National Parks & Wildlife Services (NPWS) (ND) *NPWS Map Viewer* [Online] - Available at: http://webgis.npws.ie/npwsviewer/

National Roads Authority (NRA) (2008) *Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes*

Transport Infrastructure Ireland (TII) (2013) *Notes for Guidance on the Specification for Road Works Series NG 600 - Earthworks*

von Post L., Granlund L.E., and Granlund L. (1926) *Södra Sveriges Torvtillgånger, I.* Sver.Geo. Unders. C35, 19 (2)

9 HYDROLOGY & HYDROGEOLOGY

9.1 INTRODUCTION

This chapter assesses the impacts of the Project (**Chapter 1: Introduction**) on the Hydrology and Hydrogeology environment associated with the Site. The Project refers to all elements of the application for the construction of Inchamore Wind Farm (**Chapter 2: Project Description**). Where negative effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment considers the potential effects during the following phases of the Project:

- Construction of the Project;
- Operation of the Project, and
- Decommissioning of the Project.

Common acronyms used throughout this EIAR can be found in **Appendix 1.2.** This chapter of the EIAR is supported by the following Figures provided in **Volume III** and by the appended documents provided in **Volume IV** of this EIAR.

- **Figure 9.1(a)** – Site Location & Layout Wind Farm
- **Figure 9.1(b)** – Site Location & Layout Grid Connection Route
- **Figure 9.2(a)** - Surface Water Network Wind Farm
- **Figure 9.2(b)** - Surface Water Network Grid Connection Route
- **Figure 9.3(a)** - WFD Status Wind Farm
- **Figure 9.3(b)** - WFD Status Grid Connection Route
- **Figure 9.4(a)** - WFD Risk Wind Farm
- **Figure 9.4(b)** - WFD Risk Grid Connection Route
- **Figure 9.5** - Rainfall Trends at Site
- **Figure 9.6** - Surface Water & Designated Area Flow Chart
- **Figure 9.7 (a)** - Surface Water Mapping and Survey Wind Farm
- **Figure 9.7 (b)** - Surface Water Mapping and Survey Grid Connection Route
- **Figure 9.8(a)** - Bedrock Aquifer Wind Farm
- **Figure 9.8(b)** - Bedrock Aquifer Grid Connection Route
- **Figure 9.9 (a)** - Groundwater Vulnerability Wind Farm
- **Figure 9.9 (b)** - Groundwater Vulnerability Grid Connection Route
- **Figure 9.10 (a)** - Groundwater Recharge Wind Farm
- **Figure 9.10 (b)** - Groundwater Recharge Grid Connection Route
- **Figure 9.11(a)** - Designated & Protected Areas Wind Farm
- **Figure 9.11(b)** - Designated & Protected Areas Grid Connection Route

- **Figure 9.12(a)** - Surface Water Network and Water Resources Wind Farm
- **Figure 9.12 (b)** – Surface Water Network and Water Resources Grid Connection Route
- **Figure 9.13 (a)** - Constraints Map Wind Farm
- **Figure 9.13 (b)** - Constraints Map Grid Connection Route

- **Appendix 9.1** – Inchamore Wind Farm Site Specific Flood Risk Assessment
- **Appendix 9.2** – Inchamore Wind Farm Site Photographs
- **Appendix 9.3** – Hydrochemistry Database
- **Appendix 9.4** – SW Laboratory Certs
- **Appendix 9.5** – Safety Material Datasheet-Clearbore
- **Appendix 9.6** – Conceptual and Info Graphics

A Construction and Environmental Management Plan (CEMP) is appended to the EIAR in **Appendix 2.1.** This document will be a key construction contract document, which will ensure that all mitigation measures, which are considered necessary to protect the environment during the construction phase are implemented. It will include and apply all of the construction phase mitigation described within the EIAR where relevant, and by relevant competent engineers at the detailed construction design phase of the Project. For the purpose of this application, a summary of the mitigation measures is included in **Appendix 17.1**.

9.2 PROJECT DESCRIPTION

The Project (**Figure 8.1a-b**) is described in **Chapter 2: Project Description.**

9.2.1 Statement of Authority

Minerex Environmental Ltd. (MEL), an RSK group company was commissioned to carry out this Environmental Impact Assessment Report. RSK Group, is a consultancy providing environmental services in the hydrological, hydrogeological and other environmental disciplines. The company and group provide consultancy to clients in both the public & private sectors. More information can be found at www.rskgroup.com. The members of the RSK EIA team involved in this assessment include the following persons:

- Sven Klinkenbergh – Project Manager and Lead Author – B.Sc. (Environmental Science), P.G.Dip. (Environmental Protection) – Associate, Project Manager and EIA Lead Author with c. 10 years industry experience in the preparation of environmental, geological, hydrological and hydrogeological reports. Sven's involvement in this EIAR has been conducting field surveys and a technical reviewer of both Chapter 8 and Chapter 9
- Project Scientist: Jayne Stephens - B.Sc. (Environmental Science), PhD (Environmental and Infection Microbiology). Jayne is an Environmental consultant with

c. 5 years' experience working in microbiology, water, and environmental disciplines. She graduated with a BSc in Environmental Science from National University of Ireland Galway in 2014, majoring in mammal ecology. Following this, Jayne was the successful Irish applicant to the Tropical Biological Association in Cambridge to complete a field course in tropical biodiversity and conservation in Tanzania. She holds a PhD in environmental microbiology, graduating in 2023. Jayne has worked on a large number of bathing water and surface water monitoring investigations, on project Acclimatize, an EU funded project which aimed to bridge the knowledge gap in relation to at-risk urban and rural bathing waters in Ireland and Wales. During this project, Jayne was team lead for site investigations and has a number of years' experience on microbial contamination and public involvement projects for better water quality. Jayne's involvement in this EIAR has been data analysis and technical report writing.

- Lissa Colleen McClung - B.Sc. Environmental Studies (Hons.), M.Sc. Environmental Science Hons.). Current Role: Graduate Project Scientist. Colleen has recently joined RSK Ireland as a Graduate Project Scientist under the Hydrology & Hydrogeology and Land, Soils & Geology Team. After attaining an MSc in Environmental Science, with 1.1 First Class Honours, from Trinity College Dublin in 2021. Since coming on board, Colleen has worked on a variety of projects for urban residential development schemes and renewable energy. As a Project Scientist, Colleen has undertaken technical report writing in many forms, such as: Flood Risk Assessments (Stage 1 and Stage 2) (ROI), Drainage Assessments (NI), Water Framework Directive Assessments, Environmental Impact Assessment Reports (ROI) and Environmental Statements (NI). She has also carried out extensive field work around the country. Key capabilities include preparation of Environmental Impact Assessment Reports and running software such as QGIS, Python and Matlab coding languages. Colleen's involvement in this EIAR has been data analysis, technical report writing and producing technical appendices and figures.
- Mairéad Duffy- B.Sc. Environmental Management, M.Sc. Climate Change. Current Role: Graduate Project Scientist. Mairéad has experience in technical report writing and field work surveying of hydrological and geological elements of the environment with associated proposed green energy projects around the country. Mairead's involvement in this EIAR has been data analysis and technical report writing.

9.2.2 Assessment Structure

In line with the EIA Directive as amended and current EPA (2022) *Guidelines on the information to be contained in Environmental Impact Assessment Reports* the structure of this Hydrology and Hydrogeology chapter is as follows:

- Assessment Methodology and Significance Criteria.

- Description of baseline conditions at the Site.
- Identification and assessment of impacts to hydrology and hydrogeology associated with the Development, during the construction, operational and decommissioning phases of the Development.
- Mitigation measures to avoid or reduce the impacts identified.
- Identification and assessment of residual impacts of the Development considering mitigation measures.
- Identification and assessment of cumulative impacts if and where applicable.

9.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

The following sections are general to the EIAR process and where specific items are raised, they are assessed and discussed in detail in following sections of the report.

9.3.1 Assessment Methodology

The following calculations and assessments were undertaken in order to evaluate the potential impacts of the Project on the hydrology and hydrogeology aspects of the environment at the Inchamore Site:

- Characterise the topographical, hydrological and hydrogeological regime of the Site from the data acquired through desk study and onsite surveys.
- Water balance calculation.
- Flood risk evaluations.
- Consider hydrological or hydrogeological constraints together with Project design.
- Consider drainage issues, or issues with surface water runoff quality as a result of the Development, its design and methodology of construction.
- Assessment of the combined data acquired and evaluation of any likely impacts on the hydrology and hydrogeology aspects of the environment.
- Where impacts are identified, measures are described that will mitigate or reduce the identified impact.
- Findings are presented and reported in a clear and logical format that complies with EIAR reporting requirements.

Assessments of routes (Grid Connection Route and Turbine Delivery Route) are assessed in a similar manner but use mainly desktop assessment data to evaluate and qualify potential impact at locations associated with significant infrastructure (cable joint bays and watercourse crossings). These routes generally follow existing infrastructure, namely public roads.

9.3.1.1 *General Approach*

The Environmental Impact Assessment Report (EIAR) is a comprehensive document that assesses the potential impacts of a proposed development on the environment. It typically includes several fundamental components, including an assessment of baseline conditions, identification of site constraints, evaluation of the proposed development layout, identification of potential unmitigated impacts, and the identification and description of mitigation measures to minimize potential impacts to acceptable levels where possible, and to evaluate likely or expected residual impacts posed by the Project.

During the baseline assessment phase, the importance and sensitivity of environmental attributes are qualified relative to each chapter or discipline. This process involves considering available legal instruments, guidance, and relevant information or research to form the basis of qualifying environmental attributes or receptors. Site constraints are also identified during this phase, which are then used to inform the proposed development design.

The Project frozen layout is then evaluated in terms of its likely impact on the receiving environment. Potential unmitigated impacts are identified and qualified by considering the importance and sensitivity of the receiving environment, as well as the nature, scale, magnitude, and duration etc. of the proposed activity or impact arising from the development.

Once potential impacts have been identified, the EIAR then describes mitigation measures that will be applied to minimize impacts to acceptable levels where possible. These measures are objective-driven and are applied with a view to achieving the desired end result. Mitigation by design, such as avoiding constraints, can help minimize the most significant potential impacts, but residual risks will remain. Therefore, adequate application, design and execution of described mitigation measures, ongoing monitoring, management, and escalation of emergency response mitigation where relevant will be required, and the mitigation measures may need to be redesigned, repeated or re-applied until the objectives of mitigation are being achieved.

Once mitigation measures have been established, the likely residual impacts of the development are then reported. This report is typically presented in an objective, transparent, and comprehensive manner, which is essential to ensure that stakeholders have a clear understanding of the Project's potential impacts on the environment.

9.3.1.2 Objective Led Approach

In the previous section there are two items in particular which will be linked strongly by objectives. For instance; qualifying the importance and sensitivity of an environmental attribute or receptor will align with relevant legal instruments. For example; to qualify surface water features, the EIAR will align with the objectives of the Water Framework Directive (WFD) whereby the objective for surface waters is; *member states must achieve or maintain at least Good status in all water bodies*. This approach equates to qualifying all surface water features as very important and sensitive receptors and that any adverse impact will be viewed as potentially jeopardising the objectives of the WFD.

Similarly, when assessing the Site and prescribing conceptual mitigation measures, the EIAR will set out to achieve mitigation and residual impact in line with the same objectives. For example, mitigation will set out to minimise any potential for contaminants to reach sensitive receptors identified, will monitor the efficacy of mitigation measures applied, and where failing to achieve the objectives set, emergency response and mitigation measures are escalated until such time as the site stabilises and objectives of mitigation are being achieved once more.

9.3.1.3 Striving for Nature Based Solutions and Net Benefit Impacts

Similar to objectives for water quality discussed previously, the objectives of the WFD and other instruments also include for other environmental hazards, for example; flooding. For any new development, Flood Risk Assessment will involve two main components, flood risk on site, and the potential to enhance flood risk downstream. In keeping with the objective of WFD and FRA guidance and policy, a new development in a greenfield site will invariably impact adversely on the hydrological response to rainfall whereby, unmitigated there will be a net increase in runoff rates at the site following a storm event, in turn potentially exacerbating flooding in flood risk areas downstream of the site. Despite the fact that the likely net increase will be relatively tiny compared to the runoff and discharge rates at a catchment scale, the objective set by relevant instruments and guidance is that the cumulative nature of these impacts can have significant adverse impacts, and therefore, all developments will set out to not only neutralise any potential net adverse impact, but to strive to attain a net benefit impact where by the development will attenuate more than the net increase posed by the development.

The approach to achieving objectives and net beneficial impacts is mainly through the application of Nature Based Solutions. This can include improvements rooted in an ecological context, such as areas designated for ecological improvement, but a development can also be engineered to achieve Nature Based Solutions, for example; the introduction of new drainage networks in greenfield areas has the potential to significantly alter the hydrological regime at the site, but the same drainage network will be engineered to maintain or emulate the baseline hydrological regime in so far as possible. This can be achieved through application of Sustainable Drainage Systems but the design of such systems and drainage network must also be designed and specified in an objective led manner, while also considering constraints that might limit the application or positioning of such features.

9.3.2 Relevant Legislation and Guidance

This study complies with the EIA Directive as amended which requires Environmental Impact Assessment for certain types of development before development consent is granted.

In addition, the following environmental legislation relevant to hydrological and hydrogeological aspects of the environment were adhered to:

- Drinking Water Directives (98/83/EC) on the Quality of Water Intended for Human Consumption and resultant SI No. 122 of 2014 (Drinking Water) Regulations and SI No. 464 of 2017 (Amendment) Regulations.
- Quality Required of Surface Water Intended for Abstraction of Drinking Water (75/440/EEC) and European Communities Environmental Objectives (Surface Waters) Regulations 2009 SI No. 272 of 2009 as amended (S.I. No. 327 of 2012, S.I. No. 386 of 2015, S.I. No. 77 of 2019).
- Dangerous Substances Directive (76/464/EEC) and resultant SI No. 12 of 2001: Water Quality (Dangerous Substances) Regulations
- Quality of Fresh Waters Needing Protection or Improvement in order to Support Fish Life (78/659/EEC) and resultant SI No. 293 of 1988: Quality of Salmonid Waters Regulations
- SI No. 258 of 1998: Water Quality (Phosphorous Regulations)
- The Water Framework Directive (2000/60/EC) and resultant regulations:
- European Communities (Water Policy) Regulations, 2003 (S.I. No. 722 of 2003) as amended
- European Communities Environmental Objectives (Surface Waters) Regulations, 2009 (S.I. No. 272 of 2009) as amended
- European Communities Environmental Objectives (Groundwater) Regulations, 2010 (S.I. No. 9 of 2010)

- European Communities (Technical Specifications for the Chemical Analysis and Monitoring of Water Status) Regulations, 2011 (S.I. No. 489 of 2011)
- European Union (Water Policy) Regulations 2014 (S.I. No. 350 of 2014)

The Water Framework Directive (WFD), which was passed by the European Union (EU) in 2000, requires all Member States to protect and improve water quality in all waters so that we achieve good ecological status by 2015, is a wide-reaching piece of legislation which replaces a number of the other water quality directives (for example, those on Water Abstraction). Implementation of others (for example, The Integrated Pollution Prevention and Control and Habitats Directives) will form part of the 'basic measures' for the Water Framework Directive. The fundamental objective of the Water Framework Directive aims at maintaining "high status" of waters where it exists, preventing any deterioration in the existing status of waters and achieving at least "good status" in relation to all waters by 2027* (WFD). (*Current RBMP cycle).

The Cork County Development Plan (2022-2028) and Kerry County Development Plan (2022-2028) were also consulted as part of the EIA process.

This study has been prepared using the following guidance documents, which take account the current legislation and policy:

- CIRIA (2006) Control of Water Pollution from Linear Construction Projects – Technical Guidance
- CIRIA (2015) Environmental Good Practice on Site (fourth edition) (C741)
- CIRIA (2015) The SuDS Manual (C753)
- Enterprise Ireland (n.d.) "Best Practice Guide (BPGCS005) Oil Storage Guidelines"
- Environmental Protection Agency (EPA) (2014) "Guidance on the Authorisation of Direct Discharges to Groundwater".
- EPA (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (supersedes 1997 and 2002 versions)
- Exploration & Mining Division, Minerals Ireland, Dept. of Communications, Climate Action & Environment (2019) "Exploration Drilling – Guidance on Discharge to Surface and Groundwater".
- Inland Fisheries Ireland (IFI) (2016) "Guidelines on Protection of Fisheries During Construction Works in and Adjacent to Waters" *Inland Fisheries Ireland*
- Institute of Geologists of Ireland (IGI) (2002) Geology in Environmental Impact Statements – A guide

- IGI (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements
- Irish Wind Energy Association (IWEA) (2012) Best Practice Guidelines for the Irish Wind Energy Industry
- Law, C. and D'Aleo, S. (2016) Environmental Good Practice on Site Pocket Book. (C762) 4th edition. CIRIA
- Masters-Williams, H. et al. (2001) "Control of Water Pollution From Construction Sites. Guidance for Consultants and Contractors (C532)
- Murnane, E., A. Heap, A. and Swain, A. (2006) "Control of Water Pollution from Linear Construction Projects, Technical guidance (C648)" CIRIA
- Murnane, E., A. Heap, A. and Swain, A. (2006) "Control of Water Pollution from Linear Construction Projects, Site Guide (C649) CIRIA
- Murphy, D. (2004) "Requirements for the Protection of Fisheries Habitat during Construction and Development Works at River Sites" Eastern Regional Fisheries Board
- National Roads Authority (NRA) (2008) "Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes"
- NRA (2008) "Environmental Impact Assessment of National Road Schemes" – A Practical Guide – Rev 1
- NRA (2008) "Guidelines for the Crossing of Watercourses during the Construction of National Road Schemes"
- Office of Public Works (2009) "The Planning System and Flood Risk Management, Guidelines for Planning Authorities"
- Office of Public Works (OPW) (2013) "Construction, Replacement or Alteration of Bridges and Culverts" Office of Public Works
- Scottish Environment Protection Agency (SEPA) (2010) "Engineering in the Water Environment: Good Practice Guide – River Crossings" *Scottish Environment Protection Agency*
- Scottish National Heritage (SNH) (2018) Environmental Impact Assessment Handbook – Version 5
- Scottish nature Heritage (2019) Good practice during wind farm construction 4th Edition)
- Transport Infrastructure Ireland (TII) (2014) "Drainage Design For National Road Schemes - Sustainable Drainage Options".

9.3.3 Desk Top Study

Desk top study assessments were undertaken of the hydrology and hydrogeology aspects of the Project before and after field investigations. This involved the following components:

- Obtain and compilation of all available and relevant mapped data of the Project provided by the client.
- Study and assessment of the proposed locations of turbines and access roads relative to available data on site topography and slope gradients. At minimum, open source (relatively low accuracy) data will be used where specific data is required, for example; opensource Global Digital Elevation Model (GDEM) data for topo and slope data in the absence of Lidar (relatively high accuracy) or similar.
- Study and assessment of the proposed locations of turbines, access roads and other associated infrastructure units relative to available data on hydrology and hydrogeology.
- Study of geospatial data obtained from various sources including; Environmental Protection Agency (EPA), Geological Survey Ireland (GSI), Teagasc, Ordinance Survey Ireland (OSi), National Parks and Wildlife (NPWS) overlain with the Development plan drawings using a Graphic Information System (GIS). Data was assessed at a regional, local and site-specific scale.
- Assessment of relevant additional data was obtained where relevant, for example, rain data obtained from Met Eireann, and river discharge rates and synoptic data sets obtained from the EPA.
- Assessment of site-specific aerial data (Blue Sky Lidar data (1 m)).

9.3.4 Field Work

Field inspections were carried out by Project Manager Sven Klinkenbergh, at the Site of the Project during c. January and February 2019 as well as September 2020 and November 2022.These works consisted of the following:

- Site walk over including recording and digital photography of significant features. Photographs obtained during Site Surveys are presented in **Appendix 9.2.**
- Drainage distribution and catchment mapping.
- Field hydrochemistry of the drainage network (electrical conductivity, pH and temperature).
- Recording of GPS co-ordinates for all investigation and monitoring points in the study.
- Baseline sampling of surface water for analytical laboratory testing. Four baseline sampling events were carried out i.e., targeting low and high flow conditions.
- Baseline sampling and estimating of surface water flow and discharge rates during baseline surface water sampling events.
- Limitations include some access limiting factors such as active commercial forestry and similar vegetation e.g. scrub.

9.3.5 Evaluation of Potential Effects

9.3.5.1 Sensitivity

Sensitivity is defined as the potential for a receptor to be significantly affected by a proposed development [1]. The EPA provides guidance on the assessment methodology, including defining general descriptive terms in relation to magnitude of impacts however, in terms of qualifying significance of the receiving environment the EPA guidance also states that: "*As surface water and groundwater are part of a constantly moving hydrological cycle, any assessment of significance will require evaluation beyond the development site boundary.*"[2]

To facilitate the qualification of hydrological and hydrogeological attributes, guidance specific to hydrology and hydrogeology as set out by National Roads Authority (NRA) [3], and guidance specific to landscape as set out by Scottish National Heritage (SNH) [4], has been used in conjunction with EPA guidance.

The following table presents rated categories and criteria for rating site attributes:

Table 9.1: Criteria for Rating Site Attributes – Hydrology and Hydrogeology Specific

Importance	Criteria
Extremely High	Attribute has a high quality or value on an international scale.
Very High	Attribute has a high quality, significance or value on a regional or national scale.
High	Attribute has a high quality, significance or value on a local scale.
Medium	Attribute has a medium quality, significance or value on a local scale.
Low	Attribute has a low quality, significance or value on a local scale.

