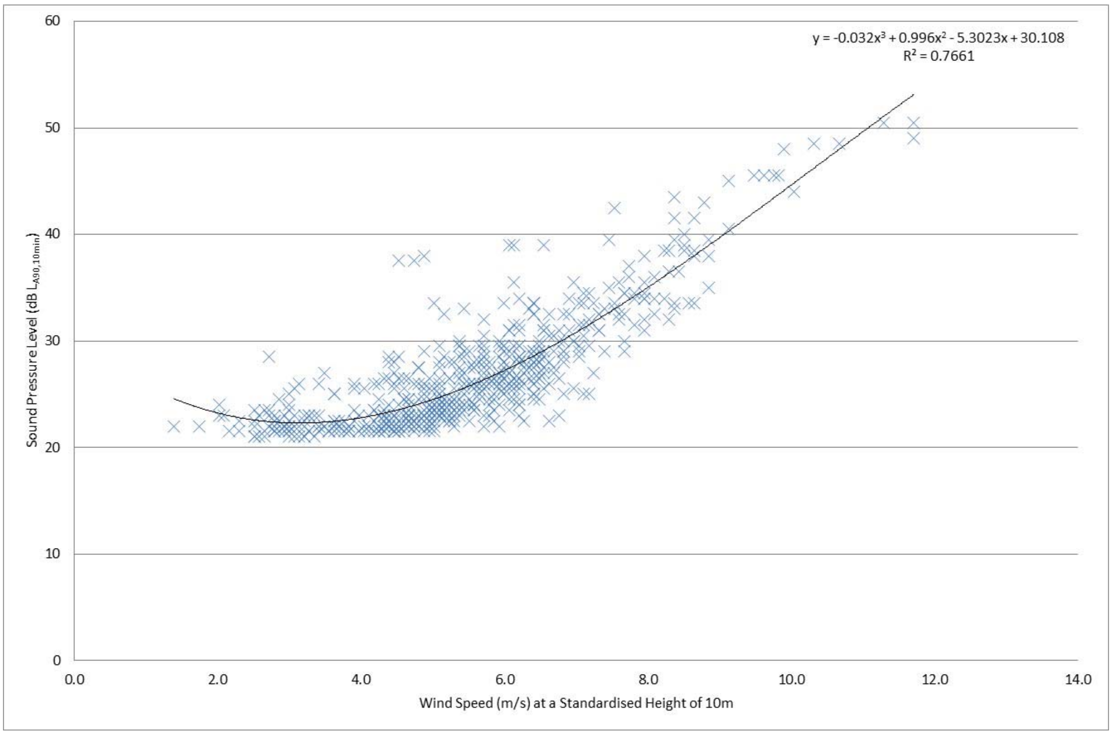


Figure 10.14 Night Regression Analysis – Location E

10.4.6.6 Summary

Table 10.6 presents the various derived $L_{A90,10min}$ noise levels for the monitoring locations for day and night time periods. These levels have been derived using regression analysis carried out on the data sets in line with best practice guidance.

Table 10.6 Derived Levels of $L_{A90,\ 10\ min}$ for Various Wind Speeds

Location	Period	Derived $L_{A90,\ 10\ min}$ Levels (dB) at various Standaridsed10m Height Above Ground Wind Speed (m/s)								
		4	5	6	7	8	9	10	11	≥12
A (H31)	Day	29.6	30.9	32.7	35.2	38.4	42.3	46.9	52.3	55.0
	Night	20.9	23.5	26.7	30.6	35.2	40.4	46.3	46.5	46.5
B (H74)	Day	29.5	30.0	30.7	31.9	33.8	36.6	40.6	46.0	46.0
	Night	22.6	23.2	25.0	28.3	32.9	38.3	43.8	47.8	48.8
C (H127)	Day	31.4	32.0	32.8	33.9	35.5	37.5	40.2	43.6	47.9
	Night	30.0	30.1	30.6	31.8	33.9	37.4	42.5	49.5	50.0
D (H153)	Day	31.9	33.0	34.4	36.1	38.3	41.0	44.2	48.1	48.1
	Night	25.2	27.1	29.2	31.5	33.9	36.5	39.3	42.3	45.4
E (H276)	Day	31.1	31.1	31.8	33.2	35.6	39.1	43.7	49.6	49.6
	Night	22.8	24.5	27.2	30.8	35.0	39.7	44.7	49.7	49.7
Envelope	Day	29.5	30.0	30.7	31.9	33.8	36.6	40.2	43.6	46.0
	Night	20.9	23.2	25.0	28.3	32.9	36.5	39.3	42.3	45.4

A worst case envelope based on the lowest average levels at the various wind speeds has been presented in Table 10.6. Therefore, the noise criteria curves for this assessment will be based on this baseline noise levels envelope. This is considered a worst case approach to this aspect of the assessment.

10.5 Likely Significant Effects and Mitigation Measures

10.5.1 Construction Phase Potential Effects

10.5.1.1 General Construction Noise

A variety of items of plant will be in use for the purposes of site preparation, construction and site works. There will be vehicular movements to and from the site that will make use of existing roads. Due to the nature of these activities, there is potential for generation of significant levels of noise.

Due to the fact that the construction programme has been established in outline form only, it is difficult to calculate the actual magnitude of noise emissions to the local environment. However, it is possible to predict typical noise levels using guidance set out in British Standard *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*. In this instance, the noise-sensitive locations surround the site at varying distances with the nearest property to any turbine being the order of 750m (i.e. Location H75 from proposed turbine T20). A number of indicative sources that would be expected on a site of this nature have been identified and noise predictions of their potential effects prepared to the closest houses. The assessment is considered to be representative of worst case and construction noise levels will be slightly lower at properites located futher than 750m from the works.

Table 10.7 outlines the noise levels associated with typical construction noise sources assessed in this instance along with typical sound pressure levels and spectra from BS 5228 – 1: 2009.

The predicted noise levels from construction activities are in the range of 27 to 45dB $L_{Aeq,1hr}$ at these locations with a cumulative level of the order of 48dB $L_{Aeq,1hr}$.

In all instances the predicted noise levels are below the appropriate Category A value (i.e. 65dB $L_{Aeq,1hr}$) and therefore a significant effect is not predicted in relation to the nearest noise sensitive locations in terms of construction noise.

Note that the predicted noise levels referred to in this section are indicative only and are intended to demonstrate that it will be possible for the contractor to comply with current best practice guidance. It should also be noted that the predicted "worst case" levels are expected to occur for only short periods of time at a very limited number of properties. Construction noise levels will be lower than these levels for the majority of the time at the majority of properties in the vicinity of the proposed development.

There are no items of plant that would be expected to give rise to noise levels that would be considered out of the ordinary or in exceedance of the levels outlined in Table 10.1.

Table 10.7 Typical Wind Farm Turbine Construction Noise Emission Levels

Item (BS 5228 Ref.)	Activity/Notes	Plant Noise Level at 10m Distance (dB $L_{Aeq,T}$) [3]	Predicted Noise Level at 700m (dB $L_{Aeq,1hr}$)
HGV Movement (C.2.30)	Removing spoil and transporting fill and other materials.	79	36
Tracked Excavator (C.4.64)	Removing soil and rubble in preparation for foundation.	77	34
Piling Operations (C.12.14)	Standard pile driving.	88	45
General Construction (Various)	All general activities plus deliveries of materials and plant.	70 – 84	27 – 41
Dewatering Pumps (D.7.70)	If required.	80	37
JCB (D.8.13)	For services, drainage and landscaping.	82	39
Vibrating Rollers (D.8.29)	Road surfacing.	77	34
TOTAL		--	48

3 All plant noise levels are derived from BS 5228: Part 1

Due to the distance of the proposed works from sensitive locations significant vibration effects are not expected.

In terms of these construction activities the assocatied effect is:

Quaility	*Significance*	*Duration*
Neutral	Impercptible	Short Term

10.5.1.2 Borrow Pit

There is a former gravel pit located in the north central section of the site, as shown on Figure 10.15. This pit was used historically by Bord na Mòna mainly for the construction and upgrading of railways and other infrastructure within the site and wider bog complex. The gravel pit was used over many years but most intensely between 1995 and 2000. The gravel pit is not in use and the rehabilitation of the borrow pit site has been completed however there remains a gravel resource at this location and it is intended to use this resource as part of the wind farm development.

The extraction of rock from the borrow pit will occur during the construction stage. This extraction is a work stage of the proposed project which will be a temporary operation run over a short period of time relative to the duration of the entire project. As outlined in the AGEC *Borrow Pit Assessment Report* 2015 (see Appendix 7-1 of this EIS), there is a layer of overburden present at the borrow pit location which will be stripped back and stockpiled using standard track mounted excavators. The extraction method for the useful rock below will be relatively simple as the rock resource is a weathered sand and gravel conforming to use for construction of roads and other infrastructure and therefore excavator's will be used to excavate the gravels and stockpile them within the borrow pit area pending loading onto trucks for use around the site.

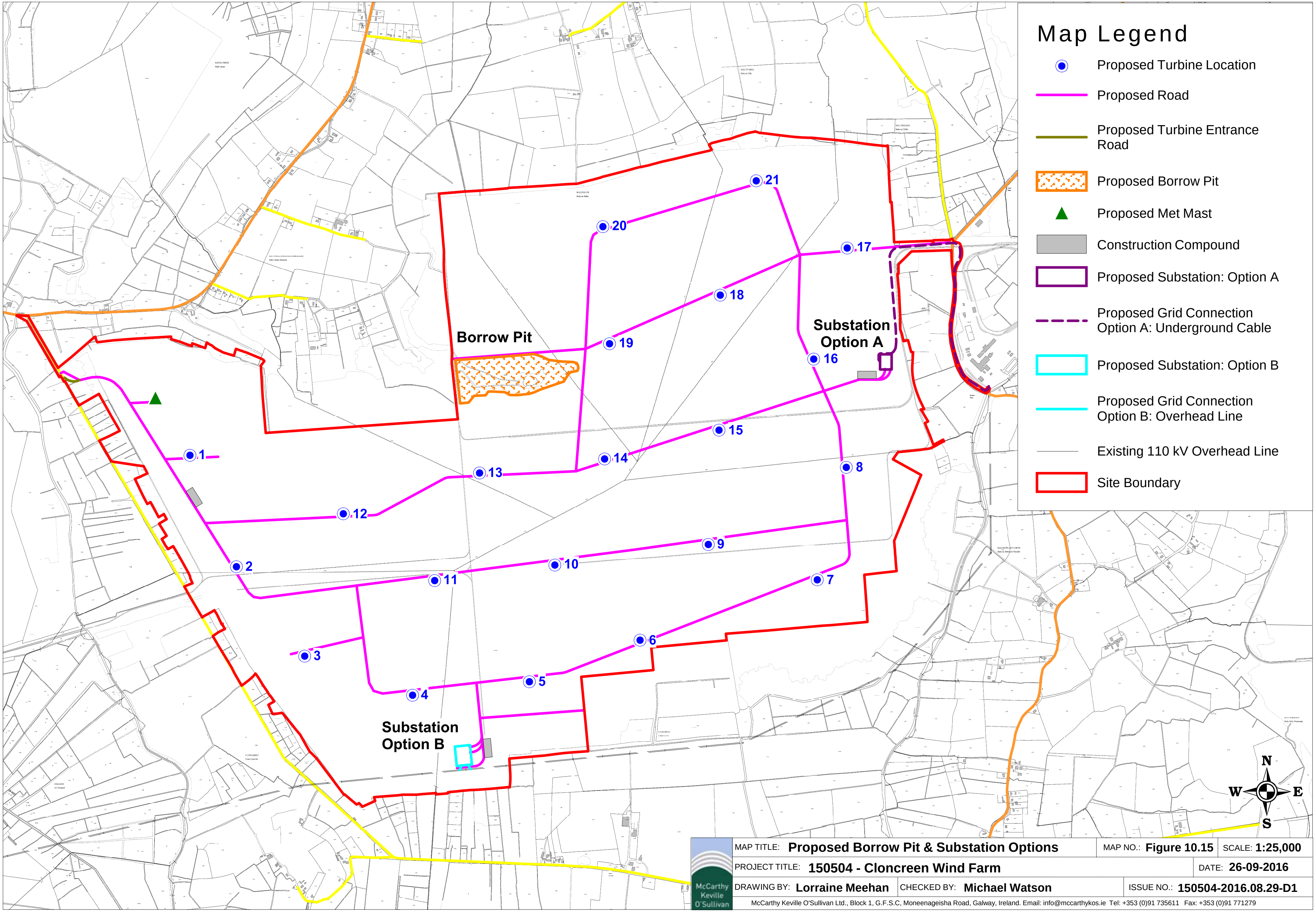
A construction noise model has been prepared to consider the expected noise emissions from the proposed construction works associated with the borrow pit. The predicted levels are detailed in Table 10.8 at the closest noise sensitive locations identified within the study area. A full listing of predictions to all locations in the study area is presented in Appendix 10-3. One potential borrow pit is proposed for the site and has been assessed in order to demonstrate the likely noise effects associated with this aspect of the development.

Review of the data contained in Table 10.8 confirms the following:

- Predicted construction noise levels for the both borrow pit is well within the best practice construction noise criteria outlined in Table 10.1. It is assumed that construction works at the borrow pit will only occur during daytime periods only (07:00 to 19:00hrs).

Table 10.8 Comparison of Predicted Construction Noise Levels – Borrow Pit

Location	Borrow Pit Predicted Construction Noise Level dB $L_{Aeq,1hr}$
H031	35
H032	34
H030	34
H029	34
H359	33



Map Legend
Proposed Turbine Location
Proposed Road
Proposed Turbine Entrance Road
Proposed Borrow Pit
Proposed Met Mast
Construction Compound
Proposed Substation: Option A
Proposed Grid Connection Option A: Underground Cable
Proposed Substation: Option B
Proposed Grid Connection Option B: Overhead Line
Existing 110 kV Overhead Line
Site Boundary
Borrow Pit
Substation Option A
Substation Option B
1
2
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4
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McCarthy Keville O'Sullivan
MAP TITLE: Proposed Borrow Pit & Substation Options
MAP NO.: Figure 10.15
SCALE: 1:25,000
PROJECT TITLE: 150504 - Cloncreen Wind Farm
DATE: 26-09-2016
DRAWING BY: Lorraine Meehan
CHECKED BY: Michael Watson
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Location	Borrow Pit Predicted Construction Noise Level dB $L_{Aeq,1hr}$
H031	35
H027	33
H028	33
H026	32
H025	32
H033	31
H024	31
H034	30
H023	30
H022	30

The noise levels associated with borrow pit operations are some30dB lower than the 65dB $L_{Aeq,1hr}$ significant effect criterion adopted in this instance. In terms of these construction activities the assocatied effect is:

Quaility	*Significance*	*Duration*
Neutral	Slight	Short Term

10.5.1.3 Grid Connection/Substation

The planning application for the proposed wind farm development includes connection to the electricity grid. It is intended that the proposed wind farm will be connected to the National Grid via one of the following routes:

- **Option A**: construction of a 110 kV substation in the eastern section of site, to connect to existing 110 kV Cushaling substation at Edenderry Power Plant. Connection will be via underground cable approx 1.7km in length, located within Bord na Móna lands and curtilage of the public road.

Or

- **Option B**: construction of a 110 kV substation in southern section of site, to connect to existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site. Connection will be via two short sections of overhead line, (less than 0.1km)

Both substations and grid connection methods have been assessed individually as part of this EIS.

The underground cable required to facilitate grid connection will be laid beneath the surface of site and/or public roads using the following methodology:

- The area where excavations are planned will be surveyed, prior to the commencement of works, with a cable avoiding tool and all existing underground services will be identified.
- Two teams consisting of two tracked excavators, two dumpers and a tractor and stone cart with side-shoot will dig the trench for and lay approximately 300m of the underground cable ducting per day.
- Both teams will start approximately 150m apart with the team behind finishing at the starting point of the team ahead.

- The excavators will open a trench at the edge of the road surface, the trench will be a maximum of 600mm wide and 1,250mm.
- Clay plugs will be installed at 50m intervals to prevent the trench becoming a conduit for surface water runoff.
- Cable joint pits will be located at approximately 500m intervals, each joint pit will be approximately 2.6x8m in size and contain a communications chamber, an earth link box and a cable joint bay, all of which will be located in the road edge and accessible for cable pulling and future maintenance.
- The excavated material will be loaded into the dumpers to be transported to a designated temporary stockpiling area to be reused as backfilling material where appropriate.
- Once the trench has been excavated, a base layer of blinding will be installed by the tractor and cart and compacted by the excavators.
- The ducting along with marker strips will then be placed in the trench as per relevant specifications.
- Blinding will be installed to 75mm above the cable ducting and compacted.
- The remainder of the trench will be backfilled with granular material and compacted.
- The trench will be surfaced as per the road surface specifications of the national or local public road.

The methodology for construction of the short section of overhead line will encompass the following:

- The existing 110kV overhead line will be modified to allow the line to turn into the new 110kV substation, this will involve the removal of one number double pole set and the installation of two number turning angle masts and two number end masts within the substation area.
- Temporary access roads will be required from the substation road to the angle mast location to enable the delivery of stone and concrete required for the angle mast foundations.
- An outage of the existing Cushaling to Mountlucas overhead line will be sought and programed by Eirgrid's on the annual grid outage programme.
- Dead man stays will be installed to support the existing poleset's prior to the breaking overhead line at the location of the new anglemasts.
- The angle and end mast foundations will then be sheet piled, excavated, blinded, stoned up, prior to concrete shuttering and pouring of base and each angle mast leg.
- After completion of concrete pouring the ground surrounding the mast will be reinstated.
- After a sufficient concrete curing period the angle and end masts will be fully assembled on the ground before being lifted into place using a mobile crane.
- Crews will fix and bolt the masts in place and attach the lightning rod.
- The installation of 3no conductors and 2 no shield wires will then tie the existing overhead line into the new station at two points or bays.
- Bird diverters may also be installed on the new conductor as required.
- It is also common for a fiber optic cable which may wrapped around one of the conductors to be terminated into the new substation.

Construction activities will be carried out during normal daytime working hours.

Construction noise predictions have been carried out using guidance set out in British Standard *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*.

In terms of the proposed substation the works are remote from the nearest residential noise sensitive locations.

Table 10.9 outlines the noise levels associated with typical construction noise sources assessed in this instance along with typical sound pressure levels and spectra from *BS 5228 – 1: 2009+A1:2014* at various distances from these works.

Table 10.9 Indicative Noise Levels from Construction Plant at Various Distances from the Grid Connection Works

Item (BS 5228 Ref.)	Highest Predicted Noise Level at Stated Distance from Edge of Works (dB $L_{Aeq,1hr}$)			
	20m	40m	60m	100m
Pneumatic breaker (C.8.12)	66	60	56	52
Wheeled loader (C.3.51)*	62	56	52	48
Tracked excavator (C.3.43)*	63	57	53	49
Dozer (C.3.30)*	64	58	54	50
Dump truck (C.3.60)*	60	54	50	46
Asphalt Spread (C.8.24)	70	64	60	56
Compressor (C.7.27)	61	55	51	47
Road Roller (C.3.114)	65	59	55	51
HGV Movements (10 per hour)	53	50	49	46

*Note ** Assume noise control measures as outlined in Table B1 of BS 5228 – 1 (i.e. fit acoustic exhaust).

The noise levels presented are within the limit values shown in Table 10.9, for daytime periods on weekdays, at distances of 20m or greater from the works. Where a noise sensitive location is within 20m of works detailed consideration to potential construction noise effects will be required and appropriate mitigation measures implemented in order to manage associated effects. Typical mitigation measures that can be considered are outlined in the mitigation section of this document with further guidance contained within the BS 5228 standards.

At distances greater than 20m from the works the total predicted noise levels are predicted to be of the order of or below the 65dB $L_{Aeq,1hr}$ construction noise criterion adopted here and therefore a significant effect is not predicted in relation to the nearest noise sensitive locations in terms of this aspect of potential construction noise. It is understood that the proposed cable route is at distances greater than 20m from existing nosie sensitive locations.

In terms of these construction activities the assocatied effect is:

Quaility	*Significance*	*Duration*
Neutral	Slight	Short Term

10.5.2 Operational Phase Potential Effects

10.5.2.1 Noise Model

A series of computer-based prediction models have been prepared in order to quantify the cumulative noise level associated with the operational phase of the proposed development and the operating Mounlucas development. This section discusses the methodology behind the noise modelling process and presents the results of the modelling exercise.

10.5.2.2 Brüel & Kjær Type 7810 Predictor

Proprietary noise calculation software was used for the purposes of this impact assessment. The selected software, Brüel & Kjær Type 7810 *Predictor*, calculates noise levels in accordance with *ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation, 1996*.

Brüel & Kjær Type 7810 *Predictor* is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. *Predictor* calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

10.5.2.3 Input Data and Assumptions

Contour and shape file information available for the site has been inputted into our Brüel & Kjaer Type 7810 Predictor noise modelling software using the *ISO 9613-2:1996 Acoustics – Attenuation of sound during propagation outdoors: General method of calculation*.

The proposal in question considers the construction of twenty-one turbine units on the site as detailed in Section 3 of this EIS.

10.5.2.3.1 Proposed Turbine Details

Table 10.10 details the co-ordinates of the turbines that are being considered as part of this assessment.

Table 10.10 Turbine Co-ordinates

Ref.	Co-ordinates		Ref.	Co-ordinates	
	Easting	Northing		Easting	Northing
T01	256,800	226,488	T12	257,619	226,175
T02	257,048	225,892	T13	258,347	226,393
T03	257,413	225,414	T14	259,015	226,468
T04	257,989	225,205	T15	259,626	226,622
T05	258,613	225,277	T16	260,132	227,002
T06	259,204	225,499	T17	260,311	227,596
T07	260,151	225,822	T18	259,633	227,344
T08	260,306	226,423	T19	259,041	227,084
T09	259,569	226,011	T20	259,006	227,710
T10	258,749	225,901	T21	259,825	227,955
T11	258,107	225,818	--		

The following sections detail the noise spectra for the various turbine units under consideration that have been used for modeling purposes.

For the purposes of this assessment, the turbine type adopted for the development site is the Vestas V126 3.3MW[4]. The turbine is a pitch regulated upwind turbine with a three-blade rotor. For the purposes of this assessment predictions have assumed the source of noise at a tip height of 170m. Each wind turbine is secured to a circular-shaped reinforced concrete foundation.

While the noise profiles of the Vestas V126 wind turbine have been used for the purposes of this assessment, the actual turbine to be installed on the site will be the subject of a competitive tender process and could include turbines not amongst the turbine models currently available. Regardless of the make or model of the turbine eventually selected for installation on site, the noise it will give rise to will be of no greater significance than that used for the purposes of this assessment, to ensure the findings of this assessment remain valid. Any references to the Vestas turbines in this assessment must be considered in the context of the above, and should not be construed as meaning it is the only make or model of wind turbine that could be used on the site.

Table 10.11 and 10.12 details the noise spectra used for noise modelling purposes for the Cloncreen and Mountlucas developments respectively. As outlined, appropriate guidance is couched in terms of a $L_{A90,10mim}$ criterion. The provided turbine noise, in terms of L_{Aeq}, has been adjusted by subtracting 2dB to give a representative L_{A90} as outlined in best practice guidance:

> *"The Noise Working Group is agreed that the $L_{A90(10\ minutes)}$ descriptor should be used for both the background noise and the wind farm noise and that when setting limits it should be borne in mind that the $L_{A90(10\ minutes)}$ from the wind farm is likely to be 1.5 – 2.5dB(A) less than the L_{Aeq} measured over the same period."*

4 Vestas Technical Report – DMS 0048-2151_V01 V126-3.3MW-Mk2A-50/60 Hz Third Octaves according to General Specification. Data has been corrected from hub height to a standardised 10m above ground wind speed with an assumed hub height of 100m. This manufacturer's data has been used, including details of noise spectra. The detailed noise spectra are not presented here due for commercial reasons and associated non-disclosure agreements with the manufacturer.

Table 10.11 L_{wA} Levels Used for Prediction Model – Vestas V126 3.3MW

Wind Speed (m/s)	dB L_{wA}
4	93.5
5	98
6	103.1
7	104.9
8	105.3
9	105.7
≥10	105.9

Table 10.12 L_{wA} Levels Used for Prediction Model – Siemens S101 3MW (Mountlucas)[5]

Wind Speed (m/s)	dB L_{wA}
4	99
5	103.9
6	105.8
≥7	107

Best practice also specifies that a penalty should be added to the predicted noise levels, where any tonal component is present. The level of this penalty is described and is related to the level by which any tonal components exceed audibility. For the purposes of this assessment a tonal penalty has not been included within the predicted noise levels. A warranty will be sought from the manufacturers of the turbine for the Cloncreen site to ensure that the noise output will not require a tonal noise correction under best practice guidance.

For the purposes of all predictions presented in this report to account for various uncertainties in the measurement of turbine source levels, a factor of 2dB has been added to the manufacturer's values in line with best practice wind turbine noise assessment.

10.5.2.4 Modelling Calculation Parameters[6]

Prediction calculations for turbine noise have been conducted in accordance with *ISO 9613: Acoustics – Attenuation of sound outdoors, Part 2: General method of calculation, 1996*.

In terms of calculation a ground attenuation factor (general method) of 0.5 and no metrological correction were assumed for all calculations. The atmospheric attenuation outlined in Table 10.13 was assumed for all calculations.

Table 10.13 Atmospheric Attenuation Assumed for Noise Calculations (dB per km)

Temp (°C)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4

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5 Siemens Technical Report – Standard Acoustic Emission, SWT-3.0-101 (107 dB), Hub Height 99.5 m Document ID: E W EN OEN DES TLS-10-0000-0300-00 HST, KOE / 2012.03.28. This manufacturer's data has been used, including details of noise spectra. The detailed noise spectra are not presented here due for commercial reasons and associated non-disclosure agreements with the manufacturer.

6 See Appendix 10-4 for further discussion of calculation parameters.

10.5.2.5 Additional Information

Building locations have been taken from information supplied by McCarthy Keville O'Sullivan. Appendix 10-5 details the locations assessed as identified in a house survey conducted of all properties in proximity of the application site boundary. Noise predictions were prepared in respect of the various turbine wind speeds at these locations.

Ground topography, geographical features have been taken from survey information supplied by McCarthy Keville O'Sullivan and Ordnance Survey maps.

10.5.2.6 Assessment of Operational Phase

As stated previously guidance in relation to acceptable levels of noise from wind farms is contained in the documents Department of the Environment, Heritage and Local Government "*Planning Guidelines on Wind Energy*" and Department of Trade & Industry (UK) Energy Technology Support Unit (ETSU) publication "*The Assessment and Rating of Noise from Wind Farms*" (1996) and considering planning conditions applied by the local authority and An Bord Pleanála in relation to other sites in the study area.

The lower daytime threshold level of 40dB(A) or a maximum increase of 5dB(A) above background level has been chosen. This has been chosen as it is in line with the intent of the relevant Irish guidance and is comparable to noise planning conditions applied to similar sites in the area previously granted planning permission by the local authority and An Bord Pleanála.

Based on the statistical analysis of wind speed data and baseline noise level information day and night time noise criteria curves have been developed and are presented in the relevant sections. The daytime curves are based on a lower fixed level of 40dB $L_{A90,10min}$. A night time criterion of 43dB $L_{A90,10min}$ has been adopted as per best practice Irish guidance.

Table 10.14 outlines the derived noise criteria curves based on the information contained within Table 10.6. Note the curves are based on the baseline noise levels which represent the lowest baseline noise levels measured as part of the noise monitoring programme.

Table 10.14 Noise Criteria Curves

Period	Derived $L_{A90, 10 min}$ Levels (dB) at various 10m Height Wind Speed (m/s)								
	4	5	6	7	8	9	10	11	≥12
Day	40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0

The cumulative noise levels for the proposed site area have been calculated. In the first instance a worst case assessment has been completed assuming all noise locations are downwind of all turbines at the same time. The predicted levels have been compared against the adopted noise criteria curves as detailed in Table 10.14. Table 10.15 presents the details of the exercise at all locations considered as part of this assessment.

Table 10.15 Review of Excesses of Day & Night Criteria Curves

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
H001	--	27.7	32.0	36.3	38.4	38.4	38.6	38.7	38.7	38.7
	Excess	--	--	--	--	--	--	--	--	--
H002	--	25.6	30.0	33.6	35.6	35.6	35.7	35.8	35.8	35.8
	Excess	--	--	--	--	--	--	--	--	--
H003	--	25.4	29.8	33.4	35.3	35.3	35.4	35.5	35.5	35.5
	Excess	--	--	--	--	--	--	--	--	--
H004	--	25.3	29.7	33.2	35.2	35.2	35.3	35.3	35.3	35.3
	Excess	--	--	--	--	--	--	--	--	--
H005	--	25.2	29.7	33.1	35.1	35.1	35.2	35.2	35.2	35.2
	Excess	--	--	--	--	--	--	--	--	--
H006	--	26.8	31.1	35.4	37.5	37.5	37.7	37.8	37.8	37.8
	Excess	--	--	--	--	--	--	--	--	--
H007	--	24.7	29.2	32.4	34.2	34.2	34.3	34.3	34.3	34.3
	Excess	--	--	--	--	--	--	--	--	--
H008	--	24.6	29.1	32.1	33.9	33.9	34.0	34.0	34.0	34.0
	Excess	--	--	--	--	--	--	--	--	--
H009	--	25.3	29.9	32.7	34.4	34.4	34.4	34.5	34.5	34.5
	Excess	--	--	--	--	--	--	--	--	--
H010	--	25.3	29.8	32.7	34.4	34.4	34.4	34.4	34.4	34.4
	Excess	--	--	--	--	--	--	--	--	--
H011	--	26.4	31.1	33.4	34.9	34.9	34.9	34.9	34.9	34.9
	Excess	--	--	--	--	--	--	--	--	--
H012	--	26.3	31.0	33.3	34.8	34.8	34.8	34.8	34.8	34.8
	Excess	--	--	--	--	--	--	--	--	--
H013	--	27.0	31.8	34.0	35.4	35.4	35.4	35.4	35.4	35.4
	Excess	--	--	--	--	--	--	--	--	--
H014	--	26.8	31.6	33.8	35.2	35.2	35.2	35.2	35.2	35.2
	Excess	--	--	--	--	--	--	--	--	--
H015	--	27.2	32.0	34.1	35.5	35.5	35.5	35.5	35.5	35.5
	Excess	--	--	--	--	--	--	--	--	--
H016	--	26.9	31.7	33.9	35.3	35.3	35.3	35.3	35.3	35.3
	Excess	--	--	--	--	--	--	--	--	--
H017	--	27.2	32.0	34.1	35.5	35.5	35.5	35.5	35.5	35.5
	Excess	--	--	--	--	--	--	--	--	--
H018	--	27.9	32.1	36.7	38.9	38.9	39.1	39.2	39.2	39.2
	Excess	--	--	--	--	--	--	--	--	--
H019	--	28.2	32.4	37.0	39.2	39.2	39.4	39.5	39.5	39.5
	Excess	--	--	--	--	--	--	--	--	--
H020	--	27.4	31.6	36.2	38.3	38.3	38.5	38.6	38.6	38.6
	Excess	--	--	--	--	--	--	--	--	--
H021	--	27.5	31.7	36.3	38.4	38.4	38.6	38.7	38.7	38.7
	Excess	--	--	--	--	--	--	--	--	--
H022	--	27.6	31.8	36.4	38.5	38.5	38.8	38.8	38.8	38.8
	Excess	--	--	--	--	--	--	--	--	--
H023	--	27.7	31.9	36.5	38.7	38.7	38.9	39.0	39.0	39.0
	Excess	--	--	--	--	--	--	--	--	--
H024	--	27.9	32.1	36.7	38.9	38.9	39.1	39.2	39.2	39.2
	Excess	--	--	--	--	--	--	--	--	--

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
H025	--	28.2	32.3	37.0	39.2	39.2	39.4	39.5	39.5	39.5
	Excess	--	--	--	--	--	--	--	--	--
H026	--	28.3	32.5	37.2	39.4	39.4	39.6	39.7	39.7	39.7
	Excess	--	--	--	--	--	--	--	--	--
H027	--	28.4	32.6	37.3	39.5	39.5	39.7	39.8	39.8	39.8
	Excess	--	--	--	--	--	--	--	--	--
H028	--	28.1	32.3	37.0	39.2	39.2	39.4	39.5	39.5	39.5
	Excess	--	--	--	--	--	--	--	--	--
H029	--	28.9	33.1	37.8	40.0	40.0	40.3	40.3	40.3	40.3
	Excess	--	--	--	--	--	--	--	--	--
H030	--	28.9	33.1	37.9	40.0	40.0	40.3	40.3	40.3	40.3
	Excess	--	--	--	--	--	--	--	--	--
H031	--	29.5	33.7	38.5	40.7	40.7	40.9	41.0	41.0	41.0
	Excess	--	--	--	--	--	--	--	--	--
H032	Farmyard	29.6	33.8	38.6	40.8	40.8	41.1	41.1	41.1	41.1
	Excess	--	--	--	--	--	--	--	--	--
H033	--	27.3	31.4	36.1	38.3	38.3	38.5	38.5	38.5	38.5
	Excess	--	--	--	--	--	--	--	--	--
H034	--	26.6	30.8	35.3	37.5	37.5	37.7	37.8	37.8	37.8
	Excess	--	--	--	--	--	--	--	--	--
H035	--	26.4	30.5	35.0	37.2	37.2	37.4	37.4	37.4	37.4
	Excess	--	--	--	--	--	--	--	--	--
H036	--	26.3	30.4	34.9	37.1	37.1	37.3	37.4	37.4	37.4
	Excess	--	--	--	--	--	--	--	--	--
H037	--	25.9	30.1	34.5	36.7	36.7	36.9	36.9	36.9	36.9
	Excess	--	--	--	--	--	--	--	--	--
H038	--	25.8	30.0	34.4	36.6	36.6	36.7	36.8	36.8	36.8
	Excess	--	--	--	--	--	--	--	--	--
H039	--	25.7	29.9	34.3	36.5	36.5	36.6	36.7	36.7	36.7
	Excess	--	--	--	--	--	--	--	--	--
H040	--	25.8	30.0	34.4	36.5	36.5	36.7	36.8	36.8	36.8
	Excess	--	--	--	--	--	--	--	--	--
H041	--	25.9	30.0	34.5	36.6	36.6	36.8	36.8	36.8	36.8
	Excess	--	--	--	--	--	--	--	--	--
H042	--	26.0	30.1	34.6	36.7	36.7	36.9	37.0	37.0	37.0
	Excess	--	--	--	--	--	--	--	--	--
H043	--	25.4	29.5	33.9	36.1	36.1	36.3	36.3	36.3	36.3
	Excess	--	--	--	--	--	--	--	--	--
H044	--	25.4	29.5	34.0	36.1	36.1	36.3	36.4	36.4	36.4
	Excess	--	--	--	--	--	--	--	--	--
H045	--	25.3	29.4	33.8	36.0	36.0	36.1	36.2	36.2	36.2
	Excess	--	--	--	--	--	--	--	--	--
H046	--	25.1	29.2	33.6	35.8	35.8	35.9	36.0	36.0	36.0
	Excess	--	--	--	--	--	--	--	--	--
H047	--	25.0	29.1	33.5	35.7	35.7	35.8	35.9	35.9	35.9
	Excess	--	--	--	--	--	--	--	--	--
H048	--	25.1	29.2	33.7	35.9	35.9	36.0	36.1	36.1	36.1
	Excess	--	--	--	--	--	--	--	--	--
H049	--	25.1	29.2	33.6	35.8	35.8	36.0	36.0	36.0	36.0

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Excess	--	--	--	--	--	--	--	--	--
H050	--	24.8	28.8	33.3	35.5	35.5	35.6	35.7	35.7	35.7
	Excess	--	--	--	--	--	--	--	--	--
H051	--	24.7	28.8	33.2	35.4	35.4	35.6	35.6	35.6	35.6
	Excess	--	--	--	--	--	--	--	--	--
H052	--	24.8	28.9	33.4	35.6	35.6	35.7	35.8	35.8	35.8
	Excess	--	--	--	--	--	--	--	--	--
H053	--	24.1	28.2	32.6	34.8	34.8	35.0	35.0	35.0	35.0
	Excess	--	--	--	--	--	--	--	--	--
H054	--	23.8	27.9	32.3	34.5	34.5	34.6	34.7	34.7	34.7
	Excess	--	--	--	--	--	--	--	--	--
H055	--	24.0	28.0	32.4	34.7	34.7	34.8	34.9	34.9	34.9
	Excess	--	--	--	--	--	--	--	--	--
H056	--	24.1	28.1	32.6	34.8	34.8	34.9	35.0	35.0	35.0
	Excess	--	--	--	--	--	--	--	--	--
H057	--	24.2	28.3	32.7	35.0	35.0	35.1	35.2	35.2	35.2
	Excess	--	--	--	--	--	--	--	--	--
H058	--	24.4	28.4	32.9	35.1	35.1	35.3	35.3	35.3	35.3
	Excess	--	--	--	--	--	--	--	--	--
H059	--	24.5	28.5	33.0	35.3	35.3	35.4	35.5	35.5	35.5
	Excess	--	--	--	--	--	--	--	--	--
H060	--	23.6	27.7	32.1	34.3	34.3	34.4	34.5	34.5	34.5
	Excess	--	--	--	--	--	--	--	--	--
H061	--	23.5	27.6	32.0	34.2	34.2	34.3	34.4	34.4	34.4
	Excess	--	--	--	--	--	--	--	--	--
H062	--	23.5	27.5	31.9	34.1	34.1	34.2	34.3	34.3	34.3
	Excess	--	--	--	--	--	--	--	--	--
H063	--	23.6	27.6	32.0	34.2	34.2	34.3	34.4	34.4	34.4
	Excess	--	--	--	--	--	--	--	--	--
H064	--	23.7	27.7	32.1	34.3	34.3	34.4	34.5	34.5	34.5
	Excess	--	--	--	--	--	--	--	--	--
H065	--	22.9	27.0	31.3	33.5	33.5	33.6	33.6	33.6	33.6
	Excess	--	--	--	--	--	--	--	--	--
H066	--	22.5	26.5	30.8	33.0	33.0	33.2	33.2	33.2	33.2
	Excess	--	--	--	--	--	--	--	--	--
H067	--	22.7	26.7	31.0	33.3	33.3	33.4	33.4	33.4	33.4
	Excess	--	--	--	--	--	--	--	--	--
H068	--	22.4	26.4	30.7	33.0	33.0	33.1	33.1	33.1	33.1
	Excess	--	--	--	--	--	--	--	--	--
H069	--	21.8	25.8	30.1	32.4	32.4	32.5	32.5	32.5	32.5
	Excess	--	--	--	--	--	--	--	--	--
H070	--	21.7	25.7	30.0	32.3	32.3	32.4	32.4	32.4	32.4
	Excess	--	--	--	--	--	--	--	--	--
H071	--	27.6	31.7	36.6	38.8	38.8	39.0	39.1	39.1	39.1
	Excess	--	--	--	--	--	--	--	--	--
H072	--	27.1	31.3	36.1	38.3	38.3	38.5	38.6	38.6	38.6
	Excess	--	--	--	--	--	--	--	--	--
H073	--	26.9	31.0	35.8	38.0	38.0	38.3	38.3	38.3	38.3
	Excess	--	--	--	--	--	--	--	--	--

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
H074	--	26.4	30.6	35.3	37.5	37.5	37.8	37.8	37.8	37.8
	Excess	--	--	--	--	--	--	--	--	--
H075	Farmyard	28.8	33.0	37.9	40.1	40.1	40.3	40.4	40.4	40.4
	Excess	--	--	--	--	--	--	--	--	--
H076	--	26.2	30.3	35.1	37.3	37.3	37.5	37.6	37.6	37.6
	Excess	--	--	--	--	--	--	--	--	--
H077	--	26.2	30.3	35.1	37.3	37.3	37.5	37.6	37.6	37.6
	Excess	--	--	--	--	--	--	--	--	--
H078	--	26.2	30.3	35.1	37.3	37.3	37.5	37.6	37.6	37.6
	Excess	--	--	--	--	--	--	--	--	--
H079	--	26.8	30.9	35.7	37.9	37.9	38.1	38.2	38.2	38.2
	Excess	--	--	--	--	--	--	--	--	--
H080	--	27.4	31.5	36.4	38.6	38.6	38.8	38.9	38.9	38.9
	Excess	--	--	--	--	--	--	--	--	--
H081	--	26.2	30.3	35.1	37.3	37.3	37.5	37.6	37.6	37.6
	Excess	--	--	--	--	--	--	--	--	--
H082	--	26.0	30.1	34.9	37.1	37.1	37.3	37.4	37.4	37.4
	Excess	--	--	--	--	--	--	--	--	--
H083	--	25.9	30.0	34.8	37.0	37.0	37.2	37.3	37.3	37.3
	Excess	--	--	--	--	--	--	--	--	--
H084	--	25.8	29.9	34.7	36.9	36.9	37.1	37.2	37.2	37.2
	Excess	--	--	--	--	--	--	--	--	--
H085	--	25.8	29.9	34.6	36.9	36.9	37.1	37.1	37.1	37.1
	Excess	--	--	--	--	--	--	--	--	--
H086	--	25.4	29.5	34.2	36.5	36.5	36.7	36.7	36.7	36.7
	Excess	--	--	--	--	--	--	--	--	--
H087	--	25.3	29.3	34.1	36.3	36.3	36.5	36.6	36.6	36.6
	Excess	--	--	--	--	--	--	--	--	--
H088	--	23.9	28.0	32.6	34.9	34.9	35.0	35.1	35.1	35.1
	Excess	--	--	--	--	--	--	--	--	--
H089	--	25.5	29.6	34.4	36.6	36.6	36.8	36.9	36.9	36.9
	Excess	--	--	--	--	--	--	--	--	--
H090	--	24.9	29.0	33.7	35.9	35.9	36.1	36.2	36.2	36.2
	Excess	--	--	--	--	--	--	--	--	--
H091	--	24.0	28.0	32.7	34.9	34.9	35.1	35.2	35.2	35.2
	Excess	--	--	--	--	--	--	--	--	--
H092	--	23.9	27.9	32.6	34.8	34.8	35.0	35.0	35.0	35.0
	Excess	--	--	--	--	--	--	--	--	--
H093	--	23.7	27.8	32.4	34.7	34.7	34.8	34.9	34.9	34.9
	Excess	--	--	--	--	--	--	--	--	--
H094	--	23.6	27.6	32.2	34.5	34.5	34.7	34.7	34.7	34.7
	Excess	--	--	--	--	--	--	--	--	--
H095	--	23.2	27.2	31.8	34.0	34.0	34.2	34.3	34.3	34.3
	Excess	--	--	--	--	--	--	--	--	--
H096	--	23.0	27.0	31.6	33.9	33.9	34.0	34.1	34.1	34.1
	Excess	--	--	--	--	--	--	--	--	--
H097	--	22.8	26.8	31.4	33.6	33.6	33.8	33.8	33.8	33.8
	Excess	--	--	--	--	--	--	--	--	--
H098	--	22.6	26.6	31.2	33.5	33.5	33.7	33.7	33.7	33.7

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Excess	--	--	--	--	--	--	--	--	--
H099	--	22.8	26.8	31.4	33.7	33.7	33.8	33.9	33.9	33.9
	Excess	--	--	--	--	--	--	--	--	--
H100	--	23.0	27.0	31.7	33.9	33.9	34.1	34.1	34.1	34.1
	Excess	--	--	--	--	--	--	--	--	--
H101	--	23.1	27.1	31.8	34.1	34.1	34.2	34.3	34.3	34.3
	Excess	--	--	--	--	--	--	--	--	--
H102	--	22.9	26.9	31.5	33.8	33.8	34.0	34.0	34.0	34.0
	Excess	--	--	--	--	--	--	--	--	--
H103	--	20.2	24.0	28.5	30.9	30.9	31.0	31.0	31.0	31.0
	Excess	--	--	--	--	--	--	--	--	--
H104	--	20.5	24.3	28.9	31.2	31.2	31.3	31.4	31.4	31.4
	Excess	--	--	--	--	--	--	--	--	--
H105	--	20.4	24.3	28.8	31.1	31.1	31.3	31.3	31.3	31.3
	Excess	--	--	--	--	--	--	--	--	--
H106	--	20.7	24.5	29.1	31.4	31.4	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H107	--	21.4	25.3	29.9	32.2	32.2	32.3	32.4	32.4	32.4
	Excess	--	--	--	--	--	--	--	--	--
H108	--	22.3	26.2	30.9	33.1	33.1	33.3	33.3	33.3	33.3
	Excess	--	--	--	--	--	--	--	--	--
H109	--	22.1	26.0	30.6	32.9	32.9	33.1	33.1	33.1	33.1
	Excess	--	--	--	--	--	--	--	--	--
H110	--	21.6	25.5	30.1	32.4	32.4	32.5	32.6	32.6	32.6
	Excess	--	--	--	--	--	--	--	--	--
H111	--	20.7	24.5	29.1	31.4	31.4	31.5	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H112	--	23.3	27.3	32.0	34.3	34.3	34.5	34.5	34.5	34.5
	Excess	--	--	--	--	--	--	--	--	--
H113	--	23.6	27.6	32.3	34.6	34.6	34.7	34.8	34.8	34.8
	Excess	--	--	--	--	--	--	--	--	--
H114	--	23.2	27.2	31.9	34.2	34.2	34.4	34.4	34.4	34.4
	Excess	--	--	--	--	--	--	--	--	--
H115	--	23.4	27.4	32.1	34.4	34.4	34.5	34.6	34.6	34.6
	Excess	--	--	--	--	--	--	--	--	--
H116	--	23.6	27.6	32.3	34.6	34.6	34.8	34.8	34.8	34.8
	Excess	--	--	--	--	--	--	--	--	--
H117	--	23.8	27.8	32.6	34.8	34.8	35.0	35.1	35.1	35.1
	Excess	--	--	--	--	--	--	--	--	--
H118	--	23.8	27.8	32.5	34.8	34.8	35.0	35.0	35.0	35.0
	Excess	--	--	--	--	--	--	--	--	--
H119	--	24.2	28.3	33.0	35.3	35.3	35.5	35.5	35.5	35.5
	Excess	--	--	--	--	--	--	--	--	--
H120	--	24.4	28.4	33.2	35.5	35.5	35.6	35.7	35.7	35.7
	Excess	--	--	--	--	--	--	--	--	--
H121	--	24.6	28.7	33.5	35.7	35.7	35.9	36.0	36.0	36.0
	Excess	--	--	--	--	--	--	--	--	--
H122	--	24.1	28.1	32.9	35.1	35.1	35.3	35.4	35.4	35.4
	Excess	--	--	--	--	--	--	--	--	--

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
H123	--	24.5	28.5	33.3	35.6	35.6	35.7	35.8	35.8	35.8
	Excess	--	--	--	--	--	--	--	--	--
H124	--	25.9	30.0	34.9	37.1	37.1	37.3	37.4	37.4	37.4
	Excess	--	--	--	--	--	--	--	--	--
H125	--	27.2	31.4	36.3	38.5	38.5	38.7	38.8	38.8	38.8
	Excess	--	--	--	--	--	--	--	--	--
H126	--	27.9	32.0	36.9	39.2	39.2	39.4	39.5	39.5	39.5
	Excess	--	--	--	--	--	--	--	--	--
H127	--	28.1	32.3	37.2	39.4	39.4	39.7	39.8	39.8	39.8
	Excess	--	--	--	--	--	--	--	--	--
H128	--	27.8	31.9	36.8	39.0	39.0	39.3	39.3	39.3	39.3
	Excess	--	--	--	--	--	--	--	--	--
H129	--	26.7	30.8	35.6	37.8	37.8	38.1	38.1	38.1	38.1
	Excess	--	--	--	--	--	--	--	--	--
H130	--	26.8	30.9	35.8	38.0	38.0	38.2	38.3	38.3	38.3
	Excess	--	--	--	--	--	--	--	--	--
H131	--	26.8	30.9	35.8	38.0	38.0	38.2	38.3	38.3	38.3
	Excess	--	--	--	--	--	--	--	--	--
H132	--	26.8	30.9	35.7	38.0	38.0	38.2	38.2	38.2	38.2
	Excess	--	--	--	--	--	--	--	--	--
H133	--	26.7	30.8	35.6	37.8	37.8	38.0	38.1	38.1	38.1
	Excess	--	--	--	--	--	--	--	--	--
H134	--	26.7	30.8	35.7	37.9	37.9	38.1	38.2	38.2	38.2
	Excess	--	--	--	--	--	--	--	--	--
H135	--	26.6	30.7	35.6	37.8	37.8	38.0	38.1	38.1	38.1
	Excess	--	--	--	--	--	--	--	--	--
H136	--	26.6	30.7	35.5	37.8	37.8	38.0	38.0	38.0	38.0
	Excess	--	--	--	--	--	--	--	--	--
H137	--	26.5	30.6	35.5	37.7	37.7	37.9	38.0	38.0	38.0
	Excess	--	--	--	--	--	--	--	--	--
H138	--	26.5	30.6	35.4	37.6	37.6	37.8	37.9	37.9	37.9
	Excess	--	--	--	--	--	--	--	--	--
H139	--	26.4	30.5	35.3	37.6	37.6	37.8	37.8	37.8	37.8
	Excess	--	--	--	--	--	--	--	--	--
H140	--	25.3	29.3	34.1	36.4	36.4	36.6	36.6	36.6	36.6
	Excess	--	--	--	--	--	--	--	--	--
H141	--	24.8	28.8	33.6	35.8	35.8	36.0	36.1	36.1	36.1
	Excess	--	--	--	--	--	--	--	--	--
H142	--	24.7	28.7	33.5	35.7	35.7	35.9	36.0	36.0	36.0
	Excess	--	--	--	--	--	--	--	--	--
H143	--	25.3	29.3	34.1	36.4	36.4	36.6	36.6	36.6	36.6
	Excess	--	--	--	--	--	--	--	--	--
H144	--	22.7	26.6	31.3	33.6	33.6	33.7	33.8	33.8	33.8
	Excess	--	--	--	--	--	--	--	--	--
H145	--	22.6	26.5	31.2	33.5	33.5	33.6	33.7	33.7	33.7
	Excess	--	--	--	--	--	--	--	--	--
H146	--	22.5	26.4	31.1	33.4	33.4	33.5	33.6	33.6	33.6
	Excess	--	--	--	--	--	--	--	--	--
H147	--	22.7	26.6	31.3	33.6	33.6	33.7	33.8	33.8	33.8

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Excess	--	--	--	--	--	--	--	--	--
H148	--	22.5	26.4	31.1	33.4	33.4	33.5	33.6	33.6	33.6
	Excess	--	--	--	--	--	--	--	--	--
H149	--	22.1	26.0	30.7	33.0	33.0	33.1	33.2	33.2	33.2
	Excess	--	--	--	--	--	--	--	--	--
H150	--	22.2	26.1	30.8	33.1	33.1	33.2	33.2	33.2	33.2
	Excess	--	--	--	--	--	--	--	--	--
H151	--	23.3	27.3	32.0	34.3	34.3	34.4	34.5	34.5	34.5
	Excess	--	--	--	--	--	--	--	--	--
H152	--	24.7	28.8	33.5	35.8	35.8	36.0	36.0	36.0	36.0
	Excess	--	--	--	--	--	--	--	--	--
H153	--	24.7	28.8	33.5	35.8	35.8	35.9	36.0	36.0	36.0
	Excess	--	--	--	--	--	--	--	--	--
H154	--	24.7	28.8	33.5	35.8	35.8	36.0	36.0	36.0	36.0
	Excess	--	--	--	--	--	--	--	--	--
H155	--	25.9	30.0	34.8	37.0	37.0	37.2	37.3	37.3	37.3
	Excess	--	--	--	--	--	--	--	--	--
H156	--	24.2	28.2	32.9	35.2	35.2	35.3	35.4	35.4	35.4
	Excess	--	--	--	--	--	--	--	--	--
H157	--	23.9	27.9	32.6	34.9	34.9	35.0	35.1	35.1	35.1
	Excess	--	--	--	--	--	--	--	--	--
H158	--	23.7	27.7	32.4	34.7	34.7	34.8	34.9	34.9	34.9
	Excess	--	--	--	--	--	--	--	--	--
H159	--	23.7	27.7	32.4	34.7	34.7	34.8	34.9	34.9	34.9
	Excess	--	--	--	--	--	--	--	--	--
H160	--	23.6	27.5	32.2	34.5	34.5	34.6	34.7	34.7	34.7
	Excess	--	--	--	--	--	--	--	--	--
H161	--	23.5	27.4	32.1	34.4	34.4	34.5	34.6	34.6	34.6
	Excess	--	--	--	--	--	--	--	--	--
H162	--	23.3	27.2	31.9	34.2	34.2	34.3	34.4	34.4	34.4
	Excess	--	--	--	--	--	--	--	--	--
H163	--	23.2	27.2	31.9	34.1	34.1	34.3	34.4	34.4	34.4
	Excess	--	--	--	--	--	--	--	--	--
H164	--	23.1	27.1	31.7	34.0	34.0	34.1	34.2	34.2	34.2
	Excess	--	--	--	--	--	--	--	--	--
H165	--	23.0	27.0	31.6	33.9	33.9	34.0	34.1	34.1	34.1
	Excess	--	--	--	--	--	--	--	--	--
H166	--	22.9	26.9	31.5	33.8	33.8	33.9	34.0	34.0	34.0
	Excess	--	--	--	--	--	--	--	--	--
H167	--	22.9	26.8	31.4	33.7	33.7	33.9	33.9	33.9	33.9
	Excess	--	--	--	--	--	--	--	--	--
H168	--	22.8	26.7	31.3	33.6	33.6	33.8	33.8	33.8	33.8
	Excess	--	--	--	--	--	--	--	--	--
H169	--	23.1	27.1	31.7	34.0	34.0	34.1	34.2	34.2	34.2
	Excess	--	--	--	--	--	--	--	--	--
H170	--	23.0	27.0	31.6	33.9	33.9	34.0	34.1	34.1	34.1
	Excess	--	--	--	--	--	--	--	--	--
H171	--	22.7	26.7	31.3	33.6	33.6	33.7	33.8	33.8	33.8
	Excess	--	--	--	--	--	--	--	--	--

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
H172	--	22.6	26.5	31.1	33.4	33.4	33.5	33.6	33.6	33.6
	Excess	--	--	--	--	--	--	--	--	--
H173	--	22.5	26.4	31.0	33.3	33.3	33.4	33.5	33.5	33.5
	Excess	--	--	--	--	--	--	--	--	--
H174	--	21.9	25.8	30.3	32.6	32.6	32.8	32.8	32.8	32.8
	Excess	--	--	--	--	--	--	--	--	--
H175	--	21.9	25.8	30.4	32.7	32.7	32.8	32.8	32.8	32.8
	Excess	--	--	--	--	--	--	--	--	--
H176	--	22.2	26.1	30.7	33.0	33.0	33.1	33.2	33.2	33.2
	Excess	--	--	--	--	--	--	--	--	--
H177	--	22.5	26.4	31.0	33.3	33.3	33.4	33.5	33.5	33.5
	Excess	--	--	--	--	--	--	--	--	--
H178	--	22.3	26.2	30.8	33.1	33.1	33.2	33.3	33.3	33.3
	Excess	--	--	--	--	--	--	--	--	--
H179	--	22.1	26.0	30.6	32.9	32.9	33.0	33.1	33.1	33.1
	Excess	--	--	--	--	--	--	--	--	--
H180	--	21.9	25.8	30.4	32.7	32.7	32.8	32.8	32.8	32.8
	Excess	--	--	--	--	--	--	--	--	--
H181	--	21.8	25.7	30.3	32.6	32.6	32.7	32.7	32.7	32.7
	Excess	--	--	--	--	--	--	--	--	--
H182	--	21.6	25.5	30.1	32.4	32.4	32.5	32.5	32.5	32.5
	Excess	--	--	--	--	--	--	--	--	--
H183	--	21.7	25.7	30.2	32.5	32.5	32.6	32.6	32.6	32.6
	Excess	--	--	--	--	--	--	--	--	--
H184	--	21.6	25.5	30.0	32.3	32.3	32.5	32.5	32.5	32.5
	Excess	--	--	--	--	--	--	--	--	--
H185	--	21.4	25.3	29.8	32.1	32.1	32.2	32.2	32.2	32.2
	Excess	--	--	--	--	--	--	--	--	--
H186	--	21.6	25.5	30.0	32.3	32.3	32.4	32.5	32.5	32.5
	Excess	--	--	--	--	--	--	--	--	--
H187	--	21.6	25.5	30.0	32.3	32.3	32.4	32.5	32.5	32.5
	Excess	--	--	--	--	--	--	--	--	--
H188	--	21.6	25.5	30.0	32.3	32.3	32.4	32.4	32.4	32.4
	Excess	--	--	--	--	--	--	--	--	--
H189	--	21.5	25.4	30.0	32.3	32.3	32.4	32.4	32.4	32.4
	Excess	--	--	--	--	--	--	--	--	--
H190	--	21.5	25.4	29.9	32.2	32.2	32.3	32.4	32.4	32.4
	Excess	--	--	--	--	--	--	--	--	--
H191	--	21.5	25.4	29.9	32.2	32.2	32.3	32.3	32.3	32.3
	Excess	--	--	--	--	--	--	--	--	--
H192	--	21.5	25.4	29.9	32.2	32.2	32.3	32.3	32.3	32.3
	Excess	--	--	--	--	--	--	--	--	--
H193	--	21.4	25.3	29.8	32.1	32.1	32.2	32.3	32.3	32.3
	Excess	--	--	--	--	--	--	--	--	--
H194	--	21.4	25.3	29.8	32.1	32.1	32.2	32.3	32.3	32.3
	Excess	--	--	--	--	--	--	--	--	--
H195	--	21.4	25.3	29.8	32.1	32.1	32.2	32.3	32.3	32.3
	Excess	--	--	--	--	--	--	--	--	--
H196	--	21.4	25.3	29.8	32.1	32.1	32.2	32.2	32.2	32.2

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Excess	--	--	--	--	--	--	--	--	--
H197	--	21.4	25.2	29.7	32.0	32.0	32.1	32.2	32.2	32.2
	Excess	--	--	--	--	--	--	--	--	--
H198	--	21.3	25.2	29.7	32.0	32.0	32.1	32.2	32.2	32.2
	Excess	--	--	--	--	--	--	--	--	--
H199	--	21.3	25.2	29.7	32.0	32.0	32.1	32.1	32.1	32.1
	Excess	--	--	--	--	--	--	--	--	--
H200	--	21.3	25.2	29.7	32.0	32.0	32.1	32.1	32.1	32.1
	Excess	--	--	--	--	--	--	--	--	--
H201	--	21.3	25.2	29.6	31.9	31.9	32.1	32.1	32.1	32.1
	Excess	--	--	--	--	--	--	--	--	--
H202	--	21.2	25.1	29.6	31.9	31.9	32.0	32.0	32.0	32.0
	Excess	--	--	--	--	--	--	--	--	--
H203	--	21.2	25.1	29.5	31.9	31.9	32.0	32.0	32.0	32.0
	Excess	--	--	--	--	--	--	--	--	--
H204	--	21.2	25.0	29.5	31.8	31.8	31.9	32.0	32.0	32.0
	Excess	--	--	--	--	--	--	--	--	--
H205	--	21.1	25.0	29.5	31.8	31.8	31.9	32.0	32.0	32.0
	Excess	--	--	--	--	--	--	--	--	--
H206	--	21.1	25.0	29.5	31.8	31.8	31.9	31.9	31.9	31.9
	Excess	--	--	--	--	--	--	--	--	--
H207	--	21.1	25.0	29.5	31.8	31.8	31.9	31.9	31.9	31.9
	Excess	--	--	--	--	--	--	--	--	--
H208	--	21.1	25.0	29.5	31.8	31.8	31.9	31.9	31.9	31.9
	Excess	--	--	--	--	--	--	--	--	--
H209	--	21.1	25.0	29.5	31.8	31.8	31.9	31.9	31.9	31.9
	Excess	--	--	--	--	--	--	--	--	--
H210	--	21.1	25.0	29.4	31.7	31.7	31.8	31.9	31.9	31.9
	Excess	--	--	--	--	--	--	--	--	--
H211	--	21.1	25.0	29.4	31.7	31.7	31.8	31.9	31.9	31.9
	Excess	--	--	--	--	--	--	--	--	--
H212	--	21.1	24.9	29.4	31.7	31.7	31.8	31.9	31.9	31.9
	Excess	--	--	--	--	--	--	--	--	--
H213	--	21.0	24.9	29.4	31.7	31.7	31.8	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H214	--	21.0	24.9	29.3	31.6	31.6	31.7	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H215	--	21.0	24.8	29.3	31.6	31.6	31.7	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H216	--	20.9	24.8	29.3	31.6	31.6	31.7	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H217	--	20.9	24.8	29.2	31.5	31.5	31.6	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H218	--	20.9	24.7	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H219	--	20.8	24.7	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H220	--	20.8	24.7	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
H221	--	20.8	24.7	29.1	31.5	31.5	31.5	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H222	--	21.0	24.8	29.3	31.6	31.6	31.7	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H223	--	20.9	24.8	29.3	31.6	31.6	31.7	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H224	--	20.9	24.8	29.3	31.6	31.6	31.7	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H225	--	20.9	24.8	29.2	31.5	31.5	31.6	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H226	--	20.9	24.8	29.2	31.5	31.5	31.6	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H227	--	20.9	24.7	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H228	--	20.8	24.7	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H229	--	20.8	24.7	29.1	31.4	31.4	31.5	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H230	--	20.9	24.8	29.2	31.5	31.5	31.6	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H231	--	20.9	24.7	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H232	--	20.8	24.7	29.1	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H233	--	20.8	24.7	29.1	31.4	31.4	31.5	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H234	--	20.7	24.6	29.1	31.4	31.4	31.5	31.5	31.5	31.5
	Excess	--	--	--	--	--	--	--	--	--
H235	--	20.7	24.6	29.0	31.3	31.3	31.4	31.5	31.5	31.5
	Excess	--	--	--	--	--	--	--	--	--
H236	--	20.8	24.6	29.1	31.4	31.4	31.5	31.5	31.5	31.5
	Excess	--	--	--	--	--	--	--	--	--
H237	--	20.7	24.6	29.0	31.3	31.3	31.4	31.5	31.5	31.5
	Excess	--	--	--	--	--	--	--	--	--
H238	--	20.6	24.5	29.0	31.3	31.3	31.4	31.4	31.4	31.4
	Excess	--	--	--	--	--	--	--	--	--
H239	--	20.6	24.5	28.9	31.2	31.2	31.3	31.4	31.4	31.4
	Excess	--	--	--	--	--	--	--	--	--
H240	--	20.6	24.4	28.9	31.2	31.2	31.3	31.3	31.3	31.3
	Excess	--	--	--	--	--	--	--	--	--
H241	--	20.5	24.4	28.8	31.1	31.1	31.2	31.3	31.3	31.3
	Excess	--	--	--	--	--	--	--	--	--
H242	--	20.5	24.3	28.8	31.1	31.1	31.2	31.2	31.2	31.2
	Excess	--	--	--	--	--	--	--	--	--
H243	--	20.4	24.3	28.7	31.0	31.0	31.1	31.2	31.2	31.2
	Excess	--	--	--	--	--	--	--	--	--
H244	--	20.5	24.3	28.7	31.1	31.1	31.2	31.2	31.2	31.2
	Excess	--	--	--	--	--	--	--	--	--
H245	--	20.6	24.4	28.9	31.2	31.2	31.3	31.3	31.3	31.3

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Excess	--	--	--	--	--	--	--	--	--
H246	--	20.6	24.5	29.0	31.3	31.3	31.4	31.4	31.4	31.4
	Excess	--	--	--	--	--	--	--	--	--
H247	--	20.7	24.6	29.1	31.4	31.4	31.5	31.5	31.5	31.5
	Excess	--	--	--	--	--	--	--	--	--
H248	--	20.8	24.7	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H249	--	21.1	25.0	29.5	31.8	31.8	31.9	31.9	31.9	31.9
	Excess	--	--	--	--	--	--	--	--	--
H250	--	21.0	24.9	29.4	31.7	31.7	31.8	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H251	--	21.2	25.1	29.6	31.9	31.9	32.0	32.0	32.0	32.0
	Excess	--	--	--	--	--	--	--	--	--
H252	--	21.7	25.6	30.2	32.5	32.5	32.6	32.6	32.6	32.6
	Excess	--	--	--	--	--	--	--	--	--
H253	--	21.2	25.1	29.7	32.0	32.0	32.1	32.1	32.1	32.1
	Excess	--	--	--	--	--	--	--	--	--
H254	--	20.8	24.6	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H255	--	20.5	24.4	28.9	31.2	31.2	31.3	31.4	31.4	31.4
	Excess	--	--	--	--	--	--	--	--	--
H256	--	20.6	24.4	28.9	31.2	31.2	31.3	31.4	31.4	31.4
	Excess	--	--	--	--	--	--	--	--	--
H257	--	20.1	23.9	28.3	30.7	30.7	30.8	30.8	30.8	30.8
	Excess	--	--	--	--	--	--	--	--	--
H258	--	19.9	23.7	28.1	30.5	30.5	30.6	30.6	30.6	30.6
	Excess	--	--	--	--	--	--	--	--	--
H259	--	24.8	28.8	33.5	35.7	35.7	35.9	35.9	35.9	35.9
	Excess	--	--	--	--	--	--	--	--	--
H260	--	25.6	29.6	34.3	36.6	36.6	36.7	36.8	36.8	36.8
	Excess	--	--	--	--	--	--	--	--	--
H261	--	26.4	30.5	35.2	37.5	37.5	37.7	37.7	37.7	37.7
	Excess	--	--	--	--	--	--	--	--	--
H262	--	27.1	31.2	36.0	38.2	38.2	38.4	38.5	38.5	38.5
	Excess	--	--	--	--	--	--	--	--	--
H263	--	26.8	31.0	35.7	37.9	37.9	38.1	38.2	38.2	38.2
	Excess	--	--	--	--	--	--	--	--	--
H264	--	26.4	30.5	35.2	37.5	37.5	37.7	37.7	37.7	37.7
	Excess	--	--	--	--	--	--	--	--	--
H265	--	23.8	27.9	32.4	34.7	34.7	34.8	34.9	34.9	34.9
	Excess	--	--	--	--	--	--	--	--	--
H266	--	24.9	28.9	33.5	35.7	35.7	35.9	36.0	36.0	36.0
	Excess	--	--	--	--	--	--	--	--	--
H267	--	25.7	29.8	34.4	36.7	36.7	36.8	36.9	36.9	36.9
	Excess	--	--	--	--	--	--	--	--	--
H268	--	26.9	31.0	35.7	37.9	37.9	38.1	38.2	38.2	38.2
	Excess	--	--	--	--	--	--	--	--	--
H269	--	27.7	31.8	36.6	38.8	38.8	39.0	39.1	39.1	39.1
	Excess	--	--	--	--	--	--	--	--	--

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
H270	--	27.7	31.8	36.6	38.8	38.8	39.0	39.1	39.1	39.1
	Excess	--	--	--	--	--	--	--	--	--
H271	--	27.7	31.9	36.7	38.9	38.9	39.1	39.1	39.1	39.1
	Excess	--	--	--	--	--	--	--	--	--
H272	--	27.8	32.0	36.8	39.0	39.0	39.2	39.3	39.3	39.3
	Excess	--	--	--	--	--	--	--	--	--
H273	--	28.3	32.5	37.3	39.5	39.5	39.7	39.8	39.8	39.8
	Excess	--	--	--	--	--	--	--	--	--
H274	--	28.2	32.4	37.1	39.3	39.3	39.5	39.6	39.6	39.6
	Excess	--	--	--	--	--	--	--	--	--
H275	--	27.9	32.1	36.8	38.9	38.9	39.2	39.2	39.2	39.2
	Excess	--	--	--	--	--	--	--	--	--
H276	--	27.8	32.0	36.7	38.8	38.8	39.1	39.1	39.1	39.1
	Excess	--	--	--	--	--	--	--	--	--
H277	--	27.7	31.9	36.6	38.8	38.8	39.0	39.1	39.1	39.1
	Excess	--	--	--	--	--	--	--	--	--
H278	--	27.0	31.1	35.7	37.9	37.9	38.1	38.2	38.2	38.2
	Excess	--	--	--	--	--	--	--	--	--
H279	--	26.3	30.4	34.9	37.1	37.1	37.3	37.4	37.4	37.4
	Excess	--	--	--	--	--	--	--	--	--
H280	--	26.3	30.5	35.0	37.2	37.2	37.4	37.4	37.4	37.4
	Excess	--	--	--	--	--	--	--	--	--
H281	--	26.6	30.8	35.3	37.5	37.5	37.7	37.7	37.7	37.7
	Excess	--	--	--	--	--	--	--	--	--
H282	--	26.8	31.0	35.6	37.7	37.7	37.9	38.0	38.0	38.0
	Excess	--	--	--	--	--	--	--	--	--
H283	--	26.7	30.9	35.4	37.5	37.5	37.7	37.8	37.8	37.8
	Excess	--	--	--	--	--	--	--	--	--
H284	--	26.9	31.1	35.6	37.8	37.8	38.0	38.1	38.1	38.1
	Excess	--	--	--	--	--	--	--	--	--
H285	--	28.4	32.6	37.3	39.5	39.5	39.7	39.8	39.8	39.8
	Excess	--	--	--	--	--	--	--	--	--
H286	--	20.6	24.6	28.7	31.0	31.0	31.1	31.1	31.1	31.1
	Excess	--	--	--	--	--	--	--	--	--
H287	--	20.8	24.7	28.9	31.2	31.2	31.2	31.3	31.3	31.3
	Excess	--	--	--	--	--	--	--	--	--
H288	--	20.8	24.8	28.9	31.2	31.2	31.3	31.3	31.3	31.3
	Excess	--	--	--	--	--	--	--	--	--
H289	--	20.8	24.8	28.9	31.2	31.2	31.3	31.3	31.3	31.3
	Excess	--	--	--	--	--	--	--	--	--
H290	--	20.7	24.7	28.9	31.1	31.1	31.2	31.2	31.2	31.2
	Excess	--	--	--	--	--	--	--	--	--
H291	--	20.7	24.7	28.8	31.1	31.1	31.2	31.2	31.2	31.2
	Excess	--	--	--	--	--	--	--	--	--
H292	--	20.7	24.7	28.8	31.1	31.1	31.1	31.2	31.2	31.2
	Excess	--	--	--	--	--	--	--	--	--
H293	--	21.1	25.1	29.1	31.3	31.3	31.4	31.5	31.5	31.5
	Excess	--	--	--	--	--	--	--	--	--
H294	--	21.2	25.4	29.2	31.3	31.3	31.4	31.4	31.4	31.4

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Excess	--	--	--	--	--	--	--	--	--
H295	--	21.5	25.7	29.4	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H296	--	21.6	25.8	29.5	31.6	31.6	31.6	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H297	--	21.5	25.7	29.3	31.4	31.4	31.5	31.5	31.5	31.5
	Excess	--	--	--	--	--	--	--	--	--
H298	--	21.6	25.9	29.3	31.3	31.3	31.4	31.4	31.4	31.4
	Excess	--	--	--	--	--	--	--	--	--
H299	--	22.1	26.4	29.7	31.6	31.6	31.6	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H300	--	22.1	26.5	29.7	31.6	31.6	31.7	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H301	--	22.0	26.4	29.7	31.7	31.7	31.7	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H302	--	21.7	25.7	29.9	32.1	32.1	32.2	32.2	32.2	32.2
	Excess	--	--	--	--	--	--	--	--	--
H303	--	21.3	25.3	29.5	31.7	31.7	31.8	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H304	--	21.1	25.1	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H305	--	21.0	25.0	29.2	31.4	31.4	31.5	31.5	31.5	31.5
	Excess	--	--	--	--	--	--	--	--	--
H306	--	20.9	24.9	29.1	31.3	31.3	31.4	31.4	31.4	31.4
	Excess	--	--	--	--	--	--	--	--	--
H307	--	20.5	24.5	28.5	30.7	30.7	30.8	30.8	30.8	30.8
	Excess	--	--	--	--	--	--	--	--	--
H308	--	20.4	24.4	28.4	30.6	30.6	30.7	30.7	30.7	30.7
	Excess	--	--	--	--	--	--	--	--	--
H309	--	20.3	24.3	28.3	30.5	30.5	30.6	30.6	30.6	30.6
	Excess	--	--	--	--	--	--	--	--	--
H310	--	21.4	25.4	29.7	32.0	32.0	32.1	32.1	32.1	32.1
	Excess	--	--	--	--	--	--	--	--	--
H311	--	21.1	25.1	29.4	31.7	31.7	31.8	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H312	--	21.1	25.0	29.4	31.6	31.6	31.7	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H313	--	21.0	25.0	29.3	31.6	31.6	31.7	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H314	--	21.5	25.5	29.9	32.2	32.2	32.3	32.3	32.3	32.3
	Excess	--	--	--	--	--	--	--	--	--
H315	--	21.1	25.0	29.4	31.6	31.6	31.7	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H316	--	20.6	24.5	28.8	31.1	31.1	31.2	31.3	31.3	31.3
	Excess	--	--	--	--	--	--	--	--	--
H317	--	20.6	24.5	28.9	31.2	31.2	31.3	31.3	31.3	31.3
	Excess	--	--	--	--	--	--	--	--	--
H318	--	20.7	24.6	29.0	31.3	31.3	31.4	31.4	31.4	31.4
	Excess	--	--	--	--	--	--	--	--	--

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
H319	--	20.7	24.7	29.1	31.4	31.4	31.5	31.5	31.5	31.5
	Excess	--	--	--	--	--	--	--	--	--
H320	--	20.8	24.8	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H321	--	20.9	24.8	29.2	31.5	31.5	31.6	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H322	--	21.0	24.9	29.3	31.6	31.6	31.7	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H323	--	21.0	25.0	29.4	31.7	31.7	31.8	31.9	31.9	31.9
	Excess	--	--	--	--	--	--	--	--	--
H324	--	20.9	24.8	29.2	31.5	31.5	31.6	31.6	31.6	31.6
	Excess	--	--	--	--	--	--	--	--	--
H325	--	20.9	24.9	29.3	31.6	31.6	31.7	31.7	31.7	31.7
	Excess	--	--	--	--	--	--	--	--	--
H326	--	21.0	24.9	29.4	31.6	31.6	31.7	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H327	--	22.0	25.9	30.5	32.8	32.8	32.9	32.9	32.9	32.9
	Excess	--	--	--	--	--	--	--	--	--
H328	--	21.8	25.8	30.3	32.6	32.6	32.7	32.7	32.7	32.7
	Excess	--	--	--	--	--	--	--	--	--
H329	--	21.7	25.7	30.2	32.5	32.5	32.6	32.7	32.7	32.7
	Excess	--	--	--	--	--	--	--	--	--
H330	--	21.7	25.6	30.1	32.4	32.4	32.5	32.6	32.6	32.6
	Excess	--	--	--	--	--	--	--	--	--
H331	--	22.8	26.8	31.4	33.6	33.6	33.8	33.8	33.8	33.8
	Excess	--	--	--	--	--	--	--	--	--
H332	--	22.6	26.6	31.2	33.5	33.5	33.6	33.6	33.6	33.6
	Excess	--	--	--	--	--	--	--	--	--
H333	--	22.1	26.1	30.6	32.9	32.9	33.0	33.1	33.1	33.1
	Excess	--	--	--	--	--	--	--	--	--
H334	--	22.3	26.3	30.8	33.1	33.1	33.2	33.3	33.3	33.3
	Excess	--	--	--	--	--	--	--	--	--
H335	--	22.5	26.4	31.0	33.3	33.3	33.4	33.5	33.5	33.5
	Excess	--	--	--	--	--	--	--	--	--
H336	--	23.0	27.0	31.6	33.9	33.9	34.0	34.1	34.1	34.1
	Excess	--	--	--	--	--	--	--	--	--
H337	--	21.9	25.9	30.4	32.7	32.7	32.9	32.9	32.9	32.9
	Excess	--	--	--	--	--	--	--	--	--
H338	--	22.4	26.4	31.0	33.2	33.2	33.4	33.4	33.4	33.4
	Excess	--	--	--	--	--	--	--	--	--
H339	--	22.1	26.1	30.6	32.9	32.9	33.1	33.1	33.1	33.1
	Excess	--	--	--	--	--	--	--	--	--
H340	--	22.2	26.1	30.7	33.0	33.0	33.1	33.2	33.2	33.2
	Excess	--	--	--	--	--	--	--	--	--
H341	--	20.9	24.8	29.3	31.6	31.6	31.7	31.8	31.8	31.8
	Excess	--	--	--	--	--	--	--	--	--
H342	--	20.4	24.3	28.8	31.1	31.1	31.2	31.2	31.2	31.2
	Excess	--	--	--	--	--	--	--	--	--
H343	--	20.2	24.1	28.5	30.9	30.9	30.9	31.0	31.0	31.0

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
Day Criterion Curve		40.0	40.0	45.0	45.0	45.0	45.0	45.2	48.6	51.0
Night Criterion Curve		43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0	43.0
	Excess	--	--	--	--	--	--	--	--	--
H344	--	19.9	23.8	28.2	30.5	30.5	30.6	30.6	30.6	30.6
	Excess	--	--	--	--	--	--	--	--	--
H345	--	20.2	24.1	28.5	30.8	30.8	30.9	31.0	31.0	31.0
	Excess	--	--	--	--	--	--	--	--	--
H346	--	19.9	23.8	28.2	30.5	30.5	30.6	30.7	30.7	30.7
	Excess	--	--	--	--	--	--	--	--	--
H347	--	21.4	25.3	29.8	32.1	32.1	32.3	32.3	32.3	32.3
	Excess	--	--	--	--	--	--	--	--	--
H348	--	21.6	25.5	30.0	32.3	32.3	32.4	32.5	32.5	32.5
	Excess	--	--	--	--	--	--	--	--	--
H349	--	21.7	25.6	30.2	32.4	32.4	32.6	32.6	32.6	32.6
	Excess	--	--	--	--	--	--	--	--	--
H350	--	25.3	29.4	33.9	36.1	36.1	36.2	36.3	36.3	36.3
	Excess	--	--	--	--	--	--	--	--	--
H351	--	25.4	29.8	33.4	35.4	35.4	35.5	35.5	35.5	35.5
	Excess	--	--	--	--	--	--	--	--	--
H352	--	21.2	25.3	29.2	31.3	31.3	31.4	31.4	31.4	31.4
	Excess	--	--	--	--	--	--	--	--	--
H353	--	27.6	31.8	36.5	38.7	38.7	39.0	39.0	39.0	39.0
	Excess	--	--	--	--	--	--	--	--	--
H354	--	24.9	28.9	33.6	35.9	35.9	36.1	36.1	36.1	36.1
	Excess	--	--	--	--	--	--	--	--	--
H355	--	22.8	26.7	31.3	33.6	33.6	33.8	33.8	33.8	33.8
	Excess	--	--	--	--	--	--	--	--	--
H356	--	27.3	31.4	36.3	38.5	38.5	38.8	38.9	38.9	38.9
	Excess	--	--	--	--	--	--	--	--	--
H357	--	19.4	23.2	27.7	30.1	30.1	30.2	30.2	30.2	30.2
	Excess	--	--	--	--	--	--	--	--	--
H358	--	19.5	23.3	27.8	30.2	30.2	30.3	30.3	30.3	30.3
	Excess	--	--	--	--	--	--	--	--	--
H359	--	29.0	33.2	38.0	40.2	40.2	40.4	40.5	40.5	40.5
	Excess	--	--	--	--	--	--	--	--	--
H360	--	19.1	22.9	27.4	29.7	29.7	29.8	29.9	29.9	29.9
	Excess	--	--	--	--	--	--	--	--	--
H361	--	22.1	26.0	30.6	32.9	32.9	33.0	33.0	33.0	33.0
	Excess	--	--	--	--	--	--	--	--	--
H362	--	25.7	29.7	34.4	36.7	36.7	36.9	36.9	36.9	36.9
	Excess	--	--	--	--	--	--	--	--	--

A noise contour for the rated power wind speed of 10m/s (i.e. highest noise emission) is presented in Appendix 10-6.

The cumulative predicted noise levels at various wind speeds have been compared against the noise criteria curves outlined in Table 10.15. The predicted noise levels at all locations for the various wind speeds do not exceed the noise criteria curves adopted for this assessment.

As previously stated the day to day operations of the proposed development will not result in a typical worst case assumption of all noise locations being downwind of all turbines at the same time.

10.5.2.7 Future Potential Guideline Amendments

The predicted noise levels have been compared against the 40dB $L_{A90,10min}$ absolute criterion that has been put forward as part of the Department of Environment, Community & Local Government (DECLG) document *Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review in relation to Noise, Proximity and Shadow Flicker (December 11th 2013).* It should be noted that this consultation document is the subject of significant debate and numerous submissions from various interested parties have been submitted as part of the ongoing process. The comments presented in the following sections should be considered with the knowledge that the intent of the document may change when finally published.

Table 10.16 Review of Consultation Absolute Noise Limit

Name	Description	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
H029	--	28.9	33.1	37.8	40	40	40.3	40.3	40.3	40.3
H030	--	28.9	33.1	37.9	40	40	40.3	40.3	40.3	40.3
H031	--	29.5	33.7	38.5	40.7	40.7	40.9	41	41	41
H032	Farmyard	29.6	33.8	38.6	40.8	40.8	41.1	41.1	41.1	41.1
H075	Farmyard	28.8	33	37.9	40.1	40.1	40.3	40.4	40.4	40.4
H359	--	29	33.2	38	40.2	40.2	40.4	40.5	40.5	40.5

It is noted that the predicted levels are within the consultation criterion of 40dB $L_{A90,10min}$ at all locations for all wind speeds with the exception of some 6 locations as detailed in Table 10.16.

The next step of the assessment was to give the issue of wind directivity due consideration.

As previously stated the day to day operations of the proposed development will not result in a typical worst case assumption of all noise locations being downwind of all turbines at the same time. Therefore, in order to address this issue, a review of expected noise levels downwind of the turbines has been prepared for various wind directions.

For any given wind direction, a property can be assigned one of the following classifications in relation to particular turbines:

- Downwind (i.e. ±80° of the turbine in question – no correction);
- Crosswind (i.e. ±10° of the turbine in question – 2 dB reduction);
- Upwind (i.e. assume a 5 dB reduction in noise emission as a conservative approach).

The cumulative predicted noise levels at various wind speeds in various wind directions have been compared against the consultation noise criterion of 40dB $L_{A90,10min}$ and any exceedances have been identified in Table 10.17.

Table 10.17 Review of Consultation Absolute Noise Limit – Directivity Considered

Name	Direction	dB $L_{A90,10min}$ at Various Standardised Wind Speeds (m/s)								
		4	5	6	7	8	9	10	11	12
H030	Southeast	28.7	32.9	37.7	39.8	39.8	40.1	40.1	40.1	40.1
H031	Southeast	29.2	33.4	38.2	40.4	40.4	40.6	40.7	40.7	40.7
	South	29	33.2	38	40.2	40.2	40.4	40.5	40.5	40.5
H032 Farmyard	Southeast	29.2	33.4	38.2	40.4	40.4	40.7	40.7	40.7	40.7
	South	29.3	33.5	38.3	40.5	40.5	40.8	40.8	40.8	40.8
H075 Farmyard	Southeast	28.7	32.9	37.8	40	40	40.2	40.3	40.3	40.3
	South	28.8	33	37.9	40.1	40.1	40.3	40.4	40.4	40.4
H359	Southeast	28.8	33	37.8	40	40	40.2	40.3	40.3	40.3

The 40dB $L_{A90,10min}$ absolute criterion is exceeded at four locations at standardised wind speeds of 7m/s and above in a south easterly and easerly wind direction. It should be noted that the predicted excess is in the range of 0.1 to 0.8dB and an excess of this order of magnitude will be indistinguishable to the human ear.

If the identified exceedances are realised on site curtailment of turbine operation can be implemented for specific turbines in specific wind conditions in order to ensure predicted noise levels are within the relevant noise criterion curves/planning conditions. Such curtailment can be applied using the wind farm SCADA system without undue impact on the wind farm operations.

The predicted results vs. the consultation noise criterion for the various wind directions are presented in Appendix 10-7.

10.5.2.8 Substation

The application includes two substations as shown on Figure 10.15, although only one of these will ultimately be constructed and operated, as described in Section 10.5.1.3 above. As part of the development the substation will be operational on a day to day basis. The noise emission level associated with a typical substation that would support a development of this nature is the order of 93dB(A) L_w.

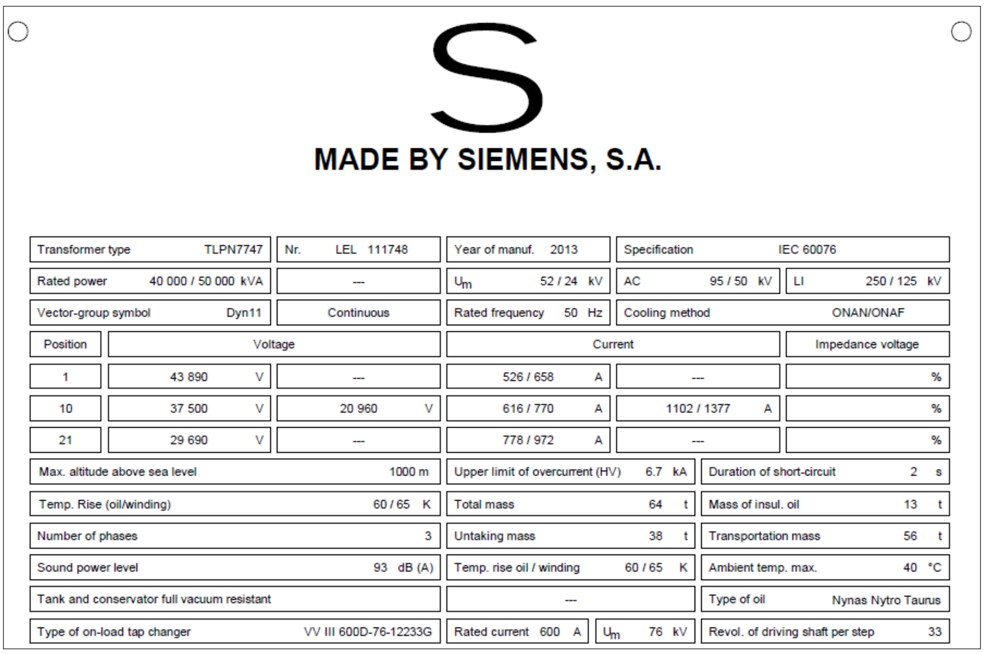


Figure 10.16 Statement of L_w for Typical Sub Station Used for Assessment

An iteration of the noise model has been developed to consider the expected noise level from the plant at the nearest noise sensitive locations. These levels are presented in Table 10.18.

Table 10.18 Predicted Noise Levels Associated with Substations

Name	Description	Height (m)	Predicted dB $L_{A90,10min}$	
			Substation A	Substation B
H001	--	4	3.4	10.1
H002	--	4	2.2	7.8
H003	--	4	2.1	7.5
H004	--	4	2	7.4
H005	--	4	1.8	7.2
H006	--	4	4.3	9.5
H007	--	4	1	6
H008	--	4	0.5	5.4
H009	--	4	--	5.4
H010	--	4	--	5.5
H011	--	4	--	3.6
H012	--	4	--	3.2
H013	--	4	--	2.5
H014	--	4	--	2.3
H015	--	4	--	2.3
H016	--	4	--	2.1
H017	--	4	--	1.9
H018	--	4	6.1	10.7
H019	--	4	6.4	11
H020	--	4	6.7	10.6
H021	--	4	6.8	10.7
H022	--	4	7	10.9
H023	--	4	7.1	11
H024	--	4	7.4	11.2
H025	--	4	8.6	11.8
H026	--	4	8.8	12
H027	--	4	9.1	12.2
H028	--	4	9.2	11.9
H029	--	4	10	12.7
H030	--	4	10.2	12.7
H031	--	4	10.4	13.3
H032	Farmyard	4	9.5	13.4
H033	--	4	9.8	10.6
H034	--	4	8.9	10.1
H035	--	4	8.2	9.9
H036	--	4	8.1	9.8
H037	--	4	7.8	9.4
H038	--	4	7.6	9.3
H039	--	4	7.2	9.2
H040	--	4	7.1	9.3
H041	--	4	7.1	9.3
H042	--	4	7	9.4
H043	--	4	7.5	8.7
H044	--	4	7.9	8.6
H045	--	4	7.7	8.5
H046	--	4	7.8	8.2

Name	Description	Height (m)	Predicted dB $L_{A90,10min}$	
			Substation A	Substation B
H047	--	4	7.9	8
H048	--	4	8.3	8.1
H049	--	4	8.3	8
H050	--	4	8.2	7.5
H051	--	4	8.3	7.4
H052	--	4	8.6	7.3
H053	--	4	8.4	6.2
H054	--	4	8.2	5.9
H055	--	4	8.5	5.9
H056	--	4	8.7	6
H057	--	4	8.9	6
H058	--	4	9.1	6.1
H059	--	4	9.3	6.1
H060	--	4	8.2	5.6
H061	--	4	8.1	5.4
H062	--	4	7.9	5.5
H063	--	4	7.9	5.6
H064	--	4	8	5.7
H065	--	4	7.4	4.9
H066	--	4	7.4	4.1
H067	--	4	7.8	4.2
H068	--	4	7.7	3.7
H069	--	4	7.4	3
H070	--	4	7.4	2.7
H071	--	4	13.3	6.5
H072	--	4	13	6.3
H073	--	4	12.8	6.1
H074	--	4	12.3	6
H075	Farmyard	4	13.8	7.3
H076	--	4	12.3	5.7
H077	--	4	12.4	5.7
H078	--	4	12.5	5.6
H079	--	4	13.1	5.7
H080	--	4	13.9	5.8
H081	--	4	12.9	5.3
H082	--	4	12.9	5
H083	--	4	12.9	4.9
H084	--	4	12.9	4.8
H085	--	4	12.9	4.7
H086	--	4	12.7	4.4
H087	--	4	12.7	4.3
H088	--	4	11.7	3.3
H089	--	4	13.6	4
H090	--	4	13.3	3.5
H091	--	4	12	3.1
H092	--	4	12	3
H093	--	4	11.9	2.9
H094	--	4	11.8	2.7
H095	--	4	11.4	2.4
H096	--	4	11.3	2.3
H097	--	4	11.1	2.2

Name	Description	Height (m)	Predicted dB $L_{A90,10min}$	
			Substation A	Substation B
H098	--	4	11.9	1.6
H099	--	4	12.2	1.7
H100	--	4	12.5	1.9
H101	--	4	12.6	2
H102	--	4	13.1	1.7
H103	--	4	12.2	--
H104	--	4	12.6	--
H105	--	4	12.8	--
H106	--	4	13.2	0.3
H107	--	4	14.2	0.8
H108	--	4	15.6	1.7
H109	--	4	15.4	1.5
H110	--	4	14.9	1.2
H111	--	4	13.8	0.6
H112	--	4	16.8	2.3
H113	--	4	17.1	2.5
H114	--	4	16.8	2.3
H115	--	4	17	2.5
H116	--	4	17.3	2.6
H117	--	4	17.5	2.7
H118	--	4	17.6	2.7
H119	--	4	18	3
H120	--	4	18.3	3.1
H121	--	4	18.6	3.3
H122	--	4	18	3
H123	--	4	18.6	3.2
H124	--	4	17.7	3.6
H125	--	4	18.2	4.2
H126	--	4	19.2	4.5
H127	--	4	19.6	4.7
H128	--	4	26.1	7.4
H129	--	4	23.6	7
H130	--	4	23	7.5
H131	--	4	22.9	7.6
H132	--	4	22.7	7.7
H133	--	4	22.3	7.7
H134	--	4	22.2	7.8
H135	--	4	21.8	7.9
H136	--	4	21.7	7.9
H137	--	4	21.4	8
H138	--	4	21.2	8
H139	--	4	21	8
H140	--	4	18.5	8
H141	--	4	17.7	7.8
H142	--	4	17.5	7.8
H143	--	4	17.6	8.5
H144	--	4	15.8	5.9
H145	--	4	15.7	5.8
H146	--	4	15.7	5.7
H147	--	4	16	5.8
H148	--	4	15.9	5.5

Name	Description	Height (m)	Predicted dB $L_{A90,10min}$	
			Substation A	Substation B
H149	--	4	15.4	5.2
H150	--	4	15.9	4.9
H151	--	4	15.2	7.4
H152	--	4	16.3	8.8
H153	--	4	16.2	8.8
H154	--	4	16	8.9
H155	--	4	16.6	10
H156	--	4	14.6	9.3
H157	--	4	13.3	10.1
H158	--	4	13	10.1
H159	--	4	13.2	9.9
H160	--	4	12.7	10.1
H161	--	4	12.5	10.1
H162	--	4	12.3	10
H163	--	4	12.4	9.9
H164	--	4	12.2	9.8
H165	--	4	12.1	9.8
H166	--	4	11.9	9.7
H167	--	4	11.7	9.9
H168	--	4	11.6	9.9
H169	--	4	11.7	10.4
H170	--	4	11.5	10.4
H171	--	4	11.3	10.1
H172	--	4	11	10.1
H173	--	4	10.8	10.1
H174	--	4	10.5	9.2
H175	--	4	10.4	9.4
H176	--	4	10.7	9.7
H177	--	4	10.6	10.3
H178	--	4	10.3	10.3
H179	--	4	10.2	10
H180	--	4	9.8	10
H181	--	4	9.7	10
H182	--	4	9.3	10
H183	--	4	9.4	10.2
H184	--	4	9.2	10.1
H185	--	4	9	9.8
H186	--	4	9	10.3
H187	--	4	8.9	10.3
H188	--	4	8.9	10.3
H189	--	4	8.9	10.3
H190	--	4	8.8	10.2
H191	--	4	8.8	10.2
H192	--	4	8.8	10.2
H193	--	4	8.7	10.2
H194	--	4	8.7	10.2
H195	--	4	8.7	10.2
H196	--	4	8.7	10.1
H197	--	4	8.6	10.1
H198	--	4	8.6	10.1
H199	--	4	8.6	10.1

Name	Description	Height (m)	Predicted dB $L_{A90,10min}$	
			Substation A	Substation B
H200	--	4	8.6	10.1
H201	--	4	8.5	10
H202	--	4	8.4	10
H203	--	4	8.4	10
H204	--	4	8.4	10
H205	--	4	8.4	9.9
H206	--	4	8.3	9.9
H207	--	4	8.3	9.9
H208	--	4	8.3	10
H209	--	4	8.3	10
H210	--	4	8.2	10
H211	--	4	8.2	10
H212	--	4	8.1	10
H213	--	4	8.1	10
H214	--	4	8	9.9
H215	--	4	8	9.9
H216	--	4	8	9.8
H217	--	4	8	9.8
H218	--	4	7.9	9.8
H219	--	4	7.9	9.7
H220	--	4	7.9	9.7
H221	--	4	7.9	9.6
H222	--	4	8.2	9.7
H223	--	4	8.1	9.7
H224	--	4	8.1	9.7
H225	--	4	8.1	9.7
H226	--	4	8	9.7
H227	--	4	8	9.7
H228	--	4	8	9.7
H229	--	4	8	9.6
H230	--	4	8.1	9.6
H231	--	4	8.1	9.6
H232	--	4	8	9.6
H233	--	4	8	9.5
H234	--	4	7.9	9.5
H235	--	4	7.9	9.5
H236	--	4	8.1	9.4
H237	--	4	8	9.3
H238	--	4	7.9	9.3
H239	--	4	7.9	9.3
H240	--	4	7.8	9.2
H241	--	4	7.7	9.2
H242	--	4	7.7	9.2
H243	--	4	7.6	9.1
H244	--	4	7.9	8.9
H245	--	4	8	9
H246	--	4	8.1	9.1
H247	--	4	8.2	9.2
H248	--	4	8.4	9.1
H249	--	4	8.5	9.6
H250	--	4	8.4	9.6

Name	Description	Height (m)	Predicted dB $L_{A90,10min}$	
			Substation A	Substation B
H251	--	4	8.7	9.7
H252	--	4	10.7	8.7
H253	--	4	10.6	7.7
H254	--	4	10.2	7.2
H255	--	4	9.9	6.9
H256	--	4	10.2	6.7
H257	--	4	9.6	6.2
H258	--	4	9.6	5.8
H259	--	4	9.3	16.9
H260	--	4	9.5	18.3
H261	--	4	9.2	20.6
H262	--	4	9.6	21.4
H263	--	4	9.3	21.4
H264	--	4	9.2	20.6
H265	--	4	7.7	16.7
H266	--	4	7.5	19.3
H267	--	4	7.4	21.3
H268	--	4	8.8	22.1
H269	--	4	8.6	24.5
H270	--	4	8.5	24.6
H271	--	4	8.4	24.8
H272	--	4	8.4	25.1
H273	--	4	6.5	26.4
H274	--	4	6	25.2
H275	--	4	5.4	23.8
H276	--	4	5.4	23.7
H277	--	4	5.3	23.4
H278	--	4	4.9	22.4
H279	--	4	4.3	20.8
H280	--	4	4.2	20.7
H281	--	4	4.3	20.9
H282	--	4	4.4	21.3
H283	--	4	4.2	20.6
H284	--	4	4.2	20.6
H285	--	4	5.4	23.6
H286	--	4	3.7	12.7
H287	--	4	3.5	13.1
H288	--	4	3.5	13.1
H289	--	4	3.6	13.1
H290	--	4	3.2	13.1
H291	--	4	3.1	13.1
H292	--	4	3	13.1
H293	--	4	2.3	13.7
H294	--	4	0.7	13
H295	--	4	0.6	13.1
H296	--	4	0.4	12.9
H297	--	4	0.1	12.6
H298	--	4	--	11.7
H299	--	4	--	11.1
H300	--	4	--	11.2
H301	--	4	--	11.5

Name	Description	Height (m)	Predicted dB $L_{A90,10min}$	
			Substation A	Substation B
H302	--	4	6.4	3.2
H303	--	4	6.6	2.4
H304	--	4	6.3	2.2
H305	--	4	6.2	2.2
H306	--	4	6.1	2.1
H307	--	4	5.3	1.6
H308	--	4	5.2	1.4
H309	--	4	5.1	1.3
H310	--	4	7.5	2.2
H311	--	4	7.4	1.8
H312	--	4	7.4	1.7
H313	--	4	7.4	1.6
H314	--	4	8.2	2
H315	--	4	7.8	1.5
H316	--	4	8.1	0.5
H317	--	4	8.2	0.5
H318	--	4	8.4	0.6
H319	--	4	8.5	0.6
H320	--	4	8.6	0.7
H321	--	4	8.7	0.7
H322	--	4	8.8	0.8
H323	--	4	9	0.8
H324	--	4	8.5	0.8
H325	--	4	8.6	0.8
H326	--	4	8.7	0.9
H327	--	4	10.4	1.5
H328	--	4	10.1	1.3
H329	--	4	10	1.3
H330	--	4	9.9	1.3
H331	--	4	11	2.2
H332	--	4	10.9	2
H333	--	4	10.5	1.6
H334	--	4	10.6	1.7
H335	--	4	10.8	1.9
H336	--	4	11.2	2.4
H337	--	4	10.6	1.3
H338	--	4	11.3	1.6
H339	--	4	10.9	1.4
H340	--	4	11	1.4
H341	--	4	9.5	0.4
H342	--	4	9.1	--
H343	--	4	8.7	--
H344	--	4	8.3	--
H345	--	4	8.8	--
H346	--	4	8.4	--
H347	--	4	10	0.9
H348	--	4	10.1	1
H349	--	4	10.2	1.1
H350	--	4	8.6	8.2
H351	--	4	2.1	7.6
H352	--	4	1.1	13.3

Name	Description	Height (m)	Predicted dB $L_{A90,10min}$	
			Substation A	Substation B
H353	--	4	8.6	24.2
H354	--	4	13.7	11.2
H355	--	4	11.9	9.5
H356	--	4	18.7	4.3
H357	--	4	12.1	--
H358	--	4	11.8	--
H359	--	4	12	11.3
H360	--	4	11.6	--
H361	--	4	10.8	1.4
H362	--	4	10.5	17

The worst-case predicted level would be expected to be the order of 26dB(A). This level is comparable to the lower noise levels measured in the area as part of the survey work undertaken for this assessment. In essence the noise from such an installation would not be expected to be audible at the majority of noise sensitive locations and will not significantly add to the overall noise levels associated with the proposed wind turbines themselves. The associated cumulative noise effect from the operation of the wind farm and the substations is not considered significant and is summarised as follows:

Quaility	*Significance*	*Duration*
Neutral	Impercptible	Long Term

10.5.2.9 Potential Effects During Decommissioning

In relation to the decommissioning phase, similar overall noise levels as those calculated for the construction phase would be expected, as similar tools and equipment will be used. During the decommissioning phase there may also be a need for rock breaking to remove the turbine foundations.

In all instances the total predicted construction and decommissioning noise levels are expected to be below the appropriate Category A value (i.e. 65dB $L_{Aeq,1hr}$) and therefore a significant effect is not predicted in relation to the nearest noise sensitive locations in terms of construction and decommissioning noise.

10.6 Remedial or Reductive Measures

In order to sufficiently ameliorate the likely noise effects, a schedule of noise control measures has been formulated for both construction and operational phases.

10.6.1 Construction Phase

With regard to construction activities, reference will be made to *British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*, which offers detailed guidance on the control of noise & vibration from demolition and construction activities. In particular, it is proposed that various practices be adopted during construction, including:

- limiting the hours during which site activities likely to create high levels of noise or vibration are permitted;
- establishing channels of communication between the contractor/developer, Local Authority and residents;
- appointing a site representative responsible for matters relating to noise and vibration;

- monitoring typical levels of noise and vibration during critical periods and at sensitive locations;
- keeping site access roads even so as to mitigate the potential for vibration from lorries.

Furthermore, a variety of practicable noise control measures will be employed. These include:

- selection of plant with low inherent potential for generation of noise and/ or vibration;
- placing of noisy / vibratory plant as far away from sensitive properties as permitted by site constraints.

It is recommended that vibration from construction activities be limited to the values set out in Table 10.2. This should be readily achieveable considering the distance between construction works and sensitive locations and the good practice measures outlined here. It should be noted that these limits are not absolute, but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage these limits may need to be reduced by up to 50%.

10.6.1.1 Mitigation Measures – Noise

The contract documents will clearly specify that the Contractor undertaking the construction of the works will be obliged to take specific noise abatement measures and comply with the recommendations of *British Standard BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise.* These measures will ensure that:

- No plant used on site will be permitted to cause an on-going public nuisance due to noise.
- The best means practicable, including proper maintenance of plant, will be employed to minimise the noise produced by on site operations.
- All vehicles and mechanical plant will be fitted with effective exhaust silencers and maintained in good working order for the duration of the contract.
- Compressors will be attenuated models fitted with properly lined and sealed acoustic covers which will be kept closed whenever the machines are in use and all ancillary pneumatic tools shall be fitted with suitable silencers.
- Machinery that is used intermittently will be shut down or throttled back to a minimum during periods when not in use.
- Any plant, such as generators or pumps, which is required to operate before 07:00hrs or after 19:00hrs will be surrounded by an acoustic enclosure or portable screen.
- During the course of the construction programme, supervision of the works will include ensuring compliance with the limits detailed in Table 10.1 using methods outlined in British Standard *BS 5228-1:2009+A1:2014 Code of practice for noise and vibration control on construction and open sites – Noise*.

10.6.2 Operational Phase

There are no locations highlighted in this document where the proposed development in combination with the existing Mountlucas wind farm exceeds the adopted day or night time noise criteria therefore no mitigation measures are required.

If alternative turbine technologies are considered for the site an updated noise assessment will be prepared to confirm that the noise emissions associated with them satisfy the noise criteria curves outlined in this assessment. If necessary suitable curtailment strategies will be designed and implemented for alternative technologies in order to comply with the relevant noise criteria curves, should detailed assessment conclude that this is necessary.

A common issue raised in relation to proposed wind farms relates to the issue of other amplitude modulation. It is reiterated that this research finds that the potential for complaints associated with the phenomenon of amplitude modulation is low. Again it is considered important to restate the conclusions of the report as summarised previously:

> *"The broad conclusions of this report were that aerodynamic modulation was only considered to be an issue at 4, and a possible issue at a further 8, of 133 sites in the UK that were operational at the time of the study and considered within the review.*
>
> *At the 4 sites where aerodynamic modulation was confirmed as an issue, it was considered that conditions associated with aerodynamic modulation is likely to occur between about 7 and 15% of the time."*

Nonetheless, the following programme of measures will be implemented in order to address any perceived issue of aerodynamic modulation associated with the site:

- A detailed noise survey conducted by an appropriately qualified acoustic consultant will be commissioned in order to confirm the presence of the issue, the extent of the issue (i.e. number of locations, wind speeds and environmental conditions in which it is occurring);
- Based on the findings of this work a schedule of measures will be formulated and agreed with the planning authority, which would typically be envisaged to focus on control and regulation of the operation of turbine unit(s) in certain atmospheric and meteorological conditions.

In the event that the 40dB $L_{A90,10min}$ absolute noise limit outlined in the Department of Environment, Community & Local Government (DECLG) document *Proposed Revisions to Wind Energy Development Guidelines 2006 – Targeted Review in relation to Noise, Proximity and Shadow Flicker (December 11th 2013)* is adopted as national guidance it has been demonstrated that this criterion can be achieved with slight curtailment of the site in specific wind directions (e.g. southerly and south easterly) at standardised windspeeds of 11m/s and above.

10.6.3 Decommissioning Phase

The mitigation measures that will be considered in relation to any decommissioning of the site are the same as those proposed for the construction phase of the development, i.e. as per Section 10.6.1.

10.7 Summary of Likely Significant Effects

This section summarises the likely noise and vibration effect associated with the proposed development, taking into account the mitigation measures.

10.7.1 Do Nothing Scenario

If the development is not progressed the existing noise environment will remain largely unchanged. Considering traffic noise is a significant source in the area increases in traffic volumes on the local road network would be expected to result in slight increases in overall ambient and background noise in the area over time.

10.7.2 Construction Phase

During the construction phase of the project there will be some effect on nearby noise sensitive properties due to noise emissions from site traffic and other activities. However, given that the construction phase of the development is temporary in nature and the distances between the main construction works and nearby noise sensitive properties, it is expected that the various noise sources will not be excessively intrusive. Furthermore, the application of binding noise limits and hours of operation, along with implementation of appropriate noise and vibration control measures, will ensure that noise and vibration effect is kept to a minimum.

The predicted construction noise and vibration effects are temporary and not significant and is summarised as follows:

Quaility	*Significance*	*Duration*
Neutral	Slight	Short Term

10.7.3 Operational Phase

Due to the fact that the predicted noise levels associated with the proposed development will be within best practice noise criteria curves recommended in Irish guidance *'Planning Guidelines for Wind Farm Development 2006'* it is not considered that a significant effect is associated with the development.

While noise levels at low wind speeds will increase due to the development the predicted levels will remain low, albeit a new source of noise will be introduced into the soundscape.

The predicted operational noise effects are summarised as follows at the closest noise sensitive locations to the site:

Quaility	*Significance*	*Duration*
Negative	Moderate	Long Term

The above effect should be considered in terms that the effect is variable and that this assessment considers periods of the greatest potential effect.

For the majority of locations assessed here the effect of the operational turbines can be considered to be as follows:

Quaility	*Significance*	*Duration*
Neutral	Slight	Long Term

Commissioning noise surveys are recommended to ensure compliance with any noise conditions applied to the development. In the instance that exceedances of these noise conditions arise and are identified the curtailment of turbine operation can be implemented for specific turbines in specific wind conditions in order to ensure predicted noise levels are within the relevant noise criterion curves/planning conditions. Such curtailment can be applied using the wind farm SCADA system without undue effect on the wind farm operations.

As it has been demonstrated that the relevant national guidance in relation to noise associated with wind turbines can be satisfied, the predicted effect associated with the operational turbines is long term and not significant.

In relation to the proposed substation the associated effect is summarised as follows:

Quaility	*Significance*	*Duration*
Neutral	Imperceptible	Long Term

10.7.4 Vibration

Levels of vibration generated as a result of the operation of wind turbine units fall off rapidly with distance away from the units. Typically, at a distance of 100m from a 1 MW turbine unit the level of vibration associated with a turbine is the order of 10^{-5} mm/s. This level of vibration is significantly below any thresholds where either cosmetic or structural damage could be caused to a building as outlined in the relevant section of this document. In relation to the issue of vibration the associated effect is summarised as follows:

Quaility	*Significance*	*Duration*
Neutral	Imperceptible	Long Term

10.7.5 Cumulative Effects

A cumulative assessment has been considered here with due consideration of proposed development in combination with the existing Mountlucas wind farm. The permitted Yellow River wind farm, which is the only other wind farm project located within a 20-kilometre radius of the Cloncreen site, is located a sufficient distance from the proposed development that cumulative noise and/or vibration impacts are not considered to be a significant issue. The nearest permitted Yellow River turbine location is located 9.2 kilometres from the Cloncreen site.

In terms of other operating and proposed developments (that are at various stages of the planning process – See Section 2.10 of the EIS for further details on cumulative projects) it is considered the most likely cumulative effects relate to the potential for construction periods to overlap. If this is the case, the construction and vibration noise limits outlined in this assessment and relevant noise and vibration assessments supporting other projects will apply. Typically, the proposed construction noise and vibration criteria, along with the mitigation measures proposed for the various projects, would be expected to be comparable. Implementation / compliance with these mitigation measures / criteria will be required in order to manage the potential cumulative noise and vibration impacts.

10.8 Monitoring

Post-commissioning of the proposed turbine units, the noise monitoring detailed in the relevant section of this report will be repeated with a view to confirming that the operational units are compliant with the relevant day and night time noise criteria curves as presented in the body of this assessment. If this study work identifies any exceedances of the appropriate criteria relevant corrective actions will be taken/implemented.

11 LANDSCAPE AND VISUAL

11.1 Introduction

This chapter of the Environmental Impact Statement (EIS) addresses the likely significant landscape and visual effects of the proposed wind farm at Cloncreen, Co. Offaly. The emphasis in this chapter is on the likely significant effects of the proposal. It outlines the methodology for the assessment, the description of the proposed development, the existing landscape, as well as landscape policy and relevant guidance. It includes a description of Offaly County Council's landscape policy, with specific reference to wind energy and the area in which the proposed development site is located. As the site is proximate to several other Counties, the relevant landscape policies of Co. Kildare, Co. Westmeath and Co. Laois are also included.

The landscape of the area is described in terms of its existing character, which includes a description of the physical, visual and image units, landscape values and the landscape's sensitivity to change. The landscape and visual impact assessment of the proposed wind farm includes the use of visibility mapping, representative viewpoints and photomontages as well as an assessment of landscape value, landscape sensitivity and viewpoint value and visual receptor sensitivity. The potential likely significant effects in both landscape and visual terms are then assessed, including cumulative effects.

11.1.1 Statement of Authority

This chapter has been prepared by Evelyn Sikora, a qualified Landscape Architect who also holds Corporate Membership of the Irish Landscape Institute. She has over five years' experience as a Landscape Architect and has worked on landscape and visual impact assessments for a variety of wind farm projects of various scales throughout Ireland. Her experience includes landscape and visual assessment for a range of other projects including road schemes, flood relief works, quarries, harbour developments, and residential developments.

11.1.2 'Do-Nothing' Scenario

In the 'Do Nothing' scenario, the proposed development would not be constructed and the permitted wind farm in the vicinity are constructed. Commercial peat extraction will cease on the site. A detailed description of 'Do Nothing' effects is contained in 11.9.2.

11.1.3 Proposed Development Description

While the proposed development is described in full in Chapter 3 of this EIS, a brief description of the key elements relevant to the Landscape and Visual Impact Assessment is included below.

i. 21 No. wind turbines with an overall blade tip height of up to 170 metres and all associated hard-standing areas.
ii. 1 No. borrow pit.
iii. 1 No. permanent Anemometry Mast up to a height of 120 metres.
iv. Provision of new site access roads and associated drainage.
v. 1 no. 110 kV Electrical substation, which will be constructed at one of two possible locations on site: either Option A in Ballykilleen townland or Option B in Cloncreen townland. The electrical substation will have 2 no. control

buildings, associated electrical plant and equipment, and waste water holding tank.

vi. 2 No. temporary construction compounds, one of which will be located in the townland of Esker More and the other at one of two possible locations: either Option A in Ballykilleen townland or Option B in Cloncreen townland.

vii. All associated underground electrical and communications cabling connecting the turbines to the proposed substation at either Ballykilleen or Cloncreen townland.

viii. All works associated with the connection of the proposed wind farm to the national electricity grid, which will be either to the existing Cushaling substation via underground cable (Option A) or to the existing Thornsberry/Cushaling 110 kV line via overhead line (Option B).

ix. Demolition of existing canteen 'tea centre' building.

x. Removal of existing telecommunications mast.

xi. Removal of existing meteorological mast.

xii. New access junctions, improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads and construction access, including: temporary upgrade of R420/R402 junction, temporary road widening at 1 no. location on R402 in Ballinagar, upgrade of R402/L1003 junction, road upgrade along the L1003 and new construction phase site entrance, and upgrade of existing site entrance on R401.

xiii. All associated site development works.

Both substation and grid connection options have been assessed as part of this EIS. All upgrades and improvements to sections of the public road network along turbine delivery route have also been assessed.

For the purposes of this assessment, the dimensions used to generate the visual tools (Zone of Theoretical Visibility (ZTV) and Photomontages) are based on a hub height of 107 metres and a rotor diameter of 126 metres, with a maximum tip height of 170 metres.

The site of the proposed development at Cloncreen measures approximately 960 hectares. The total permanent development footprint will measure 39.6ha in the event of Option A (as referred to above) being constructed, or 40.1 hectares in the event of Option B.

11.1.4 Scoping Responses

A scoping and consultation exercise has been carried out by McCarthy Keville O'Sullivan Ltd., as detailed in Section 2.9 of this EIS. The scoping responses of Offaly County Council and Kildare County Council make reference to the setting and to the landscape and visual impact assessment of the proposed development, and are briefly summarised in Table 11.1 below. Copies of all scoping responses are presented in Appendix 2-2 of this EIS.

Table 11.1 Scoping Replies and Responses relating to Landscape and Visual Effects

Planning Authority	Key Points	Response in EIS
Offaly County Council	Note proximity to Clonbullogue. Policy EP-03 refers to 2-kilometre buffer from town / village cores and European designated sites.	▪ Clonbullogue village core is located 2.2 km from the nearest turbine (T7).

		▪ There are no European designated sites within 2 km of the site.
	Policy EP-03 requires that *'wind energy developments on cutaway bogs should generally be developed from the centre out'.*	▪ Layout has been developed to optimise site. ▪ Layout designed form the centre out as per Policy EP-03. See Section 11.3.2
	Policy EP-04 refers to Cumulative Effects of Wind Farm development – to be included in assessment. Additional photomontages which demonstrate cumulative impact with Mountlucas and proposed Maighne turbines should be included.	▪ Layout reflects the landscape character and visual baseline. ▪ Cumulative ZTV includes existing and permitted and wind farms within 20-kilometre radius. ▪ Photomontages include existing Mountlucas and permitted Yellow River turbines. The Maighne turbines were refused planning permission on 14th October 2016, so are not included in the cumulative assessment. ▪ In particular, Photomontages such as 9,12, 15, 16, 17, 18, 19, 20, 21 and 23 demonstrate cumulative effects
	Reference to cutaway bogs and moderate landscape sensitivity. Reference should be made to County Development Plan and Table 7.11 and 7.113.	Section 11.3.2 and in particular 11.3.2.7 refers to these sections of the County Development Plan.
Kildare County Council	Reference to cumulative effect of proposed development and eastward expansion of wind energy developments.	Cumulative effects of proposed development have been considered in conjunction with other existing and permitted and wind farms – as noted above.
	Landscape issues which arose in the Maighne Wind Farm proposal, and which are considered to be of relevance for the Cloncreen proposal include: Cumulative wind farm landscape impacts; the significant eastward expansion of the visible presence of wind farms; visual impact on the cultural landscape; the availability of long-range views; landscape value of	Chapter 11 Landscape & Visual section of EIS identifies sensitive visual and landscape receptors and assesses predicted effects on a range of receptors which include a wide range of both undesignated and designated views and landscapes, including settlements.

	lowland areas; impacts on the setting of protected structures and the existing rural landscape skyline character; impacts on historic designed landscapes of demesne character; impacts on views and prospects to and from protected structures; impact of new site access tracks; proximity of sensitive receptors; localised landscape impacts; visual dominance of turbines; Potential visual impacts of turbines are greatest within 1.6 km.	
	Comments on angle of view of photomontages.	Photomontages are produced using a narrower angle of view; 120 degrees where possible.

11.1.5 Pre –Planning Meetings

Pre-Planning Meetings were held with the Planning Department of Offaly and Kildare County Councils in relation to the proposed development. Visual impact and photomontages were among the items discussed. A detailed description of meetings and consultation, including public consultation, is contained in Section 2.9.3 of this EIS.

11.2 Methodology and Assessment Criteria

11.2.1 Guidelines

This section broadly outlines the methodology used to undertake the landscape and visual impact assessment of the proposed development, and the guidance used in the preparation of each section. There are four main sections to this assessment:

- Outline of guidance and methodology followed
- Baseline – existing landscape, including policy, existing landscape character and sensitivity
- Nature and visibility of the proposed development
- Assessment of potential effects

The only available, quasi-official document providing guidance on landscape quality at a national level for some time was *'Outstanding Landscapes'*, published by An Foras Forbartha in 1976. In 2000, the Department of the Environment and Local Government built on this document by producing *'Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities'*, which recommended that all Local Authorities adopt a standardised approach to landscape assessment for incorporation into Development Plans and consideration as part of the planning process.

Ireland signed and ratified the European Landscape Convention (ELC) in 2002, which introduces a pan-European concept which centres on the quality of landscape protection, management and planning. The Department of Arts, Heritage and the Gaeltacht has published a National Landscape Strategy for Ireland in 2015. The Strategy aims to ensure compliance with the ELC and contains six main objectives, which include developing a national Landscape Character Assessment and Developing Landscape Policies.

Although the DoEHLG 2000 guidance remains in draft form, certain sections of this chapter have been broadly based on the landscape assessment guidelines presented in the DoELHG document. Other guidelines which are referred to in 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),
- *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 2.1* (Scottish Natural Heritage, 2014).
- *Assessing the Cumulative Impact of Onshore Wind Energy Developments*. Scottish Natural Heritage, 2012)
- *Photography and photomontage in landscape and visual impact assessment* Landscape Institute Advice Note 01/11, 2011)
- *EPA Guidelines on the information to be contained on Environmental Impact Statements (EPA 2002)*
- *EPA Advice Notes on Current Practice in the preparation of Environmental Impact Statements (EPA, 2003).*

11.2.2 Baseline Landscape and Visual Information

In order to carry out this assessment, an initial desk study was undertaken which identified relevant policies and guidelines, both at national and local level. This includes policies on wind energy, landscape and landscape character, designated landscapes and protected views.

The EIS Study Area is described in terms of Landscape Character Types as identified in *'Landscape and Landscape Assessment: Consultation Draft of Guidelines for Planning Authorities'* (Department of the Environment and Local Government, 2000), while the surrounding landscape within 20 kilometres of the Study Area boundary is described with reference to Landscape Character as well as other landscape designations contained in Offaly County Development Plan 2014 - 2020 and the Development Plans of Counties Kildare, Laois and Westmeath. In addition, field visits were undertaken in Autumn 2015 and Winter/Spring and Summer 2016 to assess the landscape character and visual elements both in the EIS Study Area and in the wider landscape.

11.2.2.1 Scope and Definition of Landscape and Visual Impact (LVIA) Study Area

Where the 'site' is referred to in this EIS, this refers to the overall Bórd na Móna Cloncreen site where the proposed development is to take place. This area is discussed in detail in terms of its landscape character. However, the landscape and visual baseline mapping, ZTV mapping, and viewpoint selection are based on a wider study area, consisting of an area of 20 kilometres from the wind farm site boundary. This follows guidance contained in the DoEHLG Guidelines (2006) for the production of ZTV mapping to extend to 20 kilometres for turbines of a height greater than 100 metres. This is the study area for which the baseline maps, Zone of Theoretical Visibility (ZTV) maps and viewpoint locations are produced and is referred to as the Landscape and Visual Impacts (LVIA) Study Area. It should be noted that the study area for Cumulative landscape and visual effects is also 20 kilometres.

11.2.2.2 Nature and Visibility of the Proposed Development

The visibility of the proposed development is described using ZTV mapping and photomontages, which show how the proposed wind turbine is likely to appear from various viewpoints within a 20-kilometre radius of the site boundary. The proposed wind turbine will have a maximum turbine base to blade tip height of up to 170 metres.

11.2.2.3 Zone of Theoretical Visibility Maps

The Zone of Theoretical Visibility (ZTV) represents the area over which a development can theoretically be seen, and is based on a Digital Terrain Model (DTM), overlaid on a map base. A DTM refers to the way in which a computer represents a piece of topography in three dimensions as a digital model. ZTV maps provide the following information:

- Where visibility of a wind energy development is most likely to occur;
- How much of the wind energy development is likely to be visible (using different coloured bands for different numbers of turbines);
- The extent and pattern of visibility.

Production of ZTV maps is usually one of the first steps of the assessment of visual effects, helping to inform the selection of the Study Area in which likely significant effects will be considered in more detail and the identification of sensitive vantage points. *(Visual Representation of Wind Farms*, Scottish Natural Heritage, 2014).

11.2.2.4 Limitations of ZTV Mapping

The Scottish Natural Heritage guidelines referred to above acknowledge the following limitations inherent to the use 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 likely significant visual effects. The visibility of the turbines will decrease with the distance from which they are viewed, but this is not accounted for in the ZTV. Figure 11.1 below provides an illustration of the differences in view relative to the distance from a turbine.

Figure 11. 1 The effect of distance on visibility of wind turbines (Illustrative Purposes Only)

- 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.

11.2.2.5 Viewpoints (Photo Locations) and Photomontages

Viewpoint Locations

The identification of viewpoint locations is an important step in the process of visual impact assessment and is aided by the production of the ZTV.

The photo locations were selected following guidance contained the DoEHLG *'Wind Energy Development Guidelines for Planning Authorities* (2006), the LI/IEMA - *Guidelines for Landscape and Visual Impact Assessment'* (2013), hereafter referred to as GLVIA (2013), and in the *'Visual Representation of Wind Farms* (Scottish Natural Heritage, 2014). The selection of photo locations is designed to give a representative range of views of the proposed development.

Definition and Uses

Photomontages are visualisations that superimpose an image of a proposed development upon a photograph or series of photographs. They are intended as graphical representations of how a proposed development will appear in the existing landscape. A series of 23 No. photomontages has been prepared as part of this assessment and are presented in a separate Volume 2 Photomontage Booklet to be submitted to along with this EIS.

Limitations

Photographs, and therefore photomontages, are subject to a range of limitations, as stated in 'Visual Assessment of Wind Farms' (Scottish Natural Heritage, 2014):

- *Visualisations provide a tool for assessment that can be compared with an actual view in the field; they should never be considered as a substitute to visiting a viewpoint in the field.*
- *Neither photographs nor visualisations can replicate a view as seen in reality by the human eye.*
- *Visualisations are only as accurate as the data used to construct them.*
- *Visualisations can only represent the view from a single location at a particular time and in particular weather conditions.*
- *Static visualisations cannot convey the effect of turbine blade movement.*

Although the scale, siting and geometry of photomontages are based on technical data, the other qualities of the image are open to judgments. The Guidance also notes that interpretation of visualisations also needs to take into account additional information including variable lighting, movement of turbine blades, seasonal differences and the movement of the viewer through the landscape. However, and accepting these limitations, the SNH guidelines state that photomontages are useful and essential tools in the Visual Impact Assessment of wind turbines.

11.2.3 Assessment of Potential Impacts

The potential significant effects of the proposed development in terms of visual and landscape effects are informed by the ZTV and photomontages. The methodology includes clearly documented methods in order to arrive at an assessment. These include consideration of landscape and visual sensitivity balanced with the magnitude of the effect in order to arrive at an assessment of the significance of likely significant landscape and visual effects. Further details on the impact assessment methodology and a description of terminology used are presented in Section 11.8.

11.2.3.1 Cumulative Landscape and Visual Effects

Cumulative effects can be described as additional changes caused by a proposed development in conjunction with other similar developments, or as the combined effect of a set of developments, taken together (SNH, 2012). The DoEHLG Guidelines (2006) define Cumulative Effects in terms of wind farms the perceived effect on the landscape of two or more wind energy developments visible from any one place.

In this case, the most likely significant effects are the cumulative visual effects with other wind farms, but for completeness, other developments in the vicinity listed below also considered.

In terms of the assessment, it follows the same structure as the assessment of landscape and visual effects which relate to the proposed project. The baseline information contained in Section 11.3 includes the information needed for the assessment of cumulative landscape and visual effects. Cumulative ZTV maps are produced which include the other wind farms. In addition, the photomontages include other projects, most notably the existing and permitted wind farms, but the cumulative landscape and visual effects are described separately in Section 11.9.

There are a number of developments (existing, permitted, and proposed and at pre-planning stage) which were identified in a planning search are described in Chapter 2 – Section 2.10.2 and which are listed below:

- Mountlucas wind farm (Existing)
- Yellow River wind farm (Permitted)
- Clonbullogue Ash Repository (Existing)
- Edenderry Power Plant (Existing with proposed continued use until 2030)
- Peat Extraction: Existing (Allen Group Bogs Offaly, Laois, Kildare & Westmeath)
- Peat Extraction: (Existing) Derrygreenagh Group of Bogs - Westmeath, Offaly & Meath.
- Barrow Blueway: (Pre Planning Stage) Lowtown, Co. Kildare to St. Mullins, Co. Carlow
- Grand Canal Blueway Shared Walking and Cycling Route - Cappancur to Lough Boora (Proposed)
- Eastern and Midlands Regional Water Supply Project (Emerging Preferred Option)
- Clonin North Solar Farm (Proposed)
- Infilling of lands for agricultural use at Shean, Co. Offaly (Proposed).

These developments fall into a number of categories. In terms of cumulative effects, both the DoEHLG (2006) Guidelines and the SNH (2012) guidance place the emphasis on other wind farms, however all of the developments were considered in terms of landscape and visual effects. The GLVIA (2013) guidance recommends that the consideration of cumulative landscape and visual effects could relate to either one or a combination of the following:

- Other examples of the same type of development

- Other types of development proposed within the study area, including those that may arise as an indirect consequence of the main project under consideration
- Different scheme components or associated and ancillary developments that in some cases may require their own planning consent

The GLVIA guidelines (2013) also suggest that schemes with planning consent, and schemes which are the subject of an undetermined but valid planning application should be included. Schemes that are at pre-planning or at scoping stage are generally not considered as there is uncertainty about what will occur. Therefore, the Emerging preferred option for the Eastern and Midlands water supply project, is not considered further in this assessment. Projects which have been refused planning permission are not considered in this assessment.

The projects listed above at various stages of development are located within the 20 kilometre study area, and particular emphasis is placed on the wind farms as these have most potential for significant cumulative landscape and visual effects. These potential cumulative effects are assessed in Section 11.9.

11.3 Wind Farm Development Guidelines and Landscape Policy Context

11.3.1 DoEHLG 'Wind Energy Development Guidelines' (2006)

This section of the EIS refers to the wind energy development guidelines set out by the DoEHLG in 2006, and the policies and objectives of Offaly County Development Plan 2014 - 2020 along with the Kildare, Westmeath and Laois County Development Plans (including references to the draft Kildare County Development Plan) with regards to landscape, landscape character and scenic amenity.

The Wind Energy Development Guidelines set out guidance for the siting and design of wind energy developments in various landscape contexts by defining six landscape character types that represent most situations where wind turbines may be proposed.

The proposed development site is on a cutover bog, a landscape that is best described as Flat Peatland as per the Wind Energy Development Guidelines 2006. There are also extensive areas of peatland within the Landscape Study Area – the area within 20 kilometres from the boundary of the proposed development site. However certain areas in the wider landscape of flat farmland where visibility of the peatlands are well screened can be described as Flat Farmland, and in certain areas the turbines will be viewed from these landscapes.

11.3.1.1 Flat Peatland

The key characteristics of the Flat Peatland landscape type, as described in the Guidelines are:

- *"Landscapes of this type comprise a vast planar extent of peatland, and have significant potential for future wind energy development"*
- *"In their relatively undisturbed and naturalistic state the wet bogs comprise a landcover mostly of heather, wild grasses and bog cotton, as well as patches of coniferous plantation"*
- *"Some of these bogs have been harvested for peat and may comprise long parallel ridges of stacked milled peat and deep drains"*
- *"Evidence of human habitation is sparse"*

- *"Roads tend to run in straight lines over considerable distances, followed by electricity and/or telephone lines and*
- *This landscape type is horizontal, open, extensive, and also characterised by a sense of remoteness"*

The majority of the landscape's characteristics is described by the text above.

The Siting and Design Guidance for Flat Peatland is as follows:

> ***"Location***
> *Wind energy developments can be placed almost anywhere in these landscapes from an aesthetic point of view. They are probably best located away from roadsides allowing a reasonable sense of separation. However, the possibility of driving through a wind energy development closely straddling a road could prove an exciting experience.*
>
> ***Spatial Extent***
> *The vast scale of this landscape type allows for a correspondingly large spatial extent for wind energy developments.*
>
> ***Spacing***
> *Regular Spacing is generally preferred, especially in areas of mechanically harvested peat ridges.*
>
> ***Layout***
> *In open expanses, a wind energy development layout with depth, preferably comprising a grid, is more appropriate than a simple linear layout. However, where a wind energy development is located close to a feature such as a river, road or escarpment, a linear or staggered layout would also be appropriate.*
>
> ***Height***
> *Aesthetically, tall turbines would be most appropriate. In any case, in terms of viability they are likely to be necessary given the relatively low wind speeds available. An even profile would be preferred.*
>
> ***Cumulative Effect***
> *The openness of the vista across these landscapes will result in a clear visibility of other wind energy developments in the area. Given that the wind energy developments are likely to be extensive and high, it is important that they are not perceived to crowd and dominate the flat landscape. More than one wind energy development might be acceptable in the distant background provided it was only faintly visible under normal atmospheric conditions."*

The proposed development will meet the above guidance in terms of spatial extent, spacing (which is geometric and regular), layout (as it appears as a grid-type layout with depth). In terms of height and cumulative effect, the proposed turbines are also in compliance with the guidelines.

As noted above, the proposed development is located in Flat Peatland but will be viewed from some surrounding areas, some of which have a character type best described as Flat Farmland, characterised by agricultural fields and farms; in some cases, the proposed development will not be viewed from or across a vast area of flat peatland. Some views are across a relatively open and large scale agricultural landscape. Views from this landscape type results in reduced visibility in some cases due to the screening provided by hedgerows and field boundaries.

11.3.1.2 Hilly and Flat Farmland

The key characteristics of this landscape type, some of which are relevant to the study area, include:

- *"Intensively managed farmland, whether flat, undulating or hilly"*
- *"A patchwork of fields delineated by hedgerows varying in size"*
- *"Farmsteads and houses are scattered throughout, as well as occasional villages and towns"*
- *"Roads, and telegraph and power lines and poles are significant components; and*
- *A working and inhabited landscape type"*

Recommendations for this landscape type (Hilly and Flat Farmland) include rational order and simplicity as well as respect for scale and human activities, and advice that due regard should be given to houses, farmsteads and centres of population. Some of the siting and design advice that pertains to this landscape type of Hilly and Flat Farmland is set out below, and some of this is relevant, though the siting and design guidelines for Flat Peatland above are more relevant and take precedent. References to elevated topography are not included as they do not apply to the study area.

> ***Location***
> *...Sufficient distance should from farmsteads, houses and centres of population in order to ensure that wind energy developments do not dominate them...*
>
> ***Spatial Extent***
> *This can be expected to be quite limited in response to the scale of fields.......Sufficient distance from buildings is likely to be critical at lower elevations, must be established to avoid dominance by the wind energy development...*
>
> ***Spacing:***
> *The optimum spacing pattern is likely to be regular, responding to the underlying field pattern.*
>
> ***Layout***
> *"The optimum layout is linear....Where a wind energy development is functionally possible on a flat landscape a grid layout would be aesthetically pleasing."*

Although, as stated above, not all of the above guidance on Hilly and Flat Farmland is relevant to the study area, the location (on a cutover bog, sufficient distance from houses and farmsteads and settlements), spacing (which is geometric and regular), and layout (as it appears as a grid-type layout) of the proposed development, follow the guidance above. The guidance on spatial extent is consistent with the Flat Peatland guidance above, and does not apply here as the turbines are situated on a cutover bog with no underlying field patterns or distinctive topographic features. In terms of height, the guidance for Flat Peatland is also relevant here. These are referred to above in Section 11.3.1.1.

11.3.2 Offaly County Development Plan 2014 – 2020

11.3.2.1 Wind Energy Strategy Policies and Objectives

Section 3.5.1 of the Offaly County Development Plan includes policies and objectives regarding wind energy development. The Plan notes the existence of Mountlucas wind farm and considers there is potential for turbines of a similar scale to be suitably sited on cutaway bog and other unobtrusive sites around the country.

The Development Plan's Wind Energy Strategy identifies areas which are considered suitable for wind energy development in the county. Map 3.2 in the Plan identifies areas suitable and not suitable for wind energy development.

> ***Areas Suitable for Wind Energy Development***
> *These areas are open to consideration for appropriate wind energy proposals, where the development of wind farms and smaller wind energy projects will be open to consideration, subject to site specific considerations and layout and demonstration that the project will not have likely significant effects on the conservation objectives of European Sites.*

The proposed wind farm is located within an area which is defined as an area suitable for and therefore considered appropriate for wind energy development. In all other areas, wind energy developments will not normally be permitted. Areas marked on the map which are not considered suitable for wind energy include the Slieve Bloom Mountains, eskers, on Croghan Hill, and the Shannon Callows.

The Plan makes particular mention of the suitability of cutaway bog for wind development. These sites are described as large and generally uninterrupted by natural features and many have the advantage of existing railway lines. The Plan also states that areas where peatlands occur have a low density road network and are the least densely populated areas in the County. The Plan recommends a two-kilometre buffer from town and village cores. Relevant policies in the Plan are as follows:

> ***Policy EP–02:*** *It is Council policy to facilitate the continual development of renewable energy sources having regard to the proper planning and sustainable development of the area concerned, the protection of amenities, landscape sensitivities, European Sites, biodiversity, natural heritage, and built heritage, and where such proposals comply with policy contained in the County Development Plan, in the interests of proper planning and sustainable development.*
>
> ***Policy EP–03:*** *It is Council policy to encourage the development of wind energy in suitable locations, on cutaway bogs within the wind energy development areas open for consideration identified in Map 3.2, in an environmentally sustainable manner and in accordance with Government policy, having particular regard to the Wind Energy Strategy for the County and Section 3.5.1, which states that appropriate buffers should be provided, which shall be a minimum of 2km from Town and Village Cores, European designated sites, including Special Areas of Conservation (SAC) and Special Protection Areas (SPA), and national designations, Natural Heritage Areas (NHA). Wind Energy developments on cutaway bogs should generally be developed from the centre out.*
>
> *The Area around Corracullin Bog, (Area 4 in Wind Energy Strategy), is omitted from the Wind Energy Development Area."*

> ***Policy EP–04:*** *Cumulative effects of wind farm development can arise as the combined consequences of proposals for more than one wind energy development within an area or proposal(s) for new wind energy development(s) in an area with one or more existing or permitted developments. Offaly County Council will monitor cumulative impact assessments of wind energy proposals over the lifetime of the plan and cumulative impacts will be a material consideration in the assessment of any planning application for wind energy development.*

It should be noted that Policy EP-03 is particularly relevant, as the proposed development at Cloncreen is located on cutaway bog and is within the areas identified as Open for Consideration on Map 3.2 of the County Development Plan. Regarding Policy EP-04, the assessment of cumulative visual and landscape effects of other existing, permitted and proposed wind farms as well as other large scale developments in the planning process are included in this Chapter and illustrated in the photomontages and ZTV maps. While the DoEHLG Guidelines only refer to cumulative effects of two or more energy developments visible from any one location, and the SNH Guidance emphasises the consideration of other wind farms, a number of other proposed non-wind farm developments are listed in Section 2.10.2 of this EIS, as consistent with the GLVIA (2013) guidance. However, for the purposes of the landscape and visual impact assessment, developments which have the potential to cause significant effects are assessed.

11.3.2.2 Offaly County Development Plan Landscape Policies and Objectives

Chapter 7 Heritage and Landscape outlines policies and objectives relating to landscape and heritage. The overall landscape of Offaly is described, with features in the landscape such as the peatlands, Slieve Bloom Mountains, Esker Ridges, the River Shannon being considered important.

The Plan also emphasises the importance of Green Infrastructure, which it defines as *'Strategically planned and interconnected networks of green space and water capable of delivering ecosystem services and quality of life benefits to people'*. This can include parks, open spaces, rivers, farmland, playing fields, woodlands, allotments and private gardens and should be designed and managed as a multifunctional resource. Connectivity is also an important aspect to Green Infrastructure. The Plan contains a number of Green Infrastructure policies and objectives, which include:

> ***Objective GIO-04:*** *It is an objective of the Council to develop and support the implementation of Green Infrastructure Strategy for Offaly working with chief stakeholders including Bord na Móna, NPWS, Coillte, WWI and Farmers, community groups and NGOs, where appropriate.*

11.3.2.3 Landscape Character Assessment

Offaly County Council does not have a Landscape Character Assessment (LCA) however there are a number of Landscape and Amenity Objectives which relate to this topic:

> ***Objective LAO-04:*** *It is an objective of the Council to investigate the feasibility of preparing a Landscape Character Assessment during the lifetime of this plan.*

> ***Objective LAO-05:*** *It is an objective to investigate the feasibility of preparing a Historic Landscape Characterisation and utilise the results to complement and contribute to comprehensive Landscape Character Assessment (LCA).*

Objective LAO-06: *It is an objective of the Council to review the Landscape Character Assessment for the county, subject to available resources.*

11.3.2.4 Areas of High Amenity

Offaly County Council has designated Areas of High Amenity (AHA) which are areas of scenic and amenity value, and these are illustrated in Map 7.17 of the Development Plan. These areas are also mapped on Figure 11.2 of this EIS section. Included as the primary AHAs are the Slieve Bloom Mountains, Clonmacnoise Heritage Zone, Lough Boora Parklands, Waterways, (including the Grand Canal and River Shannon), Croghan Hill, Raheenmore Bog, Pallas Lake, Clara Bog, Eskers including Eiscir Riada and Durrow High Cross, Abbey and surrounds.

There are no AHAs on the proposed development site. There are several AHAs within the Landscape Study Area, which is an area of 20 kilometres in radius from the site boundary. These AHAs are described below.

Eskers

The Plan notes the importance of Eskers due to their geological, zoological, botanical and scientific value. There are 28 Esker systems in the County which contain 208 segments.

The closest AHA to the site of the proposed development are some areas of Esker to the northeast and northwest of the site. These are shown in Figure 11.2. An area of AHA is located to the northwest of the site, in the townland of Ballycon, along the Regional Road R402 between Esker Bridge and the village of Mountlucas. There is evidence of a sand/gravel quarry along part of this area. This is located approximately 0.7 kilometres from the proposed development site.

Another two areas of AHA which are identified as Eskers, the closest of which is located approximately 1.5 kilometres northeast of the site at its closest point. The closest site is a sand and gravel quarry, while the area further east appears to be a quarry or former quarry close to an area of cutover bog which has large areas of scrub and vegetation.

There are several Eskers to the southeast of the proposed development site, the closest of these being approximately 12 kilometres away.

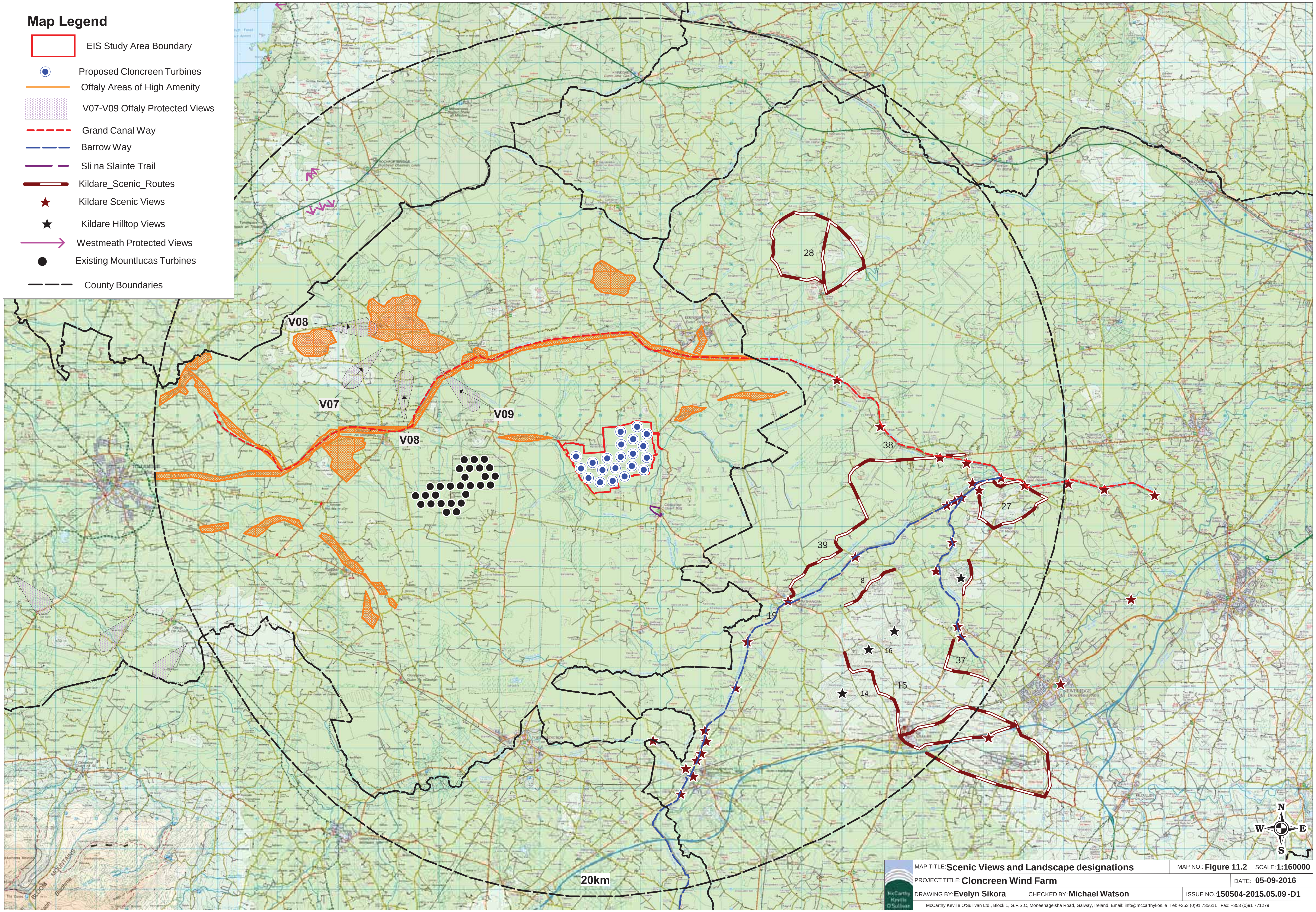
Waterways

The Grand Canal is designated as an AHA, and the Development Plan notes its wide range of uses, in particular as a focus for recreation and tourism purposes, and the visual quality of the surrounds is important to the attractiveness of the Canal corridor. The canal corridor is deemed sensitive to larger development structures, insensitively designed sporadic housing and large scale land uses such as extractive industries.

The Grand Canal lies approximately 3.4 kilometres north of the proposed development at its closest point. The canal bank is used as a walking and cycling route and is a feature of this landscape, being visible from certain sections of road, and the canal bridges and aqueducts themselves being features of the landscape.

Boglands

The Plan notes the presence of blanket bogs, while there are a number of lowland raised bogs and the Plan recognises that the peatlands comprise the main



MAP TITLE: Scenic Views and Landscape designations	MAP NO.: Figure 11.2	SCALE: 1:160000
PROJECT TITLE: Cloncreen Wind Farm		DATE: 05-09-2016
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topographical feature of the landscape in County Offaly. The Plan also notes that cutaway bogs in the county and notes that there is potential to regenerate these bogs.

Bogs, and in particular cutaway bogs, are found within the 20 kilometre radius of the proposed development, and the site itself is located on a cutaway bog. The nearby cutover bog at Mountlucas is the location for a 28-turbine wind farm.

Croghan Hill
The Development Plan recognises the importance of the Croghan Hill area for its scenic quality and recreation value and states that the Council will seek to preserve the scenic amenity and recreational potential of this area and protect it from development which would diminish its overall attractiveness and character. This area encompasses Croghan Hill itself, as well as Raheenmore Bog and Cannakill Medieval Deserted village. Map 7.17 of the Development Plan also includes the hill to the southeast of Croghan hill.

The AHA at Croghan Hill lies approximately 7.4 kilometres to the northwest of the proposed development site at its closest point.

11.3.2.5 Views and Prospects

Section 7.12 of the Plan refers to a number of views and prospects which are listed in Section 7.11.5 of the Development Plan and shown in Map 7.18 of the Plan. There are 19 views and prospects listed, however only three views, Views 7, 8, and 9 are located within 20 kilometres of the proposed development site boundary. The Plan describes these Views as follows:

Table 11.2 Views and Prospects within 20 kilometres (Co. Offaly)

View / Prospect	View From	View To
7	Road No. L-01018 in the townlands of Cannakill and Croghan Demesne	Slieve Bloom Mountains
8	Townlands of Barnan, Kilduff, Old Croghan, Croghan Demesne, Down.	Views toward Croghan Hill and Boglands.
9	Townlands of Grovesend and Coole	South to boglands

View 9 is located within 10 kilometres of the proposed development, while Views 7 and 8 are more than 10 kilometres from the proposed development. View 7 denotes views towards the Slieve Bloom Mountains which is to the southwest and away from the study area, while Views 8 are views towards Croghan Hill and not in the direction of the proposed development.

As the description above shows, and Figure 11.2 illustrates, the view which has the most potential to have visibility of the proposed development is Viewpoint 9. Section 11.7 below refers to Viewpoints 20 and 21 which is taken in the vicinity of Protected View 7, Croghan Hill, and Viewpoint 19 which is taken from Protected View 9.

The Plan contains the following objective regarding scenic views:

> ***Objective LAO-02:*** *It is an objective of the Council to preserve scenic views and prospects throughout the county which will be assessed on a case-by-case basis, as part of the development management process. (Views are listed in Table 7.11.5 and shown on Map 7.18).*

11.3.2.6 Scenic Amenity Routes

There are two designated Scenic Amenity Routes in Co. Offaly, however these are outside the 20 kilometre-radius from the proposed development site.

11.3.2.7 Landscape Sensitivity

The Development Plan contains a Landscape Sensitivity Classification, which is described and also illustrated in Map 7.15 in the Plan. (Note a separate assessment of sensitivity of the study area landscape is contained in the Assessment, in Section 11.7). Landscape Sensitivity is defined in the Development Plan as '*the measure of its ability to accommodate change or intervention without suffering unacceptable effects to its character and values".*

There are three categories of sensitivity, Low, Medium and High, which are described with reference to typical landscape characteristics and sensitivities. The proposed development site at Cloncreen is considered to be of Medium Sensitivity, while there are areas of Low, Medium and High Sensitivity within 20 kilometres of the proposed development site. These are illustrated on Figure 11.3. Key points extracted from Table 7.11.1 and Tables 7.11.2-5 of the Plan regarding landscape sensitivity are presented below.

Low Sensitivity: Rural and Agricultural Areas

The Plan describes County Offaly as a mainly rural county which comprises a predominantly flat and undulating agricultural landscape coupled with a peatland landscape. It also notes that field boundaries, particularly along roadside verges, are primarily composed of mature hedgerows typify the county's rural landscape.

The Plan states that these areas in general can effectively absorb appropriately designed and located development in all categories (including telecommunication masts and wind energy installations). Certain areas within 20 kilometres of the proposed development site fall into this category.

Medium **Sensitivity**: **Cutaway Bog**

The Plan notes that cutaway bogs cover a large part of the landscape of Offaly and cover in total approximately 42,000 hectares. Suitable land-uses for cutaway bog, include wilderness, grassland, forestry and recreation. Some cutaway bog landscapes are considered more robust and may be considered for other uses.

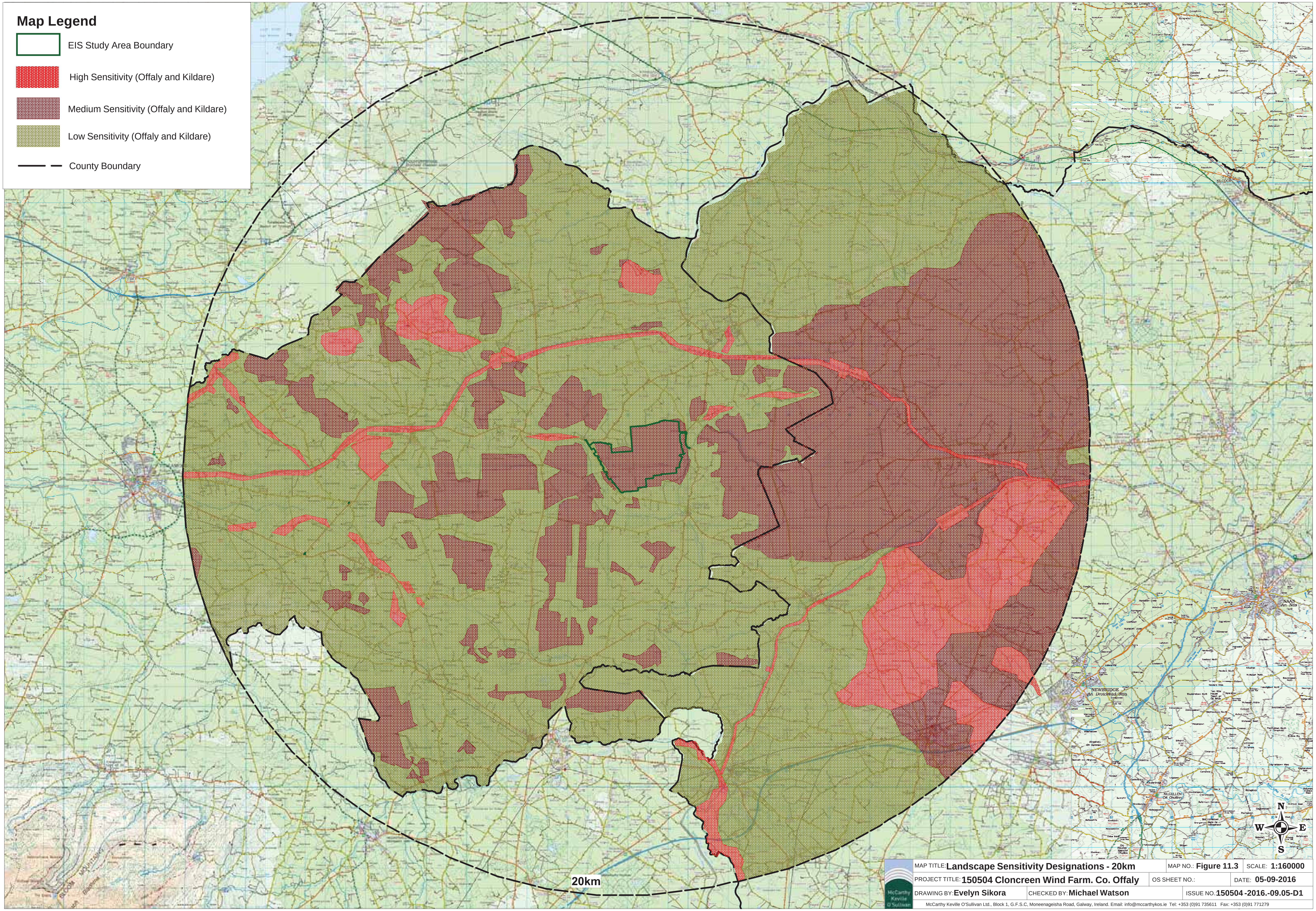
In terms of sensitivity, the plan notes that some of these cutaway bogs may be appropriate for other sensitively designed and located developments including renewable energy (wind farms, biomass crops) and/or industrial use. The proposed development site falls into this category.

High Sensitivity

Areas of High Sensitivity are described separately. These include the River Shannon, Grand Canal Corridor, Wetlands, Slieve Bloom Mountains, Croghan Hill and Environs, Bogland (not cutover bogs) and Eskers. Some areas of High Sensitivity are also found within 20 kilometres of the proposed development site. The most relevant to the proposed development are summarised below:

High Sensitivity: Grand Canal Corridor

The Grand Canal Corridor has a wide range of uses – recreation and tourism. In terms of character, the visual quality of the surrounding areas is intrinsic to the attractiveness of the canal corridor. Sensitivities outside of settlements include sensitivity to large


Map Legend
EIS Study Area Boundary
High Sensitivity (Offaly and Kildare)
Medium Sensitivity (Offaly and Kildare)
Low Sensitivity (Offaly and Kildare)
County Boundary
20km
MAP TITLE: Landscape Sensitivity Designations - 20km
MAP NO.: Figure 11.3
SCALE: 1:160000
PROJECT TITLE: 150504 Cloncreen Wind Farm. Co. Offaly
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structures, insensitively designed sporadic housing and large scale land uses such as extractive industries. In addition, the Council will also have regard to Waterways Corridor Studies 2002.

High Sensitivity: Croghan Hill and Environs
Croghan Hill, an extinct volcano, lies 234 metres above sea level and commands views over north and east Offaly and surrounding counties. The hill and environs include Raheenmore Bog and Cannakill Medieval Deserted Village.

This area is of archaeological and amenity value and is regarded as highly sensitive to new development. The Council also recognises the scenic quality and recreational value of the whole Croghan Hill area. Due to the elevation of Croghan Hill and the surrounding landscape, it is described as having an impact on the visual quality of the surrounding area and is highly sensitive to developments of any nature, particularly sand and gravel extraction.

High Sensitivity: Eskers
Eskers were built under the ice cap and have archaeological significance. Eskers have geomorphologic, scientific, historical, cultural, recreational and amenity value as well as economic importance. Sensitivities include the Esker north of Clara Bog, and all eskers are sensitive to future development and the opening up of new sand/gravel pits will be strongly resisted by the Council.

The Plan contains the following relevant Landscape and Amenity Policies:

> ***Policy LAP-02:*** *It is Council policy to control development as per the county's landscape classification listed in Tables 7.11.1-7.11.4*

Summary
In summary, the proposed development site location is described in the Plan as an area of Medium sensitivity, which as a cutover bog has some potential for alternative land uses such as renewable energy or biomass crops.

Areas of low sensitivity within 20 kilometres of the proposed development consists mainly of farmland, while there are also many areas of Medium sensitivity which consist of cutover bogs. Several Areas of High Sensitivity occur within 20 kilometres of the proposed development, the most notable being the Grand Canal Corridor as well as Croghan Hill and environs.

11.3.2.8 Walking Routes and Cycleways

The Grand Canal Way runs alongside the Grand Canal (referred to in Section 11.3.3.7 above) as the only long distance trail in the vicinity of the proposed development site. This is a popular recreational area used both for walking and cycling. Much of the Grand Canal is also an Area of High Sensitivity as described above.

There is a recently opened Slí na Sláinte trail outside Clonbullogue village and is located approximately 1.25 kilometres southeast of the proposed development. These trails are also illustrated on Figure 11.2.

11.3.3 Kildare County Development Plan 2011 – 2017

The county boundary between Kildare and Offaly lies approximately 3.6 kilometres to the east of the proposed development site. The relevant policies and objectives of the Kildare County Development Plan are outlined below.

11.3.3.1 Landscape Policies and Objectives

Chapter 15 of the Kildare County Development Plan contains policies and objectives regarding landscape, recreation and amenities.

11.3.3.2 Landscape Character Assessment

A Landscape Character Assessment of Kildare County was carried out in 2004. This identifies 14 main Landscape Character Areas (LCAs), which are then categorised into four major landscape types. These are Uplands, Lowland Plains and Boglands, Transition Lands and River Valleys and Water Corridors. These are shown on Map 14.1 of the Kildare County Development Plan 2011-2017.

Within a 20-kilometre radius of the site, there are a number of County Kildare Landscape Character Areas which are of varying sensitivities. These are shown in Figure 11.4 and are listed in 11.3.4.3 below.

11.3.3.3 Landscape Sensitivity

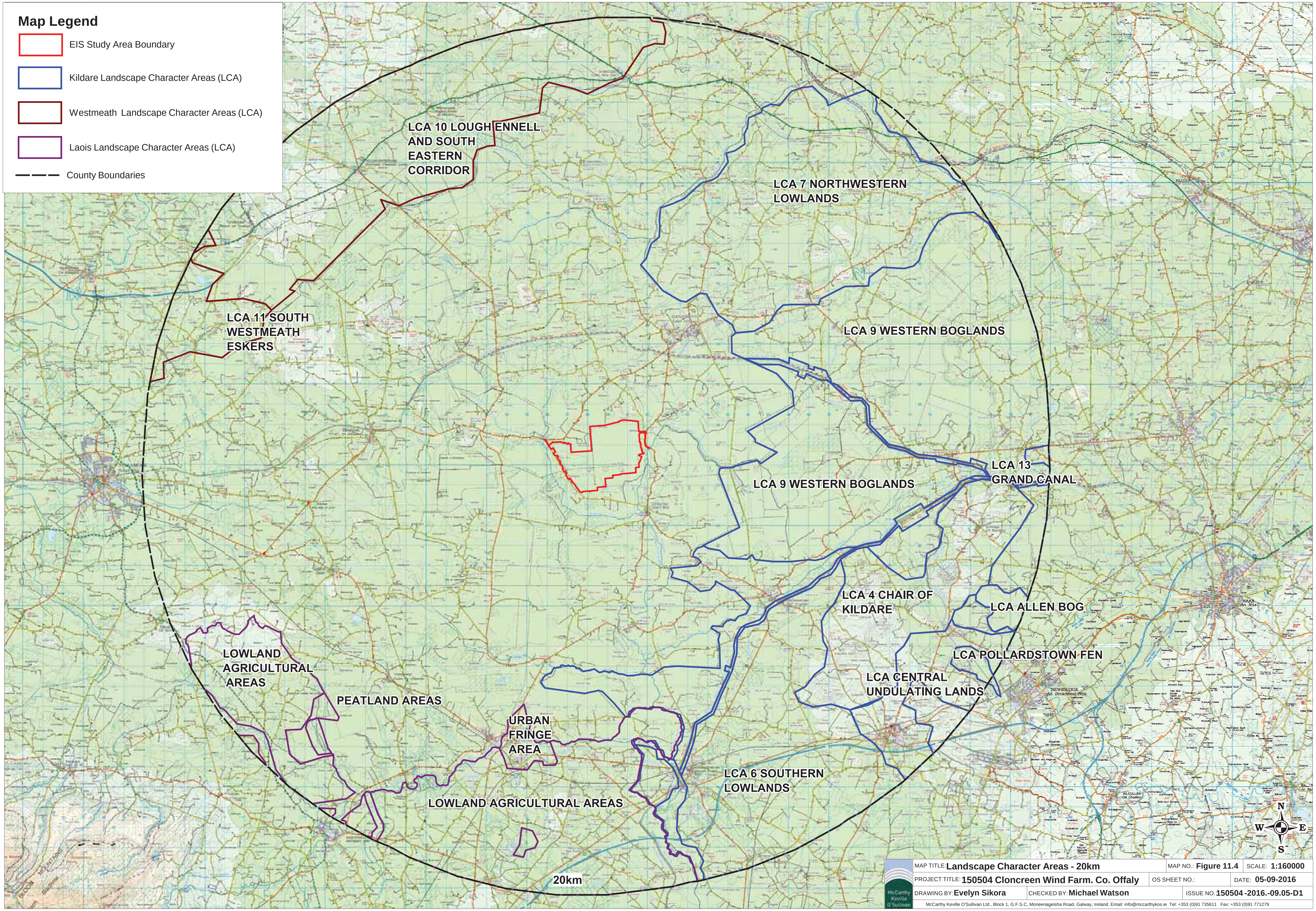
A Landscape Sensitivity Rating is based on the findings of the Landscape Character Assessment. This is defined as the measure of the landscape's ability to accommodate change or intervention without suffering unacceptable effects to its character and values. Sensitivity is assigned to each Landscape Character Area and is illustrated on Map 14.2 of the Kildare County Development Plan. However, the Plan notes that while the potential impact of the development must be viewed in light of the sensitivity of the area, all developments are unique and each site should be assessed on its individual merits. Those which directly border Co. Offaly and are closest to the proposed development include:

- North Western Lowlands (Low Sensitivity)
- Western Boglands (Medium Sensitivity)
- Southern Lowlands (Low Sensitivity)
- River Barrow Valley (High Sensitivity)
- Grand Canal Corridor (High Sensitivity)

These areas are illustrated in Figure 11.3. It should however be noted that although both Offaly and Kildare have assigned areas of High, Medium, and Low Sensitivity, and these are mapped accordingly, these do not necessarily have the same criteria used to classify sensitivity. However, these are mapped using the same colours for ease of comparison. The LCAs are described in the Appendix 3 Landscape Character Assessment of the County Development Plan 2011-2017, as summarised below.

North Western Lowlands

The North Western Lowlands LCA lies on the northwest Kildare county boundary, to the northeast of the proposed development. At its closest point, the LCA is approximately 6.37 kilometres northeast of the proposed development site. The topography is flat in general, the highest point being Carbury Hill, where there is some undulation in the landscape. Fields are medium to large in size and are bordered by hedgerows which include scattered trees. The Assessment notes that hedgerows partially screen the adjacent low lying areas, but the flat terrain allows long distance visibility. The LCA is characterised by smooth terrain, which allows long distance views, generally low vegetation and hedgerows, as well as shelter vegetation which allows visual screening. The landscape is classed as Low Sensitivity.



MAP TITLE: Landscape Character Areas - 20km	MAP NO.: Figure 11.4	SCALE: 1:160000
PROJECT TITLE: 150504 Cloncreen Wind Farm. Co. Offaly	OS SHEET NO.:	DATE: 05-09-2016
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Western Boglands
The Western Boglands LCA lies to the west of the boundary of Co. Kildare and to the east of the proposed development site. At its closest point the LCA is approximately 3.79 kilometres east of the proposed development site. The landscape is described in the Assessment as generally flat with smooth terrain and the landscape is characterised by bog land, including raised bogs and areas of reclaimed peat. Peat extraction is a major land use with some agriculture. This LCA is described as highly distinctive, characterised by bogland vegetation and smooth terrain, which allows long distance views. While vegetation is described as generally low, some stretches of shelter vegetation are present in this landscape, consisting of scattered trees and unmaintained hedgerows which border large sized open lands. Two of the water corridors which feed the Grand Canal are in this LCA and views are available from local roads and viewing points, while these areas are generally enclosed. The Landscape Sensitivity of this LCA is classed as Medium.

Southern Lowlands
The Southern Lowlands LCA covers an extensive area and lies to the southeast of the proposed development site, approximately 4.71 kilometres from the site at its closest point. This LCA is a low lying area with some distant views. Land uses include tillage and pastureland as well as some woodlands and bogland areas. Critical landscape factors include the flat topography, areas of low and high vegetation and river and water corridor views. The Landscape Sensitivity of this LCA is classed as Low.

River Barrow Valley
The River Barrow valley runs from north to south along the county boundary between Kildare and Offaly and the character unit follows the River Barrow. The riverbanks are predominantly grassland and the terrain is even with some long distance views to the east. The Barrow river is deemed as easily accessible by road and views are available from local roads and viewing points along the walkway. Sensitivity of this area is classed as High.

Grand Canal Corridor
The Grand Canal corridor flows east to west through Kildare and continues into County Offaly. The canal corridor is characterised by smooth terrain and topography and lands adjacent to the canal include pasture lands and boglands, while the canal also passes through urban areas where sections have been landscapes and enhanced. Canal locks are described as distinctive features, and long distance views are available from existing bridges and distant views of Kildare uplands can be gained from certain points. Many views of the canal are available from local roads as well as from viewing points on bridges along the canal corridor. Sensitivity of this area is classed as High.