Considering the above categories of rating importance and associated criteria, the following table presents rated sensitivity categories (SNH, 2013):

Table 9.2: Criteria for Rating Site Sensitivity - Landscape Character Specific

Importance	Criteria
High Sensitivity	Key characteristics and features which contribute significantly to the distinctiveness and character of the landscape character type. Designated landscapes e.g. National Parks, Natural Heritage Areas (NHAs) and Special Areas of Conservation (SACs) and landscapes identified as having low capacity to accommodate proposed form of change, that is; sites with attributes of **Very High Importance**.
Medium Sensitivity	Other characteristics or features of the landscape that contribute to the character of the landscape locally. Locally valued landscapes which are not designated. Landscapes identified as having some tolerance of the proposed change subject to design and mitigation, that is, sites with attributes of **Medium to High Importance**.

[1] Environmental Protection Agency (EPA) (2017) Guidelines on the information to be contained in Environmental Impact Assessment Reports
[2] Environmental Protection Agency (EPA) (2022) Advice Notes for Preparing Environmental Impact Statements Environmental Protection Agency, Ireland
[3] National Roads Authority (NRA) (2008) Guidelines on the information to be contained in Environmental Impact Assessment Reports
[4] Scottish National Heritage (SNH) (2018) Environmental Impact Assessment Handbook V5

Importance	Criteria
Low Sensitivity	Landscape characteristics and features that do not make a significant contribution to landscape character or distinctiveness locally, or which are untypical or uncharacteristic of the landscape type. Landscapes identified as being generally tolerant of the proposed change subject to design and mitigation, that is, sites with attributes of **Low Importance**.

9.3.5.2 Magnitude

The magnitude of potential impacts arising as a product of the Project are defined in accordance with the criteria provided by the EPA, as presented in the **Table 9.3**[5]. These descriptive phrases are considered general terms for describing potential effects of the Development, and provide for considering baseline tends, for example a *Moderate* impact is one which *is consistent with the existing or emerging trends*.

Table 9.3: Describing the Magnitude of Impacts

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

In terms of hydrology and hydrogeology, magnitude is qualified in line with relevant guidance, as presented in **Table 9.4** and **Table 9.5**[6]. These descriptive phrases are considered development specific terms for describing potential effects of the Project, and do not provide for considering baseline tends and therefore are utilised to qualify impacts in terms of weighting impacts relative to site attribute importance, and scale where applicable.

Table 9.4: Qualifying the Magnitude of Impact on Hydrological Attributes

Magnitude of Impact	Description	Example/s
Large Adverse	Results in loss of attribute and/or quality and integrity of attribute	Loss or extensive change to a waterbody or water dependent habitat, or

[5] Environmental Protection Agency (EPA) (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports
[6] National Roads Authority (NRA) (2008) Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes

Magnitude of Impact	Description	Example/s
		Calculated risk of serious pollution incident >2% annually, or Extensive loss of fishery
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Partial reduction in amenity value, or Calculated risk of serious pollution incident >1% annually, or Partial loss of fishery
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute.	Slight reduction in amenity value, or Calculated risk of serious pollution incident >0.5% annually, or Minor loss of fishery
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	Calculated risk of serious pollution incident <0.5% annually
Minor Beneficial	Results in minor improvement of attribute quality.	Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually
Moderate Beneficial	Results in moderate improvement of attribute quality.	Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually
Major Beneficial	Results in major improvement of attribute quality.	Reduction in predicted peak flood level >100 mm

Table 9.5: Qualifying the Magnitude of Impact on Hydrogeological Attributes

Magnitude of Impact	Description	Example
Large Adverse	Results in a loss of attribute.	Removal of large proportion of aquifer, or Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or Ecosystems, or Potential high risk of pollution to groundwater from routine run-off
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Removal of moderate proportion of aquifer, or Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or Ecosystems, or Potential medium risk of pollution to groundwater from routine run-off.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute.	Removal of small proportion of aquifer, or Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems, or Potential low risk of pollution to groundwater from routine run-off.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	Calculated risk of serious pollution incident <0.5% annually

9.3.5.3 *Significance Criteria*

Considering the above definitions and rating structures associated with sensitivity, attribute importance, and magnitude of potential impacts, rating of significant environmental impacts is done in accordance with relevant guidance as presented in **Table 9.6**. This matrix qualifies the magnitude of potential effects based on weighting same depending on the importance and/or sensitivity of the receiving environment. In terms of Hydrology and Hydrogeology, the general terms for describing potential effects (**Table 9.3: Describing the Magnitude of Impacts**) are linked directly with the Project specific terms for qualifying potential impacts (**Table 9.4: Qualifying the Magnitude of Impact on Hydrological Attributes** and **Table 9.5: Qualifying the Magnitude of Impact on Hydrogeological Attributes**). Therefore, qualifying terms (**Table 9.6**) are used in describing potential impacts of the Project. This is largely driven by the potential for effects to extend down gradient, beyond the Redline Boundary in terms of Hydrology and Hydrogeology.

Table 9.6: Weighted Rating of Significant Environmental Impacts

Sensitivity (Importance of Attribute)	Magnitude of Impact			
	Negligible (Imperceptible)	**Small Adverse (Slight)**	**Moderate Adverse (Moderate)**	**Large Adverse (Significant to Profound)**
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High	Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

9.3.5.4 *Consultations*

A Scoping Response was received for the proposed Project from the Development Applications Unit which yielded the following pertaining to a population of freshwater pearl mussel:

> *The combination of clean water diversion, lined multicelled stone-constructed sediment ponds which can be cleaned by suction rather than excavated out, an environmental management plan, alarmed autosamplers, and previous best-practice upland construction experience indicates that a sediment control system could control sediment release such that it will not have an adverse effect on freshwater life downstream.*

Responses to this Scoping Response can be found in **Section 9.6.1.2, Section 9.6.1.2.5,** and **Appendix 9.6 Tile 13.** Further information on sensitive ecological populations is detailed in **Chapter 6 Aquatic Ecology.**

9.4 BASELINE DESCRIPTION

9.4.1 Introduction

An investigation of the existing hydrologic and hydrogeologic characteristics of the study area was conducted by undertaking a desk study, consultation with relevant authorities and site-based fieldwork surveys. All data collected has been interpreted to establish the baseline conditions within the Study Area and the significance of potential adverse effects have been assessed. These elements are discussed in detail in the following sections.

9.4.2 Site Description

The Site is located 5.9 km west of Ballyvourney, Co. Cork and shares the county boundary between Cork and Kerry. It is 54 km west of Cork City, and 23 km north-east of Kenmare, Co. Kerry. The Project is located within the townlands of Inchamore, Mileeny, Derryreag and Derreenaling. The Site is characterised by relatively complex (hilly) topography with associated elevations ranging between 460 metres Above Ordnance Datum (m AOD) in the north-western side of the Site to 350 m AOD towards the eastern side of the Site. The Project is 'novel' relative to the Site which is characterised as being rural agricultural land generally, however there are a number of established wind farms in the region including Coomagearlahy Wind Farm, Coolknoohil Kilgarvan Wind Farm, Glanlee Wind Farm and Grousemount Wind Farm c. 2.7 km, 4.4 km 4.9 km, and 7.5 km southwest of the Site, respectively **(Appendix 2.3: Wind Farms within 20 km of Proposed Turbines).**

The Site extends to approximately 170 ha of which 145.4 ha consists of low yielding, commercial forestry. owned by Coillte. Coillte own 76.0 ha of the forestry (53% of forestry on site) while 69.4 ha (47%) of the forestry is owned privately. Other principal land use in the area consists of a mix of agricultural sheep and cattle grazing, farmland, residential properties, agricultural structures and open mountain heath. Topography across the site varies ranging from mostly gently to occasional steep inclinations. Rocky outcrops with steep, shear faces are occasionally distributed across several of the slope faces. Topography is discussed in greater detail in relation to stability and constraints in **Chapter 8: Soils and Geology.**

9.4.3 Rainfall and Evapotranspiration

Rainfall data for the region associated with the Project has been assessed in terms of the following parameters:

- Historical average and max monthly rainfall and effective rainfall. Effective rainfall is calculated as being rainfall minus evapotranspiration equals effective rainfall, or the amount of rainfall which will contribute to surface water runoff discharge volumes and/or groundwater recharge.
- Potential significant storm events including events with a 1 in 100 year return period over 1 hour duration, 25 day duration and 30 day or month duration (inferred using available data).
- Daily 2020 rain (specifically in relation to meteorological conditions at the time of Site Surveys).

Data from the meteorological stations listed in

Table 9.7: Meteorological Stations are used in this assessment[7]. Using data presented in **Table 9.9: Met Éireann Return Period Rainfall Depths (Irish Grid; 113392, 78786)**, storm event of 30 days duration with a 1 in 100 year return period is inferred to be 498.3 mm. For the purpose of this environmental impact assessment, predicted extreme or worst-case values are used, as presented in **Table 9.9: EIA Specific Assessment Data**. Rain fall amounts in the three days preceding baseline sampling events are presented in **Table 9.11: Rainfall Prior to Baseline Sampling Events.**

Table 9.7: Meteorological Stations [8]

Category	Meteorological Station/s & Data Set	Approx. Distance from the Site (km)
Rainfall (Historical Monthly)	M.BALLINGEARY 1948-2020	4
Rainfall (2020/21 Monthly/Daily)	M.BALLINGEARY 1948-2020	4
Evapotranspiration	Cork Airport – 2016-2019 Minimum	50

[7] Met Éireann, Historical Data, Available at; www.met.ie, Accessed; 03rd March 2021
[8] Met Éireann

Table 9.8: Met Éireann Return Period Rainfall Depths (Irish Grid; 113392, 78786)[9]

Met Eireann
Return Period Rainfall Depths for sliding Durations
Irish Grid: Easting: 113392, Northing: 78786,

DURATION	Interval 6months	1year	Years 2	3	4	5	10	20	30	50	75	100	150	200	250	500
5 mins	3.1	4.0	4.5	5.1	5.6	5.9	6.9	8.0	8.7	9.6	10.4	11.0	11.9	12.6	13.2	N/A
10 mins	4.4	5.6	6.3	7.2	7.7	8.2	9.6	11.1	12.1	13.4	14.5	15.4	16.6	17.6	18.4	N/A
15 mins	5.1	6.6	7.4	8.4	9.1	9.6	11.3	13.1	14.2	15.7	17.1	18.1	19.6	20.7	21.6	N/A
30 mins	7.2	9.2	10.2	11.6	12.5	13.2	15.4	17.8	19.2	21.2	22.9	24.2	26.2	27.6	28.8	N/A
1 hours	10.2	12.8	14.2	16.1	17.3	18.2	21.1	24.1	26.0	28.6	30.8	32.5	35.0	36.9	38.4	N/A
2 hours	14.3	17.9	19.7	22.2	23.8	25.0	28.8	32.8	35.3	38.6	41.5	43.6	46.8	49.2	51.2	N/A
3 hours	17.5	21.7	23.8	26.8	28.7	30.1	34.5	39.2	42.1	46.0	49.3	51.8	55.5	58.3	60.6	N/A
4 hours	20.1	24.9	27.3	30.6	32.8	34.4	39.3	44.5	47.7	52.1	55.8	58.5	62.7	65.7	68.2	N/A
6 hours	24.6	30.3	33.1	37.0	39.5	41.4	47.2	53.2	57.0	62.1	66.3	69.5	74.3	77.9	80.7	N/A
9 hours	30.0	36.8	40.1	44.7	47.6	49.8	56.6	63.7	68.1	74.0	78.9	82.6	88.1	92.2	95.5	N/A
12 hours	34.6	42.2	45.9	51.1	54.4	56.9	64.5	72.4	77.2	83.7	89.2	93.4	99.4	104.0	107.6	N/A
18 hours	42.3	51.3	55.6	61.7	65.6	68.5	77.4	86.6	92.2	99.8	106.2	110.9	117.9	123.2	127.4	N/A
24 hours	48.7	58.9	63.8	70.6	75.0	78.2	88.1	98.3	104.6	113.0	120.1	125.3	133.1	138.9	143.5	159.0
2 days	64.3	76.4	82.2	90.2	95.2	99.0	110.4	122.0	129.1	138.5	146.4	152.2	160.8	167.1	172.2	189.0
3 days	77.6	91.4	97.9	106.9	112.5	116.7	129.3	142.1	149.9	160.1	168.7	175.0	184.3	191.2	196.7	214.8
4 days	89.8	105.0	112.1	121.9	128.1	132.6	146.3	160.1	168.6	179.6	188.8	195.6	205.5	212.8	218.7	237.9
6 days	112.1	129.7	138.0	149.3	156.3	161.5	177.1	192.8	202.2	214.7	224.9	232.5	243.5	251.7	258.2	279.3
8 days	132.7	152.5	161.8	174.4	182.2	188.0	205.2	222.5	232.9	246.5	257.7	265.9	278.0	286.8	293.8	316.8
10 days	152.3	174.1	184.3	198.1	206.6	212.9	231.6	250.3	261.5	276.2	288.3	297.1	310.0	319.5	327.0	351.5
12 days	171.2	194.9	205.8	220.7	229.9	236.6	256.7	276.8	288.8	304.4	317.3	326.7	340.5	350.5	358.5	384.5
16 days	207.5	234.6	247.1	263.9	274.3	281.9	304.5	327.0	340.4	357.8	372.2	382.6	397.8	408.9	417.7	446.3
20 days	242.6	272.7	286.6	305.2	316.7	325.1	350.0	374.6	389.3	408.4	424.0	435.4	451.9	463.9	473.5	504.4
25 days	285.2	318.9	334.3	355.1	367.8	377.1	404.6	431.7	447.9	468.8	485.8	498.3	516.3	529.4	539.8	573.4

NOTES:
N/A Data not available
These values are derived from a Depth Duration Frequency (DDF) Model
For details refer to:
'Fitzgerald D. L. (2007), Estimates of Point Rainfall Frequencies, Technical Note No. 61, Met Eireann, Dublin',
Available for download at www.met.ie/climate/dataproducts/Estimation-of-Point-Rainfall-Frequencies_TN61.pdf

[9] Met Eireann, Rainfall Return Periods, Available at; https://www.met.ie/climate/services/rainfall-return-periods , Accessed; October 2022

Table 9.9: EIA Specific Assessment Data [10]

Category	Value
Max monthly effective rainfall (mm/month)	680.2
1 in 100 Year Rainfall Event (30 day duration) (mm/month)	498.3
1 in 100 Year Rainfall Event (1 hour duration) (mm/hour)	32.5
Minimum monthly evapotranspiration (mm/month)	9.7

Table 9.10: Rainfall Prior to Baseline Sampling Events [11]

Event No.	Date	Rainfall on days leading up to sampling event (Day 0)				Total Rain in 3 no. days prior to sampling. (Days 1-3)	Event Category	Weather Station
No.	Sampling Date (Day 0)	Day 3 mm/day	Day 2 mm/day	Day 1 mm/day	Day 0 mm/day	mm / 3 days		
1	12/08/2020	0.0	0.0	0.0	14.6*	0.0	Dry	Ballingeary
2	26/08/2020	2.3	53.4	4.0	4.0	59.7	Wet	Ballingeary
3	24/02/2021	0.5	14.1	33.2	4.8	47.8	Wet	Cork Airport
4	16/03/2021	8.1	0.0	0.0	0.0	8.1	Dry	Cork Airport
* Sampling occurred ahead of recorded rainfall for the day. Lead up to sampling event was dry.								

9.4.4 Regional and Local Hydrology

The surface water network draining the Site is mapped and presented in **Figure 9.2a.**

The Project is situated within the Lee, Cork Harbour and Youghal Bay catchment (ID: 19, Area: 2,182 km^2). Surface water runoff associated with the Site drains into the Sullane sub catchment and/or Sullane_010 river sub basins.

All surface waters drainage from the Site eventually combine in Carrigdrohid Reservoir, from which waters eventually flow to Cork Harbour and into the Celtic Sea.

9.4.5 Site Drainage

The Site is characterised by a relatively extensive network of non-mapped natural and artificial drainage channels. Drainage channels identified during desk study assessment

[10] Met Eireann
[11] Met Eireann

and during Site Surveys are presented in **Figure 9.7a and Figure 9.7b**. Photographs of some significant features are presented in **Appendix 9.2**.

Note: Mapping of minor natural or artificial drainage channels has been completed is limited in places due to some site access constraints (afforested areas). Considering the nature of the areas in question, afforested areas, it is presumed that these areas possess extensive forestry drainage channels. Similarly, there are likely to be additional culverts associated with afforested areas or with minor existing access trails and minor drainage channels. Aerial lidar survey data (topographical elevation data, accuracy 1 m) and recent aerial photography was interrogated and some additional drains were identified, however none were material to the impact assessment for the development. It is likely any residual undetected drainage features are minor in scale.

9.4.6 Water Framework Directive (WFD) Water Body Status, Risk & Objectives

Details in relation to the Water Framework Directive (WFD) 2016-2021 status assigned to surface waterbodies associated with the Site are presented in **Figure 9.3a** and **Figure 9.6.**

The WFD status (2016-2021) for the mapped surface water body / river (Sullane_010), directly draining the Site is classified as 'Good'.

Further downstream, the WFD status for rivers fluctuates between 'High' and 'Good' status. However, the status then deteriorates to 'Moderate' in places due to significant pressures in hydro-morphology from channelisation and hard infrastructure such as reservoirs, weirs, embankments and culverts.[12]

Lake water bodies associated with the surface water network possess WFD 2016-2021 status ranging from 'Moderate (e.g., Carrigdrohid Reservoir) to 'Good (e.g., Inniscarra). According to the EPA (2021), based on the 1st and 2nd RBMPs, the WFD statuses associated with the lake water bodies are due to the following actions:

The Carrigdrohid is designated as a heavily modified water bodies (HMWB) in the catchment due to power generation, in addition to 'significant unknown anthropogenic pressures' impacting Carrigdrohid. Pressures upon the Inniscarra are due to power generation and abstraction for drinking water. Both lake waterbodies (Carrigdrohid & Inniscarra) are At Risk of not achieving "Good" status.

[12] Environmental Protection Agency (2021) "3rd Cycle Draft Lee, Cork Harbour and Youghal Bay Catchment Report (HA 19)" Catchment Science & Management Unit. Version no.(1).

The headwaters of the Sullane_010, directly draining the Site, and where proposed locations of WC1, WC2 and WC3 will cross is 'At risk' of deteriorating (WFD), (**Figure 9.4a, Figure 9.6**) from significant pressures in hydro-morphology.

9.4.7 Surface Water Hydrochemistry

Baseline surface water sampling was carried out at four locations that can be seen in **Figure 9.7b** which are representative of drainage and surface water network channels associated with the Site (**Figure 9.2a**). Data on surface water flow at representative baseline sampling locations at the time of sampling is presented in **Appendix 9.5**, and laboratory certificates are presented in **Appendix 9.4**.

Surface water quality observed at all four monitoring locations is of similar standard and is generally of good quality when screened against relevant reference concentrations, however the following is noted:

- Ammoniacal Nitrogen as N was elevated above the relevant reference concentration (0.02 mg/L Ammoniacal Nitrogen as N) at all monitoring locations at given sampling dates (Min Max Range; 0.024 – 0.042 mg/L Ammoniacal Nitrogen as N). Elevations occurred during at least two out of four monitoring events for all monitoring, ranging up to four of four monitoring events at a number of locations.
- Nitrite as NO_2 was elevated above relevant reference concentration (0.05 mg/L Nitrite as NO_2) at SW1 (0.273 mg/L Nitrate as NO_3) during the 24/02/2021 sampling event.
- pH was more acidic than the relevant reference range (pH 6 – 9) at SW1 (pH 5.73) during the 26/08/2020 sampling event.

Elevated concentrations of Nitrogen compounds (Ammoniacal Nitrogen, and Nitrate) as observed at all monitoring locations is indicative of current land practices at the Site, agriculture and forestry (see Photographs **in Appendix 9.2**).

Low pH in surface water, (see **Appendix 9.3 – Surface Water Hydrochemistry Database**), can be attributed to a range of environmental characteristics and pressures, including the presence of humic and fulvic acids associated with peat (**Chapter 8: Soils and Geology**).

9.4.8 Hydrogeology – Bedrock Aquifer

Consultation with GSI Groundwater maps (2022) indicates that the entire Project is underlain by a Locally Important Aquifer (LI), that is; bedrock which is moderately productive only in local zones (**Figure 9.8a - Bedrock Aquifer**).

There are no mapped karst features within 10 km of the Wind Farm Site.

9.4.9 Groundwater Vulnerability & Recharge

Vulnerability depends on the quantity of contaminants that can reach the groundwater, the time taken by water to infiltrate to the water table and the attenuating capacity of the geological deposits through which the water travels. These factors are controlled by the types of subsoil that overlie the groundwater, the way in which the contaminants recharge the geological deposits (point or diffuse source) and the unsaturated thickness of geological deposits from the point of contaminant discharge.

Where low permeability subsoil overlies the bedrock, it is the thickness of subsoil between the release point of contaminants and bedrock that is considered when assessing vulnerability of bedrock aquifers, regardless of whether the low permeability materials are saturated or not. The GSI vulnerability mapping guidelines allow for the assignment of vulnerability ratings from "extreme" to "low", depending upon the subsoil type and thickness. Regarding sites where low permeability subsoil is present, the following thicknesses of unsaturated zone are specified.[13]

Table 9.11: Groundwater Vulnerability Ratings

Vulnerability Rating	Thickness of unsaturated zone (m)
Rock at or Near Surface (X)	0
Extreme (E)	0 to 3
High (H)	3 to 5
Moderate (M)	5 to 10
Low (L)	>10

Consultation with the GSI Groundwater Map Viewer (2022) indicates that the Wind Farm Site is underlain by areas classified predominantly mapped as 'Extreme (E)' vulnerability rating which tend to be at lower elevations, with some areas mapped as 'Rock at or Near Surface (X)' vulnerability rating particularly at higher elevations. Both the Turbine Delivery Route and Grid Connection Route traverse land with groundwater vulnerability ratings ranging from 'Moderately Vulnerable' to 'Extreme Vulnerability' (**Figure 9.9a – Groundwater Vulnerability**).