Several other Landscape Character Areas which are within the 20-kilometre radius but not directly adjacent to Co. Offaly include Northern Hills (High Sensitivity), Chair of Kildare (High Sensitivity) and the River Liffey (High Sensitivity) and Allen Bog (Medium Sensitivity) and Pollardstown Fen and the Curragh (High Sensitivity).

11.3.3.4 Areas of High Amenity

The Kildare Development Plan also defines Areas of High Amenity due to their outstanding natural beauty and/or unique interest value and which are described as generally sensitive to the impacts of development. These areas are as follows:

- The Curragh and Environs
- Pollardstown Fen

- River Liffey and River Barrow Valleys
- Grand Canal and Royal Canal Corridors
- East Kildare Uplands

11.3.3.5 Views and Prospects

Scenic Routes

There are a number of Scenic Routes within County Kildare, all of which lie to the east of the site. These are illustrated on Figure 11.2.

There are no scenic routes within five kilometres of the proposed development site. Four (or parts of four) scenic routes lie between 5- 10 kilometres from the proposed development site. These are as follows:

- Route 19: Views of Canal, River Slate and Surrounding Countryside from R414 at Rathangan. This is located approximately 8.6 kilometres southeast of the proposed development site. Several views were taken from the centre of Rathangan and these are mapped in Figure 11.11.

- Route 28: Views from County Roads (L5017 and L26) of Carbury Castle and Hill: Teelought road junction with the R403 and upland area at Mylerstown. This route lies approximately 9.7 kilometres northeast of the proposed development site at its closest point. The most notable view along this stretch north of Carbury is that of the fortified house on Carbury Hill, shown in Plate 11.1 however, is outside the ZTV and will not have any visibility.

Plate 11.1 View of fortified house from Scenic Route 28 road north of Carbury

  Further along, there is considerable roadside screening along this route.

- Route 38: Views of Allenwood to Lullymore Local Road. Part of this route lies approximately 9.4 kilometres east of the proposed development site at its closest point.

- Route 39: Views of Lullymore to Rathangan Local Road. This route lies approximately 8.2 kilometres southeast of the proposed development site at its closest point.

Although there is considerable screening along the Regional Road R414 (Scenic Routes 38,39), Viewpoint 11 represents the view from Lullymore East – as shown in Figure 11.10 and in the Photomontage Booklet.

A further five routes lie within 10-20 kilometres from the proposed development site. Where the development is visible from these routes it will be less evident due to the distance. These include:

- Route 3: Views of Curragh Plains form the M7 interchange to St Ledger's Bottoms approximately 18.85 kilometres east of the proposed development

- Route 4: Views of Curragh Plains including Little Curragh, County Road from Kildare Town Boundary to Military ranges, R413 from Kildare Town Boundary to Motorway Interchange.

- Route 8: View of Bogland Plains; L3002 from Kilmoney Cross Roads to Feighcullen Cross Roads at Boston Hill, approximately 11.91 kilometres southeast of the proposed development. This route is represented by the photomontage from Viewpoint 12.

- Route 15: Views to and from Dunmurry and Views of Central Kildare Plains and Boglands on the R401 and adjoining roads, approximately 12.87 kilometres southeast of the proposed development.

- Route 27: Views to the south of open countryside, from L138 Kilmeagiue cross roads to Coolaght. This route lies approximately 15.75 kilometres to the east of the proposed development site at its closest point.

- Route 37: Views of Pollardstown Fen. Approximately 17.18 kilometres from the proposed development at its closest point.

Kildare County Development Plan includes views which are categorised in one of two ways; either views to and from waterways (which are primarily located on bridges) or views to and from hills. Of the two, the views from waterways and bridges are more easily accessed and experienced by the public as many are on public roads.

Protected Views – Views to and from Waterways
There are a number of views to and from the waterways, and these include views to and from some river and canal bridges and banks. Within 10 kilometres of the proposed wind farm, there are three protected views;

- GC14 Ticknevin Bridge
- Rathangan Bridge
- GC 25 Wilson's Bridge, Kiltaghan North

The ZTV maps have shown that there is a slight chance of visibility of the proposed wind farm from Rathangan Bridge, but photomontages showed no visibility. Viewpoint 13 is taken from Wilson's Bridge and is included in the Photomontage Booklet in Volume 2 of the EIS. While these views are located on elevated canal bridges, there is significant vegetation which prevents open views of the proposed development. Photomontages taken from Ticknevin Bridge showed no visibility of the proposed development.

Between 10 and 20 kilometres from the proposed development, there are several protected views to and from bridges. There are some which have no theoretical visibility. Others, however, have theoretical visibility but, of these, many are surrounded by vegetation which prevents views of the proposed development. Several photomontages were taken from bridges closer to the proposed development, and from bridges where there were open views in the direction of the proposed development. These were taken from Hamilton's Bridge, (Viewpoint 10) Wilson's Bridge (Viewpoint 13) and High Bridge (Viewpoint 14). There are shown in Figure 11.11 and in the Photomontage Booklet (Volume 2 of the EIS.)

- GC1 – Grange Bridge, Old Grange
- GC 9 - Bonynge Bridge Mouds
- GC 10 – Binns Bridge, Robertstown
- GC 11 – Fenton Bridge, Lowtown
- GC 12 – Bond Bridge, Derrymullen
- GC 13 – Hamilton's Bridge -see Viewpoint 14
- GC 15 - Haberton Bridge, Littletown
- GC 16 – New Bridge, Littletown
- GC 17 – Skew Bridge, Ballyeigue North
- GC 18 – Huband Bridge, Grangeclare West
- GC19 – Pim Bridge, Newpark
- GC20 -Pluckerstown Bridge, Pluckerstown
- GC 21 - Milltown Bridge, Milltown
- GC22 - Ballyteige Bridge Ballyteige
- GC23 - Glenaree Bridge, Glenaree
- GC 24 – Rathangan Bridge, Rathangan – No visibility
- GC 25 - Wilson's Bridge, Kiltahgan North – see Viewpoint 34
- GC 28 - High Bridge, Old Grange – see Viewpoint 49
- GC 35 – Clogheen Bridge

Protected Views – Views to and from Hills
The Kildare Development Plan states that as the topography is generally flat with predominantly low vegetation, and therefore extensive views can be obtained from hilltops and allowing views over long distances. Ridgelines are also visible and seen as conspicuous features of this landscape. There are no hilltop views within 10 kilometres of the proposed development site.

11.3.4 Westmeath County Development Plan 2014 – 2020

A small portion of County Westmeath lies within 20 kilometres of the proposed development site, and is included for this reason. The closest part of the County is however at a distance of approximately 9 kilometres from the proposed development.

Chapter 6 of the Westmeath County Development Plan 2014 - 2020 contains policies and objectives relating to landscape character assessment and management. Section 6.22 of the Plan identifies a number of Areas of High Amenity. There is one area of High Amenity to the northwest of Tyrellspass but this is at a distance of greater than 20 kilometres from the proposed development site.

11.3.4.1 Landscape Character Areas

Section 6.3 of the Westmeath County Development Plan 2014-2020 refers to the Landscape Character Assessment of County Westmeath which was carried out as part of the 2008 - 2014 Development Plan. This Assessment divided the county into 11 Landscape Character Areas (LCAs). Two of these LCAs fall within the 20 kilometre radius of the proposed development site, although they are at a distance of more than 10 kilometres.

LCA 10 Lough Ennell and South-eastern corridor lies approximately 13.4 kilometres from the proposed development site at its closest point. The LCA is described by Section 6.18 of the Plan as an area of pasture land of mixed productivity, and containing Lough Ennell to the west of the LCA. The views from the R-446 between Tyrellspass and Rochfortbridge from the N6 are also mentioned. A large tract of bog is mentioned east of Rochfortbridge and Miltownspass along the boundary with County Offaly. The bog areas in this LCA are largely exploited but some are intact. A number of old demesnes are mentioned with fine mature hardwood trees and estate walls in some cases.

The half-blade ZTV Map (see Figure 11.6) indicates that the areas of high ground around Tyrrellspass will not have visibility of the proposed development. The distance of this LCA from the proposed development site means that the area is unlikely to be affected by the proposed development.

A small portion of LCA 11 South Westmeath Eskers, lies within the 20 kilometre radius at a distance of 15.75 kilometres. This LCA is described as distinguished by the presence of Esker ridges, and is now bisected by the M6 motorway. The landscape character is described as small scale and intimate. The ZTV Map indicates that there is only partial theoretical visibility in this LCA and the proposed development is not likely to have an effect on this LCA.

11.3.4.2 Views and Prospects

Section 6.24 of the Westmeath County Development Plan lists 55 protected views and prospects. Three of these views lie within 25 kilometres of the proposed development. These are illustrated in Figure 11.2 and the views relevant to the site are described in Appendix 7 of the Plan as follows:

- View 20 – View to north of Local Road L-5124 at Gneevebane
- View 21 – View to south over Co. Offaly from Garrnane Hill on the Regional Route on R-446 between Tyrellspass and Rochfortbridge
- View 56 – View of Long Hill Esker from south of the R-446 Regional Road

View 20 is looking in the opposite direction from the proposed development site and is approximately 18.04 kilometres north of the proposed development. View 21 is looking to the south towards the proposed development and is located at a considerable distance, approximately 17.5 kilometres, from the proposed development. View 56 is a view of Long Hill Esker, directly to the south, and not in the direction of the proposed development. This view is 19.95 kilometres from the proposed development site.

A photomontage from View 21 – is included in the Photomontages Booklet as Viewpoint 23.

11.3.5 Laois County Development Plan 2011 – 2017

A small portion of Co. Laois is located within 20 kilometres of the proposed development site and has been included here. The closest part of the county is located some 11.5 kilometres from the proposed development site and therefore will have limited effect on the LCA due to the distance.

11.3.5.1 Landscape Character Areas

The Laois County Development Plan includes a Landscape Character Assessment. This assessment has identified seven Landscape Character Types (LCTs), comprising Mountain Areas, Hills and Upland Areas, Rolling Hills, Lowland Agricultural Areas, Peatland Areas, Urban Fringe areas. The areas which are found within a 20-kilometre radius of the proposed development site include primarily Lowland Agricultural Areas and some small areas of Peatland.

11.3.5.2 Amenity Views and Prospects

There is one scenic view, View 006 from Grange, Mountmellick, as illustrated in Figure 11.2 of this EIS and as listed in Section 13.10 of the Development Plan. However, this view is in the opposite direction from the proposed development and at a distance of approximately 19.1 kilometres from the proposed development site and therefore will not be affected by the proposed development.

11.4 Landscape Character

Landscape character refers to the distinct and recognisable pattern of elements that occurs consistently in a particular type of landscape, and how people perceive this. It reflects particular combinations of geology, landform, soils, vegetation, land use and human settlement, and creates the particular sense of place found in different areas. The identification of landscape character as outlined in the DoEHLG Guidelines (2000) comprises the identification of primarily physical units (areas defined by landform and landcover) and, where appropriate, of visual units. Section 11.4.1 describes the general landscape context of the wider area, comprising areas within the Landscape Study Area (within 20 kilometres of the proposed development), while Sections 11.4.2 and 11.4.3 describe the landscape character of the proposed development site in some more detail.

11.4.1 General Landscape Context of the Proposed Development

The proposed development site lies in eastern Co. Offaly, approximately 3.8 kilometres from the Co. Kildare boundary, at its closest point. The closest proposed turbine is located approximately 2.2 kilometres from the village centre of Clonbullogue. The site lies approximately 4.5 kilometres southwest of Edenderry at its closest point, and approximately 7.1 kilometres southeast of the village of Rhode. The site lies approximately 9.3 kilometres northwest of Rathangan, Co. Kildare. In the wider landscape, larger settlements include Kildare town and Portarlington.

The overall landscape is largely flat or gently undulating, and is composed of large tracts of cutover bog interspersed with farmland and small settlements. Much of the bogland areas are not clearly visible when travelling through the landscape. Plate 11.2 below shows the landscape context to the north of the site.

Plate 11.2 View of landscape at Ballyfore looking towards proposed development site

Exceptions to the generally flat landscape are evident such as the extinct volcano of Croghan Hill which is a distinct feature of the landscape in this area, lying to the northwest of the site. There are panoramic views from Croghan Hill, such as shown in Plate 11.3 below.

Plate 11.3 View from Croghan hill looking towards proposed development site

Plate 11.4 View of proposed development site at Cloncreen Bog with Croghan Hill in background

Plate 11.4 above shows the views towards Croghan Hill from the site, which is a noticeable feature in the generally flat landscape. Closer to the proposed development site, a panoramic view is available from Ballykilleen Hill to the northeast of the site as shown in Plate 11.5 below.

Plate 11.5 View towards proposed development site at Cloncreen Bog from Ballykilleen Hill

The site, known as Cloncreen Bog, is a cutover bog, and is located in a generally flat landscape characterised by large tracts of peatlands, many of these cutover bogs from which peat has been harvested. Interspersed with these large areas of bog are agricultural fields and scattered houses and farms, with small settlements. Many of these peatlands are visible on maps and aerial imagery, however visibility is somewhat less on the ground due to screening by vegetation in the flat landscape and the viewer is not always aware of the extent of the peatlands due to the screening.

The operating Bord na Móna wind farm at Mountlucas lies on an area of cutover peatland approximately 3.9 kilometres to the west of the site at its closest point. The Edenderry power station is located to the east of the proposed development site, approximately 0.3 kilometres east of the site at its closest point, and both are landmarks in the mainly flat landscape.

Within a 20-kilometre radius of the proposed development site, one other wind farm is permitted, namely the permitted Yellow River wind farm which is located northwest of the proposed development site. Wind turbines are a recognizable feature of this landscape, and are associated with areas of cutover bog and the cessation of peat extraction. The nearby power station at Edenderry also emphasises the history of power generation in this area.

Another recognisable feature of the area is the Grand Canal, which is located to the north of the proposed development site, and runs east-west through the Landscape Study area. The canal, although at a low level, is visible from local roads from time to time, most notably from the high points such as the stone bridges and aqueducts which are distinctive landscape elements. The Grand Canal Way runs along the towpath and is a facility for walkers and cyclists, which can be seen in Plate 11.6 below.

Plate 11.6 The Grand Canal from Colgan's Bridge south of Edenderry

11.4.2 Physical Landscape Unit

Landform and landcover in an area combine to physically distinguish one landscape from another. These physical characteristics form individual areas or units, known as physical units, whose character can be defined by aspect, slope, scale and size. A physical unit is generally delineated by topographical boundaries and is defined by landform and landcover. In this sense, the proposed development site at Cloncreen is part of a large physical unit which is similar to the surrounds in terms of topography, however the landcover consists of cutover and regenerating bog, which is found on many peatlands in the wider area. Cloncreen bog is however distinct in terms of landcover when compared to the surrounding farmland which intersperses the areas of bogland.

11.4.2.1 Landform

Present-day landscapes owe their form to the geological materials from which they were carved. Landform is the term used to describe the spatial and formal arrangement of landscape components as a natural product of geological and geomorphologic processes in the past, and refers primarily to topography and drainage.

11.4.2.1.1 Topography

The proposed development site itself lies in a flat, inland area of cutover bog as noted above, and within 20 kilometres of the proposed development, the topography around is generally flat bogland interspersed with agricultural fields and small settlements. The closest hill is that at Ballynakill to the northwest of the site. Some distant hills are visible, such as Croghan Hill, while there are several hills in West Kildare at some distance away to the east.

The topography of the site itself appears almost flat, with any changes in level barely noticeable on the ground. The levels range from approximately 68-75 m OD in this part of the site with some localised variations. The nearest hill to the site is located just to the northeast at Ballynakill and rises to a height of 109 metres OD. This is clearly noticeable against the flat topography of the site, as shown in Plate 11.7 below.

Plate 11.7 View of flat topography at Cloncreen Bog with Ballynakill hill in background

11.4.2.1.2 Drainage

As outlined in Chapter 8, the surface of the cutover bog is drained by a network of east /west orientated peat drains that are typically spaced every 15 to 20m. These drains typically slope in both an easterly and westerly direction from the central north / south trending railway track line. Surface water outflows from the bog are located along the western, southern and eastern boundaries of the site and comprise both gravity and pumped outfalls. Other than the designated surface water outfalls, there are no other areas where runoff can leave the site. The site is located on a local scale, within the catchment of the Figile river, which runs within 0.5 km of the east of the site. The site is also in the River Barrow surface water catchment.

11.4.2.2 Landcover

The site at Cloncreen is described part of a large area of peatland known popularly as the Bog of Allen. This is a complex of bogs which ranges through several counties including Offaly and Kildare. The proposed development site itself extends to 960 ha.

In the vicinity of the site, other areas of landcover includes extensive areas of bogland, most of which are large area of industrial cutover bogland, and some of which were replanted with areas of coniferous forestry. However due to the nature of the topography and the screening provided by roadside vegetation, these are not often perceived when travelling around the proposed development site but are clearly visible on aerial imagery. The existing Mountlucas wind farm which is located on cutover bog, is located to the west of the proposed Cloncreen wind farm.

Immediately adjacent to the proposed development site, landcover consists primarily of farmland, with some areas of tree plantations, visible in the background, as shown in Plate 11.8 below.

Plate 11.8 Landcover consisting of cutover peat at proposed development site with farmland in background

Areas of tree cover are visible to the north of the site as seen in Plate 11.7 and 11.8 above. To the east and west of the site boundary, a number of roads travel close to the site. These roadsides have considerable hedgerows in certain sections, which restrict views. Plate 11.9 below shows images of the roadside vegetation directly to the west of the site.

Plate 11.9 Roadside vegetation looking south along local road to the west of site (L1003)

Some areas of roadside vegetation with some gaps allowing views to the site, particularly to the east of the development where coniferous tree felling is occurring.

Landcover of Proposed Development Site

The landcover of the proposed development site itself is composed primarily of industrial cutaway peat which is currently being harvested, and it almost completely cutover, as shown in Plate 11.8 above. While peat ridges are a feature of the extraction phase, these will not remain after peat extraction has ceased.

An ash repository is located in the south east corner of the site and is used to store ash from the nearby power station (EPA Licence No. W0049-02, Bord na Móna Energy Ltd.). A disused gravel pit is also present in the northern section of the site. Chapter 5 indicates that the Cloncreen study area is dominated by Cutover Raised Bog. This is a variable habitat, or complex of habitats, that in the case of Cloncreen includes mosaics of bare peat and pioneer revegetated areas with secondary woodland, scrub, heath, fen/flush and grassland communities.

There are areas of regenerating scrub and vegetation on the site, as shown in Plate 11.10 below, which have a different character to the areas of bare peat.

Plate 11.10 Landcover consisting of cutover peat with regenerating scrub alongside railway tracks

It is expected that once peat extraction ceases, projected to occur in 2018, regenerating vegetation will colonise areas which are left undisturbed. Other manmade features on site include the bog railway tracks, a tea centre for workers to the south of the former gravel pit, an wind measurement mast and a telecommunications mast.

11.4.2.3 Landuse

Cloncreen is a single peat production bog unit within the Bord na Móna Derrygreenagh peat production bog group. The land-use/activities within and adjacent to the proposed development site comprise a mix of active peat extraction (IPC Licence No. P503-01), bare cutaway peat, re-vegetation of bare peat, an EPA-licenced ash repository (Licence No. W0049-02) and wind measurement (a single 100-metre meteorological mast). There are also a number of Bord na Móna rail lines that pass through the bog facilitating the transportation of milled peat and ash.

Land-use in the surrounding landscape comprises a mix of agricultural land, forestry, cutaway peatlands and energy production. The main existing significant energy infrastructure in the local area is Edenderry Power Plant, located directly east of the Cloncreen site, associated grid infrastructure in the form of the Cushaling substation (adjacent to Edenderry Power Plant), the 110 kV pylons network (and in particular the Thornsberry/Cushaling line), and the operational Mountlucas wind farm, located 4.0 kilometres to the west of the site. Mountlucas comprises 28 no. turbines, with a total power output of 84 Megawatts (MW), and has been in operation since 2014. Clonbullogue aerodrome is located approximately 2.2 kilometres south of the site boundary.

Plate 11.11 View of current land use at Cloncreen, with Edenderry Power Plant in background

11.4.2.4 Visual Landscape Unit

Landscape characterisation also takes account of the visual unit, which considers the visual extents of the area. In this case, the proposed development site is part of a large physical unit, comprising a large flat area with many areas of peatlands. Interspersed with this are smaller areas of farmland, forestry, waterways, a wind energy development, energy production and small settlements, which represent different land uses and which have different patterns of visibility.

In terms of visibility, the large physical unit within which the site is located is rarely seen by the person moving through the landscape due to the largely flat topography and screening by vegetation, and in some cases, settlements. Several smaller visual units therefore can be identified, which are part of the larger physical unit with the mosaic of peatland and agricultural land, including these include Cloncreen bog itself and other peatlands.

11.5 Indications of Landscape Value

11.5.1 Landscape Value

In order to determine the landscape sensitivity, and ultimately the likely significance of the effects, assessments of landscape value for the proposed development site and wider (LVIA) study area were assessed. Landscape value includes designations such as scenic views and sensitivity designations found in Development Plans, as well as values which are attached to undesignated landscapes. A number of criteria were developed in order to assess the landscape values of the study area. These then contribute to the assessment of landscape sensitivity.

Table 11.3 Features of Landscape Value

Feature	Description
Landscape Designations	A number of designations are found in Development Plans or other documents, e.g. Scenic Views and Routes - see Section 11.3 of this EIS which indicate areas/elements/views that are valued
Landscape Quality/Condition	This refers to the physical state of the landscape, and the condition of individual elements. The site itself and the majority of other peatlands are largely modified and degraded. Other landscape elements such as bog woodland are in good condition, and some regeneration and revegetation is occurring.
Aesthetic Qualities	Some panoramic views of flat landscape and bogland have high aesthetic quality, while views limited by vegetation in some areas. Waterways and bridges are noticeable features of the area and some are of high aesthetic quality and are protected views.
Wildness/naturalness	The landscape has been largely modified by industrial peat harvesting and agriculture, and has not many wild qualities. However regenerating vegetation on cutover bogs and some areas of uncut bogs add an element of naturalness.
Rarity/Conservation Interests	A number of conservation interests are referred to in Section 5 Flora and Fauna. However there are no SPA, or SACs within the site. Section 12 Cultural Heritage includes references to a small number of monuments on the site itself, while 57 RMPs lie within 5 kilometres of the site.
Cultural Meaning/Associations	Peatlands have many cultural associations. The Lullymore Heritage and Biodiversity Park includes a range of interests associated with peatlands which include cultural, natural heritage and archaeological associations. The Grand Canal also has cultural significance as their role in the transportation of goods, including turf. Cultural meaning is also associated with the waterways and associated bridges and locks.
Recreation Value	The site itself is not utilised for recreation, however nearby features used for recreation include the Grand Canal Way, the Barrow Way, and Mountlucas wind farm Cycle and Walkway Park.

11.6 Views to and From Site

Site visits were carried out to assess the visibility of the site from the surrounding area, as well as the view available from the site. This informs the visual baseline study, and, in conjunction with the ZTV, informed the areas which have potential visibility and informed the choice of viewpoint locations.

As the site is located in an expansive, flat landscape, with considerable vegetative screening, an assessment of roadside screening within five kilometres of the site was carried out in order to produce a more accurate picture of the visibility. This is described in Section 11.6.2.

11.6.1 Views from the Site

Views from the site are available in all directions. Some are long distance views, while others are restricted by the roadside vegetation and areas of tree planting. The main views are shown in Plates 11.12 to 11.15 below.

Plate 11.12 View within site looking south towards proposed development site

Plate 11.12 above shows the view along one of the existing access roads to the site, while Plate 11.13 below shows the view from within the site to the east towards Edenderry Power Station which is a landmark in the mainly flat landscape. Some regenerating vegetation partially restricts this view.

Plate 11.13 View east from the site towards Edenderry Power Station

Plate 11.14 below shows the view to the north, and while the views to the bog are open, in this view the landscape beyond is screened by intervening mature deciduous trees.

Plate 11.14 View to the north from the site

Plate 11.15 below shows the view to the west of the site, where some deciduous and coniferous vegetation is visible. The Mountlucas turbines are also visible in the distance.

Plate 11.15 View to the west with vegetation and Mountlucas turbines visible

11.6.2 Views towards the Site

This section includes a brief description of some of the views closest to the site. The accompanying Photomontage Booklet (EIS Volume 2) shows a wide range of the views towards the site. In addition to this, a comprehensive analysis of screening of the main routes within five kilometres of the site (which has an effect on the visibility of the proposed wind farm), was carried out. Visibility from the roads towards the site are therefore discussed more comprehensively in Section 11.7: Visibility of the Proposed Development.

Views from the roads closest to the site are shown below. While views vary Plate 11.16 shows the view from a crossroads close to the north of the site, showing a flat landscape with some vegetation in the foreground. An open view is found further south (shown in Plate 11.5) near Ballykilleen Hill where the bog itself can be seen.

Plate 11.16 View from Ballykilleen cross roads which runs to the north of the proposed development site

To the west of the site, a local road (L1003) runs close to the site and there are areas of open views along this route, as well areas where visibility is restricted due to vegetation. Plates 11.17 and 11.18 below shows both open views and restricted views along this route.

Plate 11.17 Open view to the east from the local road (L1003) which runs adjacent to the proposed development site

Plate 11.18 Restricted view looking south from the local road (L1003) which runs west of the proposed development site

Plate 11.19 below shows a view from the L1003 road to the south where there are both open and restricted views over the flat landscape.

Plate 11.19 Open view from the local road which runs south of the proposed development site

11.7 Visibility of the Proposed Development

11.7.1 Cumulative Visibility - Other Wind Farms

Existing, and permitted wind farms in the area are shown on the Cumulative and Comparative ZTVs (Figures 11.7 to 11.9) below. They are also included in the Photomontages contained in the EIS Volume 2: Photomontages.

Table 11.4 Other Existing, Permitted and Proposed Wind Farms within 20 km

Site	Status	No. of Turbines	Turbine Height (metres)
Mountlucas	Operating	28	150 m
Yellow River	Permitted	29	156-166 m
Total		**57**	

11.7.2 Cumulative Visibility - Non-Wind Developments

There are a number of permitted and proposed developments which were identified in a planning search are described in Chapter 2 – Section 2.10.2. These include both other wind farms and non-wind farm developments. These are also listed in Section 11.2.3.1 above and in Section 2.10.2 of this EIS in more detail. These are not included in the ZTV maps, which depict the cumulative visibility of other wind farms.

All developments which are existing, permitted, proposed (in the planning process) and some which are not yet in the planning process, were considered. The only development which is not included in the list below is the Emerging Preferred Option for the Eastern and Midlands Regional Water Supply Project, as this is an option, which is not yet in the planning process, and there is uncertainty about what will occur. The effects of this emerging preferred option therefore cannot be 'reasonably foreseeable'. The following developments are considered in the assessment of cumulative visual effects:

- Barrow Blueway (Pre Planning Stage) Lowtown, Co. Kildare to St. Mullins, Co. Carlow
- Grand Canal Blueway Shared Walking and Cycling Route - Capancur to Lough Boora
- Clonbullogue Ash Repository (Existing)
- Edenderry Power Plant (Existing with proposed continued use until 2030)
- Peat Extraction: Existing (Allen Group Bogs Offaly, Laois, Kildare & Westmeath)
- Peat Extraction: (Existing) Derrygreenagh Group of Bogs - Westmeath, Offaly & Meath.
- Clonin North Solar Farm (Proposed)
- Infilling of lands for agricultural use at Shean, Co. Offaly (Proposed).

Note that although peat extraction is carried out in a number of counties, the visual effects of the peat extraction within 20 kilometres of the proposed development site is assessed in this Chapter.

The two proposed upgraded walk/cycleways along the Grand Canal and Barrow. The proposed Barrow Blueway will be located approximately 9.5 kilometres southeast of the proposed development site at Cloncreen at its closest point, and is not yet in the planning process. However, as the route and the description of proposed works is known, this has been included, a number of photomontages, specifically Viewpoints 13 and 14 are taken from along this route. The Grand Canal Blueway is the subject of a current Part 8 Planning Application by Offaly County Council. This is approximately 19.3 kilometres to the west of the proposed development at Cloncreen at its closest point.

In terms of the depiction of the visual effects, the extent of the proposed Clonin North solar farm is depicted on the photomontages. In addition, the ZTV map for the Clonin North solar farm which is part of the planning application was studied in order to compare theoretical visibility. The existing Edenderry Power Plant is visible in some of the photomontages and forms part of the visual baseline. Peat extraction is currently carried out in other peatlands in the vicinity of the site and this is also visible in a number of photomontages. The existing Clonbullogue Ash repository is not visible from any Photomontages. The proposed site infilling and occasional concrete crushing proposed at Shean, close to the Cloncreen site, may be visible from the immediate environs of the site but is not likely to give rise to visual effects in the wider area or to contribute to cumulative effects. However, any likely and significant cumulative effects are discussed in Section 11.9.

11.7.3 Zone of Theoretical Visibility: Methodology

Maps showing the Zone of Theoretical Visibility (ZTV) have been prepared for the proposed wind turbine, using the software package WindFarm Version 4.2.5.1 (Copyright 1997 – 2015, ReSoft Ltd.). WindFarm is a commercially available software tool that enables developers to analyse, design and optimise wind energy developments. The applications of this system include the production of detailed ZTV or zone of visual influence maps.

The ZTV maps presented in this section of the EIS show visibility of the proposed wind farm using the hub and half blade of the wind turbines as points of reference. The maps also show the theoretical visibility of the proposed wind turbine in addition to visibility of other existing and permitted turbines in the area. The area covered by the ZTV maps has a radius of 20 kilometres from the boundary of the EIS Study Area.

ZTV maps assume a worst-case or 'bare ground' scenario, i.e. no land-cover. They represent theoretical visibility of the proposed wind farm in the absence of all natural and manmade features from the landscape, including vegetation, houses and other buildings. In reality, such features will restrict or limit visibility of the wind turbines, due to the screening effects of vegetation, for example forestry and road-side hedgerows and trees, and buildings, particularly within towns and villages. The ZTV map should be read in conjunction with the Route Screening maps and photomontages in the Photomontage Booklet (EIS Volume 2).

A total of five ZTV maps have been prepared:

- A large scale (AO) Map showing the half blade ZTV for the proposed Cloncreen turbines is included in Appendix 11-1.
- Figures 11.5 and 11.6 show the theoretical visibility of the proposed Cloncreen turbines, using the hub and half-blade as points of reference.
- Figures 11.7 and 11.8 show the cumulative theoretical visibility of the proposed Cloncreen turbines, which includes existing Mountlucas, and the permitted Yellow River turbines using the hub and half blade as points of reference.
- Figure 11.9 shows the additional theoretical visibility which will be generated by the proposed Cloncreen turbines in addition to the existing Mountlucas and permitted Yellow River turbines.

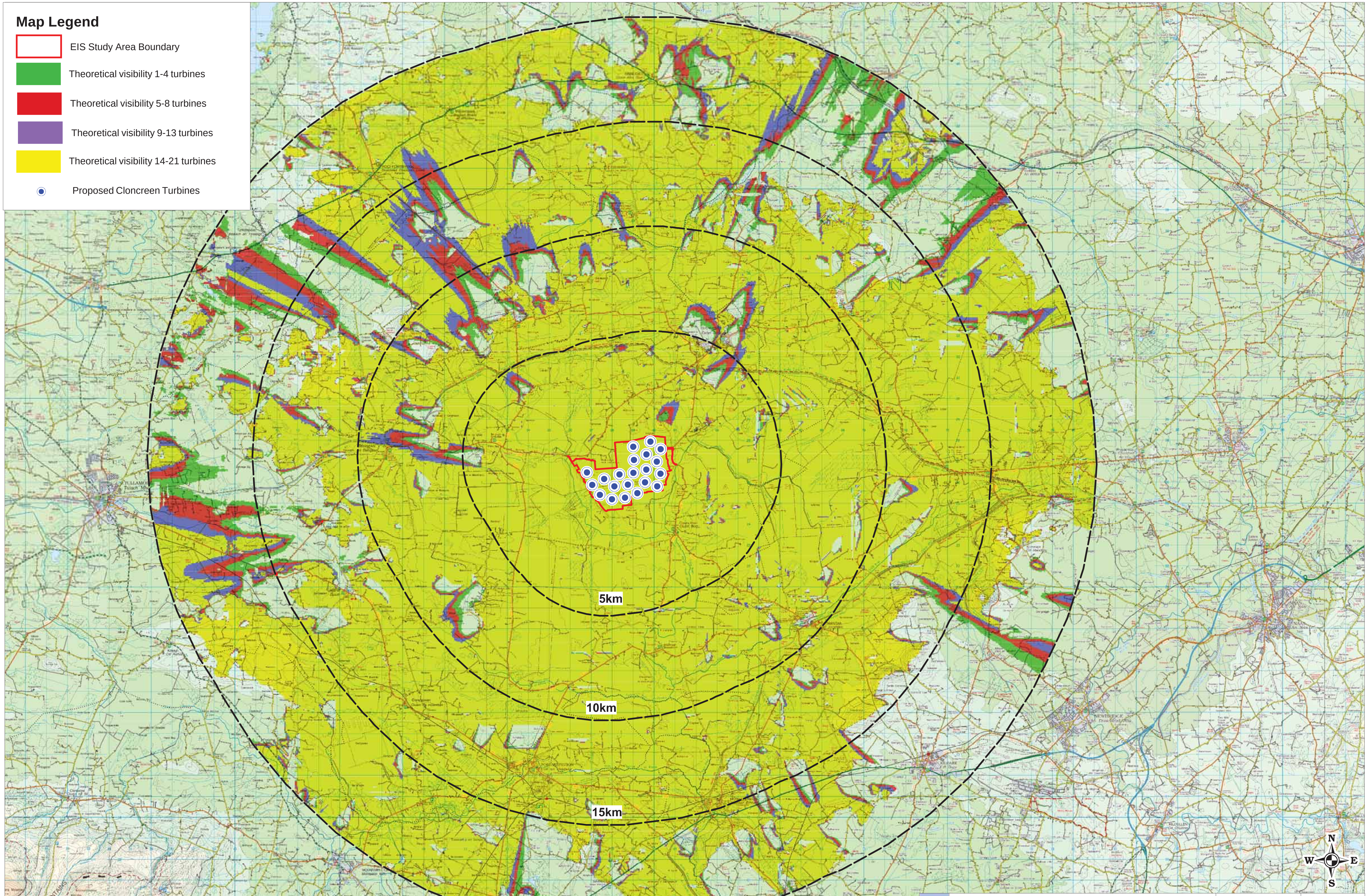
The proposed Clonin Solar farm ZTV was also assessed in conjunction with the Cumulative ZTV Maps referred to above.

11.7.4 Description of ZTV Maps

11.7.4.1 Theoretical Visibility of the Proposed Development

Figure 11.6 shows the theoretical visibility of the proposed development to half the blade tip which is displayed in four colour bands. Areas shaded green represent areas where 1 to 5 turbines are theoretically visible, areas shaded in red represent areas where between 6 and 11 turbines are theoretically visible. Areas shaded in purple represent areas where between 12 and 16 turbines are theoretically visible, while areas shaded yellow represent areas where between 17 and 21 turbines are theoretically visible.

Within 5 kilometres of the proposed development, the ZTV map indicates that most areas theoretically have full visibility of 17 to 21 turbines. Exceptions to this are small areas on the outskirts of Edenderry, and near areas of high ground such as Dromcooly Hill. There are areas which have clear views of the proposed turbines, and there are also, in reality, areas where visibility is restricted due to vegetation and screening. A wide range of views are these are represented by photomontages, taken from the most open viewpoints where possible, including viewpoints 1,2,3,4,6,8,9,18. Although Clonbullogue is shown as having theoretical visibility of 17-21 turbines, visibility will be restricted due to the buildings in the village. Parts of the settlement of Edenderry do not have theoretical visibility, while areas of the town within the ZTV are largely screened by the wind farm due to buildings and vegetation. Visibility from the R402 to the north is shown, as well as the R401 to the east, R400 to the west, and the L1003 and other local roads surrounding the site. These routes have however roadside screening in certain sections which results in intermittent visibility as illustrated in Section 11.7.4 below. The Grand Canal way also has theoretical visibility of the proposed development. However, in order to depict the screening along the route, this is included in the Route Screening map and discussed further below.



MAP TITLE: Hub Height ZTV Map - 20km	MAP NO.: Figure 11.5	SCALE: 1:160,000
PROJECT TITLE: Cloncreen Wind Farm		DATE: 04-10-2016
DRAWING BY: John Staunton	CHECKED BY: Michael Watson	ISSUE NO.: 150504-2016.10.04 -D1

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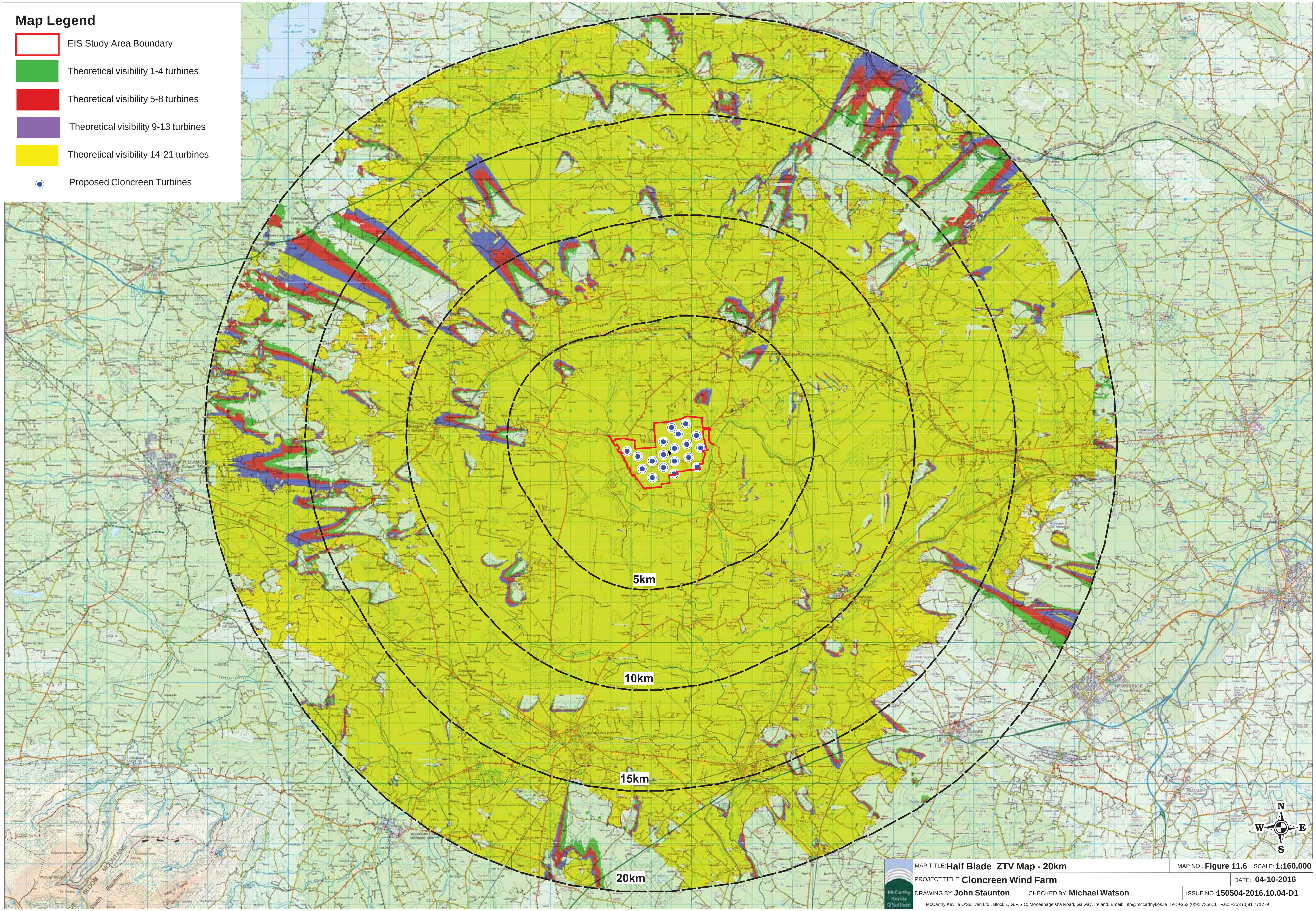

Map Legend
EIS Study Area Boundary
Theoretical visibility 1-4 turbines
Theoretical visibility 5-8 turbines
Theoretical visibility 9-13 turbines
Theoretical visibility 14-21 turbines
Proposed Cloncreen Turbines
5km
10km
15km
20km
N
W
E
S
MAP TITLE: Half Blade ZTV Map - 20km
MAP NO.: Figure 11.6
SCALE: 1:160,000
PROJECT TITLE: Cloncreen Wind Farm
DATE: 04-10-2016
DRAWING BY: John Staunton
CHECKED BY: Michael Watson
ISSUE NO. 150504-2016.10.04-D1
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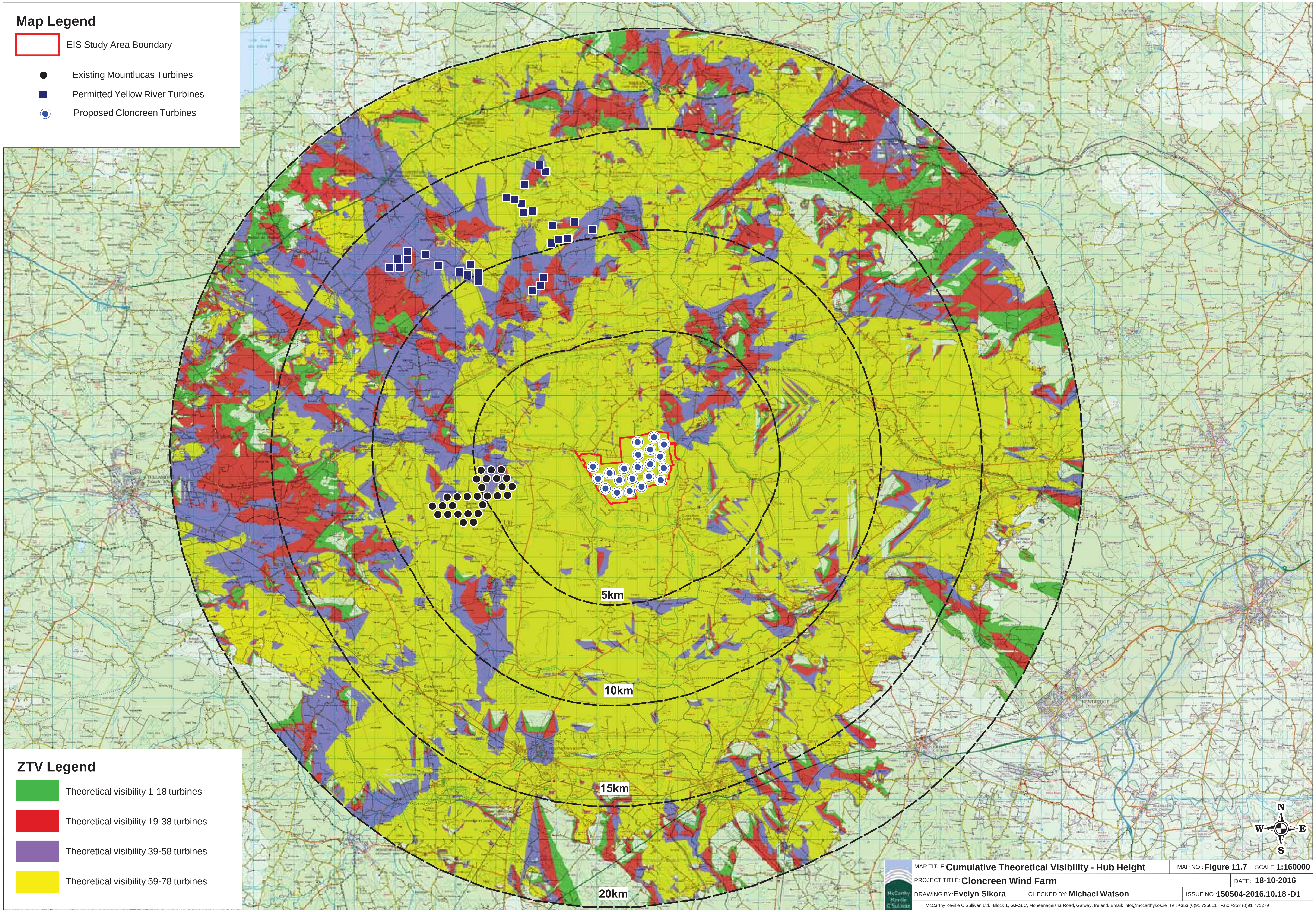
Map Legend
EIS Study Area Boundary
Existing Mountlucas Turbines
Permitted Yellow River Turbines
Proposed Cloncreen Turbines
5km
10km
15km
20km
ZTV Legend
Theoretical visibility 1-18 turbines
Theoretical visibility 19-38 turbines
Theoretical visibility 39-58 turbines
Theoretical visibility 59-78 turbines
N
W
E
S
MAP TITLE: Cumulative Theoretical Visibility - Hub Height
MAP NO.: Figure 11.7
SCALE: 1:160000
PROJECT TITLE: Cloncreen Wind Farm
DATE: 18-10-2016
DRAWING BY: Evelyn Sikora
CHECKED BY: Michael Watson
ISSUE NO. 150504-2016.10.18 -D1
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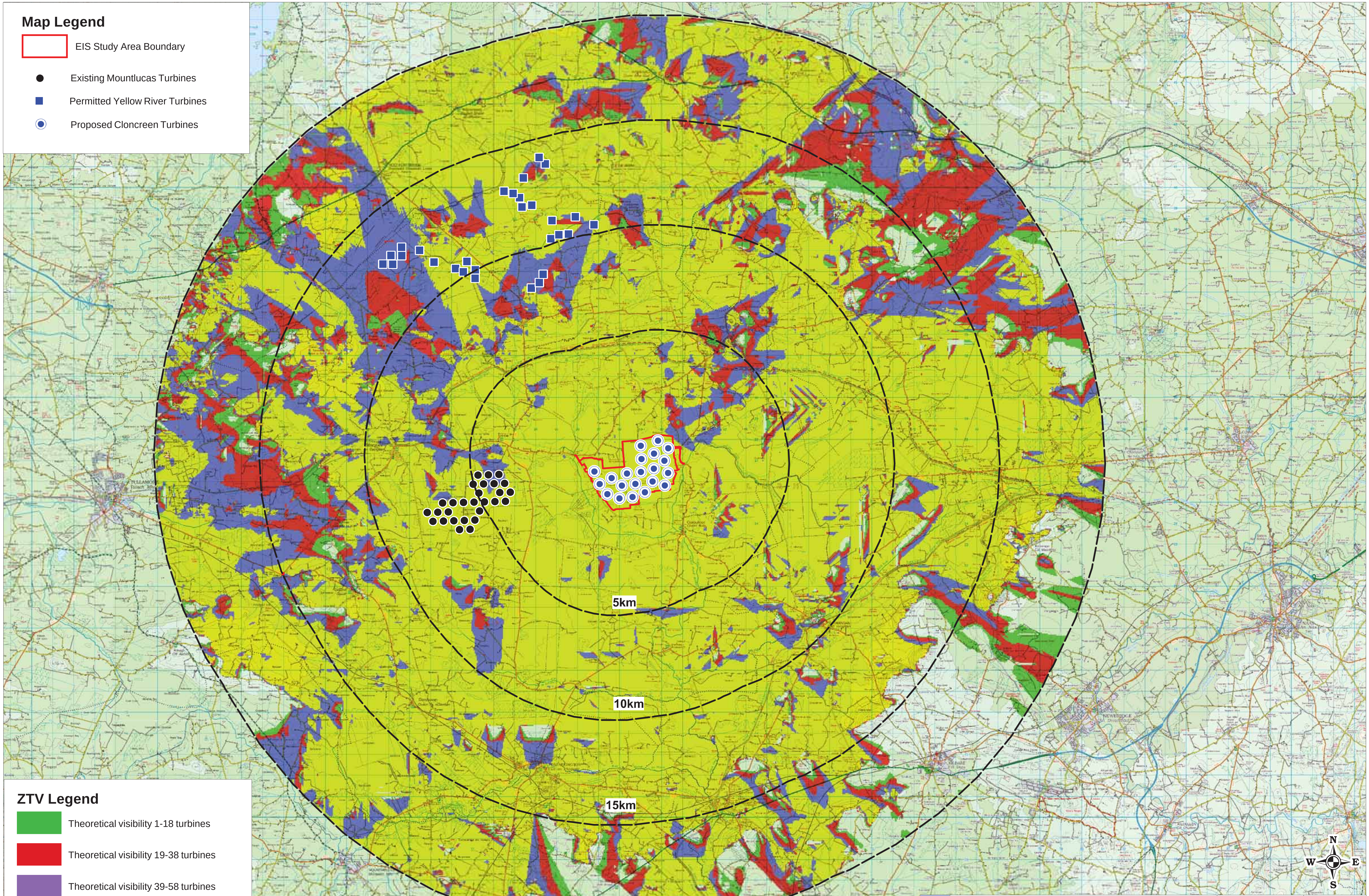

MAP TITLE: **Cumulative Theoretical Visibility to Half Blade**		MAP NO.: **Figure 11.8**	SCALE: **1:160000**
PROJECT TITLE: **Cloncreen Wind Farms**			DATE: **18-10-2016**
DRAWING BY: **John Staunton**	CHECKED BY: **Michael Watson**		ISSUE NO.: **150504-2016-10-18 D1**

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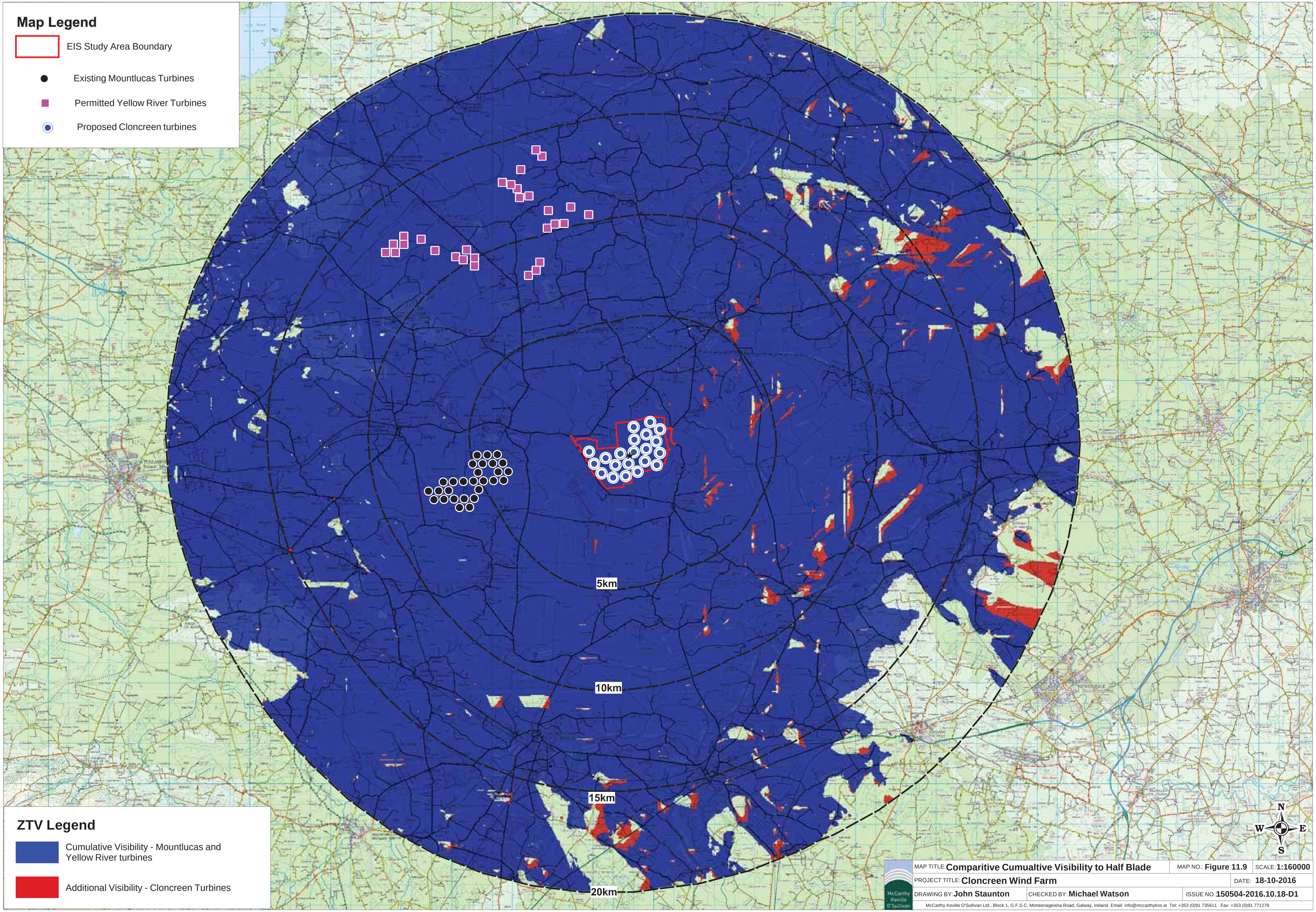
Map Legend
EIS Study Area Boundary
Existing Mountlucas Turbines
Permitted Yellow River Turbines
Proposed Cloncreen turbines
5km
10km
15km
20km
N
W
E
S
ZTV Legend
Cumulative Visibility - Mountlucas and Yellow River turbines
Additional Visibility - Cloncreen Turbines
MAP TITLE: Comparitive Cumualtive Visibility to Half Blade
MAP NO.: Figure 11.9
SCALE: 1:160000
PROJECT TITLE: Cloncreen Wind Farm
DATE: 18-10-2016
DRAWING BY: John Staunton
CHECKED BY: Michael Watson
ISSUE NO.: 150504-2016.10.18-D1
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Within 5-10 kilometres of the proposed development, most areas have theoretical visibility of 17-21 turbines. Area which do not have theoretical visibility to half blade include pockets on the east side of Croghan Hill, near Rhode village, to the north and east of Edenderry, as well as the centre of Rathangan. Again these areas will have less actual visibility as vegetation and built form will further limit visibility.

Between 10-20 kilometres from the proposed development, while many areas have theoretical visibility of 17-21 turbines, there are large pockets without theoretical visibility. To the west of the Mountlucas turbines, there are several areas without theoretical visibility, including to the northwest and west of Croghan Hill, the town of Tyrrellspass and its immediate surroundings. There is theoretical visibility from the settlements of Rochfortbridge and Kinnegad, but again actual visibility will be less due to the built environment. There are areas south and east of Kinnegad which have no theoretical visibility, as well as a substantial area to the east, north and east of Carbury where there is no theoretical visibility. To the southeast, the map shows no theoretical visibility from Kildare town and its environs.

The ZTV maps are to be read in conjunction with the Route Screening Maps, described and included in Section 11.7.5 below, which give an additional picture of the extent of screening along the roads in the vicinity (within 5 kilometres) of the site.

11.7.4.2 Theoretical Cumulative Visibility to half-blade

The Cumulative ZTVs should be read in conjunction with the Photomontages in Volume 2, which show actual visibility from throughout this area and illustrate the effect of screening and distance, which are not represented in the ZTV. In addition, Section 11.7.5 below refers to the Route Screening Analysis that was undertaken for roads and the Grand Canal towpath within five kilometres of the site.

The Zone of Theoretical Visibility (ZTV) Maps presented in Figures 11.7 and 11.8 of this EIS section show the cumulative visibility of the proposed Cloncreen wind farm with the other permitted wind turbines in the vicinity at hub and half blade respectively.

Figure 11.8 illustrates the cumulative visibility to half blade. The areas where numbers of turbines are theoretically visible are represented in four colours, as follows:

- Green: 1 to 18 turbines visible
- Red: 19-38 turbines visible
- Purple: 39 to 58 turbines visible
- Yellow: 59-78 turbines visible

It should be noted that in the Cumulative ZTV maps, the proposed Cloncreen turbines are shown in addition to the existing Mountlucas turbines, as well as the permitted Yellow River turbines and therefore shows theoretical visibility should the permitted Yellow River and proposed Cloncreen wind turbines be constructed. Again, these ZTV maps assume a 'bare earth scenario' and do not take into account screening by buildings or vegetation.

Within 5 kilometres of the proposed development, Figure 11.8 illustrates that there is considerable theoretical cumulative visibility of between 59-78 turbines, which is indicated by the areas shaded yellow, while to the northeast of the site visibility is less due to topography, with areas shaded red (representing between 19 and 38 turbines) and areas shaded purple (representing theoretical visibility of between 39-58 turbines.)

The Mountlucas turbines fall partly within five kilometres of the proposed Cloncreen turbines.

Between 5 and 10 kilometres, to the south, east and north many areas have theoretical visibility of between 59-78 turbines (areas shaded yellow) however to the northwest and west as well as pockets in the northeast and southeast, there are areas shaded purple and red, which have less theoretical visibility.

Between 10 and 20 kilometres from the proposed development study area, there are areas primarily to the south, north and the east which have areas of theoretical visibility of between 59-78 turbines. There are areas to the northwest, northeast and scattered patched to the south where visibility is less and ranges from areas shaded green, red and purple.

The ZTV shows no theoretical visibility in several areas which include Kildare town and the land to the north, including the eastern slopes of the Kildare hills. There are also smaller scattered areas to the south, southeast, and northeast where there is no theoretical visibility, including most of the village of Carbury, Co, Kildare.

11.7.4.3 Comparative Cumulative Visibility

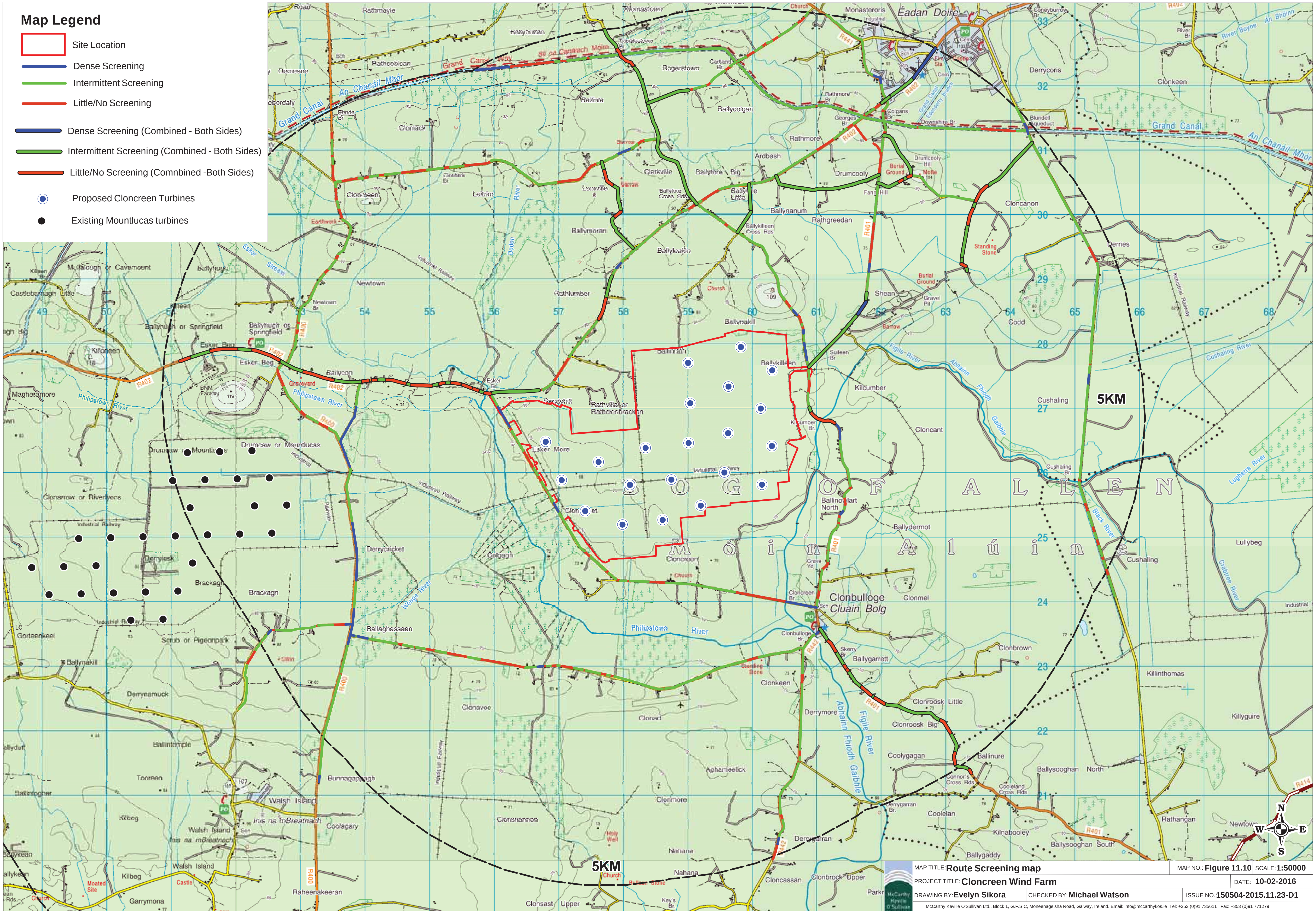
Figure 11.9 shows the cumulative theoretical visibility of the existing Mountlucas and permitted Yellow River single colour (blue). Overlaid on this in red are any areas of additional visibility as a result of the proposed Cloncreen turbines. This map demonstrates that the proposed Cloncreen turbines will result in a very minor increase in the pattern and extent of visibility to the east of the site, with many of these areas of additional visibility between 10 and 20 kilometres from the proposed development.

11.7.5 Route Screening Methodology - Roads

In order to comprehensively demonstrate the varying characteristics of the roads (and the Canal path closest to the site), and to record the actual visibility in comparison to the theoretical visibility, a methodology was developed. Within a five-kilometre radius of the proposed development site boundary, each route indicated on Figure 11.10 with theoretical visibility was driven once in each direction, with notes taken on screening, views, and the direction of the views to the proposed development. The site visits were carried out in March and April 2016 at a time when vegetation was not in full foliage.

In preparation for the route screening assessment, the ZTV maps were overlaid with aerial imagery and printed at a large scale. Each route was driven once in each direction as a minimum. The route was driven slowly along the route and mapping and notes of each section of roadway on a high resolution aerial image was carried out. Screening between the wind farm and the relevant side of the road was marked. In cases where the road travels in the direction of the proposed wind farm, screening on both sides of the road was included and the most representative of the two roadsides were mapped.

In addition, geo-referenced photographs were taken at regular intervals of approximately 500 metres along the routes to allow later confirmation of mapping, and to methodically record the views along the route. A hand held GPS was used to confirm the location of each image. A photograph of the view along the road was taken in each direction, as well as the view to either side of the road. These images and the location from which they were taken are contained in Appendix 11-2. Following the site visit, a map was created of each route. The screening along the route was mapped as one of three categories:



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- Little/no screening – mainly open and with some very light vegetation
- Partial Screening – light deciduous roadside vegetation and vegetation with short gaps which would allow intermittent or partial views
- Dense Screening – vegetation which is dense enough to block views (e.g. coniferous forestry)

Plates 11.20 to 11.22 show the typical screening that represents the above categories respectively.

Plate 11.20 Example of little/no screening

Plate 11.21 Example of partial screening

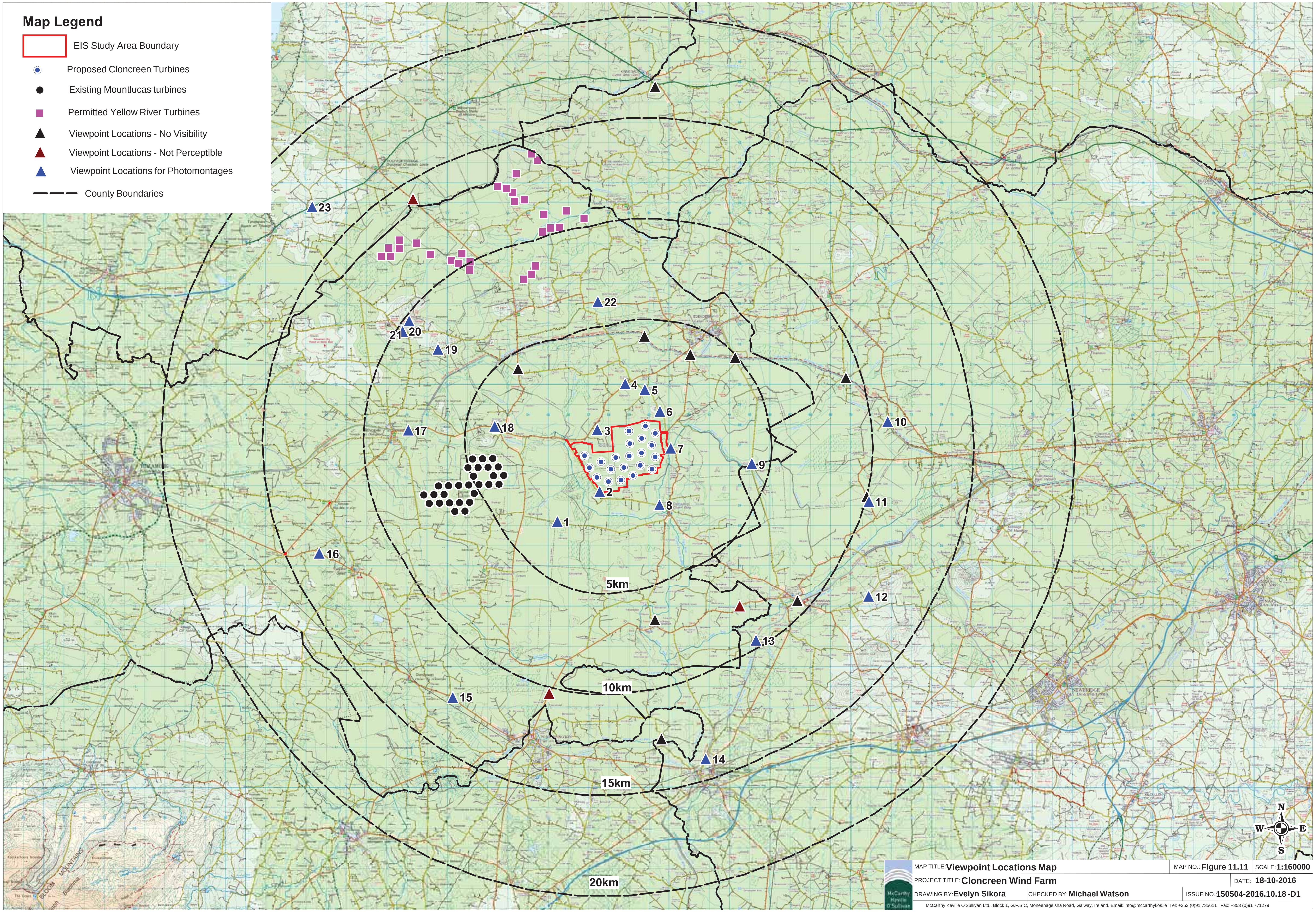
Plate 11.22 Example of dense screening

11.7.5.1 Route Screening Map – Roads within 5 Kilometres

Figure 11.10 outlines the Route Screening within a five-kilometre radius of the proposed development site. This map shows that the routes in the immediate vicinity of the development (to the north, south, east and west of the site) have considerable screening, the majority of which is classed as 'partial screening' (green on Figure 11.10) which will result in partial views of the proposed turbines which will change as one moves along these roads, and which indicates that there are not extensive sections of clear unobstructed views of the turbines. Figure 11.10 indicates the sections of the roads marked orange have little or no screening, and these are found primarily to the road south of the site east of Clonbullogue, with some sections along the road to the west, mainly where felling has occurred. A number of photomontages were taken from these areas with open views, as shown in Figure 11.11 Viewpoint Locations.

The majority of the roadside vegetation in the immediate vicinity of the site is described as 'Partial'– and therefore while views will be possible from some of these roads, this is likely to result in partial views of turbines, or views where turbines are seen but through foreground vegetation which lessens the effects, depending on the direction of the view. There are some limited areas indicated in dark blue, which have dense screening, and these are unlikely to have visibility of the turbines, or may have very minimal visibility.

Further away from the site, to the south of the site, screening along the roads is mainly classed as 'Partial' (shaded green) however there are several sections with no screening or low screening. To the west, areas along the roadside are classed as 'partial' or 'dense' screening, the latter mostly by coniferous forestry. West of the site, the R402 travelling east-west has considerable areas of low or no vegetation, and a photomontage is included from this location. North of the site, roadside vegetation is classed as 'partial' for the majority of areas, with occasional open stretches. Further east of the site, the roadside screening is largely classed as 'partial screening'.


Map Legend
EIS Study Area Boundary
Proposed Cloncreen Turbines
Existing Mountlucas turbines
Permitted Yellow River Turbines
Viewpoint Locations - No Visibility
Viewpoint Locations - Not Perceptible
Viewpoint Locations for Photomontages
County Boundaries
1
2
3
4
5
6
7
8
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11
12
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14
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16
17
18
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22
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5km
10km
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MAP TITLE: Viewpoint Locations Map
MAP NO.: Figure 11.11
SCALE: 1:160000
PROJECT TITLE: Cloncreen Wind Farm
DATE: 18-10-2016
DRAWING BY: Evelyn Sikora
CHECKED BY: Michael Watson
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In summary, the majority of the roadside screening is classed as 'Partial'. Thus, while there are sections of the road where there is little or no screening, and areas where there is dense screening, the visibility of the proposed turbines is likely to be considerably less than the theoretical visibility, and many viewers will experience partial or intermittent visibility in areas where partial or dense screening is indicated. The Photomontages described in Section 11.7.5 below indicate actual visibility of the proposed turbines.

11.7.5.2 Route Screening Methodology – Grand Canal

Route screening was also carried out for a section of the Grand Canal that lies within 5 kilometres of the proposed development site boundary, to assess the screening which would be experienced by walkers and cyclists along the route. The methodology was the same as for the route screening along the roads, but in this case the route was walked in both directions. Images were taken at 500 metres and are contained in Appendix 11.2, along with the map showing the location of images.

Images of various types of screening along the canal are as follows:

Plate 11.23 Example of little/no screening

Plate 11.24 Example of partial screening

Plate 11.25 Example of dense screening

11.7.5.3 Route Screening Map – Grand Canal Way

The results of the Route Screening for the Grand Canal Way are also illustrated on Figure 11.10. Approximately 8.8 kilometres in length of the Grand Canal Way lies within a five kilometre radius of the proposed development site. Screening is present along the majority of this section of the Grand Canal Way, and is classed as 'Partial Screening' – this is mainly deciduous trees which may allow some visibility to the land beyond but which prevent open views out from the canal path. A section of dense screening is found between Trimblestown and Rhode bridges, consisting of dense coniferous and deciduous tree planting as shown in Plate 11.25 above. Some areas where there is little or low vegetation occur west of Trimblestown bridge, as seen in Plate 11.23 and from this location some of the Mountlucas turbines were evident. A section close to the Blundell Aqueduct has low vegetation, however much of this has coniferous forestry as a backdrop which is likely to restrict views in certain directions. A number of bridges are located along the route, and from these elevated locations some views of the surrounding landscape are evident. A number of photomontages were taken from bridges, along this route including Cartland Bridge, Colgan's Bridge and the Blundell Aqueduct, however views of the proposed development were all prevented by screening. Thus the viewers from the Grand Canal towpath will experience partial screening for almost the entire length of the route, the location of the most open views mainly located to the west of Trimblestown Bridge and some to the west of the Blundell Aqueduct.

11.7.6 Viewpoint Locations/ Viewshed Reference Points

A total of 23 Viewpoint Locations used in the preparation of the photomontages are described in Table 11.5 below and shown in Figure 11.11.

It is not possible to present every view angle in photomontages. The panoramic views presented in the photomontages represent as wide a range as possible from the photo locations. The choice of viewpoint locations is influenced by both the view available and the type of viewer, and includes viewpoint locations from local roads and settlements, Mountlucas, Daingean and the outskirts of Edenderry, populated areas and local and Regional roads (R400, R401 and R402, L1003). Also taken into account were landscape designations, and views and prospects, scenic routes and recreational areas such as the Grand Canal Way. The selection of these viewpoint locations was also influenced by the ZTV Map which indicates theoretical visibility. A number of viewpoints (Viewpoints 3, 5) were included following Public Consultation meetings in response to local residents' concerns.

Viewpoints were chosen having regard to the SNH Guidance (2014) which advises that a range of views should be shown at a range of distances and aspects, as well as at varying elevations and showing both where the development will be completely visible as well as partially visible, and these are reflected in the choice of viewpoint locations. Views are taken from different landscape character areas in the vicinity of the site, and views were taken in close proximity to the site, where turbines are likely to be more visible, as well as more distant views. Consideration was also given to ensure that photomontages captured other wind farms in order to assess cumulative visual effects, in particular with the existing Mountlucas turbines. Thus some of the viewpoint locations used in the Mountlucas EIS are also used here where appropriate.

In all cases, the most open view was chosen where possible, and where possible, images were taken at a time when vegetation was not in full leaf, to show the 'worst case scenario'. Following the selection of an initial number of views, several viewpoints which had theoretical visibility on the ZTV map, displayed no visibility of the proposed development due to screening by vegetation and built form. Several views were taken on the outskirts of Edenderry at bridges over the Grand Canal but showed no turbine visibility. A view taken to the north along the R400 Regional road south of Rhode showed no visibility due to screening, while further south at Bracknagh, and further south at Baylough Bridge along the Barrow also showed no visibility. The locations which showed theoretical visibility on the ZTV but where there was no actual visibility on the ground are illustrated in Figure 11.11 (coloured black).

A final list of viewpoints was then drawn up reflecting actual visibility on the ground. The A0 ZTV Map contained in Appendix 11-1 shows the ZTV along with the viewpoint locations from which photomontages were produced.

Table 11.5 Viewpoint Locations

Viewpoint	Description	Grid Reference Coordinates
1	View from the local road in the townland of Clonavoe, approximately 2.9 kilometres southwest of the nearest turbine	E 255 453 N 223 171
2	View from the local road in the townland of Clongarret approximately 0.71 kilometres west of the nearest turbine.	E 257 545 N 224 652
3	View from the local road in the townland of Rathvilla, approximately 1.57 kilometres west of the nearest turbine	E 257 430 N 227 721
4	View from the Regional Road R402 in the townland of Ballyleakin, approximately 2.3 kilometres north of the nearest turbine	E 258 813 N 229 999
5	View from the local road at Ballykilleen Cross Roads, in the townland of Ballykileen, approximately 1.7 kilometres north of the nearest turbine	E 259 788 N 229 715
6	View from the local road in the townland of Ballykilleen, approximately 0.98 kilometres from the nearest turbine.	E 260 534 N 228 638
7	View from the Regional Road R401 in the townland of Ballykilleen, approximately 0.85 kilometres from the nearest turbine.	E 261 071 N 226 809
8	View from the local road in the townland of Cloncreen, approximately 1.9 kilometres southeast of the nearest turbine	E 260 516 N 223 999
9	View from the local road in the townland of Cushaling approximately 4.7 kilometres east of the nearest turbine	E 265 097 N 226 044
10	View from the local road (adjacent to protected view) at Hamilton's Bridge in the townland of Killinagh Lower, approximately 11.5 kilometres east of the nearest turbine.	E 271 829 N 228 129
11	View from R414 and Scenic Route 39 in the townland of Lullymore East, approximately 10.8 kilometres east of the nearest turbine.	E 270 898 N 224 161
12	View from the local road and Scenic Route 8 in the townland of Drinanstown South, approximately 12.45 kilometres southeast of the nearest turbine	E 270 886 N 219 461
13	View from Wilson's Bridge, a Protected View, in the townland of Kiltaghan South, approximately 9.9 kilometres southeast of the nearest turbine.	E 265 299 N 217 283
14	View from the local road at High Bridge, in the townland of Old Grange in Monasterevin, approximately 14.49 kilometres southeast of the nearest turbine	E 262 807 N 211 395
15	View from the Regional Road R420 in the townland of Clonyquin, approximately 13.07 kilometres southwest of the nearest turbine.	E 250 265 N 214 454
16	View from the Regional Road R420 in the townland of Curragh, approximately 14.5 kilometres southwest of the nearest turbine	E 243 648 N 221 595
17	View from the Regional Road R402 in the townland of Townparks, approximately 8.8 kilometres northwest of the nearest turbine.	E 248 060 N 227 702

Viewpoint	Description	Grid Reference Coordinates
18	View from the Regional Road R402 in the townland of Esker Beg approximately 4.6 kilometres northwest of the nearest turbine.	E 252 345 N 227 890
19	View from the local road in the townland of Coole, in an Area of High Amenity, and a protected view, approximately 8.9 kilometres northwest of the proposed development.	E 249 530 N 231 715
20	View from the local road in the townland of Croghan Demesne, in an Area of High Amenity, and a protected view, approximately 10.9 kilometres northwest of the proposed development	E 247 780 N 232 602
21	View from the summit of Croghan Hill in the townland of Croghanhill, approximately 10.9 kilometres northwest of the nearest turbine	E 248 106 N 233 113
22	View from the Regional Road R441 in the townland of Ballybryan, approximately 6.5 kilometres northwest of the nearest turbine	E 257 456 N 234 069
23	View from the Regional Road R446 in the townland of Garrane, approximately 18.2 kilometres northwest of the proposed development	E 243 296 N 238 780

11.8 Landscape and Visual Impact Assessment Methodology

11.8.1 Assessing Landscape Effects

The potential visual effects of the proposed development are informed by the nature of the proposal, desk study, site visit, along with tools such as ZTV and photomontages. The methodology uses qualitative methods in order to arrive at an assessment, which is based on the Landscape and Landscape Assessment (2000) Guidelines as well as the GLVIA (2013), and the DoEHLG (2006) Guidelines were also taken into account. Landscape and Visual Impact Assessment, though related, can be described separately. Descriptions below are based on the GLVIA (2013).

Landscape Effects: This can be described as changes which affect the landscape as a resource. This includes how the proposal will affect the elements that make up the landscape, the aesthetic and perceptual aspects, and its landscape character. Landscape effects also relate to changes in the structure of the landscape. Under the GLVIA (2013), the assessment of likely significant effects on landscape receptors includes a judgement on both the sensitivity of the receptor as well as magnitude of the change.

Assessing Landscape Sensitivity

Landscape Sensitivity, which is described in the GLVIA (2013) as a combination of the landscape's susceptibility to change as well as the value attached to the landscape, as shown in Table 11.6 below. Susceptibility to change can be described as the ability of the landscape receptor (either the overall character or quality of the landscape, or a particular landscape feature), to accommodate the proposed development without undue consequences for the maintenance of the baseline (existing) landscape situation, and/or the achievements of landscape planning policies and strategies. Landscape value is a combination of values which are assessed in the landscape baseline, combining any formal landscape designations with the criteria included in Table 11.7 below.

Assessing Magnitude of the change
This is then combined with the magnitude of the effects, which is a combination of the visual presence - size and scale - of the change, the extent of the area to be affected, and the duration and reversibility of the effect.

Significance is then calculated by combining the magnitude and sensitivity judgements.

Table 11.6 Assessing Landscape Sensitivity

Susceptibility of landscape to change	Description and example criteria
High	This includes landscapes where the overall landscape character or condition is highly susceptible to change, and where the landscape receptor has a low ability to accommodate the proposed development without undue consequences for the maintenance of the landscape character and the achievement of planning policies/strategies. Other susceptible landscapes include those or areas with highly distinctive landscape features and clear cultural associations. Landscapes and landcover which shows low evidence of human influence can be more susceptible.
Medium	This includes landscapes where the overall landscape character has a moderate ability to accommodate the proposed development without undue consequences for the maintenance of the landscape character and the achievement of planning policies/strategies. These landscapes may have locally distinctive landscape features and have local cultural or heritage associations. These landscapes tend to have some clear evidence of human influence and include land uses which result in variation and changes to the landcover.
Low	This includes landscapes where the overall landscape character has a strong ability to accommodate the proposed development without undue consequences for the maintenance of the landscape character and the achievement of planning policies/strategies. This can include landscapes where human influence is clearly evident, where there are not distinctive landscape features cultural and heritage associations, and contain land uses which are subject to a high level of change.
Value attached to Landscape elements	**Description and example criteria**
High	This includes landscapes which are designated as high value, or are designated as (e.g. Areas of High Amenity, Scenic Routes/Views) in the Development Plan, or areas designated at a national or International level.
Medium	This includes landscapes where value is not formally designated, but are of value as they display good examples of good quality, intact landscapes, and areas deemed to be of relatively high scenic quality, landscapes which contains some rare elements, which have areas which are wild or have a sense of naturalness, strong cultural associations or which have recreational value.
Low	This includes landscapes which are not formally designated and which are considered to be modified. These include areas which do not have particular scenic qualities and do not include rare elements or landscape features and do not have strongly evident cultural or heritage associations.

Table 11.7 Assessing Magnitude of Landscape Effects

Magnitude of Change	Description
High	This includes landscapes which will experience a loss of landscape features over a large extent, and where this has an effect on the overall landscape character, and where there this results in a high degree of change to the aesthetics of the landscape. This includes landscapes where the effects affect key characteristics of the landscape's character. The geographical extent of these changes is evident over a wide area.
Medium	This includes landscapes where there is some loss of landscape features over a medium extent which will result in some change to landscape features and aesthetics. This includes landscapes where there is a moderate effect on the overall landscape character but does not affect key characteristics.
Low	This includes landscapes where these is loss of or change to landscape features of limited extent, and where these changes do not have an effect on the overall landscape character and does not affect key characteristics. Changes to the overall aesthetics of the landscapes are low. Changes to the landscape are more evident at a local level and not over a wide geographical area.

11.8.2 Assessing Visual Effects

Visual effects relate to changes in views and visual amenity of the surroundings of individuals or groups of people. These may result from changes in content and character of views as a result in changes to the landscape. The assessment of visual effects is based on views shown in photomontages and also on the potential visibility indicated by the ZTV maps, as well as actual visibility on the ground.

It should be noted that in assessing visual effects, there are different types of visual effects:

<u>Visual obstruction:</u> This occurs when there is an impact on a view which blocks the view

<u>Visual intrusion:</u> This occurs when there is an impact on a view but which does not block the view.

Due to the nature of the development and the appearance of wind turbines, visual intrusion occurs more frequently than obstruction.

The likely significant effects of the proposed development in terms of visual and landscape effects are informed by the ZTV and photomontages. Visual effects relate to changes in views and visual amenity of the surroundings of individuals or groups of people. These may result from changes in content and character of views as a result of changes to the landscape. The significance of the effect on visual receptors is a combination of the sensitivity of the receptor as well as the magnitude of the change.

Assessing Magnitude and Sensitivity

Visual Receptor Sensitivity depends on the occupation or activity of the people, as well the extent to which the attention is focused on views and visual amenity, according to the GLVIA Guidelines (2013). Value of the visual receptor is a combination of values are assessed in the landscape baseline, combining any formal landscape designations with the criteria such as those included in Table 11.8. This is then combined with the Magnitude of the effect, which is a combination of size and scale of the change, the extent of the area to be affected, and the duration and reversibility of the effect.

The assessment is based on the methodology described below and the likely significant visual effect for each photomontage viewpoint is then assessed by reviewing the photomontage and taking account of the criteria mentioned above and the results are presented in Table 11.32.

Table 11.8 Assessing Visual Receptor Sensitivity

Susceptibility of visual receptor	Description and example criteria
High	These include viewers at designated views or landscapes; Viewers such as residents which are focussed to a large extent on the development due to location in close proximity; viewers at well-known heritage or popular tourist or recreational areas, viewers along scenic or tourist routes
Medium	These include viewers who may have some susceptibility to a change in view, such as those from views which are not designated but may have local recreational uses or those travelling along routes or at view which are considered moderately scenic.
Low	These include viewers engaged in activities where the focus is not on the landscape or view. These including those travelling along a busy route, viewers at work or engaged in sport not related to views or experience of the landscape.
Value attached to the view	**Description and example criteria**
High	These include protected views of views from designated landscapes of national or international importance, and views indicated on tourist/cultural publications, or views considered of high scenic quality, naturalness, tranquillity or the presence of rare elements in the view.
Medium	Views which are not designated but which include panoramic views or views judged to be of some scenic quality, which demonstrate some sense of naturalness, tranquillity, or some rare element in the view.
Low	Views which are not designated and which are not judged to be panoramic views, of particular scenic quality as described above. These are views which have no distinctive features.

Table 11.9 Assessing Magnitude of Visual Effects

Magnitude of Change	Description
High	This includes viewpoints where the proposed development results in a large scale change of the view and its composition, and creates a high degree of contrast. This includes viewpoints where the proposed development is fully or almost fully visible over a wide extent, at close proximity to the viewer. The duration of the effect is long term or permanent and have a low level of reversibility.
Medium	This includes viewpoints where the proposed development results in a moderate scale change of the view and a moderate degree of contrast with the existing view. This includes viewpoints where the development is partially visible over a moderate or medium extent, and viewpoints which are not in close proximity to the development.
Low	This includes viewpoints where the proposed development results in a low level of change in the view and its composition and a low degree of contrast. This includes viewpoints where the development is partially or barely visible, and over a small extent,

Magnitude of Change	Description
	and includes viewpoints at a distance from the proposed development.

11.8.3 Assessing Cumulative Landscape and Visual Effects

The Cumulative Landscape and visual effects are assessed following the same principles as the Landscape and Visual Assessment, as described above.

For this assessment, the SNH (2012) definition of Cumulative effects as *additional changes caused by a proposed development in conjunction with other similar developments,* is used, however this assessment also considers other types of developments. The definition in the DoEHLG Guidelines (2006) defines Cumulative Impacts in terms of wind farms, as the perceived effect on the landscape of two or more wind energy developments visible from any one place, and this is also relevant to when relating to other wind energy projects.

Study area
Cumulative Visual Effects are assessed using the same study area as for the main landscape and visual impact assessment, which is 20 kilometres from the proposed development site boundary.

Baseline
The baseline is the same as for the landscape and visual assessment, which is described in detail in Sections 11.3 to 11.7.

Sensitivity
Sensitivity criteria for both landscape and visual receptors is the same as those outlined above in Section 11.8.1 and 11.8.2.

Magnitude
The magnitude of the effect includes the size and scale of the change, the extent of the area to be affected, and the duration and reversibility of the effect.

The GLVIA (2013) and SNH (2012) guidance also notes that in terms of identifying cumulative visual effects, an important element is the way in which they are experienced, and that they can be both experienced in combination, where two or more developments are visible from one viewpoint, as well as sequentially, where a viewer moves to another viewpoint and sees the same or different developments. The Viewpoints 1-23 in Section 11.9.1 below are important in terms of illustrating the Cumulative assessment of visual effects, as they illustrate combined visibility, and analysis of the photomontages and route screening allows sequential visibility to be assessed.

11.9 Likely and Significant Effects & Associated Mitigation Measures

The section below discusses the potential significant effects under a variety of headings. It should be noted that, as per the EPA guidance, effects (or Impacts are they are referred to in the guidance) are described with reference to Quality, Significance, Duration and Type. These are described in accordance with the EPA Classification Terminology contained in Chapter 1. As stated previously, in Section, 11.8.2, with reference to visual effects of wind turbines, quality is somewhat subjective as acknowledged by the DoEHLG (2006) Guidance – and the quality of the effect will not necessarily appear the same to different viewers. However non-turbine effects are assessed in terms of their quality, whether positive, negative, or neutral. The likely significant effects are discussed below in terms of Significance, Duration, and where necessary, are distinguished by Type. Where mitigation measures are proposed, a residual effect is then included. By the nature of wind turbine developments and associated works, most effects are direct rather than indirect, and are therefore direct effects unless otherwise stated.

11.9.1 Viewpoint Assessment and Photomontage Booklet

The Viewpoints 1 to 23 presented in the accompanying Photomontage Booklet show three views from each viewpoint location:

- 'Do Nothing Scenario' panoramic view: The proposed development does not go ahead, existing developments and Mountlucas turbines are visible, the permitted Yellow River turbines and the proposed Clonin Solar farm, are constructed.
- Photomontage panoramic view: The proposed development is shown, along with existing Mountlucas and permitted Yellow River turbines.
- Wireframe panoramic view. The wireframe view shows the visibility of the proposed Cloncreen turbines in the absence of all landcover, as well as the existing and permitted turbines. The extents of the proposed solar farm at Clonin North is also indicated on the wireframe, where visible.

It should be noted that the proposed Cloncreen Meteorological mast and substation options (A) and (B) are not depicted in the photomontages. However, the likely significant landscape and visual effects of these elements are discussed in text under the relevant sections. The technical data for each photomontage is also included on the Photomontage Booklet.

Tables 11.10 to 11.32 below present the overall assessment of visual effects based on the 23 viewpoints. These tables should be read in conjunction with Volume 2 Photomontages. Each table includes the viewpoint name and details, as well as descriptions of the views which lead to an assessment of the Viewpoint sensitivity and magnitude of change. These are then combined to come to a final assessment of effects for each viewpoint.

With regards to the classification of the quality of effects, the Department of the Environment, Heritage and Local Government (2006) Guidelines state that while many issues in relation to wind energy development can be assessed in quantitative terms, aesthetic or visual considerations are more subjective and qualitative.

Visualisations such as photomontages are tools that can represent the likely effect of a development at a particular time and are used to inform the viewer's prediction of how that development will appear. In terms of the predicted visual quality of the proposed turbines however, i.e. whether a visual effect is deemed to be positive, negative or neutral, this involves a degree of subjectivity. What appears to be a positive effect to one viewer could be deemed to be a negative effect by another viewer. All predicted visual effects of the Viewpoints 1-23 below are Long Term and Direct effects.

When viewing the photomontages, it should be noted that the photographs for photomontages reflect the weather conditions of the particular day. The photographs also depict atmospheric or weather conditions. In some photomontages, the existing Mountlucas turbines in the images may appear further away and less distinct when seen next to the proposed Cloncreen turbines. This is because the Cloncreen turbines, being rendered in by a computer programme, are not seen through atmospheric conditions and subject to the same lighting as the turbines which exist in the baseline image. Therefore, it should be noted in several photomontages (such as Viewpoints 19,20,21) that while the Cloncreen turbines appear closer, in reality when they are constructed they would not appear as close to the viewer as they would be seen in the same light and through the same atmospheric conditions as the other existing turbines.

Table 11.10 Viewpoint 1

Viewpoint 1 **Clonavoe**	**Approximate Distance from nearest turbine (km): 2.9** **Grid Reference E 255 453 N 223 171** **No. of turbines visible: 21/21**
View Description:	View from the local road in the townland of Clonavoe, approximately 2.9 kilometres southwest of the nearest turbine.
'Do Nothing Scenario' (including Cumulative effect)	The 'Do Nothing' scenario shows an open view from a local road south of the site. In the foreground, the view shows an area of cutover bog which allows clear views. A block of deciduous woodland is visible further down the road. In the middle ground and in the distance, deciduous and coniferous trees are visible, providing contrast with the flat peatland. The landscape here, while it has a tranquil character, is evidently modified. To the left of the image, the permitted Yellow River turbines are screened by the intervening deciduous and coniferous woodland. The 'Do Nothing scenario is considered to have no visual effects.
Proposed Photomontage Description (Including Cumulative effect)	The proposed photomontage shows the proposed Cloncreen turbines appearing in a relatively contained group to the rear of the trees. The turbines have a limited spatial extent from this view, and while they are clearly visible they are not considered dominant. The permitted Yellow River turbines are screened by vegetation.
Visual Receptor Sensitivity	The visual receptor sensitivity at this location is considered to be Medium – the area is tranquil but there is no residential development in this location and there are no designations.
Magnitude of Change	The extent, scale and duration of the change in a landscape which has been modified is considered to be Medium at this location.
Significance of Effect	**Slight**, that its, an impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect. The turbines have a limited spatial extent from this viewpoint.

Table 11.11 Viewpoint 2

Viewpoint 2 Clongarret	Approximate Distance from nearest turbine (km): 0.71 Grid Reference E 257 545 N 224 652 No. of turbines visible:21/21
View Description:	View from the local road in the townland of Clongarret approximately 0.71 kilometres west of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows an open expanse of flat peatland which has been commercially harvested, with small clumps of vegetation to the left. Several wooden electricity poles carrying an overhead line are evident. There are long distance views in this image, and the Edenderry power station is visible in the background. Many elements of the landscape are associated with electricity and energy generation. The Do Nothing Scenario is considered to be Long Term, Imperceptible visual effect.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines, all of which are visible. Some of the turbines are seen in close proximity while some are seen in the distance. Many of the turbines appear in rows. The spatial extent of the turbines is large from this view, which is consistent with the siting and design guidance for Flat Peatland.
Visual Receptor Sensitivity	The visual receptor sensitivity is considered to be Medium – the peatland has cultural associations, but this is not a designated landscape or viewing point, and there are not highly sensitive visual receptors.
Magnitude of Change	The magnitude of change is considered to be High owing to the spatial extent, scale and visibility of the turbines.
Significance of Effect	**Moderate** – An impact that alters the character of the environment in a manner consistent with existing and emerging trends.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.12 Viewpoint 3

Viewpoint 3 Rathvilla	Approximate Distance from nearest turbine (km): 1.57 Grid Reference E 257 430 N 227 721 No. of turbines visible: 18 /21
View Description:	View from the local road in the townland of Rathvilla, approximately 1.57 kilometres west of the nearest turbine.
'Do Nothing Scenario' (including Cumulative effect)	The 'Do Nothing' scenario shows a relatively open flat landscape, primarily composed of a large agricultural field bordered by a low hedgerow in the foreground. To the right of the image is a residence with farm buildings. In the middle ground, several scattered houses are seen against a backdrop of deciduous trees. The 'Do Nothing scenario' is considered to have a no visual effects.
Proposed Photomontage Description (Including Cumulative effect)	The proposed photomontage shows the proposed Cloncreen turbines visible across this view, having a wide spatial extent. There are a number of residences in this image and these will have varying levels of visibility of the proposed turbines. The largely flat nature of the landscape assists in absorbing the proposed development.
Visual Receptor Sensitivity	The visual receptor sensitivity is considered to be High, as this is a local road, with a number of houses in the image in close proximity to the proposed development.
Magnitude of Change	The magnitude of change is considered to be High, due to the wide spatial extent of the turbines from this viewpoint.
Significance of Effect	**Significant** – An impact which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.13 Viewpoint 4

Viewpoint 4 Ballyleakin	Approximate Distance from nearest turbine (km): 2.3 Grid Reference: E 258 813 N 229 999 No. of turbines visible: 17/21
View Description:	View from Regional Road R402 in the townland of Ballyleakin, approximately 2.3 kilometres north of nearest turbine.
'Do Nothing Scenario' (including Cumulative effect)	'Do Nothing' scenario shows a generally flat, partially open landscape with a Regional Road in the foreground with an agricultural field in the middle ground. Houses and agricultural sheds are visible, surrounded by vegetation, while in the background mature trees are visible on the skyline. To the right, some of the Mountlucas turbines are partially visible, though faint, and are partly screened. There are no visual effects arising from the 'Do Nothing scenario'.
Proposed Photomontage Description (Including Cumulative Effect)	The Cloncreen turbines appear in the centre of the image. In this view 15 of the proposed 21 turbines are visible, while more would be visible during the winter months. The proposed turbines occupy a proportion of the available view, but the screening mitigates this somewhat. The turbines, while tall, are seen in the context of other screening and structures to the right of the image. Several turbines are seen to overlap. Overall the turbines are clearly visible but not dominant and the landscape is considered of an open nature to be able to absorb this scale of development.
Visual Receptor Sensitivity	The visual receptor sensitivity is regarded as low. The Regional Road in an agricultural location where susceptibility to change is considered to be low. Residences are present but views have some screening towards proposed turbines. The value of the view here is considered low.
Magnitude of Change	The magnitude of change is considered to be medium. The visual presence of the turbines at close proximity, some of which overlap, increase the complexity of the image. Some turbines are screened from view, but combined with the scattered buildings in the foreground, results in a magnitude of change considered to be Medium.
Significance of Effect	**Slight** – an impact which causes noticeable changes in the environment without affecting its sensitivities
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006). The layout has depth and is in a grid-like formation, for Flat Peatland, in terms of location, spatial extent, spacing, layout, height and cumulative effect. Mitigating factors include siting of the turbines in a compact dense formation from this location.

Table 11.14 Viewpoint 5

Viewpoint 5 Ballykilleen Cross Roads	**Approximate Distance from nearest turbine (km): 1.7** **Grid Reference E 259 788 N 229 715** **No. of turbines visible: 20/21**
View Description:	View from the local road at Ballykilleen Cross Roads, in the townland of Ballykilleen, approximately 1.7 kilometres north of the nearest turbine
'Do Nothing Scenario' (including Cumulative effect)	The 'Do Nothing' scenario shows a relatively open agricultural landscape with a fenced field in the foreground. . A cluster of houses is seen to the right of the image. A number of agricultural fields are seen on the higher ground to the left of the image. Deciduous trees are evident in the distance and along the roadside, close to the cluster of houses. There are no visual effects relating to the 'Do Nothing Scenario.
Proposed Photomontage Description (Including Cumulative effect)	The proposed photomontage shows the proposed Cloncreen turbines which appear in a cluster in the centre of the image, seen among deciduous trees. The spatial extent of the turbines is relatively limited.
Visual Receptor Sensitivity	The visual receptor sensitivity is considered to be High, as this is a local road, with a number of houses in close proximity to the proposed development.
Magnitude of Change	The magnitude of change is considered to be Moderate. Although the spatial extent of the turbines is limited, they are clearly visible and at relatively close proximity.
Significance of Effect	**Moderate** – An impact that alters the character of the environment in a manner consistent with existing and emerging trends
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.15 Viewpoint 6

Viewpoint 6 **Ballykilleen**	**Approximate Distance from nearest turbine (km): 0.98** **Grid Reference E 260 534 N 228 638** **No. of turbines visible: 21/21**
View Description:	View from the local road in the townland of Ballykilleen, approximately 0.99 kilometres from the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows an open, flat bogland landscape seen from an elevated location. This is one of the few locations where the site is clearly seen from a height. In the foreground, an open arable field is visible, and the topography slopes away from the viewer towards Cloncreen Bog. Long distance views are available with some distant low hills visible. Edenderry power station is seen in the left of the image, with some mixed tree plantation in the foreground to the left. The presence of the power station and cutaway peatland add an industrial element to the landscape. There are no visual effects relating to the 'Do Nothing Scenario.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines are visible in a cluster on the cutover bog which is at a lower level. The turbines are clearly visible from this view, and appear large due to the proximity to the viewer. The spatial extent of the turbines is relatively contained.
Visual Receptor Sensitivity	The visual receptor sensitivity is considered to be Medium at this location. This is not a designated view or landscape, however it is a noticeable panoramic view of the surrounding bogland landscape, and can be described as having scenic qualities. The extensive bogland landscape also has cultural associations.
Magnitude of Change	The magnitude of change is considered to be High, owing primarily to the height and proximity of the turbines as they appear to the viewer in this location. They occupy a limited spatial extent
Significance of Effect	**Moderate** – An impact that alters the character of the environment in a manner consistent with existing and emerging trends.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.16 Viewpoint 7

Viewpoint 7 **Ballykilleen**	**Approximate Distance from nearest turbine (km): 0.58** **Grid Reference E 261 071 N 226 809** **No. of turbines visible: 18/21**
View Description:	View from the Regional Road R401 in the townland of Ballykilleen, approximately 0.85 kilometres from the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows a partially enclosed, flat landscape. Kilcumber bridge and road are visible in the foreground, with vegetation to the left and right of the road. The Edenderry Power Station lies to the right of the image, while to the left lies a field with scattered vegetation. Wooden power lines are visible along the roadside. The Power Station adds an industrial element to the landscape. The effect of the 'Do Nothing Scenario' is considered Long Term, Imperceptible visual effect.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows 11 of the proposed 21 Cloncreen turbines visible at close proximity. The turbines however are partially screened by the roadside trees and vegetation. The wooden poles provide some form of vertical emphases which is echoed by the turbines. The turbines have a relatively wide spatial extent.
Visual Receptor Sensitivity	The visual receptor sensitivity is considered to be Low. This is not a designated view or landscape, and is not considered of particular scenic value and does not represent highly susceptible visual receptors.
Magnitude of Change	The magnitude of change is considered to be Medium, due to the presence of 11 turbines at close proximity and over a relatively large spatial extent.
Significance of Effect	**Slight** – an impact which causes noticeable changes in the environment without affecting its sensitivities
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.17 Viewpoint 8

Viewpoint 8 Cloncreen	Approximate Distance from nearest turbine (km): 1.9 Grid Reference: E 260 516 N 223 999 No. of turbines visible: 21/21
View Description:	View from the local road at Cloncreen Bridge in the townland of Cloncreen, approximately 1.9 kilometres southeast of the nearest turbine
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows an open, expansive, flat landscape seen from Cloncreen bridge with a large agricultural field in the foreground. Roadside vegetation is low in this location and allows clear views, while distant vegetation is seen in the distance. No buildings are visible. A coniferous plantation is seen to the left of the image. The existing Mountlucas turbines are hidden by roadside vegetation. To the left of the image is a seating area and a bottle bank. The effect of the 'Do Nothing Scenario' is considered Long Term, Imperceptible visual effect.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines appearing in the centre of the image. The turbines are clearly visible, with all turbines being fully or partially visible. The large scale open landscape is suited to the turbine layout, and ensures that the turbines do not dominate and are enhanced by the simplicity of the landcover.
Visual Receptor Sensitivity	The sensitivity of the visual receptor is considered medium, as it is along a 'Slí na Sláinte trail named the Figile River Walk with a seating area visible in the image. There are no houses close to this viewpoint but it is considered to have local amenity value.
Magnitude of Change	The magnitude of the change is considered to be high, due to the proximity of the turbines, the visibility and spatial extent of turbines from this view. However the turbines are of an extent and scale that is in harmony with the open, simple landscape.
Significance of Effect	**Moderate** – An impact that alters the character of the environment in a manner consistent with existing and emerging trends.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect. The spatial extent of the turbines is limited and the turbines are seen in an expansive landscape

Table 11.18 Viewpoint 9

Viewpoint 9 Cushaling	Approximate Distance from nearest turbine (km): 4.7 Grid Reference E 265 097 N 226 044 No. of turbines visible: 21/21
View Description:	View from the local road in the townland of Cushaling, approximately 4.7 kilometres east of the nearest turbine
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows a partially open landscape from a local road. In the foreground is a large field, while a clump of coniferous forestry is seen to the left in the middleground. Deciduous trees are seen to the left and in the distance. The Edenderry power station is partially visible from this viewpoint. The visual effects of the 'Do Nothing Scenario' are considered Long Term Imperceptible visual effects.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines are visible in the distance, in the centre of the image. All 21 turbines are visible; some are wholly visible while some are partially visible behind the trees. The spatial extent is limited, and the vertical elements of the forestry provide some comparable height to the turbines. At this distance the turbines are visible but not dominant.
Visual Receptor Sensitivity	Visual receptor sensitivity is considered Low. The area is not a designated view or landscape, and are not considered to be not of particular scenic quality or located close to highly sensitive visual receptors.
Magnitude of Change	The magnitude of change is considered Low. The proposed Cloncreen turbines do not result in large scale change in the view, and the turbines are of limited spatial extent, and many are partially visible behind trees.
Significance of Effect	**Slight** – an impact which causes noticeable changes in the environment without affecting its sensitivities
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.19 Viewpoint 10

Viewpoint 10 Hamilton's bridge	Approximate Distance from nearest turbine (km): 11.5 Grid Reference E 271 829 N 228 129 No. of turbines visible: 12/21
View Description:	View from the local road (adjacent to protected view) at Hamilton's Bridge in the townland of Killinagh Lower, approximately 11.5 kilometres east of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows a view from Hamilton's bridge on the Grand Canal, which shows a partially enclosed landscape, small fields, houses and sheds in both the foreground and middleground and a considerable amount of deciduous and coniferous vegetation in the middleground and background. The vegetation somewhat restricts the views. The existing Mountlucas turbines are screened from view, as are the permitted Yellow River turbines. The Do Nothing Scenario is considered to have no visual effects.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines appearing in the distance, and the tips of some turbines will be visible in the background to the right of the image. The turbine appear at some distance and are only partially visible, seven being clearly visible, more may be visible in winter. The spatial extent of the turbines from this view is limited and they appear as distant elements.
Visual Receptor Sensitivity	The sensitivity of the visual receptor is considered to be High as the viewpoint is adjacent to a protect view from Hamilton's bridge.
Magnitude of Change	The magnitude of change is considered to be low due to the limited spatial extent and size and scale of the proposal, which is barely visible and not in close proximity and taken up a very small proportion of the view.
Significance of Effect	**Imperceptible** – an impact capable of measurement but without noticeable consequences.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.20 Viewpoint 11

Viewpoint 11 Lullymore	**Approximate Distance from nearest turbine (km): 10.8 Grid Reference E 270 898 N 224 161 No. of turbines visible: 14/21**
View Description:	View from R414 and Scenic Route 39 in the townland of Lullymore East, approximately 10.8 kilometres east of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows a partially enclosed landscape which is along a scenic route. In the foreground, scattered vegetation is seen along the roadside, while a large field is evident in the Middleground. Scattered clumps of shrubs and small trees are visible, while in the distance there are glimpses of open bogland. The existing Mountlucas turbines are screened and in the conditions are not visible. There are no visual effects relating arising from the 'Do Nothing scenario'.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines appearing in the distance, through the gaps in vegetation. Fourteen turbines are clearly visible, though others may be visible in winter. The proposed turbines are at some distance and are not in any way dominant, and the vertical turbines complement the existing vegetation and trees.
Visual Receptor Sensitivity	Visual receptors are considered of High sensitivity in this location, as this is designated as a scenic route.
Magnitude of Change	The magnitude of change is considered to be Low, due to the partial visibility of the turbines, the small proportion of the view occupied and the distance of the turbines.
Significance of Effect	**Slight** – an impact which causes noticeable changes in the environment without affecting its sensitivities
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect. The turbines are partially visible and are of limited spatial extent.

Table 11.21 Viewpoint 12

Viewpoint 12 Drinanstown South	Approximate Distance from nearest turbine (km): 12.45 Grid Reference E 270 886 N 219 461 No. of turbines visible: 21/21
View Description:	View from the local road and Scenic Route 8 in the townland of Drinanstown South, approximately 12.45 kilometres southeast of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows an open, expensive and panoramic view of a flat landscape from an elevated location. A number of houses as well as a large field are visible in the foreground, while in the distance, an expanse of fields, bogland interspersed with trees and buildings can be seen. The existing Mountlucas turbines are faintly visible in the distance, due to weather conditions. The Edenderry power station is visible in the distance, while the permitted Yellow river turbines are seen in the distance to the right of the image. Steel lattice towers and wooden poles supporting Power lines are also visible. The cutover bog, power station and turbines signify the presence of energy generation in this landscape. The effects of the Do Nothing Scenario are considered Long Term, Slight visual effects.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows all 21 of the proposed Cloncreen turbines are visible in the centre of the image The turbines are seen as a group, distinct from the Mountlucas turbines, however the permitted Yellow River turbines are visible to the rear of some Cloncreen turbines. While the proposed turbines are clearly visible, they are seen at some distance and are not dominant. The large scale nature of the landscape is of a scale and character to accommodate the turbines, which appear in a generally evenly spaced, similar to that of Mountlucas, as seen in the wireframe.
Visual Receptor Sensitivity	Visual Receptor sensitivity is High as the viewpoint is located on a scenic route and is adjacent to residences.
Magnitude of Change	The magnitude of change is considered Medium. The proposed Cloncreen turbines have a moderate spatial extent and height form this viewpoint, and while they are visible do not alter the view to a large extent.
Significance of Effect	**Slight** – an impact which causes noticeable changes in the environment without affecting its sensitivities
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.22 Viewpoint 13

Viewpoint 13 Wilson's Bridge	Approximate Distance from nearest turbine (km): 9.9 Grid Reference E 265 299 N 217 283 No. of turbines visible: 15/21
View Description:	View from Wilson's Bridge, a Protected View, in the townland of Kiltaghan South, approximately 9.9 kilometres southeast of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows a partially open landscape, which is mainly flat, seen from the slightly elevated Grand canal bridge. In the foreground, the main feature is the canal bridge wall and the canal itself, with a walkway on one side and marginal vegetation on the other. Shrubs and small trees are seen on either side of the canal. To the left of the image, the road is visible, with some buildings. A large agricultural field is evident in the middleground. There are some views to the distance, where vegetation and some forestry is seen along the horizon. To the left in the distance, some of the Mountlucas turbines are discernible but they appear faint. The permitted Yellow River turbines are barely visible. The proposed Barrow Blueway will be visible from this view. The effects of the Do Nothing Scenario are considered Long Term, Imperceptible to Slight visual effects.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows that some of the proposed Cloncreen turbines will be visible along the horizon where there are gaps in both foreground and middleground vegetation. However at this distance, the turbines can be seen but are not in any way dominant.
Visual Receptor Sensitivity	Visual Receptor sensitivity is High, as the viewpoint is a protected view, and the canal bridge and towpath are a recreation area where viewers are highly susceptible to change.
Magnitude of Change	The magnitude of the effect is considered low due to the scale, extent, and duration of the change. The turbines are partially visible for a limited proportion of the view through vegetation.
Significance of Effect	**Imperceptible.** An impact capable of measurement but without noticeable consequences.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.23 Viewpoint 14

Viewpoint 14 High Bridge	Approximate Distance from nearest turbine (km): 14.4 Grid Reference E 262 807 N 211 395 No. of turbines visible: 21/21
View Description:	View from the local road at High Bridge, a protected view, in the townland of Old Grange, Monasterevin, and approximately 14.4 kilometres southeast of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows a panoramic view from an elevated location on High Bridge, a protected view. The surrounding landscape is largely flat. The landscape is composed of a bridge and the Grand Canal in to the right of the image, which is a noticeable element of the view. To the left, the landcover is composed of agricultural fields with low hedgerows in the foreground, which changes to wet grassland closer to the canal. The existing Mountlucas turbines are visible in the wireframe on the bottom panel, but screened by the tree in the foreground. Deciduous trees with areas of coniferous plantation are visible on the horizon across. The proposed Barrow Blueway scheme will be visible from this view. The effects of the Do Nothing Scenario are considered Long Term, Imperceptible to Slight visual effects.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows all of the proposed Cloncreen turbines are visible in the distance, and appear in a cluster along the horizon. The distance renders these turbines as a distant element of the landscape, but an element which does not affect the overall view from this location. The appearance in terms of extent, and scale and the proposed turbines from this view is considered low.
Visual Receptor Sensitivity	The visual receptor sensitivity is considered High, as the viewpoint is a protected view. The canal bridge and path are also a recreational area thus viewers are more susceptible to change.
Magnitude of Change	The magnitude of change is considered Low as the turbines are partially visible, occupy a small proportion of the view and are seen at a distance.
Significance of Effect	**Imperceptible.** An impact capable of measurement but without noticeable consequences.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.24 Viewpoint 15

Viewpoint 15 **Clonyquin**	**Approximate Distance from nearest turbine (km): 13.07** **Grid Reference: E 250 265 N 214 454** **No. of turbines visible: 16/21**
View Description:	View from the Regional Road R420 in the townland of Clonyquin, approximately 13.07 kilometres southwest of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows an open, large scale landscape. In the foreground, a large field is evident, with some broadleaf trees. In the distance, trees are visible along the horizon. A number of the Mountlucas turbines are visible to the left of the image. The permitted Yellow River turbines are not visible due to screening in this image. There are no visual effects relating arising from the 'Do Nothing scenario'.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines are visible in the distance, beyond the distant trees. From this view, a number of turbines (up to sixteen) turbines are only partially visible behind trees, and are not in any way dominant.
Visual Receptor Sensitivity	The visual receptor sensitivity is considered Low – there are no designations, tourist or heritage attractions or areas of particular scenic quality.
Magnitude of Change	From this location the magnitude of change is considered to be low, due to the limited spatial extent of the turbines and the partial visibility of the turbines.
Significance of Effect	**Imperceptible** – an impact capable of measurement but without noticeable consequences
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.25 Viewpoint 16

Viewpoint 16 Curragh	Approximate Distance from nearest turbine (km): 14.5 Grid Reference: E 243 648 N 221 595 No. of turbines visible: 21/21
View Description:	View from the Regional Road R420 in the townland of Curragh, approximately 14.5 kilometres southwest of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows a relatively open landscape which has long distance views. In the foreground a large field lies alongside the road with a hedge in places. While the remaining landscape elements include a patchwork of fields, hedgerows composed of deciduous trees, and scattered dwellings. In the distance, higher ground is visible - on the extreme right, Croghan Hill is visible, and there are several other areas of higher ground. In the centre of the view, the existing Mountlucas turbines are clearly visible in a cluster. The proposed Clonin North solar farm is indicated in this image though at some distance. The effects of the Do Nothing Scenario are considered Long Term, Slight visual effects.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines are visible behind the existing Mountlucas turbines. While some turbines overlap, the Cloncreen turbines have a limited spatial extent and appear smaller than the Mountlucas turbines. Some of the permitted Yellow River turbines appear in the distance also. This results in the existing cluster appearing as an increasingly dense cluster, with only a minor increase in spatial extent. From this distance, (14.5 kilometres) the turbines will be more difficult to distinguish in certain weather conditions.
Visual Receptor Sensitivity	The visual receptor sensitivity is considered to be Medium as the road is slightly elevated and there are long distance views in many directions, including a view of Croghan Hill.
Magnitude of Change	The magnitude of change is considered to be Low, due to the limited spatial extent of the turbines, and the distance from the turbines.
Significance of Effect	**Slight** – an impact which causes noticeable changes in the environment without affecting its sensitivities
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.26 Viewpoint 17

Viewpoint 17 Townparks	Approximate Distance from nearest turbine (km): 8.8 Grid Reference: E 248 060 N 227 702 No. of turbines visible: 14/21
View Description:	View from the Regional Road R402 in the townland of Townparks, approximately 8.8 kilometres northwest of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows a relatively open landscape along the Regional Road. The landscape in the foreground is generally flat however a low hill is visible in the distance. Large fields with hedgerows composed of deciduous trees are the main features of the landscape. The existing Mountlucas turbines are visible to the right of the image. There are no visual effects relating arising from the 'Do Nothing scenario'.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines are visible to the right of the hill. Some 14 turbines are partially visible. They occupy a small proportion of the overall view and the visual extent is limited from this view. The Mountlucas turbines appear in closer proximity than the proposed Cloncreen turbines.
Visual Receptor Sensitivity	Visual Receptor sensitivity is considered to be Low. There are no designations, heritage or tourist attractions and the view is from a busy road, where it is considered that visual receptors will be have a low sensitivity.
Magnitude of Change	The magnitude of change is considered to be Low, due to the limited spatial extent, the distance of the turbines and partial visibility of the turbines, which are mostly visible at or above hub height.
Significance of Effect	**Slight** – an impact which causes noticeable changes in the environment without affecting its sensitivities.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.27 Viewpoint 18

Viewpoint 18 Esker Beg	Approximate Distance from nearest turbine (km): 4.6 Grid Reference E 252 345 N 227 890 No. of turbines visible: 13/21
View Description	View from the Regional Road R402 in the townland of Esker Beg approximately 4.6 kilometres northwest of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows a relatively open landscape with gently sloping topography, a rise in ground is visible to the right of the image. The regional road is visible in the centre of the view, with fields and deciduous trees evident on either side. To the right of the image, the Mountlucas turbines are visible on the high ground. There are no visual effects relating arising from the 'Do Nothing scenario'.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines, thirteen of which appear in the distance to the left of the image as well as in the centre. They are partially screened by the intervening vegetation and building. The turbines occupy a limited spatial extent in this view remain distinct from the Mountlucas turbines.
Visual Receptor Sensitivity	The visual receptor sensitivity is considered to be Low, this is not a designated view or landscape and is a busy road where most receptors are travelling in vehicles.
Magnitude of Change	The magnitude of change is considered to be Low, given the limited spatial extent of the turbines, and the fact that they are only partially visible when vegetation is not in leaf.
Significance of Effect	**Imperceptible** – an impact capable of measurement but without noticeable consequences.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.28 Viewpoint 19

Viewpoint 19 Coole	Approximate Distance from nearest turbine (km): 8.9 Grid Reference E 249 530 N 231 715 No. of turbines visible: 21/21
View Description:	View from the local road in the townland of Coole, in an Area of High Amenity, and a protected view, approximately 10.8 kilometres northwest of the proposed development
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows an extensive panoramic views for some distance from an elevated roadside location. The landscape is open and generally flat or gently undulating, with some distant hills visible to the left of the image. Land cover consists of agricultural fields, tracts of peatland, and large areas of tree cover and some blocks of forestry. The Mountlucas turbines are visible in the right of the image. Some turbines, and especially blades, appear slightly faint owing to light and weather conditions. The effects of the Do Nothing Scenario are Long Term, Imperceptible visual effects.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines are visible to the left of the image. While the proposed turbines are clearly visible, they occupy a limited proportion of this protected view and are seen as distinct from the Mountlucas turbines. The vast panoramic view is still visible, as are the hills behind the proposed turbines. It is likely that the Cloncreen turbines, which are further from the viewpoint than Mountlucas turbines, will appear fainter in reality some of the time, similar to the Mountlucas turbines, depending on light and weather conditions.
Visual Receptor Sensitivity	The visual receptor sensitivity is High from this location, which is in an area of High Amenity and is the location of a protected view.
Magnitude of Change	The magnitude of change, (the extent, scale and duration), is considered to be Medium. The proposed turbines result in a medium degree of contrast and while they are clearly visible over a proportion of the view, the spatial extent is limited to a section of the left of the image, and are seen as distinct to the Mountlucas turbines.
Significance of Effect	**Moderate**– An impact that alters the character of the environment in a manner consistent with existing and emerging trends.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect, and 'stacking' or overlapping of turbines has been avoided from this sensitive viewpoint. The proposed turbines occupy a section of the overall view.

Table 11.29 Viewpoint 20

Viewpoint 20 Croghan Demesne	Approximate Distance from nearest turbine (km): 10.9 Grid Reference E 224 780 N 232 602 No. of turbines visible: 16/21
View Description:	View from the local road in the townland of Croghan Demesne, in an Area of High Amenity, and a protected view, approximately 10.9 kilometres northwest of the proposed development
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows an extensive panoramic view from an elevated roadside on the side of Croghan Hill. To the left of the image lies another hill, while some distant hills are visible. To the left, the image shows an extensive view of a generally flat landscape with minor undulations, composed of large fields in the foreground with considerable areas of tree cover. Mountlucas turbines are visible in the centre of the image, with some hills in the background, however some of the blades are difficult to see and appear at a distance, due to the light and weather conditions. To the right of Mountlucas, some electricity pylons are visible in the distance. There are no visual effects arising from the 'Do Nothing scenario'.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines are visible in a tight cluster to the left of the image, and some are visible as blade tips only which emerge from behind the hill. However, the proposed turbines occupy a limited proportion of this protected view. The landscape is large scale and open, and the two wind farms will be viewed as distinct entities. It is likely that the proposed Cloncreen turbines will appear to be fainter in reality, some of the time, similar to the Mountlucas turbines, due to distance, light and weather conditions.
Visual Receptor Sensitivity	Visual receptor sensitivity is High from this location, which is in an area of High Amenity and location of a protected view.
Magnitude of Change	The magnitude of change, (the extent, scale and duration), is considered to be Low. The siting of the proposed turbines result in a low degree of contrast and are visible over a small proportion of the view, and some are partially screened, and not in close proximity.
Significance of Effect	**Slight**, that its, an impact which causes noticeable changes in the character of the environment without affecting its sensitivities.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect. The proposed turbines occupy only a small proportion of the overall view.

Table 11.30 Viewpoint 21

Viewpoint 21 Croghan Hill	**Approximate Distance from nearest turbine (km): 10.9km** **Grid Reference E 248 106 N 233,113** **No. of turbines visible: 21/21**
View Description:	View from the summit of Croghan Hill in the townland of Croghanhill, approximately 10.9 kilometres northwest of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows an extensive panoramic view from the summit of Croghan Hill. In the foreground a graveyard is visible on the hill. The view looks over a largely flat, open landscape, composed of peatlands, of which cutover peatlands are most evident particularly to the left and centre of the image, interspersed with flat or gently undulating agricultural fields surrounded by hedgerows. Scattered building clusters as well as small clumps of trees are evident. There are long distance views from this viewpoint. To the right of the image the existing Mountlucas turbines are seen, and they appear are somewhat dull in appearance due to weather conditions. The turbine towers are more visible than the blades due to the blades being seen against the sky. Some of the permitted Yellow River turbines are seen to the left of the image in the foreground. The proposed Clonin North solar farm is also likely to be visible on the hill to the left of the image, as indicated in the wireframe. The effects of the Do Nothing Scenario are considered Long Term, Slight to Moderate visual effects.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines are visible in the centre of the view. Through three wind farms are visible, these are well separated from each other. The proposed Cloncreen are artificially rendered in and therefore they do appear more clearly visible as they are not affected by atmospheric and weather conditions as the existing turbines are. This is the case in a number of images. It is likely that the proposed Cloncreen turbines will appear to be fainter in reality, similar to the Mountlucas turbines, due to distance, light and weather conditions. The turbines are all visible but are seen at some distance, and they appear similar in layout and spacing to the Mountlucas turbines. The spatial extent of the Cloncreen turbines is relatively limited and they appear clearly distinct from the other turbines in the view.
Visual Receptor Sensitivity	Visual Receptor sensitivity is High, as the view from Croghan Hill is a protected view as well as an area of High Amenity and is an important landmark and has cultural heritage connotations.

Magnitude of Change	The magnitude of change is considered to be Medium from this viewpoint. The turbines are all visible but occupy a limited proportion of the view, and do not have a large spatial extent. The proposed Cloncreen turbines have a moderate degree of change in the view, which includes cutover peatlands, agricultural fields and other wind turbines. The long distance views from this viewpoint and the wide and extensive panorama of the landscape, and sense of openness of the view still remains.
Significance of Effect	**Moderate** – An impact that alters the character of the environment in a manner consistent with existing and emerging trends.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect, and 'stacking' or overlapping of turbines has been avoided from this sensitive viewpoint.

Table 11.31 Viewpoint 22

Viewpoint 22 **Ballybryan**	**Approximate Distance from nearest turbine (km): 6.5** **Grid Reference E 257 456 N 234 069** **No. of turbines visible: 20/21**
View Description:	View from the Regional Road R441 in the townland of Ballybryan, approximately 6.5 kilometres northwest of the nearest turbine.
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows a partially open landscape with gently sloping topography. In the foreground, behind the hedgerow which contains two large trees, is a large arable field which slopes up, away from the viewer. Mature deciduous hedgerows are evident behind this field and to the left of the image. To the right, the landscape is flatter and less enclosed by the topography and vegetation, with longer distance views. A number of scattered dwellings are visible to the right of the image. Also visible in a steel lattice tower which is part of the electricity network. There are no visual effects relating arising from the 'Do Nothing scenario'.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines appear in a small cluster behind the ridge of higher ground in the centre of the image. The turbines are seen among deciduous trees and therefore they continue the linear element along the ridge. From this view the turbines are noticeable but not dominant, and some are partially screened, and have a limited spatial extent. It is probable that fewer will be visible when vegetation is in full leaf in summer.
Visual Receptor Sensitivity	Visitor sensitivity is considered to be Low. The viewpoint is not designated and the view is not particularly scenic. There are no highly sensitive receptors in this location.
Magnitude of Change	Magnitude of change is considered to be Low – the proposed turbines are of limited spatial extent and partially visible, and are seen at some distance.
Significance of Effect	**Imperceptible.** An impact capable of measurement but without noticeable consequences.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.32 Viewpoint 23

Viewpoint 23 Garrane	Approximate Distance from nearest turbine (km): 18.2 Grid Reference: E 243 296 N 238 780 No. of turbines visible: 5 /21
View Description:	View from the Regional Road R446 in the townland of Garrane, a protected view, approximately 18.2 kilometres northwest of the proposed development
'Do Nothing Scenario' (including Cumulative Effect)	The 'Do Nothing' scenario shows an open, expansive view from an elevated location along the R446. The landscape is mainly flat, with the distinctive Croghan Hill in the distance. In the foreground is a large open field with a backdrop of a mature hedgerow. Between the trees, some of the permitted Yellow River turbines are visible. The effects of the Do Nothing Scenario are considered Long Term, Slight visual effects.
Proposed Photomontage Description (Including Cumulative Effect)	The proposed photomontage shows the proposed Cloncreen turbines are visible in the distance. However, these are only barely visible due to the distance and do not have an effect on the protected view.
Visual Receptor Sensitivity	Visual Receptor sensitivity is High, as the viewpoint is a protected view.
Magnitude of Change	The magnitude of change is described as Low. The spatial extent is limited, and the turbines result in a low level of change to the view and its composition.
Significance of Effect	**Imperceptible.** An impact capable of measurement but without noticeable consequences.
Mitigation Measures & Mitigating Factors	The siting and design was developed in accordance with the DoEHLG Guidelines (2006) for Flat Peatland in terms of location, spatial extent, spacing, layout, height and cumulative effect.

Table 11.33 Viewpoint Impact Assessment Results

Viewpoint	Impact Assessment Result
1	Slight
2	Moderate
3	Significant
4	Slight
5	Moderate
6	Moderate
7	Slight
8	Moderate
9	Slight
10	Imperceptible
11	Slight
12	Slight
13	Imperceptible
14	Imperceptible
15	Imperceptible
16	Slight
17	Slight
18	Imperceptible
19	Moderate
20	Slight
21	Moderate
22	Imperceptible
23	Imperceptible

Of the 23 photomontages, a total of seven viewpoints were judged to have an 'Imperceptible' effect, while nine were considered Slight. Six viewpoints were considered to have Moderate effects while one was considered Significant.

11.9.2 'Do Nothing' Scenario

If the wind energy development for which this EIS has been prepared does not go ahead, it is to be assumed that the character of the landscape of the Cloncreen site, and its uses will remain much as they are today, i.e. peat harvesting will continue as projected until 2018 and after this period the cutaway bog will continue to develop typical cutaway habitats.

In terms of landscape and visual effects in the wider landscape, existing operations and processes such as peat extraction will continue, and it is expected that the permitted Yellow River turbines will be constructed. Other proposed developments, including the continued operation of the Edenderry power station, and the proposed Clonin North solar farm, may be constructed. Peat extraction will continue in the wider area, and the Barrow Blueway, which is not yet in the planning process, and the proposed Grand Canal walkway may be constructed. The 'worst case scenario' assumes all the permitted and proposed developments will go ahead.

The likely landscape effects of the Do Nothing scenario are, at a site level, a Long Term to Permanent, Slight, positive landscape effect, as the Cloncreen Bog itself undergoes rehabilitation. In the wider landscape, assuming that the development of any permitted and proposed projects will go ahead, these landscape effects will range from Imperceptible landscape and visual effects in the case of continued operation of the

Clonbullogue Ash Repository, and the proposed Grand Canal Blueway and Barrow Blueway. However larger developments such as the permitted Yellow River turbines will likely result in changes to the overall landscape character, as well as localised changes to the landscape fabric. The most notable changes will however potentially be to the landscape character and visual amenity of the wider area, due to the construction of a large scale wind energy and a solar project which also have the potential for Slight to Moderate effects on landscape character.

11.9.3 Construction Phase Effects

11.9.3.1 Visual Effects

It is estimated that the construction phase of the proposed development will last for approximately 18 months. This stage of the development will involve the movement of construction and turbine transport vehicles into and out of the site. It is considered that this is a Temporary, to Short Term Slight Negative effect in terms of visual effects.

11.9.3.1.1 Turbines

The visual effects of the turbines will be evident during the operational phase rather than the construction phase and these are described fully in Section 11.9.4.1.1.

11.9.3.1.2 Borrow Pit

The borrow pit is to be located within the site, along the western boundary, and is not visible from any main roads outside the site due to screening by vegetation. This is a rehabilitated former gravel pit and the area to be excavated is estimated at 11.17 hectares. The existing rehabilitated former gravel pit will be enlarged and extended to the west, as shown in Figure 3.6 in Chapter 3. The borrow pit will, on removal of all necessary and useful rock, yield an estimated 168,000m3 of overburden. The predicted effect is Temporary to Short-term Slight negative effect.

Mitigation

The borrow pit will, on removal of all necessary and useful rock, be reinstated and made safe from a health & safety perspective and the slopes be graded using the overburden current at this location which will also encourage a return to the existing habitats currently at the borrow pit. Full details of the borrow pit proposals are contained in Chapter 3.

The overburden which is expected to be extracted will be stripped back and stockpiled within the borrow pit footprint and will be available for the reinstatement process post construction. Post-construction, the borrow pit area will be permanently secured and a stock-proof fence and/or berms will be erected around the area to prevent access. Appropriate health and safety signage will also be erected on this fencing and at locations around the fenced area. Vegetation will be allowed to establish around the perimeter and in the vicinity which will mitigate the appearance of the borrow pit.

The visual effects of the borrow pit will be localised as, due to its location within the site, it is not likely to be visible from the public roads. The predicted residual effect (following mitigation and re-vegetation), is therefore Long Term, Imperceptible, Neutral Effect.

11.9.3.1.3 Removal of 'existing tea centre', telecommunications mast and existing meteorological mast

As part of the construction of the Borrow Pit, the existing tea centre to the west of the site is to be removed, along with the existing Meteorological mast and the

Telecommunications mast. The visual effect of the demolition of the tea centre will be localised and is likely to result in a Permanent, neutral visual effect. The visual effects of the removal of the telecommunications mast is considered to be a Permanent, Imperceptible, neutral visual effect. The removal of the existing Meteorological mast is considered to have an Imperceptible, neutral visual effect.

11.9.3.1.4 Substations and Grid Connection

There are two possible locations for the substation both of which are within the site and not in immediate proximity to a public road. The footprint of the proposed electricity substation Option A measures c.80 metres in length by c.60 metres and for Option B c.104 metres in length and c.82 metres in width.

The construction of either substation option will not require significant removal of landscape elements as both are located in areas of primarily cutover peat from where peat has already been extracted. There are no areas of significant vegetation. With regard to the grid connection, Option A proposes an underground cable connection, some of which will run within the curtilage of the public road. Following the laying of the cable, the trench will be resurfaced as per the road surface specifications referred to in Chapter 3. This will have a Temporary, Slight negative visual effect during the construction phase.

Option B proposes a short section of overhead line within the site and will not include any works on the public road. A temporary access road will be required from the substation road to the angle mast location. This will have a Temporary, Slight negative visual effect during the construction phase

11.9.3.1.5 Other Infrastructure – Roads, Cabling, Met mast, Construction compounds and parking areas

Roads and car parking

It is proposed to construct 21.5 kilometres of new roadway as part of the proposed development. The routes of the proposed new roads are shown in Figure 3.1 in Chapter 3 of this EIS. New roadways will have a running width of approximately six metres, with wider sections at corners and on the approaches to turbine locations. Parking areas will be provided at the temporary construction compounds, and the parking for amenity users at the eastern entrance will be completed towards the end of the construction phase. The construction of the proposed roadways and parking areas may be visible from elevated locations close to the site, and will result in a temporary to Short term, Slight negative visual effect.

Mitigation

Where possible, those areas that have a vegetated upper layer shall be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation to improve the visual effect. The predicted visual effects of the new roads are expected to be localised and, in general, will not be visible from outside the site except possibly from elevated locations in close proximity. In addition, following revegetation of the bare peat on site, the visual effect of the roadways will be reduced. The predicted residual effect is therefore Short term, Imperceptible Negative visual effect.

Cabling

The electricity and fibre-optic cables running from the turbines to the substation compounds will be run in cable ducts approximately 1.2 metres below the ground surface, along the sides of roadways. During construction, there is potential for Temporary to Short Term Imperceptible, negative visual effect – as these cables will be laid in conjunction with the road construction. Mitigation measures are as per those for Roads and Car Parking.

Temporary Construction Compounds
Two temporary construction compounds are proposed within the site. One is located along the western boundary of the site, while the second location will be one of two locations, depending on which substation is constructed. In all locations, the compounds will not be easily visible from any public areas and visual effects will be localised. The proposed compounds will be removed following construction. Mitigation measures will be as outlined in the CEMP. Upon completion of the project the compound will be decommissioned by backfilling the area with the material arising during excavation, landscaping with peat as required. The predicted landscape effects are Temporary to Short term, imperceptible visual effect.

11.9.3.1.6 Junction Accommodation Works

Ballina (Junction of R420/R402)
The proposed upgrade of the R420/R402 junction will be an extension of a previous upgrade carried out as part of the works required to transport large turbine components to the Mountlucas wind farm during its construction in 2014. This upgrade will consist of clearing back the existing vegetation at the junction, excavation of material to allow the placing of stone within the redlined area. Following this the area will be finished in tar and chip or appropriate hardstanding. A series of removable bollards will be placed along the existing road edge in order to preserve the structure of the junction outside of those periods when deliveries of components are underway. The visual effect is predicted to be Short Term, Slight negative visual effect.

Mitigation
A permanent fence will be erected once the deliveries are completed restoring the junction to its existing configuration. The hardstanding area created to accommodate the works will be top soiled over and allowed to reseed naturally. The residual effect is predicted to be Short-term Slight negative visual effect. This will diminish once recolonisation is completed.

Ballinagar
Temporary road widening is proposed at Ballinagar on the R402. This is for the purposes of turbine delivery and will include the temporary removal of a section of open space from the village, which includes a section of grass and trees. There is the requirement to remove a number of semi mature ornamental trees including ornamental Maple (*Acer* sp), Ash (*Fraxinus escelsior*), Elm (*Elmus* sp.) and Birch (*Betula* sp.). Further excavations will be required to allow the importation of suitable fill material to build the area back up to the existing road level. The extended area will then be stoned over that will allow the traverse of the vehicles carrying the large components. Once the deliveries are completed the area will be reinstated in accordance with the requirements of Offaly County Council. The visual effect is predicted to be Short Term, Slight negative visual effect.

Mitigation
Following construction, the area will be reinstated - grass will be re-seeded and trees planted to replace those lost. It is recommended that the replacement trees should be of the same species and planted as light standards (girth 8-10cm) or heavy standards (10-12cm) as the trees to be removed are semi mature. The area will be reinstated in accordance with the requirements of Offaly County Council The residual effect is

predicted to be Short term Slight negative visual effect. This will diminish once the trees have established and grown.

Esker More Junction of R402/L1003

The upgrade to the junction of the R402/L1003 is required to facilitate the movement of vehicles carrying large turbine components off the R402 and onto the L1003. The land on the southern side of the R402 between the bridge over the Phillipstown River and the junction will be elevated using suitable fill material to the level of the existing road. The required area to accommodate the large turbine component movements will be surfaced and a series of temporary bollards installed. The bollards will be removed when the widened area is required for deliveries and replaced when not in use in order to preserve the junction configuration. The visual effect is predicted to be Long Term, Slight negative visual effect.

Mitigation

Once the deliveries have been completed a permanent fence will be erected in order to preserve the integrity of the junction and prevent unauthorised access to the hard standing area. The residual effect is predicted to be Long-term Slight negative visual effect.

L1003 Road Widening

It is proposed that the existing L1003 local road is widened to 6 metres, from the junction of the R402 and L1003 to the proposed western entrance to Cloncreen wind farm. This widening will involve the creation of a 0.5m wide verge on the eastern side of the road and extension of the road width a distance of 6m to the west from the newly created verge. In order to accommodate these works it is necessary to remove the existing vegetation to a maximum distance of 10m from the existing road edge, infill the required area along the western edge of the L1003 to facilitate these widening works and develop an appropriate side slope from the new edge into the adjacent agricultural land. Therefore the trees along the western edge of the road will be removed. Tree removal along the eastern edge of the road will be carried out only where necessary, and will be minimal, with the majority of the trees likely to be retained. This will have a Long Term, Slight negative visual effect.

Mitigation

Once the road widening is completed a programme of planting along the new drainage feature in parallel to the road will be completed. It is recommended that planting is composed of several rows of mixed of native deciduous species, and includes the same species as the trees which are to be removed. The planting will be defined using a timber post and rail fence to enclose the planting. Following mitigation, the landscape effect is likely to be Short term, Slight negative visual effect and this will diminish as the re-planted trees grow.

Site Access

There is an existing entrance into the eastern side of the site via the R401 in the townland of Ballykilleen which is proposed for a portion of the general construction traffic and for during the operational phase. Minor upgrade works will be required to the eastern entrance in order to accommodate access and egress of construction vehicles. The location of these entrances is shown on the site layout drawing in Figure 3.1.

A construction phase site access on the western side of the site, along the L-1003, includes a proposed temporary construction entrance as well as a temporary access for turbine delivery. This will result in the removal of an area of approximately 1.2 hectares of bog woodland. In addition, tree removal and/or trimming will be necessary along the edge of the road in order to provide sightlines. The visual effect is predicted to be Long term, Slight negative effect.

Mitigation

Following construction, replanting with the same native species to those removed will be carried out where possible. Once the construction phase of the wind farm is completed and the wind farm is fully operational the construction entrance will then be permanently fenced off, re-soiled and planted with similar tree species to those removed. Once the large turbine components deliveries cease the large turbine component entrance will be permanently fenced off to the road verge. The large turbine component entrance and roadway will be covered in top soil and allowed to reseed naturally.

The residual effect is predicted to be Short term, Slight negative effect. This will diminish once the trees have established and grown.

11.9.3.2 Landscape Effects

11.9.3.2.1 Turbines

The overall effect on the landscape fabric of the site, which is a cutover peatland, as a result of the turbine bases will be minimal. Some areas have partially revegetated but cutover bog is the primary habitat where the turbine bases are proposed and therefore there is not a removal of valued or sensitive landscape elements. The predicted landscape effects are considered Long Term, Imperceptible, and negative effect.

11.9.3.2.2 Borrow Pit

The borrow pit is to be located within the site, along the western boundary, and is not visible from any main roads outside the site due to screening by vegetation. This is a rehabilitated former gravel pit and the area to be excavated is estimated at 11.17 hectares. The existing restored former gravel pit will be enlarged and extended to the west, as shown in Figure 3.6 in Chapter 3 of this EIS. The borrow pit will, on removal of all necessary and useful rock, yield an estimated 168,000m3 of overburden. The predicted effect is Temporary to Short-term Slight negative landscape effect. Full details of borrow pit proposals are included in Chapter 3.

Mitigation

The borrow pit will, on removal of all necessary and useful rock, be reinstated and made safe from a health & safety perspective and the slopes be graded using the overburden current at this location which will also encourage a return to the existing habitats currently at the borrow pit

The overburden which is expected to be extracted will be stripped back and stockpiled within the borrow pit footprint and will be available for the reinstatement process post construction. Post-construction, the borrow pit area will be permanently secured and a stock-proof fence and/or berms will be erected around the area to prevent access. Appropriate health and safety signage will also be erected on this fencing and at locations around the fenced area. Vegetation will be allowed to establish around the perimeter and in the vicinity which will mitigate the appearance of the borrow pit. The predicted residual effect (following mitigation), is therefore Long Term, Imperceptible, Neutral effect.

11.9.3.2.3 Removal of 'existing tea centre', telecommunications mast and existing meteorological mast

As part of the construction of the Borrow Pit, the existing tea centre to the west of the site is to be removed, along with the existing Meteorological mast and the Telecommunications mast. The landscape effect of the demolition of the tea centre will be localised and is likely to result in a Permanent, neutral effect. The effects of the removal of the telecommunications mast existing Meteorological mast are considered to be a Permanent, Imperceptible, neutral landscape effect. The removal of this considered to have an Imperceptible, neutral visual effect.

11.9.3.2.4 Substations and Grid Connection

The construction of either substation option (A or B) will not require significant removal of landscape elements as both are located in areas of primarily cutover peat from where peat has already been extracted. There are no areas of significant vegetation. With regard to the grid connection, Option A proposes an underground cable connection, some of which will run within the curtilage of the public road. Following the laying of the cable, the trench will be surfaced as per the road surface specifications of the national or local public road, and as detailed in Chapter 3. This will have a Temporary, Imperceptible landscape effect during the construction phase.

Option B proposes a short section of overhead line within the site and will not include any works on the public road. A temporary access road will be required from the substation road to the angle mast location, which is located on primarily cutover peat. This will have a Temporary, Imperceptible negative landscape effect during the construction phase.

11.9.3.2.5 Other Infrastructure – Roads, Control Buildings, Cabling, Met mast, Construction compounds and parking areas

Roads and car parking

It is proposed to construct 21.5 kilometres of new roadway as part of the proposed development. The routes of the proposed new roads are shown in Figure 3.1. New roadways will have a running width of approximately six metres, with wider section at corners and on the approaches to turbine locations. Car parking areas will be provided at the temporary construction compounds, and the car parking for amenity users at the eastern entrance will be completed towards the end of the construction phase. The roads and parking areas will be constructed on primarily areas of cutover peat, but some areas of road are to be constructed are on areas of revegetating ground. The predicted effect is therefore Short term, Imperceptible Negative landscape effect.

Mitigation

Where possible, those areas with a vegetated upper layer shall be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation to ameliorate the effect. The predicted residual effect is therefore Short term, Imperceptible Negative landscape effect.

Cabling

The electricity and fibre-optic cables running from the turbines to the substation compounds will be run in cable ducts approximately 1.2 metres below the ground surface, along the sides of roadways. During construction, there is potential for Temporary to Short Term Imperceptible, negative landscape effect – as these cables will be laid in conjunction with the road construction. Mitigation measures are therefore contained under 'Roads and car parking' in the text above.

Temporary Construction Compounds
Two temporary construction compounds are proposed within the site. One is located along the western boundary of the site, while the second location will be one of two locations, depending on which substation is constructed. In all locations, the proposed compounds are located on areas of primarily cutover peat, and do not result in removal of important landscape elements. The compounds will be removed following construction. The predicted landscape effects are Temporary to Short term, imperceptible landscape effect.

11.9.3.2.6 Junction Accommodation Works

Ballina (Junction of R420/R402
The proposed upgrade of the R420/R402 junction will be an extension of a previous upgrade carried out as part of the works required to transport large turbine components to the Mountlucas wind farm during its construction in 2014. This upgrade will consist of clearing back the existing vegetation at the junction, excavation of material to allow the placing of stone within the redlined area. Following this the area will be finished in tar and chip or appropriate hardstanding. A series of removable bollards will be placed along the existing road edge in order to preserve the structure of the junction outside of those periods when deliveries of components are underway. The visual effect is predicted to be Short Term, Imperceptible landscape effect.

Mitigation
A permanent fence will be erected once the deliveries are completed restoring the junction to its existing configuration. The hardstanding area created to accommodate the works will be top soiled over and allowed to reseed naturally. The residual effect is predicted to be Short term imperceptible negative effect. This will diminish once recolonisation is completed.

Ballinagar
Temporary road widening is proposed at Ballinagar on the R402. This is for the purposes of turbine delivery and will include the temporary removal of a section of open space from the village, which includes a section of grass and trees. There is the requirement to remove a number of semi mature ornamental trees including ornamental Maple (*Acer* sp), Ash (*Fraxinus escelsior*), Elm (*Elmus* sp.) and Birch (*Betula* sp.). Further excavations will be required to allow the importation of suitable fill material to build the area back up to the existing road level. The extended area will then be stoned over that will allow the traverse of the vehicles carrying the large components. Once the deliveries are completed the area will be reinstated in accordance with the requirements of Offaly County Council. The effect is predicted to be Short Term, Slight negative landscape effect.

Mitigation
Following construction, the area will be reinstated - grass will be re-seeded and trees planted to replace those lost. It is recommended that the replacement trees should be of the same species and planted as light standards (girth 8-10cm) or heavy standards (10-12cm) as the trees to be removed are semi mature. The area will be reinstated in accordance with the requirements of Offaly County Council The residual effect is predicted to be Short term Slight negative landscape effect. This will diminish once the trees have established and grown.

Esker More Junction of R402/L1003
The upgrade to the junction of the R402/L1003 is required to facilitate the movement of vehicles carrying large turbine components off the R402 and onto the L1003. The

land on the southern side of the R402 between the bridge over the Phillipstown River and the junction will be elevated using suitable fill material to the level of the existing road. The required area to accommodate the large turbine component movements will be surfaced and a series of temporary bollards installed. The bollards will be removed when the widened area is required for deliveries and replaced when not in use in order to preserve the junction configuration. The landscape effect is predicted to be Short Term, Imperceptible negative effect.

Mitigation
Once the deliveries have been completed a permanent fence will be erected in order to preserve the integrity of the junction and prevent unauthorised access to the hard standing area. The residual effect is predicted to be Short term imperceptible negative effect landscape effect.

L1003 Road Widening
It is proposed that the existing L1003 local road is widened to 6 metres, from the junction of the R402 and L1003 to the proposed western entrance to Cloncreen wind farm. This widening will involve the creation of a 0.5m wide verge on the eastern side of the road and extension of the road width a distance of 6m to the west from the newly created verge. In order to accommodate these works it is necessary to remove the existing vegetation to a maximum distance of 10m from the existing road edge, infill the required area along the western edge of the L1003 to facilitate these widening works and develop an appropriate side slope from the new edge into the adjacent agricultural land. Therefore the trees along the western edge of the road will be removed. Tree removal along the eastern edge of the road will be minimal and the majority of the trees are likely to be retained. This will have a Long Term, Slight negative effect on the landscape.

Mitigation
Once the road widening is completed a programme of planting along the new drainage feature in parallel to the road will be completed. It is recommended that planting is composed of several rows of mixed of native deciduous species, and includes the same species as the trees which are to be removed. The planting will be defined using a timber post and rail fence to enclose the planting. Following mitigation, the landscape effect is likely to be Short term, Slight negative effect and this will diminish as the re-planted trees grow.

Site Entrance
There is an existing entrance into the eastern side of the site via the R401 in the townland of Ballykilleen which is proposed for a portion of the general construction traffic and for during the operational phase. Minor upgrade works will be required to the eastern entrance in order to accommodate access and egress of construction vehicles. The location of these entrances is shown on the site layout drawing in Figure 3.1.

A construction phase site access on the western side of the site, along the L-1003, includes a proposed temporary construction entrance as well as a temporary access for turbine delivery. This will result in the removal of an area of approximately 1.2 hectares of bog woodland. In addition, tree removal and or/trimming will be necessary along the edge of the road in order to provide sightlines. The effect is predicted to be Long term, Slight negative landscape effect.

Mitigation
Following construction, replanting with the same native species to those removed will be carried out where possible. Once the construction phase of the wind farm is completed and the wind farm is fully operational the construction entrance will then be permanently fenced off, re-soiled and planted with similar tree species to those removed. Once the large turbine components deliveries cease the large turbine component entrance will be permanently fenced off to the road verge. The large turbine component entrance and roadway will be covered in top soil and allowed to reseed naturally. The residual effect is predicted to be Short term, Slight negative effect. This will diminish once the trees have established and grown.

11.9.4 Operational Phase Effects

11.9.4.1 Visual Effects

11.9.4.1.1 Turbines

The 23 photomontages, presented in the Volume 2 Photomontages in this EIS, illustrate views of the proposed development from 23 viewpoints. The predicted likely significant effects at these viewpoints are described using the criteria set out at the beginning of Section 11.8 and the EPA criteria referred to in Section 1.6.2 of the EIS.

The baseline information, together with the ZTV maps, route screening and photomontages combine to provide the basis upon which the assessment of visual effects can be carried out. The baseline information records a number of protected views and scenic routes and landscape designations (which are set out and described above in Sections 11.3.2-11.3.5), and landscape features and sensitivity within the 20 kilometre LVIA Study area (which are set out and described above at Section 11.5). This, along with the ZTV mapping, influenced the choice of viewpoints. Selection of viewpoints is described in some detail in Section 11.7.6.

There are areas within the 20 kilometre radius which are likely to have clear views of the proposed turbines, and there are also, in reality, areas where visibility is likely to be restricted due to vegetation and screening, as illustrated by some photomontages and by the Route Screening Maps. Several viewpoints which indicated full theoretical visibility of the turbines (on the ZTV Map) were visited but the resulting photomontages showed no visibility of the proposed turbines due to screening – these include viewpoints marked in black on Figure 11.11, several of which are protected/designated views. These include Cartland Bridge, Colgan's Bridge, Blundell Aqueduct near Edenderry, as well as Ticknevin Bridge, Rathangan Bridge, Bracknagh village and Baylough Bridge near Monasterevan.

Of the 23 photomontages, some nine were designated as either protected views or scenic routes, and several of these views also represented Areas of High Amenity, areas of various landscape sensitivities, recreational sites and trails as well as settlements, local, regional and national roads.

Views in Close Proximity of Site - 1-5 Kilometres
The ZTV map for the proposed Cloncreen turbines shows that within 5 kilometres of the proposed development, the ZTV map indicates that most areas theoretically have full visibility of 17 to 21 turbines. Exceptions to this are small areas on the outskirts of Edenderry, and near areas of high ground such as Dromcooly Hill. The Route Screening maps provide additional information as to the potential screening afforded by vegetation and structures along roads within 5 kilometres, and the map shows that

while there are open views, many areas will probably have partial visibility due to the effect of roadside vegetation, in particular when the vegetation is in full foliage.

Within five kilometres of the site, Viewpoints 1-9 and Viewpoint 18 illustrate various open views within this area, and most of these correspond to areas identified as having little or no screening in the Figure 11.10 Route Screening Map. These views show the turbines will be clearly visible from these viewpoints, as would be expected in close proximity to the turbines. The photomontages show the proposed turbines are located in a cutover peatland in a primarily flat landscape with some undulations, and these views show an open, large scale landscape. The likely effects from these viewpoints range from Imperceptible to Significant, as seen in Table 11.33 above, with one viewpoint (Viewpoint 3) considered Significant, one Imperceptible (Viewpoint 18) and the others considered Slight (Viewpoints 1,4,7,9) or Moderate (Viewpoints 2,5,6,8). None of these viewpoints are from areas of High Amenity of High Sensitivity as classified in the Offaly Development Plan. A number of viewpoints, particularly bridges, in areas of High Amenity were visited but photomontages showed there was no visibility. These locations are illustrated on Figure 11.11. A section of the Grand Canal lies within five kilometres of the proposed development site, and much of this has vegetation which provides partial screening and there are few completely open views. It is anticipated that views of the proposed turbines will be possible at two particular locations along the canal towpath, one near Blundell Aqueduct and another to the east near Trimblestown Bridge.

Views 5-10 Kilometres from Site

Within 5-10 kilometres of the proposed development site boundary, the most open views are represented by Viewpoints 13, 17, 19, 22. The likely effects are considered Imperceptible in two of the viewpoints (Viewpoints 13, 22) Slight in one (Viewpoints 17,) and Moderate in one (19). These include one view from near Croghan Hill. Several scenic routes lie within Co. Kildare, and some of these have areas of theoretical visibility. Scenic Route 19 has theoretical visibility, and views from Rathangan were visited. However, the buildings are likely to prevent visibility. Scenic Route 28 is likely to have some intermittent visibility but the most notable view along this stretch north of Carbury is that of the fortified house on Carbury Hill, shown in Plate 11.1 however, is outside the ZTV and is not likely to have any visibility. Further along the route here is considerable roadside screening along this route, which will result in intermittent views towards the proposed development site. At this distance of approximately 10 kilometres from the site, it is anticipated that the likely visual effects will not be significant. There is considerable screening along the Regional Road R414 (Scenic Routes 38,39), Viewpoint 11 represents a more open view from Lullymore East – as shown in Figure 11.11 and in the Photomontage Booklet.

Views 10-20 Kilometres from Site

Beyond 10 kilometres from the site, the visual effects are expected to lessen due to distance. However, a number of Viewpoints are located beyond 10 kilometres, namely 10, 11, 12 14, 15, 16, 20, 21, and 23, and these include two viewpoints from the vicinity of Croghan Hill. The visual effects range from Imperceptible (Viewpoints 10, 14, 15, 23) to Slight (12, 16, 20). The viewpoint from the top of Croghan Hill (20) is considered to have a Moderate visual effect. The views from scenic routes at a distance of greater than 10 kilometres are likely to be less affected, and Photomontage 11, a view from protected view 8 in Co. Kildare, is the closest scenic view to the site between 10-20 kilometres from the site. The predicted visual effect from this viewpoint is Slight.

Designated Views/Routes and Areas of High Amenity within 20 kilometres
The results of the visual assessment from the protected views and scenic routes within 20 kilometres confirms that the likely visual effects range from Imperceptible in four cases (Viewpoints 10,13,14,23) Slight in three cases (Viewpoints 11,12,20) with two considered Moderate (Viewpoints 19,21).

None of these designated viewpoints are in close proximity to the development - there are no protected views or scenic routes located within 5 kilometres of the proposed development. The closest Area of High Amenity will be the Grand Canal and the Grand Canal Way which runs approximately 3.4 kilometres north of the site at its closest point. This walkway runs along the canal and the route screening map indicates that there are two main areas along the walkway where clear, open views of the turbines may occur for some distance, but intermittent screening along much of the canal bank is likely to greatly reduce visibility. Visibility from the canal bridges closest to the site are likely to be blocked by screening, as indicated in Figure 11.11, and while views from the canal bridges are likely to occur further away, as shown in Viewpoints 10, 13, 14, the turbines are not expected to have a significant effect on the views.

Viewpoints from Croghan Hill and the vicinity (Area of High Amenity and location of two protected views) which is considered an important area in terms of amenity and cultural heritage are well represented by Viewpoints 19, 20 and 21 and these are considered to have likely visual effects ranging from Slight (Viewpoints 20) to Moderate (Viewpoints 19,21).

Beyond 10 kilometres, canal bridge viewpoints 10, 13, 14 are included, but the proposed turbines will be at some distance from these viewpoints and it is considered that they are not likely to affect their sensitivities. Viewpoint 12 is located on a scenic route with good long distance views, and Viewpoint 23 is a designated view. However, both will be at some distance from the proposed turbines and the likely visual effects are considered Slight and Imperceptible respectively.

Conclusion
Overall, the visual effect of the turbines is expected to vary depending on the location, and is likely to be more pronounced in locations between 1-5 kilometres from the site, where there are open views, and gradually diminish as one moves further away from the site, particularly between 10 and 20 kilometres from the turbines. Within five kilometres, in areas where the turbines are likely to be clearly visible, the likely visual effects are mostly considered Slight or Moderate, with one viewpoint considered Imperceptible and one Significant. These include some viewpoints where the overall visual sensitivity is High (such as the Grand Canal) but there are no designated views or scenic routes within 5 kilometres. The Grand Canal is an area of High Amenity in close proximity to the site but it is considered that the proposed development will be partially visible from the canal and will not result in significant visual effects when viewed from the canal. The highly sensitive viewpoints in the vicinity of Croghan Hill are approximately 10 kilometres from the proposed turbines and the effects from these viewpoints are deemed Slight to Moderate. The likely visual effects on viewpoints between 10 and 20 kilometres from the turbines are considered Imperceptible to Slight. The overall likely visual effect of the proposed development is considered to range from Long Term, Slight to Long Term, Moderate visual effect. There effects are considered to be direct.

11.9.4.2 Cumulative Visual Effects

The DoEHLG 2006 Guidelines for Planning Authorities on wind energy development is referred to in Section 11.3.1.1. For Flat Peatland, the Guidelines state:

> *"The openness of the vista across these landscapes will result in a clear visibility of other wind energy developments in the area. Given that the wind energy developments are likely to be extensive and high, it is important that they are not perceived to crowd or dominate the flat landscape. More than one wind energy development might be acceptable in the distant background provided it was only faintly visible under normal atmospheric conditions.*

The landscape is an open, flat expansive landscape in general, and many viewpoints illustrate areas with panoramic or long distance views. As discussed below, the cumulative effect of the proposed Cloncreen turbines along with other turbines does not result in the turbines crowding or dominating the flat landscape. Several photomontages demonstrate the visibility of the existing Mountlucas turbines, which often appear fainter due to atmospheric conditions. Consideration is also given to the GLVIA (2013) which refer to combined and sequential effects.

Cumulative Theoretical Visibility

The Cumulative ZTVs include other wind farm projects only. However, the ZTV for the proposed Clonin solar farm was studied in relation to the Cumulative ZTVs. Particular emphasis is placed on the potential cumulative effects of the proposal with other wind farms, as these have the greatest potential to generate significant effects.

As outlined in Section 11.7, the ZTV maps Figures 11.7 and 11.8 and 11.9 illustrate theoretical cumulative visual effects and these are discussed above. Figure 11.9 illustrates that the pattern and extent of Cumulative visibility resulting from the existing Mountlucas turbines and permitted Yellow River turbines will change very little when the proposed Cloncreen turbines are included.

Cumulative Visibility in Photomontages

The 23 photomontages illustrate visibility of the proposed Cloncreen turbines with the two existing and permitted wind farms within 20 kilometres. The photomontages also indicate the existing Edenderry power station, other areas of peat extraction, as well as the location and extent of the proposed Clonin North solar farm. Certain existing developments (e.g. The Clonbullogue Ash repository) are not visible in any of the photomontages due to the nature of the development and screening. The Viewpoint Assessment tables for Viewpoints 1-23 contained in Section 11.8.4 above describe the photomontages and include references to cumulative visibility.

The cumulative visual effects of each of the Viewpoints 1-23, based on the Tables 11.10-11.32, were assessed, and are listed below. The viewpoint characteristics and sensitivity are set out in the tables, while for each Viewpoint, the magnitude of the change was assessed. This is focussed on *additional changes caused by the proposed development in addition to other similar developments, as well as other types of development*. A final assessment of the visual effects was produced and is set out below:

Table 11.34 Cumulative Viewpoint Impact Assessment Results

Viewpoint	Cumulative Visual Impact Assessment Result
1	None
2	Imperceptible

Viewpoint	Cumulative Visual Impact Assessment Result
3	None
4	Imperceptible
5	None
6	Imperceptible
7	Slight
8	Imperceptible
9	Imperceptible
10	Imperceptible
11	Imperceptible
12	Slight
13	Slight
14	Imperceptible
15	Imperceptible
16	Slight
17	Imperceptible
18	Slight
19	Moderate
20	Slight
21	Moderate
22	Imperceptible
23	Imperceptible

The table above shows that overall, cumulative visibility ranges from No effect in three cases, to Imperceptible in 12 cases, Slight in 6 cases and Moderate in two cases.

Within five kilometres of the site, the viewpoints show few cumulative effects of other wind farms. Cumulative effects with existing Mountlucas turbines are visible in some but not all of the Viewpoints within 5 kilometres, including Viewpoints 4, 9, and 18, where the Mountlucas turbines are clearly visible. In several views within 5 kilometres, the Mountlucas turbines are screened from view by vegetation, topography or structures, which lessens cumulative effects, such as Viewpoints 5, 6, 7, 8. Where the permitted Yellow River turbines are likely to be visible, (for example in Viewpoints 2, 4, 9), they will be seen at some distance from the Cloncreen turbines. A number of the photomontages (2, 6, and 7) within five kilometres of the site show the existing Edenderry Power Station, both from a distance and at long range. The power station is an existing large scale industrial structure in the landscape which is directly related to the process of industrial peat harvesting. The proposed turbines are additional elements of large scale energy production in the landscape.

Viewpoints located between 5-10 kilometres from the site show that that the existing Mountlucas turbines are clearly visible in Viewpoints 17, but barely visible in Viewpoint 13. In these viewpoints, the Yellow River turbines will be in the distance.

There are viewpoints which are at approximately 10 kilometres from the proposed Cloncreen site, and which are from elevated locations with panoramic views such as the vicinity of Croghan Hill (19, 20,21). Viewpoint 12 from Drinanstown, Co Kildare is also an elevated long distance view, approximately 12 kilometres from the Cloncreen site. While the Cumulative visual effects ranges from Slight to Moderate, these views are of large scale extensive landscapes, and the Cumulative effect is not likely to dominate or crowd the flat landscape.

While in Viewpoints 19, 20 and 21, the existing Mountlucas turbines are closer than the proposed Cloncreen turbines, but they appear fainter and less clearly visible, it should be noted that the proposed Cloncreen turbines are rendered into the image and therefore are shown in the image without the effects of distance, light or weather conditions. In viewpoints 16 and 21, the proposed Clonin North solar farm is indicated, as it is potentially visible from these locations, but particularly from Viewpoint 21.

Cumulative visual effects between 10-20 kilometres are seen in Viewpoints 12 and 16, where one or more wind farm, and in Viewpoint 16, the proposed Clonin North Solar farm, is visible. However, at these distances, the wind energy developments, while visible, do not crowd or dominate the flat landscape, and visibility is likely to be less than the photomontages illustrate.

The Ash repository which is located within the footprint of the site, is well screened from view and is not visible from the public road L1003 which is the closest public road to the site. The areas of potential visibility along with the proposed Cloncreen turbines are from the road approaching the site used by employees. The ash repository is not visible from any photomontages.

The proposed walkways along the Grand Canal and the Barrow, while will be visible in some photomontages, will not contribute significantly to cumulative effect, any visual effects being extremely localised.

Sequential Cumulative Visibility in Photomontages
Sequential visibility is discussed briefly, in terms of the roads and walkways closest to the site, as well as the nearby Grand Canal Walkway. It is likely that sequential visibility will mostly be experienced along the roadways such as the R401 and R402, as well as the local road L1003 to the west and south of the site. Along the R401, sequential views are likely between Edenderry and Clonbullogue, although these will be intermittent due to intervening vegetation, while along the R402, from Edenderry to Dangean, as well as south to Clonygowan, sequential views will be available. However, the frequency of the views will vary depending on the speed of the viewer, and may be described as frequent if the traveller is moving at speed. From the L-1003, sequential views will be generally experienced at a slower pace of travel. Travelling east-west along the L1003, more limited opportunities are likely to arise for sequential views. Viewers who are travelling on foot, or are traveling along the Canal bank or the Canal itself, are likely to experience views which are only occasionally sequential.

Cumulative visual effects of the proposed project, in addition to the other wind farms, as well as non-wind farm projects listed above vary, and overall can be described as Long Term, Slight to Long Term, Moderate visual effects. Effects are considered to be direct.

11.9.4.3 Mitigation

Mitigation, in terms of landscape and visual effects, can include both primary measures – those developed through the design process and have resulted in the current project design – and secondary measures, which address any residual adverse effects which remain. In a wind farm development, primary mitigation measures, which occur during the design process, are much more common, and these include the site selection process, as well as changes to the siting, design and layout of turbines. In this case, attention was given to developing the optimum layout taking into consideration the

DoEHLG (2006) siting and design guidance for wind energy developments for this landscape type. This process is referred to in Chapter 2.

Mitigation measures such as screening by vegetation or other means, are limited when dealing with wind turbines, although they are useful in mitigating other potential landscape and visual effects of other elements of the wind farm. Measures to retain vegetation where possible were also included in the site design.

The wind turbines that will be installed on the site will be conventional three-blade turbines, that will be geared to ensure the rotors of all turbines rotate in the same direction at all times. The turbines will be white or off-white matt colour. The Residual effect of the mitigation measures is the same as described above.

11.9.4.3.1 Borrow Pit

The borrow pit is to be located within the site, along the western boundary, and is not visible from any main roads outside the site due to screening by vegetation. This is a restored former gravel pit and the area to be excavated is estimated at 11.17 hectares. The existing restored former gravel pit will be enlarged and extended to the west, as shown in Figure 3.6. As the main effects are likely at the construction stage, and mitigation measures will have been put in place, the predicted residual visual effects are expected to be localised, and are the same as described in the Construction Phase.

11.9.4.3.2 Substations and Grid Connection and Cabling

There are two possible locations for the substation locations, both which are within the site and not in immediate proximity to a public road. The footprint of the proposed electricity substation Option A measures c.80 metres in length by c.60 metres and for Option B c.104 metres in length and c.82 metres in width.

Option A: Construction of a 110 kV substation in the eastern section of the site. This substation will connect to the National Grid via an underground cable (1.7 kilometres in length) running from the substation to the existing 110 kV Cushaling substation at Edenderry Power Plant, located directly east of the proposed wind farm site. The proposed underground cable will be located on Bord na Móna lands and within the curtilage of the public road.

Or:

- **Option B:** Construction of a 110 kV substation in the southern section of the site. This substation will connect to the National Grid via a short section of overhead line (less than 0.1km) to the existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site.

Two wind farm control buildings will be located within whichever substation compound is constructed. Control Building 1 will measure c.18 metres by c.10 metres and 6 metres in height. Control Building 2 will measure c.14 metres by 10 metre by 6 metres in height. Layout and elevation drawings of the control buildings are included in Appendix 3-1 of this EIS.