The potential groundwater recharge rate (recharge coefficient) for the local area, as mapped by GSI (2022), ranges significantly depending on the underlying soil / subsoil type and

[13] Geological Survey Ireland (2022) Story Map Series. Available at: <https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228>

varies significantly relative to the thickness of overburden or aquifer vulnerability, and corresponds to the recharge capacity of the underlying bedrock aquifer. The underlying bedrock aquifer is classified as Locally Important and will therefore have an inferred maximum recharge capacity per annum assigned, that is; effective rainfall available for recharge but in excess of maximum recharge capacity will form rejected recharge once conditions become saturated. Peat has very low permeability, however peat stores large amounts of water, that is; bog water levels in intact peatland areas are generally near the surface[14]. Combining these factors results in the Site being characterised by low recharge rates and high surface water runoff rates.

In peat areas associated with the Site the mapped groundwater recharge coefficient is as low as 20% of effective rainfall. This recharge coefficient is considered very low [15]. Whereas areas where bedrock is at or near the surface the mapped groundwater recharge coefficient is 85% of effective rainfall. This recharge coefficient is considered very high. However, the maximum recharge capacity of the aquifer will limit recharge to groundwaters.

Areas of the Site underlain by Locally Important Aquifer (LI) possess a maximum annual recharge capacity of 200 mm effective rain fall. **(Figure 9.10a)**. For additional context, the maximum recharge capacity of 200 mm per annum equates to a recharge coefficient of approximately 15% of effective rainfall respectively, in line with peat which is considered highly impermeable with a recharge coefficient <20%.

Considering all of the above, the Site is characterised by low to very low recharge rates in overburden (soils/subsoils) and very low recharge capacity in the underlying bedrock aquifer. This implies that, particularly during seasonally wet or extreme meteorological conditions, the majority of water (rain) introduced to the Site will drain off the Site as surface water runoff, and the rejected recharge water volumes will likely discharge to surface waters relatively rapidly and locally. As such, the surface water network associated with the Site is characterised as having a rapid hydrological response to rainfall (i.e., a flashy regime). This is indicative of lands comprising of blanket peat or catchments with elevated peat cover [16] [17].

[14] Labadz J, et al (2010) Peatland Hydrology. Draft Scientific Review, IUCN UK Peatland Programme's Commission of Inquiry on Peatlands. UK.
[15] Williams N. H., et al. (2011) A NATIONAL GROUNDWATER RECHARGE MAP FOR IRELAND. National Hydrology Conference 2011, Ireland.
[16] Misstear B., Brown L. (2008) Water Framework Directive – Recharge and Groundwater Vulnerability. EPA STRIVE Report, EPA, Ireland.
[17] Jennings S. (2008) Further Characterisation Study: An Integrated Approach to Quantifying Groundwater and Surface Water Contributions of Stream Flow, RPS, Ireland

9.4.10 Flood Risk Identification

A Site Flood Risk Assessment (SFRA) Stages 1 & 2 for the Wind Farm Site is presented in **Appendix 9.1 – Inchamore Wind Farm Site Specific Flood Risk Assessment**. Conclusions are summarised as follows:

- The Site is not within a probable flood zone, nor has it experienced any historical flooding.
- With reference to **Table 4.4 of Appendix 9.1**, the Project will lead to a net increase in runoff equating to 0.253 m^3/s or 2.06% relative to the Site area. This is considered an imperceptible impact of the Project.
- The associated drainage will be attenuated for greenfield run-off and the Project will not increase the risk of flooding elsewhere in the catchment.

Consultation with OPW Flood Maps (Accessed; October 2022) indicates that:

- No Arterial Drainage Schemes (ADS) have been implemented.
- The Catchment Flood Risk Management Plan (CFRAM) programme did not indicate any flood extents within the proposed Site boundaries, nor its immediate surrounding vicinity.
- There has been only one recorded localised flood event between the Site and the CFRAM mapped probable flood areas. This event 'Flooding at Coolea, Milleeny and Derreenaling' took place on 11/09/2015, however no further information about the event was available.

The closest mapped probable flood areas are associated with:

- The Sullane (030) river approximately four kilometres to the north-east of the Site near Ballymakeery town.

Flood Relief Schemes for Ballymakeery town (flood area identified above) include Measures Applicable in All Areas, which includes:

- Sustainable Drainage Systems (SuDS). Objective: Planning authorities will seek to reduce the extent of hard surfacing and paving and require the use of sustainable drainage techniques to reduce the potential impact of development on flood risk downstream.
- Land Use Management and Natural Flood Risk Management Objective: during the project-level assessments of physical works and more broadly at a catchment-level to identify any measures, such as natural water retention measures (such as restoration of wetlands and woodlands), that can have benefits for Water Framework Directive, flood risk management and biodiversity objectives.

Broad stroke objectives such as the above in addition to those outlined in **Section 9.6.1.2** are relevant to the Project whereby any development within the catchment of a Flood Relief Scheme should aim for a minimal or neutral impact in terms of net change in surface water runoff and in turn impacts downstream. Furthermore, any mitigation which promotes beneficial impacts, i.e., net-decrease in runoff or delaying the hydrological response to rainfall, contributes to the objectives of the Flood Relief Schemes and ultimately the WFD.

In regard to the Grid Connection Route, there are no recorded historic flood events along the proposed Grid Connection Route. However, there is a portion of the route near the proposed HDD crossing of Stream 3 (ITM: 517767, 583303), that crosses both a National Indicative Fluvial Mapping (NIFM) Medium (1% AEP) and Low (0.1% AEP) probability scenario. Both these risks are mapped for the current and future scenarios.

In regard to the Turbine Delivery Route, there have been several 'Single' and 'Reoccurring' Flood Events along the Sullane, in particular near the townlands of Baile Bhuirne, Macroom and closer to Cork Harbour along the River Lee. It is proposed that the TDR will utilise the Macroom to Ballyvourney Dual Carriageway. Along this route, NIFM flood risks have been identified at the following crossing locations:

- ITM: 519851, 578443
- ITM: 527446, 573948
- ITM: 535259 ,572778

Furthermore, where the Sullane meets the River Lee, south of Macroom CFRAM River Flood Extents have been mapped for the surrounding areas of 0.1%, 1% and 10% AEP, where the Turbine Delivery Route follows the N22.

9.4.11 Wells

Consultation with GSI (2022) well database indicates there are no mapped wells within the Redline Boundary. Governing industry guidelines stipulate a buffer zone of 250 m is required of from boreholes used for drinking water abstraction when assessing excavations for Turbine Foundations. The closest mapped wells are more than 1 km from the Redline Boundary (southeast of proposed T5 works), **Figure 9.12a**, suggesting that any potential impact from the Project is low risk for wells in the immediate vicinity.

With reference to **Section 9.4.9**, the groundwater aquifer underlying the Inchamore Wind Farm Site is classified as a Locally Important Aquifer (LI) – Bedrock which is Moderately Productive only in Local Zones.

The Grid Connection Route traverses land underlain by a LI aquifer. Similarly, a small portion of the Turbine Delivery Route, c. 5 km, is underlain by a Poor Aquifer – 'Bedrock which is generally Unproductive except for Local Zones' (PI), the remaining track has been routed over a LI aquifer. While no wells were identified along the Grid Connection Route during the desk top assessment, **Figure 9.12b**, Any identified boreholes along these route during the detailed design stage will highlight the significant potential for the Project to impact groundwater supplies in local zones.

9.4.12 Groundwater Levels, Flow Direction & Groundwater Hydrochemistry

With reference to **Appendix 8.1** and **Appendix F**, groundwater observations during SI rotary core drilling to bedrock depths indicate that the underlying siltstone bedrock is weathered to a minor degree only, with minor volumes of groundwater perched on top of bedrock in the subsoil underlying the Site. This is of importance for a groundwater dependent ecosystem such as the superficial peat observed on Site, that grows in the saturated zone. No significant water strikes were encountered, as would generally be the case in the absence of folding and faults, (maximum drill depth was approximately 10.5 m).

Groundwater flow patterns, or the water table of an entire aquifer, can often mimic surface water flow patterns. Overall, groundwater will follow the regional topographical gradient of a given area, moving along flow paths from areas of recharge to areas of discharge, i.e., surface waterbodies. Therefore, groundwater flow directions at the Site are presumed to follow the topography of the area, and flow paths are considered to be short due to the moderately productive underlying bedrock aquifer. Groundwater flow likely circulates in the upper overburden saturated zone, recharging and discharging in local zones with a high flowrate; thus, the groundwater is considered to be young. The implications for 'young' groundwater is that it will be more vulnerable in terms of water quality from a pollution incident.

Due to the absence of any recorded groundwater quality data within or proximal to the Study Area, no published data on groundwater quality for the Site is available. However, the 2016-2021 WFD Groundwater status for groundwater underlaying the Site is 'Good' (Groundwater unit: Ballinhassig West) and is considered not at risk.

Peat at the Site is generally shallow but with areas or pockets of deeper peat (**EIAR Chapter 8: Soils & Geology, Appendix 8.1 – App A**). Furthermore, extensive drainage and general topography conditions indicate that bog water levels will be variable and are likely impacted to a minor extent by existing drains etc., with the exception of isolated pockets of moderately deeper intact peat areas where bog water levels are likely in line with Active Blanket Bog i.e. near or at the surface.

9.4.13 Designated & Protected Areas

Special Areas of Conservation (SACs) and Special Protection Areas (SPAs), often referred to as "European Sites" or "Natura 2000 Sites", are the means by which European legislation protects threatened or rare habitats and species. Candidate sites (i.e. cSAC or cSPA) have the same level of protection as fully designated sites under Irish Law. Candidate sites are those that are currently under consideration by the Commission of the European Union for SAC or SPA status in accordance with the Habitats Directive. Natural heritage areas (NHAs) are designated areas that are protected under the Wildlife Act 2000 for areas considered important for the habitats present or which hold species of plants and animals whose habitat needs protection. Proposed natural heritage areas (pNHAs) are sites not yet offered the same statutory protection as NHAs but which may become NHAs in due course and are sites of significance for wildlife and habitats.

Designated and Protected Areas, as outlined above, associated with the Project are detailed in **Figure 9.6** and presented in **Figure 9.11a** and **9.11b**.

The Site and Turbine Delivery Route are not positioned within or directly adjacent to or immediately upstream of any designated or protected area (Special Protection Area (SPA), Special Area of Conservation (SAC), Natural Heritage Area (NHA)). The nearest downstream designated areas include the following as outlined in **Figure 9.6** and **Figure 9.11b.**

- St. Gobnet's Wood SAC and proposed Natural Heritage Area (pNHA) (EPA Site Code: 000106) which boarders the Sullane_010 approximately 5 km southeast of the Site.
- Prohus Wood Proposed NHA (Site Code: 001248), approximately 18 km downstream of the Site
- Lee Valley Proposed NHA (Site Code: 000094), located approximately 54 km downstream of the Site
- Cork Harbour SPA (EPA Site Code: IE0004030); Douglas River Estuary Proposed NHA (Site Code: 001046); Rockfarm Quarry, Little Island Proposed NHA (Site Code: 001074); Great Island Channel SAC (SiteCode: 001058), approximately 60 km downstream of the Site.

Sections of the Grid Connection Route cross certain watercourses that flow into designated Natural Heritage Areas (NHA) and Special Area of Conservation (SAC) of Killarney National Park, approximately 40 m from proposed works in some areas, **Figure 9.11b**. Particular attention to stockpiling of material will be paid along the proposed Grid Connection Route that runs parallel to the designated area. Horizontal Directional Drilling (HDD) will be utilised, where standard trenching methodologies cannot be applied, to facilitate underground cabling to mitigate the impact to the surrounding ecology through minimising vegetation cutting near the designated areas.

9.4.14 Water Resources

Drinking water rivers designated in accordance with European Communities (Drinking Water) (No. 2) Regulations 2007 (SI no. 278/2007) which are protected for the purposes of drinking water abstraction are presented in **Figure 9.12a** and **Figure 9.12b,** however none are located within the River Subbasin or Sub Catchment associated with the Site.

Surface water bodies designated for drinking water downstream of the Site include:

- Sullane_060. The Sullane_010 flows into the Sullane_020, _030, _040 and _050 until reaching the Sullane_060 approximately 23.5 km southeast of the Site. From here waters flow into the Lee (Cork)_060 which continues east and flows into Carrigdrohid Reservoir and Inniscarra Reservoir which are not designated, however the reservoir discharges to the downstream section of the Lee (Cork) river (090) which is designated for drinking water.

Groundwater encompassing all elements of the Project is (nationally) protected under the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. no. 278/2007). Therefore, although the groundwater aquifer at the site is classed Locally Important, and relatively low on the scale in terms of importance or sensitivity compared to, for example; Regional Important Kart Aquifer, all groundwater is considered an important and sensitive receptor, groundwater is considered a very important and sensitive attribute and receptor.

9.4.15 Receptor Sensitivity

All receptors associated with the Project i.e., groundwater, streams and rivers, are considered highly sensitive receptors when considering:

- Water Framework Directive (WFD) status (2016-2021) "Good". The principal objective of the WFD is to achieve good status or higher in all waters and to ensure that status does not deteriorate in any waters.
- The down-stream designations (sensitive protected areas e.g., SAC, SPA) associated with the catchment and the sensitive habitats and species associated with same (i.e., Freshwater Pearl Mussel (FWPM)).
- The designation of all waterbodies within the boundary of the Site and downstream surface water bodies and all groundwater bodies as sources of drinking water.

Ultimately, all surface waters and groundwaters associated with the Site are considered sensitive and important attributes in their own right and must be protected in accordance with the WFD to achieve and maintain at least 'Good' status. However, waterbodies associated with additional receptor sensitivities such as designated and protected areas (e.g., FWPM, SAC, SPA), should be considered at the highest level on the sensitivity scale, due to the increased risk associated with specific additional ecological attributes they possess.

Risk to receptors must consider both the hazard, and likelihood of adversely impacting on any given sensitive receptor, and therefore parameters such as, distance from potential source of hazard to receptor, pathway directness and/or connectivity, and assimilative capacity of the receiving water body will also be considered.

In terms of groundwater sensitivity and susceptibility, as discussed in previous sections, all groundwater associated with the Site is protected as a source of drinking water, under the European Communities (Drinking Water) (No. 2) Regulations 2007 (S.I. no. 278/2007). However, the bedrock aquifer underlying the Project is Locally Important (LI), which can be expressed as an aquifer with relatively low to moderate production and connectivity, and therefore the risk of potential adverse impacts on groundwater will be limited to localised zones within the Site. It is noted, with reference to **Section 9.3.14,** no wells have been identified within the 250 m buffer zone of shallow excavations for any element of the Project.

In terms of surface water sensitivity, as stated above, the vast majority of potential contaminants or unmitigated adverse impacts will infiltrate to surface water bodies, however sensitive receptors are of variable distance from the Project and the pathways are of variable condition for each proposed turbine location and for any part of the Development.

9.5 ASSESSMENT OF POTENTIAL EFFECTS

In relation to the assessment of effects the following sub-sections consider the potential worst case or unmitigated scenarios which are likely to occur as part of the proposed development, or similar developments in the context of the observed baseline conditions, e.g. effects of construction on peatlands or the receiving surface water network. The potential effects identified will be mitigated to minimise impacts, and reduce the potential adverse unmitigated impacts in line with achievable mitigation objectives.

9.5.1 Significance Rating

The receiving environment associated with the Project is considered as ranging from Low to Very High Sensitivity. With reference to **Section 9.3.5**, receptor sensitivity is qualified as follows:

- Surface Water; Very High
- Groundwater; Bedrock Aquifer; Low
- Bog Water - In areas of cut over peat, forestry or where existing drainage networks exist; Medium
- Bog Water - In areas of intact habitat and/or designated areas e.g., blanket bog / SAC; Very High

These items are discussed further in the following sections.

To account for this, the potential impacts associated with the Project will be limited to Magnitudes associated with respective environmental characteristics, as presented in the **Table 9.14.**

Table 9.12: Magnitude of potential impacts relative to receptor sensitivity

Sensitivity (Importance of Attribute)	Magnitude of Impact			
	Very Small (Imperceptible)	Small Adverse (Slight)	Moderate Adverse (Moderate)	Large Adverse (Significant to Profound)
Very High (Surface Water, Groundwater Regionally Important Aquifers, Bog water in intact or designated peat)	Imperceptible	Significant / Moderate	Profound / Significant	Profound
High (Groundwater but with limited abstraction potential / recorded abstraction points)	Imperceptible	Moderate / Slight	Significant / Moderate	Profound / Significant
Medium (Groundwater but with limited abstraction potential / recorded abstraction points) (Bog water in existing impacted areas)	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight / Moderate

In terms of determining and assessing the magnitude of impacts on surface water features, or groundwater features, categories of magnitude relate to the potential effect on the status of the attribute, that is; the attribute driving the classification of sensitivity is the current WFD status (if applicable) and baseline condition of the surface water feature/s, the risk of not reaching WFD objectives (if applicable) and the potential for the surface water system to support, or function as part of designated and protected areas (SAC, drinking water, etc.) downstream of the Site.

9.5.2 Do Nothing Impact

The "Do Nothing Impact" is the effect on the Site should the Project not be constructed. Site investigations and assessment of the baseline hydrological and hydrogeological conditions at the Site indicate that parts of the Site have already experienced impacts to baseline conditions through the planting and the installation of drainage networks associated with commercial forestry (**Appendix 9.2 – Plate 5 and Plate 9**), and peat harvesting across portions of the Site (**Appendix 9.2 – Plate 5**),

Planting of commercial forestry and agriculture / land reclamation activities (reconstitution of soils and drainage) have had a significant impact to the Site relative to absolute baseline or (hypothetically) perfect natural conditions with regard to the hydrology or hydrogeology of the Site in terms of drainage infrastructure in particular. Those activities are likely to apply pressure to the receiving surface water network and potentially regularly contribute nutrients and/or suspended solids to the receiving surface water systems. Release of contaminants will likely peak on occasion particularly during intrusive activities such as felling or after heavy rainfall events.

Should the Project not proceed, the existing land-use practice of commercial afforestation, will continue with associated gradual alteration of the existing environment and associated pressures on surface water and groundwater quality.

9.5.3 Construction Phase Potential Effects

9.5.3.1 Earthworks

The construction phase of the Project will involve the following primary excavations activities which may have the potential to adversely impact on surface water and groundwater:

- Construction of Site Access Roads
- Temporary Construction Compound
- Turbine Foundations and Turbine Hardstands
- Foundations for the Onsite Substation and Control Building
- On-Site Borrow Pit
- Foundations for the proposed Met Mast
- Trenching for underground electrical cabling, including along the Grid Connection Route.
- Temporary and permanent stockpiling of peat, subsoils and bedrock.

All of the above-mentioned excavations which will be required will necessitate the removal of vegetation, the excavation of peat and mineral subsoils. Such excavations and associated ground disturbance may increase the risk of either point source or diffuse sediment laden run-off to sensitive receptors via drainage channels and discharge routes. The proposed earthworks therefore have the potential to result in the release of elevated suspended solids to surface waters, particularly during prolonged heavy rainfall events. The release of elevated suspended solids to watercourses would adversely affect water quality and potentially negatively affect aquatic habitats downstream of the discharge source point if not mitigated against. The most vulnerable areas to surface water quality deterioration through the release of elevated suspended solids are considered to be:

- Proposed access track crossing the Sullane_010 River at (Watercourse = WC) WC1, WC2 and WC3 locations.
- Verge widening and strengthening along the Turbine Delivery Route Turning point over Flesk (Kerry)_030 headwaters.
- Proposed Grid Connection Routes Horizontal Directional Drilling crossing points of Streams 1, 2 and 3 as well as crossing of existing culverts.
- Turbine Hardstand and infrastructure development, particularly in close proximity to existing drainage with direct connection to surface waterbodies (T2, T3, T4, T5).

The **potential** unmitigated release of elevated suspended solids to surface waters is considered to be a **direct, adverse, large** in scale, **moderate to profound**, **temporary** effect of the Project. This potential impact arising from earthworks is considered **unavoidable** and **conforms to Baseline** (e.g., forestry tracks or operations), and is limited to the footprint of the Project (limits of vehicular movements, discussed later in report). Considering the mobility characteristics of surface waters to downstream receptors, it is not considered reversible and has the potential for indirect impacts to receptors downstream. However, with appropriate mitigation measures in place and via the implementation of environmental engineering controls, this impact will be reduced to within water quality regulatory limits. Potential effects impacting on water quality are discussed in greater detail in the following sections of this chapter.

9.5.3.2 *Clear Fell of Afforested Area*

Felling of forestry at the Site will be necessary for areas of the Project in afforested sections within the Redline Boundary. This is an **unavoidable** consequence of the Project. The Site contains 145.4 ha of commercial forestry. Turbines T2, T3, T4 and T5 are within afforested areas. Subsequently, tree felling will be required as part of the Project. To facilitate the construction of access roads, civil works, site compounds, borrow pits and Turbine Hardstands, 25.68 ha coniferous forestry will need to be clear-felled. The likely felled area of approximately 25.68 ha will represent approximately 15.11% of the proposed Site area (170 ha). In a spatial or land use context this is considered a **slight** to **moderate** impact.

The clear fell of afforested areas is in line with baseline conditions and future activities as part of Do Nothing impact. Therefore, in the context of the Project, the clear fell of forestry overall is considered **neutral**, however there is a range of potential **adverse** impacts associated with the activity which will require management and mitigation. Potential effects include:

1. Soil erosion, compaction and degradation: The removal of trees and underbrush during clear-felling can expose soils to wind and water erosion, leading to soil loss, compaction and degradation. This is mainly caused by vehicular movements (**Section 9.5.3.4 Figure 9.1a**).
2. Geology: Clear-felling can cause changes in the geology of an area, leading to soil instability, landslides, and other geological hazards (**Chapter 8 Section 8.4.3.3, Figure 8.7)**
3. Hydrology & Hydrogeology: The removal of trees and vegetation can lead to changes in hydrological processes, causing changes in water flow rates and patterns, such as the lowering of water tables.
4. Water quality: Clear-felling can cause increased sediment runoff and nutrient pollution in waterways, which can impact water quality, negatively affecting aquatic ecosystems and downstream water users.
5. Soil nutrient loss and nutrient loading of receiving waters: Clear-felling removes vegetation and leaves soil bare, exposing it to weathering, which can cause the entrainment of solids and/or the loss of soil nutrients, essential for plant growth. This in turn will lead to an increase in nutrients i.e. Nitrogen and Phosphorous compounds, dissolved organic carbon, potassium etc. in receiving waters flowing from the Site, which is considered a negative impact of the Project.

The overall potential effects here are considered to be of **moderate** significance, **permanent but reversible**, and **adverse**, though this is of a minor scale in comparison to the normal forestry activities taking place at the Site (i.e., small-scale felling proposed). If the Project does not take place, it is likely that the forestry at the Site will eventually either be clear felled or felled in larger volumes than the amount proposed as a function of this Project. Therefore, the resulting incremental felling of the afforested area will benefit the receiving environment, namely the receiving surface water network by means of reducing the potential magnitude of impacts, namely erosion, solids entrainment, and shock nutrient and sediment loading. With appropriate mitigation measures, planning and management this impact can be reversed, and disturbance minimised.

9.5.3.3 Release of Suspended Solids

Excavation and construction activities, associated with the Project, such as stockpiling material and vehicular movements of plant machinery introduce the **potential** risk of solids being entrained in runoff. Runoff contaminated with suspended solids will add turbidity to the receiving surface water body, can block fish gills and smother spawning grounds, reduce light penetration for flora growth, and promote bacteria and algae production. Nutrients that are associated with the solids (inorganic nutrients such as phosphorus and organic such as hydrocarbons, and sewage if present) can lead to eutrophication of the water environment and eventually to fish-kills due to lowering of oxygen supply.

The degree to which inorganic solids are entrained in runoff is related to the particle sizing of the soil components. Smaller inorganic particles (e.g. clay) will be easily entrained and will remain in suspension for a longer period than larger particles (silt / sand), and will require lower flow rates and longer retention rates to settle out of the water column when given the opportunity. Peat, comprising mostly of organic matter, will behave in a similar manner to a fine grained soil whereby much of the material will remain in suspension for a relatively long period of time, but will also dissolve and degrade within the water body, dramatically impacting on water quality.

- Forestry operations will continue at the Site. With reference to **Chapter 8: Soil and Geology**, forestry operations, harvesting and planting, will likely lead to a release of solids and nutrients entrained in surface water runoff.
- Release of suspended solids can be attributed to enhanced nutrient enrichment. This is highly dependent on the type of soil, for example peat released in water will disintegrate and most of the constituents of the peat material (carbon) will eventually dissolve into the water column and / or be consumed by micro-organisms. However, peat and other soils / subsoils will contribute varying degrees of loading of various compounds and nutrients, including Nitrogen (N) and Phosphorous (P) compounds, which are attributed to Nutrient Enrichment, or excessive loading of N and P in waters leading to eutrophication and potentially profound adverse impacts on ecological attributes downstream of the Site.
    - Given the historical land use of the Site, i.e., agricultural forestry, there is likely to be trace amounts of fertiliser in the vicinity of the afforested Site. Teagasc (2017) has stated routine fertiliser application is undertaken following chemical analysis of foliar (tree leaf) samples. If thresholds are not met, fertiliser is applied manually between the months of April and August, avoiding drains and a 20 m buffer zones to waterlogged and aquatic areas. Ground Rock Phosphate (GRP) is used in two forms: Granulated Rock Phosphate (c. 11% P) and Ungranulated Rock

Phosphate (c. 14% P), in application process, given there are no adverse environmental impacts, e.g. deterioration in water quality status.

- Peat soils behave differently to mineral soils, when it comes to some nutrients such as phosphorous. High organic matter soils (OM > 20%, i.e. peat) do not adsorb P in the same way that mineral soils do. Therefore, P does not bind to peat soil particles, however mineral soils associated with forestry do have the capacity to build up or increase the store of phosphorous they hold.

During excavation, storage and reuse of materials, it is likely that a high volume of suspended solids will be entrained by surface water runoff and intercepted by surface water networks associated with the Project, particularly during sustained rainfall events and when in close proximity to receptors.

The aspects of the Project most likely to impact surface water quality and result in deterioration are:

- Exposed soils / peat generally, including new drainage channels, temporary stockpiles.
- Construction of infrastructure within surface water buffer zones (i.e., site access tracks asses tracks to proposed location of T2 and on-site Sub station, WC1, WC2, WC3), and/or relatively close proximity to surface water receptors, or areas characterised by extensive existing drainage networks which present a direct connection to mapped surface water features, will cross buffers in a perpendicular direction i.e., to minimise any potential effects), and/or instream works associated with proposed watercourse crossing locations.

In addition to potentially direct adverse impacts on ecological sensitivities down-gradient of the Site, runoff of suspended solids will potentially impact on the WFD status and objectives associated with the surface water networks both within and downstream of the Project. Considering the 'Good quality of the baseline surface waters draining from the Site, in addition to the sensitivity and 'Very High' importance of the associated surface water networks, any introduction of contaminants is considered an adverse impact of high significance.

Mechanism/s:

- Construction activities; Excavation, handling/transport, temporary storage of soils / subsoils / bedrock, vehicle tracking.
- Erosion in areas impacted by construction activities.
- Erosion in areas with newly formed preferential pathways for water runoff.

- Peat / slope stability, significant or localised.
- Reinstatement activities; similar to construction.

Impact
- Release of suspended solids and nutrients entrained in runoff, intercepted by surface water network.

Receptor/s:
- Surface Water. Surface water quality, ecological sensitivities and WFD status.

The **potential** release of elevated suspended solids to surface waters is considered to be an **unavoidable, direct, adverse, moderate to profound significance, small to moderate** in scale impact of the Project. This potential impact is considered to contrast to baseline conditions when considering the intensive nature of the construction phase, however forest felling activities occur on site and therefore occasional **temporary** release. Considering the long ranging mobility of surface waters, this potential impact is not considered reversible and can have indirect impacts upon receptors downstream (i.e., potential regionally). However, with the implementation of mitigation measures and appropriate environmental engineering controls, this impact can be reduced to within water quality regulatory limits.

It is considered that the release of suspended soils does not have significant potential to adversely impact on groundwater due to the natural process of filtration associated with percolation of water through soils. This principle is particularly pertinent at a Site of this nature where a combination of low permeability subsoils beneath the peat and low recharge rates at the Site are anticipated.

Chapter 8: Soils and Geology indicates that peat depths are generally low and the risk of significant stability issues leading to mass movement or landslides is low, however there is elevated risk of localised stability issues, particularly in areas in close proximity to sensitive receptors i.e., rivers.

The Project will invariably alter drainage at the Site which if unmanaged has the potential to create new preferential pathways for runoff potentially leading to erosion of soils / construction materials and entrainment of solids in runoff in the process.

9.5.3.4 Vehicular Movements

During the construction phase of the Project, vehicles will cross over or excavate into areas in order to construct the proposed access tracks, hardstands, and gain access to the Project areas. There is the potential for soil compaction, erosion and degradation during such vehicular movements. Localised stability issues, and erosion or degradation of soil by e.g., vehicular movements, have the potential to increase the potential for entrainment of suspended solids in surface water runoff, impact or obstruct established drainage networks, and increase the amount of excavation works required generally which in turn increases the potential for standard effects associated with earthworks. Earthworks in relation to reinstatement must also be considered.

Potential localised peat stability issues, and erosion or degradation of peat such as by vehicular movements have the potential to increase the potential for entrainment of suspended solids in surface water runoff, impact or obstruct established drainage networks, and increase the amount of excavation works required generally which in turn increases the potential for standard effects associated with earthworks. This is considered an **unavoidable, direct and indirect, adverse, moderate to significant**, localised and potentially regional impact on receiving surface waters. However, with the implementation of mitigation measures and appropriate environmental engineering controls, this impact can be reduced. While small to moderate in scale this effect is considered to conform to Baseline (e.g. forestry operations).

[1] Assuming mitigation measures described in **Chapter 8 – Soils and Geology** and in this chapter will be implemented and adhered to, localised stability issues are unlikely to give rise to impacts on surface water networks associated with the Project.

[2] With reference to **Appendix 8.1 Peat Stability Risk Assessment and Chapter 8 – Soils and Geology,** the risk of mass movement of peat is considered to be low.

9.5.3.5 Release of Hydrocarbons

Hydrocarbons are a pollutant risk due to their inherent toxicity to all flora and fauna organisms. Hydrocarbons chemically repel water and do not readily dissolve in polar solvents such as water. Most hydrocarbons are light non-aqueous phase liquids (L-NAPL's) that they are less dense than water. If hydrocarbons are accidentally released to water, they will therefore float on the water's surface. Hydrocarbons adsorb onto the majority of natural solid objects they come in contact with, such as peat, soil, vegetation and animals. Hydrocarbons will burn most living organic tissue they come in contact with due to their volatile chemistry. Hydrocarbons also represent a nutrient supply for adapted micro-organisms, this process in turn can rapidly deplete dissolved oxygen and thus result in fish kills or mortality of water based vertebrate and invertebrate life.

During the construction phase, vehicles and plant associated with excavation, material transport, and construction activities introduce the risk of hydrocarbon spillages and leaks from fuels and oils. The risk is increased when regular refuelling is required which in turn implies the requirement of a designated refuelling area which will likely require fuel storage on Site. Alternatively, the fuel could be supplied by fuel tanker scheduled to refuel the plant and equipment directly.

Hydrocarbons or any other forms of toxic chemicals such as paints or adhesives etc. accidentally released to the environment will likely be intercepted by drainage and surface water networks at the Site. The low permeability subsoils beneath the peat and low recharge rates at the Site will inhibit the spatial distribution and temporal variation of hydrocarbon mass and concentration should an accidental spill occur. This results in limited potential for contaminant movement through peatland. Therefore, the risk to subsoils / peat is limited, and in turn the risk to groundwater at a significant scale is also limited.

Mechanism/s:

- Lubricants and other construction consumables – minor in scale.
- Fuel leak from personnel vehicle – minor in scale.
- Fuel leak from plant machinery – minor in scale.
- Fuel spill during refuelling – significant in scale.
- Fuel leak from storage - significant in scale.

Impact

- Release of hydrocarbons in runoff, intercepted by surface water network.
- Release of hydrocarbons to ground, intercepted by groundwater.

Receptor/s:

- Surface Water. Surface water quality, ecological sensitivities and WFD status.
- Groundwater. Groundwater quality for the purposes of extraction.

With regards to surface waters at the Site, an accidental hydrocarbon spillage is considered a **likely, adverse, direct and indirect, small** in scale, **moderate to profound significance, localised (potentially regional), permanent but reversible** effect which is in contrast to baseline conditions. However, with implementing mitigation and best practice the risk of an accidental spill can be greatly reduced.

In terms of groundwater associated with the Site an accidental hydrocarbon spillage is considered to be a **likely, indirect, adverse, small** in scale, **moderate to profound significance, localised (potentially regional), permanent but reversible** effect of the Project, which is in contrast to baseline conditions. With the implementation of appropriate mitigation measures and environmental engineering, these potential risks will be significantly reduced.

9.5.3.6 Release of Horizontal Directional Drilling Materials

With reference to **Section 9.2.1.1**, there are 4 No. locations along the Grid Connection Route which will require HDD. Depending on the drill material in question, etc. the introduction of such materials can lead to a local change in hydrochemistry and impact on sensitive attributes e.g., ecology. For example, the introduction of bentonite-based clay material can lead to changes in water quality as opposed to a non-toxic single component polymer-based product.

In terms of the HDD process, drilling will involve plant machinery which will be powered by hydrocarbons, therefore risk during the refuelling process as stated previously remains the same. The risk of hydrocarbon spills stems primarily from broken hydraulic hoses used during the drilling/boring process. Small-scale quantities of greases known as 'drilling fluids' are also commonly used during the drilling process to keep components of the drill rig cool and lubricated. These drilling fluids are commonly composed of a mixture of bentonite clay, which can be harmful to the environment[18]. Therefore, there is a risk of a potential oil leak from horizontal directional drilling (HDD) along the grid connection route. It is unspecified at this time which drilling lubricant will be used during UGC route works. From experience in the industry the use of Clearbore is recommended, and this or a similar product will be used when working beneath watercourses. Clearbore is a single component polymer-based product that is designed to instantly break down and become chemically destroyed in the presence of small quantities of calcium hypochlorite. The product is not toxic to aquatic organisms and is biodegradable.

An accidental contaminant spillage (also known as drill return or frack out), would have a **likely, adverse, direct, small** in scale, **slight, localised (potentially regional), long term to permanent** effect which is in contrast to baseline conditions. However, with implementing mitigation and best practice the risk of an accidental spill can be greatly reduced.

[18] Moore Group (2016) "Appropriate Assessment of Cork Lower Harbour Main Drainage Project Estuary Crossing by Horizontal Directional Drilling", Moore Group Environmental Services on behalf of Irish Water, Ref No. 15184.

In terms of groundwater associated with the Site an accidental drilling fluid breakout is considered to be a **likely, direct and indirect, adverse, small** in scale, **moderate to significant, localised (potentially regional), temporary to long term but reversible** effect of the Project, which is in contrast to baseline conditions. With the implementation of appropriate mitigation measures and environmental engineering, these potential risks can be significantly reduced.

Spoil arising from drilling activities will require temporary stockpiling and has the potential to be entrained by surface water runoff (suspended solids). Spoil arising from drilling activities could be mobilised by large volumes of water which would rapidly traverse overland if not managed appropriately and has the potential to mobilise additional solids via eroding soils, or other contaminants, and infiltrate the receiving surface water bodies, or groundwater bodies. Similar to the release of suspended solids, **Section 9.5.3.3,** the introduction of drill arisings to the receiving surface water receptor is considered a **direct, adverse,** potentially **moderate to profound significance** impact of the Development.

9.5.3.7 *Release of Wastewater Sanitation Contaminants*

The installation of permanent sanitation facilities at the Site will not be required for the operational phase of the Project, s however temporary sanitation facilities for site workers during the construction phase are proposed. Therefore the Project has the potential to result in the accidental leakage of wastewater or chemicals associated with wastewater sanitation onto peat/soils and ultimately into surface waters during the construction phase of the project.

Accidental release of wastewater to surface waters would likely result in an increase in biochemical oxygen demand (BOD) which in turn would lower the dissolved oxygen concentration and adversely impact on aquatic life. Wastewater sanitation chemicals are also pollutant risks due to their inherent toxicity to aquatic flora and fauna and their potential to adversely impact on the productivity or status of surface water systems. The level of risk posed by such temporary facilities is dependent upon the following key factors:

- The location of the proposed temporary sanitation facilities relative to sensitive receptors
- The condition, emptying schedule and maintenance of the facilities
- The level of toxicity of the chemical agents used to aquatic flora and fauna.

In addition to direct adverse impacts on ecological sensitivities downgradient of the site, runoff of suspended solids and/or other contaminants will potentially impact on the WFD status and objectives associated with the receiving surface water networks associated with the Project. Considering the quality of the surface water draining from the site (baseline), and the 'Very High' sensitivity and importance of the associated surface water networks downstream, any introduction of contaminants is considered a potentially profound adverse impact of the Project.

Potential incidents of release contaminants at the Site will likely be short lived or temporary, however the potential impacts to downstream receptors can be long lasting, or permanent. With appropriate environmental engineering controls and mitigation measures these potential impacts can be significantly reduced.

Mechanism/s:
- Waste water leak – minor in scale.
- Chemical leak – minor in scale

Impact
- Release of waste water / chemicals in runoff, intercepted by surface water network.

Receptor/s:
- Surface Water. Surface water quality, ecological sensitivities and WFD status.
- Groundwater. Groundwater quality for the purposes of extraction.

A potential worst case scenario(s) associated with wastewater sanitation is the potential for wastewater or sanitation chemicals to accidentally spill or leaking and to be intercepted by surface water drainage features, ultimately discharging to surface waters. This is considered to be a **likely, adverse, direct and indirect,** and therefore **localised and potentially regional** effect. While **small** in scale, it is considered to be **moderate to significant, temporary to long term but reversible** impact of the Project, which is in contrast to baseline. With the implementation of appropriate mitigation measures and environmental engineering, these potential risks can be significantly reduced.

9.5.3.8 Release of Construction or Cementitious Materials

The construction phase of the Project has the potential to result in the accidental spillage or deposition of construction waste into peatland or soils. This in turn has the potential for waste materials to leach out toward preferential drainage flow paths that may ultimately be connected to the surrounding surface water network.

The accidental leaching of cementitious wastes such as concrete, lean mix or cement used in turbine foundations, can result in an adverse change to hydrochemistry which can adversely impact on sensitive aquatic flora fauna. Cementitious materials are highly alkaline and if accidentally released to surface waters can significantly elevate the pH concentration above the tolerance range of fish such as cyprinid and salmonid species. Freshly poured or wet concrete has greater potential to leach out towards preferential flow paths when compared to set concrete which is considered inert in comparison, the risk from wet concrete is further increased during periods of heavy rainfall. Surface water runoff that comes into contact with concrete will be impacted to a lesser extent than water percolating through lean mix concrete which will be impacted significantly. Regardless of the nature of the construction waste in question, the deposition of any construction materials or waste deposited at the Site that does not form part of the constructed development, even if inert, is considered contamination.

Mechanism/s:

- Accidental spillage or unmanaged deposition of construction materials such as wet concrete which is intercepted by drainage or surface water networks associated with the Development.
- Dust generation in relation to the production of concrete and management of raw materials.
- Transport of material on Site and washout of plant machinery.
- Pouring, forming, deposition of concrete during construction.
- Generation of waste.

Impact

- Release of cementitious material in runoff, intercepted by surface water network.

Receptor/s:

- Surface Water. Surface water quality, ecological sensitivities and WFD status.
- Groundwater. Groundwater quality for the purposes of extraction.

This process also gives rise to result in the accidental spillage or deposition of construction waste into soils and in turn impact on surface water runoff, or accidental spillages directly intercepted by drainage or surface water networks associated with the Project. The accidental spillage or deposition of construction materials such as wet or lean mix concrete which is intercepted by drainage or surface water networks is considered a **likely, adverse, direct and indirect,** and therefore **localised and potentially regional** effect. While **small to moderate** in scale, it is considered to be **a moderate to significant, temporary to**

medium term effect of the Project, which is in contrast to baseline. With the implementation of appropriate mitigation measures and environmental engineering, these potential risks can be significantly reduced.

Local Groundwater Supplies (Wells)

The Project has the potential to impact on ground water levels proximal to excavation and dewatering activities. Dewatering of excavations in particular can create a relatively significant cone of depression or lowering of the water table in the surrounding area. The degree to which the water table is lowered is dependent on the baseline static water level, is proportional to the depth of the particular excavations and/or depth at which the pump is placed, and the hydrogeological characteristics of the surrounding geology / aquifer.

The potential productivity and connectivity of groundwater in the underlying bedrock aquifer/s is considered low (Baseline, **Section 9.4**) however the availability of groundwater in a social or agricultural sense is considered important, therefore the importance of groundwater quantities underlying the Site is considered 'Medium to High' sensitivity and importance. Any impact to the availability of groundwater for use (lowering of water level in wells) is considered a **potentially significant adverse** impact of the Project.

Contaminants released due to an environmental incident have the potential to infiltrate soils/subsoils potentially reaching the water table and in turn adversely impacting on groundwater quality. However, it is noted that the Proposed Wind Farm, Grid Connection Route and Turbine Delivery Route do not interfere with any Public Source Protection Areas as mapped by GSI (2022) or Zones of Contribution under the National Federation of Group Water Schemes as outlined and mapped by the EPA and GSI (2022).

Considering the quality of the groundwater underlying the Site (Baseline, **Section 9.4**), and the 'Medium to High' sensitivity and importance associated with groundwaters nationally, any introduction of contaminants is considered an **unlikely, direct and indirect, adverse, slight**, **temporary** effect of the Project which conforms to Baseline (e.g., other shallow excavations). With the implementation of appropriate mitigation measures and environmental engineering controls, these potential risks can be significantly reduced.

The release of suspended soils does not have significant potential to adversely impact on groundwater due to the natural process of filtration associated with percolation of water through soils and bedrock (Potential exception: Karst geology. There is no indication of karst geology underlying the Site (Baseline, **Section 9.4**). Hydrocarbons (e.g., diesel) pose the most significant risk to groundwater quality and can persist for many years.