Substation Option A will be located to the west of the R401 where there are intervening trees. The substation base is 2 metres above ground level, and the height of the control buildings is 6 metres, it is likely that the proposed substation, including the control buildings, will be largely screened by the intervening vegetation and the predicted effect will be Permanent, Imperceptible negative visual effect.

Substation B is located to the south of the site, north of the L-1003. It will be located at some distance north of the road. Due to vegetation in the intervening fields, the visibility of the proposed substation will be intermittent, and will result in a Permanent, Imperceptible negative visual effect.

11.9.4.3.3 Other Infrastructure – Roads, Control Buildings, Cabling, Met mast, Construction compounds and parking areas

Roads
It is proposed to construct 21.5 kilometres of new roadway as part of the proposed development. The routes of the proposed new roads are shown in Figure 3.1. New roadways will have a running width of approximately six metres, with wider section at corners and on the approaches to turbine locations. The parking for amenity users at the eastern entrance will be completed towards the end of the construction phase and will remain during the operational phase to facilitate public access to the site. Where possible, those areas that have a vegetated upper layer will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation to improve the visual effect. The predicted visual effects of the new roads are expected to be localised and, in general, will not be visible from outside the site except from elevated locations in close proximity. The predicted effect is therefore Long Term, Imperceptible Negative visual effect.

Cabling
The electricity and fibre-optic cables running from the turbines to the substation compounds will be run in cable ducts approximately 1.2 metres below the ground surface, along the sides of roadways. These will therefore have no predicted visual effects at the operational stage.

Anemometry Mast
One permanent anemometry mast is proposed as part of the proposed development. The anemometry mast will be equipped with wind monitoring equipment at various heights. The masts will be located along the western boundary of the site as shown on the site layout drawing in Figure 3.1. The structure will be most visible from the R-402 and the L-1003 to the northwest of the site. The mast will be a slender, free-standing structure up to 120 metres in height. The predicted visual effect will be Long Term, Imperceptible neutral visual effect.

Temporary Construction Compounds
The visual effects of the temporary construction compounds are discussed in Section 11.9.1.1.4 above.

11.9.4.3.4 Junction Accommodation Works and Road Upgrades

A number of junctions will have works carries out to them as part of the Construction phase, and these are dealt with in the Construction Phase Effects. Permanent upgrades are to be carried out to the L1003 which runs to the west and to the south of the site, and the upgrade of existing site entrance on the R401. These are likely to have Permanent, Imperceptible neutral visual effect.

11.9.4.4 Landscape Effects – Operational Phase

The landscape effects of the proposed development are described in relation to both effects on the wider landscape character, and effects on the landscape fabric and components of the site. The main landscape fabric can be described as cutover bog with small areas of scrub which are revegetating

11.9.4.4.1 Turbines

The landscape effects of the turbines are minimal, with the effects being mainly visual. The permanent footprint of the proposed development, including the turbine bases and all ancillary equipment, will either be 39.6ha in the event of Option A (as referred to above) being constructed, or 40.1 hectares in the event of Option B. The site of the proposed development at Cloncreen measures approximately 960 hectares, so the overall effect on the landscape fabric of the site, which is a cutover peatland, as a result of the turbine bases will be minimal. Some areas have partially revegetated but cutover bog is the primary habitat where the turbine cases are proposed. On decommissioning, the turbines and bases can be removed. The predicted landscape effects are considered Long Term, Imperceptible, negative effect.

11.9.4.4.2 Borrow Pit

The landscape effects of the borrow pit are assessed during the Construction Phase. During the Operational Phase the effect will be the same as the residual effect described in the Construction phase, when the mitigation measures have been put in place.

11.9.4.4.3 Substations and Grid Connection

The landscape effects of the proposed substation (and associated Control buildings) proposed in Option A relate to the size of the footprint. As they are to be constructed on an area of cutover bog, there will not be a removal of landscape elements as the proposed location of both substations is on an area of cutover bog. The predicted landscape effects of Substations Options A and B will be a Permanent, Imperceptible negative effect.

The Grid Connection Options A and B will have effects mainly at the Construction stage. Option A, where the proposed cable route is underground, will have no landscape effects during the operational stage as mitigation measures are carried out following construction. Option B, which has a short section of overhead line, is predicted to have an Imperceptible operational landscape effect due to the very small increase in the amount of overhead line.

11.9.4.4.4 Other Infrastructure – Roads, Control Buildings, Cabling, Met mast, Construction compounds and parking areas

Roads and parking areas

It is proposed to construct 21.5 kilometres of new roadway as part of the proposed development. The routes of the proposed new roads are shown in Figure 3.1. New roadways will have a running width of approximately six metres, with wider section at corners and on the approaches to turbine locations. The majority of the roads are on areas of cutover peat. The parking for amenity users at the eastern entrance will be completed towards the end of the construction phase and will remain during the operational phase to facilitate recreation. During the Operational Phase the effect will be the same as the residual effect described in the Construction phase, when the mitigation measures have been put in place.

Mitigation

Where possible, those areas with a vegetated upper layer shall be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation. The roads will be constructed on cutover peatland, residual effect is expected to be Long Term, Imperceptible negative effect.

Cabling, Anemometry Mast, and Temporary Construction Compounds

The landscape effects of the cabling, and construction compounds relate to the Construction phase. The Temporary construction compounds will be removed following construction. The landscape effect of the Anemometry Mast will be Long Term, Imperceptible, neutral effect.

11.9.4.4.5 Junction Accommodation Works

Junction accommodation works are proposed at three locations. The Construction phase effects describe the proposed effects and mitigation measures, as well as residual effects once the mitigation measures have been carried out. Operational phase effects are in all cases the same as the residual effects, with the exception of the western access.

In the case of the western access, where some bog woodland is not to be replanted along the Temporary Turbine Delivery Access, the effects are Permanent, Imperceptible negative landscape effect.

11.9.4.4.6 Landscape Effects - Enhancement

The planning drawings indicate that there will be an area for public parking, at the eastern entrance to the site. This car parking area will be served by the entrance from the east along the R401. The intention is to facilitate public access to the site roads for recreation and amenity purposes once operational.

Chapter 5 (Flora and Fauna) refers to the finalisation of a Cutaway Bog Rehabilitation Plan once peat extraction has ceased on the site. This plan will aim to stabilise the site following peat production through revegetation of bare peat areas and encouragement of natural colonisation. This will also have positive visual effects and reduce visibility of the proposed roads from elevated locations.

The facilitation of public access and the implementation of a Rehabilitation Plan and the revegetation of the bare peat are considered to be elements which have Long Term, Positive landscape effect.

In addition, Cloncreen bog is connected to the neighbouring Mountlucas and Ballycon bogs by a Bórd na Móna railway line and Machinery pass. A potential recreational connection between the existing Mountlucas wind farm, the Ballycon bog which is a Rehabilitated cutaway bog, and the proposed Cloncreen wind farm, will be investigated.

11.9.4.5 Conclusion on Landscape Effects – Operational Phase

In conclusion, while the operational phase landscape effects of the proposed development are described separately, an overall comment on the landscape effects can be made.

The overall value and sensitivity of the landscape resource on the site of the proposed development is assessed as Medium. This is consistent with the sensitivity designation contained in the Offaly County Council Development Plan. As stated earlier in this chapter, areas within the wider 20 kilometres area from the proposed development site vary from areas of high, medium and low sensitivity.

Should the proposed wind energy development proceed, it is likely that the main land-use of the area will effectively remain as cutover/regenerating cutover bog, with wind energy generation being a land-use that is superimposed over the cutover bog during the lifetime of the proposed development.

The landscape character of the site and the surrounding vicinity of low-lying land will experience some changes, but it is not considered that these changes will change the key characteristics of this open, extensive landscape, which includes large tracts of cutover bog, agricultural fields, areas of tree cover and bog woodland, and elements such as the Grand Canal and its associated towpaths and bridges. Areas of High Amenity such as Croghan Hill will remain as a key feature in this landscape. The closest Landscape Character areas of Kildare which include the Western Boglands LCA, an area of Medium Sensitivity and the Southern Lowlands and Northwestern Lowlands which are both classed as Low Sensitivity by the Kildare County Development Plan. The proposed development, while visible from areas of these LCA, is not expected to change the character of these LCAs. Particular attention is paid to the LCAs with High Sensitivity, and areas considered highly susceptible in this report, including the Grand Canal and waterways, and associated bridges, which have been represented by a number of photomontages (10, 13, and 14) as well as LCAs such as the Chair of Kildare with elevated ground and scenic routes, represented by Photomontage 12. Visibility from the hills in the LCA Chair of Kildare may be possible due the elevated nature of the topography, however this is at some distance (greater than 10km) from the proposed development and the ZTV indicates that much of the higher ground to the west of the LCA will not have visibility, and that the effect will not change the overall character of this landscape.

Effects of the turbine and non-turbine elements of the project during the construction and operational phases relating to the fabric of the landscape include the construction of elements, the majority of which are to be constructed on areas of cutover peat. Some areas of regenerating vegetation are to be removed, generally for the road construction. Some tree removal will occur, most notably to the west of the site along the L-1003, to allow for the western access and construction traffic, which will affect the landscape. In the majority of cases, construction will not involve the removal of valued or important landscape elements. However, mitigation measures proposed replanting in the majority of areas, so these effects will diminish over time. The landscape character of the area will undergo a degree of change, though the turbine elements are not new in this landscape. The overall landscape effect of the proposed development, after mitigation, is considered to be Long Term, Slight, Direct landscape effect.

11.9.4.6 Cumulative landscape Effects

The Cumulative landscape effects occur mainly at the landscape character scale, although they may involve the removal of landscape elements such as trees and some vegetation, the potentially significant effects are on the overall character of the landscape. The key consideration when assessing cumulative landscape effects are the effects on the key characteristics of the landscape in question

This landscape can be described as relatively open, and largely flat, expansive landscape with tracts of peatland interspersed with agricultural land and scattered small settlements. The provision of the proposed Cloncreen development, in addition to the existing, permitted and proposed developments, will contribute to a slight change to the overall landscape character. However, due to the compact nature of the proposed development and the large, extensive character of the landscape, it is considered that the overall Cumulative landscape effect is also considered to be Long Term, Slight Cumulative landscape effect.

12 ARCHAEOLOGY AND CULTURAL HERITAGE

12.1 Introduction

This archaeological and cultural heritage chapter was prepared by Tobar Archaeological Services. It presents the results of an archaeological and cultural heritage impact assessment of the proposed wind farm development.

The purpose of this report is to assess the likely significant effects of the proposed development on the surrounding archaeological, architectural and cultural heritage landscape. The assessment is based on a desktop review of the available cultural heritage and archaeological data and on a comprehensive programme of field survey of the study area. The report amalgamates desk-based research and the results of field-walking to identify areas of archaeological/architectural/cultural significance or potential, likely to be impacted by the proposed development. An assessment of likely significant effects is presented and a number of mitigation measures are recommended where appropriate. The visual impact of the proposed development on newly discovered monuments/sites of significance as well as known recorded monuments is also assessed.

12.1.1 Statement of Authority

Miriam Carroll and Annette Quinn are the directors of Tobar Archaeological Services and both graduated from University College Cork in 1998 with a Master's degree in Methods and Techniques in Irish Archaeology. Both directors are licensed by the Department of Arts, Heritage and the Gaeltacht to carry out excavations and are members of the Institute of Archaeologists of Ireland. Annette Quinn and Miriam Carroll have been working in the field of archaeology since 1994 and have undertaken numerous projects for both the private and public sectors including excavations, site assessments (EIS/EIA) and surveys. Both authors are competent experts in the field of Cultural Heritage assessments for EIA and had direct input into the new draft Environmental Protection Agency (EPA) Guidelines on information to be contained in an EIS / Advice Notes.

12.1.2 Proposed Development

This assessment forms part of the Environmental Impact Statement (EIS), which will accompany the planning application. The proposed development comprises the construction of 21 No. turbines and infrastructure, and all associated works. Full details of the proposed development are described in Chapter 3 of this EIS.

The proposed development layout was designed sympathetically to the known cultural heritage features which exist on the site. Every effort was made to ensure that the development proposal would have the minimum impact possible by placing turbines and access roads in areas which avoid known archaeological /architectural/cultural heritage features. The design and layout of the proposed development has had regard to the *'Wind Energy Development Guidelines'* (Department of the Environment, Heritage and Local Government, 2006) and the *'Best Practice Guidelines for the Irish Wind Energy Industry'* (Irish Wind Energy Association, 2012).

12.1.3 Site Location and Topography

Cloncreen Bog is a flat single peat production bog unit situated at the eastern limit of the Derrygreenagh bog group, southwest of Edenderry Town. Esker, Ballycon and

Derrycricket Bogs bound Cloncreen on its western and north-western sides. Clonsast East and Clonsast Extension lie to its south and Ballydermot Bog is to its southeast. The R402 road from Edenderry to Daingean runs along the north of the bog, the Philipstown River is located beyond its south and southwestern margins and the Figile River lies beyond its eastern limits. Cloncreen Bog is located within Bord na Móna's Derrygreenagh bog group. The bog has been in industrial production since 1961 and is partially milled out with the greatest depth of peat remaining on the eastern side. The bog is categorised by the EPS (Corrine 2006) as Raised Bog however the site has been intensively drained and milled with much of the bog now being cutaway.

The site measures 3 kilometres (km) North-South by 4 km East-West. Peat extraction is currently ongoing within the bog and is estimated to continue until approximately 2018. Peat depths within the bog vary as described in Chapter 7 Soils & Geology, with subsoil having being exposed in a number of places examined. The total proposed development site measures approximately 960 hectares.

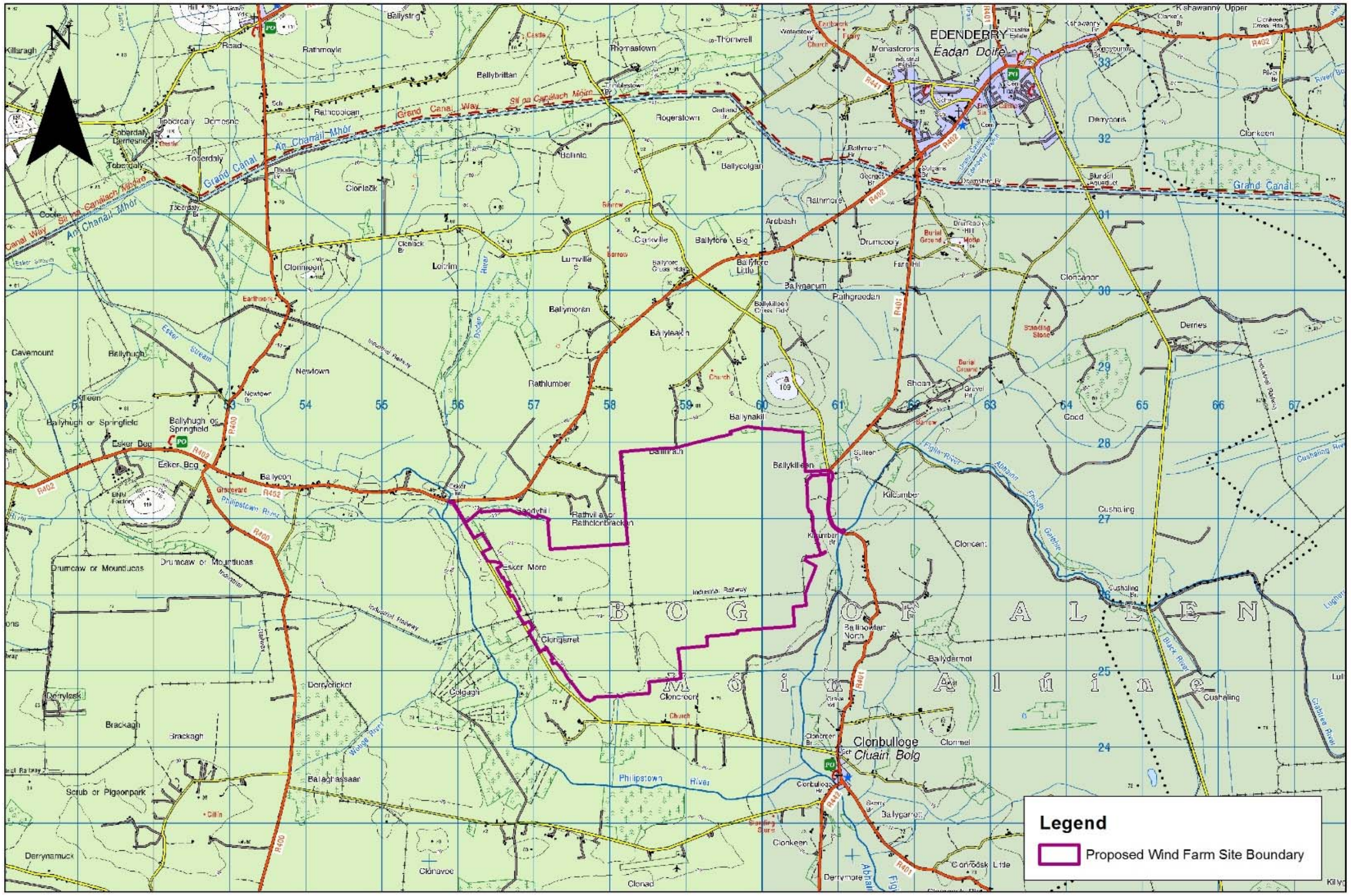


Figure 12-1: Site Location

Figure 12-2: Site location on aerial background, showing approximate peat depths in areas under active peat extraction

12.1.4 Statutory Context

12.1.4.1 Current Legislation

Archaeological monuments are safeguarded through national and international policy and the relevant Irish legislation (as described below), which is designed to secure the protection of the cultural heritage resource. This is undertaken in accordance with the provisions of the European Convention on the Protection of the Archaeological Heritage (Valletta Convention). This was ratified by Ireland in 1997.

Both the National Monuments Acts 1930 to 2014 and relevant provisions of the Cultural Institutions Act 1997 are the primary means of ensuring protection of archaeological monuments, the latter of which includes all man-made structures of whatever form or date. There are a number of provisions under the National Monuments Acts which ensure protection of the archaeological resource. These include the Register of Historic Monuments (1997 Act) which means that any interference to a monument is illegal under that Act. All registered monuments are included on the Record of Monuments and Places (RMP).

The Record of Monuments and Places (RMP) was established under Section 12 (1) of the National Monuments (Amendment) Act 1994 and consists of a list of known archaeological monuments and accompanying maps. The Record of Monuments and Places affords some protection to the monuments entered therein. Section 12 (3) of the 1994 Amendment Act states that any person proposing to carry out work at or in relation to a recorded monument must give notice in writing to the Minister for Arts, Heritage, and the Gaeltacht, by virtue of the Heritage (Transfer of Functions of Commissioners of Public Works) Order, 1996 and shall not commence the work for a period of two months after having given the notice. All proposed works, therefore, within or around any archaeological monument are subject to statutory protection and legislation (National Monuments Acts 1930-2014).

The term 'national monument' as defined in Section 2 of the National Monuments Act 1930 means a monument 'the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto'. National monuments in State care include those which are in the ownership or guardianship of the Minister for Arts, Heritage and the Gaeltacht. Section 5 of the National Monuments Act (1930) allows owners of other national monuments to appoint the Minister for the Arts, Heritage and the Gaeltacht or the relevant local authority as guardian of such monuments, subject to their consent. This means in effect that while the property of such a monument remains vested in the owner, its maintenance and upkeep are the responsibility of the State. Monuments are also protected by Preservation Orders, also National Monuments. National Monuments also includes (but not so as to limit, extend or otherwise influence the construction of the foregoing general definition) every monument in Saorstát Eireann to which the Ancient Monuments Protection Act, 1882, applied immediately before the passing of this Act, and the said expression shall be construed as including, in addition to the monument itself, the site of the monument and the means of access thereto and also such portion of land adjoining such site as may be required to fence, cover in, or otherwise preserve from injury the monument or to preserve the amenities thereof.

Under the Heritage Act (1995) architectural heritage is defined to include *'all structures, buildings, traditional and designed, and groups of buildings including street-scapes and urban vistas, which are of historical, archaeological, artistic,* *engineering, scientific, social or technical interest, together with their setting, attendant grounds, fixtures, fittings and contents…'*. A heritage building is also defined to include *'any building, or part thereof, which is of significance because of its intrinsic architectural or artistic quality or its setting or because of its association with the commercial, cultural, economic, industrial, military, political, social or religious history of the place where it is situated or of the country or generally'*.

12.1.4.2 Granada Convention

The Council of Europe, in Article 2 of the 1985 Convention for the Protection of the Architectural Heritage of Europe (Granada Convention), states that *'for the purpose of precise identification of the monuments, groups of structures and sites to be protected, each member State will undertake to maintain inventories of that architectural heritage'*. The Granada Convention emphasises the importance of inventories in underpinning conservation policies.

The NIAH was established in 1990 to fulfil Ireland's obligations under the Granada Convention, through the establishment and maintenance of a central record, documenting and evaluating the architectural heritage of Ireland. Article 1 of the Granada Convention establishes the parameters of this work by defining *'architectural heritage'* under three broad categories of Monument, Groups of Buildings, and Sites:

- **Monument:** all buildings and structures of conspicuous historical, archaeological, artistic, scientific, social or technical interest, including their fixtures and fittings;

- **Group of buildings**: homogeneous groups of urban or rural buildings conspicuous for their historical, archaeological, artistic, scientific, social or technical interest, which are sufficiently coherent to form topographically definable units;

- **Sites:** the combined works of man and nature, being areas which are partially built upon and sufficiently distinctive and homogenous to be topographically definable, and are of conspicuous historical, archaeological, artistic, scientific, social or technical interest.

The Council of Europe's definition of architectural heritage allows for the inclusion of structures, groups of structures and sites which are considered to be of significance in their own right, or which are of significance in their local context and environment. The NIAH believes it is important to consider the architectural heritage as encompassing a wide variety of structures and sites as diverse as post boxes, grand country houses, mill complexes and vernacular farmhouses.

12.1.4.3 Offaly County Development Plan 2014-2020

Areas of High Amenity Policies:

AHAP-01 It is Council policy to protect and preserve the county's primary areas of high amenity namely the Slieve Bloom Mountains, Clonmacnoise Heritage Zone, Durrow High Cross, Abbey and surrounding area, the River Shannon, Lough Boora Parklands, Grand Canal, Croghan Hill, Raheenmore Bog, Pallas Lake, Clara Bog and Eskers, Eiscir Riada and other eskers. These areas are indicated on Map 7.17 of the County Development Plan.

Notwithstanding the location of certain settlements, or parts of, for which there are settlement plans (towns, villages, 'sráids'), within the Areas of High Amenity, it is not the intention of this policy to hinder appropriate sustainable levels of development (as set out in the plans and subject to proper planning). Further, it is policy to facilitate the sustainable extension and expansion of existing visitor, tourist related or other rural enterprises within the Areas of High Amenity, where such development is appropriate and where it can be demonstrated that it gives 'added value' to the extending activity and to the immediate area which is the subject of the 'Area of High Amenity' designation.

AHAP-02 It is Council policy, in both cases above, to ensure that issues of scale, siting, design and overall compatibility (including particular regard to environmental sensitivities) with the site's location within an Area of High Amenity are of paramount importance when assessing any application for planning permission. The merits of each proposal will be examined on a case-by case basis.

Areas of High Amenity Objectives:
AHAO-01 It is an objective of the Council to protect and preserve the county's primary areas of high amenity namely the Slieve Bloom Mountains, Clonmacnoise Heritage Zone, Durrow High Cross, Abbey & surrounding area, the River Shannon, Lough Boora Parklands, Grand Canal, Croghan Hill, Raheenmore Bog, Pallas Lake, Clara Bog and Eskers, Eiscir Riada and other eskers.

Landscape Sensitivity
H) ARCHAEOLOGICAL AND HISTORICAL LANDSCAPES
Characteristics:

- County Offaly is rich in landscapes of archaeological and historic interests as is shown in Map 7.16. This ranges from large ecclesiastical sites such as Clonmacnoise and Durrow Abbey to archaeological features such as the Durrow High Cross.
- Section 7.18, Built Heritage of this plan provides further policies and objectives concerning the county's archaeological and historical landscapes. These primarily include Clonmacnoise, Durrow, Killeigh, Leamonaghan and Rahan.

Sensitivities:

- These landscapes are highly sensitive to new developments, which could potentially damage the historical character and the cultural and social importance of the area.
- The Council shall endeavour to ensure that planning applications for development, refurbishment and restoration works etc. within close proximity to these areas are sympathetic to the sensitive nature of the landscape.

Architectural and Archaeological Heritage Policies:
AAHP-01 It is Council policy to ensure that the alteration or extensions to protected buildings and structures will only be permitted if the proposals are in keeping with the character of the building and preserve the architectural and historic features of the buildings or structures.

AAHP-02 It is Council policy to encourage the retention, sympathetic maintenance, and appropriate re-use of the vernacular buildings, in both the towns and rural areas of the county, including the retention of the original fabric, such as windows, renders, shop fronts, gates, yards, boundary walls and other significant features where possible, to discourage the replacement of good quality vernacular buildings with modern structures;

AAHP-03 It is Council policy to ensure that new build adjoining, and extensions to, vernacular buildings are of an appropriate design and do not detract from the building's character.

AAHP-04 It is Council policy to apply the following principles to the archaeological heritage:

- To facilitate appropriate guidance in relation to the protection of the county's archaeological heritage.
- To promote public awareness of the rich archaeological heritage in this area.
- To protect and enhance archaeological monuments and their settings and Zones of Archaeological Potential.

AAHP–05 It is Council policy that the area comprising the National Monument at Clonmacnoise, enclosing Eskers, Mongans Bog, Clonmacnoise Callows, Fin Lough and the limestone pavement at Clorhane shall retain its nominated status as the "Clonmacnoise Heritage Zone", in accordance with the recommendations of the study of the area carried out by the Environmental Sciences Unit of Trinity College, Dublin and as indicated on Map 7.21.

AAHP-06 It is Council policy that, in the primary control zone around the National Monument, development will be strictly curtailed, so as to preserve and protect the unique character and distinctive quality of this area. The boundaries of the secondary control area correspond with that of the Shannon Area of High Amenity. Within this secondary area the controls applicable to Areas of Special Control will apply together with a further requirement that the Planning Authority must be satisfied that the particular purpose of the proposal justifies the location proposed.

AAHP-07 It is policy of the Council to promote awareness of, and access to, the archaeological inheritance of Offaly.

AAHP-08 It is Council policy to ensure that development in the immediate vicinity of a recorded monument is sensitively sited and designed so that it does not significantly detract from the monument. Where upstanding remains exist, a visual impact assessment may be required.

AAHP-09 It is Council policy to inform and seek guidance from the National Museum of Ireland if an unrecorded archaeological object is discovered, or the National Monuments Service of the Department of Arts, Heritage and the Gaeltacht in the case of the discovery of an unrecorded archaeological site, in accordance with National Monuments legislation.

AAHP-10 It is Council policy to ensure that full consideration is given to the protection of archaeological heritage when undertaking, approving or authorising development in order to avoid unnecessary conflict between development and the protection of the archaeological heritage.

AAHP-11 It is Council policy to ensure that all development proposals affecting sites specified in the Record of Monuments and Places or Zones of Archaeological Potential are referred to the prescribed bodies (as set out in the Planning and Development Act

2000, as amended) and to have regard to the advice and recommendations of the prescribed bodies in relation to undertaking, approving or authorising development.

AAHP-12 It is Council policy to ensure that when an unrecorded archaeological object or site is discovered, any works that threaten the object or site are immediately suspended and that the appropriate Government agency is informed.

AAHP-13 It is Council policy to protect historical burial grounds within Offaly and encourage their maintenance in accordance with conservation principles.

AAHP-14 It is Council policy to facilitate appropriate guidance in relation to the protection of the archaeological heritage in the area covered by the plan.

AAHP-15 It is Council policy that developments, which require vehicular access from public roads that were formerly towpaths or from existing towpaths along the Grand Canal, are very strictly controlled. This is in addition to restrictions relevant to the Canal's designation as a Natural Heritage Area and consequently as an Area of Special Control. It is policy to consider housing applications for established families* only along roads that were formerly towpaths along the Grand Canal and that such developments will be strictly controlled. (*Families for the purpose of this policy are defined as husband, wife and their children, siblings of the husband and wife and their sons and daughters.)

AAHP-16 It is Council policy to encourage the protection, promotion and enhancement of heritage gardens and parks in the county and support public awareness, enjoyment of and access to these sites.

AAHP-17 It is Council policy to protect archaeological sites and monuments, underwater archaeology, and archaeological objects, which are listed in the Record of Monuments and Places, and to seek their preservation in situ (or at a minimum, preservation by record) through the planning process. It is Council policy to seek to protect important archaeological landscapes from inappropriate development.

AAHP-18 It is Council policy to encourage and promote the appropriate management and maintenance of the County's archaeological heritage, including historical burial grounds, in accordance with conservation principles and best practice guidelines.

AAHP-19 It is Council policy to continue to develop the Council's advisory/educational role with regard to heritage matters and to promote awareness, understanding, and appreciation of the architectural heritage of Offaly.

AAHP-20 It is Council policy to encourage, where appropriate, the adaptive re-use of existing buildings and sites in a manner compatible with their character and significance.

AAHP-21 It is Council policy to identify places of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest and where appropriate to define them as Architectural Conservation Areas.

AAHP-22 It is Council policy to require that all development proposals within an ACA should be appropriate to the character of the area, inclusive of its general scale and materials, and are appropriately sited and sensitively designed having regard to the advice given in the Statements of Character for each area.

Architectural and Archaeological Heritage Objectives:
AAHO-01 It is an objective of the Council to examine the feasibility of designating Architectural Conservation Areas in the county over the plan period.

AAHO-02 It is an objective of the Council to protect all structures listed in the Record of Protected Structures, that are of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest throughout the county.

AAHO-03 It is an objective of the Council to protect the Slí Mór and Slí Dála routes and sign post them where appropriate.

AAHO-04 It is an objective of the Council to secure the protection (i.e. preservation in situ or at a minimum protection by record) of all archaeological monuments included in the Record of Monuments and Places as established under Section 12 of the National Monuments (Amendment) Act 1994, and their setting.

AAHO-05 It is an objective of the Council to protect and preserve archaeological sites and their settings discovered since the publication of the Record of Monuments and Places and the publication of the Urban Archaeology Survey.

AAHO-06 It is an objective of the Council to protect the Zones of Archaeological Potential identified in the Record of Monuments and Places.

AAHO-07 It is an objective of the Council to prohibit the demolition of a structure that positively contributes to the character of an ACA, except in exceptional circumstances. The Council will require such applications to be accompanied by a measured and photographic survey, condition report and architectural heritage assessment of the structure. Where permission for demolition is granted within an ACA, an assessment of the impact of the replacement building on the character of the ACA will be required.

AAHO-08 It is an objective of the Council to ensure that any new development within or contiguous to an ACA is sympathetic to the character of the area and that the design is appropriate in terms of scale, height, plot density, layout, materials and finishes.

AAHO-09 The council acknowledges the nomination by the Government of Ireland, of two Monastic sites, Clonmacnoise and Durrow, on the tentative list for inclusion to the UNESCO World Heritage sites list. It is an objective of the Council to explore potential of further designating the Monastic Sites at Clonmacnoise and Durrow as prospective UNESCO World Heritage Sites.

12.2 Methodology

The assessment of the archaeology, architecture and cultural heritage of the proposed development area included desk-based research as well as field walking. A desk-based study of the proposed development site was undertaken in order to assess the archaeological, architectural and cultural heritage potential of the area and to identify constraints or features of archaeological/cultural heritage significance within or near to the proposed development site.

Extensive field survey of the study area was undertaken in April and May 2016 to determine if previously unrecorded archaeological/architectural or cultural heritage features were located in the area of the proposed development and to assess any likely significant effects on known or previously unrecorded sites or monuments within the study area and along the proposed grid connection route options and haul route.

The inspection consisted of an extensive walkover examination of the site (within the study area), an assessment of any remaining recorded monuments, architectural, built or cultural heritage items within the site, where accessible, and the potential direct and indirect construction phase and operational phase impacts on those monuments. Any newly discovered archaeological monuments, items of built heritage or cultural heritage value within the study area were also recorded during the field inspection.

12.2.1 Desktop Assessment

A primary cartographic source and base-line data for the archaeological assessment was the consultation of the Sites and Monuments Record (SMR) and Record of Monuments and Places (RMP) for County Offaly. All known recorded archaeological monuments are indicated on 6-inch Ordnance Survey (OS) maps and are listed in the aforementioned records. The 1st (1838-9) and 2nd (1910) edition OS maps for the area were also consulted as were aerial photographs.

Cloncreen bog, in the ownership of Bord na Móna, has been subject to two archaeological peatland surveys in 2002 and 2013. A number of archaeological sites identified during the surveys were subsequently excavated. All works undertaken in the past and up to when the peat extraction finishes are done so under the Code of Practice between Bord na Móna and the DAHG. A review of the peatland surveys and the preliminary excavation reports was undertaken to inform the full archaeological potential of the bog for this assessment.

The primary source and base-line data for the architectural assessment was the consultation of the Record of Protected Structures and the National Heritage of Architectural Heritage for County Offaly. Consultation of the historic mapping and field work assisted in the recording of previously unknown architectural heritage feature deemed to be of significance.

The following sources were consulted for this assessment:

- The Record of Monuments and Places (RMP)
- The Topographical Files of the National Museum of Ireland
- First edition Ordnance Survey maps (OSI.ie)
- Second edition Ordnance Survey maps (OSI.ie)
- Third edition Ordnance Survey Map (Record of Monuments and Places for County Offaly)
- Down Survey maps for County Offaly (www.downsurvey.tcd.ie)
- Aerial photographs (copyright of Ordnance Survey Ireland (OSI.ie)
- Database of Irish Excavation Reports
- Offaly County Development Plan 2014-2020
- National Inventory of Architectural Heritage (NIAH)
- Landed Estates Database (NUI Galway)
- Archaeological Wetland Unit Cloncreen Bog Survey Catalogue of Sites, 2002
- Corcoran and Whitaker 2003, Fourteen Excavations in Cloncreen Bog
- Re-assessment Peatland Survey 2013 Blackwater, Boora, Derrygreenagh, Mountdillon Group of Bogs
- Whitaker J, 2014 Preliminary Report of an Excavation of Site OF-CCN002, 2014 under licence 14E0255
- Code of Practice between Bord na Móna and DAHG

12.2.1.1 Record of Monuments and Places

A primary cartographic source and base-line data for the assessment was the consultation of the Sites and Monuments Record (SMR) and Record of Monuments and Places (RMP) for County Offaly. All known recorded archaeological monuments are indicated on 6-inch Ordnance Survey (OS) maps and are listed in these records. The SMR/RMP is not a complete record of all monuments as newly discovered sites may not appear in the list or accompanying maps. In conjunction with the consultation of the SMR and RMP the electronic database of recorded monuments (www.archaeology.ie) was also consulted.

12.2.1.2 Cartographic Sources and Aerial Photography

The 1st (1838-9) edition and 2nd (1910) edition OS maps for the area were consulted, where available, as was OSI aerial photography on OSI.ie. The Down Survey maps for this area of County Offaly were also consulted.

12.2.1.3 Topographical Files - National Museum of Ireland

Details relating to finds of archaeological material and monuments in numerous townlands in the country are contained in the topographical files held in the National Museum of Ireland. The files were consulted on the 21st and 22nd March 2016 (See Appendix 12-9 of this EIS).

12.2.1.4 Archaeological Inventory Series

Further information on archaeological sites may be obtained in the published County Archaeological Inventory series prepared by the Department of Arts, Heritage and the Gaeltacht. The archaeological inventories present summarised information on sites listed in the SMR/RMP and include detail such as the size and location of particular monuments as well as any associated folklore or local information pertaining to each site. The inventories, however, do not account for all sites or items of cultural heritage interest which are as yet undiscovered.

12.2.1.5 County Development Plan

The County Development Plan for Offaly (2014-20) was consulted for the schedule of buildings (Record of Protected Structures) and items of cultural, historical or archaeological interest which may be affected by the proposed wind farm. The townlands within and surrounding the study area were entered into the list of protected structures in the development plan to assess the proximity and potential impact of the proposed development on such structures. The development plan also outlines policies and objectives relating to the protection of the archaeological, historical and architectural heritage landscape of County Offaly. A digital dataset for the RPS was download on ArcGIS online and overlaid on the GIS maps for the subject site and study area.

12.2.1.6 Database of Irish Excavation Reports

The database of Irish excavations contains annual summary accounts of all excavations carried out under license. The database is available on line at www.excavations.ie and includes excavations from 1985 to 2015. This database was consulted as part of the desktop research for this assessment to establish if any archaeological excavations had been carried out within or near to the proposed development area. Numerous results were found due to the peatland surveys and excavations undertaken in 2013 and are outlined separately in Appendix 12-8.

12.2.1.7 National Inventory of Architectural Heritage (NIAH)

This source lists some of the architecturally significant buildings and items of cultural heritage and is compiled on a county by county basis by the Department of the Environment, Heritage and Local Government. The NIAH database was consulted for all townlands within and adjacent to the study area. The NIAH survey for Offaly has been published and was downloaded on to the base mapping for the proposed wind farm (www.buildingsofireland.ie). The National Inventory of Architectural Heritage (NIAH) is a state initiative under the administration of the Department of Arts, Heritage and the Gaeltacht and established on a statutory basis under the provisions of the Architectural Heritage (National Inventory) and Historic Monuments (Miscellaneous Provisions) Act 1999.

The purpose of the NIAH is to identify, record, and evaluate the post-1700 architectural heritage of Ireland, uniformly and consistently as an aid in the protection and conservation of the built heritage. NIAH surveys provide the basis for the recommendations of the Minister for the Department of Arts, Heritage and the Gaeltacht to the planning authorities for the inclusion of particular structures in their Record of Protected Structures (RPS). The published surveys are a source of information on the selected structures for relevant planning authorities. They are also a research and educational resource. It is hoped that the work of the NIAH will increase public awareness and appreciation of Ireland's architectural heritage.

12.2.2 Geographical Information Systems

GIS is a computer database which captures, stores, analyses, manages and presents data that is linked to location. GIS is geographic information systems which includes mapping software and its application with remote sensing, land surveying, aerial photography, mathematics, photogrammetry, geography and tools that can be implemented with GIS software. A geographic information system (GIS) was used to manage the datasets relevant to the archaeological and architectural heritage assessment and for the creation of all the maps in this section of the report. This involved the overlaying of the relevant archaeological and architectural datasets on georeferenced aerial photographs and road maps (ESRI), where available. The integration of this spatial information allows for the accurate measurement of distances of a proposed development from archaeological and cultural heritage sites and the extraction of information on 'monument types' from the datasets. Areas of archaeological or architectural sensitivity may then be highlighted in order to mitigate the potential negative effects of the development on archaeological, architectural and cultural heritage.

12.2.3 Field Inspection

The study area was surveyed by Tobar Archaeological Services over several days between April and June 2016. The inspection consisted of an extensive walkover examination of the site (within the study area), an assessment of any remaining recorded monuments, architectural, built or cultural heritage items within the site, where accessible, and the potential direct and indirect impacts on those monuments. Any newly discovered archaeological monuments, items of built heritage or cultural heritage value within the study area were also recorded during the field inspection. A full photographic record of the site was made. An inspection of the proposed grid connection route and haul route was also undertaken. The site description and photographic record is presented in Appendix 12-1.

A standardised approach was utilised for the assessment of indirect impacts according to types of monuments and cultural heritage assets which may have varying degrees of sensitivity. This assessment does not include site visits to each and every site as this would considered to be beyond the scope of the EIS. Only sites that were publically accessible were visited. Otherwise the assessment was assisted by cartographic analysis and photomontages undertaken as part of the Landscape and Visual Impact Assessment (see Chapter 11 of this EIS).

Table 12-1: Heritage sites considered according to Sensitivity

Heritage Site Type	Distance Considered
UNESCO World Heritage Sites (including tentative sites)	25km
National Monuments (State Ownership and Preservation Order Sites)	10km
Recorded Monuments, RPS	5km
NIAH and Historic Gardens	3km
Undesignated sites, if relevant	500m from Site Boundary, cable route or Haul Route

Table 12-2: Model to assist in ascertaining significance of impact on setting of assets

	Distance of Asset to Proposed Development		
Sensitivity of asset	**0-1km**	**1-2km**	**2-3km**
Low	Slight	Slight	Negligible
Medium	Moderate	Moderate	Slight
High	Significant	Significant	Moderate

12.2.3.1 Limitations Associated with Fieldwork

No significant limitations were encountered during field survey. A large number of drains and surfaces were overgrown within some areas of the bog therefore the examination of the drain sections was limited in places. (See Appendix 12-1).

12.3 Existing Environment

12.3.1 Archaeological Heritage

For the purposes of this report, archaeological heritage includes:

- UNESCO World Heritage Sites
- National Monuments (Ownership, Guardianship and Preservation Orders)
- Recorded archaeological monuments listed in the RMP/SMR
- Newly discovered archaeological sites
- Archaeological Landscapes or Areas of High Amenity (County Development Plan)

12.3.1.1 Proposed Wind Farm

12.3.1.1.1 UNESCO World Heritage Sites (and those on tentative List)

Offaly County Council have acknowledged the nomination by the Government of Ireland, of two Monastic sites, Clonmacnoise and Durrow, on the tentative list for inclusion to the UNESCO World Heritage sites list. It is an objective of the Council to explore the potential of further designating the Monastic Sites at Clonmacnoise and Durrow as prospective UNESCO World Heritage Sites. Given the high status and sensitivity of these sites, such monuments within 25km of the proposed development were assessed.

Durrow Abbey is located 24km to the north-west and therefore the immediate visual setting of the site will not be impacted by the proposed development. Clonmacnoise is located 55km to the west of the development site and again will not be impacted by the proposed development (Figure 12-3).

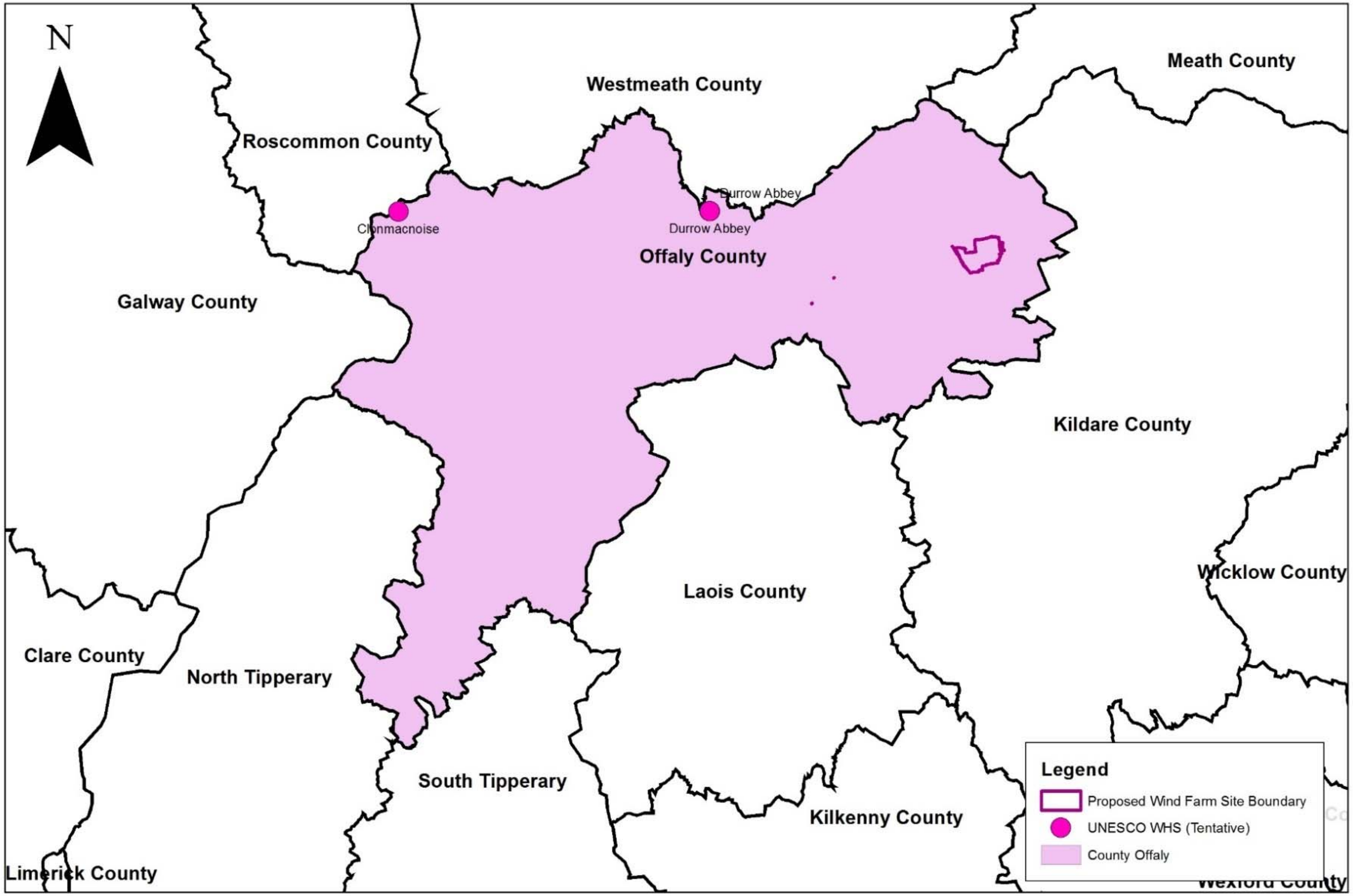


Figure 12-3: UNESCO World Heritage Sites on tentative list

12.3.1.1.2 National Monuments

As these monuments are categorised as being of National Importance, monuments within 10km of the site were assessed for impact on visual setting. The nearest monuments to the proposed development site are Clonin Earthworks (NM 532) at 8km to the north and the Medieval Deserted Village at Cannakil (NM 617) at 11km to the northwest and Grange Castle, County Kildare. Cannakil Complex and Croghan Hill is acknowledged in the Offaly County Development Plan as part of the Croghan Hill complex. The Council recognises the scenic quality and recreational value of the Croghan Hill area. Croghan Hill, Raheenmore Bog (which is a designated Nature Reserve under the Wildlife Act 2000 as amended) and Cannakill Deserted Medieval Village are the main elements of the Area of High Amenity. The Council, through its development control function will seek to preserve the scenic amenity and recreational potential of this area and to protect it from development that would damage or diminish its overall attractiveness and character.

The potential impacts on these National Monuments are addressed in Section 12.4 below.

Table 12-3: National Monuments (Ownership / Guardianship), County Offaly

NAT MON	LOCATION	NUMBER
Cross, Church, graveslabs & motte	Durrow Demesne	313 and 367 (O)
High Cross and Remains of Church, Kinnitty	Castletown and Glinsk	510 (O)
Sier Kieran Monastic Church and Settlement	Clonmore and Churchtown	497 (O)
Earthwork	Clonin	532 (O)
Churches, Two Round Towers, Crosses, slabs	Clonmacnoise	81, 250 & 601 (O)
Two Churches	Rahan Demesne	82 (O)
Early Medieval Ecclesiastical Site	Clonmacnoise	601 (O)
Medieval Deserted Village	Cannakill	617 (O)
Clonfinlough Stone	Clonfinlough	336 (G)
Church and Slabs	Gallen	504 (G)

Table 12-4: National Monuments with Preservation Orders, County Offaly

No. of Preservation Order	Monument	Townland	Effective Date of Order
8	Crannog (Ballinaderry Lough)	Ballinahinch	5/1/33
49	Coole Castle	Kilcolgan	1/1/37
86	Clonony Castle	Clonony More	15/10/40
6/56	Ringfort	Broughal	22/2/56
1/57	Ballykean Ring Barrow (O' Dempsey's Ring)	Ballykean	23/1/57
3/86	Motte Castle Earthworks	Rathlihen	12/9/86

No. of Preservation Order	Monument	Townland	Effective Date of Order
23/76	Hillfort (excluding School and Rectory bldgs.)	Glebe and Ballycurragh	4/6/76
5/2000	Cemetery and Enclosure	Derryvilla	N/A
TPO 12.01	Ecclesiastical Remains	Clonmacnoise	19/10/01

Table 12-5: National Monuments within 10km of the site boundary (All Counties)

NAT MON	LOCATION	NUMBER	County	Distance to nearest Turbine
Clonin Earthwork	Clonin	532 (O)	Offaly	8.3km
Cannakill Medieval Deserted Village	Cannakill (included due to site being part of Croghan Hill Complex)	617 (O)	Offaly	11km
Grange Castle	Grange East Townland	629	Kildare	8.8km

National Monument 532 Clonin Earthwork OF011-001
Class: Barrow - ring-barrow
Townland: CLONIN
Description: 'National Monument in State Ownership No. 532. In pasture on top of Clonin Hill with extensive views of the surrounding countryside. Impressive view of burial mound (OF010-004001-) on top of Croghan Hill 4.5km to W. Smaller ring-barrow (OF011-001002-) now levelled located c. 20 metres to NW. Circular flat topped mound (diam. 46.6m; H 2.5m - 0.5m) enclosed by inner fosse (Wth 2m) with external bank (Wth 5.3m; H 0.3m) intersected by stone wall/field boundary at W. Natural rock outcrop with decorated surface known locally as a mass-rock (OF011-001001-) protrudes from the surface of the fosse at SW.

The above description is derived from the published 'Archaeological Inventory of County Offaly' (Dublin: Stationery Office, 1997). In certain instances, the entries have been revised and updated in the light of recent research. Compiled by: Caimin O'Brien. Date of revised upload: 25 January 2016. Date of last visit: January 22, 2016.

Given the topography on which the earthwork sits (on high ground), the wind farm will be visible despite its distance of 8.3km. The immediate setting of the monument will not be impacted however. The Zone of Theoretical Visibility (ZTV) model shows that all turbines will be visible from this hill. The turbines will not however impact on the existing view between the Clonin mound and the cairn at Croghan Hill, a view which is important to maintain. The likely significant effects are addressed in Section 12.4 below.

Plate 12-1: Ring-barrow OF011-001 in distance (photo courtesy of National Monument Service)

Plate 12-2: View of Croghan hill burial mound 5km to west from ring barrow at Clonin looking West (photo courtesy of NMS, DAHG)

National Monument 617 Cannakill Deserted Medieval Settlement OF010-010001-
Class: Settlement deserted - medieval
Townland: CANNAKILL
Description: 'National Monument in State Ownership No. 617. Situated on the SW downslope of Croghan Hill with a church and graveyard (OF010-010006/007-) immediately W and a fortified house (OF010-010003-) nearby to SW. The remains of this deserted settlement of probable medieval date comprises a large rectangular enclosure (dims. 36m N-S x 45m E-W) defined by grass-covered wall-footings (Wth 3m) to which a series of additional enclosures are adjoined on its N, E and S sides. Grass-covered banks in the E part of the interior of the main enclosure indicate that it may have been divided internally at some stage. An annexe with entrance on its E side (Wth 3m) attached to the S side of the main enclosure may also be a later addition. Its W half overlain by a later field wall. To S of this there are the remains of a possible rectangular house site (int. dims. 12m N-S x 2.5m E-W). An oval-shaped area (dims. 17m N-S x 27m E-W) enclosed by a bank (Wth 3m) and intersected by a modern road on its N side, lies to N of the main enclosure and a burial mound (OF010-010002-) or motte surrounded by a wide shallow fosse, is situated at E. Approximately 200m E of this again there are the remains of a square enclosure (int. dims. 12.5m N-S x 10.5m E-W). In the 1940s unburnt animal bone and pottery was discovered in an area which had been quarried to S of the village.

Present remains consist of four enclosures and a mound, possibly of earlier date. There are numerous rock quarry holes. The enclosures are widely spaced, three are rectangular in shape and are defined by low stone walls. The fourth is circular and is defined by a low earth and stone bank. The date of these features is unknown. Located on the southern slopes of Croghan Hill. Present remains consist of several enclosures all of which seem to be adjoined to the main rectangular shaped enclosure which measures internally 36m N-S x 45m E-W and is enclosed by grass covered walls which measure 3m wide. This main enclosure appears to have been altered and may have been divided internally via the presence of grass covered banks in the eastern interior of the enclosure. Another later addition to the site may have been the annexe on the southern side of the enclosure. There is an entrance feature present on the E side of the enclosure which measures 3m wide. A field wall now destroys the western section of this enclosure. To the N of the site there is another oval shaped enclosure intersected by a modern road on its N side. This enclosure may have originally had an internal diameter of 17m N-S x 17m E-W with an external enclosing bank 3m wide. To the E of the main enclosure there is a burial mound (OF010-010002-) which has a wide shallow fosse. To the S there is what appears to be the remains of a possible rectangular house site with internal dimensions of 12m N-S x 2.5m E-W. Further E approx. 200m away are the remains of a square enclosure which has internal dimensions of 12.5m N-S x 10.5m E-W. Possible medieval village associated with the nearby tower house (OF010-010003-) with church and graveyard (OF010-010006/007-) to the S. Davies (ITA Survey 1942) discovered some unburnt animal bones and pottery which had been revealed by quarrying to the S of the village. The above description is derived from the published 'Archaeological Inventory of County Offaly' (Dublin: Stationery Office, 1997). In certain instances, the entries have been revised and updated in the light of recent research.
Date of upload: 23 May 2011. Date of last visit: January 22, 2016'

The Likely significant effects are addressed in Section 12.4 below.

Plate 12-3: Earthen remains of Medieval settlement at Cannakill on lower slope of Croghan Hill (photo courtesy of NMS, DAHG)

National Monument 629 Grange Castle KD002-007
Class: Castle - tower house
Townland: GRANGE WEST
Description: A National Monument (No 629). Recorded in the Civil Survey of 1654-56 as comprising a castle, orchard and dove house owned by Edward Bermingham and valued at 'forty pounds'. A 1785 estate map names it 'the Seat of William Tyrrell Esqr.', in whose family it remained until 1988 when it was placed in State care. (Cumming 1991, 222-5). In open, gently undulating pastureland. The monument is abutted at W by a single-storied farmhouse and incorporated into the SW angle of an 18th/19th c. farmyard which obscures an earlier bawn (KD007-007001-). The castle is probably late-15th/early-16th century in date and is a four storied, rectangular structure (ext. dims. L 8.4m E-W; Wth 6.5m N-S; H c. 13m) with rounded corners and a gentle base-batter (H 1.5m), built of coursed, hammer-dressed, mortared limestone blocks. Jacobean-style chimney stacks, centrally placed in the S, W and E walls, (the first functioning, the latter two ornamental) together with Dutch gable-type battlements with drain-holes and projecting string course below, on the N and S walls, are 17th century additions. A pointed-arched entrance doorway in the W wall, with a yett-hole on its N side, is defended by a small machicolation above at third-floor level, and gives to a small lobby, with a second doorway opposite, opening to the main ground-floor chamber which is lit by two loops in broadly splayed embrasures, in the E and S walls. From the lobby a lintelled, intramural stairs in the W wall leads E to first-floor level, from where a spiral stairs in the NW angle, lit by loops, leads up the building, ending in a small cap- house. Floor levels are indicated by opposing joist-holes in the N and S walls, with no vaulting visible. First-floor level is lit by two twin-light windows, in the N and E walls, with a loop in the S wall, and there is a large garderobe chamber in the SW angle. At second-floor level the main room is lit by two loops, in the N and S walls, and by a twin-light window with hood moulding in the E wall. There is a fine, decorated fireplace in the S wall, and a second garderobe in the SW angle is accessed off the stairs. Third-floor level is lit by

two twin-light windows with hood-moulding, in the N and E walls. (Simington (ed.) 1952, Vol. VIII 183-4; Sweetman 1999, 156, Fig. 131)

Compiled by: Gearóid Conroy. Date of upload: 10 June 2011. Date of last visit: October 7, 1998

The ZTV model for the proposed development shows that at least 14 to 21 turbines will be visible from this location. The ZTV is a worse-case scenario, however, and is based on a clear landscape with no intervening vegetation. The monument although well preserved and now restored has no public access. The area is well screened by vegetation and this is particularly the case in summer months.

The likely significant effects on this site and its immediate setting are addressed in Section 12.4 below.

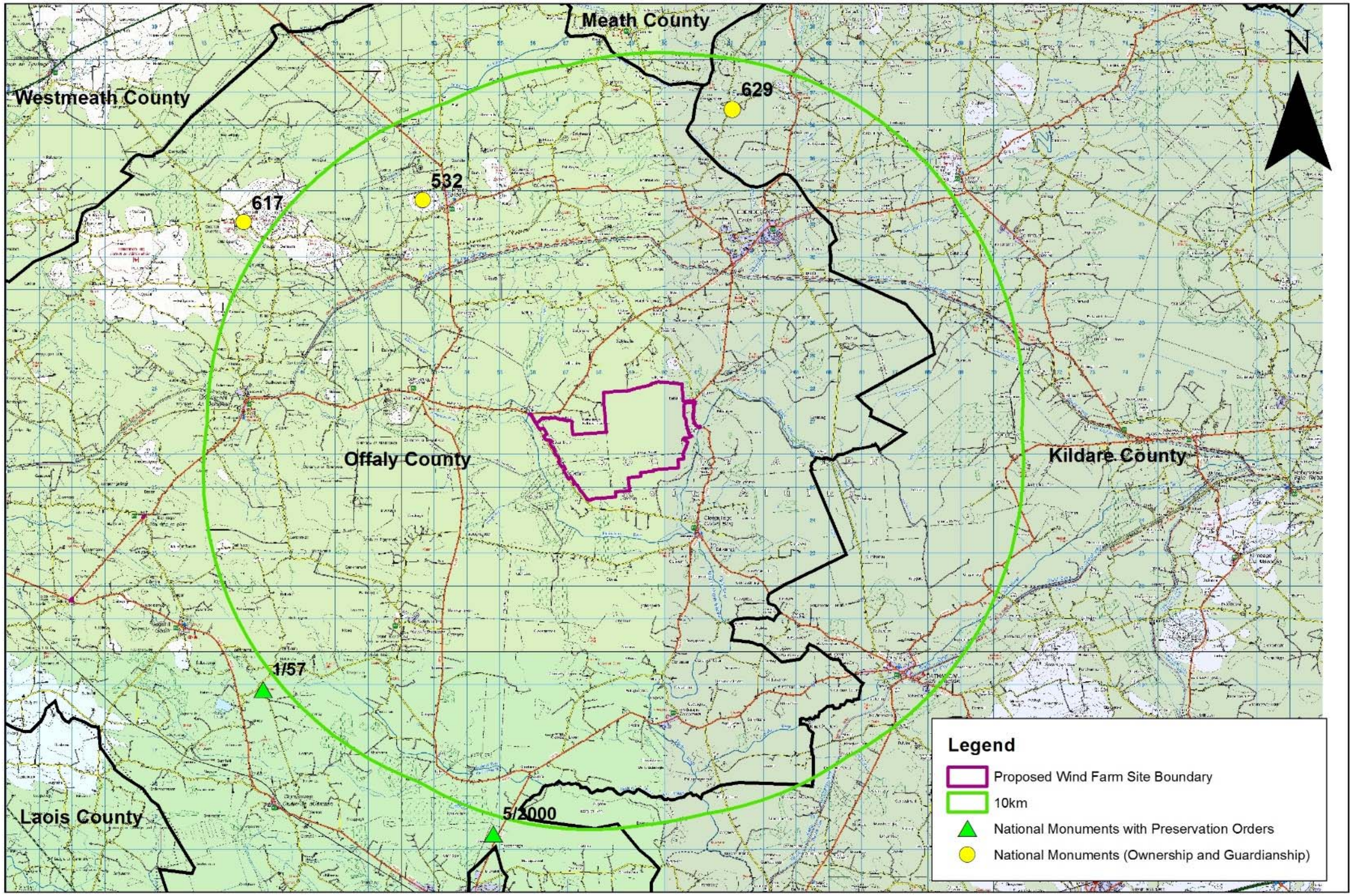


Figure 12-4: National Monuments within 10km of the proposed wind farm site

12.3.1.1.3 Recorded Archaeological Monuments located within Proposed Wind Farm Site Boundary

This section presents the archaeological monuments within the study area boundary listed in the Record of Monument and Places. These sites are all sub-surface and consist of peatland sites such as toghers and trackways which were identified during Archaeological Peatland Surveys commissioned by Bord na Móna in 2002 and 2013 (See Section 12.3.1.1.4). The majority of these sites may no longer be extant due to the ongoing peat milling and extraction. Furthermore, some of these monuments were subject to archaeological investigation / excavation and consequently removed or partially removed (See Appendix 12-8 Excavation Summaries). All peat milling and works within Cloncreen Bog are operated under the Code of Practice between Bord na Móna and the DAHG (Appendix 12-12). Any new sites uncovered during the lifetime of the working bog are dealt with under the code of Practice between the DAHG and Bord na Móna.

Redundant Records are those 'sites' where the evidence is not sufficient to warrant its acceptance as the remains of an archaeological monument. Due to the large number of records (105) these are described in more detail in Appendix 12-3. The majority of sites are Redundant Records, followed by Class 3 Toghers, Class 2 Toghers, Class 1 Toghers with only one example of a post row.

Classification of Toghers

Road - class 1 togher

A peatland trackway/causeway constructed of wood and intended to traverse a bog which have a known orientation. In most instances they comprise substantial timber planks and have good structural definition. They may have several phases of construction indicative of long-term use and reuse. These may date from the Neolithic (c. 4000-2400 BC) to the medieval period (5th-16th centuries AD).

Road - class 2 togher

A length of peatland trackway, constructed of wood, believed to be over 15m in length. They have a clear orientation and good structural definition. Class 2 Toghers may date from the Neolithic (c. 4000-2400 BC) to the medieval period (5th-16th centuries AD).

Road - class 3 togher

A short stretch of peatland trackway, constructed of wood, up to 15m in length with a discernible orientation. It may not be possible to trace them beyond a single sighting. They have evidence of deliberate structure and are interpreted as laid down to cross a small area of bog. Such sites may date from the Neolithic (c. 4000-2400 BC) to the medieval period (5th-16th centuries AD).

Table 12-6: RMPs within proposed wind farm site boundary

SMRS	ITM_E	ITM_N	CLASS DESC.	TLAND_NAME
OF019-020----	660256	727511	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-021----	660294	727544	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-022----	660271	727547	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-023----	660408	727702	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-024----	660403	727702	Redundant record	BALLYKILLEEN (Coolestown By.)

SMRS	ITM_E	ITM_N	CLASS DESC.	TLAND_NAME
OF019-025----	660364	727699	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-026----	660362	727700	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-027----	660359	727699	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-028----	660354	727699	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-029----	660350	727700	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-030----	660334	727698	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-031----	660246	727690	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-032----	660126	727674	Road - class 2 togher	BALLYKILLEEN (Coolestown By.)
OF019-033----	660193	727963	Redundant record	BALLYNAKILL (Coolestown By.)
OF019-034----	660192	728004	Redundant record	BALLYNAKILL (Coolestown By.)
OF019-035----	660188	728000	Road - class 3 togher	BALLYNAKILL (Coolestown By.)
OF019-036----	660184	728001	Redundant record	BALLYNAKILL (Coolestown By.)
OF019-037----	660281	728010	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-038----	660392	727976	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-039----	660326	727980	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-040----	660401	727977	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-041----	660384	727990	Road - class 1 togher	BALLYKILLEEN (Coolestown By.)
OF019-042----	660380	728005	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-043----	660376	728005	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-044----	660371	728005	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-045----	660390	728019	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-046----	660358	728005	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-047----	660329	727994	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-048----	660297	727980	Road - class 2 togher	BALLYKILLEEN (Coolestown By.)
OF019-049----	660285	727973	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-050----	659714	728107	Road - class 3 togher	BALLYNAKILL (Coolestown By.)
OF019-051----	660244	728110	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)

SMRS	ITM_E	ITM_N	CLASS DESC.	TLAND_NAME
OF019-052----	660181	728046	Redundant record	BALLYNAKILL (Coolestown By.)
OF019-053----	660207	727986	Redundant record	BALLYKILLEEN BALLYNAKILL
OF019-054----	660204	727953	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-055----	660292	728000	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-056----	660284	728022	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-057----	660312	728011	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-058----	660289	727969	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-059----	660212	727982	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-060----	660276	727949	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-061----	660117	727998	Redundant record	BALLYNAKILL (Coolestown By.)
OF019-062----	660105	727950	Road - class 1 togher	BALLYNAKILL (Coolestown By.)
OF019-063----	660095	727972	Road - class 3 togher	BALLYNAKILL (Coolestown By.)
OF019-064----	660156	727928	Road - class 3 togher	BALLYNAKILL (Coolestown By.)
OF019-065----	660164	727939	Road - class 3 togher	BALLYNAKILL (Coolestown By.)
OF019-066----	660194	727943	Road - class 3 togher	BALLYNAKILL (Coolestown By.)
OF019-067----	660279	727998	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-068----	660274	727998	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-069----	660271	728009	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-070----	660288	728010	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-071----	660264	727985	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-072----	660263	727978	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-073----	660206	727943	Road - class 3 togher	BALLYNAKILL (Coolestown By.)
OF019-074----	660216	727944	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-075----	660223	727909	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-076----	660224	727932	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-077----	660231	727946	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-078----	660240	727946	Redundant record	BALLYKILLEEN (Coolestown By.)

SMRS	ITM_E	ITM_N	CLASS DESC.	TLAND_NAME
OF019-079----	660283	727949	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-080----	660271	727936	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-081----	660274	727937	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-082----	660311	727950	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-083----	660215	727849	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-084----	660219	727850	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-085----	660224	727846	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-086----	660234	727848	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-087----	660128	727766	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-088----	660242	727783	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-089----	660275	727787	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-090----	660302	727788	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-091----	660335	727780	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-092----	660357	727782	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-093----	660368	727784	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-094----	659001	725722	Road - class 3 togher	CLONCREEN
OF019-095----	660245	727975	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-096----	660273	727981	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-097----	660274	727978	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-098----	660329	727798	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-099----	660281	727787	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-100----	660289	727786	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-101----	660386	727803	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-102----	660110	727692	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-103----	660362	727792	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-104----	660342	727798	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-105----	660389	727779	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-106----	660438	727797	Redundant record	BALLYKILLEEN (Coolestown By.)

SMRS	ITM_E	ITM_N	CLASS DESC.	TLAND_NAME
OF019-107----	660374	727954	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-108----	660405	727947	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-109----	660433	727878	Road - class 2 togher	BALLYKILLEEN (Coolestown By.)
OF019-110----	660257	728104	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-111----	660315	728117	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-112----	660369	728118	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-113----	660375	728113	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-114----	660376	728125	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-115----	660334	728116	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-116----	660091	728095	Redundant record	BALLYNAKILL (Coolestown By.)
OF019-117----	660167	728102	Post row - peatland	BALLYNAKILL (Coolestown By.)
OF019-118----	660400	727946	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-119----	660430	727885	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-120----	660227	727994	Road - class 2 togher	BALLYKILLEEN (Coolestown By.)
OF019-121----	660189	728002	Redundant record	BALLYNAKILL (Coolestown By.)
OF019-122----	660401	727991	Redundant record	BALLYKILLEEN (Coolestown By.)
OF019-123----	660209	727992	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)
OF019-124----	660199	727992	Road - class 3 togher	BALLYKILLEEN (Coolestown By.)

Given that only two sites were detected in the 2013 Re-Assessment survey of Cloncreen bog in stark contrast to the 117 sites found in 2002, it is likely that the majority of the RMPs have been removed (Some sites were registered in the Record of Monuments and Places after the 2002 survey). The area of high sensitivity and archaeological potential is mainly confined to the north-eastern corner of the bog. The proposed layout avoids the sites listed in the RMP although trackways by their very nature may extend beyond the limit of the centre points shown for each monument.

Any potential impacts on the monuments in Cloncreen Bog are addressed in Section 12.4 below.

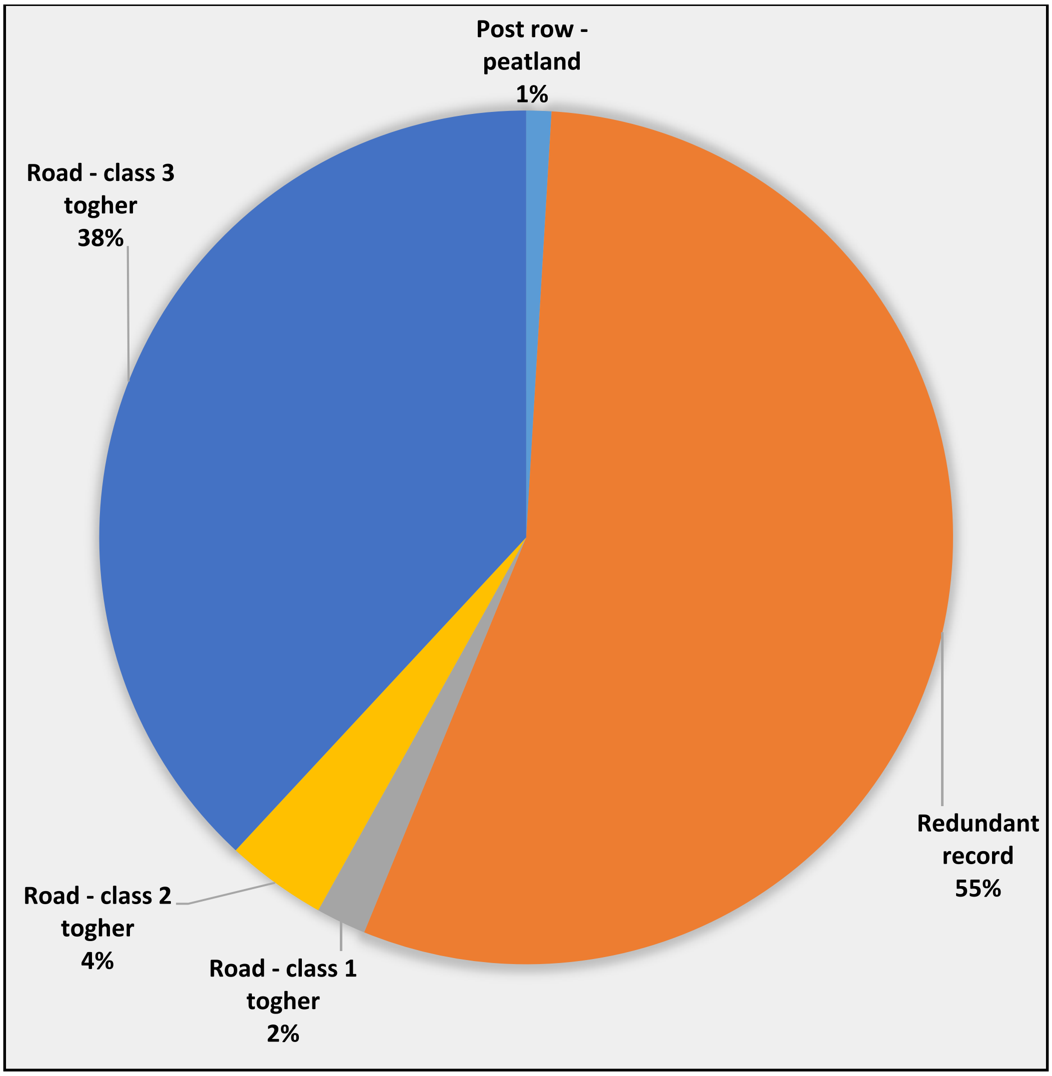


Figure 12-5: Percentage of monument types within proposed development area

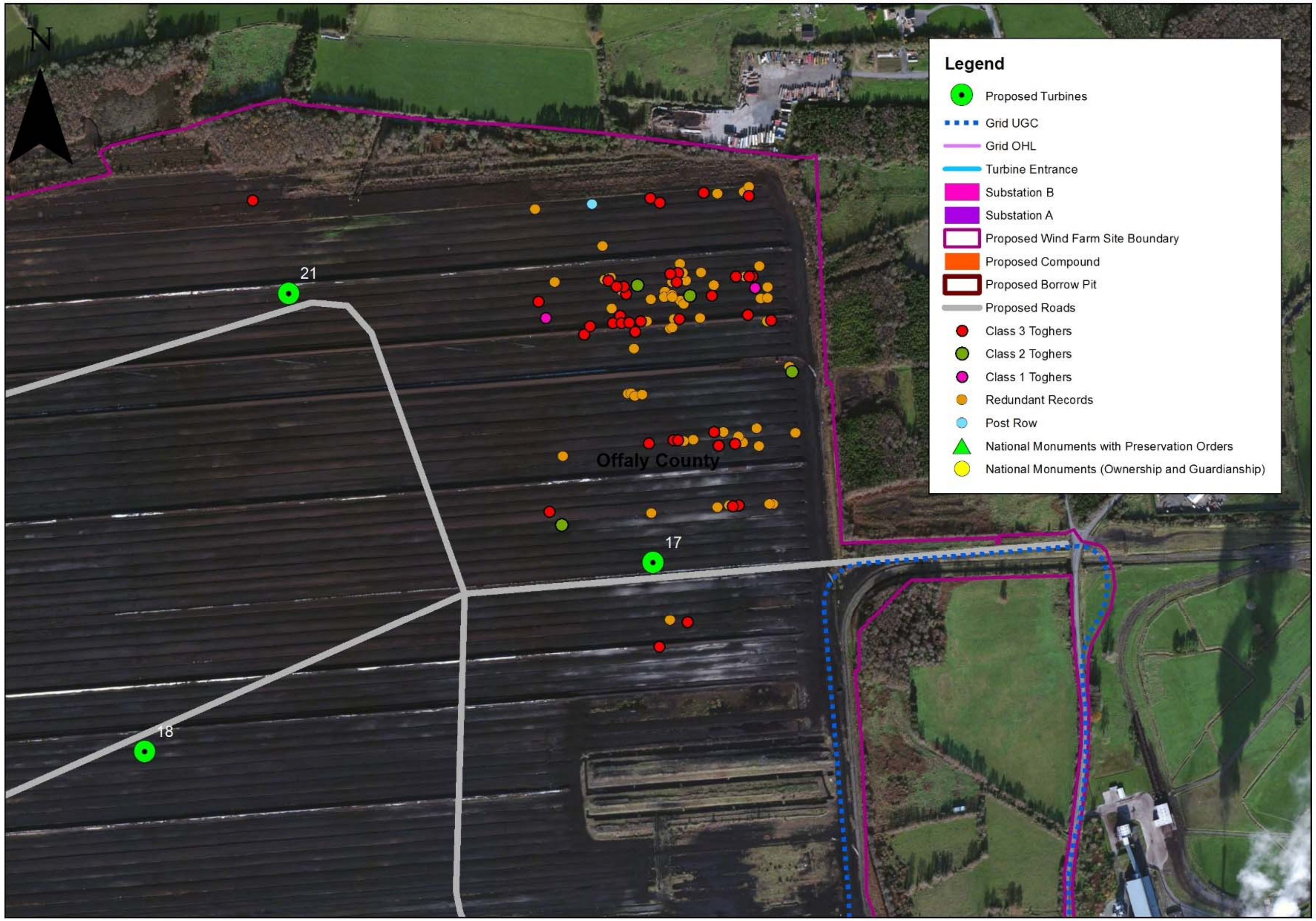


Figure 12-6: Concentration of RMPs in north-eastern corner of site

12.3.1.1.4 Previous Archaeological Work

Numerous surveys and excavations were undertaken within Cloncreen Bog commencing in 2002 until the last re-assessment survey in 2013 and excavation in 2014. This resulted in many new sites being added to the Record of Monuments and Places (see above). The large number of sites demonstrates the high sensitivity of the site in terms of sub-surface archaeology contained within the peat. The high number of artefacts registered in the National Museum of Ireland also demonstrates the artefact bearing potential of the bog. The following is a synopsis of the work undertaken within Cloncreen bog to date. More detail is presented in Appendices 12.4 – 12.7.

Catalogue of 2002 AWU sites

In 2002 the Archaeological Wetland Unit (AWU) undertook a survey of Cloncreen Bog taking in the townlands of Ballinakill, Ballykileen, Eskermore, Clongarret and Cloncreen. This catalogue describes the sites that were discovered at the time as well as a description of the artefacts found within the bog. During this initial phase of work 117 sites were found within the bog, the majority being concentrated in the north-eastern corner of the site. It was this survey information that provided the basis for the mitigation strategy adopted in 2003 (excavation). Thirteen artefacts and six additional environmental objects were recovered during the survey. These were a primary chert flake, a struck chert pebble, a chert leaf shaped arrowhead, a flint plano convex knife, a flint arrowhead, a flint arrowhead fragment, a flint leaf shaped arrowhead, a notched roundwood, a notched timber, portion of a whithe, a wooden object, a wooden implement, a hollowed grooved wooden object, two horn cores, four horn fragments and a degraded fragment of bone. The sites surveyed are described in detail in Appendix 12-4.

Excavations in Cloncreen Bog – Ballinakill and Ballykileen, (Corcoran and Whitaker) - 2003

This report outlines the excavation of fourteen groups of archaeological sites in Cloncreen Bog. The total number of sites excavated within these fourteen groups was 38. The sites were contained within a group of 104 sites located in the north-eastern corner of Cloncreen Bog. The details of the Excavations are presented in Appendix 12-5.

Re-assessment Peatland Survey 2013 - Blackwater, Boora, Derrydreenagh, Mountdillon Group of Bogs County Offaly, Longford, Westmeath and Roscommon, Jan 2014

ADS Ltd. carried out a re-assessment field-walking survey of selected Bord na Móna (Bord na Mona) industrial peatlands in the Blackwater, Boora, Derrygreenagh and Mountdillon groups of bogs in Counties Longford, Offaly, Westmeath, Roscommon during the 2013 field seasons. This work was commissioned by Bord na Móna and its purpose was to determine the nature, extent and complexity of archaeological sites and zones of archaeological potential within the bogs surveyed and compile this data in a manner that it could be used by Bord na Móna, in partnership with their project archaeologist, to develop innovative bog management strategies and form the basis for future mitigation strategies and archaeological services tenders as per the Bord na Móna Code of Practice. Cloncreen Bog was one of those selected for survey.

The re-assessment survey carried out in 2013 on behalf of Bord na Móna identified 2 sites in the north eastern extent of Cloncreen Bog both of which were in poor condition and exposed on the field surface. One of the sightings, OF-CCN001a, was quite dispersed and the peat was re-deposited which led the author to believe that it represented the remains of a previous excavation cutting from the 2003 Bord na Mona Mitigation season. This was later confirmed by consulting previous reports and National Grid references.

The results of the 2013 Re-Assessment Survey were in stark contrast to the earlier 2002 Peatland Survey where the number of sites had reduced dramatically from 104 to 2 in the northeastern extent of Cloncreen Bog. As with the site selected for excavation in 2014 (OF-CCN002), the majority of the sites recorded in 2002, 38 of which were subsequently excavated in 2003, were field surface sightings and it is not surprising therefore that they have since been removed by peat production activities. The excavated site OF-CCN-002 represents further evidence of Bronze Age activity on the bog surface in the north-east of Cloncreen Bog. This is detailed in Appendix 12-6, which presents the Cloncreen section of the Re-Assessment Survey Report.

Excavation of a site OF-CCN002 discovered in 2013 Re-assessment survey (14E0255 IAC, 2014)
This report is at the preliminary stage and the details of the excavation are presented in Appendix 12-7.

12.3.1.1.5 New Potential Archaeology Recorded Within Site Boundary

All areas proposed for development were examined by a walkover survey. No intrusive investigation was undertaken and the survey was limited to a visual inspection only. A number of areas of archaeological potential were noted within the bog and are tabulated below (Table 12-7). As the bog is still in active production and peat milling is ongoing, the bog is an ever changing environment with new surfaces being exposed as the peat is being milled. This is clearly demonstrated by the contrasting numbers of sites exposed in 2002 (117) against 2013 (2). Any sites found during the course of this field assessment were photographed and a National Grid reference taken for each. Each site was reported to the Bord na Móna project archaeologist as these sites are dealt with under the Code of Practice between Bord na Móna and the DAHG during the lifetime of the peat milling. The bog is highly likely to have changed significantly between now and 2018 when the bog will be out of production. New sites may be uncovered during this active milling period (managed under the Code of Practice DAHG/BORD NA MONA). The classification of these new sites noted during field survey is notably difficult without investigating the sites themselves and undertaking some level of excavation. A tentative classification is therefore provided below.

Table 12-7: New sites identified within Cloncreen bog

REF.	ITM_E	ITM_N	TOWNLAND	Distance To Nearest Turbine / Road	Potential Impact	Section in Appendix 12-1
Unclassified Togher 1	659486	727355	BALLINAKILL	66m to T18 and on roadway between T18 and T19	Yes	Appendix 12-1 Section 12.1.3
Possible Peatland Structure 1	659703	726116	CLONCREEN	212m to T9 and 20m to roadway	Yes	Appendix 12-1 Section 12.1.8
Possible Upright Posts	658946	726496	RATHVILLA	Adjacent to T14	Yes	Appendix 12-1 Section 12.1.13

12.3.1.1.6 Archaeological Excavations Undertaken Within Vicinity of Proposed Wind Farm Site

The database of excavations undertaken in Ireland (www.excavations.ie) was checked for those carried out in close proximity to the proposed development area. A number of licensed archaeological excavations were undertaken in the general vicinity of the wind farm study area boundary, primarily in the peat bog. These excavations and investigations again relate to the Peatland Surveys undertaken between 2002 and the present.

Details of the summaries are provided in Appendix 12-8.

12.3.1.1.7 Topographical Files of the National Museum

The topographical files of the National Museum were consulted on the 21st and 22nd March 2016 to assess the artefact bearing potential of the bog and proposed development area. All finds registered in the National Museum are detailed and described in Appendix 12-9. The significance of the number of finds within the bog is high and the potential for uncovering additional finds is also high.

12.3.1.1.8 Recorded Archaeological Monuments Within 5km of the Proposed Wind Farm Site

Fifty-seven recorded monuments are located within 5km of the wind farm study area boundary and are included here for purposes of establishing the archaeological context of the immediate environs of the proposed development site. The majority of the monuments within 5km were not individually visited, however, being located on private lands. Where possible the nearest point along the public roads (adjacent to the sites) were utilised for the assessment. The majority of the 57 monuments (i.e. 44) are located in excess of 1km from the proposed development site. Detailed monument descriptions pertaining to these sites are presented in Appendix 12-2. Monuments with a visual dominance and accessible from public roads were visited where possible. The monuments are listed in Table 12-8 below and those which survive above ground are highlighted in green.