It is noted:

- Excavations will be of c. 2.8 m to 3.2 m depth for Turbine Foundations (**Chapter 2: Project Description**). Some deeper excavations will occur, for example, the proposed borrow pit. (See Drawing No. **6226-PL-804**).
- The recommended buffer distance determined by relevant Industry Guidance (**Section 9.3.2**), for existing wells in relation to Turbine Foundations is 250 m. There are no mapped wells within the Site, or with 1 km of the Development.
- Governing Industry Guidelines (**Section 9.3.2**) stipulate a groundwater buffer zone of 100 m is required of from wells used for drinking water abstraction in relation to the proposed Site Access Roads and cable trenches i.e., shallow excavations.

Given the incomplete nature of the GSI well database and the rural location, it has been assumed for the purpose of conservatism that all dwellings in the vicinity of the Site are utilising a private groundwater well and that groundwater flow direction in the underlying aquifer mimics the local topography. In other words, the groundwater flow paths are expected to be from topographic high points to lower elevated discharge points at streams, drains and rivers. Utilising this conceptual model of groundwater flow, dwellings that are located down gradient of the Site can be identified as potential receptors. The groundwater flow direction in the area of the Site is expected to be predominantly in a north to south direction. There are no dwellings located withing the redline Site boundary, however numerous dwellings are located within 2 km of the Site, **Figure 9.12b**. It is anticipated that any potential groundwater impacts will have attenuated across these distances in the underlying aquifer.

Considering the baseline data and Project characteristics, the risk of lowering groundwater levels to a significant extent is not considered likely. Furthermore, there are no mapped wells (**Figure 9.12a**) within the Redline Boundary, and no mapped wells were identified within a 100 m buffer along the proposed Grid Connection Route or Turbine Delivery Routes.

A combination of low permeability soils (. i.e. peat), the temporary nature of the construction works, and low recharge rates at the Site is expected to result in a likely, **neutral to negative, slight to moderate significance, localised** impact of the Project which is in contrast to the baseline. With appropriate mitigation measures in place, the potential impacts on groundwater wells can be managed and reduced to **Imperceptible to Slight.**

9.5.3.9 *Groundwater or Bog Water Associated with Wind Farm*

The Project has the potential to impact on bog water levels proximal to excavations and/or drainage channels. Existing drainage at the Site, particularly in forestry and agricultural areas, are intended to drain the respective area, however existing tracks and adjacent drains can also impact on bog water levels. Lowering of the water table in peat lowers the potential for peat growth i.e., sub-optimal conditions. This will lead to the gradual decline in productivity in the acrotelm (living layer of peat), and in time the degradation of the drained peat area, potentially leading to erosion.

The scale of the impact is dependent on the depth of the excavation in question and subsequent lowering of the water table at the location. This can vary depending on the underlying characteristics of the Project. In peat the impact can be minimal in scale initially but over time and as the acrotelm layer degrades and recedes the impact can continue to progress slowly/chronically, potentially leading to profound impacts in worst case scenarios. However, it is noted that the Site is characterised by shallow peat or peaty soil generally with isolated areas of moderately deep saturated peat (**Chapter 8: Soils and Geology**). Therefore, the scale of such impact is likely limited to the extent of those isolated pockets, near the proposed location of T1, if impacted. Furthermore, the Site is generally characterised as having extensive existing drainage features, and therefore impacts arising from drainage can be in line with baseline conditions.

With regards to bog water levels at the Site, drainage is considered a **likely, adverse, direct and indirect, small to moderate** scale, **moderate to significant, localised, permanent but reversible** effect which conforms to baseline conditions (forestry drains).

With appropriate environmental engineering controls and measures (i.e. Mitigation measures), these potential risks can be significantly reduced. Additionally, in areas impacted by draining activities, if considered adequately, mitigation measures have the potential to have a **positive beneficial** impact on bog water levels, particularly in places already impacted by drainage.

Furthermore, groundwater levels are unlikely to be impacted to a significant extent due to:

- Baseline conditions (**Section 9.4**) i.e., upland area, locally important aquifer with low productivity and low groundwater recharge (indicative of low groundwater levels). Site investigation data indicates (**Appendix 8.1 and Appendix D**), that in most instances trial pits (in line with construction depths) were dry. Shallow groundwater encountered (**Appendix F**) is associated with areas of deeper peat (bog water) and perched groundwater (perched on bedrock or bedrock troughs).

- Characteristics of the Project i.e., excavations will generally be shallow and any potential dewatering will likely be for short duration. Deeper excavations will potentially encounter groundwater. However due to the Baseline character, volumes will likely be low and dewatering of such locations will not impact groundwater levels to a significant extent.

*9.5.3.10 **Groundwater and Surface Water Associated with Grid Connection Cable Works***

The GSI well database has not indicated any wells mapped along or within the vicinity of the proposed Grid Connection route. Given the incomplete nature of the GSI well database and the rural location, there is a potential for more private wells in use along the proposed Grid Connection route, however it is noted the route traverses mainly forestry lands in the absence of any identified dwellings. Shallow trenching (c.1,220 mm deep) which will be backfilled is expected to be required for the proposed Grid Connection, with a depth of c. 1,500 mm at Horizontal Drilling locations.

Due to the vast majority of the gird connection requiring shallow trenching and the temporary nature of the construction works, it is expected to result in a **likely, direct and indirect, adverse, small** in scale, **slight and temporary** effect which conforms to Baseline (e.g. public roads and services). With appropriate environmental engineering controls and measures (i.e. Mitigation measures), these potential risks can be significantly reduced.

*9.5.3.11 **Excavation Dewatering & Construction Water***

Construction waters arising from open excavations, or construction waters intercepted from construction areas are likely to be heavily laden with suspended solids. The dewatering of excavations during construction phase of the Project is likely to have significant adverse effects on surface water runoff quality in the absence of mitigation measures. Should dewatering of open excavations, Turbine Foundations etc. be required, the receiving engineered drainage and attenuation features will likely receive water discharges elevated in suspended solids.

This impact is considered to be in contrast to baseline conditions although it is also temporary. Although temporary, considering the mobility characteristics associated with flowing surface waters, it is not considered reversible. However, with the implementation of appropriate mitigation measures and environmental engineering controls, this potential impact can be reduced to within water quality regulatory limits. Potential effects impacting on water quality are discussed in greater detail in the following sections of this report.

Potential dewatering through drainage in advance of excavation activities, or dewatering via pumping during excavation activities, will likely impact on groundwater and hydrogeological flow regimes at a localised scale but not at a regional scale. This is considered to be a **likely, adverse, direct and indirect, localised (potentially regional), temporary to permanent** effect of the Project which is in contrast to the baseline conditions. While **small to moderate** in scale it is considered to be **moderate to profound in significance**. With appropriate environmental engineering controls and measures (i.e. Mitigation measures), these potential risks can be significantly reduced.

The potential effects on groundwater during the proposed operational phase of the Project is considered to be **not significant.**

Considering the nature of the site, it is assumed that there is no significant source of ground contamination at the Site and therefore the potential to draw in contaminants during dewatering activities is **not significant.**

9.5.3.12 Constructed Drainage, Diversion or Enhancement of Drainage

Drainage features constructed at a Site have the potential to significantly adversely impact on the baseline hydrological regime, particularly in areas of intact peatland habitat, but equally in peatland areas impacted by artificial drainage and forestry operations, there is the potential for the Project to have a beneficial impact to the hydrological regime and to peatland regeneration. Peatland groundwater levels are generally dependent on rainfall. Rainfall infiltrates and percolates into peat/soil (recharge), initially through vegetated / root conduits in the acrotelm peat (living vegetated layer) or upper soil horizons, however percolation and/or permeability rates in peat, particularly the catotelm (decomposing lower layer) are poor and therefore peatland areas are characterised by rapid hydrological responses to rain fall i.e., rapid surface water runoff intercepted by the receiving drainage and surface water network. Due to this characteristic, peatlands require consistent rainfall to ensure adequate wetting of water dependant blanket peat habitats.

Poor drainage design has the potential to drain excess surface water runoff and draw water away from areas of peatland, thus reducing the potential of recharge to ground in those areas and creating an even greater hydrological response to rain fall in the receiving surface water network via more direct connections to the surface water network i.e., bypassing the peatland. Furthermore, uncontrolled surface water runoff interacting with the Project footprint has the potential to lead to adverse impacts including the development of new preferential pathways, erosion and peat degradation – particularly during and immediately after construction phase whereby unvegetated soils are exposed and wetting and/or drying of peat areas potentially occurs.

The Project will likely result in diversion, alteration and/or enhancement of the existing drainage networks at the Site during the construction phase relative to baseline conditions. The existing drainage network at the Site is mapped and presented in **Figure 9.7a.** Diversion of artificial drainage channels will be required at locations where the Project layout intercepts existing artificial drainage networks. This includes minor modifications where existing drainage will be aligned with proposed culverts etc. and/or where proposed drainage interacts or connects with existing drainage networks. Drainage modification / diversions is required at, but not limited to;

- Access track between T2 and T3 where cut and fill extents overlaps an existing drainage feature.
- Substation, where the footprint of the hardstand is over an existing drainage feature.
- Other non-mapped drainage within forestry areas i.e. commercial forestry locations will inherently possess extensive drainage channels.

Considering that pre-existing natural and artificially established drainage networks are present at the Site, the diversion, enhancement or introduction of additional drainage features is considered an **unavoidable, direct and indirect, adverse, localised (potentially regional)** and **permanent** effect of the Project which conforms to baseline conditions. While small in scale the effect is considered to be of **moderate to profound significance.** There are potential risks associated with the earthworks required to carry out such drainage works, and it is very important to recognise the drainage and surface water network are connected, that is in terms of assessing source pathway receptor, the construction or diversion of drainage is connecting source, pathway, and receptor. With appropriate environmental engineering controls and measures (i.e. Mitigation measures), these potential risks can be significantly reduced.

The potential impacts of excavations are addressed in **Section 9.5.3.1** and in **Chapter 8: Soils and Geology, Section 8.4.3.3.1**. Management of storm and construction water runoff to prevent loading of the receiving network with contaminants in detailed in the later sections, that is; these potential impacts can be mitigated.

9.5.3.13 Watercourse Crossings

9.5.3.13.1 Surface Water Crossings - Bridges & Culverts over Mapped Rivers and Non-Mapped Drains

In terms of mapped streams and rivers there are a number of existing bridges at the site are associated with the development footprint (e.g. along Turbine Delivery Routes). The development will also require a number of new bridges, including on the Wind Farm Site.

In terms of non-mapped surface water features and drains there are a number of existing culverts at the site are associated with the Project footprint. The Project will also require a number of new drainage culverts under the proposed access track, particularly in areas of extensive existing drainage (Figure 9.5a). Although more minor in scale, and less significant in terms of ecological importance and sensitivity, such culverts must be considered similarly to watercourse crossings in terms of potential impacts associated with poor design and construction. Note; existing culverts presented in Figure 9.5a were observed during site surveys and/or from desk top assessment of aerial imagery and site drainage mapping, including recent Lidar and Aerial Survey data (BlueSky) available for the site. There is potential for buried stone culverts/ land drains to be present on Site which are not mapped here and which could be discovered during excavations.

Through the design and construction and operation of watercourse crossings, examples of associated activities or impact mechanisms include:

- Significant changes to the hydrological regime at the Site.
- Construction activities (Earthworks, addressed under Release of Suspended Solids)
- Construction activities (Earthworks) within existing drainage channels and/or streams and rivers.
- Connecting new and existing drainage channels.
- Poor design and/or installation of watercourse crossings.
- Poor design and/or installation of culverts.
- Upgrading of existing bridges where necessary.
- Upgrading of existing culverts where necessary.
- Poor design and/or installation of drainage infrastructure including culverts attenuation features.

Potential impacts arising from such activities include:

- Release of suspended solids or other contaminants, intercepted by surface water network.
- Significant surge release of suspended solids, intercepted by surface water network.
- Altering hydrological regime at a particular location. Potentially leading to erosion / deposition not in line with baseline conditions.
- Restricting water flow.

Receptors include; Surface Water, and in terms of; Surface water quantity and flood risk, Surface water quality, ecological sensitivities and WFD status.

Mechanism/s:

- Significant changes to the hydrological regime at the Site.
- Construction activities (Earthworks, addressed under Release of Suspended Solids)
- Construction activities (Earthworks) within existing drainage channels.
- Connecting new and existing drainage channels.
- Poor design and/or installation of drainage network
- Poor design and/or installation of drainage infrastructure including culverts.
- Upgrading of existing culverts where necessary.
- Poor design and/or installation of drainage infrastructure including culverts attenuation features.

Impact

- Drying - Lowering of bog / groundwater table proximal to respective drainage features.
- Wetting – Excess discharge in a particular area (local flooding)
- Increasing hydrological response to rainfall.
- Release of suspended solids, intercepted by surface water network.
- Significant surge release of suspended solids, intercepted by surface water network.

Receptor/s:

- Surface Water. Surface water quantity and flood risk. Surface water quality, ecological sensitivities and WFD status.
- Groundwater. Groundwater / bog water quantity for water dependent terrestrial habitats.

Watercourse crossings and associated portions of access track are naturally in very close proximity to or directly within sensitive receptor buffer zones i.e. surface waters or drainage features discharging to surface water features. As sited in **Chapter 8 Land, Soils and Geology** it is very important to consider the potential for ground stability issues arising. Due to the close proximity to the receptor, minor, or localised stability issues arising can potentially have profound impacts on surface water features.

Potential effects with regards to upgrading and installing watercourse crossings at the Site are considered to be **unavoidable, adverse, direct and indirect, small to moderate** in scale, **moderate to profound significance, localised (potentially regional** when considering the extensive downstream surface water network), and **permanent** which conforms to baseline conditions (e.g. existing bridges and roads in the area. However, with implementing mitigation and best practice the risk of an accidental spill can be greatly reduced.

9.5.3.13.2 Wind Farm

The potential impacts that could arise from the Project during the construction, operational and decommissioning phases relate to the potential for increased suspended sediment concentrations associated with site preparation activities and excavations for the infrastructure elements including the turbine foundations, cable trenches and watercourse crossings (77,262 m^3). There will be no change to the potential impacts or predicted effects irrespective of which turbine is selected within the Turbine Range because of the design phase mitigation measures which will be implemented prior to construction. All works will be outside of the 65 m buffer from watercourses and 20 m buffer from drains, where possible. Where this is not possible, additional mitigation measures such as increased use of Sustainable Drainage Systems (SuDS), will be implemented. Additionally, all temporary stockpiles will be at no less than 25 m from watercourses. This will be implemented regardless of the volume of excavated materials created as a result of the Turbine Range.

The Development has been assessed at EIA stage in terms of the intersection of the Development footprint and existing surface water and drainage features at the Site. With particular reference to tributary locations identified (**Figure 9.7a**), these locations relate to where the Development footprint intersects with EPA mapped rivers, and it must be noted that the actual drainage design will include some degree of drainage diversion and relocation and / or removal of some the listed *culvert* locations, however all will be considered in terms of maintaining the hydrological regime at the Site.

Regarding WFD or EPA mapped rivers, watercourse crossing locations identified are listed here:

There are three <u>new</u> watercourse crossings over mapped rivers included as part of the proposed Development (**Figure 9.7a**).

- WC1 and WC2 are located in close proximity to each other on two headwater tributaries of the Sullane_010 on the approach to proposed location of T2 hardstand area. Both the river sections at these locations span approximately 1.0 m in width and are observed to discharge water throughout the year, potentially with the exception of prolonged dry periods during summer months where there is the potential for the river to be at very low levels or dry. The banks of the rivers are low and the adjacent lands are characterised as agricultural (pasture) / mountain heath / blanket bog. Site photos of monitoring locations SW1 presented in **Appendix 9.2,** which is a short distance downstream from the WC1 and WC2 gives context to the significance of the feature. It is noted that the surface water features in this particular area of the site have likely been impacted and altered by historic agricultural activities at the site. A Clear Span Bridge is proposed at this location with the following indicative dimensions: 10 m width, 3.5 m water depth (flood level), 0.3 m freeboard, and standard length, that is; in line with width of Site Access Road.

- WC3 is located on the headwaters of the Sullane_010 and along the proposed Site Access Tracks between the proposed location of the On-Site Substation (west) and proposed locations of T4 and T5 (east). The river section at this location spans approximately 1.0 to 2.0 m in width and is observed to discharge water throughout the year, potentially with the exception of prolonged dry periods during summer months where there is the potential for the river to be at very low levels or dry. The banks of the rivers are variable with some overhanging peat or boulders etc. and the adjacent lands are characterised as agricultural (pasture) / mountain heath / blanket bog and forestry. Site photos of monitoring locations SW2 presented in **Appendix 9.2,** which is a short distance downstream from the WC3 gives context to the significance of the feature. It is noted that the surface water features including the riparian zone in this particular area of the site have likely been impacted and altered by historic agricultural and forestry activities at the site. A Clear Span Bridge is proposed at this location with the following indicative dimensions: 10 m width, 3.5 m water depth (flood level), 0.3 m freeboard, and standard length, that is; in line with width of Site Access Road.

Identified surface water crossings are listed in **Table 9.12.**

Table 9.12: Surface Water Crossings – Mapped Rivers (WFD / EPA)

Surface Water Crossings - Mapped Rivers (WFD/EPA)					
Category	ID	Description	Easting ITM	Northing ITM	Comment
River Crossing	WC1	New; Clear-Span Bridge	512924.6	578627.8	Watercourse Crossing under the proposed Site Access Tracks on approach to T2 **Clear Span Bridge**
River Crossing	WC2	New; Clear-Span Bridge	512943.8	578678.8	Watercourse Crossing under the proposed Site Access Tracks on approach to T2 **Clear Span Bridge**

Surface Water Crossings - Mapped Rivers (WFD/EPA)					
Category	**ID**	**Description**	**Easting ITM**	**Northing ITM**	**Comment**
River Crossing	WC3	New; Clear-Span Bridge	513495.5	578692.9	Watercourse Crossing under the proposed Site Access Tracks between the proposed location of the On-Site Substation (west) and proposed locations of T4 and T5 (east) **Clear Span Bridge**
Sub-Total	New	3			

A number of existing minor drains along the existing and proposed Site Access Road network within the Site (**Figure 9.7a**) will require upgrading to accommodate the increased width of the road. These minor surface drains can be dry and receive flows only following heavy rainfall events throughout the year, however, due to their connectivity to mapped surface water network within the catchment, appropriate measures outlined in the Mitigation Section, **Section 9.6**, of this report will be required during construction to avoid siltation or other pollutants entering the drainage network. **Table 9.13** lists culvert locations of crossings over non-mapped drains.

Table 9.13: Surface Water Crossings – Non-Mapped Drains

Surface Water Crossings - Drainage and/or Non-mapped Surface Water Features					
Category	**ID**	**Description**	**Easting ITM**	**Northing ITM**	**Comment**
Culvert	CULV-01	New	514047.1	578568.2	
Culvert	CULV-02	New	513347.1	578655.6	
Culvert	CULV-03	New	513300.4	578636.6	
Culvert	CULV-04	New	512732.5	578983.4	
Sub-Total	New	4			Number will potentially change pending detailed design.
Sub-Total	Existing				
Total	All				

9.5.3.13.3 Grid Connection Route

With reference to **Figure 9.2b** and **Section 9.5.3.3**, works along the Grid Connection Route related to culverts in the northeast portion of the route are hydrologically linked to the surface waterbody Garrane [Lee] (EPA Code: 19G03). Grid Connection Route works encompassing the HDD locations for Stream 1, Stream 2, Stream 3 and the N22 HDD are hydrologically linked to the Flesk [Kerry] River (EPA Code: 22F02). A worst-case scenario could possibly occur whereby the proposed works of HDD could result in a **direct, negative, potentially significant**, impact of the Project. This impact could result from any number of indirect anthropogenic sources, most commonly would be from: inadvertent drill returns containing bentonite clay, as mentioned above or by spillages of oil, fuel, or drilling fluid disposal. Such spillages could potentially affect either surface water or groundwater depending on the nature of the contamination issue, and to varying degrees depending on the hydrological and hydrogeological characteristics of the Site area.

Potential incidents of release contaminants at the Site will likely be **short lived or temporary**, however the potential secondary impacts to downstream receptors, through leeching, can be **long lasting, or permanent**. With appropriate environmental engineering controls and mitigation measures these potential impacts can be significantly reduced.

9.5.3.13.4 Turbine Delivery Route

The Turbine Delivery Route will require road junction widening and one turning point off the N22 (**EIAR Chapter 2**). The estimated excavation amounts for the Turbine Delivery Route equates to approximately 1,870 m^2 (refer to **Table 2.1, Management Plan 4 Appendix 2.1** of the CEMP). Works relating to the Turbine Delivery Route will be hydrologically linked to the Sullane_010 River (EPA Code:19S02).

This portion of the Project and associated construction impacts are similar to those described for the construction of the wind farm infrastructure. Construction of any new watercourse crossing or modification of any existing watercourse crossing will have inherent risk given the level of disruption (e.g. excavations, heavy plant machinery) involved with construction activities, and the proximity to the primary sensitive receptor, that is; the watercourse itself.

Potential impacts on hydrology and water quality associated with the construction or upgrading of water course crossings include:

- Alteration of flow regime potentially leading to erosion and/or flooding.

- Potential loss of natural feature e.g., closed culverts implies the replacement of river/stream bed with the invert of the culvert structure, and the loss of riparian / vegetated banks.
- Potential loss of ecological function or service e.g., relatively long span structures have the potential to block light and lower soil moisture, in turn leading to loss in vegetation and bank stability through erosion.
- Harmful discharges during construction and operation, in particular the release of suspended solids.
- Other impacts associated with ecological sensitivities.

Unmitigated, the alteration of watercourse crossings poses a high level of risk and adverse but imperceptible to slight impact adverse, potentially permanent impacts on the quality and flow characteristics of the receiving surface water feature.