Table 12-8: RMPs located within 5km of site

SMRS	ITM_E	ITM_N	DESCRIPTION	TOWNLAND	Distance To Boundary (metres)	Surface Trace Y/ N
OF011-020	655348	731357	Enclosure	CLONLACK	4304	Y
OF011-021	655379	731532	Ringfort - rath	CLONLACK	4469	Y
OF011-022	658164	731077	Barrow - ring-barrow	CLARKVILLE	3148	Y
OF011-023001	657988	730327	Enclosure	BALLYMORAN	2415	N
OF011-023002	657998	730187	Field system	BALLYMORAN	2275	N
OF011-024	660668	731507	Enclosure	BALLYCOLGAN	3344	N
OF011-025	660897	731307	Enclosure	RATHMORE (Coolestown By.)	3169	N
OF011-027	653552	729953	Enclosure	NEWTOWN (Coolestown By.)	3876	N
OF011-028	657258	729288	Ringfort - rath	RATHLUMBER	1599	Y

SMRS	ITM_E	ITM_N	DESCRIPTION	TOWNLAND	Distance To Boundary (metres)	Surface Trace Y/ N
OF011-029	657438	729128	Enclosure	RATHLUMBER	1372	N
OF011-030	658708	729808	Castle - tower house	BALLYLEAKIN	1808	N
OF011-031	660458	729918	Enclosure	BALLYNANUM	1741	N
OF011-032	658711	728794	Castle - unclassified	BALLINRATH	827	N
OF011-033	659218	729238	Enclosure	BALLYNAKILL (Coolestown By.)	1101	N
OF011-034001	659287	728964	Church	BALLYNAKILL (Coolestown By.)	819	PARTIAL
OF011-034002	659287	728963	Graveyard	BALLYNAKILL (Coolestown By.)	818	Y
OF011-034003	659288	728988	Field system	BALLYNAKILL (Coolestown By.)	842	Y
OF011-035001	660290	728871	Ringfort - rath	BALLYKILLEE N (Coolestown By.)	681	Y
OF011-035002	660289	728877	Designed landscape - tea house	BALLYKILLEE N (Coolestown By.)	687	Y
OF011-053	654648	730151	Enclosure	CLONMEEN	3399	N
OF011-054	657878	730577	Barrow - ring-barrow	CLARKVILLE	2674	Y
OF011-062	654911	730338	Redundant record	LEITRIM	3456	N
OF012-002	661627	732807	Ringfort - rath	MONASTEROR IS	4782	PARTIAL
OF012-004	661727	731707	Enclosure	EDENDERRY	3757	N
OF012-005001	662361	730636	Church	DRUMCOOLY	3111	N
OF012-005002	662367	730647	Graveyard	DRUMCOOLY	3124	N
OF012-006001	662528	730640	Castle - motte and bailey	DRUMCOOLY	3219	Y
OF012-006002	662504	730651	Enclosure	DRUMCOOLY	3212	Y
OF012-007001	662669	728883	Church	SHEAN	2219	N
OF012-007002	662667	728888	Graveyard	SHEAN	2220	Y
OF012-008	663666	729626	Standing stone	CLONCANON	3461	Y
OF012-014	662277	732037	Font (present location)	EDENDERRY	4272	Y
OF018-194	651285	723754	Redundant record	SCRUB OR PIGEONPARK	4940	N
OF019-001001	652919	727529	Graveyard	BALLYCON	3163	N

SMRS	ITM_E	ITM_N	DESCRIPTION	TOWNLAND	Distance To Boundary (metres)	Surface Trace Y/ N
OF019-001002	652929	727524	Enclosure	BALLYCON	3152	N
OF019-001003	652919	727529	Church	BALLYCON	3163	N
OF019-002	655319	727321	Enclosure	ESKER MORE	794	N
OF019-003	660278	728318	Enclosure	BALLYKILLEEN (Coolestown By.)	131	PARTIAL
OF019-004	659012	724304	Church	CLONCREEN	635	Y
OF019-004001	659012	724304	Graveyard	CLONCREEN	635	Y
OF019-005	652569	723092	Children's burial ground	BALLAGHASSAAN	4107	Y
OF019-006	660087	723121	Redundant record	CLONKEEN	1919	N
OF019-009	660538	727988	Road - unclassified togher	BALLYKILLEEN (Coolestown By.)	63	N
OF019-018	655389	726898	Redundant record	ESKER MORE	648	N
OF019-019	655833	725657	Redundant record	ESKER MORE	203	N
OF020-001	661309	722538	Enclosure	DERRYMORE (Coolestown By.)	2941	N
OF020-002	664197	723163	Enclosure	CLONBROWN	4224	Y
OF020-005	662037	728338	Barrow - ring-barrow	SHEAN	1395	Y
OF027-006	657694	720292	Ritual site - holy well	CLONSHANNON	4341	Y
OF027-007	657769	719661	Cairn - unclassified	CLONSAST UPPER	4973	N
OF027-008001	657838	719725	Ecclesiastical site	CLONSAST UPPER	4911	Y
OF027-008002	657843	719725	Church	CLONSAST UPPER	4911	Y
OF027-008003	657850	719717	Graveyard	CLONSAST UPPER	4919	N
OF027-008004	657855	719702	Enclosure	CLONSAST UPPER	4934	N
OF027-009001	657928	719650	Ritual site - holy tree/bush	CLONSAST UPPER	4990	Y
OF027-009003	657915	719642	Cairn - unclassified	CLONSAST UPPER	4997	N
OF028-001	661938	720781	Ringfort - rath	DERRYGARRAN	4776	Y

Figure 12-7 and Figure 12-8 show the percentages of monument types within 5km of the study area boundary and the survival rate of these 57 monuments, respectively.

<u>The Prehistoric Period</u>

Only 7 monuments within 5km of the proposed development site date to the prehistoric period and these consist of Ring Barrows (3), Cairns (2) (both levelled), Standing Stones (1) and Toghers (Road) (1). This however does not include the monuments within the site which almost entirely date to the prehistoric period. This substantial evidence for the prehistoric period was identified through the many peatland surveys in Cloncreen Bog and are discussed separately above.

Ring Barrows

Three ring barrows occur within 5km of the proposed development site. Ring barrows may be defined as a circular or oval raised area (generally up to 1m above the external ground level or level with it) enclosed by fosse(s) and outer bank(s), with or without an entrance. They comprise part of the Bronze/Iron Age burial tradition (c. 2400 BC - AD 400).

Cairns

Two unclassified cairns are located within 5km of the proposed development site. An unclassified cairn may be defined as a mound constructed primarily of stone but which cannot be classified as a specific cairn type. Numerous types of cairn are known such as boundary cairns, wayside cairns, clearance cairns and burial cairns. Consequently, cairns can date to any period from prehistory onwards, depending on their function. The term cairn is derived from the Irish word 'carn' meaning a heap or pile of stones.

Standing Stones

Standing stones are a common feature of the prehistoric Irish landscape consisting of single, upright stones. They are known by various names such as gallán, dallán and long stone. All standing stones are not necessarily of the same date or have the same function. Excavations of standing stones have shown that some mark prehistoric burials and some may have had a ritual or commemorative function. They have similar axis to standing stone pairs and may therefore date to the Bronze Age (2400-500BC). One standing stone is located within 5km of the proposed development site.

Toghers

Toghers are monument types typically found in peat bogs of the Midlands and comprised a means of crossing the bog in ancient times. Class 1 toghers are defined as peatland trackways/causeways constructed of wood and intended to traverse a bog. They have a known orientation and in most instances they comprise substantial timber planks and have good structural definition. They may have several phases of construction indicative of long-term use and reuse. Class 1 toghers may date from the Neolithic (c. 4000-2400 BC) to the medieval period (5th-16th centuries AD). Class 3 toghers are defined as a short stretch of peatland trackway, constructed of wood, up to 15m in length with a discernible orientation. It may not be possible to trace them beyond a single sighting but they have evidence of deliberate structure and are interpreted as laid down to cross a small area of bog. These may date from the Neolithic (c. 4000-2400 BC) to the medieval period (5th-16th centuries AD). Stone or gravel trackways in a peatland context consist wholly or substantially of gravel (including sand and clay), cobbles or stone slabs, or a combination of these. They predominately date to the medieval (5th-16th centuries AD) and later periods.

<u>Early Medieval Period</u>

The Early Medieval period is represented mainly by enclosures and ringforts (22, 13 of which are levelled) and 1 Ecclesiastical site.

Ringforts and Enclosures
Ringforts and enclosures are the most numerous archaeological monuments in the Irish landscape. They consist of a circular or roughly circular area enclosed by an earthen bank formed by material thrown up from the digging of a concentric ditch on its outside. Ringforts are usually enclosed by a single bank (univallate) while bivallate or trivallate ringforts i.e. those enclosed by double or triple rings of banks are less common. The number of banks and ditches enclosing these monuments are considered to reflect the status of the site, rather than the strengthening of its defences. Archaeological excavation has shown that the majority of ringforts functioned as enclosed farmsteads, built during the Early Christian period (5th – 9th century A.D.). Excavation within the interior of the monuments has traced the remains of circular and rectangular dwelling houses as well as smaller huts probably used to stall animals. The enclosing earthworks would also have protected domestic livestock from natural predators such as wolves and foxes. One such enclosure visible from the proposed wind farm site and vice versa is that at Ballykileen, some 681m to the north-northeast (OF011-035-001) (See Appendix 12.1). It is likely that this monument will be impacted due to the clear views to the proposed development site. Impacts are discussed below.

Ecclesiastical Sites
Ecclesiastical sites are locations where a religious foundation existed but where there is insufficient evidence to allow for a more precise classification. Such sites date from the medieval period (5th-16th centuries AD) up to the 18th century and may contain the surviving remains of a church, graveyard or other features relating to the use of the site as a religious foundation.

<u>Medieval Period</u>
The Medieval Period is well represented with Castles (3), Churches (6), 3 of which are gone, Graveyards (6) 3 of which are gone, Field Systems (2) – 1 levelled, Medieval Fonts (1) and a Ritual Site – Holy bush (1).

Castles and Tower Houses
Three sites classified as castles (motte and bailey, unclassified and tower house) are located within 5km of the proposed development site. A motte and bailey is an early form of castle consisting of a flat-topped, steep-sided, earthen mound supporting a wooden tower, with an associated courtyard or bailey, which is often raised and enclosed by a bank and fosse. These sites were constructed by the Anglo-Normans in the late 12th and early 13th century AD.

Tower houses comprise a fortified residence in the form of a tower, usually four or five storeys high, and for the most part slightly more rectangular than square in plan. They were constructed by a lord or landholder and were often partially or completely enclosed by a bawn. The majority date to the 15th and 16th centuries AD.

An unclassified castle is one that cannot be more precisely classified. They can date from the late 12th to the 16th century AD.

Churches and Graveyards
Churches are buildings used for public Christian worship and can be of any date from c. 500 AD onwards. Many ruined stone churches visible in the Irish countryside represent the remains of medieval parish churches and typically have an associated graveyard or burial area which date from the medieval period (5th-16th centuries) onwards.

Field Systems
A field system may be defined as a group or complex of fields which appear to form a coherent whole. The practice of enclosing fields for agricultural purposes in Ireland dates back to the Neolithic period, with the Céide fields in county Mayo providing a well-known example. Regularly laid out stone-wall enclosed fields are usually interpreted as evidence for a pastoral farming economy while cultivation ridges and clearance cairns indicate that tillage was practiced. Fields may also be enclosed by low earthen banks and can date to any period from the Neolithic (c. 4000-2400 BC) onwards.

Medieval Fonts
One medieval font is located within 5km of the proposed development site. A font may be described as a vessel, usually made of stone, over which baptisms were held. They date from the medieval period (5th-16th centuries AD) onwards.

Holy Bush and Holy Wells
Holy bushes and holy wells share a general association and are often found in close proximity. A holy bush is a named tree or bush, sometimes associated with a particular saint, often considered to have miraculous properties. They are generally found in close proximity to holy wells and formed part of the associated patterns or rounds performed on certain days. They are known in Irish as 'bile', which translates as sacred tree, sometimes corrupted into the English words 'bell' or bellow'. These may have their origins in prehistory but are associated with devotions from the medieval period (5th-16th centuries AD) onwards. Holy wells comprise a well or spring, though in some unusual cases a natural rock basin, which usually bears a saint's name and is often reputed to possess miraculous healing properties. They may have their origins in prehistory but are associated with devotions from the medieval period (5th-16th centuries AD) onwards.

<u>Miscellaneous</u>
A number of other monument types are represented which can be multi-period and these are Children's Burial Grounds (1), Designed Landscape – Tea House (1), Redundant Records (5) and a Holy Well (1) (see description above).

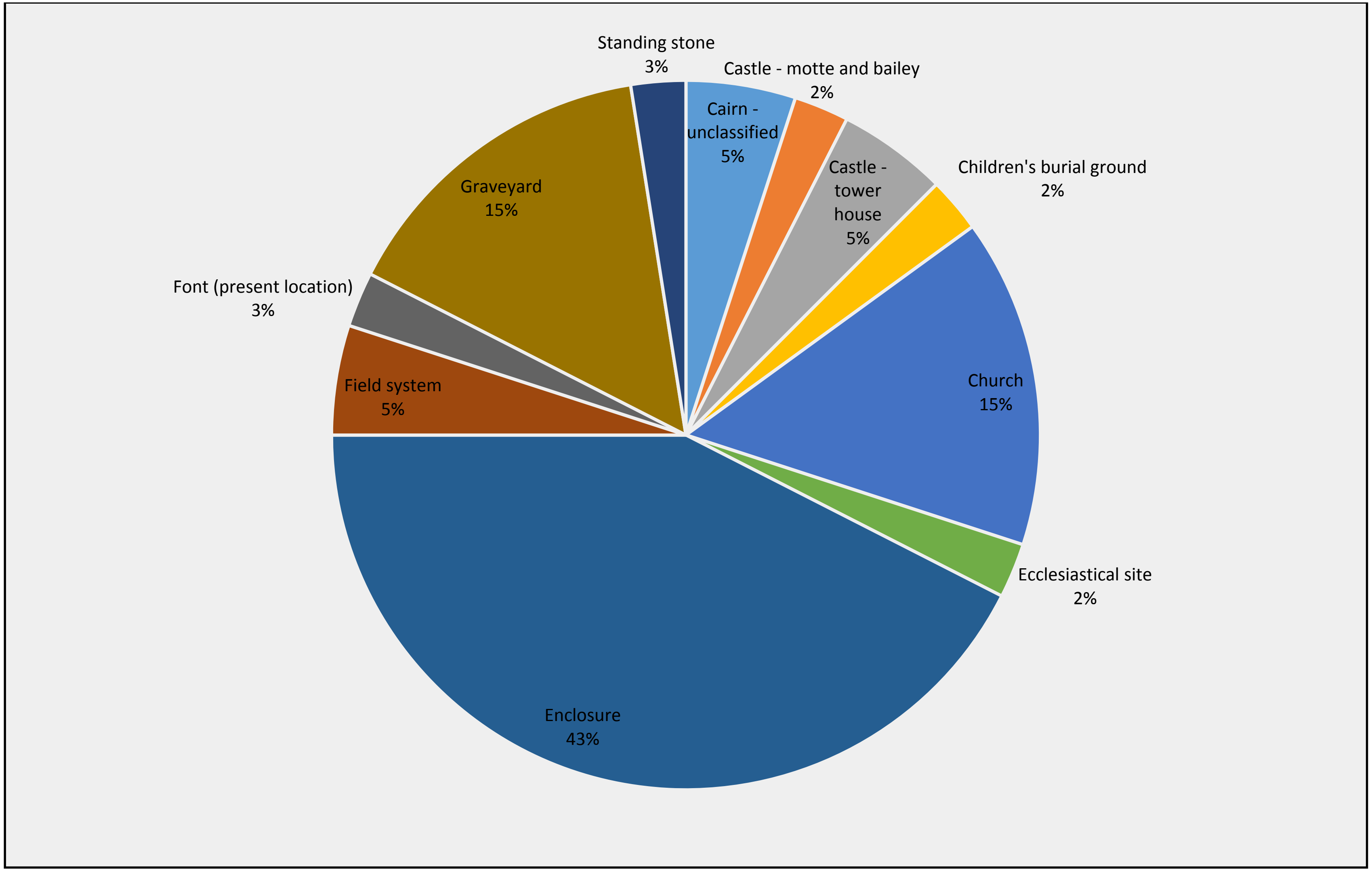


Figure 12-7: Percentages of monument types within 5km of proposed development site

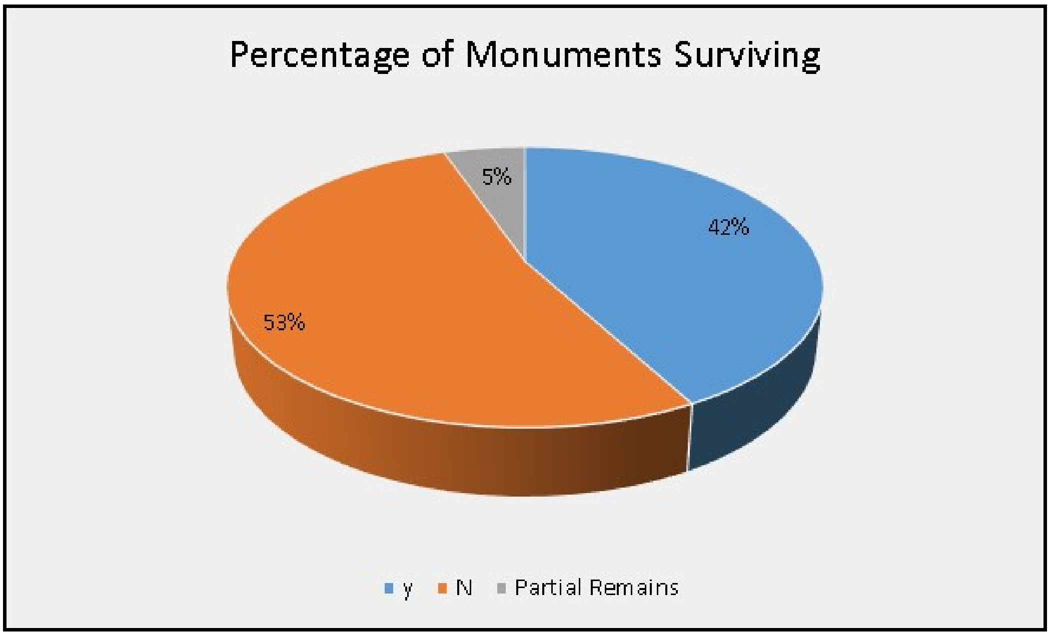


Figure 12-8: Pie Chart showing percentage rate of survival of monuments within 5km

12.3.1.1.9 Archaeological Landscapes

Croghan Hill is designated as an area of High Amenity from a landscape perspective in the Offaly County Development plan. This is considered in the Landscape and Visual Impact Assessment chapter but it also considered here as Croghan Hill has historical and archaeological value associated with it. The individual monument types that are located on Croghan Hill include the hill top cairn and the Deserted Medieval village of Cannakill at the base (National Monument). These monuments are described above in more detail. Hill tops with extensive views were often chosen in prehistory for their ritual setting for monuments such as burial mounds or cairns. One such cairn is situated on the summit of Croghan hill and is visible at a distance from the proposed development site. The intervisibility of similar monument types may have been intentional when the location of these monuments were originally sought out. One such example is the existing intervisibility between the cairn on Croghan Hill and the burial mounds on Clonin Hill c. 5km to the East. The continuation of the ability to view one from the other uninterrupted is significant from an archaeological landscape point of view. The proposed development, while it will be visible from both hills, does not interrupt this potentially prehistoric intervisibility.

The potential impact on this archaeological landscape is addressed in Section 12.4 below.

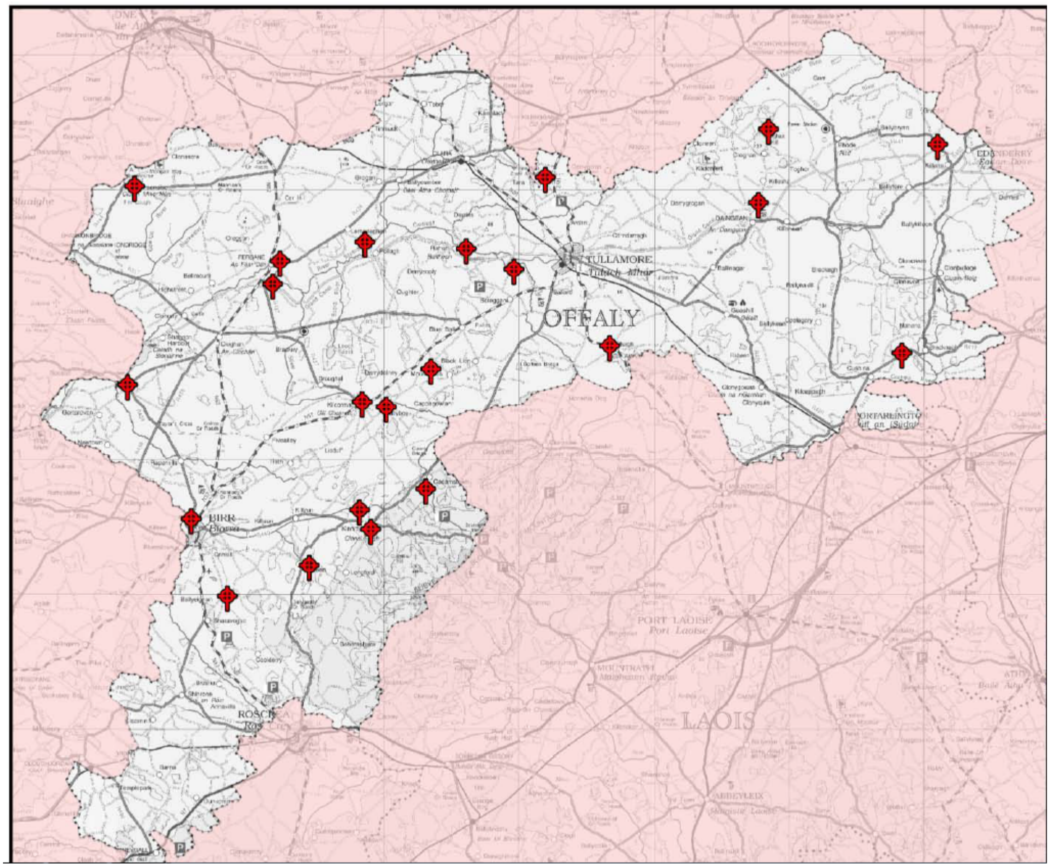
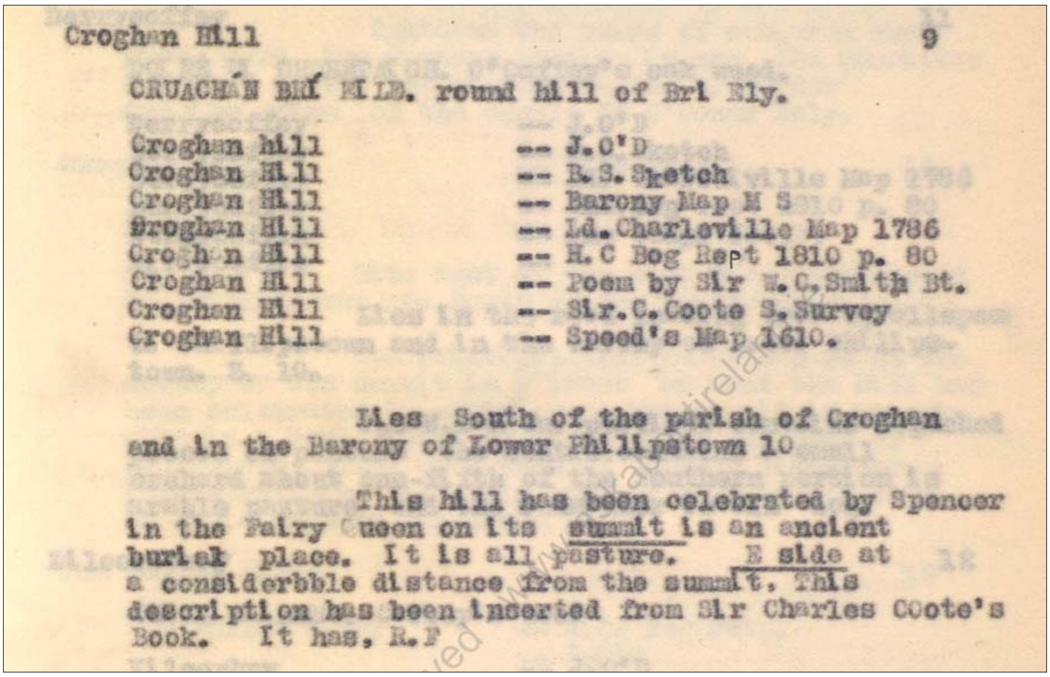


Figure 12-9: Map showing areas of High Amenity (Offaly County Development Plan 2014-2020)

Croghan Hill was a significant sacred place during the Bronze Age and Iron Age and is one of the most prominent landmarks in the area. The mountain was known as 'Cruachán Brí Éile' meaning mound/hill of Brí Éile which in turn gave a name to the surrounding bogland – 'Móin Éile' or Bog of Allen (O' Brien, 2006). In legends Brí Éile is the daughter of the King of Tara and sister to Queen Maeve of Connaught and she is reputed to be buried at Croghan Hill. It commands extensive views of the surrounding landscape, overlooking the proposed development area. A Bronze Age burial mound (RMP OF010-004001) and a ring barrow (RMP OF010-010008) are located on the summit of the hill and several sites located within the vicinity may be associated with this. Iron Age bog body 'Oldcroghan Man' was found in a bog near the hill and it is suggested that his burial may be associated with a former royal estate (Kelly 2006a, 26). O' Brien (2006) records that the mountain had been claimed by the O' Connors of the Uí Failghe tribe by the 5th century. In 475 the King of Tara defeated the Laigin tribe in a battle at Croghan Hill and following the battle of Drum Derge in c. 516 a divise boundary was drawn across Croghan Hill between Leinster and Meath (ibid.). The hill functioned as an inauguration site for the Uí Failghe, after which the county Offaly is named (Kelly, 2006b).

Croghan Hill is mentioned in the OS Names Books and the extract is detailed below:



Croghan Hill 9

CRUACHÁN BRÍ EILE. round hill of Bri Ely.

Croghan hill — J.O'D
Croghan Hill — B.S. Sketch
Croghan Hill — Barony Map H S
Croghan Hill — Ld.Charleville Map 1786
Croghan Hill — H.C Bog Rept 1810 p. 80
Croghan Hill — Poem by Sir W.C.Smith Bt.
Croghan Hill — Sir.C.Coote S.Survey
Croghan Hill — Speed's Map 1610.

Lies South of the parish of Croghan and in the Barony of Lower Philipstown 10

This hill has been celebrated by Spencer in the Fairy Queen on its summit is an ancient burial place. It is all pasture. E side at a considerbble distance from the summit. This description has been inserted from Sir Charles Coote's Book. It has, R.F

Figure 12-10: Extract from OS namebooks (www.logainm.ie)

Table 12-9: Origin of the townland name Croghan (http://www.logainm.ie/en/2016)

Date Recorded	Name	Source
1302-1306	Crouchan	· Pap. Tax., *247*
1429	super rectoria parrochialis ecclesia de Killcorbay alias de Cruachan	· Ann. Dub., *48*
1489	St. Patrick de Cruechan alias of St. Corban de Killeorbay	· CPL, *XIV 249*
1550	Towecroghane Lordship of	· Offaly Survey
1550	Croghan Parsonage of	· Offaly Survey
1550	Croham	· F, *581*
1551	Towecrohan, in Offalye	· F, *663*
1563c	TOVOCROGHAN	· Cotton Map
1633	Croghan	· Inq. Lag., *25 C I*
1638c	ecclesia Sancti Patricij de Cruaghain	· 'Cillsheanchais Chill Dara', *II, 32*
1655-7	Crochane	· DS
1660c	Parish Croghane, Killclonfarte &	· BSD (UF), *19*
1837	Croghan	· Tax. Hen. VIII:AL, *18*
1837	Croghan	· Seward:AL
1837	Croghan	· Charleville Map 1786:AL, *18*
1837	Croghan	· BS:AL
1837	Croghan	· BM:AL
1838	Cruachán Brí Eile, 4 Masters	· OD:ALPB
1838	Croghan, Croghane, Croughan	· Inq.:ALPB
1838	Crohane	· DS:ALPB
1838	Crochane	· DS:ALPB
1969	Cruachán	Bailte Poist

12.3.1.2 Proposed Grid Connection Routes

The planning application includes 2 No. substations (Option A and Option B) and associated grid connections; however, only one substation and associated grid connection will ultimately be constructed. The proposed wind farm will connect to the grid via one of the following methods:

- **Option A**: construction of a 110 kV substation in the eastern section of site, to connect to existing 110 kV Cushaling substation at Edenderry Power Plant. Connection will be via underground cable approx 1.7km in length, located within Bord na Móna lands and curtilage of the public road.

Or

- **Option B**: construction of a 110 kV substation in southern section of site, to connect to existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site. Connection will be via two short sections of overhead line, (less than 0.1km)

Both substation locations have been assessed (see Appendix 12-1).

12.3.1.2.1 National Monuments

No national monuments in state care or subject to a preservation order are located along either of the proposed grid connection routes.

12.3.1.2.2 Recorded Archaeological Monuments

No recorded Monuments are located along either of the routes. The nearest RMPs are located 197m to the west of Option B and consist of RMP OF019-020 – OF019-022 toghers. These are described in Appendix 12-3.

12.3.1.2.3 New Potential Archaeological Sites

No new potential archaeological sites were noted along the proposed grid connection routes during the site inspection. As previously described the bog is an area of high archaeological potential and sub-surface sites and artefacts may be located along the proposed grid routes. The likely significant effects relating to the proposed grid connection routes and mitigation measures are described below.

Figure 12-11 A: Archaeological constraints in north-east corner of site in relation to Substation Option A and associated grid underground cable route

Figure 12- 11 B: Southern substation Option B and associated OHL connecting to existing electricity line

12.3.1.3 Proposed Haul Route (Transport Delivery Route)

It is proposed that the large wind turbine plant will be delivered to the site via the M6 before turning south onto the N52 National Primary Road at Kilbeggan. The route follows the N52 south, bypassing Tullamore to the east before turning east on the R420 Regional Road. Approximately 6 kilometres (kms) east of this point, the route then turns northeast onto the R402 at the priority junction at Ballina Cross. The route then follows the R402 northeast for approximately 9 kms through the village of Ballinagar, turning due east at Daingean for approximately 10 kms. The proposed wind farm site is then accessed via a right turn at the priority junction with the L1003 which provides access to the site by means of a new priority junction 430 metres southeast of the junction with the R402. The proposed turbine haul route is shown on Figure 3.13 in Chapter 3 of this EIS. All deliveries of turbine components to the site will only be by way of the proposed transport route outlined in Figure 3.13.

There are three locations along the turbine haul route which will require alteration works (minorground disturbance); the R420/R402 junction at Ballina Cross, a section of the public park along the R402 in Ballinagar and the R402/L1003 junction to access the wind farm site. Details regarding the proposed alteration works at each of these locations are provided in Section 3.3.12 of the EIS. These locations (junction accommodations works) were also inspected and assessed for any potential impacts. The text in this section of the Cultural Heritage chapter addresses the haul route up to the point it meets the main wind farm site.

Eight Recorded Monuments are located within 100m of the turbine delivery route (TDR) and are detailed below. They are described in detail in Appendix 12-10.

Table 12-10: RMPs located within 100m of TDR.

SMRS	ITM_E	ITM_N	DESCRIPTION	TOWNLAND	Distance To TDR (Metres)	Surface Trace Y/ N
OF017-017	639132	722859	Enclosure	MEELAGHANS	53m	No
OF018-006	647130	727348	Historic town	TOWNPARKS (Phillipstown Lower By.)	TDR extends through historic town	Yes
OF018-006003	647166	727315	Church	TOWNPARKS (Phillipstown Lower By.)	34m	16th Century church gone
OF018-006009	647258	727643	Armorial plaque (present location)	TOWNPARKS (Phillipstown Lower By.)	14m	Removed
OF019-001001	652919	727529	Graveyard	BALLYCON	52m	No remains within
OF019-001002	652929	727524	Enclosure	BALLYCON	52m	No surface Trace
OF019-001003	652919	727529	Church	BALLYCON	83m	Possible sub-surface
OF019-002	655319	727321	Enclosure	ESKER MORE	87m	No

Figure 12-12: OF017-017 Enclosure (cropmark and boundary) in relation to TDR – no works proposed in this location

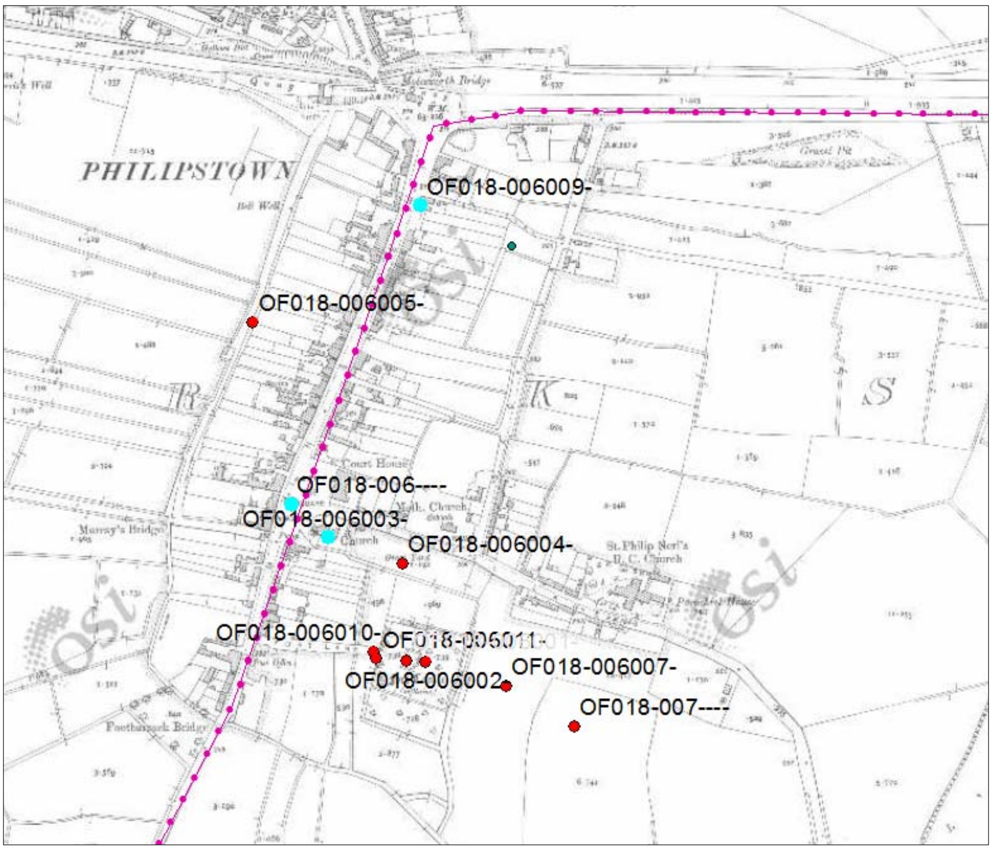


Figure 12-13: RMPs in Daingean (Philpstown) within 100m of TDR (2nd Ed Map early 1900s) – no works proposed in this location

Figure 12-14: As per Figure 12-13, on aerial – no works proposed in this location

Figure 12-15: OF019-001 – 003 in relation to TDR – no works proposed in this location

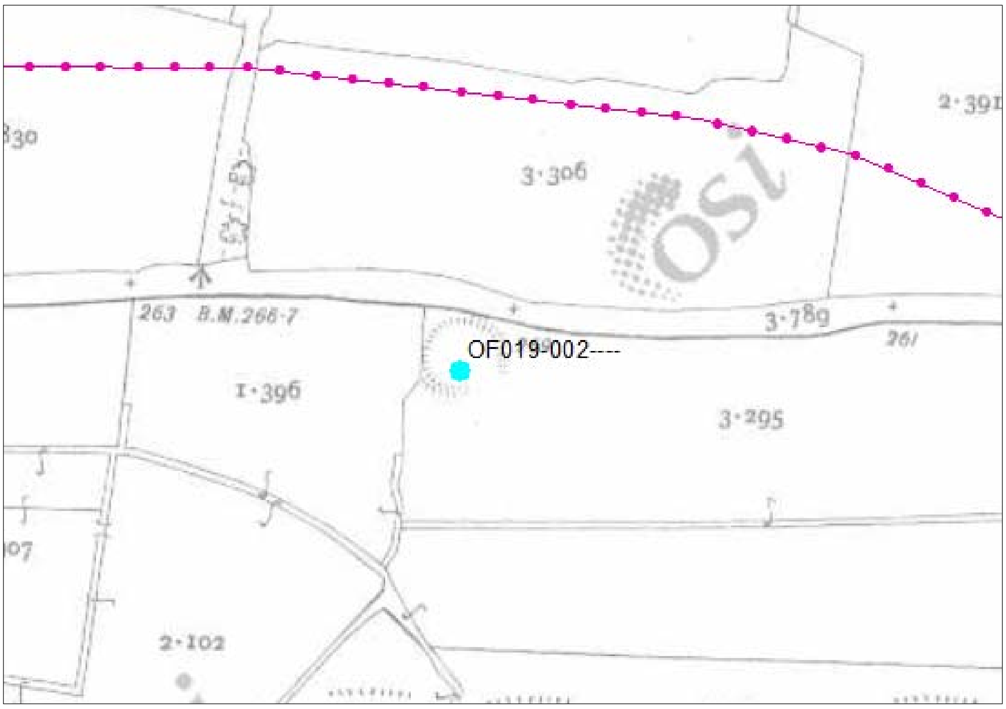


Figure 12-16: Depiction of Enclosure (now levelled) on 2nd Ed OS map – no works proposed in this location

The public road on which the haul route is now located was constructed sometime after the 1900s and realigned, and is therefore not visible on Figure 12-16. The enclosure shown was located along the original public road, but this part of the road is now disused.

The junction accommodation works at Ballina townland (westernmost) does not have any known constraints within close proximity, as shown in Figure 12-17.

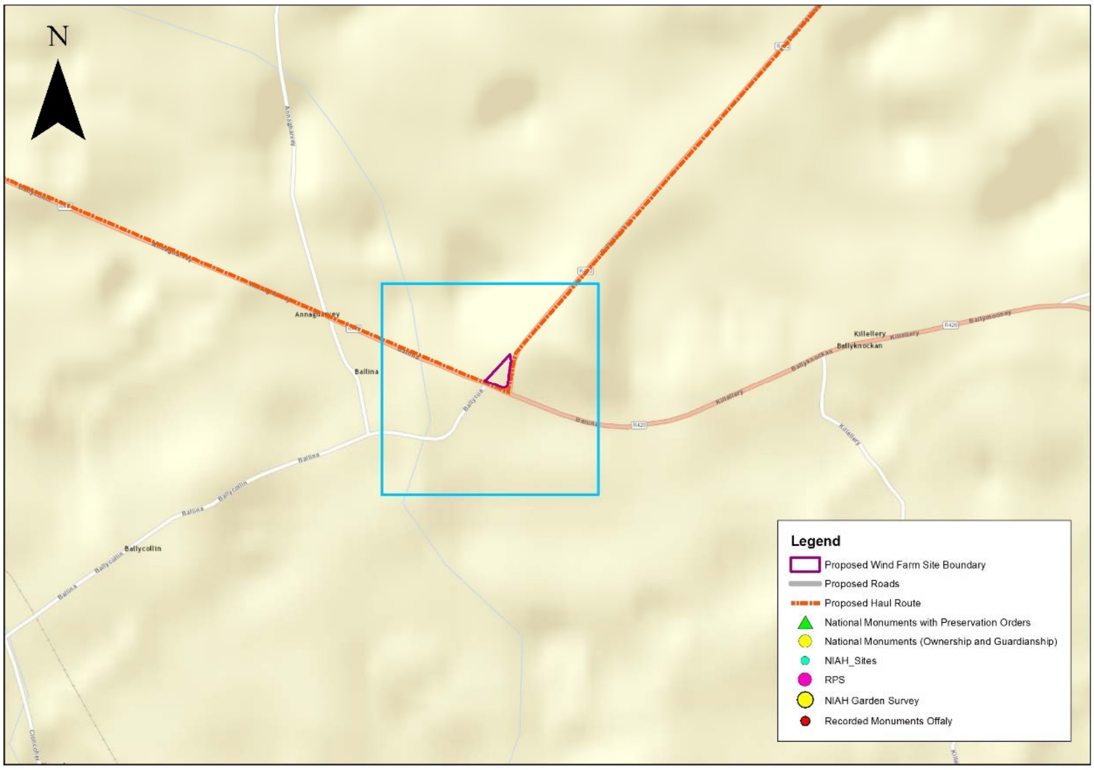


Figure 12-17: Transport Route with proposed junction accommodation works at Ballina, no known constraints

The junction accommodation works at Ballinagar is not located in close proximity to any known archaeological monuments, as shown in Figure 12-18.

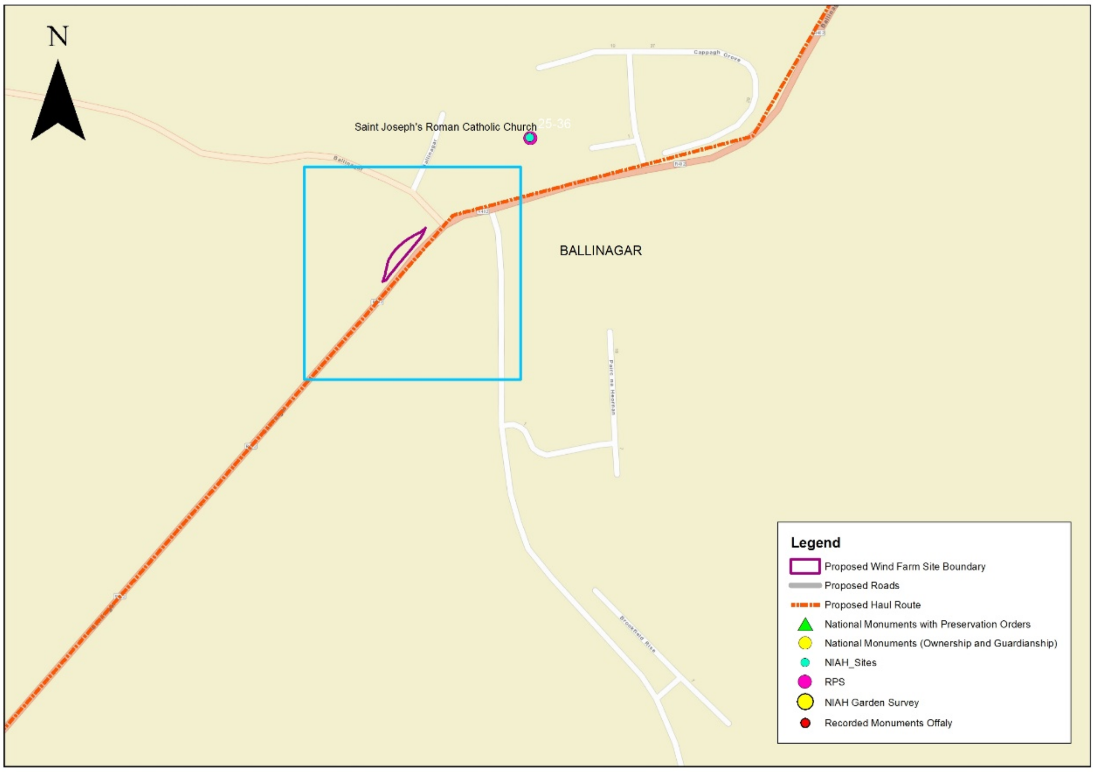


Figure 12-18: Junction Accommodation Works in relation to constraints

The likely significant effects in relation to the proposed Junction Accommodation Works and site access road, and the suggested mitigation measures are detailed in Section 12.4 below. The location of the proposed junction works at the R402/L1003 junction to access the proposed wind farm site was assessed as part of the main site field inspection.

12.3.2 Architectural and Cultural Heritage

For the purposes of this report, architectural heritage includes known (documented) and newly recorded features, if present.

- Record of Protected Structures (RPS)
- NIAH structures
- NIAH Garden Surveys
- Any other structures / features noted during field assessment
- Cultural Heritage items (tangible assets) likely to be impacted by the proposed development

12.3.2.1 Proposed Wind Farm Site

12.3.2.1.1 Record of Protected Structures

This dataset was obtained from ArcGIS online, Offaly County Council and added to the GIS map used in this assessment. No structures listed in the Record of Protected Structures are located within the EIS study area boundary for the proposed wind farm.

The Architectural Heritage Protection Guidelines for Planning Authorities (2011) discusses the notion of curtilage and attendant grounds associated with protected structures. While the notion of curtilage is not defined by legislation, it is taken to be the 'parcel of land immediately associated with that structure and which is (or was) in use for the purposes of the structure.' (ibid., 191). In the case of a large country house items such as stable buildings, walled gardens, lawns and ha-has may all be considered to form part of its curtilage unless at a distance from the building (ibid.). It is also noted, however, that the extent of the curtilage of a protected structure would need to be determined on a case-by-case basis and 'ideally should be identified by the planning authority prior to inclusion of the structure in the RPS….' (ibid.). The Guidelines go on to say that in instances where the curtilage of a protected structure has not previously been identified 'a planning authority should take the opportunity to identify its extent at the time of making a declaration in respect of the protected structure' (ibid., 192).

A similar scenario exists when determining the attendant grounds of a protected structure. Attendant grounds are those lands located outside the curtilage but which are associated with the structure and are 'intrinsic to its function, setting and/or appreciation' (ibid.). A planning authority has the power to protect all features of importance which lie within the attendant grounds of a protected structure, however, such features must be specified in the RPS. The Guidelines go on to say that where the curtilage of a protected structure has not been established at the time of inclusion in the RPS, the planning authority should ensure that all important features are either 'a) specified as being in the attendant grounds of the protected structure or b) are themselves entered into the RPS and c) the owners and occupiers notified of the protection.'

Fifty-four structures are located within 5km of the proposed development site and are presented in Table 12-11 below. Detailed descriptions of each structure are presented in Appendix 12-11. The structures are mapped on Figure 12-19 below.

Table 12-11: RPS within 5km of proposed wind farm

RPS Ref	NIAH	DESCRIPTION	STREET 1	TOWN	ITM E	ITM N
27-1	14809001	Milestone	-	Clonbullogue	660725	723313
27-2	14809002	Saint Patrick's Bridge	-	Clonbullogue	660914	723521
27-3	14809011	Cloncreen Bridge	-	Clonbullogue	660460	724027
27-4	14809003	Forge	-	Clonbullogue	660945	723549
27-5	14809008	Saint Michael's Roman Catholic Church	-	Clonbullogue	660932	723674
27-6	14809010	Saint Broughan's Hall	-	Clonbullogue	660941	723912
27-7	14809004	House	-	Clonbullogue	660957	723520
27-8	14809007	Post box	-	Clonbullogue	660996	723593
27-9	14809009	Saint Michael's Roman Catholic Church	-	Clonbullogue	660951	723685
27-10	14809005	Water pump	-	Clonbullogue	660978	723564
27-11	14809006	Clonbullogue Garda Station	-	Clonbullogue	661003	723591
27-12	14809012	Saint Kevin's Church of Ireland Church	-	Clonbullogue	660977	724487
17-41	14804042	Saint Mary's Convent	Saint Mary's Road	Edenderry	662505	732449
17-42	14804043	Saint Mary's Roman Catholic Church	Saint Mary's Road	Edenderry	662527	732372
17-43	14804044	Bella Vista	Saint Mary's Road	Edenderry	662519	732298
17-44	14804045	Saint Mary's Graveyard	Saint Mary's Road	Edenderry	662731	732208
17-45	14804046	Edenderry Garda Station	Saint Mary's Road	Edenderry	662550	732255
17-46	14804048	Presbytery	Saint Mary's Road	Edenderry	662088	731927
17-47	14804049	Cast iron post box	Saint Mary's Road	Edenderry	662020	731815
17-48	14804050	Cross	Saint Mary's Road	Edenderry	662024	731860
17-49	14804051	Church of Ireland Rectory/Glebe	Monasteroris	Edenderry	661776	732701

RPS Ref	NIAH	DESCRIPTION	STREET 1	TOWN	ITM E	ITM N
17-50	14804052	House	Saint Francis Street	Edenderry	662342	732741
17-51	14804054	High Cross	Saint Mary's Road	Edenderry	662566	732289
17-39	14804040	Saint Joseph's Hall	St. Mary's Road	Edenderry	662689	732521
17-40	14804041	Saint Mary's Convent National School	Saint Mary's Road	Edenderry	662614	732424
17-57	14911006	Monasterois House	Monasteroris	Monasteroris	660893	732972
16-9	14911007	Cartland Bridge	Monasteroris	Monasteroris	659701	732381
17-58	14911013	Monasteroris House Icehouse	Monasterois	Monasteroris	660857	732818
17-59	14911021	Rathmore Bridge	Rath	Rath	660983	731731
27-14	14920002	Ballydermot House	Ballydermot	Clonbullogue	661629	725477
16-10	14911008	Trimblestown Bridge	Rogerstown	Rogerstown	657900	732510
16-18	14911022	Ballymoran House	Ballymoran	Ballymoran	657636	729497
16-15	14911015	Ballinla House	Ballinla	Rhode	657275	731958
25-43	14919001	Mount Lucas	-	-	651544	727931
26-1	14919002	Springfield House	Mountlucas	Daingean	652731	728246
26-2	14919003	An Scoil Náisunta Eiscir	-	-	654111	727470
27-13	14919004	Kilcumber Bridge	-	-	661004	726835
26-3	14919005	Cloncrane House	-	-	659109	724298
26-4	14919008	Ballaghassaan House	-	-	653124	723577
25-44	14919010	Former stewards house	-	-	651329	727845
37-2	14927001	4 bay detached thatched house	-	-	660451	720992
37-3	14927002	Detached 2 storey former presbytery	Clonmore	Edenderry	660340	720429
37-1	14920001	Detached 4 bay thatched farmhouse	-	-	662927	722156
17-61	14912004	Colgan's Bridge	-	Edenderry	661973	731477
17-62	14912005	Downshire Bridge	-	Edenderry	662478	731399

RPS Ref	NIAH	DESCRIPTION	STREET 1	TOWN	ITM E	ITM N
17-63	14912006	Drumcooly Park	Drumcooly	Edenderry	662402	730758
17-64	14912007	House	Drumcooly	-	662880	730299
17-65	14912008	Blundell Aqueduct	-	-	664206	731329
37-6	14927009	Cast iron post box	-	-	660368	720985
36-4	14919006	Thatched House	-	-	656423	723028
36-5	14919007	Thatched House	-	-	656520	723023
17-102		House	St. Marys Road	Edenderry	662714	732533
27-15		House	The Green	Clonbulloge	660963	723592
27-16		St Patricks National School	-	Clonbulloge	661054	723538

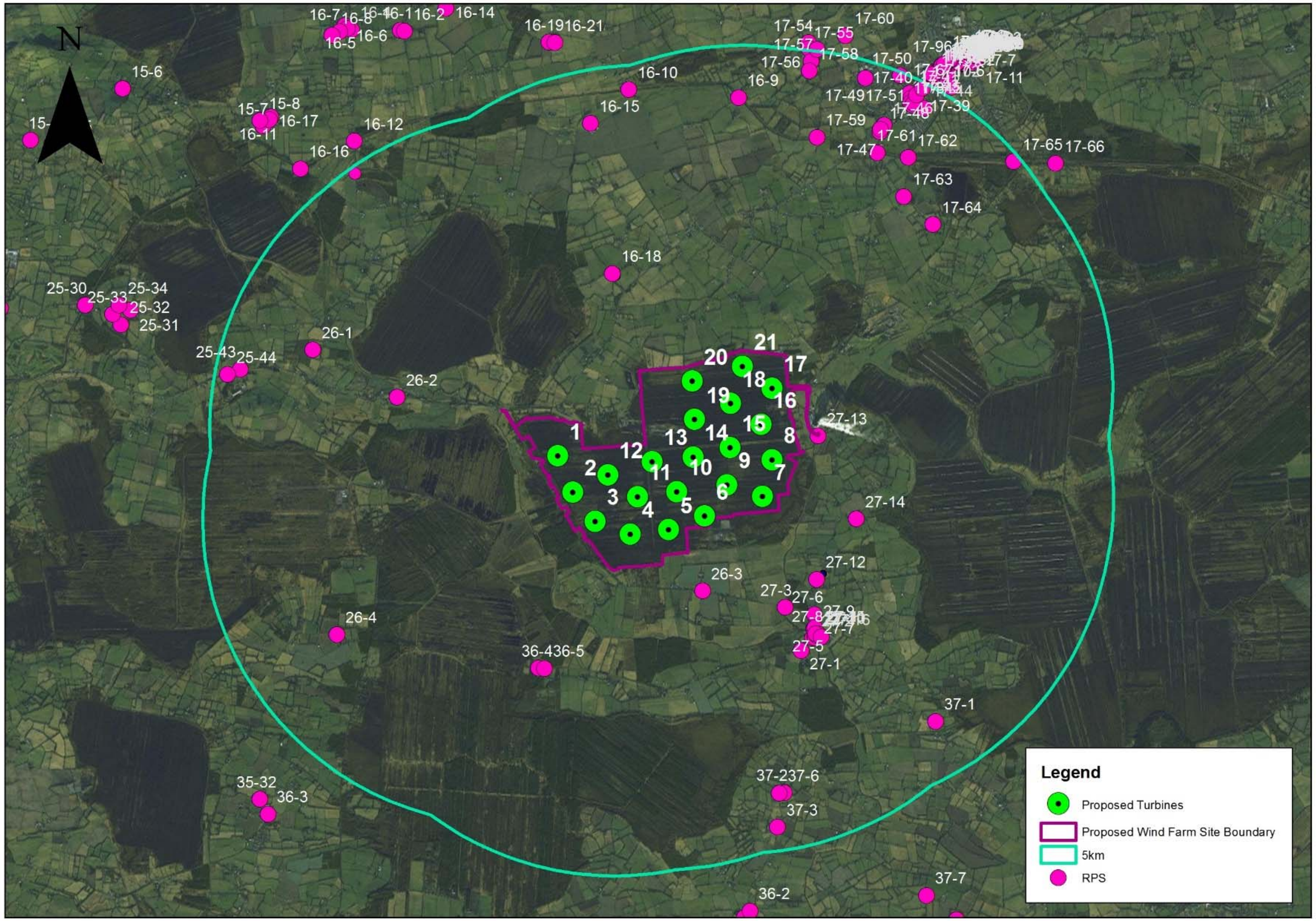


Figure 12-19: RPS within 5km of proposed turbines

12.3.2.1.2 National Inventory of Architectural Heritage (NIAH)

The National Inventory of Architectural Heritage sites located within 3km of the proposed wind farm are listed below. It is not intended to describe these sites individually as all structures are also listed in the Record of Protected Structures. The Record of Protected Structures is largely informed by the list of NIAH sites. All potential impacts relating to this section is dealt with under Protected Structures therefore.

Table 12-12: NIAH within 3km of the proposed wind farm

NIAH	DATE	STRUCTURE	TOWN
14809001	1830 - 1870	-	CLONBULLOGE
14809002	1930 - 1935	Saint Patrick's Bridge	CLONBULLOGE
14809003	1865 - 1870	-	CLONBULLOGE
14809004	1780 - 1820	-	CLONBULLOGE
14809005	1860 - 1900	-	CLONBULLOGE
14809006	1820 - 1830	Clonbullogue Garda Station	CLONBULLOGE
14809007	1920 - 1930	-	CLONBULLOGE
14809008	1810 - 1830	Saint Michael's Roman Catholic Church	CLONBULLOGE
14911022	1780 - 1820	Ballymoran House	BALLYMORAN
14919003	1960 - 1965	An Scoil Náisunta Eiscir	ESKER MORE
14919004	1840 - 1860	Kilcumber Bridge	BALLINOWLART NORTH, BALLYKILLEEN (CL. BY.),KILCUMBER
14919005	1870 - 1890	Cloncrane House	CLONEEN
14919006	1780 - 1820	-	CLONAVOE
14919007	1780 - 1820	-	CLONAVOE
14919009	1850 - 1900	-	CLONBULLOGE
14920002	1770 - 1810	Ballydermot House	BALLYDERMOT

12.3.2.1.3 NIAH Garden Survey

Demesnes date back to the Anglo-Normans, when they formed the portion of a manor retained by the lord for his own occupation and use. But the great flourishing of garden design came in the eighteenth and nineteenth centuries - with "geometric" layouts being replaced by more natural layouts in the later period. This was also the period when many of our town squares and public gardens were developed. The designs and subsequent changes reflect the aesthetic, cultural and social aspirations of their owners and users.

The objective of the garden survey is to begin a process of understanding the extent of Ireland's historic gardens and designed landscape. Sites were identified using the 1st edition Ordnance Survey maps. These were compared with current aerial photography to assess the level of survival and change. This assessment is not an indication of a site's heritage importance. Fieldwork is now in progress to compile more accurate data and site assessments. The results will be added to the NIAH website as this work progresses.

Various factors have contributed to many of the significant changes that have occurred. Changes in aesthetic values and the development and expansion of our cities and towns have played a part. But the most significant are a direct result of 150 years of history, particularly changes in land ownership arising from the Encumbered Estates Act 1849 to the Land Acts of the late nineteenth and early twentieth centuries.

The following gardens are located within 3km of the proposed wind farm all of which are associated with demesne houses.

Table 12-13: NIAH Garden Survey within 3km of proposed wind farm

REF	NAME	REF 2	ITM E	ITM N	Feature Rich Index (mapping)
4119	Leitrim House	OF-49-N-566304	656538	730427	1 - Large modern agricultural buildings have been constructed in the core landscape shown on the 1836 - 1846 OS map. Screening woodland shown on the boundary of this site has been removed.
4148	Ballymoran House	OF-49-N-576295	657538	729527	3
4160	Clarkville House	OF-49-N-583307	658238	730727	1
4173	Ballyleakin House	OF-49-N-587297	658638	729727	0 - Site Status: Virtually no recognisable features
4252	Ballydermot House	OF-49-N-617254	661637	725428	2- Main features unrecognisable - peripheral features visible and Few features of the designed landscape shown on the 1836 - 1846 OS map are visible in aerial photography.

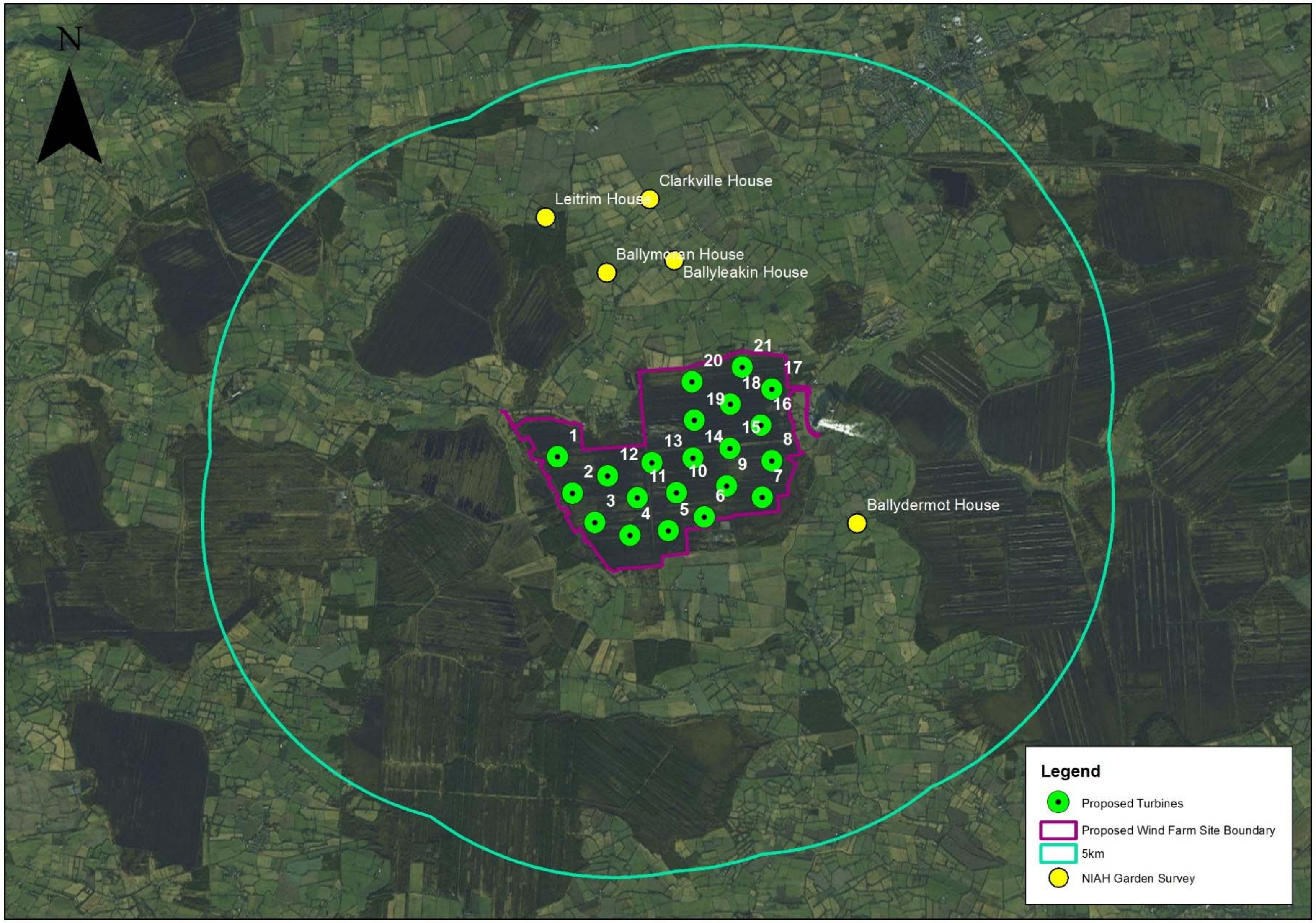


Figure 12-20: NIAH Garden survey associated with private houses within 3km of proposed t turbines

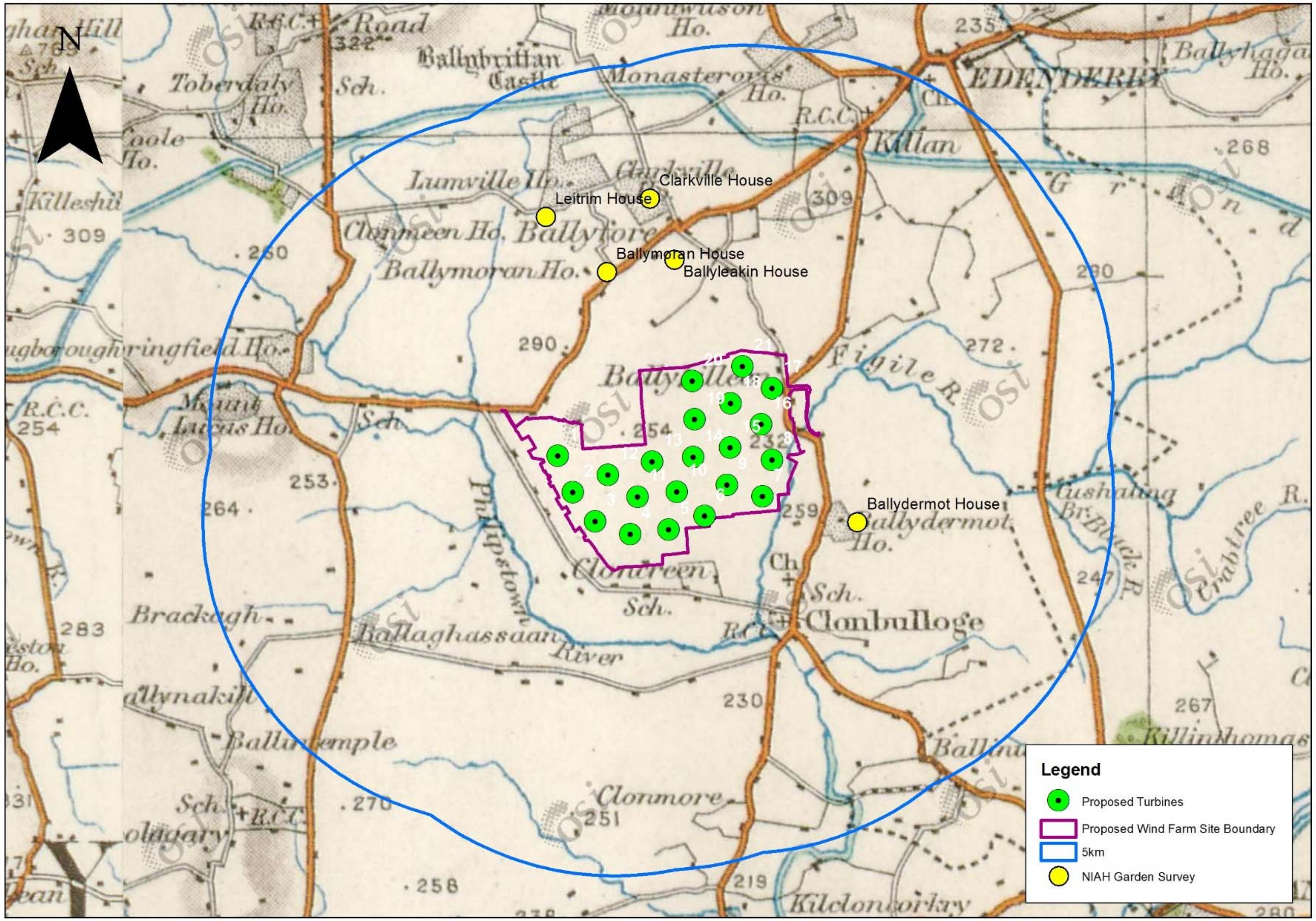


Figure 12-21: NIAH Garden Survey associated with private houses in relation to proposed wind farm site on historic mapping background

12.3.2.1.4 Language and the Gaeltacht

The proposed development site is not located within a designated Gaeltacht area, therefore there are no impacts on language in this regard (Census 2011, Gaeltacht Areas).

12.3.2.1.5 Placename Evidence

Place names may be derived from geological, archaeological or topographical features within the landscape or may also have taken the name of an important or famous person who once lived in an area. Place name evidence can refer to archaeological monuments within the vicinity which may no longer be visible in the landscape or which are now only documented through local history or tradition. The database of Irish placenames, www.logainm.ie, was consulted for the meaning of the placenames located within and immediately surrounding the study area boundary.

Ballinrath – Derived from the Irish *Baile an Rátha* it may be translated as the town or townland of the fort or ringfort and is recorded since *c*. 1550.

Ballynakill – Derived from the Irish *Baile na Cille* this placename may be translated as the townland of the church. It is recorded since the 15th century (1476) in the Calendar of Papal Letters.

Ballykilleen – Similar to the previous placename Ballykilleen is derived from the *Irish Baile an Chillín* meaning the townland of the little church. It is recorded since 1550.

Cloncreen – Derived from the Irish Cluain Críon, the former element of which refers to a meadow or pasture. Joyce translates it as the 'withered meadow'.

Clongarret – Derived from the Irish Cluain Gearóid it may be translated as Gerald or Garret's meadow.

Esker More – Derived from the Irish An Eiscir Mhór, this placename refers to 'the big esker' which is a geological feature in the landscape. It is recorded since 1550.

Rathvilla or Rathclonbrackan – The latter is derived from the Irish Ráth Cluana Breacáin which refers to the ringfort of the meadow or pasture. This placename is recorded since 1550.

Ballinowlart North – Derived from the Irish *Baile an Abhalloirt Thuaidh*. The *Baile* element refers to town or townland but no translation or meaning is given for the remainder of the placename.

12.3.2.1.6 Historic Cartographic Sources

All available cartographic sources for the proposed development area were reviewed as part of the cultural heritage assessment. Historic mapping for the area is available in the form of the seventeenth century Down Survey Barony maps, first edition six-inch OS mapping (1838-9), second edition 25-inch OS mapping (1910) and later third editions. No items of cultural heritage significance were noted within the majority of the proposed development area on the available historic mapping as the majority comprises open bog. At the west side of the site a feature names as 'Kites Liberty' is shown on the first edition (1839) OS map in Clongarret townland. It may be a body of water such as a small lake as what appears to be a watercourse extends from it in a south-westerly direction into a small settlement named as 'Woodenbridge Village'.

Kites Liberty is not shown or named on the second edition OS map, however, a small settlement at Woodenbridge is still apparent and named. A portion of the settlement at Woodenbridge is located within the EIS study area boundary but is largely overgrown with trees and scrub.

12.3.2.2 Proposed Grid Connection

Option A Substation and associated underground cable route (Figure 12-22)
The proposed grid connection associated with Substation Option A is located at the eastern side of the site. Kilcumber Bridge (NIAH 14919004 and RPS 27-13 4) is located 6m to the south east of the Grid connection. The bridge which is a Protected Structure and therefore subject to statutory protection will not be impacted by the grid connection however. No works are proposed in the vicinity of this designated bridge. No other known features of Architectural or Cultural Heritage are located within the vicinity of the grid connection.

Option B Substation and associated overhead line connection Figure 12-23)
The grid connection associated with Substation Option B located at the southern side of the site consists of two short sections of overhead line to link in with the existing 120KV electricity line extending E/W through the southern side of the site boundary. No architectural heritage features will be impacted by this proposal and none are located within the vicinity of same.

Figure 12-22: Grid connection associated with Substation Option A in relation to Kilcumber Bridge Protected Structure 27-13

Figure 12-23: Substation Option B and associated Overhead Line

12.3.2.3 Proposed Haul Route

Junction accommodation works are proposed for three locations along the Transport Delivery Route; at Ballina Cross, Ballinagar public park, and at the R402/L1003 junction to access the site. The Delivery Route itself will not arise in any impacts to the architectural heritage assets of the immediate environment. Architectural Heritage sites (RPS, NIAH) within 100m of the TDR are tabulated below:

Table 12-14: NIAH located within 100m of TDR

NIAH	DATE	STRUCTURE	TOWN
14912003	1790 - 1830	Drumcooly House	DRUMCOOLY
14918012	1955 - 1965	office	ESKER BEG
14918008	1870 - 1910	Saint Joseph's Roman Catholic Church	BALLINAGAR
14918011	1955 - 1965	gates/railings/walls	ESKER BEG
14919001	1850 - 1870	gate lodge	KILLEEN (BB. BY.)
14919003	1960 - 1965	An Scoil Náisunta Eiscir	ESKER MORE
14919010	1800 - 1840	steward's house	ESKER BEG
14808026	1880 - 1920	office	Daingean
14808039	1780 - 1820	Midway Park Hotel	Daingean
14808020	1820 - 1860	Saint Annes	Daingean
14808001	1780 - 1810	Footbarrack Bridge	Daingean
14808002	1860 - 1900	vent pipe	Daingean
14808003	1850 - 1900	water pump	Daingean
14808004	1755 - 1765	house	Daingean
14808005	1930 - 1950	Daingean Garda Station	Daingean
14808006	1850 - 1900	water pump	Daingean
14808007	1805 - 1810	Daingean Court House	Daingean
14808008	1830 - 1840	church/chapel	Daingean
14808009	1840 - 1880	outbuilding	Daingean
14808018	1780 - 1820	house	Daingean
14808019	1780 - 1820	The Blackthorn	Daingean
14808021	1840 - 1880	Jubilee House	Daingean
14808022	1760 - 1800	house	Daingean
14808023	1790 - 1810	store/warehouse	Daingean
14808024	1795 - 1805	quay/wharf	Daingean
14808024	1795 - 1805	quay/wharf	Daingean
14808024	1795 - 1805	quay/wharf	Daingean
14808025	1795 - 1800	Molesworth Bridge	Daingean
14808026	1880 - 1920	office	Daingean

Table 12-15: RPS structures located within 100m of TDR

RPS REF	NIAH REF	STRUCTURE	TOWN
25-45	0	House	Daingean
25-46	0	House	Daingean
25-47	0	House	Daingean
25-49	0	Quinns (Spar)	Daingean
25-50	0	House/ shop	Daingean
25-48	0	The Welcome Inn	Daingean

RPS REF	NIAH REF	STRUCTURE	TOWN
25-Jan	14808004	House	Daingean
25-Feb	14808005	Daingean Garda Station	Daingean
25-Mar	14808007	Daingean Court House	Daingean
25-Apr	14808008	Church of Ireland Church	Daingean
25-Aug	14808018	House	Daingean
25-Sep	14808019	The Blackthorn	Daingean
25-Oct	14808020	Saint Annes	Daingean
25-Nov	14808021	Jubilee House	Daingean
25-Dec	14808022	House	Daingean
25-13	14808023	Canal store	Daingean
25-14	14808024	Quay	Daingean
25-15	14808025	Molesworth Bridge	Daingean
25-16	14808026	Building	Daingean
25-36	14918008	Saint Joseph's Roman Catholic Church	-
25-43	14919001	Mount Lucas	-
26-Feb	14919003	An Scoil Náisunta Eiscir	-
25-44	14919010	Former stewards house	-
25-51	0	House	Daingean
25-45	0	House	Daingean

The junction accommodation works area at Ballina townland (westernmost) does not have any known architectural heritage constraints within close proximity.

The junction accommodation works area at Ballinagar is not located in close proximity to any known architectural heritage constraints. St Joseph's Roman Catholic Church (RPS 25-36) is located to the north-east of the proposed works and will not be affected by the proposed junction works.

The junction accommodation works area the R402/L1003 junction to access the site does not have any known architectural heritage constraints within close proximity.

The likely significant effects in relation to the proposed Junction Accommodation Works and the suggested mitigation measures are detailed in Section 12.4 below.

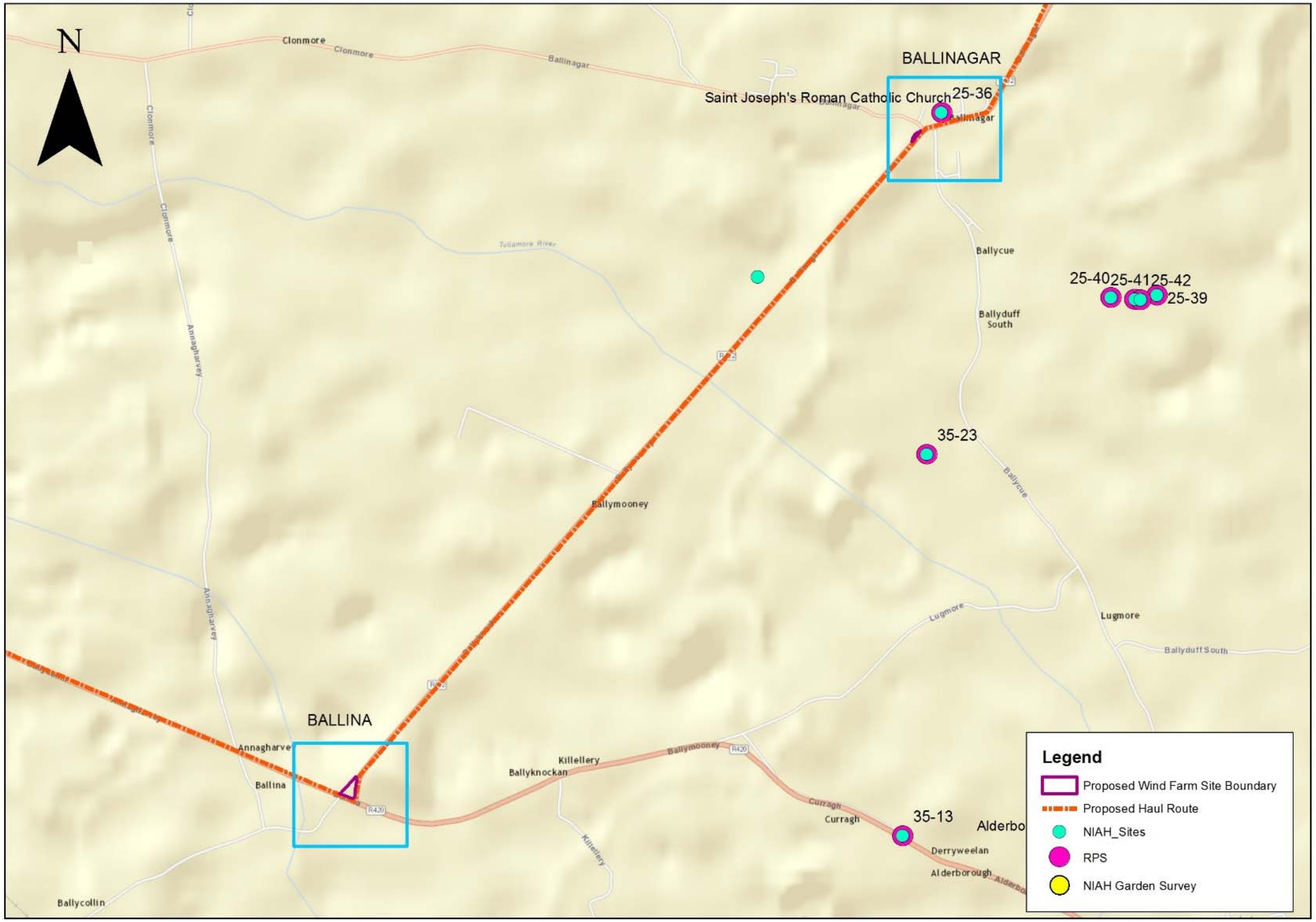


Figure 12-24: Haul route showing Junction Accommodation works at Ballina and Ballinagar in relation to known NIAH and RPS structures

12.4 Likely Significant Effects and Mitigation Measures

12.4.1 Types of Effects

Direct effects arise where an archaeological heritage feature or site is physically located within the footprint of the proposed development whereby the removal of part, or all of the feature or site is thus required.

Indirect effects may arise as a result of subsurface works undertaken outside the footprint of the development, secondary environmental change such as a reduction in water levels and impacts on visual setting of cultural heritage assets.

Cumulative effects arise when the addition of many effects create a larger more significant effect.

Residual effects are the degree of environmental changes that will occur after the proposed mitigation measures have been implemented.

12.4.2 Magnitude of Effects

Severe: Applies where mitigation would be unlikely to remove adverse effects. Reserved for adverse, negative effects only. These effects arise where an archaeological site is completely and irreversibly destroyed.

Major: An effect which, by its magnitude, duration or intensity, alters an important aspect of the environment. An impact like this would be where part of a site would be permanently impacted upon, leading to a loss of character, integrity and data about an archaeological site.

Moderate: A moderate effect arises where a change to an archaeological site is proposed which though noticeable, is not such that the integrity of the site is compromised and which is reversible. This arises where an archaeological site can be incorporated into a modern day development without damage and that all procedures used to facilitate this are reversible.

Minor: An effect which causes changes in the character of the environment which are not high or very high and do not directly impact or affect an archaeological site.

Negligible: An effect on an archaeological site capable of measurement but without noticeable consequences.

12.4.3 Construction Phase Potential Effects: Direct

Direct effect refers to a 'physical effect' on a monument or site. The construction phase of the development consists largely of earthmoving activities such as peat and topsoil removal for access roads, turbine hardstand areas, construction compounds, substation and grid connection routes (Option A or Option B), borrow pits. This may have a number of potential negative effects on the known and potential archaeological heritage of the area. These are outlined below with the suggested mitigation measures. Only those elements of the existing archaeological and cultural heritage environment which are likely to be affected by the proposed development are listed below.

12.4.3.1 Turbines

12.4.3.1.1 Recorded Archaeological Monuments (RMPs

The majority of RMP sites are located in the north-eastern corner of the site and this area has been avoided by the proposed wind farm layout.

The various peatland surveys undertaken by the Irish Archaeological Wetland Unit between 2002 and 2013 have shown that the sites detected in 2002 (117) were gone by 2013 when only 2 new sites were detected and subsequently excavated in 2014. The potential for impacting on the known archaeological resource is therefore minimal although given the nature of trackways it is possible that sites/features associated with the known RMPs sites may be uncovered during groundworks associated with the Turbines and Hardstands, in particular Turbine 17 and Turbine 21, located within close proximity to the cluster of RMPs in the north-eastern corner of the bog.

Pre Mitigation Effect
This potential effect would be a significant negative permanent effect as machinery has the potential to remove all or part of the sites.

Proposed Mitigation Measures
Because the bog is a changing environment and milling will continue between now and 2018 it is possible that archaeological features associated with the Recorded Monuments will be exposed between now and the construction phase and reported to the DAHG in line with the Code of Practice.

- A walkover survey / re-assessment survey of the proposed turbine and hardstand locations will be undertaken prior to construction to assess if any sites which may be related to the known Recorded Monuments are present or visible on the surface / drain sections.
- Any sites detected during the latter walkover survey will be archaeologically excavated under licence prior to construction. The archaeologist will liaise with the DAHG regarding the methods being proposed for excavation.
- Pre-construction archaeological testing of turbine bases and hardstands will be completed. A report will be submitted to the relevant authorities for consideration.
- Archaeological monitoring and metal detection of spoil will be carried out during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Effect
The sites, if detected, during the pre-construction walkover will be preserved by record (archaeologically excavated) and therefore permanently removed with a full record made. In this regard the potential effect after the mitigation measures is likely to be slight-moderate.

Significance of Effects
Slight-Moderate Effect

12.4.3.1.2 New Sites Recorded during EIS Preparation

The excavation of the peat associated with the construction of turbine bases and hardstands may impact on the potential new sites discovered during the site assessment as part of this EIS chapter. The new sites consisted of an Unclassified Togher (1), a possible peatland structure and two possible upright posts (See Section

12.3.1.1.5). As these sites were discovered during active peat extraction and milling their present management comes under the Bord na Móna / DAHG code of practice. The sites were reported to the Bord na Móna project archaeologist who in turn reports the sites to the DAHRRG. Peat extraction is projected to continue in these areas until 2018 and the sites are therefore currently dealt with under the latter Code of Practice.

Pre Mitigation Effect
Should the aforementioned sites be identified in the re-assessment survey when the project comes to construction, the effect on the sites by machinery/excavation would potentially be significant negative and permanent.

Proposed Mitigation Measures

- The 3 potential new sites will be inspected prior to construction to re-assess their survival or otherwise.
- If present, the sites will be archaeologically excavated under licence prior to construction. The archaeologist will liaise with the DAHRRG regarding the methods being proposed for excavation.
- Pre-construction archaeological testing of turbine bases and hardstands. A report submitted to the relevant authorities for consideration.
- Archaeological monitoring and metal detection of spoil during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Effect
The sites, if detected, during the pre-construction walkover will be preserved by record (archaeologically excavated) and therefore permanently removed with a full record made. In this regard the potential effect after the mitigation measures is likely to be slight-moderate.

Significance of Effects
Slight-Moderate Effect

12.4.3.1.3 Unknown Sub-Surface Sites

It has been demonstrated through the detailed description of the existing environment that Cloncreen Bog is an area of high archaeological sensitivity and potential both in terms of sites and artefacts being discovered during the various peatland surveys and excavations since 2002. It is possible that further sites will be uncovered both within the peat and/or at the level of the underlying natural subsoil. The excavation of the peat associated with the construction of turbine bases and hardstands may impact on any new sites that may be present.

Pre Mitigation Effect
Should new sites be present within the peat (currently not visible on the surface or in drain sections) the effect is likely to be significant negative and permanent (i.e. the movement of peat by machinery would permanently remove the sites resulting in a significant negative effect).

Proposed Mitigation Measures

- The pre-construction walkover survey / re-assessment survey as mitigated above of areas proposed for excavation will be undertaken to re-assess the bog for new sites that may be exposed.
- If present, the sites will be archaeologically excavated under licence prior to construction. The archaeologist will liaise with the DAHRRG regarding the methods being proposed for excavation.

- Pre-construction archaeological testing of turbine bases and hardstands will be carried out and a report submitted to the relevant authorities for consideration.
- Archaeological monitoring and metal detection of spoil during construction will be carried out. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Effect
The sites, if detected, during the pre-construction walkover will be preserved by record (archaeologically excavated) and therefore permanently removed with a full record made. In this regard the potential effect after the mitigation measures is likely to be slight-moderate.

Significance of Effects
Slight-Moderate Effect

12.4.3.2 Borrow Pit

12.4.3.2.1 Potential Effect on sub-surface archaeological deposits by machinery

The proposed borrow pit is located in an area which has now largely been quarried out in particular towards the centre of the area. Some peat remains at the northern edge of the area along the proposed road to T19 therefore some mitigation is required to assess these areas for sub-surface archaeology / finds.

Pre Mitigation Effect
Should previously unrecorded sites or features be present within the peat then peat stripping in this area would result in a significant negative long-term effect on the archaeology. This 'pre-mitigation effect' can be negated by implementing mitigation measures prior to construction.

Proposed Mitigation Measures
The proposed mitigation measures for the borrow pit are the same as those previously mentioned and included the following:

- A pre-construction walkover survey / re-assessment survey of the northern section of the borrow pit will be undertaken to re-assess the bog for new sites that may be exposed.
- If present, the sites will be archaeologically excavated under licence prior to construction. The archaeologist will liaise with the DAHRRG regarding the methods being proposed for excavation.
- Pre-construction archaeological testing of turbine bases and hardstands will be carried out and a report submitted to the relevant authorities for consideration.
- Archaeological monitoring and metal detection of spoil during construction will be carried out. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Effect
The sites, if detected, during the pre-construction walkover will be preserved by record (archaeologically excavated) and therefore permanently removed with a full record made. In this regard the potential effect after the mitigation measures is likely to be slight-moderate.

Significance of Effects
Slight-Moderate

12.4.3.3 Substation and Grid Connection

12.4.3.3.1 Effect of Substations and Grid Connection (Options A and B) on unknown sub-surface sites

It is possible that the excavation associated with the substations and grid connection routes may impact on sites within the peat currently not visible on the surface or within the drain sections. Peat extraction is complete on the eastern substation site as well as the area of the grid connection route but is continuing within a portion of the southern substation site.

Pre Mitigation Effect
Should new sites be present within the peat (currently not visible on the surface or drain sections) the effect is likely to be significant negative and permanent, i.e. the stripping of peat by machinery would permanently remove the sites resulting in a significant negative effect and a total loss of information relating to the sites.

Proposed Mitigation Measures

- A pre-construction walkover survey / inspection of both Option A and B substation sites and associated roads and grid connection infrastructure will be undertaken to re-assess the bog for new sites that may be exposed. Peat extraction is continuing in the southern site and may reveal new sites between now and the time of construction.
- If present, any new sites will be archaeologically excavated under licence prior to construction. The archaeologist will liaise with the DAHRRG regarding the methods being proposed for excavation.
- Pre-construction archaeological testing of the substation sites (either the eastern or southern) will be carried out and a report submitted to the relevant authorities for consideration.
- Archaeological monitoring and metal detection of spoil in the vicinity of the either substation and associated roads and cable infrastructure works during construction. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Effect
If new archaeological sites are detected, during the pre-construction walkover, they will be preserved by record (archaeologically excavated) and therefore permanently removed with a full record made. In this regard the potential effect after the mitigation measures is likely to be slight-moderate.

Significance of Effects
Slight-Moderate Impact

12.4.3.4 Other Infrastructure

This section relates to other non-turbine elements: access roads, control buildings and cabling, construction compounds and parking areas, anemometry mast.

12.4.3.4.1 Effect of Infrastructure on unknown sub-surface archaeological features / sites

All proposed infrastructure was inspected as part of this assessment and any new sites noted and recorded. It is possible that excavation associated with the proposed infrastructure such as roads, compounds or any elements listed above may impact on as yet undiscovered sites within the peat or at the level of the underlying natural boulder clay.

Pre Mitigation Effect

Ground works associated with the proposed infrastructure within the site may result in a permanent significant negative effect on unknown subsurface sites, if present.

Proposed Mitigation Measures

- A re-inspection of the proposed infrastructure will be undertaken prior to construction to assess if any sites are present or visible on the surface / drain sections.
- Any sites detected during the latter walkover survey will be archaeologically excavated under licence prior to construction. The archaeologist will liaise with the DAHRRG regarding the methods being proposed for excavation.
- Pre-construction archaeological testing of the proposed site compounds, control buildings (areas of large peat extraction) will be carried out. The applicant will liaise with DAHG should archaeology be uncovered. A report submitted to the relevant authorities for consideration.
- Archaeological monitoring and metal detection of spoil of all proposed infrastructure during construction will be carried out. The applicant will liaise with DAHRRG should archaeology be uncovered. A report on the results of the monitoring shall be compiled and submitted to the relevant authorities on completion of the project.

Residual Effect

If new archaeological sites are detected, during the pre-construction re-inspection, testing or monitoring, they will be preserved by record (archaeologically excavated) and therefore permanently removed with a full record made. In this regard the potential effect after the mitigation measures is likely to be slight-moderate.

Significance of Effects

Slight to Moderate

12.4.3.5 Junction Accommodation Works

12.4.3.5.1 Effect on as yet undiscovered sub-surface sites

No known sites such as RMPs, RPS or NIAH were noted within the footprint of any proposed junction accommodation areas, all of which were inspected as part of the EIS. Sub-surface sites may exist within the areas proposed for topsoil removal resulting in a permanent significant negative effect if present.

Pre Mitigation Effect

Permanent significant negative effect if subsurface sites / features are present

Proposed Mitigation Measures

Archaeological monitoring during construction. A report on the monitoring should be compiled and the results submitted to the relevant authorities.

Residual Effect
Slight

Significance of Effects
Slight

12.4.4 Construction Phase Potential Effects: Indirect

All likely effects at the construction stage are likely to be direct. No indirect effects at the construction stage were identified.

12.4.5 Operational Phase Potential Effects: Direct

No direct effects were identified which would take place at the operational stage of the project. All potential direct effects would be likely to occur at the construction stage of the project (see Section 12.4.3).

12.4.6 Operational Phase Potential Effects: Indirect

Indirect effects are where a feature or site of archaeological, architectural heritage merit or their setting is located in close proximity to a proposed development. Indirect effects here are mainly concerned with effects on setting.

Effects on settings of sites may arise when a development is proposed immediately adjacent to a recorded monument or cluster of monuments. While the proposed development may not physically impact on a site, it may alter the setting of a monument or group of monuments. There is no standardised industry-wide approach for assessing the degree of impact on the setting of a monument. For purposes of assessing impact on visual setting, the uniqueness of the monuments, the potential interrelationships of monuments, the inter-visibility of monuments, visual dominance and whether a setting is altered or unaltered can be used to assess impact. Sites with available public access such as National Monuments were visited to assess the nature of the potential indirect effects. The likely significance of indirect effects for heritage assets such as Recorded Monuments, RPS, and NIAH structures with no public access were assessed using the ZTV model, the nature of the monument itself (visually dominant or Low visibility), distance to nearest Turbine etc.

12.4.6.1 Turbines

12.4.6.1.1 UNESCO World Heritage sites (Tentative list)

Durrow Abbey is located 24km to the north-west of the proposed development site.

Pre Mitigation Effect
The immediate visual setting of the site will not be impacted by the proposed development.

The pre mitigation effect is likely to be Negligible as the asset is located 24km away.

Proposed Mitigation Measures
No mitigation measures are proposed.

Residual Effect
Negligible.

Significance of Effects
No significant effects.

12.4.6.1.2 Effect of Turbines on setting of National Monuments

Three National Monuments were considered in this assessment report for purposes of assessing effects on their visual setting.

Clonin Earthwork

The proposed development will be visible from this location given that Clonin Earthworks are located on higher ground than the lands to the south of same. The ZTV model, assuming no vegetation or screening, also shows that 14 to 21 turbines would be visible from here. The important view towards Croghan Hill, however will be maintained and not impacted by the proposed development.

Grange Castle

The immediate surroundings of Grange castle are well screened by hedgerows and field boundaries and again the immediate setting of the monument will not be impacted. The ability to see the proposed development alters its setting slightly however but this is confined to the upper levels of the castle as from ground level the enjoyment of the monument as a heritage asset will not be impeded by the proposed development.

Cannakill Deserted Medieval Settlement

The proposed development will not be visible from the public road at Cannakill or indeed from the western portion of the site. Partial views however will be possible at a distance from the eastern part of the site. Similar to above, the immediate setting of the monument will not be impacted by the proposed development and in this regard the ability to view the proposed development from the site will result in a slight effect on setting. The nearest photomontage taken from this location is Viewpoint 20 (See LVIA chapter for details).

The intervisibility between monuments, particularly those of similar date range and function would be considered to be a factor in assessing effects on settings of monuments. One such important view is between Clonin Earthworks (ring barrows) and the burial mound on top of Croghan Hill to the west. This view was acknowledged by the National Monuments Service in their description provided of the site at Clonin. The proposed wind farm will not impact on views from one site to another and therefore any intended prehistoric intervisibility will continue unimpeded.

Pre Mitigation Effect

Summarised in table below.

Table 12-16: Table of Pre-Mitigation Effects on setting of National Monuments

NAT MON	NUMBER	Sensitivity	Distance to nearest Turbine	Significance of Indirect Effects
Clonin Earthwork	532 (O)	High	8.3km	Slight Effect on Setting
Cannakill Medieval Deserted Village	617 (O)	High	11km	Slight Effect on Setting
Grange Castle	629	High	8.8km	Slight Effect on Setting

Proposed Mitigation Measures

No mitigation is proposed

Residual Effect
Slight Negative Effect

Significance of Effects
Slight Negative Effect

12.4.6.1.3 Effect of Turbines on setting of Croghan Hill Complex

Croghan Hill is acknowledged by Offaly County Council as an area of high amenity (See LVIA chapter and photomontage Viewpoint 21). Croghan hill and the monuments therein are not National Monuments, however their association with Cannakil Desserted Medieval settlement (National Monument) and their prominent location within the landscape merited inclusion for assessment from an archaeological perspective.

The existing view to Clonin earthwork to the west will not be impacted. Views to the south in all directions from this monument will however change. In this regard the potential effect on the visual setting of the archaeological complex is slight-moderate. Cumulative effects may increase when considering the existence of other projects however (see below).

12.4.6.1.4 Effect of Turbines on setting of Recorded Monuments

The table below presents the recorded archaeological monuments within 5km of the site according to their sensitivity (visual dominance, above ground trace, uniqueness, proximity to site, etc.) and the likely potential pre-mitigation effect on their setting. For example, low visibility monuments such as enclosures, ringforts and many earthen monuments at a distance of 3-5km could be considered to have less potential to be impacted by the proposed development. Monuments on higher ground (visually dominant) within close proximity to the site, however, may be more at risk in terms of effect on their setting. Monuments that do not have any surface trace are not capable of having their setting impacted and these effects are categorised as negligible. The ZTV model for the site, assuming no vegetation or screening, shows that virtually all areas within 5km would be capable of seeing the majority of turbines. This is the worst case scenario, however, as in reality screening in the form of dense field boundaries and trees is provided from many locations within 5km of the proposed development. Furthermore, 53% of monuments within 5km have no visible surface trace with a further 5% within only partial remains. The likely pre-mitigation effects are summarised below and these are based on both the ZTV model, the nature of the archaeological monument and distance to the site. The monuments in Table 12-7 were not visited being located on private land and the assessment is based on the aforementioned criteria as well as views from nearby public areas. Appendix 12.1 provides a description of recorded monuments near to the proposed wind farm and should be read in conjunction with this section.

Pre Mitigation Effects
Summarised in table below.

Table 12-17: Table of Likely Pre-Mitigation Effects on setting of RMPs within 5km

SMRS	DESCRIPTION	TOWNLAND	Distance To Boundary (m)	Surface Trace Y / N	Sensitivity of asset	Likely Significance of Indirect Effects
OF011-020	Enclosure	CLONLACK	4304	Y	Low	Minor
OF011-021	Ringfort - rath	CLONLACK	4469	Y	Low	Minor
OF011-022	Barrow - ring-barrow	CLARKVILLE	3148	Y	Low	Minor
OF011-023001	Enclosure	BALLYMORAN	2415	N	Low	Negligible
OF011-023002	Field system	BALLYMORAN	2275	N	Low	Negligible
OF011-024	Enclosure	BALLYCOLGAN	3344	N	Low	Negligible
OF011-025	Enclosure	RATHMORE (Coolestown By.)	3169	N	Low	Negligible
OF011-027	Enclosure	NEWTOWN (Coolestown By.)	3876	N	Low	Negligible
OF011-028	Ringfort - rath	RATHLUMBER	1599	Y	Low	Minor
OF011-029	Enclosure	RATHLUMBER	1372	N	Low	Negligible
OF011-030	Castle - tower house	BALLYLEAKIN	1808	N	Low	Negligible
OF011-031	Enclosure	BALLYNANUM	1741	N	Low	Negligible
OF011-032	Castle - unclassified	BALLINRATH	827	N	Low	Negligible
OF011-033	Enclosure	BALLYNAKILL (Coolestown By.)	1101	N	Low	Negligible
OF011-034001	Church	BALLYNAKILL (Coolestown By.)	819	PARTIAL	Medium	Moderate
OF011-034002	Graveyard	BALLYNAKILL (Coolestown By.)	818	Y	Medium	Moderate
OF011-034003	Field system	BALLYNAKILL (Coolestown By.)	842	Y	Low-Medium	Moderate
OF011-035001	Ringfort - rath	BALLYKILLEEN (Coolestown By.)	681	Y	Medium	Moderate
OF011-035002	Designed landscape - tea house	BALLYKILLEEN (Coolestown By.)	687	Y	Medium	Minor to Moderate
OF011-053	Enclosure	CLONMEEN	3399	N	Low	Negligible
OF011-054	Barrow - ring-barrow	CLARKVILLE	2674	Y	Low	Minor
OF011-062	Redundant record	LEITRIM	3456	N	Low	Negligible

SMRS	DESCRIPTION	TOWNLAND	Distance To Boundary (m)	Surface Trace Y / N	Sensitivity of asset	Likely Significance of Indirect Effects
OF012-002	Ringfort - rath	MONASTERORIS	4782	PARTIAL	Low	Minor
OF012-004	Enclosure	EDENDERRY	3757	N	Low	Negligible
OF012-005001	Church	DRUMCOOLY	3111	N	Low	Negligible
OF012-005002	Graveyard	DRUMCOOLY	3124	N	Low	Negligible
OF012-006001	Castle - motte and bailey	DRUMCOOLY	3219	Y	Medium	Minor
OF012-006002	Enclosure	DRUMCOOLY	3212	Y	Low	Minor
OF012-007001	Church	SHEAN	2219	N	Low	Negligible
OF012-007002	Graveyard	SHEAN	2220	Y	Medium	Minor
OF012-008	Standing stone	CLONCANON	3461	Y	Medium	Minor
OF012-014	Font (present location)	EDENDERRY	4272	Y	Low	Minor
OF018-194	Redundant record	SCRUB OR PIGEONPARK	4940	N	Low	Negligible
OF019-001001	Graveyard	BALLYCON	3163	N	Low	Negligible
OF019-001002	Enclosure	BALLYCON	3152	N	Low	Negligible
OF019-001003	Church	BALLYCON	3163	N	Low	Negligible
OF019-002	Enclosure	ESKER MORE	794	N	Low	Negligible
OF019-003	Enclosure	BALLYKILLEEN (Coolestown By.)	131	PARTIAL	Low	Minor-Moderate
OF019-004	Church	CLONCREEN	635	Y	Medium	Moderate
OF019-004001	Graveyard	CLONCREEN	635	Y	Medium	Moderate
OF019-005	Children's burial ground	BALLAGHASSAAN	4107	Y	Low-medium	Minor
OF019-006	Redundant record	CLONKEEN	1919	N	Low	Negligible
OF019-009	Road - unclassified togher	BALLYKILLEEN (Coolestown By.)	63	N	Low - Medium	Negligible
OF019-018	Redundant record	ESKER MORE	648	N	Low	Negligible
OF019-019	Redundant record	ESKER MORE	203	N	Low	Negligible
OF020-001	Enclosure	DERRYMORE (Coolestown By.)	2941	N	Low	Negligible
OF020-002	Enclosure	CLONBROWN	4224	Y	Low	Minor

SMRS	DESCRIPTION	TOWNLAND	Distance To Boundary (m)	Surface Trace Y / N	Sensitivity of asset	Likely Significance of Indirect Effects
OF020-005	Barrow - ring-barrow	SHEAN	1395	Y	Medium	Minor
OF027-006	Ritual site - holy well	CLONSHANNON	4341	Y	Medium	Minor
OF027-007	Cairn - unclassified	CLONSAST UPPER	4973	N	Low	Negligible
OF027-008001	Ecclesiastical site	CLONSAST UPPER	4911	Y	Medium-High	Minor
OF027-008002	Church	CLONSAST UPPER	4911	Y	Medium-High	Minor
OF027-008003	Graveyard	CLONSAST UPPER	4919	N	Low	Negligible
OF027-008004	Enclosure	CLONSAST UPPER	4934	N	Low	Negligible
OF027-009001	Ritual site - holy tree/bush	CLONSAST UPPER	4990	Y	Low-Medium	Minor
OF027-009003	Cairn - unclassified	CLONSAST UPPER	4997	N	Low	Negligible
OF028-001	Ringfort - rath	DERRYGARRAN	4776	Y	Low	Minor

Proposed Mitigation Measures
It is not possible to mitigate against potential effects on the visual setting of recorded monuments. No mitigation is proposed therefore.

Residual Effects
Same as Pre Mitigation Effects

Significance of Effects
Same as Pre Mitigation Effects

12.4.6.1.5 Effect of Turbines on setting of RPS structures

Similar to Recorded monuments and National Monuments the sensitivity of an asset is categorized on a case by case basis. Structures of National and World Heritage importance would be considered to be of High Sensitivity. Low visibility structures such as milestones, post boxes, bridges are less likely to have a setting associated with them and are less likely to be visually impacted in contrast to more dominant structures such as houses and churches which have obvious visible remains. The sensitivity of an asset together with the distance from the proposed wind farm dictates the likely significance of potential effects. These are categorised not based on individual monument visits (unless publically accessible) but rather cartographic sources as well as the ZTV provided in the LVIA chapter. None of the structures listed below will be directly impacted and no significant or adverse effects will take place. The ZTV shows that the majority of turbines (14-21) will be visible from most locations within 5km. The effect on setting decreases with distance and the sensitivity of the asset. Negligible effects arise where the sensitivity of the asset is low and the distance from the wind farm is such that no effect on setting would be likely. Slight effects may potentially occur where the sensitivity of an asset is low although is closer to the proposed wind farm and by virtue of the fact that it may be possible to see the proposed turbines. Moderate effect on setting may occur where an asset is deemed to be medium sensitivity and is situated closer to the proposed turbines increasing the likelihood of the ability to see the turbines from the asset.

Pre Mitigation Effect
Summarised in table below.

Table 12-18: Table of Pre-Mitigation Effects on setting of RPS structures – 5km

RPS Ref	NIAH	DESCRIPTION	Distance To Boundary (m)	Surface Trace Y / N	Sensitivity of asset	Likely Significance of Effects
27-1	14809001	Milestone	1987	Y	Low	Slight
27-2	14809002	Saint Patrick's Bridge	1930	Y	Low	Slight
27-3	14809011	Cloncreen Bridge	1251	Y	Low	Slight
27-4	14809003	Forge	1929	Y	Medium	Moderate
27-5	14809008	Saint Michael's Roman Catholic Church	1828	Y	Medium	Moderate
27-6	14809010	Saint Broughan's Hall	1670	Y	Medium	Moderate
27-7	14809004	House	1959	Y	Medium	Moderate
27-8	14809007	Post box	1931	Y	Low	Slight
27-9	14809009	Saint Michael's Roman Catholic Church	1833	Y	Medium	Moderate
27-10	14809005	Water pump	1940	Y	Low	Slight
27-11	14809006	Clonbullogue Garda Station	1937	Y	Medium	Moderate
27-12	14809012	Saint Kevin's Church of Ireland Church	1292	Y	Medium	Moderate
17-41	14804042	Saint Mary's Convent	4744	Y	Medium	Slight
17-42	14804043	Saint Mary's Roman Catholic Church	4684	Y	Medium	Slight
17-43	14804044	Bella Vista	4614	Y	Medium	Slight
17-44	14804045	Saint Mary's Graveyard	4633	Y	Medium	Slight
17-45	14804046	Edenderry Garda Station	4590	Y	Medium	Slight
17-46	14804048	Presbytery	4096	Y	Medium	Slight
17-47	14804049	Cast iron post box	3966	Y	Low	Negligible
17-48	14804050	Cross	4009	Y	Medium	Slight
17-49	14804051	Church of Ireland Rectory/Glebe	4720	Y	Medium	Slight

RPS Ref	NIAH	DESCRIPTION	Distance To Boundary (m)	Surface Trace Y / N	Sensitivity of asset	Likely Significance of Effects
17-50	14804052	House	4945	Y	Medium	Slight
17-51	14804054	High Cross	4627	Y	Medium	Slight
17-39	14804040	Saint Joseph's Hall	4890	Y	Medium	Slight
17-40	14804041	Saint Mary's Convent National School	4769	Y	Medium	Slight
17-57	14911006	Monasterois House	4825	Y	Medium	Slight
16-9	14911007	Cartland Bridge	4139	Y	Low	Negligible
17-58	14911013	Monasteroris House Icehouse	4668	Y	Medium	Slight
17-59	14911021	Rathmore Bridge	3602	Y	Medium	Slight
27-14	14920002	Ballydermot House	1191	Y	Medium	Moderate
16-10	14911008	Trimblestown Bridge	4599	Y	Low	Negligible
16-18	14911022	Ballymoran House	1645	Y	Medium	Moderate
16-15	14911015	Ballinla House	4126	Y	Medium	Slight
25-43	14919001	Mount Lucas	4533	Y	Medium	Slight
26-1	14919002	Springfield House	3439	Y	Medium	Slight
26-2	14919003	An Scoil Náisunta Eiscir	1927	Y	Medium	Moderate
27-13	14919004	Kilcumber Bridge	342	Y	Low	Slight
26-3	14919005	Cloncrane House	649	Y	Medium	Moderate
26-4	14919008	Ballaghassaan House	4220	Y	Medium	Slight
25-44	14919010	Former stewards house	4734	Y	Medium	Slight
37-2	14927001	4 bay detached thatched house	4081	Y	Medium	Slight
37-3	14927002	Detached 2 storey former presbytery	4619	Y	Medium	Slight
37-1	14920001	Detached 4 bay thatched farmhouse	4314	Y	Medium	Slight
17-61	14912004	Colgan's Bridge	3638	Y	Medium	Slight
17-62	14912005	Downshire Bridge	3808	Y	Medium	Slight
17-63	14912006	Drumcooly Park	3236	Y	Medium	Slight
17-64	14912007	House	3222	Y	Medium	Slight
17-65	14912008	Blundell Aqueduct	4899	Y	Medium	Slight
37-6	14927009	Cast iron post box	4073	Y	Low	Slight

RPS Ref	NIAH	DESCRIPTION	Distance To Boundary (m)	Surface Trace Y / N	Sensitivity of asset	Likely Significance of Effects
36-4	14919006	Thatched House	2016	Y	Medium	Moderate
36-5	14919007	Thatched House	1964	Y	Medium	Moderate
17-102	n/a	House	4912	Y	Medium	Slight
27-15	n/a	House	1910	Y	Medium	Moderate
27-16	n/a	St Patricks National School	2011	Y	Medium	Moderate

Proposed Mitigation Measures
No mitigation is proposed

Residual Effect
As outlined in table above

Significance of Effects
As outlined in table above

12.4.6.1.6 Effect of Turbines on setting of NIAH structures

As the Record of Protected Structures is largely based on and informed by the list of NIAH structures any likely significant effects on setting of RPS structures is the same as that for NIAH buildings (See Table 12-18).

Pre Mitigation Effect
See above

Proposed Mitigation Measures
No mitigation is proposed

Residual Effect
As outlined in table above

Significance of Effects
As outlined in table above

12.4.6.1.1 Effect of Turbines on setting of NIAH garden survey

The sensitivity of each garden / historic demesne is based on the survival rate of the asset and this is based on cartographic sources compared with historic OS mapping as described under Existing Environment above. None of the NIAH garden surveys are of high architectural or cultural heritage significance and this is taken into consideration when assessing the overall significance of effects.

Pre Mitigation Effect
Summarised in table below.

Table 12-19: Table of Pre mitigation Effects of historic gardens within 3km

REF	NAME	Distance from wind farm (m)	Sensitivity
4119	Leitrim House Garden	2700	Low
4148	Ballymoran House Garden	1500	Medium
4160	Clarkville House Garden	2500	Low

REF	NAME	Distance from wind farm (m)	Sensitivity
4173	Ballyleakin House Garden	1600	Low
4252	Ballydermot House Garden	1000	Low

Proposed Mitigation Measures
No mitigation is proposed

Residual Effect
As outlined in Table above

Significance of Effects
As outlined in table above

12.4.6.2 Borrow Pit

No operational Effects

12.4.6.3 Eastern Substation (Option A) and associated Grid Connection

12.4.6.3.1 Operational Effect of the proposed substation and grid connection on Heritage Assets (RMPs, RPS, NIAH, sub-surface sites)

This proposed substation is not located immediately adjacent to any designated sites. Any designated sites within the study area boundary are sub-surface and are not capable of having their settings impacted as a result of the substation.

Pre Mitigation Effect
The substation sites may have a slight negative effect on the surrounding cultural heritage landscape by virtue of the fact that it can be seen from some locations of heritage assets.

Proposed Mitigation Measures
Maintain the existing screening and tree cover along the eastern boundaries of Cloncreen bog which may alleviate any potential effects on visual setting.

Residual Effect
Slight-Negligible

Significance of Effects
No significant effects, slight to negligible.

12.4.6.3.2 Effect of grid connection (option A) on Heritage Assets (RMPs, RPS, NIAH, sub-surface sites)

As the grid connection is sub-surface, no effects on setting are anticipated.

12.4.6.4 Southern Substation (Option B) and associated Grid Connection (OHL)

12.4.6.4.1 Operational Effect of the proposed substation and grid connection on Heritage Assets (RMPs, RPS, NIAH, sub-surface sites)

This proposed substation is located 1km to the north-west of Cloncrane house (RPS 26-3) and Recorded monument Cloncreen Church (OF019-004). The curtilage of the house will not be impacted as it never extended as far as the proposed wind farm site boundary. Furthermore, its setting is now much altered with modern buildings being located in the vicinity. The ability to see the proposed substation may alter the visual setting of these sites however and in this regard the potential indirect (operational) effect is likely to be slight- moderate.

Pre Mitigation Effect
The substation site at the south along with the short section of Overhead line may have a slight-moderate negative effect on these sites by virtue of the fact that they may be seen from the locations of heritage assets.

Proposed Mitigation Measures
There is natural screening along the boundary of the proposed wind farm site and this should be maintained as it may alleviate the potential effects on visual setting.

Residual Effect
Slight-Moderate

Significance of Effects
No significant effects, slight to moderate.

12.4.6.5 Other Infrastructure

This section relates to other non-turbine elements: access roads, control buildings and cabling, construction compounds and parking areas, anemometry mast. The majority of these elements are low visibility or sub-surface such as proposed access roads, cabling parking areas etc. The construction compounds are also low-visibility and temporary and effects on setting of heritage assets will not occur in this regard.

12.4.6.5.1 Effect of anemometry mast on heritage assets

Pre Mitigation Effect
Slight to negligible as not located adjacent to any recorded monuments

Proposed Mitigation Measures
None

Residual Effect
Slight to negligible

Significance of Effects
Slight to negligible

12.4.6.6 Junction Accommodation Works

No Indirect (operational) Effect or effect on setting of heritage assets.

12.4.7 Do-Nothing Scenario

If the development were not to proceed, the potential effects on heritage assets resulting from the wind farm would not apply with no need for mitigation. It must be borne in mind, however, that the heritage assets within Cloncreen Bog are constantly changing due to human processes (i.e. Peat Extraction, Milling, Drainage). Potential effects arising from such processes are managed under the Code of Practice between Bord na Móna and the Department of Arts, Heritage, Gaeltacht, Regional and Rural Affairs.

12.4.8 Worst-Case Scenario

The worst case scenario would be if the development were to proceed without implementing mitigation measures. The mitigation measures are mainly relating to construction effects (direct effects on heritage assets) however. The potential effects without mitigation measures would result in an irreversible adverse effect on heritage with a total loss of information relating to the heritage assets, known and unknown, within the site.

12.4.9 Cumulative Effects

Cumulative impact is defined as *'The addition of many small impacts to create one larger, more significant, impact'* (EPA 2002, 33). It is also defined as *'impacts that result from incremental changes caused by other past, present or reasonably foreseeable actions together with the project'* (EC 1999). Cumulative effects encompass the combined effects of multiple developments or activities on a range of receptors. In this case the receptors are the archaeological monuments and architectural/cultural heritage sites in the immediate vicinity of the proposed development. Cumulative Effects at the Operational Stage is discussed.

Projects which have a visual dominance in the landscape such as wind farms are considered here for potential indirect cumulative effects. Other low visibility developments such as the Clonbullogue Ash Repository, Peat Extractions (Derrynagreenagh and Allen Group etc. – see Section 2.10.2 of the EIS for further details on other projects considered in the cumulative assessment) would not be considered to increase the indirect effect when taking into consideration the proposed Cloncreen wind farm. The latter developments would be considered to potentially increase the direct cumulative effects.

In this regard in order to assess overall cumulative effects on archaeology and cultural heritage the proposed project is considered in the context of other developments, namely

- Mountlucas Wind farm – operating
- Yellow River Wind Farm– permitted
- Clonin North Solar Farm
- Other Developments as detailed in Section 2.10.2 of this EIS

12.4.9.1 Cumulative Effects (Indirect)

National Monuments

The operational wind farm at Mountlucas can be viewed from a number of heritage assets in the vicinity of the proposed development. When this existing wind farm and permitted Yellow River wind farm and the proposed Clonin North Solar farm project are considered in the context of the proposed development the cumulative effects will increase. This is mainly due to the location of the National Monuments on higher ground with increased views in all directions. The immediate setting of the monuments will not be affected but the views from the heritage assets will change resulting in the cumulative effects increasing. It is not possible to mitigate against this effect.

Table 12-20: Potential Cumulative Effects on National Monuments and Archaeological Landscapes when other wind farms are considered

NAT MON	NUMBER	Sensitivity	Distance to nearest Turbine	Significance of Effects	Cumulative Effect
Clonin Earthwork	532 (O)	High	8.3km	Slight Effect on Setting	Slight-Moderate
Cannakill Medieval Deserted Village	617 (O)	High	11km	Slight Effect on Setting	Slight-Moderate
Grange Castle	629	High	8.8km	Slight Effect on Setting	Slight-Moderate
Croghan Hill Complex (included due to its archaeological landscape sensitivity)	Not a NM	High	9km	Slight-Moderate	Moderate

Recorded Monuments / Protected Structures

The permitted Yellow River wind farm is not visible from the cultural heritage assets within the immediate vicinity of the proposed wind farm due to the topography, screening, vegetation in the general area and the distance from the environs of the proposed site. It is not anticipated that there will be any increase in terms of indirect effects on the setting of monuments and protected structures within the immediate vicinity of the Cloncreen Wind Farm due to the distance. Mountlucas is however visible from some locations within the immediate vicinity of the proposed development and when this is taken into consideration the indirect effect on Recorded Monuments will increase from some locations.

12.4.9.2 Cumulative Effects (Direct)

The addition of the proposed development to the other permitted and proposed projects as outlined in Section 2.10.2 of the EIS is such that potential direct effects on the known and unknown subsurface archaeology may increase due to the peat extraction associated with such projects. In particular, the ongoing operations within the Derrygreenagh Group (Reference: IPC Licence P0501-01) and Allen Group (References: IPC Licence P0503-01) involve milling, harrowing, ridging and harvesting of peat.

Furthermore, the addition of the proposed development to the excavation works associated with the Eastern and Midlands Regional Water Supply Project may also increase the potential effects to sub-surface archaeology. The significance of this cumulative effect would be considered to be high although if the appropriate mitigation measures are implemented for each project then the overall significance of effect would decrease.

12.4.10 Decommissioning Phase

There will be no significant potential effects on the archaeological, architectural and cultural heritage environment during the decommissioning of the development. Any potential direct effects will already have been resolved through mitigation measures and the established access tracks will be used for the removal of the built features of the wind farm.

12.5 Conclusion

This report comprises an assessment of the likely significant effects of the proposed wind farm and associated infrastructure at Cloncreen Bog, Co. Offaly, including grid connection and substation sites. The effects on the archaeological, architectural and cultural heritage landscape were assessed. The assessment was based on desktop research and field survey. Through a detailed examination of the baseline data available, including previous extensive archaeological investigations at the site, and a detailed site inspection, it was concluded the archaeological potential of Cloncreen Bog is high.

In 2002 117 monuments were located within the bog itself, with only 2 recorded in 2013 during a re-assessment of the bog by the Irish Archaeological Wetland Unit. Three potential new sites were noted within the bog during field inspection and these are being managed under the Code of Practice between Bord na Móna and the DAHG during the lifetime of Peat Extraction. Fifty-seven RMPs sites are located within 5km of the proposed site.

Where significant effects are likely appropriate mitigation measures have been recommended in order to minimise any such effects. Recommended mitigation includes re-assessment surveys due to the changing levels within the bog due to on-going milling, pre-development archaeological testing and archaeological monitoring during the construction stage of the project. An assessment of cumulative effects was also undertaken and only minor increases in indirect effects will occur. No significant cumulative effects have been identified.

13 MATERIAL ASSETS

Material Assets are defined in the *'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements'* (EPA, 2003) as *'resources that are valued and that are intrinsic to specific places'*. This includes cultural assets, economic assets of natural heritage, and economic assets of human origin. The cultural assets of Archaeology and Cultural Heritage are addressed in Chapter 12 of this Environmental Impact Statement (EIS). Economic assets of natural heritage include non-renewable resources such as minerals or soils, and renewable resources such as wind and water. These assets are addressed in Chapter 7: Soils and Geology, Chapter 8: Hydrology and Hydrogeology, and Chapter 9: Air and Climate. Tourism and amenity, which are also considered material assets, are addressed in Chapter 4 on Human Beings. The Human Beings chapter also assesses the likely significant effects of the proposed development in terms of employment and economic activity, and on land-use.

This chapter of the EIS addresses the likely significant effects of the proposed development on transportation infrastructure (Section 13.1 Traffic and Transport) and on Telecommunications and Aviation (Section 13.2), which are economic assets of human origin.

13.1 Traffic and Transport

13.1.1 Introduction

13.1.1.1 Background and Objectives

The purpose of this section is to assess the effects on traffic and transport of the additional traffic movements that will be generated by the proposed development, as well as set out [and assess the likely significant effects of] the improvements and temporary modifications to existing public road infrastructure required to facilitate delivery of abnormal loads, including the construction access, the temporary upgrade of the R420/R402 junction, temporary road widening at 1 no. location on the R402 in Ballinagar, upgrade of the R402/L1003 junction, road upgrade along the L1003, the new construction phase site entrance and upgrade of the existing site entrance on the R401. The assessment assesses potential effects during both the construction and operational phases of the development. A full description of the proposed project, including construction phasing details, is provided in Chapter 3 of this EIS.

For developments of this nature, the construction phase is the critical period with respect to the traffic effects experienced on the surrounding road network in terms of both the additional traffic volumes that will be generated on the network, and the geometric requirements of the abnormally large loads associated with the wind turbine plant. The requirements of the additional traffic and abnormal loads generated during the construction stage were assessed on both the external highway network and at the proposed junctions that will provide access to the site. Locations where remedial measures are required to accommodate the abnormal loads are identified. It should be noted that this report does not assess the strength of the road network or associated structures.

The magnitude of the increase in traffic volumes experienced on the surrounding network is identified during the various construction stages of the development. A preliminary traffic management plan is also provided aimed at minimising the traffic impact on the local highway network.

13.1.1.2 Statement of Authority

This section of the EIS has been prepared by Alan Lipscombe of Alan Lipscombe Traffic and Transport Consultants. Alan is a competent expert in traffic and transport assessments. In 2007 Alan set up a traffic and transportation consultancy providing advice for a range of clients in the private and public sectors. Prior to this Alan was a founding member of Colin Buchanan's Galway office having moved there as the senior transportation engineer for the Galway Land Use and Transportation Study. Since the completion of that study in 1999, Alan has worked throughout the West of Ireland on a range of projects including: major development schemes, the Galway City Outer Bypass, Limerick Planning Land-Use and Transportation Study, Limerick Southern Ring Road Phase II, cost benefit analyses (COBA) and various studies for the NUI Galway. Before moving to Galway in 1997, Alan was involved in a wide variety of traffic and transport studies for CBP throughout the UK, Malta and Indonesia. He has particular expertise in the assessment of development related traffic and transport modelling, including for numerous wind farm developments, and is an accomplished analyst who has experience of a wide variety of modelling packages and methods.

13.1.1.3 Guidance and Legislation

This section of the EIS has been completed in accordance with the guidance set out by the Environmental Protection Agency in *'Guidelines on Information to be contained in Environmental Impact Statements'* (EPA, 2002). This assessment uses standard terminology to describe the likely significant effects associated with the proposed development. Further information on the classification of effects used in this assessment is presented in Section 1.6.2 of this EIS.

13.1.1.4 Methodology and Section Structure

The report adopts the guidance for such assessments set out by Transport Infrastructure Ireland, or TII, (formerly the National Roads Authority or the NRA) in the document *'Guidelines for Traffic and Transport Assessments, May 2014'*. The geometric requirements of the transporter vehicles were assessed using Autocad and Autotrack.

The Traffic and Transport Section of the EIS is set out as follows:

- A review of the existing and future transport infrastructure in the vicinity of the development, including an assessment of 2016 traffic flows and traffic forecasts during an assumed construction year of 2019 *(Sections 13.1.2 - Receiving Environment and 13.1.3 – Existing Traffic Volumes)*,
- A description of the nature of the proposed development and the traffic volumes that it will generate during the different construction stages and when it is operational *(Section 13.1.4 – Proposed Development and Traffic Generation)*,
- A description of the abnormally large loads and vehicles that will require access to the site *(Section 13.1.5 – Construction Traffic Design Vehicles)*,
- A review of the effects of development generated traffic on links and junctions during construction and when the facility is operational *(Section 13.1.6 –Traffic effects during construction and during operation)*,
- A geometric assessment of the route and its capacity to accommodate the abnormal loads associated with the development *(Section 13.1.7 – Route Assessment)*,
- An assessment of the provision for sustainable modes of travel (in this case primarily with respect to the transport of construction staff) *(Section 13.1.8 – Provision for Sustainable Modes of Travel)*,
- The description of likely significant effects is provided in Section 13.1.9.

13.1.2 Receiving Environment

13.1.2.1 Site Location

The location of the proposed wind farm development is in County Offaly, and is shown in the context of the national and local highway network in Figure 13.1. The site is located off the Local L1003 road in the townland of Cloncreen, approximately 10 kilometres (kms) east of Daingean, Co Offaly.

13.1.2.2 Proposed Abnormal Load Delivery Route

It is proposed that the large wind turbine plant will be delivered via the M6 before turning south onto the N52 at Kilbeggan. The route will follow the N52 south, bypassing Tullamore to the east before turning east on the R420. Approximately 6 kms east the route will then head northeast onto the R402 at the priority junction at Ballina Cross. The route will then follow the R402 northeast for approximately 9 kms through the village of Ballinagar, turning due east at Daingean for approximately 10 kms. The site is then accessed via a right turn at the priority junction with the L1003 which provides access to the site by means of a new priority junction 360m southeast of the junction with the R402. The proposed route is shown on Figure 13.1.

The route assessment, which is discussed in Section 13.1.7, covers the following parts of the delivery route;

- Locations 1 to 4 shown in Figure 13.1 on the route between the R420 to the east of Tullamore and the right turn off the R402 onto the L1003 identified as requiring geometric checks with respect to accommodating the large wind turbine vehicles, and
- The access junction (Location 5) that will provide access into the site, and will require works on the existing public highway network.
- Location 6, which is an existing junction on the R401 and will be utilised for a limited number of deliveries to the site using conventional goods vehicles.

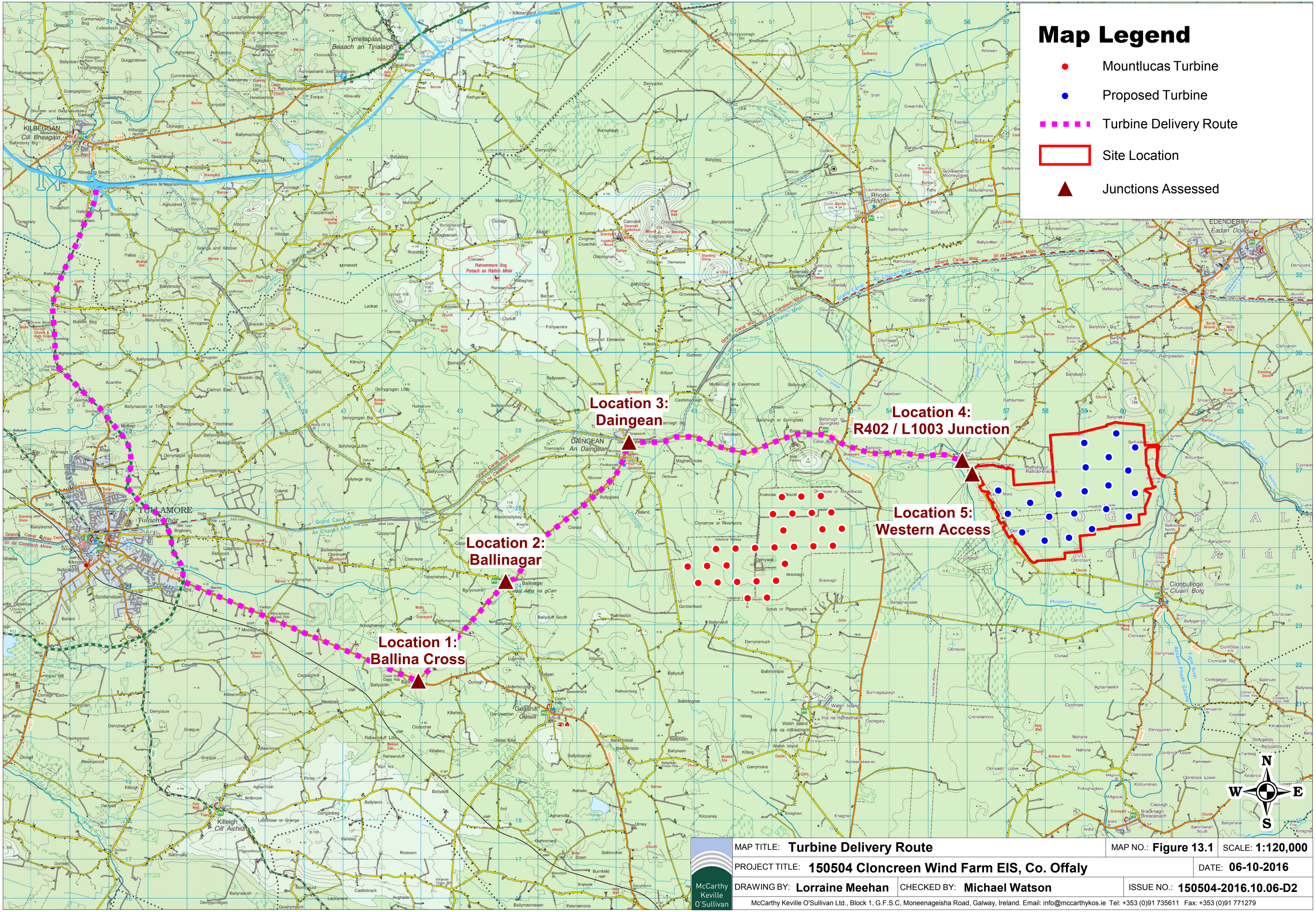
Autotrack assessments were also undertaken to identify the temporary works that would be required at the following additional locations;

- N52 roundabout at Kilbeggan,
- The N52 Ardan Roundabout,
- The N52 Cappancur Roundabout,
- The N52 Cloncollog Roundabout.

The assessment established that the wind turbine plant vehicles will be accommodated at all of these roundabout locations with only minor temporary works within the existing highway boundary required.

13.1.2.3 Proposed Construction Traffic Haul Route

The proposed route for general HGV construction traffic is shown in Figure 13.2. While it is estimated that 90% of this traffic will use exactly the same route as described above for the wind farm plant vehicles, approximately 10% will continue east on the R402 towards Edenderry, before turning right to access the site via a second site entrance located on the R401. This is an existing entrance and minor upgrade works will be required in order to accommodate access and egress of construction vehicles.



MAP TITLE: **Turbine Delivery Route** | MAP NO.: **Figure 13.1** | SCALE: **1:120,000**

PROJECT TITLE: **150504 Cloncreen Wind Farm EIS, Co. Offaly** | DATE: **06-10-2016**

DRAWING BY: **Lorraine Meehan** | CHECKED BY: **Michael Watson** | ISSUE NO.: **150504-2016.10.06-D2**

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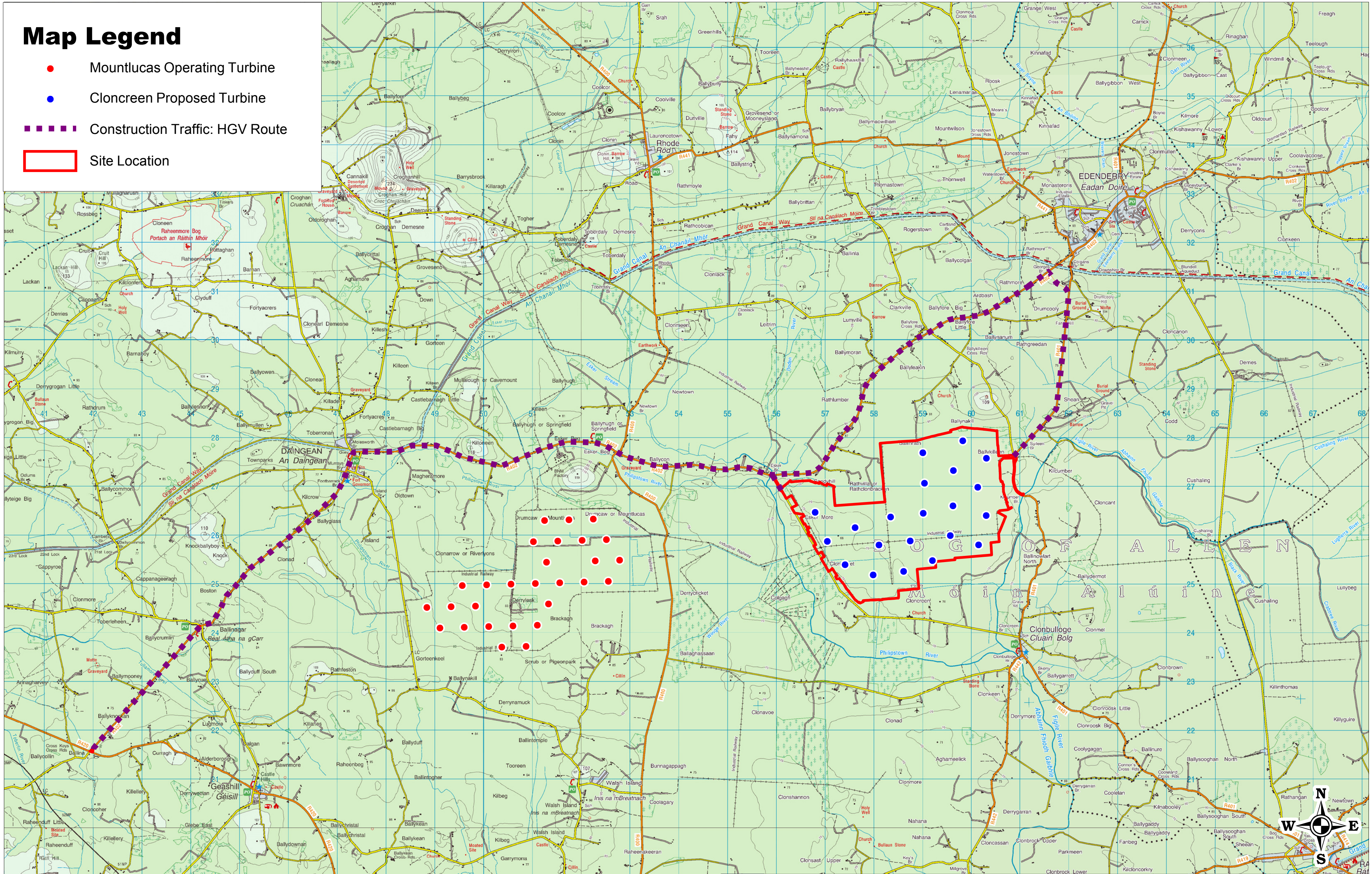

MAP TITLE: Construction Materials Haul Route	MAP NO.: Figure 13.2	SCALE: 1:100,000
PROJECT TITLE: 150504 Cloncreen Wind Farm EIS, Co. Offaly		DATE: 06-10-2016
DRAWING BY: Lorraine Meehan	CHECKED BY: Michael Watson	ISSUE NO.: 150504-2016.10.06-D2

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13.1.2.4 Other Access Locations

There is an existing entrance to the site at the north central section off a local road connected to the R402 which is currently used for access to the peat production areas of the bog and the Bord na Móna 'tea centre', which is currently in use by employees. It is not proposed to use this access location for abnormal loads or general construction traffic. It will be necessary for a small number of vehicles to use this entrance to access the proposed borrow pit in order to begin those operations and also to implement the proposed demolition of the 'tea centre' building and the dismantling of the existing telecoms mast and meteorological mast. This entrance will also be used for the operational phase when the traffic volumes will be very small and significantly less than the existing traffic associated with the peat production activities and employees accessing the 'tea centre'.

At the southern section of the site, to the east of the proposed southern substation there is a proposed internal roadway leading to the existing ash repository site. It is not proposed to use this access location for abnormal loads or general construction traffic. This access will be used during the operational phase of the project when traffic volumes will be limited. Utilisation of this access point during the operation of the wind farm will be heavily influenced by the construction of the Option B substation.

13.1.3 Existing Traffic Volumes

It should be noted that traffic volumes are discussed in passenger car units, or pcus, where each vehicle is expressed in terms of its demand on the network relative to the equivalent number of cars. For example, an articulated HGV was given a factor of 2.4 passenger car units, while one of the extended loaders required to transport the wind turbine equipment was assigned a value of 10.

13.1.3.1 Background Traffic Flows

A continuous traffic counter is maintained by the TII on the N80 south of Tullamore. This information, together with short term traffic counts undertaken on various links on the delivery route, as shown in Figure 13.2, on Wednesday 2nd September, 2016 (between the hours of 17:00 and 18:00), was used to provide sample background traffic volumes on the study road network.

Daily flow profiles were applied to the short period traffic counts using the data from the continuous traffic counter site on the N80 which shows that the average annual daily traffic flow, or AADT, is 11.62 times the flow observed during the hour of 17:00 to 18:00. Existing traffic volumes on the delivery route are shown in Table 13.1 and range from 1,836 vehicles per day on the L1003 approaching the site, to 5,903 pcus on the R402 through Daingean.

Table 13.1 Observed PM peak and all day flows, 2016 (2-way pcus)

Link	Observed flow	Observed hour	AADT factor	All day flow
1 R420 west of Ballina Cross	200	17:00 – 18:00	11.62	2,324
2 R402 south of Ballinagar	344	17:00 – 18:00	11.62	3,997
3 R402 south of Daingean	508	17:00 – 18:00	11.62	5,903
4 R402 west of L1003	475	17:00 – 18:00	11.62	5,520
5 L1003	158	17:00 – 18:00	11.62	1,836
6 R402 east of west access	475	17:00 – 18:00	11.62	5,520

13.1.3.2 Future Background Traffic Volumes

Revised guidelines for forecasting annual growth in traffic volumes were produced by the TII in January 2011, as set out by region in the NRA Project Appraisal Guidelines (Unit 5.5). The annual growth rates for light vehicles for the central east of Ireland, including County Offaly, and factors for the years relevant to this study, are shown in Tables 13.2 and 13.3, with traffic volumes forecast to increase during the period from 2016 to 2019 (the assumed construction year) by 5%, assuming a medium growth scenario. Year 2016 and 2019 AADT flows on the study area network are compared in Table 13.4.

Table 13.2 TII Traffic Growth Indices by growth scenario and year (central east, including County Offaly)

Year	Lights – Annual Factor			Lights – Cumulative Index		
	Low	Medium	High	Low	Medium	High
2009	1.012	1.015	1.025	101.2	101.5	102.5
2010	1.012	1.015	1.025	102.4	103.0	105.1
2011	1.012	1.015	1.025	103.6	104.6	107.7
2012	1.012	1.015	1.025	104.9	106.1	110.4
2013	1.012	1.015	1.025	106.1	107.7	113.1
2014	**1.012**	**1.015**	**1.025**	**107.4**	**109.3**	**116.0**
2015	1.012	1.015	1.025	108.7	111.0	118.9
2016	1.012	1.015	1.025	110.0	112.6	121.8
2017	1.012	1.015	1.025	111.3	114.3	124.9
2018	1.012	1.015	1.025	112.7	116.1	128.0
2019	1.012	1.015	1.025	114.0	117.8	131.2

Source: TII Project Appraisal Guidelines – Unit 5.5

Table 13.3 NRA traffic growth rates by growth scenario

Period	New Factors		
	Low	Medium	High
2016 – 2019	1.04	1.05	1.08

Table 13.4 Average all day flows by location and year (2-way PCUs)

Link	2016	2019
1 R420 west of Ballina Cross	2,324	2,440
2 R402 south of Ballinagar	3,997	4,197
3 R402 south of Daingean	5,903	6,198
4 R402 west of L1003	5,520	5,795
5 L1003	1,836	1,928
6 R402 east of west access	5,520	5,795

The TII traffic count data recorded on the N80 was also used to estimate the existing percentage of HGVs on the study area network. The observed percentage of HGVs was 5.9% with volumes on the study network shown in Table 13.5.

Table 13.5 AADT, percentage HGVs and HGV flow by location, 2019

Link	AADT	% HGV's	HGV flows	Cars / LGV's
1 R420 west of Ballina Cross	2,440	5.9%	144	2,296
2 R402 south of Ballinagar	4,197	5.9%	248	3,950

Link	AADT	% HGV's	HGV flows	Cars / LGV's
3 R402 south of Daingean	6,198	5.9%	366	5,832
4 R402 west of L1003	5,795	5.9%	342	5,454
5 L1003	1,928	5.9%	114	1,814
6 R402 east of west access	5,795	5.9%	342	5,454

13.1.4 Proposed Development and Traffic Generation

13.1.4.1 Development Content

The proposed development is described in detail in Chapters 2 and 3 and comprises of a wind farm development, consisting of 21 No. turbines and associated infrastructure.

Development Trip Generation – During Construction
For the purpose of assessing the traffic effects of traffic generated during the construction of the proposed development, the construction phase is considered in two stages.

- Stage 1 - Site preparation and groundworks, and,
- Stage 2 - Turbine construction.

13.1.4.1.1 Stage 1 - Site Preparation and Ground Works

The site preparation and groundworks stage will last approximately 17 months (for assessment purposes 360 working days have been assumed) with the total numbers of deliveries made to the site during that period shown in Table 13.6.

During the 17-month period there will be two distinct types of days with respect to trip generation. A total of 21 days will be used to pour the 21 concrete wind turbine foundations. Foundations will be poured one per day, with circa 75 concrete loads required for each turbine delivered to the site over a 12-hour period, resulting in just over 6 HGV trips to and from the site per hour. On all of the 360 working days for this stage (including the days that concrete will be delivered to the site), other general materials will be delivered to the site.

During all of Stage 1 it is estimated that 25,562 two-way trips will be made to the site by trucks and large articulated HGVs, as set out in Table 13.6, with the daily effect on the local road network shown in Tables 13.7 and 13.8. The figures show that on the 21 days that concrete will be delivered to the site an additional 360 two-way pcus will be added to the network (comprising 75 two-way HGV trips with 2.4 PCUs per movement), as shown in Table 13.7. Similarly, on all 360 days when other materials will be delivered to the site, traffic volumes on the local network will increase by an average of 320 PCUs, as set out in Table 13.8.

Table 13.6 Stage 1 - Site preparation and groundworks - total movements

Material	Total no. Truck Loads	Truck type
Concrete	1,575	Trucks
Steel	42	Large artic
Sand / binding/stone	23,911	Truck
Ducting	8	Large artic
Cabling	13	Large artic
Coms / ducting	13	Large artic
Total	**25,562**	

Table 13.7 Stage 1 – Concrete foundation pouring - total movements and volumes per delivery day

Material	Total Truck Loads	Truck type	PCU Value	Total PCUs	PCU Movements /day*	2- way PCUs/day
Concrete	1,575	Truck	2.4	3,780	180.0	360.0
* Estimation based on 21 concrete pouring days						

Table 13.8 Stage 1 – Site preparation and groundworks - total movements and volumes per delivery day

Material	Total Truck Loads	Truck type	PCU Value	Total PCUs	PCU Movements /day*	2- way PCUs/day
Steel	42	Large artic	2.4	101.8	0.3	0.6
Sand/bind/stone	23,911	Truck	2.4	57,386.4	159.4	318.8
Ducting	8	Large artic	2.4	20.2	0.1	0.2
Cabling	13	Large artic	2.4	30.2	0.1	0.2
Coms ducting	13	Large artic	2.4	30.2	0.1	0.2
Total	**23,987**	**-**		**57,567.8**	**159.9**	**319.8**
* Estimation based on ground work period of 360 working days						

13.1.4.1.2 Stage 2 - Turbine Construction

During the turbine construction stage, including delivery and assembly, there will be deliveries to the site made by very large vehicles, referred to in this section as *extended artics*, transporting the component parts of the turbines (nacelles, blades and towers) and there will be deliveries made by normal large HGVs, transporting cables, tools and smaller component parts. The types of load and associated numbers of trips made to the site during the turbine construction period are shown in Table 13.9, which summarises that a total of 189 trips will be made to and from the site by extended artics, with a further 63 trips made by conventional large articulated HGVs.

Table 13.9 Stage 2 - Wind turbine plant - total movements

Material	Units	Quantity per Unit	Total Quantity	Quantity per Truck	Total Truck Loads	Truck type
Nacelle	21	1	21	1	21	Extended Artic
Blades	21	3	63	1	63	Extended Artic
Towers	21	5	105	1	105	Extended Artic
Sub total					**189**	
Cables/ controllers	21	1	21	1	21	Large Artic
Blade hub	21	1	21	1	21	Large Artic
Tools and generator	21	1	21	1	21	Large Artic
Sub total					**63**	
Total					**252**	

It is estimated that the turbine delivery element will progress at the rate of 5 extended artic trips made by convoy to the site on 2 days per week, resulting in this stage taking 38 days spread over 19 weeks. On a further two days per week, lasting for 11 weeks, the remaining equipment required during this phase will be delivered to the site. The additional traffic movements for these 2 types of days are summarised in Tables 13.10 and 13.11. In Table 13.10 a PCU equivalent value of 10 was allocated to each extended artic movement, resulting in an additional 100 PCUs on the study network on these 2 days per week, while an additional 14.4 PCUs are forecast to be on the network on two other days per week, as shown in Table 13.11, during the turbine construction phase.

Table 13.10 Stage 2 - Wind turbine plant, extended artics - total movements and volumes per delivery day

Material	Units	Truck Type	PCU Value	Total PCUs	2-way PCUs/ day
Nacelle	1	Extended Artic	10	10.0	20.0
Blades	3	Extended Artic	10	30.0	60.0
Towers	5	Extended Artic	10	50.0	100.0
Total per turbine	**9**	Extended Artic **-**	**10**	**90.0**	**180.0**
Total per delivery day	**5**	Extended Artic	**10**	**50**	**100.0**
* Estimation based on 5 abnormal loads being delivered per day on 2 days per week					

Table 13.11 Stage 2 - Wind turbine plant, normal artic HGVs - total movements and volumes per delivery day

Material	Units	Quantity per Unit	PCU Value	Total PCU's	PCU Movements/ day**	2-way PCUs / day
Cables / controllers	21	1	2.4	12	2.4	4.8
Blade hub	21	1	2.4	12	2.4	4.8
Tools and generator	21	1	2.4	12	2.4	4.8
Total	**63**	**-**	**-**	**36**	**7.2**	**14.4**
* Estimation based on equipment for 2 turbines being moved per week spread over 2 days						

13.1.4.1.3 Construction Employee Traffic

It is estimated that a maximum of 120 staff members will be employed on the site at any one time during the 17-month long site preparation and groundworks stage of construction, reducing to a maximum of 80 staff at any one time during the turbine construction stage. If a worst case is assumed that all staff will travel to / from the site by car, at an average of 2 persons per car, then a total of 120 pcu movements (each trip is two way) will be added to the network during the groundworks stage of the development, reducing to 80 pcu trips during the turbine construction stage.

13.1.4.2 Development Trip Generation – During Operation

It is estimated that the traffic volumes that will be generated by the development once it is operational will be minimal, with a likely maximum of 6 staff employed on site at any one time. The impact on the network of these trips during the operational stage is discussed in Section 13.1.6.

13.1.5 Construction Traffic Design Vehicles

13.1.5.1 Construction Traffic Vehicle Types

The test turbine is based on a blade length of 65.5m. It should be noted that the transportation of the blades and the mid-section of the steel tower are the critical elements in terms of dimensions and were therefore adopted for the assessment.

While the turbine dimensions of a 131 metres rotor diameter turbine have been used for the purposes of this assessment, the actual turbine to be installed on the site will be the subject of a competitive tender process, and could include turbines not amongst those originally considered as part of this assessment because they are not yet available on the market. Regardless of the make or model of the turbine eventually selected for installation on site, a detailed delivery assessment and program will be carried out by the turbine delivery company and a similar methodology will be adopted as set out here to ensure the findings of this assessment remain valid for whatever model of turbine is selected. Any references to the turbine dimensions in the text below must be considered in the context of the above, and should not be construed as meaning it predetermines the dimensions of any wind turbine that could be used on the site.

The key dimensions are as follows:

Transport of Blades – Articulated HGV with blade

Total length	71.5 m
Length of blade	65.5 m

Inner radius	25.0 m

Transport of Tower – Using low-bed or drop deck trailers

Total length (with load)	46.7 m
Length of load	29 m
Inner radius	25.0 m

The critical vehicles in terms of size and turning geometry requirements, and used in the detailed route assessment discussed in Section 13.1.7 are the blade transporter and the tower transporter with the geometry of each shown in Figures 13.3 and 13.4 respectively. It should be noted that for the blade transport vehicle it is assumed that the blade will overhang the rear of the trailer by 11m, as shown in Figure 13.3.

The vehicles used to transport the nacelles will be similar to the tower transporter although will be shorter in length.

All other vehicles requiring access to the site will be standard HGVs (maximum 16.5 metres long) and will be significantly smaller than the design test vehicles.

13.1.6 Traffic Effects During Construction and During Operation

13.1.6.1 Traffic Effect During Construction and During Operation

Effect on Link Flows – During Construction

Background traffic volumes and development generated traffic volumes are shown for the three typical construction days discussed in Section 13.1.4 in Tables 13.12 to 13.15 and are summarised in Tables 13.16 and 13.19.

While all of the large turbine plant vehicles will access the site via the haul route and the access junction on the L1003, as shown in Figure 13.1, as stated previously, it is estimated that 90% of all other construction traffic will use exactly the same route, with the remaining 10% continuing east on the R402 towards Edenderry, before turning right to access the site via a second site entrance located on the R401, as shown in Figure 13.1. This is reflected in the number of days each location on the route is effected as set out in Tables 13.16 to 13.19.

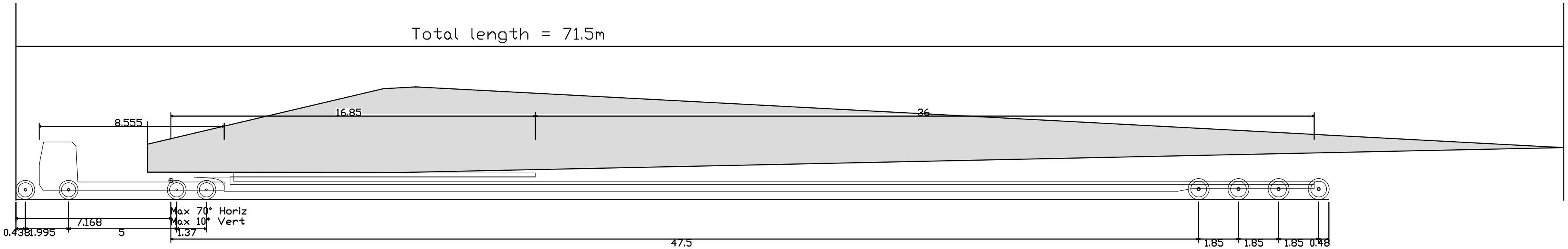
In terms of daily traffic flows the effects may be summarised as follows:

During Stage 1 – Concrete pouring, Site Preparation and Groundworks

For 21 weekdays when the concrete foundations are poured simultaneously to general site preparation and groundworks being undertaken on the site, an additional 800 PCUs will travel on the study network. On these days the percentage increase in traffic volumes experienced on the study network will be between 12.9% on the R402 south of Daingean, and 41.5% on the L1003 approaching the site.

During Stage 1 - Site Preparation and Groundworks

For 339 weekdays, an additional 440 PCUs will travel on the local highway network resulting in a percentage increase in traffic volumes of between 7.1% on the R402 south of Daingean and 22.8% on the L1003 leading to the site.



N131 (65.5 Blade)

Overall Length	60.697m (excluding blade overhang, total length = 71.5m)
Overall Width	2.550m
Overall Body Height	2.661m
Min Body Ground Clearance	0.375m
Track Width	2.500m
Lock to Lock Time	6.00s
Wall to Wall Turning Radius	9.800m

NOTES:

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FIGURE 13.3 Design blade extended artic profile

PROJECT: Cloncreen Wind Farm EIS

CLIENT: Bord na Móna

SCALE: NTS

PROJECT NO: 4250

DATE: 05.09.16

DRAWN BY: AL

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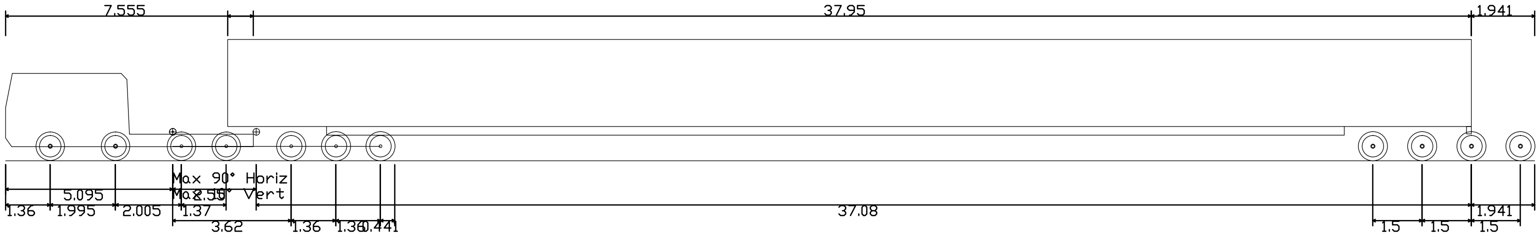

Siemens Tower 46.75 (Final)

Overall Length	46.666m
Overall Width	2.550m
Overall Body Height	3.695m
Min Body Ground Clearance	0.427m
Max Track Width	2.520m
Lock to Lock Time	6.00s
Wall to Wall Turning Radius	9.800m

NOTES:

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FIGURE 13.4 Design tower extended artic profile

PROJECT:	Cloncreen Wind Farm EIS		
CLIENT:	Bord na Móna	SCALE:	NTS
PROJECT NO: 4250	DATE: 05.09.16	DRAWN BY:	AL

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During Stage 2 - Turbine Construction Stage – Delivery of large equipment using extended articulated vehicles

The additional 180 PCUs (made up of cars and large extended artics) will appear on the study network for 38 days. On the days this impact occurs volumes will increase by 2.9% on the R402 through Daingean and by 9.3% on the L1003.

The traffic impact during these days may be the most experienced due to the proposed development primarily due to the slow speeds, size and geometric requirements of these vehicles. The provision of traffic management measures, addressed at a preliminary level in Section 13.1.6, will be required to minimise the impact of development traffic on the study network on these days.

During Stage 2 - Turbine Construction Stage – Other deliveries using conventional articulated HGVs

For 21 weekdays on the delivery route 95 additional PCUs (made up of cars and normal articulated HGV movements to the site and back) will travel on the study network. On these days the percentage increase on the study network will be between 1.5% (on the R402 through Daingean) and 4.9% (on the L1003).

Table 13.12 Effects of development traffic during concrete pouring

Link	Background PCUs			Development PCUs			Total PCUs		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 R420 west of Ballina Cross	2,296	144	2,440	120	680	800	2,416	824	3,240
2 R402 south of Ballinagar	3,950	248	4,197	120	680	800	4,070	928	4,997
3 R402 south of Daingean	5,832	366	6,198	120	680	800	5,952	1,046	6,998
4 R402 west of L1003	5,454	342	5,795	120	680	800	5,574	1,022	6,595
5 L1003	1,814	114	1,928	120	680	800	1,934	794	2,728
6 R402 east of west access	5,454	342	5,795	120	360	480	5,574	1,022	6,595

Table 13.13 Effects of development traffic during site preparation and groundworks

Link	Background PCUs			Development PCUs			Total PCUs		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 R420 west of Ballina Cross	2,296	144	2,440	120	320	440	2,416	464	2,880
2 R402 south of Ballinagar	3,950	248	4,197	120	320	440	4,070	568	4,637
3 R402 south of Daingean	5,832	366	6,198	120	320	440	5,952	686	6,638
4 R402 west of L1003	5,454	342	5,795	120	320	440	5,574	662	6,235
5 L1003	1,814	114	1,928	120	320	440	1,934	434	2,368

6 R402 east of west access	5,454	342	5,795	120	320	440	5,574	662	6,235

Table 13.14 Effect of development traffic during turbine construction - extended artics

Link	Background PCUs			Development PCUs			Total PCUs		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 R420 west of Ballina Cross	2,296	144	2,440	80	100	180	2,376	244	2,620
2 R402 south of Ballinagar	3,950	248	4,197	80	100	180	4,030	348	4,377
3 R402 south of Daingean	5,832	366	6,198	80	100	180	5,912	466	6,378
4 R402 west of L1003	5,454	342	5,795	80	100	180	5,534	442	5,975
5 L1003	1,814	114	1,928	80	100	180	1,894	214	2,108
6 R402 east of west access	5,454	342	5,795	80	100	180	5,534	442	5,975

Table 13.15 Effect of development traffic during turbine construction – other deliveries

Link	Background PCUs			Development PCUs			Total PCUs		
	Car	HGV	Total	Car	HGV	Total	Car	HGV	Total
1 R420 west of Ballina Cross	2,296	144	2,440	80	15	95	2,376	159	2,535
2 R402 south of Ballinagar	3,950	248	4,197	80	15	95	4,030	263	4,292
3 R402 south of Daingean	5,832	366	6,198	80	15	95	5,912	381	6,293
4 R402 west of L1003	5,454	342	5,795	80	15	95	5,534	357	5,890
5 L1003	1,814	114	1,928	80	15	95	1,894	129	2,023
6 R402 east of west access	5,454	342	5,795	80	15	95	5,534	357	5,890

Table 13.16 Summary effect of development traffic during concrete pouring and site preparation and groundworks

Link	Background	Development	Total	% increase	No days
1 R420 west of Ballina Cross	2,440	800	3,240	32.8%	21
2 R402 south of Ballinagar	4,197	800	4,997	19.1%	21
3 R402 south of Daingean	6,198	800	6,998	12.9%	21
4 R402 west of L1003	5,795	800	6,595	13.8%	21
5 L1003	1,928	800	2,728	41.5%	19
6 R402 east of west access	5,795	800	6,595	13.8%	2

Table 13.17 Summary effect of development traffic during site preparation and groundworks

Link	Background	Development	Total	% increase	No days
1 R420 west of Ballina Cross	2,440	440	2,880	18.0%	339
2 R402 south of Ballinagar	4,197	440	4,637	10.5%	339
3 R402 south of Daingean	6,198	440	6,638	7.1%	339
4 R402 west of L1003	5,795	440	6,235	7.6%	339
5 L1003	1,928	440	2,368	22.8%	305
6 R402 east of west access	5,795	440	6,235	7.6%	34

Table 13.18 Summary effect of development traffic during turbine construction – extended artics

Link	Background	Development	Total	% increase	No days
1 R420 west of Ballina Cross	2,440	180	2,660	7.4%	38
2 R402 south of Ballinagar	4,197	180	4,377	4.3%	38
3 R402 south of Daingean	6,198	180	6,378	2.9%	38
4 R402 west of L1003	5,795	180	5,975	3.1%	38
5 L1003	1,928	180	2,108	9.3%	38
6 R402 east of west access	5,795	0	5,795	0%	0

Table 13.19 Summary effect of development traffic during turbine construction – other deliveries

Link	Background	Development	Total	% increase	No days
1 R420 west of Ballina Cross	2,440	95	2,535	3.9%	21
2 R402 south of Ballinagar	4,197	95	4,292	2.3%	21
3 R402 south of Daingean	6,198	95	6,293	1.5%	21
4 R402 west of L1003	5,795	95	5,890	1.6%	21
5 L1003	1,928	95	2,023	4.9%	19
6 R402 east of west access	5,795	95	5,890	1.6%	2

An assessment of the impact on link capacities in the study area was undertaken for the various construction stages as set out in Tables 13.20 to 13.22. The capacity for each link in the study area is shown in Table 13.20. The capacities range from a daily flow of 8,600 vehicles on the R402 to 5,000 vehicles on the L1003 once widened to 6.0m, and are based on road widths and capacities set out in the Transport Infrastructure Ireland Standards document DN-GEO-03031 Road Link Design, Table 6/1. Background, or do nothing traffic flows, are compared to flows forecast for the various construction delivery stages in Table 13.21 with the percentage capacity reached for each link and stage shown in Table 13.21. Based on this assessment the following points should be noted;

- All links for all stages are forecast to operate within capacity,
- The link on the study network under most pressure based on background traffic levels is the R402 south of Daingean, which will operate at 72% without any additional construction traffic. For the worst case construction days, the 21 days that concrete will be poured and other site and groundworks will also be undertaken, this link will operate at 81% of capacity, still well within capacity.

Table 13.20 Carriageway width, link type and link capacity

Link	Width (m)	Link type	Link capacity
1 R420 west of Ballina Cross	6.8	Type 2 single	8,600
2 R402 south of Ballinagar	6.5	Type 2/3 single	6,800
3 R402 south of Daingean	7.0	Type 2 single	8,600
4 R402 west of L1003	7.0	Type 2 single	8,600
5 L1003	6.0	Type 3 single	5,000
6 R402 east of west access	7.0	Type 2 single	8,600

Table 13.21 Link capacity and summary of link flows by construction delivery stage

Link	Link capacity	Construction delivery stage				
		Background traffic	Concrete pour	Other site works	Turbine plant	Turbine equipment
1 R420 west of Ballina Cross	8,600	2,440	3,240	2,880	2,620	2,535
2 R402 south of Ballinagar	6,800	4,197	4,997	4,637	4,377	4,292
3 R402 south of Daingean	8,600	6,198	6,998	6,638	6,378	6,293
4 R402 west of L1003	8,600	5,795	6,595	6,235	5,975	5,890
5 L1003	5,000	1,928	2,728	2,368	2,108	2,023
6 R402 east of west access	8,600	5,795	6,595	6,235	5,975	5,890

Table 13.22 Link capacity and % of link capacity by construction delivery stage

Link	Link capacity	Construction delivery stage				
		Background traffic	Concrete pour	Other site works	Turbine plant	Turbine equipment
1 R420 west of Ballina Cross	8,600	28%	38%	33%	30%	29%
2 R402 south of Ballinagar	6,800	62%	73%	68%	64%	63%
3 R402 south of Daingean	8,600	72%	81%	77%	74%	73%
4 R402 west of L1003	8,600	67%	77%	73%	69%	68%
5 L1003	5,000	39%	55%	47%	42%	40%
6 R402 east of west access	8,600	67%	77%	73%	69%	68%

Effect on Link Flows – During Operation

Once the wind farm is operational it is estimated that there will be a maximum of 6 staff members employed on site with a similar number of vehicle trips. It is considered that the traffic impact during this phase will be negligible.

Effect on Junctions – During Construction

The capacity of the study area junction most affected was assessed using the industry standard junction simulation software PICADY, which permits the capacity of any junction to be assessed with respect to existing or forecast traffic movements and volumes for a given time period. The capacity for each movement possible at the junction being assessed is determined from geometric data input into the program with the output used in the assessment as follows:

Queue – This is the average queue forecast for each movement and is useful to ensure that queues will not interfere with adjacent junctions.

Degree of Saturation or ration of flow to capacity (% Sat or RFC) – As suggested, this offers a measure of the amount of available capacity being utilised for each movement. Ideally each movement should operate at a level of no greater 85% of capacity.

Delay – Output in minutes, this gives an indication of the forecast average delay during the time period modelled for each movement.

Scenarios Modelled

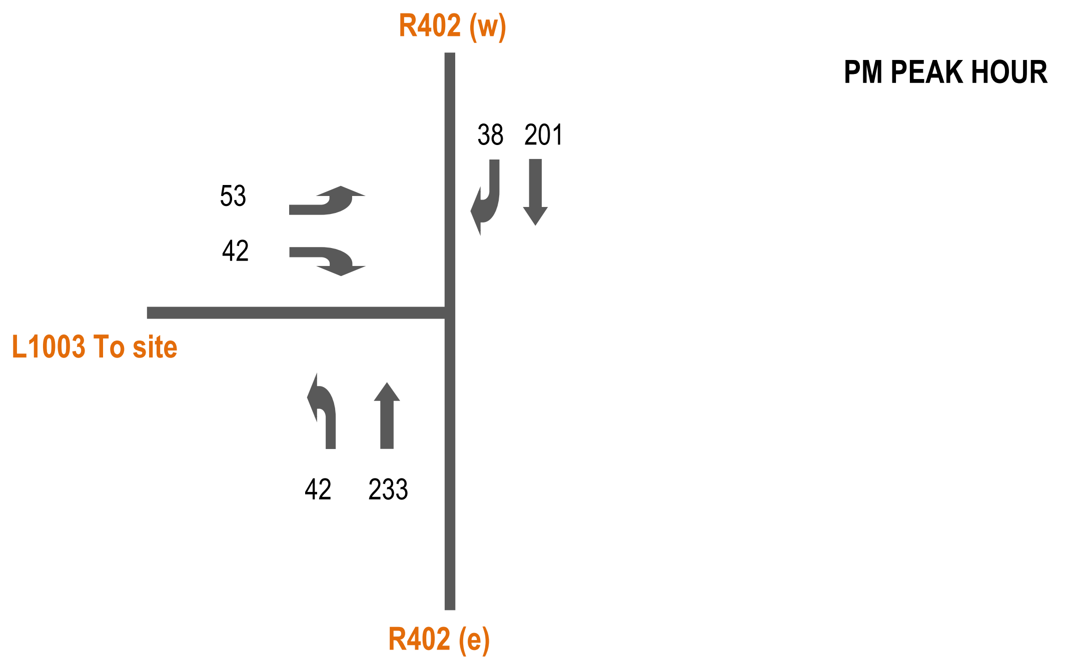
While other junctions and links on the network will experience an increase in traffic volumes passing through them, as discussed previously and set out in Tables 13.16 to 13.19 above, the worst case effect will be experienced during peak hours at the junction between the R402 and the L1003, when, during peak construction periods, up to 120 workers (60 cars) will pass through it. It is noted that deliveries of materials to the site will take place during the day after the workers have arrived on site, and before they leave at the end of the day, and will therefore not occur at the same time.

R402 / L1003 junction Capacity Test Results

The PM peak hour traffic flows for the year 2019 without and with construction workers passing through this junction are shown in Figure 13.15, with the capacity results shown in Table 13.23. The results show that additional 60 car trips passing through the junction will have a minor effect, increasing the maximum ratio of flow to capacity (RFC) at the junction from 13.3% to 23.1% for the exit from the local L1003 road onto the R402 (well within the acceptable limit of 85%).