The main contributing factors for achieving worst-case scenario/s associated with installation of new watercourse crossings include:

- The potential for poor planning and construction methodology,
- Potential for poor design of new watercourse crossings,

Poor design and construction can potentially result in significant changes in flow, erosion and deposition patterns and rates associated with the surface water feature, which can potentially lead to flow being restricted leading to increased risk of flooding locally.

9.5.4 Operational Phase Potential Effects

The Operational Phase (OP) of the development will include maintenance and monitoring with a minor quantity of site presence in terms of personnel, welfare, and vehicles. In the context of operational staff / contractors during the OP, residual risk following the Construction Phase (CP) include the potential for; vehicular movements, accidental hydrocarbon or contaminant releases, wastes streams etc. The scale of potential impacts during the OP are small relative to the CP, however relevant mitigation measures outlined for the CP will be applied to maintenance and monitoring operations during the OP.

Other Operational Phase specific mitigation are described in the following sub-sections.

9.5.4.1 Increased Hydraulic Loading & Flood Risk

The Project has the potential to result in increased rates of runoff during the operational phase relative to baseline conditions. This is a function of the progressive excavation and removal of vegetation cover and replacement with hardstanding surfaces (effectively or assumed impermeable) and installation of constructed drainage along the Project footprint and thus removing the hydraulic absorption / buffer control from this part of the Site. Such an increase in surface water runoff, or an increased hydrological response to rainfall, has the potential to exacerbate flooding events and impact on hydro morphology of waterbodies downstream of the development, and/or to exacerbate flooding and erosion within the boundary of the Site.

Mechanism/s:

- Significant changes to the hydrological regime at the Site.
- Replacement of vegetated land with respective recharge capacity with impermeable (assumed) hardstand surfaces. Introduction of constructed drainage intercepting greenfield runoff. Construction activities (Earthworks) within existing drainage channels and/or streams and rivers.
- Connecting new and existing drainage channels.

Impact

- Increase in runoff at the Site.
- Increase in hydrological response to rainfall at the Site and in downstream surface water bodies.

Receptor/s:

- Surface Waters. Site hydrological response to rainfall and potential downstream flood risk areas.

Preliminary water balance calculations indicate that the Project will lead to a net increase of surface water runoff of approximately 0.253 m^3/sec (or 2.06 % relative to the area of the Site) during a 1 in 100 year storm. This calculation, as shown in **Table 4.4** of **Appendix 9.1,** assumes that all road and hardstand surfaces would be fully impermeable as a precautionary scenario which is unlikely to be considered as an option during the detailed design phase. This is considered to be an **unavoidable, direct and indirect adverse, slight, permanent** impact of the Project which conforms to Baseline (e.g., existing forestry tracks). The increase in hardstand area associated with the Project will likely impact on groundwater and hydrogeological flow regimes at a localised scale but not at a regional scale.

With appropriate environmental engineering controls and mitigation measures, i.e. attenuation features, these potential impacts can be significantly reduced. Furthermore, if considered adequately, mitigation measures have the potential to have a positive impact on the hydrological response to rainfall at the Site, whereby, if the Project can reduce discharge rates at the Site below estimated greenfield or baseline runoff rates, it will have a beneficial impact by reducing the Site hydrological response to rainfall and mitigate against potential flood events downstream.

Minimal land take is associated with the Grid Connection route, considering all proposed works will traverse already existing public roadways (i.e., Site access tracks to be constructed as part of the Project public and local road networks as well as privately owned forestry tracks.

Land take is required for the Turbine Delivery Route, off the N22 in the form of widening of existing portions of roads which typically involves digging out road verges to c. 0.4 m and replacing with compact stone for facilitate a turning point along the route for large plant machinery and vehicles. c. 1,870 m^2 of road is to be upgraded). Works involving existing portions of roads which traverse greenfield / green verge areas are considered to be small scale of disturbances (shallow excavation, superficial paving) the impact is considered **slight**. Similarly, there is unlikely to be an increase in the rate of runoff from the construction of both these routes due to utilization of pre-existing road infrastructure.

9.5.5 Decommissioning Phase

Decommissioning of the Project would result in the cessation of renewable energy generation at the end of the operational life of the wind farm with the removal of various infrastructural elements. The drainage network of the Site will be inspected by a SuDS hydrologist prior to any works commencing. The Decommissioning phase will involve the removal of the above ground elements of the wind farm which will require:

- Controlled dismantling of turbine components such as blades, blade hub & nose cone, tower, nacelle (generator and gearbox) and transformer
- Controlled removal of the Met Mast
- Removal of de-energised underground cables and electrical control systems from ground and disposed of to a licensed recycling facility.

It is anticipated that the following elements of the wind farm will be left in place after Decommissioning:

- The reinforced concrete Turbine Foundations
- The Crane Hardstand Areas adjacent to the turbines
- All Site Access Roads
- Substation
- Grid Connection

There will not be a requirement for additional drainage measures to be implemented during the Decommissioning phase of the Project. With the passage of time, the constructed drainage network will likely become full of deposited sediment and revegetation will naturally occur which will render the drainage system less effective over time. The Site will therefore revert over time to a more natural drainage regime. All anticipated impacts are similar in nature to those already highlighted during the construction phase of the Project, i.e., release of hydrocarbons, wase water / sanitation and suspended soils through the excavation of material in order to remove cabling from joint bay locations.

The works to be completed during the Decommissioning phase are expected to be an **imperceptible to slight, neutral, permanent impact** on the hydrological and hydrogeological setting surrounding the Site.

9.6 MITIGATION MEASURES AND RESIDUAL EFFECTS

The Project has associated potential impacts as described in the previous sections of this report. The following sections describe mitigation measures that will be implemented during the design, construction, operational and decommissioning phases of the Project. Potential residual effects after mitigation measures are implemented are also described in the following sections.

9.6.1 Design Phase

9.6.1.1 Mitigation by Avoidance

The fundamental mitigation measure implemented during each stage of the Project was the avoidance of sensitive hydrological or hydrogeological receptors wherever possible, this key principle is referred to as "mitigation by avoidance". This principle was adopted during the design of the turbine and associated infrastructure layout across multiple design iterations. Hydrological constraints maps have been developed which identified areas of the Site where surface water and drainage constraints resulted in areas of the Site being deemed less suitable for development. The constraints map is presented in **Figure 9.13a Figure 9.13b.**

The identified constraints have been extensively discussed in consultation between RSK Ireland Ltd. and the design team. The final Site layout plan has been identified as the optimal layout design available for protecting the existing hydrological regime of the Site, while at the same time incorporating and overlaying engineering and other environmental constraints as detailed in this EIAR.

9.6.1.2 Mitigation by Design

The descriptive mitigation measures outlined in this report will be applied to the development design and construction methodologies with a view to avoiding and/or minimising any potential adverse impacts to water quality in the receiving surface water network. Details on how such measures will be applied (objectives, design considerations, layout) are contained in a Surface Water Management Plan (SWMP) (see Management Plan 3 appended to the CEMP, EIAR **Appendix 2.1**). The aims and examples of important considerations in relation to mitigation measures described in the EIAR are further clarified here.

9.6.1.2.1 Nature Based Solutions

Nature Based Solutions (NBS) will be adopted at the Wind Farm site where possible. NBS include Sustainable Drainage Systems (SuDS), which will be employed to attenuate runoff and reduce the hydrological response to rainfall at the Site. Extending or maximising this approach sufficiently has the potential to attain net beneficial impacts i.e., a net reduction in runoff rates at the Site, beneficial impacts to water quality and reducing flood risk to downstream flood risk areas. Coupling SuDS with ecology and biodiversity mitigation can also provide opportunities to attain net biodiversity gain.

In peatland areas, one of the main objectives of Nature Based Solutions and SuDS is to create an array of runoff stilling areas / standing water and promote diffuse discharge and recharge of runoff on peatland. Generally, and as is the case on the subject site, peatlands have been subject to peat cutting and forestry operations which include extensive drainage networks and draining of peatland bogs. Lowering bog water levels leads to increases erosion, release of carbon to atmosphere and the receiving surface water network and reduces the productivity and general health of the bog, potentially leading to chronic degradation and decline. The objective of nature based solutions in peatlands will be to reverse this impact where there is the opportunity and where it is appropriate through surveying and risk assessment.

Runoff attenuation features or SuDS will be included as part of the Project as detailed in the following sections of this report. Best practice and relevant guidance in the design and construction of drainage features will be followed. This includes, but is not limited to;

- CIRIA (2015) The SuDS Manual (C753)
- Scottish Natural Heritage (2019) Good practice during wind farm construction 4th Edition)

The following sections outline design considerations for working towards effective nature based solutions and net beneficial impact, for example; maximising the distribution of check dams and stilling ponds and similar features where appropriate *, with the objective of attenuating as much water as possible safely, and to promote diffuse discharge to vegetated lands where valued *, and to promote and maintain high bog water levels and healthy peatland conditions.

* Relevant guidance on the Wise Use of Mires and Peatlands (Joosten H, Clarke D, 2022) outlines principals for decision making through considering the cultural, or other values held by stakeholders associated with the subject peatland. It is noted that active peat cutting, and commercial forestry operations require networks of drainage channels, with the objective of reducing and maintaining relatively low bog water levels. This is in contrast to promoting and maintaining higher bog water levels for healthy peatland function. Much of the mitigation outlined in the following sections is intended to attenuate water on site and promote the diffuse discharge and recharge of runoff on peatland at the site. Nature based solutions including SuDS will be designed in a manner that respects the ongoing land uses and stakeholder values, where valid and in line with local, national, and international, law, policy and guidance. That is, where stakeholders have a right, and value the peatland, and intend to maintain existing drainage arrangements, the Development drainage design will incorporate checks on suitability particular features at given locations, and to direct runoff on site to suitable locations for targeting rewetting, or the promotion and maintaining of high bog water levels.

9.6.1.2.2 Constructed Drainage

The drainage design for the Project (Surface Water Management Plan, **Appendix 2.1**), has been planned so that drains are positioned adjacent to the footprint of the Project, therefore the proposed drainage infrastructure can be considered part of the footprint. The scale of the impact a shallow drain poses on the surrounding peatland area is minor particularly in areas impacted as baseline. Therefore, the potential magnitude or scale of impact to waters posed by the introduction of the proposed drainage extends to a minor extent beyond the footprint of the Project. However, it is important to consider the gradual degradation over time.

The design principles of the proposed drainage network will facilitate:

- The collection of surface water runoff from the footprint of the Project i.e., the construction area (construction runoff interceptor drains) and management of potentially contaminated runoff in the constructed treatment train. Where possible the buffered outfalls from the treatment train / stilling ponds will be redistributed with a view to maintaining or improving the hydrological regime at the Site.

- Where extensive drainage networks exist, collected / diverted runoff will likely be diverted back into the existing network. In such instances it is important to include the existing drainage network in designing and specifying the treatment train and attenuation features, including improving, modifying, and constructing attenuation features in drainage channels. Similar to considerations for newly constructed drainage channels, the modification and/or improvements of existing drainage will be designed with a view to maintaining or improving the hydrological regime at the Site.

Maintaining or improving the hydrological regime at the Site involves achieving the objectives of the Surface Water Management Plan (SWMP) (**Appendix 2.1**) i.e., mitigating against potential adverse impacts to the hydrological response to rainfall at the Site, as well as monitoring water quality in the receiving surface water network during construction phase.

9.6.1.2.3 Attenuation Features

Mitigation measures to address surface water runoff and drainage will be implemented, including in line attenuation features such as check dams and stilling ponds and buffered outfalls. Both check dams and stilling ponds provide mitigation against potential impacts to water quality, erosion, and discharge velocity, however they also facilitate buffered and diffuse percolation of surface water runoff into the receiving environment along the permitter of the development footprint. Attenuation features have been designed to take into consideration for a 1 in 100-year rainfall event, including an additional 20% to account for climate change, **Appendix 9.1**.

9.6.1.2.4 Checked Dams

Check dams will be constructed along the length of constructed drainage at regular intervals in line with relevant guidance (**Section 9.3)** along with engineered calculations presented in **Table 5.1** of Management Plan 3, **Appendix 2.1**. Check dams (**Appendix 9.6– Tiles 3-6**), will be permanent (for the life of the project / drainage network), made of suitable locally sourced coarse aggregate (similar geology), and will attenuate (impede) surface water runoff in the drainage channel, therefore slowing the velocity of the runoff in turn reducing the potential for erosion in the channel and allowing suspended solids to settle out if present. At low velocity, the runoff has increased opportunity to percolate through the coarse aggregate and into the surrounding peat area, effectively contributing to bog water levels at that location.

Check Dams will be distributed widely, that is; exhausting all opportunities for placement of check dams in the drainage network across the development footprint. The distribution will be in line with relevant guidance (including CIRIA SuDS Manual), but aim to attenuate as much runoff in the drainage network itself as practically feasible. This is in line with Nature Based Solutions and striving for net beneficial impacts. Checks dams in the drainage network will attenuate runoff and reduce the hydrological response to rainfall at the site, mitigating against downstream flood risk, and will promote a more diffuse discharge of storm runoff into adjacent peatland by infiltration and recharge. The features once established could also provide some biodiversity gains.

9.6.1.2.5 Stilling Ponds

Stilling ponds with buffered outfalls will be constructed at drainage outfalls associated with the constructed drainage network. 28 No. buffered outfalls will be established at intervals along the clean runoff drainage network. Multiple outfalls (i.e., the proposed three consecutive cluster ponds shown on **Plate 5.4b** Management Plan 3 **Appendix 2.1**), along the drainage routes facilitates the strategic management of runoff with a view to maintaining the baseline hydrological regime in so far as possible.

Similar to check dams; stilling ponds will be permanent (for the life of the projects / drainage network), made of suitable coarse aggregate, and will attenuate surface water runoff in the drainage channel, slowing the velocity of the runoff before discharging to vegetated areas (buffered outfall). Slowing the water velocity allows suspended solids to settle out if present (to a degree of <25 mg/L), to not impact any sensitive receptors. At low velocity the runoff has increased opportunity to percolate through the coarse aggregate and into the surrounding peat area. Through both forms of discharge (buffered outfall and percolation through aggregate) the stilling ponds will contribute to bog water levels at their locations and are designed to provide attenuation to greenfield run-off rates. The 28 No. designed stilling ponds that will be constructed on site will have a combined area of 2,368 m^2. Please **see Management Plan 3: Surface Water Management Plan** of the CEMP (**Appendix 2.1**) for further details. Refer to detail drawings (**Drawing No. 6226-PL-303).**

9.6.1.2.6 Promotion of Peatland Habitats

Excavated peat will be deposited in order to restore infilled excavation areas associated with the Site e.g., adjacent to hardstand areas and borrow pits. The deposition of peat, particularly in cutover peat areas, once successfully restored / revegetated will promote the recovery and development of peatland habitats. This will also lead to improvements to the hydrological regime as a function of the Project through promoting the recovery and development of peat habitats, particularly in previously impacted areas due existing land use practices of constructed forestry drainage. For example; re-establishing degraded peatland, and promoting bog water levels and healthy ecosystems will improve environmental services provided by the site including improving isokinetic runoff storage (vegetation reducing runoff rates and promoting infiltration and recharge).

The Project layout and existing drainage network, and their interaction, are assessed in detail and a detailed constructed drainage and attenuation network layout has been provided which will be implemented in full and presents the requirement, locations and conceptual function and objective of the drainage network and treatment trains tailored to the Project footprint (**Section 5** of Management Plan, **Appendix 2.1**).

9.6.1.3 Constraints & Buffer Zones

The descriptive mitigation measures outlined in this report will be applied to the Project design and construction methodologies with a view to avoiding and/or minimising any potential adverse impacts to water quality in the receiving surface water network. Details and a description of how such measures will be applied (objectives, design considerations, layout, mitigation measures) are contained within this Chapter and in the Surface Water Management Plan (**Appendix 2.1**).

As part of mitigation by avoidance principles applied during the design phase of the Project, self-imposed groundwater, surface water, and drainage buffer zones were established where applicable. Buffer zones intended to inform the design process by minimising or avoiding the risk to surface water or other receptors and by restricting construction disturbance to outside these zones in so far as possible. Buffer zones will in turn provide enhanced potential for nature based mitigation including, for example; allowing filtering capacity of runoff within surface water riparian zone. However, it is important to note that buffer zones will not be relied upon to mitigate acute issues such as construction water laden with solids arising at the site.

The available guidance (**Section 9.3**) stipulates that surface water buffer zones should be prescribed to mapped surface waterbodies or aquatic zones i.e., defined as a permanent or seasonal river, stream or lake shown on an Ordnance Survey 6-inch map, however guidance also states any drainage features leading from the Site and flowing into the receiving surface water network which may short circuit buffer zones must also be considered. The prescription of surface water and groundwater buffer zones (sometimes referred to as setback distances), is in line with relevant guidance relating to forestry, agriculture, water resources, direct discharges and wind farm development guidance documents (**Section 9.3**).

The available guidance stipulates varying surface water buffer widths depending on type of activity, receptor type and sensitivity, and riparian zone characteristics including topography (steepness). Recommended surface water buffer widths range from 5 m to 50 m depending on site specific and activity specific characteristics. For the purposes of this assessment the following conservative approach has been applied:

- 50 m Surface Water Buffer Zone - Mapped surface water features i.e., mapped streams, rivers, lakes. Source for mapped surface water features; EPA.
- 15 m Drainage Buffer Zone - Non-mapped drainage features i.e., non-mapped streams, natural and artificial drainage features. Source for non-mapped surface water features desk study and aerial photography assessment, and field observations. Significant drainage features have been identified and mapped in so far as practical. Some drainage features will likely not be recorded due to issues relating to access and complexity e.g., within afforested areas. Such drainage features, while not mapped or prescribed buffer zones, will be treated with the same consideration as mapped drainage during the design and construction phase of the Project i.e., mitigating for the potential for drainage connection to receiving surface water network.

Wind Farm Surface Water Buffers are presented in **Figure 9.13a.** Grid Connection Route Surface Water Buffers are presented in **Figure 9.13b.**

Groundwater buffer zones are dependent on the characteristics of the receptor e.g., private well, or public supply source protection zone, and the characteristics of the underlying geology and associated aquifer e.g., poor unproductive aquifer, or regionally important karstified aquifer. Recommended groundwater buffer zones range from e.g., 15 m (exclusion zone karst swallow holes) to entire catchments (source protection in regionally important karstified aquifer) depending on site specific characteristics. For the purpose of this assessment the following conservative approach has been applied:

- 100 m Groundwater Buffer Zone – Groundwater abstraction points in relation to proposed access tracks and cable trenches i.e., shallow excavation. Source for mapped abstraction points: GSI. Not applicable, none within 100 m of the Site, Turbine Delivery Route or Grid Connection Route.
- 250 m Groundwater Buffer Zone – Groundwater abstraction points in relation to proposed borrow pits and foundations. Source for mapped abstraction points: GSI. Not applicable, none within 250 m of the Site.

Some portions of the Project infrastructure footprint falls within buffer zones due to the unique and limiting circumstances associated with the Site and the Project, such as constraints related to other environmental disciplines including; surface water receptors, ecology, ornithology, etc. restricted due to the proposed infrastructure itself whereby the proposed turbines require a minimum distance from each other to ensure the potential for wind turbulence impacting on downwind locations is minimised.

None of the proposed turbines or Turbine Hardstands fall within a buffer zone associated with a mapped stream / river. The proposed Site Access Roads and associated widening where required, watercourse crossings, etc. naturally fall within buffer zones associated with mapped streams / rivers. The proposed Site Access Roads and fill material intersect the Sullane_010 river surface waterbody and associated buffer zone at each water course crossing (WC1, WC2, WC3) which will result in implementation of clear span bridges during construction works.

Following Site Surveys significant natural and artificial drainage features observed which are relatively well connected to the mapped surface water network have been included in considering constraints. Some of the proposed Turbine Hardstands (T3, T4, T5), and Site Access Roads fall within the 15 m buffer zones associated with existing natural and constructed drainage features at numerous locations highlighted in pink in **Figure 9.13a**. These features pose an elevated risk in terms of connectivity to surface water receptors; streams and rivers.

No groundwater buffer zones are required for the Project, refer to the baseline section of this report. With reference to **Appendix 8.1 and Appendix H (a - c),** areas have been identified as Geo-Hazards and an effective drainage buffer zone will be applied whereby it is intended to divert runoff away from those areas. The areas in question are characterised as having steep incline, potential for deep till deposits and iron pan. These have elevated stability risk particularly in potential instances where hydrogeological conditions are adversely impacted, i.e., where the enhancement of recharge of groundwater and the perching of groundwater occurs in higher risk areas increasing pore water pressure against potentially parallel failure planes. Particular areas are discussed in **Chapter 8: Soils and Geology**, however in terms of drainage constraints, mapped High Landslide Susceptibility (GSI) (**EIAR Figure 8.6a**) is used to indicate constraints in relation to hydrogeology and stability (**Appendix 8.1 and supporting Appendices A-I**), which is overlaid with hydrological buffer zones as presented in **Figure 9.8 a-k**. Areas which are particularly sensitive include:

- The approach to proposed location to T2, in an area of moderately high landslide susceptibility (GSI) and will require the crossing of two WFD mapped river headwaters.

Furthermore, this area is surrounded by drainage channels with evidence of iron pan in the vicinity.

- The portion of the site south of T3 and proposed location of T5. These areas are characterised similar to the above scenario. Land surrounding T3 also contain areas of elevated localised stability risk due to steep localised inclines.

In the scenarios above, the Turbine Hardstands and associated drainage will divert runoff away from these higher risk areas and design the drainage network to place buffered outfalls in more favourable areas adjacent to the Project footprint, that is; avoiding steep inclines, areas of elevated stability risk, areas with degraded and exposed soils/peat etc, and targeting areas which will receive the runoff to vegetated, low risk areas where vegetation present will provide isokinetic storage, filtering and generally buffering runoff before being intercepted again by the side existing drainage and surface water network.