Table 13.23 Junction capacity test results, R402 / L1003 junction, PM peak, without and with construction staff, year 2019

Year	Location	Without construction traffic			With construction traffic		
		RFC	Queue (vehicles)	Delay (minutes)	RFC	Queue (vehicles)	Delay (minutes)
2016	Right turn from L1003	13.3%	0.15	0.20	23.1%	0.30	0.24
	Left turn from L1003	11.1%	0.12	0.13	19.4%	0.24	0.15
	Right turn into L1003	10.0%	0.18	0.10	10.6%	0.19	0.11



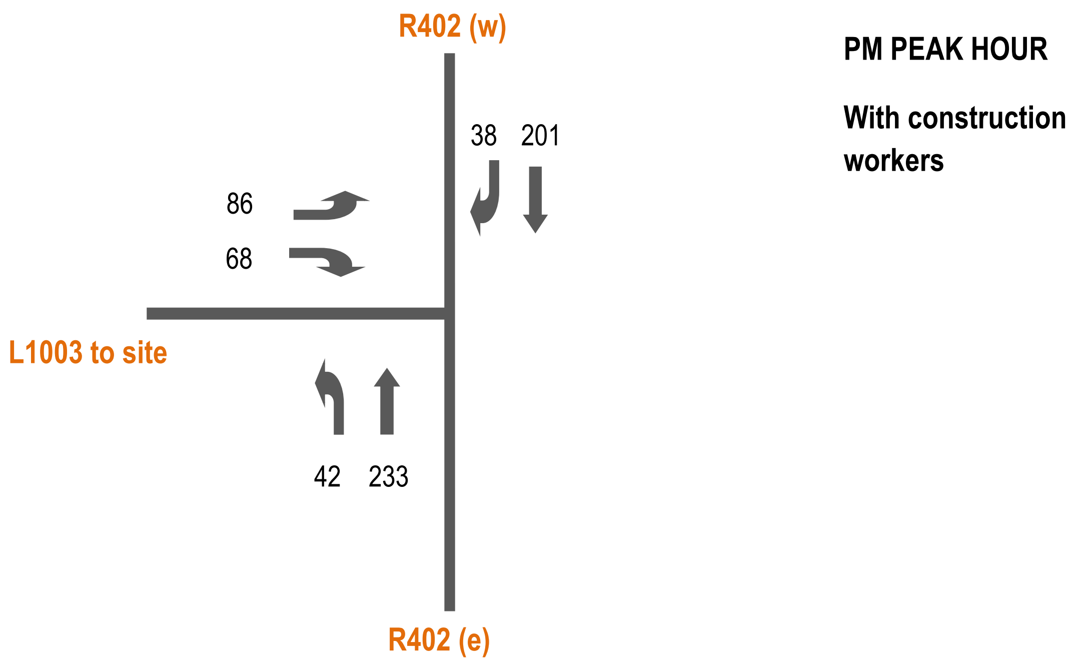


FIGURE 13.15	R402 / L1003 junction turning flows, PM Peak hour, without and with construction workers, 2019

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		Drawn by:	AL
Client:	Bord na Móna	Project No.:	4250

Effect on Junctions – During Operation
As discussed in Section 13.1.6 it is forecast that once operational, the development will generate a maximum of 3 to 5 trips per day for maintenance purposes. It is therefore concluded that the development will have a negligible effect on the local network once constructed.

Effect on network of Grid Connection
The planning application includes 2 No. substations and associated grid connections; however, only one substation and associated grid connection will ultimately be constructed. The proposed wind farm will connect to the grid via one of the following methods:

- Option A: Construction of a 110 kV substation in the eastern section of the site. This substation will connect to the National Grid via an underground cable (1.7 kilometres in length) running from the substation to the existing 110 kV Cushaling substation at Edenderry Power Plant, located directly east of the proposed wind farm site. The proposed underground cable will be located on Bord na Móna lands and the public road.

Or:

- Option B: Construction of a 110 kV substation in the southern section of the site. This substation will connect to the National Grid via a short section of overhead line (less than 0.1km) to the existing 110 kV Thornsberry/Cushaling electricity transmission line, located within the site.

Should Option A be constructed the cable will require to be set along approximately 1km of the R401 regional road. Approximately 300m of cable will be installed per day, meaning that traffic on this section of the R401 will experience short delays for approximately 3 to 4 days due to the temporary closure of one traffic lane and a "stop and go" type traffic management measure put in place.

Should Option B be constructed there will be no effects on the local road network.

Traffic Management of Large Deliveries
The greatest effect on the road network will likely be experienced on the approximately 38 days during which the 5 very large loads comprising the tower sections, the blades and the nacelles are delivered to the site.

Prior to the construction stage a detailed traffic management plan will be prepared by the haulage company and submitted to Offaly County Council for approval. The plan will include:

- A delivery schedule,
- Details of the alterations required to the infrastructure identified in this report and any other minor alteration identified (hedge rows etc),
- A dry run of the route using vehicles with similar dimensions.

It is proposed that deliveries will be made to the site in a convoy of 5 vehicles at a time with Garda escorts at the front and rear operating a "stop and go" system. There will be no more than 2 convoys per day.

It is not anticipated that any sections of the local road network will be closed, although there may be significant delays to local traffic at various locations if the deliveries are made during daylight hours. During these periods it may be appropriate to operate local diversions for through traffic. The effect of this stage may be minimised by the deliveries of the abnormally large loads taking place during the night.

At a minimum, all of the deliveries comprising abnormally large loads will be made outside the normal peak traffic periods to avoid disruption to work and school related traffic.

13.1.7 Route Assessment

13.1.7.1 Preliminary Route Assessment

The preliminary assessment is confined to locations considered as potentially presenting issues for the abnormal loads, as identified from site visits and indicated in Figure 13.1. For these locations road and junction alignments based on OS mapping or site survey data were supplied by the project team. A preliminary swept path analysis was then undertaken using Autotrack in order to establish the locations where the wind farm transporter vehicles will be accommodated, and the locations where some form of remedial measure may be required. However, it is recommended that a dry run using vehicles with the same dimensions as the actual delivery vehicles to be used is undertaken before the construction phase.

Location 1 – Left turn from R420 to R402 at Ballina Cross
It is proposed that the large turbine vehicles will turn left at this junction with the geometric requirements of the large turbine vehicles shown in Figures 13.5 and 13.6. The figures show that the existing junction layout will not accommodate the design vehicles and Figure 13.5, which shows the swept path of the blade transporter, indicates the area of land that will be required on temporary basis, during the delivery stage of the development. The R420/401 junction is shown in Plates 13.1 and 13.2.

Plate 13.1 R420 / R402 junction

NOTES:

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Figure 13.5 Location 1 - Left turn from R420 to R402, blade extended artic (survey base)

PROJECT:	Cloncreen Wind Farm EIS
CLIENT:	Bord na Móna
SCALE:	1:1000
PROJECT NO:	4350
DATE:	05.09.16
DRAWN BY:	AL

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Figure 13.6 Location 1 - Left turn from R420 to R402, tower extended artic (survey base)

PROJECT: Cloncreen Wind Farm EIS			
CLIENT: Bord na Móna		SCALE: 1:1000	
PROJECT NO: 4350	DATE: 05.09.16	DRAWN BY: AL	

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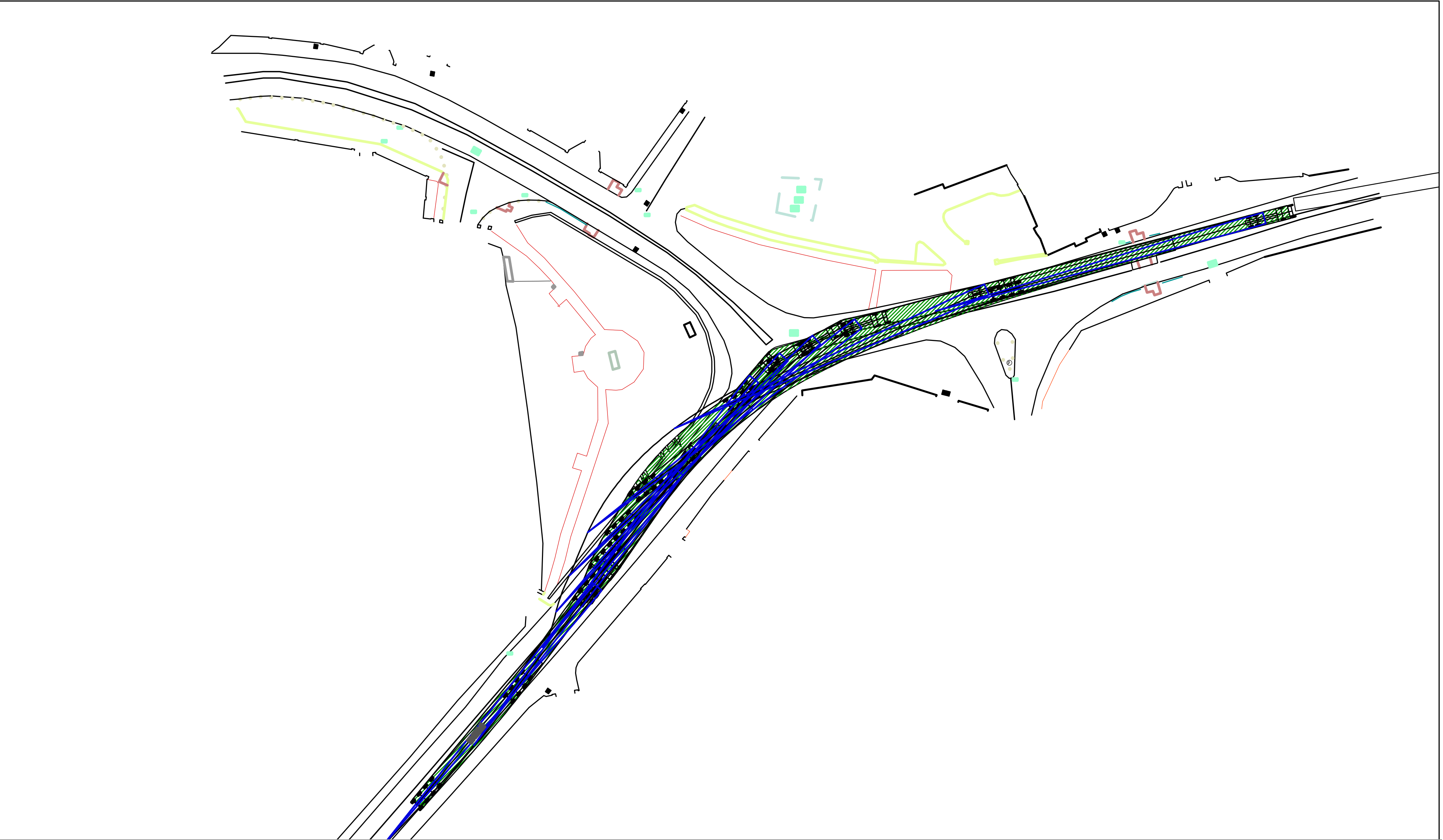
Plate 13.2 R420 / R402 junction – looking northeast along R402

Location 2 – R402 on approach to Ballinagar

Similarly, as shown in Figures 13.7 and 13.8, the swept path analysis undertaken for this location indicates that the existing geometry at this bend on the approach to Ballinagar will not accommodate the design turbine vehicles. Figure 13.7, which shows the geometric requirements of the blade transporter, indicates the land on the northwest corner of the junction that will be required on a temporary basis during the delivery stage of the development. This location is shown in Plate 13.3.

Plate 13.3 R402 on approach to Ballinagar



NOTES:

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Figure 13.7 Location 2 - Right turn on R402 on approach to Ballinagar, blade extended artic (survey base)

PROJECT:	Cloncreen Wind Farm EIS		
CLIENT:	Bord na Móna	SCALE:	1:1000
PROJECT NO: 4350	DATE: 05.09.16	DRAWN BY:	AL

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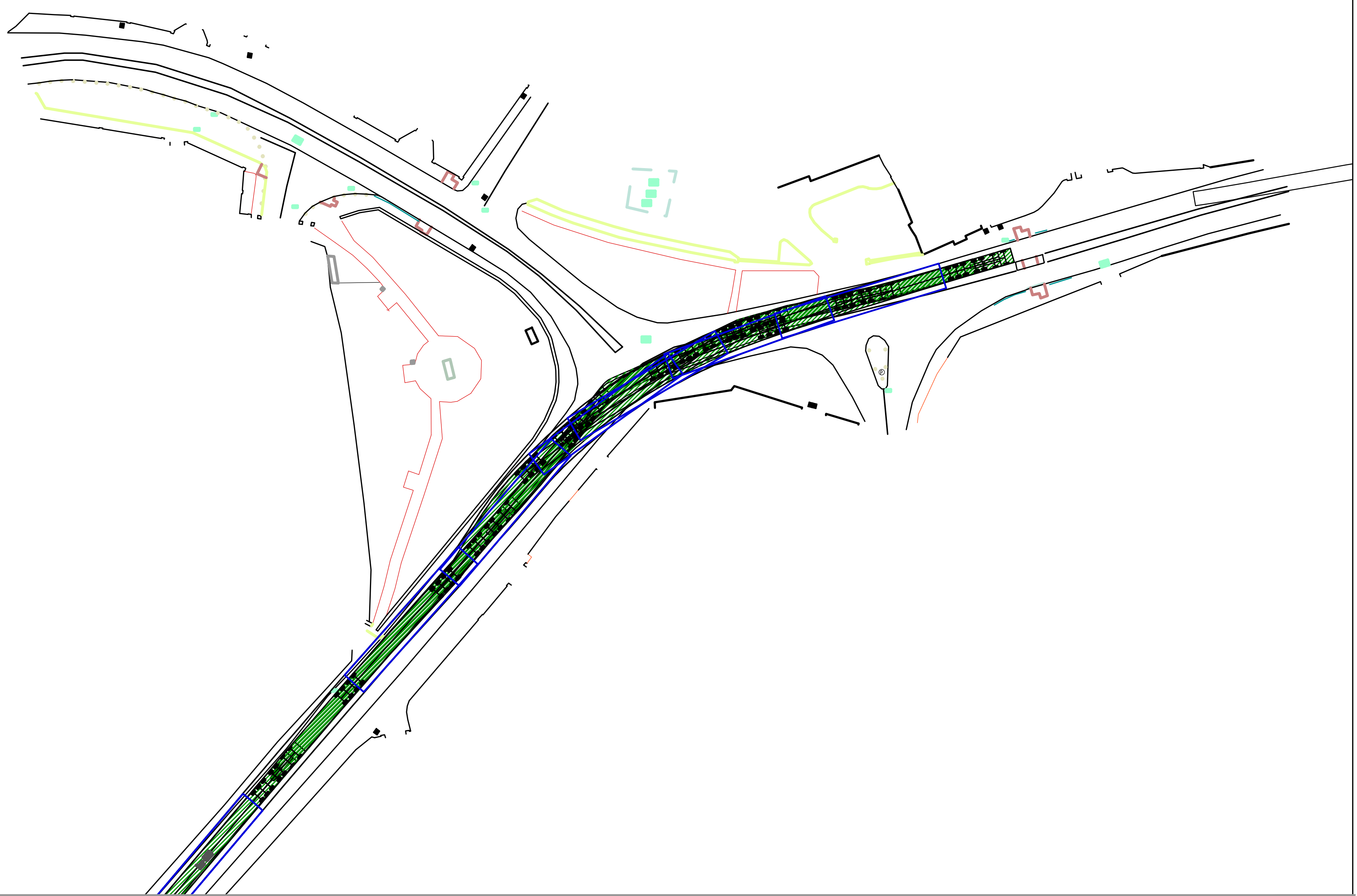

NOTES:

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Figure 13.8 Location 2 - Right turn on R402 on approach to Ballingar, tower extended artic (survey base)

PROJECT: Cloncreen Wind Farm EIS			
CLIENT: Bord na Móna		SCALE: 1:1000	
PROJECT NO: 4350	DATE: 05.09.16	DRAWN BY: AL	

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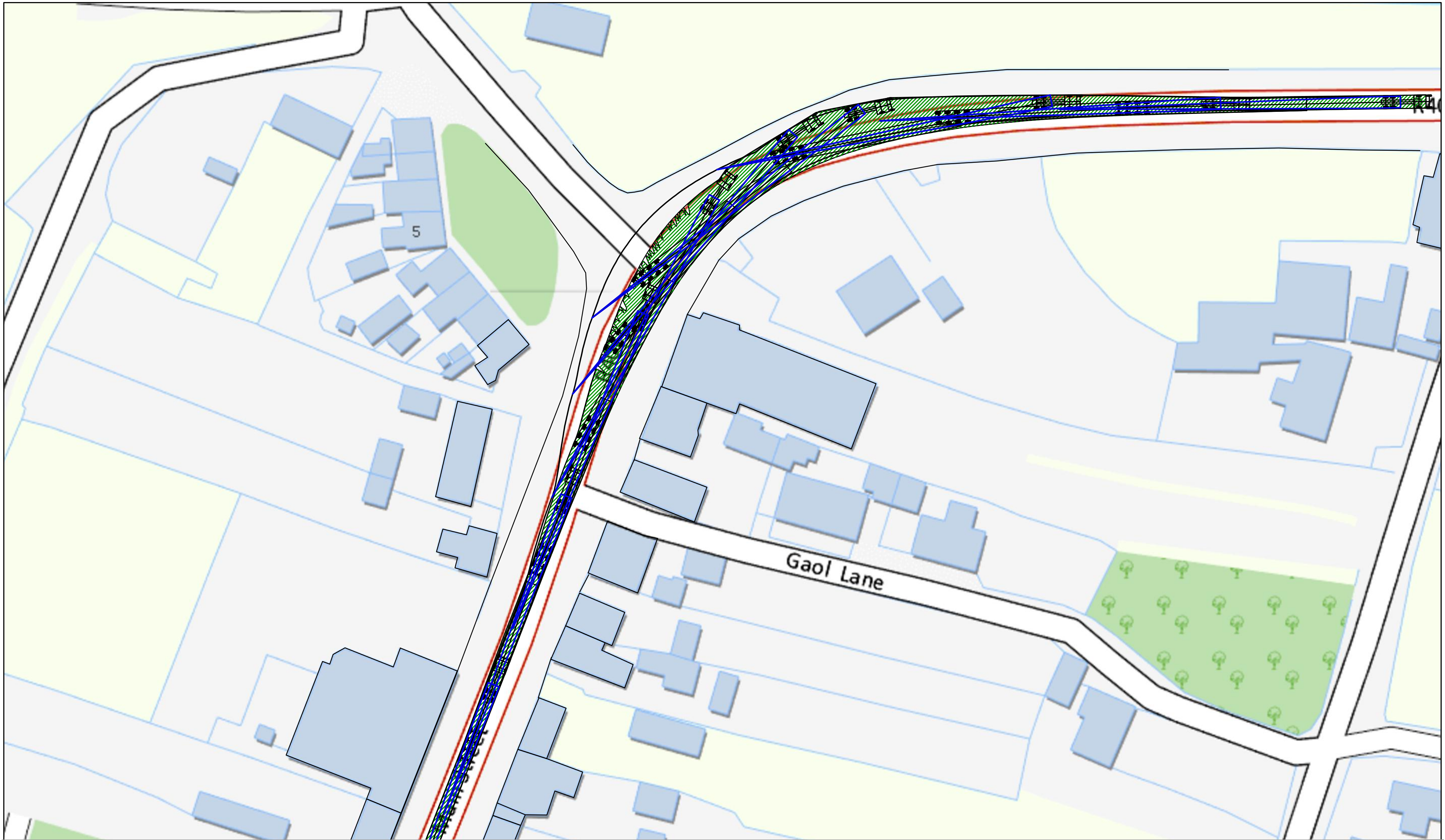
Location 3 – Right hand bend on R402 through Daingean
Figures 13.9 and 13.10 illustrate that this location will accommodate the wind turbine design vehicles. The approach to the right hand bend is shown in Plate 13.4.

Plate 13.4 Approach to right hand bend on R402 through Daingean

Location 4 – Right turn off R402 onto the L1003
The assessment for this location is illustrated in Figures 13.11 and 13.12. The swept path analysis shows that a small section of the south west corner will be required as a temporary over-run area during the delivery stage of the large turbine plant. The assessment indicates that the ESB post on the south side of the road (as shown in Plate 13.5) will not be affected.

Plate 13.5 Junction between the R402 and the L1003

Location 5 – Access junction on L1003
The design drawings for the proposed access junction on the L1003 are included in Appendix 3-1 of the EIS. The swept path requirements of the turbine plant vehicles



NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 13.9 Location 3 - Right hand bend through Daingean on R402, blade extended artic (OS base)

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PROJECT NO: 4350	DATE: 05.09.16	DRAWN BY:	AL

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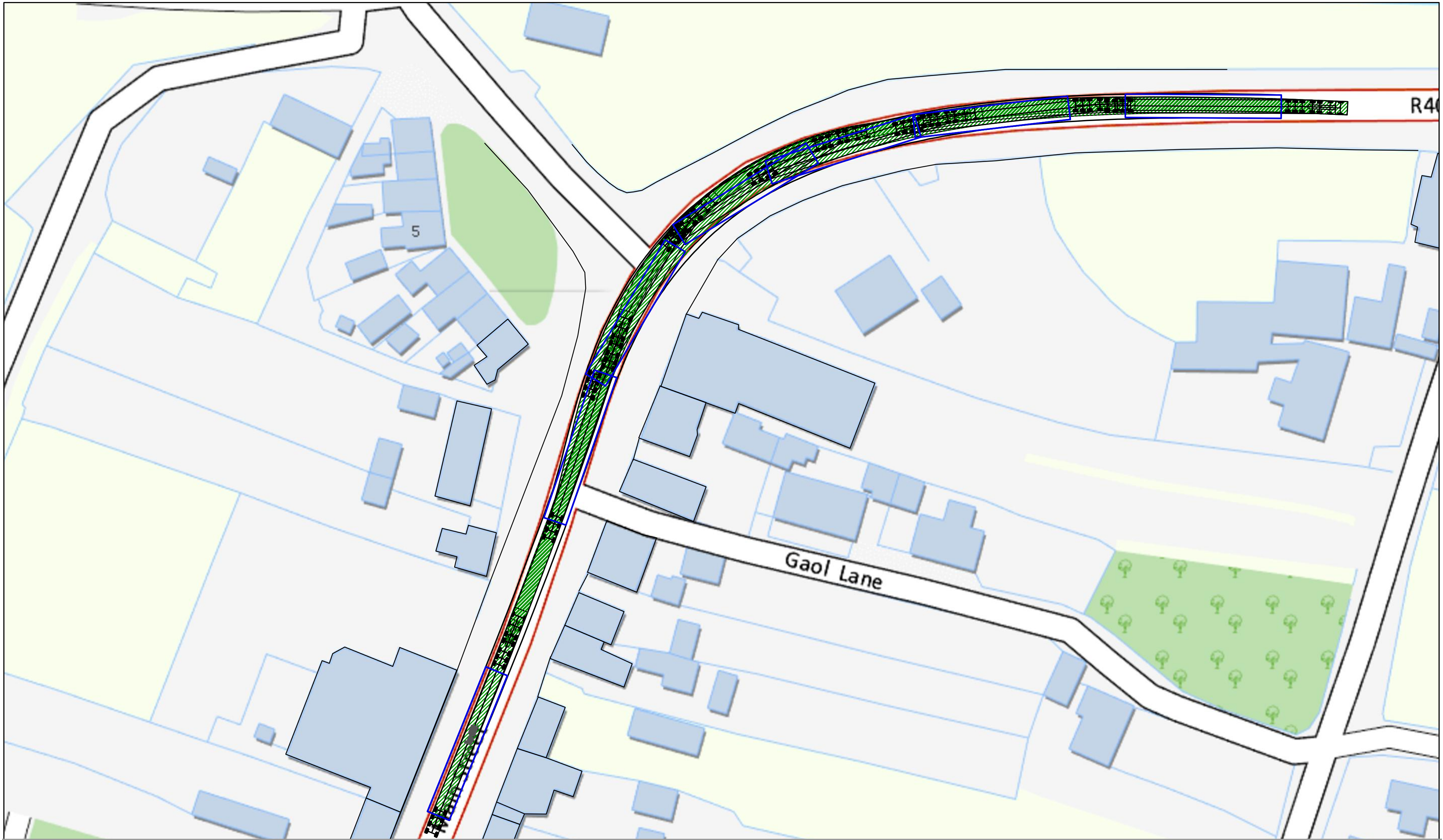

NOTES:

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Figure 13.10 Location 3 - Right hand bend through Daingean on R402, tower extended artic (OS base)

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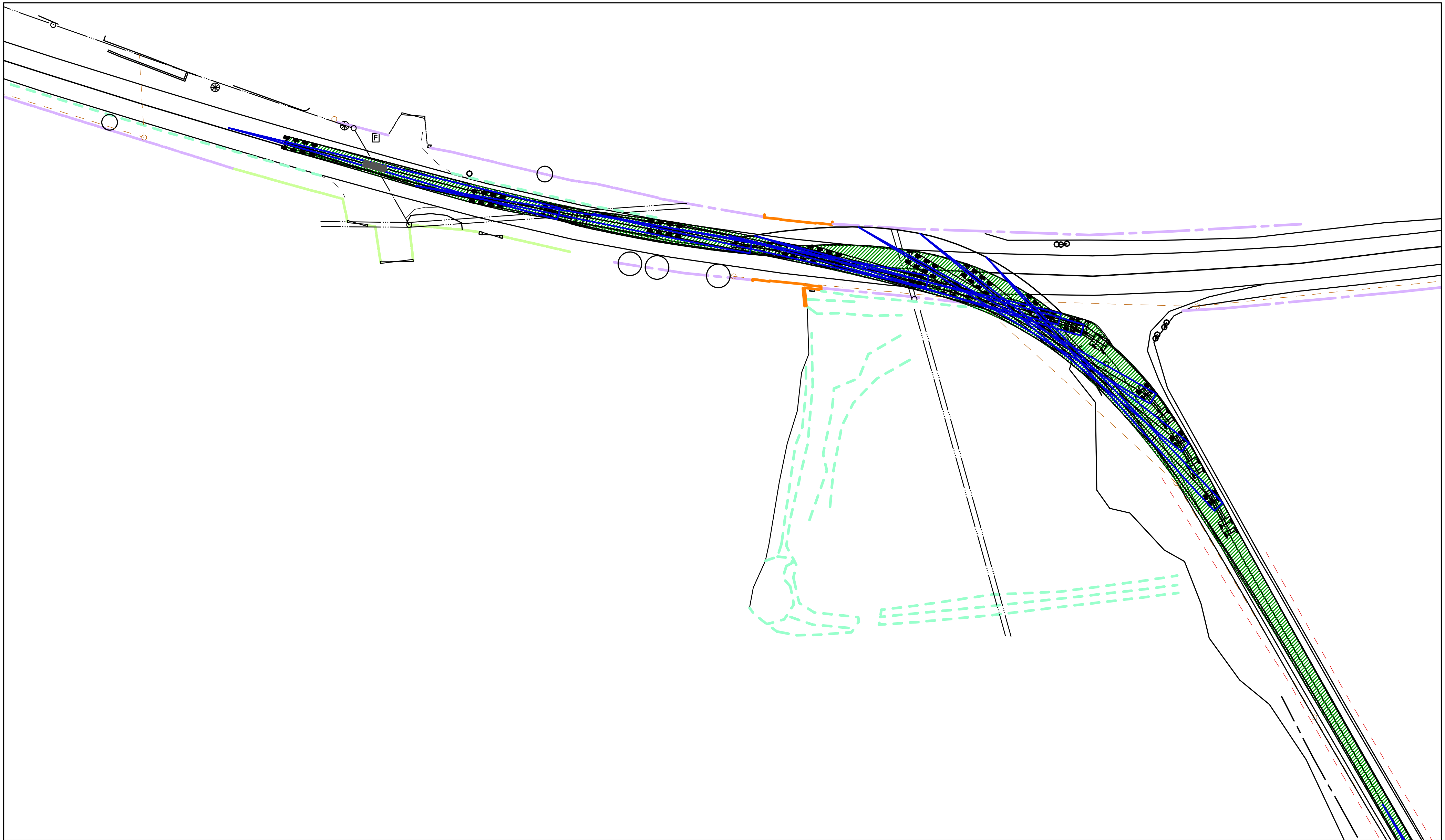

NOTES:	Figure 13.11 Location 4 - Right turn from R402 to L1003, blade extended artic (survey base)
PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES	PROJECT: Cloncreen Wind Farm EIS
	CLIENT: Bord na Móna
	SCALE: 1:1000
	PROJECT NO: 4350
	DATE: 05.09.16
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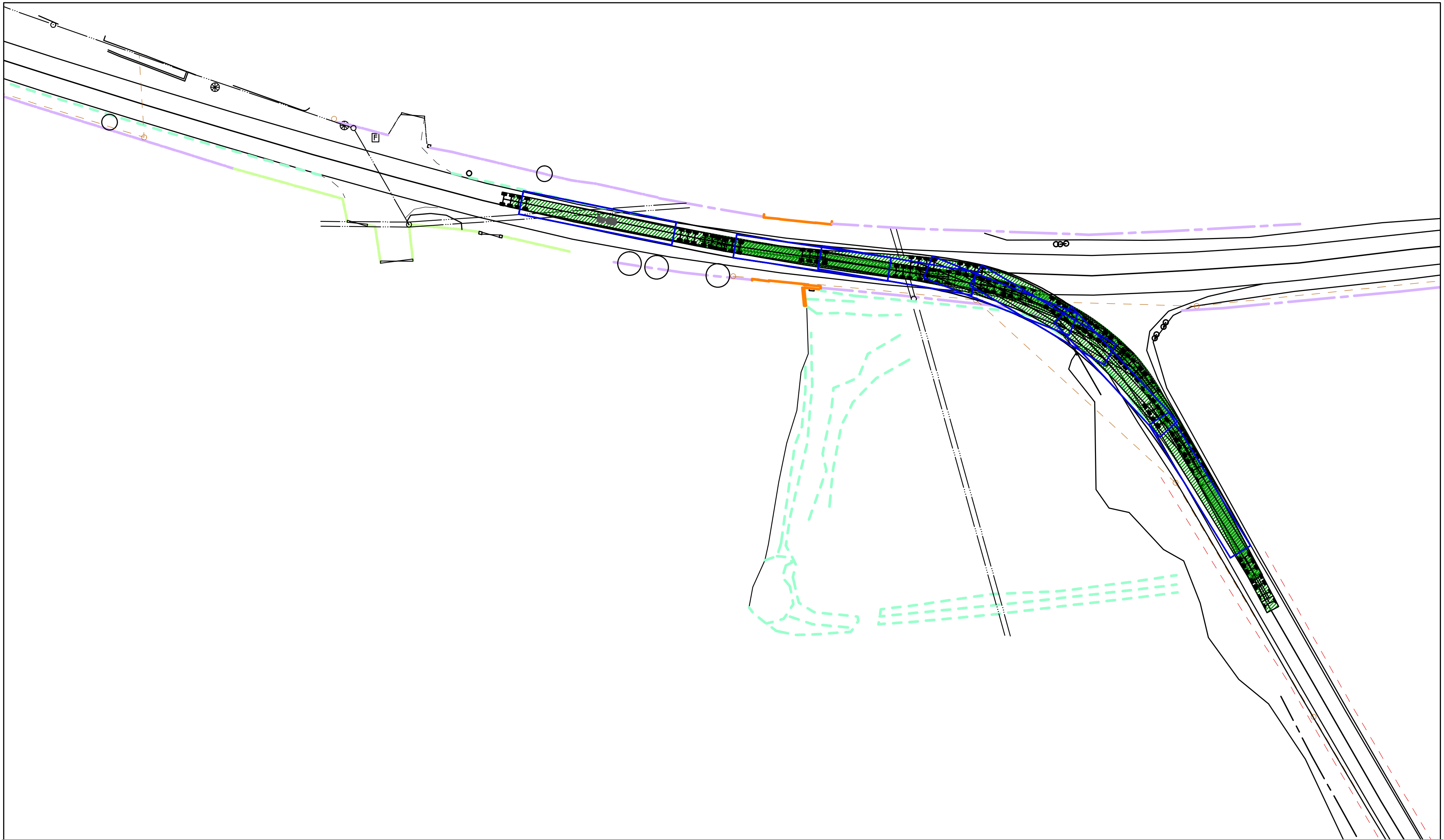

NOTES:

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Figure 13.12 Location 4 - Right turn from R402 to L1003, tower extended artic (survey base)

PROJECT: Cloncreen Wind Farm EIS			
CLIENT: Bord na Móna		SCALE: 1:1000	
PROJECT NO: 4350	DATE: 05.09.16	DRAWN BY: AL	

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were taken account of in the design, shown in Figures 13.13 and 13.14. Once the wind farm is fully operational this access will be closed.

Location 6 – Access junction on R401

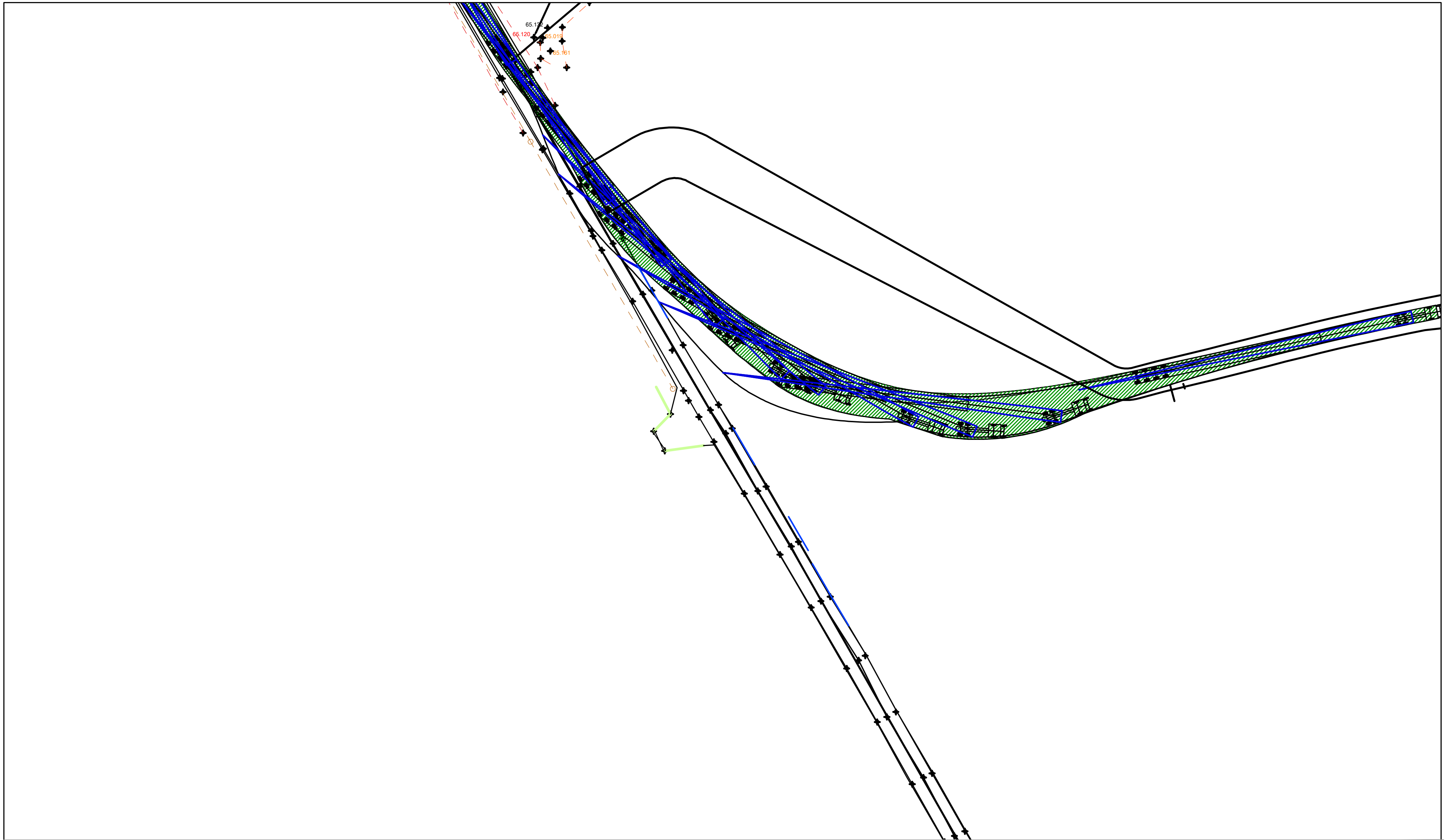
The eastern junction, which will be used to access the site by standard articulated HGVs from the R401, is shown in Plate 13.6. The layout of this proposed access location is shown on the design drawings included in Appendix 3-1 of this EIS.

Plate 13.6 Access junction off the R401

13.1.7.2 Junction Accommodation and Public Road Works

Improvements and temporary modifications to existing public road infrastructure to facilitate delivery of abnormal loads will be required, in particular a temporary upgrade of the R420/R402 junction, temporary road widening at 1 no. location on the R402 in Ballinagar, upgrade of the R402/L1003 junction, road upgrade along the L1003 and the new construction phase site entrance and upgrade of the existing site entrance on the R401.

The upgrade of the R420/R402 junction will be an extension of a previous upgrade carried out as part of the works required to transport large turbine components to the Mountlucas wind farm during its construction in 2014. This upgrade will consist of clearing back the existing vegetation at the junction, excavation of material to allow the placing of stone within the redlined area. Following this the area will be finished in tar and chip. A series of removable bollards will be placed along the existing road edge in order to preserve the structure of the junction outside of those periods when deliveries of components are underway. A permanent fence will be erected once the deliveries are completed restoring the junction to its existing configuration. The hardstanding area created to accommodate the works will be top soiled over and allowed to reseed naturally.



NOTES:

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Figure 13.13 Location 5 - Main access junction on L1003 - blade extended artic (survey base)

PROJECT:	Cloncreen Wind Farm EIS		
CLIENT:	Bord na Móna	SCALE:	1:1000
PROJECT NO: 4350	DATE: 05.09.16	DRAWN BY:	AL

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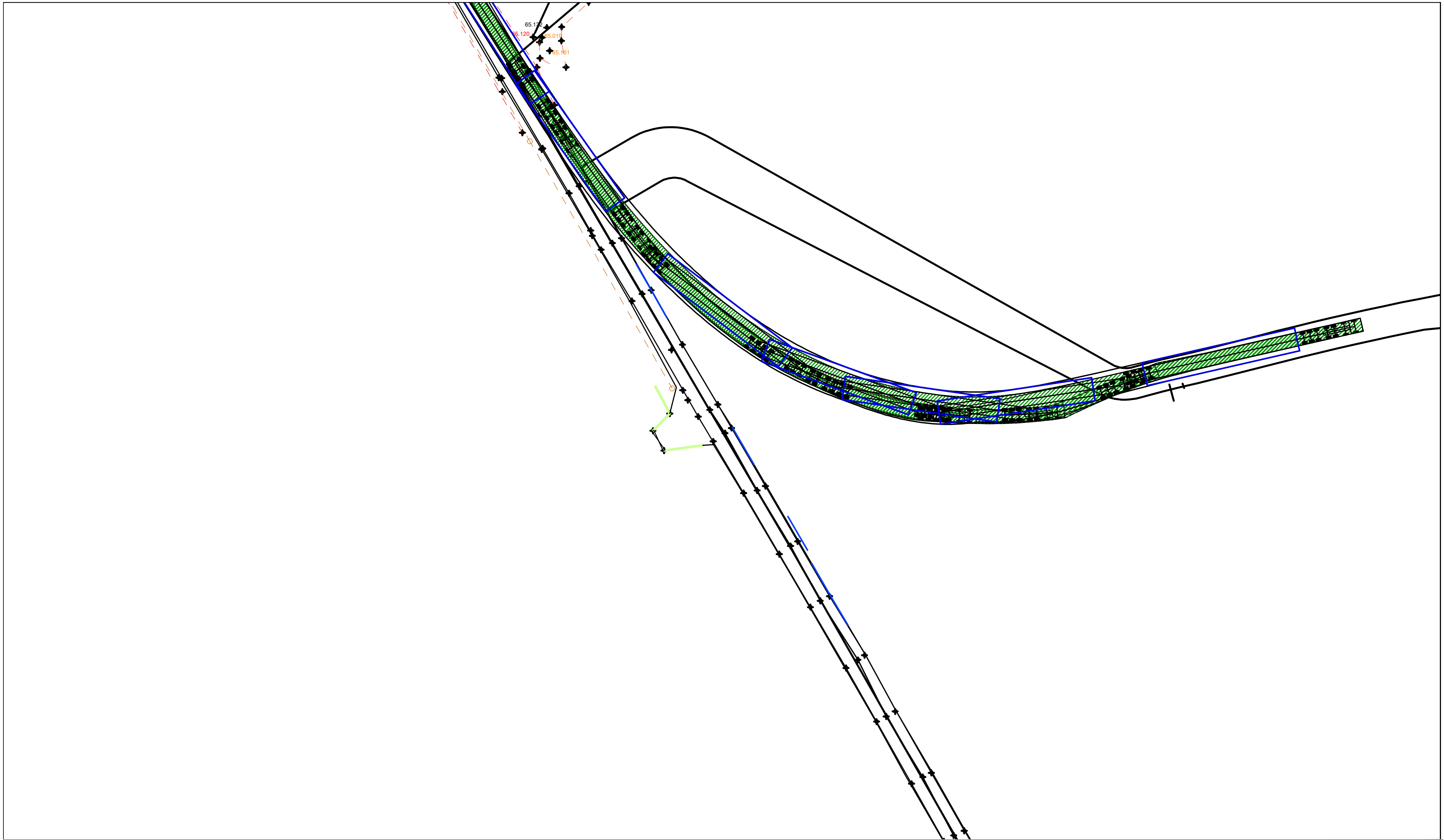

NOTES:

PLANNING DRAWING ONLY - NOT FOR CONSTRUCTION PURPOSES

Figure 13.14 Location 5 - Main access junction on L1003 - tower extended artic (survey base)

PROJECT: Cloncreen Wind Farm EIS			
CLIENT: Bord na Móna		SCALE: 1:1000	
PROJECT NO: 4350	DATE: 05.09.16	DRAWN BY: AL	

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The temporary widening of the R402 in Ballinagar, discussed below, is required to accommodate the movement of large components (specifically transportation of blades) around this bend. The temporary works will require the temporary removal of the existing footpath, vegetation and boundary wall that form part of the public park area. Further excavations will be required to allow the importation of suitable fill material to build the area back up to the existing road level. The extended area will then be stoned over that will allow the traverse of the vehicles carrying the large components. Once the deliveries are completed the area will be reinstated in accordance with the requirements of Offaly County Council.

The upgrade to the junction of the R402/L1003 is required to facilitate the movement of vehicles carrying large turbine components off the R402 and onto the L1003. The swept path analysis indicates that road widening will be required at this junction to facilitate these vehicle movements. The land on the southern side of the R402 between the bridge over the Phillipstown River and the junction will be elevated using suitable fill material to the level of the existing road. The required area to accommodate the large turbine component movements will be surfaced and a series of temporary bollards installed. The bollards will be removed when the widened area is required for deliveries and replaced when not in use in order to preserve the junction configuration. Once the deliveries have been completed a permanent fence will be erected in order to preserve the integrity of the junction and prevent unauthorised access to the hard standing area.

It is proposed that the existing L1003 local road is widened to approximately 6m from the junction of the R402 and L1003 to the proposed western entrance to Cloncreen wind farm. This widening will involve the creation of a 0.5m (approximately) wide verge on the eastern side of the road and extension of the road width a distance of approximately 6m to the west from the newly created verge. In order to accommodate this, the following works will need to be carried out along the western edge of the existing road.

- Removal of the existing vegetation to a maximum distance of 10m from the existing road edge.
- Extension of the road edge to ensure a full 6m width up to the proposed site entrance.
- Realignment of the centreline of the road
- In fill of the required area along the western edge of the L1003 to facilitate these widening works,
- The creation of an appropriate side slope from the new edge into the adjacent agricultural land,
- The movement of the existing open drainage features to accommodate the works
- A programme of planting along the new drainage feature in parallel to the road
- Installation of a 'TII' standard timber post and rail fence to enclose the planting.

The proposed works would result in a permanent upgrade of the L1003 from the R402/L1003 junction to the proposed site entrance.

A new site entrance is required along the L1003 to facilitate the delivery of the construction materials and turbine components. There are two proposed components that will make up this temporary entrance:

1. A construction entrance will be located adjacent to the northern boundary of Bord na Móna lands on the eastern side of the road. This entrance will facilitate deliveries of stone, concrete, steel and other equipment/materials.
2. The second component will be a large turbine component entrance that will have a larger footprint that will include the footprint of the proposed construction entrance. This entrance will be used for large turbine component delivery only. Passive screening will be put in place as part of the construction of this element to ensure maximum screening possible between the L1003 and the large turbine roadway as it extends in to Bord na Móna Lands. The extent of this entrance will be restricted in a similar fashion to the proposed junction upgrades through the use of temporary bollards that will be removed and reinstated as required.

Appropriate sightlines (160m at a setback of 3m) will be established to both the north and south of the proposed site entrance to accommodate exiting traffic. Once the large turbine components deliveries cease the large turbine component entrance will be permanently fenced off to the road verge. The large turbine component entrance and roadway will be covered in top soil and allowed to reseed naturally. Once the construction phase of the windfarm is completed and the wind farm is fully operational the construction entrance will then be permanently fenced off. In this case as there are other entrances to the site to facilitate operational traffic, the construction roadway will be covered in topsoil and a suitable replanting programme completed to encourage re growth.

13.1.8 Provision for Sustainable Modes of Travel

13.1.8.1 Walking and Cycling

The provision for these modes is not relevant during the construction stage of the development and travel distances (approximately 8kms from Edenderry and 10km from Daingean) will likely exclude any employees walking or cycling to work.

13.1.8.2 Public Transport

There are no public transport services that currently pass the site although mini buses may be considered for transporting staff to and from the site in order to minimise traffic generation and parking demand on site.

13.1.9 Likely and Significant Effects and Associated Mitigation Measures

13.1.9.1 "Do Nothing" Scenario

If the proposed wind farm does not proceed there will be no additional traffic generated or works carried out on the road network and therefore no effects with respect to traffic.

13.1.9.2 Construction Phase

During the 21 days when the concrete foundations are poured at the same time as general site preparation and groundworks are progressing, the effect on the surrounding road network will be negative, resulting in an increase in traffic levels ranging from 12.9% on the R402 south of Daingean, to an increase of 41.5% on the L1003 leading to the site. The effect will be temporary, lasting for 21 days, and will be moderate.

During the remaining 339 days for the site preparation and ground works when deliveries to the site will take place, the effect on the surrounding road network will be negative, resulting in an increase in traffic levels ranging from 7.1% on the R402 south of Daingean, to an increase of 22.8% on the L1003 leading to the site. The effect will be temporary, lasting for 339 days, and will be slight to moderate.

During the 21 days of the turbine construction stage when general materials are delivered to the site, the delivery of construction materials will result in a negative impact on the surrounding road network, increasing traffic levels ranging from 1.5% on the R402 south of Daingean, to an increase of 4.9% on the L1003 leading to the site. The effect will be temporary, and will be slight.

During the 38 days when the various component parts of the wind turbine plant are delivered to the site using extended articulated HGVs, the effect of the additional traffic on these days will be moderate due to the size of vehicles involved, resulting in increased traffic volumes of between 2.9% and 9.3%, but will be temporary. The effect may be reduced to slight if the delivery of the large plant is done at night, as is frequently the case for abnormally large loads.

It was determined that all links in the study area will operate within operational capacity for all days within the construction period.

13.1.9.3 Operational Phase

During the operational phase the effect on the surrounding local highway network will be negative and long term, but will be imperceptible given that there will be a maximum of 6 staff members on site at any one time, resulting in typically 2 visits to the site on any one day made by a car or light goods vehicle.

13.1.9.4 Cumulative Effects

The projects included in the cumulative impact assessment are described in Section 2.10 of this EIS.

An assessment of the potential cumulative traffic effects with the proposed Cloncreen Wind Farm set out in Table 13.24 below. As part of the assessment the following criteria were considered:

- Project status (proposed to operational): Of the 12 developments considered, 4 are operational with traffic generated by these sites included in the study background traffic flows with therefore no potential for additional cumulative effects. All other levels of project status were considered with regard to the potential for cumulative effects.
- Degree of overlap with the Cloncreen delivery highway network (low to high): 6 of the remaining 8 projects were considered to have a low level of overlap with the Cloncreen highway network, with only the Eastern and Midlands Regional Water Supply project (see No. 9 in table below) and the Shean Site Infill (see No. 12 in table below) passing the site.
- Traffic volumes: (low to high).

With the traffic levels generated by the Eastern and Midlands Regional Water Supply project likely to be low, it is considered that the cumulative traffic effects between it and the proposed Cloncreen Wind Farm development will be slight, and only then if it proceeds during the construction stage of the subject development. It is estimated that the cumulative traffic effects of the 7 remaining developments not already in operation will be imperceptible.

Table 13.24 Summary of projects considered in cumulative assessment and potential for cumulative traffic effects with proposed Cloncreen Wind Farm

Project	Status	Degree of overlap of highway network (low / medium / high)	Traffic volumes (low / medium / high)	Potential cumulative traffic effects
1. Mountlucas Wind Farm	Operating	Not relevant	Not relevant	Included in background traffic levels
2. Yellow River Wind Farm	Permitted	Low	Similar to Cloncreen WF	Imperceptible
3. Clonbullogue Ash Repository	Operating	Not relevant	Not relevant	Included in background traffic levels
4. Edenderry Power Plant	Proposed	Low	Low	Imperceptible
5. Peat Extraction - Allen Group	Operating	Not relevant	Not relevant	Included in background traffic levels
6. Peat Extraction – Derrygreenagh Group	Operating	Not relevant	Not relevant	Included in background traffic levels
7. Barrow Blue Way	Pre-planning	Low	Low	Imperceptible
8. Grand Canal Blueway Shared Walking and Cycle Route	Proposed	Low	Low	Imperceptible
9. Eastern and Midlands Regional Water Supply Project	Pre-planning	High	low	Slight
10. Land improvement scheme, Clonbullogue	Proposed	Low	Low	Imperceptible
11. Clonin North Solar Farm	Proposed	Low	Low	Imperceptible
12. Shean site infill	Proposed	Medium	Low	Imperceptible

13.1.9.5 Mitigation Measures

This section summarises the mitigation measures to minimise the effects of the proposed Cloncreen Wind Farm development during both the construction and operational stages.

Mitigation by Design

Mitigation by design measures include the following;

- Selection of the most appropriate delivery route to transport the wind turbine components, requiring the minimum remedial works to accommodate the vehicles as set out in Section 13.1.2.2.
- Inclusion of a borrow pit on site in order to minimise the delivery of materials to the site.

Mitigation Measures During Construction Stage

Mitigation measures proposed during the construction stage are as follows;

- A temporary new junction on the L1003 providing access to the site,
- Temporary upgrade of the R420 / R402 junction,
- Temporary widening of section of R402 through Ballinagar,
- Upgrade of R402 / L1003 junction,
- Upgrade of section of L1003 between the junction with the R402 and the proposed access junction.

In addition, a detailed traffic management plan, as summarised in Section 13.1.6, will be implemented during the construction stage. The management plan will include the option to deliver the large wind turbine plant components at night in order to minimise disruption to general traffic during the construction stage.

Mitigation Measures During Operational Stage
Due to the very low traffic generation during this stage no mitigation measures are required.

13.2 Telecommunications and Aviation

13.2.1 Introduction

This section of the EIS assesses the likely significant effects of the proposed wind farm on telecommunications and aviation. Section 13.2.2 describes the way in which wind turbines can potentially interfere with telecommunications signals or aviation activities. Section 13.2.3 presents details on how such effects will be avoided. Additional details on aviation and parachuting are presented in Section 13.2.4, with the likely significant effects assessed (and mitigation measures proposed) in Section 13.2.5.

13.2.1.1 Methodology and Guidance

This section of the EIS has been prepared in line with the guidance set out by:

- *'Advice Notes on Current Practice in the Preparation of Environmental Impact Statements'* (EPA, 2003)
- *'Guidelines on the Information to be contained in Environmental Impact Statements'* (EPA, 2002)

This section of the assessment focuses particularly on the scoping and consultation exercise conducted with telecommunications operators and aviation authorities. Scoping was carried out in line with the above EPA guidelines, and the *'Best Practice Guidelines for the Irish Wind Energy Industry'* (Irish Wind Energy Association, 2012), which provides a recommended list of telecommunications operators for consultation. A full description of the scoping and consultation exercise is provided in Section 2.9 of this EIS.

The assessment of likely significant effects on material assets uses the standard methodology and classification of effects as presented in Section 1.6.2 of this EIS. The full project description, including proposed turbine locations and elevations, is provided in Chapter 3.

13.2.1.2 Statement of Authority

This section of the EIS has been prepared by Lorraine Meehan (B.Sc. Env.), Environmental Scientist with McCarthy Keville O'Sullivan Ltd. Lorraine has over 9 years' experience in the preparation of EISs, including the assessment of likely significant effects on material assets. She has coordinated the scoping and consultation exercise with telecommunications operators and aviation authorities for numerous wind energy developments, and prepared the relevant sections of the EISs.

13.2.2 Background

13.2.2.1 Broadcast Communications

Wind turbines, like all large structures, have the potential to interfere with broadcast signals, by acting as a physical barrier or causing a degree of scattering to microwave links. The alternating current, electrical generating and transformer equipment associated with wind turbines, like all electrical equipment, also generates its own electromagnetic fields, and this can interfere with broadcast communications. The most significant effect at a domestic level relates to a possible flicker effect caused by the moving rotor, affecting, for example, radio signals. The most significant potential effect occurs where the wind farm is directly in line with the transmitter radio path.

13.2.2.2 Domestic Receivers

Depending on local topography, a domestic receiver may receive broadcast signals from more than one location. The strength of the signals varies with distance from the transmitter, and the receiver's antenna is generally always directed towards the most local, and usually strongest, broadcasting station.

There are two types of potential electromagnetic interference to domestic receivers, depending on the location of the receiver in relation to a wind farm. 'Shadowed' houses are located directly behind a wind farm, relative to the location from where the signal is being received. In this case, the main signal passes through the wind farm and the rotating blades can create a degree of signal scattering. In the case of viewers located beside the wind farm (relative to the broadcast signal direction), the effects are likely to be due to periodic reflections from the blade, giving rise to a delayed signal.

In both cases, i.e. shadowed houses located behind the wind farm and those located to the side of it, the effects of electromagnetic interference may depend to some degree on the wind direction, since the plane of rotation of the rotor will affect both the line-of-sight blockage to viewers located behind the wind farm and the degree of reflection to receivers located to the side.

13.2.2.3 Other Signal Types

Wind turbines have the potential to affect other signal types used for communication and navigational systems, for example tower-to-tower microwave communication links, and airborne and ground radar systems. Interference with radar systems occurs when wind turbines are located close to an airport or directly in line with the instrument landing approach. The nearest such airport to the proposed development site is Casement Aerodrome, located approximately 42 kilometres east of the site, and therefore outside the range at which such issues would be expected.

Potential effects on broadcast communications are generally easily dealt with by detailed micro-siting of turbines in order to avoid alignment with signal paths or by the use of repeater relay links out of line with the wind farm.

13.2.3 Preventing Electromagnetic Interference

13.2.3.1 National Guidelines

The *'Wind Energy Development Guidelines for Planning Authorities'* (Department of the Environment, Heritage and Local Government, 2006) state that interference with broadcast communications can be overcome by the installation of deflectors or repeaters where required. Developers are advised to contact individual local and national broadcasters and mobile phone operators to inform them of proposals to develop wind farms. This consultation has been carried out by MKO as part of the assessment of the proposed development; full details are provided in Section 2.9. of this EIS.

13.2.3.2 Scoping and Consultation

As part of the scoping and consultation exercise, MKO contacted the relevant national and regional broadcasters, fixed and mobile telephone operators, aviation authorities and other relevant parties. Consultation was also carried out with ComReg in order identify any other additional licensed operators in the vicinity of the site to be contacted, who may not have been on the list of main operators. The telecommunications and aviation consultees are presented below in Table 13.25.

Table 13.25 Telecommunications and Aviation Scoping Responses

Consultee	Response	Potential Interference Flagged?
Airspeed	Emails received 15th Sept 2015 & 4th May 2016	Yes – see below
Broadcasting Authority of Ireland	Letter received 22nd April 2016	No
BT Communications Ireland	Emails received 14th Sept 2015 & 28th April 2016	No
ComReg (Commission for Communications Regulation)	Email received 14th Sept 2015	No
Department of Defence	Email received 7th Oct 2015	No
Eircom	No response	No
ESB Telecoms	Emails received 14th Sept 2015 & 7th June 2016	No
Irish Aviation Authority	Letter received 2nd Nov 2015. Email sent to Bord na Móna 30th June 2016	Yes – see below
Irish Parachute Club	Letters received 29th Sept 2015 & 19th May 2016	Yes - see below
Offaly County Council Telecoms Section	No response	No
Meteor Mobile Communications	Emails received 21st Sept 2015 & 27th April 2016	Yes – see below
RTE Transmission Network (2rn)	Emails received 16th Sept 2015 & 29th April 2016	No
Tetra Ireland Communications (emergency services)	Emails received 28th Sept 2015 & 26th April 2016	No
Three Ireland (now includes O2 Ireland)	Email received 25th April 2016	No

Consultee	Response	Potential Interference Flagged?
Towercom	No response	No
TV3	Letter received 24th Sept 2015	No
UPC Communications Ireland	Email received 18th Sept 2015	No
Vodafone Ireland	Emails received 23rd Sept 2015 & 22nd April 2016	Yes – see below

The scoping responses from the telecommunications and aviation consultees are summarised below. Copies of scoping responses are provided in Appendix 2-1.

13.2.3.2.1 Broadcasters

The scoping responses from RTÉ Transmission Network (2rn) stated that they have no links in the vicinity of the site, and no concerns regarding interference from the proposed development. The response states that the risk of interference to domestic Saorview reception is minimal; however, in the event of this occurring, it can be addressed by the realignment of aerials to an alternative transmitter. The TV3 scoping response stated that TV3 is a customer of RTE (2rn), therefore any issues would be addressed by them.

It is standard practice of 2rn to produce a Protocol Document for wind farm developments, which will be signed by the developer. The Protocol Document ensures that in the event of any interference occurring to RTÉ television or radio reception due to operation of the wind farm, the required measures, as set out in the document, will be carried out by the developer to rectify this. The Protocol Document ensures that the appropriate mitigation is carried out in the event of unanticipated broadcast interference arising to RTÉ television or radio reception as a result of the proposed wind farm.

13.2.3.2.2 Telephone and Broadband Operators

Of the responses from fixed and mobile telephone and broadband operators, those received from BT Communications, ESB Telecoms, Three Ireland and UPC stated that the proposed development would have no effect on their networks.

The scoping responses of Meteor, Vodafone and Airspeed flagged potential interference issues as a result of the proposed development, as follows:

- Meteor and Vodafone currently operate links from the existing onsite telecommunications mast, which it is proposed to remove as part of the proposed development.
- Airspeed operates a broadband link through the northwest corner of the site, which may be affected by proximity to one turbine.

These effects and associated mitigation are addressed in Sections 13.2.5.2 and 13.2.5.3 below.

Scoping responses were not received from Eircom, Towercom or the Offaly County Council telecoms section.

13.2.3.2.3 Aviation and Parachuting

Irish Aviation Authority

The initial scoping response of the Irish Aviation Authority (IAA) requested that if the proposed development is permitted, the applicant will provide details for an agreed scheme of aviation obstacle warning lights, coordinates and elevations for built turbines and notification at least 30 days prior to erection of the turbines. This information will be provided to the IAA by the applicant.

The IAA also provides a software tool called ASSET whereby developers can check turbine coordinates online and submit them to the IAA for response. Following submission of the final proposed turbine coordinates to the ASSET tool, the following response was received by Bord na Móna from the IAA on 30th June 2016:

> *"The nearest wind turbine in this windfarm is located 2,730 m, approx., from the runway centreline at Clonbullogue Aerodrome at which the Irish Parachute Club carry out parachuting activities. The Conical Surface, (obstacle limitation surface), for Clonbullogue starts 2,000 m from the runway centreline, (at the edge of the Inner Horizontal Surface), and slopes upward at a 5% slope to a height of 35 m above the Inner horizontal Surface. The Inner horizontal Surface for Clonbullogue is located at 45 m above the runway surface and has a radius of 2,000 m. This means that some of the wind turbine blades will penetrate the Conical Surface for Clonbullogue Aerodrome when they are oriented north-south when the wind is from the east or west. In addition the windfarm could potentially produce turbulence downstream of the turbines which could affect flight operations at Clonbullogue including parachuting. "*

The comments of the IAA are addressed in Section 13.2.4 below.

Irish Parachuting Club

The scoping responses of the Irish Parachute Club (IPC) state that the club has safety concerns with regard to the proposed installation of wind turbines within five kilometres of Clonbullogue Airfield. The IPC considers such structures as a hazard to flying and parachuting operations at the airfield. These concerns are addressed in Section 13.2.4 below.

Department of Defence

The Department of Defence response stated that having consulted with the Air Corps, Casement Aerodrome, they would make a number of requirements in relation to turbine lighting, in order to aid the visual acquisition of wind farms. If planning permission is granted, the applicant will agree the required turbine lighting scheme with the Department of Defence and the IAA.

13.2.3.2.4 Other Consultees

TETRA Ireland Communications (Emergency Services radio network) stated that the proposed development poses no network or coverage concerns.

The Broadcasting Authority of Ireland (BAI) response stated that there are no issues from wind farms on existing FM networks, and that the proposed development is not located close to any existing or planned FM transmission sites.

13.2.4 Aviation and Parachuting Activities - Response

All parachute drops from civil registered aircraft in Irish Airspace are regulated by the IAA and must be conducted in accordance with the requirements of Article 7 of Irish Aviation Authority (Rules of the Air) Order, 2004, S.I. No. 72 of 2004.

The scoping responses of the Irish Parachute Club refer to safety concerns for flying and parachuting operations with regard to the proposed installation of wind turbines within five kilometres of Clonbulloge Airfield. The IPC responses also refer to Statutory Instrument S.I. 235 of 2008 of the Planning and Development Regulations 2008; it is noted by the applicant however that this section of legislation relates to *'the construction, erection or placing within the curtilage of an industrial building or light industrial building, or business premises of a wind turbine'*, which is not the case in the proposed development.

In 2015, Bord na Móna commissioned a Safety Report to be prepared on the effect of the proposed development with regard to Clonbullogue Airfield and the Irish Parachute Club. The Safety Report was prepared by Mr. Ronald Overdijk, a leading European expert on parachuting. A full copy of the report is included as Appendix 13-1 to this EIS. The *'Safety Report - Wind Farm Development Cloncreen & Ballydermot - Clonbullogue Airfield - Irish Parachute Club'* (Mr. Ronald M.A. Overdijk, Parachuting consultant, Barendrecht, The Netherlands, May 2015) states that the International Civil Aviation Organisation (ICAO) has designated aerodromes into four categories (or Codes) for obstacle limitation purposes, based on runway lengths. With these Codes, distances to obstacles have been defined. For each of these runway length categories, ICAO sets out different requirement, in the form of 3-dimensional geometric shapes, so-called Obstacle Limitation Surfaces. These limit the heights and/or closeness of an object in the vicinity of an aerodrome. In general, any new object should not penetrate such an Obstacle Limitation Surface. For Clonbullogue, ICAO has defined the limit of the Obstacle Limitation Surface to be 2.7 kilometres (2,700 metres).

The obstacle limitation surfaces, referenced in the June 2016 response from the IAA and contained within the IAA's document *'Guidance Material on Aerodrome Annex 14 Surfaces'* (IAA, 2015), require an exclusion zone of 2,700 metres from the runway centreline. The coordinates for Clonbullogue Aerodrome are given in the Aeronautical Information Publication (AIP) published by the IAA. The required 2,700-metre exclusion zone, centered on the runway, was used by Bord na Móna early in the wind farm design process. Allowing for a 65-metre maximum blade length, no turbine will be located within 2,765 metres of the runway centreline. Detailed GIS analysis shows that the nearest two turbines (T4 and T5) are both located 2,790 metres from the centreline of the runway. Furthermore, both of these turbines are outside the conical surface from Clonbullogue Aerodrome, as referred to in the IAA response.

The main key findings of the Clonbullogue Airfield Safety Report state the following:

- *"Parachuting takes place in a variable environment, depending on windspeed, parachute opening altitude, parachute type and size, parachute flying, the parachutists experience, etc. All efforts are made to make sure that parachutists land on the dropzone, by the airplane pilot, by the CCI and by the parachutist himself. Off dropzone landing do occur, the further away, the less likely. There are no hard data on the number and distance of off dropzone landings. Any structure can be a hazard, whilst a wind turbine definitely is a serious hazard if a turning rotor is hit. Turbulence seems less likely to be a problem.*

- *IAA regulations state an obstacle clearance zone of 2,7 km relating to aircraft operations but does not give any specific guidance in relation to distances in relation to the impact of a development on parachuting activities. In the UK, CAP 764 only refers to construction (of windturbines) within 1200 m of the parachute landing area.*

- *The maximum expected effect of turbulence, with the maximum rotor diameter of 132 m is about 2.1 km. Generally this effect will be more closer to the ground the further away from the turbine. No effect would be noticed if the wind turbines would be further away from the dropzone than this distance.*

- *Therefore, my conclusion is that 2,7 km would be a safe distance for a windfarm to be constructed from the airfield (runway a starting point in all directions), with chances of a parachutist having negative effects of turbulence when landing within 1 km of the dropzone would be very unlikely. Furthermore, it is important to note that the potential impact of turbulence will only occur if the wind is blowing from the wind farm to the drop zone. Please note that the distance is from the runway to the actual wind turbines, not the outer perimeters of the windfarm locations.*

It should be noted no turbines structure or blades are proposed to be located within 2.7 kilometres of the runway centerline, which is considered an appropriate safe distance. The issue of the potential for turbulence to affect light aircraft and parachuting operations at Clonbullogue is also addressed in the Safety Report, as summarised above, which concludes that turbulence is unlikely to be a disturbing factor, even when allowing for a reasonable overshoot of the landing zone.

13.2.5 Likely Significant Effects and Associated Mitigation Measures

13.2.5.1 'Do-Nothing' Scenario

If the proposed development were not to proceed, the existing telecommunications mast would remain onsite, with no change to existing operations.

13.2.5.2 Construction Phase

Construction of the proposed wind farm will entail the removal of the existing 40-metre telecommunications mast onsite, which is owned and operated by Bord na Móna. In the absence of any mitigation measures, the removal of the mast would have a permanent, significant negative effect on the existing Vodafone and Meteor links which operate from this mast.

Mitigation

Bord na Móna has long-standing commercial relationships with telecoms providers. There is a range of options available which will be used to mitigate against removal of the mast and to prevent any effect on existing links. These measures include:

1. Technology Upgrade: Replacement of the existing telecommunications service equipment with another less affected type.
2. Diverting telecommunications link: The possibility of diverting telecommunications links to another telecommunications tower in the vicinity can be investigated.
3. Special Purpose Mitigation Tower: The possibility of diverting the links and consolidating the existing towers to one tower can be explored.

4. Relocation of telecommunications equipment: The possibility of moving telecommunication equipment to another telecommunications tower in the vicinity can be investigated.
5. Fibre-optic communication systems: The possibility of installing fibre cables underground in conjunction with wind farm electricity transmission cables could be explored. The use of underground fibre-optic cable in lieu of telecommunication links would avoid the wind farm interference effects.
6. Wind Turbine Tower: To mitigate interference a turbine tower could be utilised as a transmitter / received (hop point).
7. Combination: The possibility of providing one or a mix of the above will be explored.

If planning permission is granted, Bord na Móna will liaise further with Vodafone and Meteor to identify the most appropriate and preferred technical solution for each provider, including re-routing links via existing local mast infrastructure, use of signal deflectors or the potential for relocation of the mast within the Bord na Móna landbank (subject to the appropriate consents). Such measures have been used successfully at other wind farms currently under construction. A pre and post-construction coverage study will be conducted to ensure that there is no negative effect on coverage levels as a result of the proposed development.

Residual Effect
No residual effect is expected following the implementation of the appropriate technical solution as detailed above.

13.2.5.3 Operational Phase

13.2.5.3.1 Telecommunications

The scoping responses from RTE Transmission Network (2rn), TV3, BT Communications, ESB Telecoms, Three Ireland, UPC, the Broadcasting Authority of Ireland (BAI), and TETRA Ireland Communications (Emergency Services radio network) state that the proposed development will have no effect on existing networks.

The scoping responses of Meteor, Vodafone and Airspeed flagged potential interference issues as a result of the proposed development:

- In the absence of any mitigation, the removal of the existing telecommunications mast from the proposed development site would have a permanent, significant negative effect on the existing Vodafone and Meteor links which operate from this mast.
- One turbine (T1) was flagged by Airspeed as being within the potential interference zone for its link through the northwest corner of the site. In the absence of any mitigation, interference could have a permanent moderate significant effect on this link.

Mitigation
The mitigation measures described in Section 13.2.5.2 above, which will be implemented during the construction phase in order to prevent a negative effect on Meteor and Vodafone links, will also apply during the operational phase. The appropriate technical solution will be agreed with each provider to ensure there is no disruption to coverage as a result of removal of the existing onsite mast.

With regard to the Airspeed link and potential interference from Turbine T1, Bord na Móna has calculated the 2nd Fresnel zone, i.e. the three-dimensional elliptic shaped region surrounding the line of sight path from the transmitter to the receiver, around this link. Wind turbine exclusion zones are typically required to be equal to the complete 2nd Fresnel zone, as per *'A proposed method for establishing an exclusion zone around a terrestrial fixed radio link outside of which a wind turbine will cause negligible degradation of the radio link performance'* (Bacon, 2002, https://licensing.ofcom.org.uk/binaries/spectrum/fixed-terrestrial-links/wind-farms/windfarmdavidbacon.pdf). In siting T1, Bord na Móna has used the 2nd Fresnel zone + 25m allowance for GPS inaccuracy as referenced by Bacon. The proposed turbine is located 75 metres away from this zone, meaning that assuming the maximum blade length of 65 metres is used, there will still be 10 metres clearance between the blade tip and the 2nd Fresnel / exclusion zone. There is therefore no likely significant effect on the Airspeed link as a result of the proposed development.

Notwithstanding the above, Bord na Móna will work with each operator, including Airspeed, prior to commencement of the construction phase, to ensure there are no disruptions to coverage as a result of the proposed development.

Residual Effect
No residual effect is expected following the implementation of the appropriate technical solutions as detailed above.

13.2.5.3.2 Aviation and Parachuting

The layout of the proposed development has been designed taking into account the required 2,700-metre exclusion zone specified in the IAA guidance document *'Guidance Material on Aerodrome Annex 14 Surfaces'* (IAA, 2015). Allowing for a 65-metre maximum blade length, no turbine is proposed to be located within 2,765 metres of the runway centreline. As per the Safety Report prepared by Mr. Ronald Overdijk, leading European expert on parachuting, the exclusion zone of 2,700 metres represents a safe distance from Clonbullogue airfield runway for construction of the proposed wind farm.

Mitigation
Bord na Móna will agree an acceptable aviation obstacle warning lighting scheme with the IAA and Department of Defence ahead of turbine construction. Bord na Móna will also supply the requested information (coordinates and elevations for built turbines and notification at least 30 days prior to erection of the turbines) to the IAA.

Residual Effect
There is no likely significant effect from the proposed development on the safety of flying and parachuting operations associated with Clonbulloge Airfield.

13.2.5.4 Cumulative Effect

Section 2.10 of this EIS describes the methodology used in compiling the list of projects considered in the assessment of cumulative effects, and provides a description of each project, including current status. The assessment of cumulative effects on telecommunications and aviation focuses on the wind farm developments operating or permitted within a 20-kilometre radius of the proposed development site, due to the physical nature of these projects and the potential for likely significant effects.

There are two wind farm projects located within a 20-kilometre radius of the proposed development site: Mountlucas (operating) and Yellow River (permitted, not yet constructed). The locations of these sites are shown on Figure 2.6 in Chapter 2 of the EIS (Section 2.7.3). Potential effects on telecommunications and aviation are addressed and mitigated on a project-by-project basis. During the development of any large project that holds the potential to impact on telecommunications or aviation, the developer is responsible for engaging with all relevant operators to ensure that the proposal will not interfere with broadcast or telecommunications signals. In the event of any potential effect, the Developer for each individual project is responsible for ensuring that the necessary mitigation measures are in place.

The operational Mountlucas Wind Farm is located 4.2 kilometres west of the proposed development site. Of the telecommunications links referred to by Vodafone, Meteor and Airspeed during consultation for the proposed Cloncreen development, none of these links are located in proximity to the Mountlucas site, therefore there is no cumulative effect resulting from both sites. The Yellow River EIS describes consultation undertaken in relation to that project, and identified that this wind farm would have no likely significant effects on telecommunications or aviation. There is therefore no potential for cumulative effects due to Yellow River and Cloncreen.

13.2.5.5 Conclusion

In the absence of any mitigation, the proposed wind farm development could have a negative effect on telecommunications links operated by Vodafone, Meteor and Airspeed. Following the implementation of the appropriate mitigation measures, as required by the operators, the proposed development will have no significant effects on telecommunications.

Aviation safety, and in particular the activities of the Irish Parachute Club, has been taken into account from the early design stage of the proposed development. Bord na Móna engaged a leading European consultant on parachuting safety, to ensure that proposed turbine locations were set back the required distance from Clonbullogue Airfield. Bord na Móna will agree an acceptable aviation obstacle warning lighting scheme with the IAA and Department of Defence ahead of turbine construction, and will supply the coordinates and elevations for built turbines to the IAA. The proposed development will have no likely significant effect on aviation.

14 INTERACTION OF THE FOREGOING

14.1 Introduction

The preceding Sections 4 to 13 of this EIS identify the potential significant environmental effects that may occur in terms of Human Beings, Flora and Fauna, Ornithology, Geology and Soils, Hydrology and Hydrogeology, Air and Climate, Noise, Landscape, Cultural Heritage and Material Assets, as a result of the proposed development as described in Chapter 3. All of the potential significant effects of the proposed development and the measures proposed to mitigate them have been outlined in the preceding sections of this EIS. However, for any development with the potential for significant environmental effects there is also the potential for interaction between these potential significant effects. The result of interactive effects may exacerbate the magnitude of the effects or ameliorate them, or have a neutral effect.

A matrix is presented in Table 14.1 below to identify potential interactions between the various aspects of the environment already assessed in this EIS. The matrix highlights the occurrence of potential positive or negative effects during both the construction (C) and operational (O) phases. The matrix is symmetric, with each environmental component addressed in the previous sections of this EIS being placed on both axes of a matrix, and therefore, each potential interaction is identified twice.

Table 14.1 Interaction Matrix

	Phase	Human Beings	Flora & Fauna	Ornithology	Soils & Geology	Hydrology & Hydrogeology	Air & Climate	Noise	Landscape	Cultural Heritage	Material Assets
Human Beings	C	—				Negative	Negative	Negative	Negative		Negative
	O	—					Positive	Negative	Neutral		Negative
Flora & Fauna	C		—		Negative	Negative	Negative		Negative		
	O		—			Negative	Positive		Neutral		
Ornithology	C			—	Negative	Negative	Negative				
	O			—			Positive				
Soils & Geology	C		Negative	Negative	—	Negative	Negative				
	O				—						
Hydrology & Hydrogeology	C	Negative	Negative	Negative	Negative	—					
	O		Negative			—					
Air & Climate	C	Negative	Negative	Negative	Negative		—				Negative
	O	Positive	Positive	Positive			—				
Noise	C	Negative	Negative					—			
	O	Negative	Negative					—			
Landscape	C	Negative	Negative						—		
	O	Neutral	Neutral						—		
Cultural Heritage	C									—	
	O									—	
Material Assets	C	Negative					Negative				—
	O	Negative									—

Legend: **No Interacting Effect:** (blank) **Positive Effect:** Positive **Neutral Effect:** Neutral **Negative Effect:** Negative

The potential for interaction of effects has been assessed as part of the Impact Assessment process. While the work on all parts of the Environmental Impact Statement (EIS) were not carried out by McCarthy Keville O'Sullivan, the entire project and all the work of all sub-consultants was managed and coordinated by the company. This EIS was edited and collated by McCarthy Keville O'Sullivan. as an integrated report of findings from the impact assessment process, by all relevant experts, and effects that potentially interact have been assessed in the individual chapters of the EIS above.

14.2 Effect Interactions

14.2.1 Human Beings

Human Beings and Air & Climate / Noise

As identified in Chapter 4 of this EIS, the construction phase has the potential to generate noise and dust, which could create a temporary nuisance for occupants of nearby dwellings. During the operational phase the proposed development has the potential to generate noise but as identified in Chapter 10, this can be mitigated to acceptable levels.

During the operational phase, the energy generated will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a positive effect on climate (i.e. slowing the rate of global warming). In doing so, there will likely be reduced effects from climate change on human beings over the 'do nothing' scenario and continuing to generate energy using fossil fuels.

Human Beings and Hydrology & Hydrogeology
As described in Chapter 8 of this EIS, the construction phase of the proposed development has the potential to give rise to some water pollution as a result of site activities, and any water pollution could have a potential significant effect on other users of that water within the catchment. Mitigation measures are also detailed in Chapter 8 to minimise the risk of any such issues.

Human Beings and Material Assets
Chapter 13 of this EIS discusses how the construction phase of the project will give rise to traffic movements of abnormal loads, and is likely to create some short-term inconvenience for other road users.

The operation of the proposed development has the potential to cause some interference with electromagnetic signals and might have an effect on telecommunications services or other transmission services used by individuals. Construction of the proposed wind farm will entail the removal of the existing 40-metre telecommunications mast onsite, which is owned by Bord na Móna. A range of mitigation options are given in Chapter 13 of this EIS to prevent any significant impacts as a result of the removal of the mast.

Human Beings and Landscape
The construction phase of the proposed development will see the temporary introduction of construction machinery and the erection of wind turbines into a natural, but already highly modified landscape. Whether the long-term change in landscape created by the erection of the turbines is deemed to be positive or negative is a subjective matter. What appears to be a positive visual effect to one viewer could be deemed to be a negative effect by another viewer. The erection of the turbines in particular will change the existing landscape.

14.2.2 Flora and Fauna

Flora & Fauna and Soils & Geology
The extraction of rock onsite for use as part of the proposed development will give rise to habitat loss and some disturbance of fauna in the areas surrounding the proposed borrow pit.

The removal of overburden soils within the development footprint is likely to result in habitat loss and some disturbance of fauna in the non-designated areas surrounding the proposed works area. This overburden will however be used for the reinstatement of the borrow pit post construction.

Flora & Fauna and Hydrology & Hydrogeology
Site activities during the construction phase have the potential to give rise to some water pollution, and consequential indirect effects (such as disturbance and deterioration of habitat quality) on flora and fauna that use that water within the same catchment.

The site activities during the construction phase, and continuing on for the operational phase, will give rise to additional localised drainage, which has the potential to have a significant effect on flora and their associated habitats.

Flora & Fauna and Air & Climate / Noise
Site activity during the construction phase could give rise to noise that could be a temporary nuisance for fauna.

During the operational phase, the proposed development will help offset carbon emissions from fossil fuel based electricity generation plants, which will help contribute to a slower increase in the rate of global warming and, consequently, could in combination with other renewable energy projects, contribute to preventing the loss of breeding bird species from Ireland as a result of climate change.

Flora & Fauna and Landscape
The removal of some vegetation within the development footprint and surrounding areas is likely to result in a change to the visual landscape during the construction phase, which will become part of the normal landscape of the wider area for the duration of the operational phase.

14.2.3 Ornithology

Ornithology and Soils & Geology
The extraction of rock onsite for use as part of the proposed development is likely to give rise to habitat loss and some disturbance of birds in the areas surrounding the proposed borrow pit.

The removal of overburden soils within the development footprint is likely to result in habitat loss and some disturbance of birds in the areas surrounding the proposed works area.

Ornithology and Hydrology & Hydrogeology
Site activities during the construction phase have the potential to give rise to some water pollution, and consequential indirect effects on birds and their prey species (such as disturbance and deterioration of habitat quality) that use that water within the same catchment.

The site activities during the construction phase, and continuing on for the operational phase is likely to give rise to additional localised drainage, which has the potential to have an effect on the habitats of birds.

Ornithology and Air & Climate / Noise
Site activity during the construction phase could give rise to noise that could be a nuisance for birds.

During the operational phase, the proposed development will help offset carbon emissions from fossil fuel based electricity generation plants, which will help contribute to a slower increase in the rate of global warming and, consequently, could in combination with other renewable energy projects, contribute to preventing the loss of bird species from Ireland as a result of climate change.

14.2.4 Soils and Geology

Soils & Geology and Hydrology & Hydrogeology

As identified in Chapter 7 of this EIS, the movement and removal of soils, overburden and rock during the construction phase has the potential to have an effect on water quality. The excavation of roads and other works areas has the potential to intercept larger volumes of drainage water that will require management. Mitigation measures are presented in Chapter 8.

Soils & Geology and Air & Climate / Noise

The movement and removal of soils, overburden and rock during the construction phase has the potential to give rise to dust effects (as described in Chapter 9 of this EIS), which could in turn reduce the local air quality.

14.2.5 Air and Climate / Noise

Material Assets and Air & Climate / Noise

The movement of construction vehicles both within and to and from the site has the potential to give rise to noise and dust nuisance effects during the construction phase. This is assessed further in Chapter 9 of this EIS, and mitigation measures are presented to minimise any potential effects.

14.2.6 Landscape

Landscape and Cultural Heritage

As described in Chapter 12 of this EIS, the proposed development has the potential to change the landscape setting of recorded sites and monuments in proximity to the site. Effects on the setting of a site may arise when a development is proposed immediately adjacent to a recorded monument or cluster of monuments. While the proposed development may not physically impact on a site, it may alter the setting of a monument or group of monuments. There is no standardised industry-wide approach for assessing the degree of impact on the setting of a monument, and further details of the methods used for the proposed development are given in Chapter 12.

14.3 Mitigation and Residual Effects

Where any potential interactive negative effects have been identified in the above, a full suite of appropriate mitigation measures have already been included in the relevant sections (Sections 4-13) of the EIS. The implementation of these mitigation measures will reduce or remove the potential for these effects. Information on potential residual effects, and their significance, is also given in each chapter.

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