Some of the Project footprint will fall within buffer zones due to the unique and limiting circumstances associated with the Project, including; the proposed infrastructure itself whereby the Grid Connection Route traverses a relatively large distance and is limited to public and local road networks and privately owned forestry access tracks. Portions of the Grid Connection Route pass through numerous surface water buffers. Of note are the three watercourse crossings, which by their nature will be within surface water buffer zones. Given the extensive drainage network existing at the Site the construction activities associated with the Project will invariably be in close proximity to surface water / drainage features, including within the buffer zones.

Careful consideration and special attention to planning is required for the identified locations within the surface water buffer zones. The Surface Water Management Plan (**Appendix 2.1**) details multiple mitigation measures for works proposed within buffer zones. Method statements and the proposed design of the watercourse crossings (as detailed in **Appendix 2.1 Construction Environmental Management Plan; Management Plan 2 Water Quality Management Plan**) will require agreement from Inland Fisheries Ireland (IFI) in advance of construction which invariably must be constructed within the buffer zones. The mitigation measures described in the following sections will also be applied.

9.6.2 Construction Phase

9.6.2.1 Earthworks Proposed Mitigation Measures

9.6.2.1.1 General / Wind Farm

Management and mitigation for earth works is covered in further detail in **Chapter 8: Soils and Geology**. Mitigation measures to reduce the potential for adverse impacts arising from earth works and management of spoil include the following which will be implemented in full:

- Management of excavated material –with a view to establishing material balance (reuse of excavation arisings) during the proposed construction phase, thus minimising the potential for or the length of time excavated materials are exposed and vulnerable to entrainment by surface water runoff. A Peat and Spoil Management Plan has been prepared and forms **Management Plan 4** of the Construction & Environmental Management Plan (CEMP, **Appendix 2.1**), which adopts the mitigation measures outlined below.
- No permanent stockpile will remain on the site during the construction or operational phase of the Project Excavated materials will be stored temporarily adjacent to the excavation sites within the Project footprint while avoiding areas identified as Geo Hazards in **Chapter 8: Soils and Geology, Appendix H,** as well as prescribed surface water buffers (50 m for mapped river 15 m for drainage features, **Figure 9.13a**.
- Earthworks will be limited to seasonally dry periods and will not occur during sustained or intense rainfall events. Similar to measures outlined in relation to ground stability during excavation works (**Chapter 8: Soils and Geology**), an emergency response system has been developed for the construction phase of the project (see **Management Plan 1 – Environmental Response Plan** and **Section 5.10 of Management Plan 3, Appendix 2.1**), particularly during the early excavation phase. This involves 24-hour advance meteorological forecasting (downloadable from Met Éireann) linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g., sustained rainfall (any foreseen rainfall event longer than 4-hour duration) and/or any yellow or greater rainfall warning (>25 mm/hour) issued by Met Éireann), planned responses will be undertaken. These responses will include; cessation of construction until the storm event including storm runoff has passed over, assessment of construction areas and infrastructure by Ecological Clerk of Works, and confirmation no additional escalation of response is required. All construction works will cease during storm events such as yellow warning (Met Éireann) rainfall events. Following heavy rainfall events, and before construction works recommence, the Site will be inspected and corrective measures implemented to ensure safe working

conditions, for example, dewatering of standing water in open excavations, repair works to drainage features if necessary.

- Exposed soils/peat (exposed temporary stockpiles) will be covered with plastic sheeting during all heavy rainfall / storm events and during periods where works have temporarily ceased before completion at a particular area (e.g., weekends, overnight, etc), in a effort to minimise sediment laden runoff.
- All drainage infrastructure (as per drainage design, **Sections 4 and 5 of Management Plan 3, Appendix 2.1**) required for the management of surface water runoff or draining peat ahead of excavation works will be established before excavation works commence. Similarly, mitigation measures related to surface water quality and the release of suspended solids (**Section 9.6.2.8**) will be implemented before excavation works commence.

9.6.2.1.1 Grid Connection Route

The Grid Connection Route will require excavation of cable trenches in existing roadways as well as forestry tracks and private lands. With reference to general excavation practices discussed above, excavation of cable trenches in close proximity to (0 m at crossings) surface water features will require special consideration in terms of managing movements, spoil arising from excavations, and entrainment of solids and contaminants in surface water runoff.

Mitigation measures to reduce the potential for adverse impacts arising from earth works and management of spoil include the following:

- In sensitive areas, excavation of material will be conducted in a controlled manner whereby any temporary deposit of the material in buffer zones will be minimised. Vacuum excavation techniques or similar will be used for excavations within Surface Water Buffer zones and other sensitive areas (such as constraints, **Section 9.6.1.3**) (**Figure 9.13a**). Excavated soil will be removed to temporary storage areas.
- Management of excavated material will adhere to the measures related to the management of temporary stockpiles outlined in **Chapter 8: Soils and Geology**, a Peat and Spoil Management Plan has been established and forms part of the Construction & Environmental Management Plan (CEMP, **Appendix 2.1, Management Plan 4**) with a view to establishing material balance during the proposed construction phase, thus minimising the potential for, or the length of time excavated materials are exposed and vulnerable to entrainment by surface water runoff. No permanent, or semi-permanent stockpile will remain on the site during the construction or operational phase of the Project.

- All spoil from trenches in public roadways will be removed from works areas as it is excavated and transported to a licenced facility this is due to the presence of bituminous material and potential hydrocarbon contaminants which will not have the opportunity to be entrained in runoff from stockpiling, but rather removed (i.e., mitigation by avoidance).
- Temporary stockpile locations will be situated outside of Surface Water Buffer Zones (as seen in **Figure 9.13a)**. Temporary Spoil stockpiles will have side slopes battered back to a safe angle of repose, e.g., 1:1. Silt fencing will be erected around the base of the temporary mound. Soil will be reinstated on completion of drilling and jointing operations. Temporary storage areas will require bunding and management of runoff likely contaminated with suspended solids (**Appendix 9.6 – Tile 7, 8, 9**). Management of construction waters is discussed in following sections.
- Earthworks will be limited to meteorologically dry periods and will not occur during sustained or intense rainfall events. Similar to measures outlined in relation ground stability during excavation works (**Chapter 8: Soils and Geology**), and as discussed in this chapter, an emergency response system has been developed for the construction phase of the project (see **Management Plan 1** appended to the CEMP, **Appendix 2.1**), particularly during the early excavation phase. This, at a minimum, will involve 24 hour advance meteorological forecasting (Met Éireann download) linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g., 1 in 100 year storm event or very heavy rainfall at >25 mm/hr), planned responses will be undertaken. These responses will include cessation of construction until the storm event including storm runoff surge has passed over. Following heavy rainfall events, and before construction works recommence, the site will be inspected and corrective measures implemented to ensure safe working conditions, for example dewatering of standing water in open excavations and transfer to treatment train.

9.6.2.2 *Excavation Dewatering Proposed Mitigation Measures*

Mitigation measures to reduce the potential for adverse impacts arising from earth works / management of spoil and associated entrainment of solids in runoff and construction water will include the following:

- **Appendix 9.6 – Tiles no. 7, 8 and 9** present layout and specification for Active Management treatment trains (containment, management and treatment of construction water) and emergency response and intervention (recycling or diversion of poor-quality runoff to the Active Management portion of the treatment train). Continuous real time monitoring is also detailed.

- Management of excavations, that is areas of soil / subsoils to be excavated will be drained ahead of excavation works by sumps, in a stepped / phased approach whenever necessary, with the aim of temporarily lowering groundwater levels to allow excavation to be carried out in dry and stable conditions. For example, saturated areas of peat will require dewatering prior to excavation, thus reducing the volumes of water encountered during excavation works.
- Engineered drainage and attenuation features (discussed in following sections) will be established concurrent with excavation works.
- Dewatering flow rate or pumping rate will be controlled by an inline gate valve or similar infrastructure (**Appendix 9.6- Tile 8, Tile 11**). This will facilitate reduction of loading on the receiving drainage and attenuation network, thus enhancing the attenuation and settlement of suspended solids. All pumped water will be discharged to constructed drainage and in line treatment train or to a vegetated surface through a silt bag (**Appendix 9.6 – Tile 12**) outside of surface water buffer zones **(Management Plan 3, Appendix 2.1** and **Appendix 9.6 – Tiles 7, 9 and 12).** Dewatering is a dynamic process and will require continuous monitoring and modification depending on conditions encountered (**Appendix 9.6 – Tile 8, refer to Section 9.5.5.5**).
- In some areas of the Project constraints related to incline and/or stability, or construction activities within the prescribed buffer zones, will likely limit the potential for installation of engineered attenuation features. In such instances water arising from dewatering activities will be directed or pumped to a settlement tank (**Appendix 9.6 – Tile 8**) before being discharged to the receiving drainage network, or pumped to an area of the site where the installation of attenuation features is suitable. Areas with such constraints are presented in **Figure 9.13a**.
- No extracted or pumped water will be discharged directly to the drainage or surface water network associated with the Site (This is in accordance with the Local Government (Water Pollution) Act, 1977 as amended).
- All pumps, tanks, settlement ponds, dewatering bags and check dams used in the dewatering process will be regularly inspected and maintained as necessary to ensure surface water run-off is appropriately treated.

9.6.2.3 Excavation Dewatering Proposed Mitigation Measures- Active Construction Water Management

In all instances where construction water, or runoff has the potential to entrain solids during excavation and other construction activities, runoff will be contained by means of temporary berms (lined geotextile of similar), bunds (lined) and sumps. This will be referred to as Dewatering. Construction water (contaminated) will be pumped to the Treatment Train (**Appendix 9.6 Tiles 7,8 and 9**).

Contaminated water arising from construction works, namely; excavations, drilling and temporary stockpiling, will be contained and treated prior to release or discharge. The schematic presented here is a conceptual model of measures implemented to manage arisings and runoff (Letter headings align with **Appendix 9.6 – Tile 8)**:

A. Arisings. Arisings from the launch / reception pit, or any other significant excavation (e.g., cable joint bays), will be directed the treatment train.
B. Temporary Bund. Arising control area i.e., a temporary bund. Gross solids will be temporarily deposited here. Water arising with the material will be allowed to drain to sump.
C. Sump / Pump. Sump will discharge by gravity / pumped to stilling pond.
D. Temporary Stilling Pond. This can be constructed using soils for bunding in combination with an impermeable liner.
E. Outfall. The outfall from the stilling pond will be buffered (coarse aggregate) to dissipate energy and diffuse discharging water.
F. Silt Screen. A silt screen will be in place down gradient of the Stilling Pond outfall. This is a precautionary measure to mitigate peak loads or surcharges in the system.
G. Monitoring Location/s. Discharge quality will be monitored in real time using telemetry systems. Monitoring of discharge quality will be carried out at the outfall of the stilling pond i.e., before being actually discharged to surface vegetation or surface water (licenced).
H. Sump / Pump. Discharge By-Pass. If water discharging from the stilling pond exceeds quality reference limits water will be diverted (pumped) from the stilling pond to the settlement / treatment tank.
I. Stilling Pond By-Pass. Similar to Discharge By-Pass, if conditions dictate water can be diverted directly to Settlement / Treatment Tank.
J. Settlement / Treatment Tank. A settlement tank will be on standby and ready to use in line with the drainage network if required i.e., water quality at stilling pond outfall fails to meet quality reference limits. The tank will be equipped with treatment systems which will be activated as the need arises, for example, very fine particles which are very slow to settle can be treated with a flocculant agent to promote settlement of particles.
K. GAC Vessel/s. As a precautionary measure, GAC (Granulated Activated Carbon) vessel/s will be in line and ready to use if required. GAC vessels are used to filter out low concentrations of hydrocarbons. Significant hydrocarbon contamination is only envisaged under accidental circumstances. If a hydrocarbon spill does occur, normal

operations will pause and the treatment train will be utilised to remediate captured contaminated runoff.

L. GAC Vessel By-Pass. If the quality of the water is acceptable in terms of hydrocarbon contamination.

M. Treated water will be discharge by gravity / pump to the stilling pond for additional clarification, monitoring and buffered discharge to vegetated area.

N. Silt Bag. A silt bag can be used as alternative to stilling ponds. However, silt bags must only be used as primary method in lower risk areas i.e., outside of buffer zones, etc. Stilling ponds will be the primary method (D, N) is circumstances where risk is elevated, however a gate vale and silt bag can be included in the treatment train and used as an emergency discharge route in the event that the stilling pond needs remediation or maintenance.

In all instances, stilling ponds (D), Silt Bags (N) and outfalls (E) will be situated outside of surface water buffer zones. At many locations, particularly at HDD locations works will be within buffer zones. In these instances, waters will be pumped to the treatment train which can be positioned upgradient along the road (Grid Connection Route) where discharge to vegetated areas / roadside drains can be managed.

Discharge of non-contaminated storm runoff to vegetated land within a site red line boundary is not a licenced activity however this methodology is possible only under relatively low flow conditions (e.g., <2 litres per second (L/s) typical of runoff over a relatively small site area. In the event that the expected incoming flow rate or dewatering rate is relatively high (>2 L/s) a discharge licence will be acquired, and trade effluent will be discharge directly to the surface water network. The latter will include all works associated with HDD.

The discharge points will be identified during the licence application process. As discussed previously, the main components of the treatment will be positioned outside of the prescribed surface water buffer zone where possible. The developer will identify suitable locations for the establishment of temporary infrastructure considering other variable such as traffic and access management. Similarly, the preferred location of discharge points will be outside of buffer zones and into minor or non-mapped surface water / drainage features where possible. The subject drain will be inspected to ensure connection to the mapped network (not blocked).

The quality of the water being discharged will be monitored. If discharge water quality is poor (e.g., >25 mg/L) additional measures will be implemented including Active Water Management to ensure the source of the spike in contaminants is identified, isolated and managed with a view to re-establishing favourable conditions in runoff and within receiving surface water bodies, for example; pausing works as required and treating construction water by dosing with coagulant to enhance the settlement of finer solids – this can be done in a controlled manner by means of a suitably equipped settlement tank. Collected and treated construction water will be discharged by gravity / pump to a vegetated area of ground within the Site. Silt fences will be established at the discharge area to ensure potential residual suspended solids are attenuated and the potential for erosion is reduced. The discharge area will be outside of designated surface water buffer areas (similar to dewatering of excavations. The quality of water discharged will be in line with licence discharge limits assigned by the Council and will be monitored in real time (telemetry with 15 minutes sampling rate), as well as laboratory samples taken, analysed and reported and the frequency indicated in the licence. Daily sampling is recommended given the short duration and temporary nature of the works.

Discharging of construction water (trade effluent) directly to surface waters or groundwater is a licenced activity. (This is in accordance with Local Government (Water Pollution) Act, 1977 as amended).

Active Construction Water Management will be utilised for all works within surface water buffer zones, and for all over pumping.

9.6.2.4 *Excavation Dewatering Proposed Mitigation Measures- Passive Construction Water Management*

Passive management systems (**Appendix 9.6 – Tile 7,** refer also to diagrams in **Management Plan 3, Appendix 2.1**) include some of the features described in Active Management treatment trains. The following measures will be implemented:

- Spoil bunds and/or temporary berms. Spoil bunds and/or berms will be constructed using either crushed rock or clean soils and overlain or lined with an impermeable layer e.g., geotextile or plastic membrane. These features are intended to control the movement of construction water / runoff with a view to:
    - Containing contaminated water (e.g., drilling / excavation spoil and runoff laden with solids). Temporary bunds will be used to manage spoil arising from drilling operations or saturated spoil arising from excavations in sensitive areas e.g., within SW buffer zones.

- To divert runoff i.e., divert clean/storm runoff during construction works or contaminated construction water away from sensitive receptors such as drains/surface waters directly adjacent to construction areas.

- Silt screens. These will be utilised in a similar sense to berms whereby, silt screens will be installed between construction areas and sensitive receptors, including:
  - At the outfall of the treatment train where discharging to vegetated ground or within non-mapped drains (within redline boundary).
  - Along the perimeter of construction areas which are directly adjacent to watercourses or within surface water buffer zones. This includes all watercourse crossings and sections of Grid Connection Route alongside adjacent watercourses.

Passive systems are intended to function with minimal supervision, however in the management of construction water on this site or development, in many cases the diverted water will likely require active management to ensure sensitive receptors are protected. Diverted storm water, if clean will discharge to the receiving vegetated areas or existing drains, but any construction waters impacted by contaminants on the site will be managed, and potentially active management / treatment will be implemented.

9.6.2.5 Grid Connection Route – Excavation of Cable Trenches, Watercourse Crossings and Horizontal Directional Drilling

Excavation and installation of cable ducts within existing bridges (alteration) will require consent from the OPW and various mitigation measures. Mitigation measures outlined in this Report have been developed to minimise the environmental impacts of the grid connection route on the receptors of conservation importance that have been recorded in the area. Mitigation measures mentioned in this Report are included in the CEMP, **Management Plan 2- Water Quality Management Plan, Appendix 2.1**.

Detailed site risk assessments will be carried out with a view to identifying and qualifying risk associated with all watercourse crossings associated and in close proximity (within buffer zones) to the grid route connection corridor. In relation to directional drilling, and the general risk to groundwater during grid connection route construction, risk assessment and prescription of mitigation measures will be designed in accordance with relevant guidance and reference documents, **Section 9.3**.

Risk assessments involved identifying pathways and receptors for each potential source of contamination. This included each directional drilling location and is particularly important in relation to groundwater source protection zones and surface water bodies protected for the purposes of drinking water. Prescription mitigation measures are driven by the identification and qualified risk associated with each particular location and are as follow:

General Overview of Works Mitigation Measures

- The timing of grid connection cable laying will be carried out during metrologically dry seasons/periods.
- An Environmental Clerk of Works (EnvCoW) will be onsite in order to lessen environmental disruption and ensure site integrity is maintained. The Environmental Clerk of Works (EnvCoW) will also be responsible for routine environmental monitoring and report writing.
- Methodology Statements of works, prepared by the Contractor, will be submitted to the local and relevant authorities associated with the Development.
- Any temporary access structures, put in place to allow machinery access to the area will be arranged in discussion with the Environmental Clerk of Works (EnvCoW) and the site will be fully restored post grid route connection (GRC) works.
- All chemical fluids used in the boring process are to be inert to the environment (environmentally safe) and follow the relevant legislation. The Contractor will retain a chemical register and have Safety Data Sheet (SDS) documents available onsite during the operation. The Contractor will also be responsible for a Fluid Management procedure which will include:
    - Drilling Fluid program and Safety Data Sheets
    - Management of spoil including volume on site, specialised site storage
    - Management of drilling fluid displacement (expected volumes and proposed storage)
- Considering the high volumes, high flow rates and high contaminant content (drilling spoil) of water arising for drilling activities, water will be managed and treated by means of a settlement tank and/or associated infrastructure (**Appendix 9.6 – Tile 8**). If a separation (recycling) system is to be used it will be adequately sized and bunded to handle the through-put of the drilling fluid so continuous drilling and reaming operation can be maintained. A separation system will be complete with screens and hydro - cyclones to separate the solids from liquid. Drilling fluids and drill spoils will be disposed off-site at an approved licensed location or discharged to the local surround area with approved licencing permits.

Good Practice of Plant Machinery

- All equipment used during HDD will be in good working order, checked regularly and maintained when necessary. Fluid return lines used in HDD process will be tested for leaks prior to use to check their reliability. Plant machinery not in use will have drip trays below engines as well as at refuelling points, if necessary.
- All practices involving bentonite will be monitored closely, that is: pumping pressure, drilling mud formulation i.e., drilling fluid volume and the volume of mud returns.
- Fuels, lubricants and hydraulic fluids for equipment use on Site will be carefully handled to avoid spillage, properly secured and provided with spill containment kits in case of incident to ensure best practice.
- Spill kits, hydrocarbon mats, oil booms etc., will be maintained at areas of works for emergency use and replaced when necessary.

Contingency Plan

- In the event that a drilling fluid spill or 'breakout' occurs, the Contractor will cease drilling immediately, notify the Environmental Clerk of Works (EnvCoW) and Emergency Service Management Personnel.
- Emergency contact numbers for the Local Authority Environmental Section, Inland Fisheries Ireland, the Environmental Protection Agency and the National Parks and Wildlife Service will be displayed in a prominent position within the site compound. These agencies will be notified immediately in the event of a pollution incident.
- The Contractor will draft and apply a Contingency Plan highlighting with the principal HDD risks. At minimum, the Contractor will have equipment and materials on standby to mitigate against the following risks associated with HDD[19]:
  - Hydro-lock (loss of fluid flow)
  - A hydro-fracture incident (loss of fluid pressure)
  - Fluid spill over
  - Hydrocarbon/fuel spill
  - Drill pipe rupture
  - Borehole path failure
  - Major workplace safety events in remote areas

- The HDD operators will need to be equipped with straw bales, stakes to secure bails, oil booms, silt fences, sandbags, shovels, pumps, and any other materials or equipment necessary to contain and clean up and properly dispose of unintentional releases.

[19] MDM (2018) "Rockabill System Specifications for Cable Installation", McMahon Design & Management Ltd. Consulting Engineers and Project Managers, Job no. 1319

9.6.2.6 *Groundwater Contamination Proposed Mitigation Measures*

As identified and discussed, the risk posed to groundwater quality by the Project is low, however mitigation measures to further reduce the risk will be implemented.

The main threat to groundwater quality is the introduction of hydrocarbons. In order to mitigate groundwater contamination by hydrocarbons in particular, the following will be implemented:

- Minimum fuel storage will occur on site and re-fuelling of vehicles will occur off-site at a controlled fuelling station whenever possible.
- Where fuelling must occur on site due to logistical reasons, then a discrete "fuel station" will be used.
- For large machinery such as cranes, drip tray will be used and spill kits will be on hand.

The following mitigation measures will be implemented in relation to non-hydrocarbon potential contamination:

- Wastewater from the sanitation facility will be mitigated by use of temporary, self-contained compound. This facility will not interact with the existing hydrological environment in any way and wastewater will be removed off-site weekly, by a licensed wastewater disposal company and disposed at an appropriate licenced facility.
- Inorganic nutrients such as nitrogen and phosphorus compounds (if present in excavated sediment and as discussed in discussed in **Section 9.5.3.2** with commercial forestry) will be controlled by the attenuation of the suspended solids to which they adsorb to and by retention of discharge waters within stilling ponds to allow peak runoff to recede prior to discharge (refer to the next section, **9.6.2.12** for monitoring details). It is noted that the baseline surface water chemistry indicates elevated Ammoniacal Nitrogen and Phosphate.
- Bacteriological contamination arising from availability of nutrients (e.g., livestock etc.) will be mitigated by appropriate self-contained sanitation facilities (above) and livestock grazing control on the site overall, but particularly on areas zoned for excavation and development.
- There is low risk of mobilising trace metals that may naturally be present, refer to **EIAR Chapter 8: Soils and Geology, Appendix C** for recoded locations of iron pan. The potential impact may arise from introduced water percolation with excavated bedrock substrate[20]. Concentrations of trace metals are usually low in the natural environment; however, water quality will be checked for metals concentration before, during and after the construction phase as part of monitoring at river monitoring locations.

[20] Teagasc (n.d.) "Research Soils Special: Irish Soil Information System" *Agriculture and Food Development Authority*

9.7 RELEASE OF SUSPENDED SOLIDS PROPOSED MITIGATION MEASURES

Graphics associated with mitigating runoff quality are presented in **Appendix 9.6 – Tiles 7 - 9.**

To mitigate the impact posed by release of suspended solids to the surface water environment, the following mitigation measures will be implemented. The drainage, attenuation and other surface water runoff management systems will be installed concurrent with the main construction activities to control increased runoff and associated suspended solids loads in runoff during intensive construction activities e.g., excavation of turbine base. Vehicular movements will be restricted to the footprint of the Project and advancing ahead of any constructed hardstand will be minimised in so far as practical. For example, excavation ahead of established hardstands will be in line with expected phases of Turbine Hardstand and Site Access Road construction in terms of both delivery of and installation of material and site activity periods whereby excavations will not be opened ahead of site shut down periods. This will be done with a view to minimising soils / subsoils exposure to rain and runoff. Drainage infrastructure will be installed during meteorologically dry ground conditions **(Section 9.6.2.2)**.

Diffuse surface water runoff will be managed as follows:

- With reference to **Management Plan 3, Appendix 2.1**, collector drains and/or soil berms will be established to direct/divert surface water runoff from development areas, including temporary stockpiles, and direct same into established treatment trains including stilling ponds, buffered discharge points or other surface water runoff control infrastructure as appropriate. This is particularly important for effective surface water management associated with proposed infrastructure within the varied surface water buffer zones. The drainage system will be permanent (see also **Appendix 9.6** for conceptual graphics).
- Silt fences will be established along the perimeter of source areas e.g., stockpiles, within the drainage network, and in existing natural drains and degraded peat areas which are likely to receive surface water runoff (**Appendix 9.6 – Tile 14).** Section 5.5 of the Surface Water Management Plan (**Management Plan 3, Appendix 2.1**) describes this in more detail. This will reduce the potential for surface water runoff loaded with suspended solids to rapidly infiltrate towards and be intercepted by drainage or significant surface water features. Where possible multiple silt fences will be installed at multiple locations in drains / treatment trains discharging to the surface water network. Double silt fences / screens will be deployed at outfalls within surface water buffer areas (**Appendix 9.6 – Tiles 7 – 9**). Silt fences will be temporary features

but will remain in place for a period following the completion of the Construction Phase (until such time that site conditions are stable.

Waters arising as a product of excavation activities will be managed as follows:

- Waters arising from dewatering practices during excavation works will be significantly loaded with suspended solids. As such, constructed stilling ponds followed by buffered outfalls may be insufficient in controlling the release of suspended solids to the surface water network. Routine monitoring will prevent the possibility of clogging from significant volumes of settled or attenuated solids. Therefore, any water pumped from excavations, or any waters clearly heavily laden with suspended solids will be contained and managed and pumped through the preestablished Active Management treatment train (**Appendix 9.6 – Tile no. 8, 9 and 11).** This will include continuous active monitoring of water quality by turbidity measurement on an hourly basis.

Waters (likely loaded with suspended solids) intercepted by the established drainage network will be managed as follows:

- In line Stilling Ponds will buffer the run-off discharging from the drainage system during construction, by retaining water, thus reducing the hydraulic loading to watercourses. Stilling ponds are designed to reduce flow velocity to 0.3 m/s at which velocity, silt particle settlement occurs. Stilling ponds will be permanent (life of development at minimum). The locations of stilling pond have been chosen as a part of the drainage design, refer to **Series 100 Site Layout Plans 6225-PL-100-108 planning drawings.** Flow control devices such as weirs and baffles will facilitate achieving better attenuation, particularly when considering fluctuating runoff rates (**Appendix 9.6 – Tile 11**).
- In line Check Dams will be constructed across drains (**Appendix 9.6 - Tiles 3 – 6, Section 5.6 of Management Plan 3, Appendix 2.1**). Check dams will reduce the velocity of run-off in turn facilitating the settlement of solids upstream of the dam. Check dams will also reduce the potential for erosion of drains. Rock filter bunds may be used for check dams however, wood or straw/hay bales (**Appendix 9.6 – Tile 13**) can also be used if properly anchored, that is; supported with rock or fitted timber to reduce potential for material to be swept away by incoming water. Multiple check dams will be installed, particularly in areas immediately downgradient of construction areas. Check dams will only be constructed in drainage infrastructure and not in significant surface water features i.e., streams or rivers. Check dams (comprised of rock) established will be permanent. The following will be implemented in the design of check dams and their deployment (CIRA, 2004):

- Permanent rock filter bunds (coarse aggregate) will be used for check dams however, temporary wood or straw/hay bales can also be used if properly anchored and if the need arises. Permanent rock filter bunds are preferred and is therefore prescribed, as this will ensure that rapid surface water runoff is mitigated against for the life of the Development.
- Check dams will be installed at c. 20 m intervals within the length of drainage channels. This is dependent on the slope angle and height of check dams constructed, refer to **Appendix 9.6 – Tile no. 3**.
- Check dams will include a small orifice / pipe at the base to allow the flow of water during low flow conditions i.e., maintain hydrological regime during low flow conditions. Note: the use of coarse aggregate will facilitate some infiltration.
- Erosion protection will be established on the downstream side of the check dam i.e., cobbles or boulder (100-150 mm diameter) extending at least 1.2 m **(Appendix 9.6 – Tile no. 3 and 4).**
- Check dams will be constructed as part of the drain i.e., reduce the potential for bypassing between the drain wall and check dam.
- Further details and design considerations are presented in **Appendix 9.6 – Tile no. 3 to 6**, refer also to **Section 5 of Management Plan 3, Appendix 2.1**.

- Surface water runoff will be discharged to land via buffered drainage outfalls (refer to **Appendix 9.6 Tiles 7, 8 and 12**, see also **Figure 4.2** and **Drawing Nos. 6226-PL-301** and **6226-PL-100 to 108** in **Management Plan 3**, **Appendix 2.1**). Buffered drainage outfalls will contain hard core material of similar or identical geology to the bedrock at the site to entrap suspended sediment. In addition, these outfalls promote sediment percolation through vegetation in the buffer zone, removing sediment loading to acceptable levels any adjacent watercourses and avoiding direct discharge to the watercourse. A relatively high number of discharge points / buffered outfalls have been established as part of the design, thus decreasing the loading on any particular outfall. Discharging at regular intervals mimics the natural hydrology by encouraging percolation and by decreasing individual hydraulic loadings from discharge points.
- As per the drainage design (**Figure 2.6**), buffered drainage outfalls will be located outside of surface water buffer zones. Similarly, outfalls will not be positioned in areas with extensive existing erosion and exposed soils. Buffered outfalls will be fanned and be comprised of coarse aggregate (cobbles / boulders) (**Appendix 9.6 – Tiles 12 and 13**). These structures will be akin to rip raps (coastal erosion defences/ outfall erosion defences). Silt fences (**Figure 2.6** and **Sections 4 and 5 of Management Plan 3, Appendix 2.1**) will be established downstream of buffered outfalls with a view to

ensuring the effectiveness of the attenuation train, particularly during elevated flow events. Buffered outfalls established will be permanent.

- Very fine solids, or colloidal particles, are very slow to settle out of waters and the finest of particles require near still water and relatively long periods of time to settle, therefore, such particles are unlikely to settle despite the aforementioned measures. To address this, as required, flocculant will be used to promote the settlement of finer solids prior to redistributing to the treatment train and discharging to surface water networks. Flocculant 'gel blocks' are available and can be placed in drainage channels upstream of stilling ponds. Gel blocks are passive systems, self-dosing and self-limiting, however they still require management (by the Contractor's Environmental Manager and supervised by the Developer appointed Environmental Clerk of Works (EnvCoW)) as per the manufacturer's instructions. Flocculants are made from ionic polymers. Cationic polymers (positive charge) are effective flocculants; however, their positive charge make them toxic to aquatic organisms. Anionic polymers (negative charge) are also effective flocculants, and are not toxic i.e., environmentally friendly [21]. Therefore, when flocculants are required, the material used must be made from anionic polymer. Gel blocks will be a temporary measure during the construction phase.
- Straw bales (similar to stone check dams) (**Appendix 9.6 - Tile 13**), and silt fences (discussed under diffuse runoff) will also be used within drainage channels for the purposes of attenuating runoff and entrained suspended solids, however these measures should be considered temporary and will be used mainly in managing potential acute contamination incidents (e.g. additional features to control runoff during excavation works) or to facilitate temporary works (e.g. corrective actions, discussed in later sections). The installation of straw bales or silt fences will require checking on a daily basis by the Contractor's Environmental Manager and supervised by the Environmental Clerk of Works (EnvCoW) to ensure the bypassing does not occur. Coarse stone / boulders will be used in conjunction with these measures to address such issues.

The above measures, buffer zones, constructed drainage, check dams, two-stage stilling ponds design for attenuation, buffered outfalls are referred to as The Treatment Train, whereby the runoff will continuously be treated from source (construction area) to receptor (site exit, outfall of attenuation lagoon). Where necessary (>25 mg/L suspended solids) the treatment train will be augmented through the use of anionic polymer gel blocks. These measures reduce the suspended sediment and associated nutrient loading to surface water

[21] USEPA (2013) Stormwater Best Management Practice – Polymer Flocculation (Available at: http://www.siltstop.com/pictures/US_EPA_Polymer_Flocculant_Handout__3-14.pdf)

courses and mitigates potential impacts to water quality and on plant and animal ecologies downstream of the Site.

The precautionary and mitigation measures listed here will avoid, reduce or remedy all potential impacts on water quality and will ensure that the sensitive receptors in the catchment of the Project do not suffer any deterioration in water quality, either during construction, operation, or decommissioning. With reference to **EIAR Chapter 6: Aquatic Biology**, the populations of Freshwater Pearl Mussel in the lower catchments of the wind farm (Sullane) and along the grid connection route will not be negatively affected by the proposed development. Therefore, the risk to sensitive receptors is low.

Particularly sensitive areas are identified and presented in **Figure 9.13a** to inform the drainage design. Refer also to specific constraints relating to drainage, outfalls and stability in **EIAR Chapter 8 Land, Soils and Geology** and **Figure 8.7a**. Sensitive areas include identified site constraints / buffer zones, but also particular areas with elevated soil or slope stability risk results. Drainage design will not include outfalls discharging to those particular sensitive areas without proper consideration and tailored mitigation in buffer zones and will be avoided outright in areas of elevated risk.

The drainage design is presented on **JOD Drawings 6226-PL-100 to 6226-PL-108** and calculations are included in **Management Plan 3 – Surface Water Management Plan** appended to the CEMP, **Appendix 2.1**. The design indicates in detail the locations of treatment train features, and the specification required at each location.

9.8 RELEASE OF HYDROCARBONS PROPOSED MITIGATION MEASURES

The following mitigation measures to reduce potential impacts from the environmental release of hydrocarbons and other harmful chemicals to the surface waters will be implemented:

- Refuelling of vehicles will be carried out off Site to the greatest practical extent. This refuelling policy will mitigate the potential for impacts by avoidance. Due to the remote location nature of the Site, it is unlikely that implementation of this refuelling policy will be practical in all circumstances (e.g., bulldozers, cranes, etc.). In instances where refuelling of vehicles on Site is unavoidable, a designated and controlled refuelling area will be established at the Site (**Figure 2.16**). The designated refuelling area will enable low risk refuelling and storage practices to be carried out during the works. The designated refuelling area will contain the following attributes and mitigation measures as a minimum requirement:

- The designated refuelling area will be located a minimum distance of 50 m from any surface waters or Site drainage features
- The designated refuelling area will be bunded to 110% volume capacity of fuels stored at the Site
- The bunded area will be drained by an oil interceptor that will be controlled by a pent stock valve that will be opened to discharge storm water from the bund
- Management and maintenance of the oil interceptor and associated drainage will be carried out by a suitably licensed contractor on a regular basis, including Decommissioning following construction.
- Any oil contaminated water will be disposed of at an appropriate Licensed wate disposal site.
- Any minor spillage during this process will be cleaned up immediately
- Vehicles will not be left unattended whilst refuelling
- All machinery will be checked regularly for any leaks or signs of wear and tear
- Containers will be properly secured to prevent unauthorised access and misuse. An effective spillage procedure will be put in place with all staff properly briefed. Any waste will be collected, stored in appropriate containers and disposed of offsite in an appropriate manner.

Notwithstanding the management of refuelling and fuel storage at the designated refuelling area, the potential risk of hydrocarbon spills from plant and equipment or other general chemical spills at other areas of the Site remains. As a precautionary measure, to mitigate against potential spills at other areas of the Site, the following mitigation measures will be implemented:

- Oil absorbent booms and spill kits will be available adjacent to all surface water features associated with the Project. The controls will be positioned downstream of each construction area and at principal surface water drainage features. Oil booms deployed will have sufficient absorbency relative to the potential hazard
- Spill kits will also be available at construction areas such as at turbine erection locations, the Temporary Construction Compound, Onsite Substation, spoils storage areas and Met Mast location etc.
- Spill kits will contain a minimum of oil absorbent pads, oil absorbent booms, oil absorbent granules, and heavy-duty refuse bags for collection and appropriate disposal of contaminated matter
  - Should an accidental spill occur during the construction or operational phase of the Project such incidents will be addressed immediately, this will include the cessation of works in the area of the spillage until the issue has been resolved.

- Spill kits will be kept in each vehicle at the Site and will be readily available to all operators
- No materials, contaminated or otherwise will be left on the Site
- Suitable receptacles for hydrocarbon contaminated materials will also be available at the Site
- A detailed spill response plan will be prepared as part of the Site specific CEMP.

Implementation of the above mitigation measures will significantly reduce the risk of hydrocarbon contamination being released to the surface water network. Nevertheless, the potential risk cannot be entirely eradicated. Therefore, precautionary measures and emergency response protocols have been established and specified in Management Plans 1 and 3 of the CEMP, **Appendix 2.1**.

9.8.1.1 Release of Horizontal Directional Drilling Material Proposed Mitigation Measures

In consultation with Drilling Supplies Europe[22], following the polymer break down, cuttings will settle out of the drill fluid which will form approximately 20% of the volume, the liquid phase will form about 80% of the volume. It is noted that settlement will be done overnight in a pit or holding tank, to leave a fluid phase of less than 400 ppm suspended solids.[21] As has been seen in the past, the remaining water phase will be decanted and disposed of to a wastewater treatment facility or in the sewerage infrastructure, with appropriate discharging licenses from relevant authorities; and the sludge/solids will be disposed of as semi-dry waste to landfill at a reduced cost.[21]

Quantities of drillings cuttings have not been specified to date; however, it is noted that in each entry and exit pit associated with HDD, a 1 m x 1 m x 2 m steel box will be installed to contain any drilling fluid returns from the borehole. The drilled cuttings will be flushed back by drilling fluid to the steel box in the entry pit. It has been determined that drilling rig and fluid handling units will be located on one side of each bridge and will be stored on double bunded 0.5 mm PVC bunds which will contain any fluid spills and storm water run-off. Upon completion of the HDD process, the steel boxes will be removed, with the drilling fluid disposed of to a licensed facility.

Drilling mud containing spoil recovered from the bored path can be retrieved at the launch and reception sites of the bore. This bentonite contaminated spoil will be treated in one of two ways. It can either be transferred off-site to an approved and authorized EPA license

[22] Drilling Supplies Europe (2022) "ClearBore" *Drilling Supplies Europe*. Available at: <https://www.drillingsupplieseurope.com/drilling-fluids/clearbore/>

facility (in accordance with the Waste Management Act 1996 as amended) to be properly disposed of; or the spoil can be pumped to a mechanical separation container (**Appendix 9.6 – Tile 14**). This involves drill mud being stored within a holding tank until separation of particulates can be achieve only then can the fluid be discharged to the surrounding area.

Very fine solids, or colloidal particles, are very slow to settle out of waters and the finest of particles require near still water and relatively long periods of time to settle, therefore, such particles are unlikely to settle despite at sufficient rates. To address this, flocculant will be used to promote the settlement of finer solids prior to discharging to surface water networks. Flocculant 'gel blocks' are passive systems, self-dosing and self-limiting, however they still require management as per the manufactures instructions. Flocculants are made from ionic polymers. Cation polymers (positive charge) are effective flocculants; however, their positive charge makes them toxic to aquatic organisms. Anionic polymers (negative charge) are also effective flocculants, and are not toxic i.e., environmentally friendly.[23] Therefore, if flocculants are deployed the material used must be made from anionic polymers.

9.8.1.2 Release Wastewater Sanitation Contaminants Proposed Mitigation Measures

A temporary compound area will be constructed on-site to contain temporary facilities for the construction phase including 'port-a-cabin' structures. The temporary compound will be constructed on a base of geo-textile matting laid at ground level. This will be stabilized with the laying of hardcore material on top. During the construction phase, foul effluent will be periodically removed for offsite disposal.

Wastewater/sewerage from the staff welfare facilities located in the Temporary Construction Compound will be collected and held in a sealed storage holding tank, fitted with a high-level alarm. The high-level alarm is a device installed in the storage tank that is capable of sounding an alarm during a filling operation when the liquid level nears the top of the tank. Chemicals are likely to be used to reduce odours.

All wastewater will be emptied periodically, tankered off-site by a licensed waste collector to the local wastewater sanitation plant for treatment. There will be no onsite treatment of wastewater. A wastewater or sewerage leakage is not anticipated in a properly managed Site.

[23] USEPA (2013) "Stormwater Best Management Practice: Polymer Flocculation" *United States Environmental Protection Agency: Office of Water*, 4203M.

9.8.1.3 Release of Construction and Cementitious Materials Proposed Mitigation Measures

In order to mitigate the potential impact posed by the use of concrete and the associated effects on surface water in the receiving environment, the following precautions and mitigation measures will be implemented:

- The acquisition, transport and use of any cement or concrete on site will be planned fully in advance of commencing works by the Contractor's Environmental Manager and supervised at all times by the Developer appointed Environmental Clerk of Works (EnvCoW). This entails minimising quantities on site, planning delivery routes and washout stations.
- Precast concrete will be used wherever possible i.e., formed offsite. Elements of the Project where precast concrete will be used have been identified and are indicated in the CEMP, **Appendix 2.1.** Elements of the Project where the use of precast concrete will be used include structural elements of watercourse crossings (single span / closed culverts) as well as Cable Joint Bays. Elements of the development where the use of precast concrete is not possible includes turbine foundations and joint bay pit excavations. Where the use of precast concrete is not possible the following mitigation measures will be implemented.
    - Lean mix concrete, often used to provide protection to main foundations of infrastructure from soil biome, can alter the pH of water if introduced, which would then require the treatment of acid before being discharged to the surrounding environment. The use of lean mix concrete will be minimized, limited to the requirement of turbine foundations. The risk of runoff will be minimal, as concrete will be contained in an enclosed, excavated area.
    - Vehicles transporting such material will be relatively clean upon arrival on site, that is; vehicles will be washed/rinsed removing cementitious material leaving the source location of the material. There will be no excess cementitious material on the vehicle which could be deposited on trackways or anywhere else on site. To this end, vehicles will undergo a visual inspection prior to being permitted to drive onto the proposed site or progress beyond the Contractor's yard. Vehicles will also be in good working order.
        - Drivers of such vehicles will be instructed to ensure that all vehicles are washed down in a controlled environment prior to the departure of the source site, such as at concrete batching plants. **(Appendix 9.6 – Tile 21)**
- Concrete will be poured during metrological dry periods/seasons in so far as practical and reasonably foreseeable. This will reduce the potential for surface water run off being significantly affected by freshly poured concrete. This will require limiting these works to dry meteorological conditions i.e., avoid foreseen sustained rainfall (any

foreseen rainfall event longer than 4-hour duration) and/or any foreseen intense rainfall event (>3 mm/hour, yellow on Met Éireann rain forecast maps), and do not proceed during any yellow (or worse) rainfall warning issued by Met Éireann. This also will avoid such conditions while concrete is curing, in so far as practical.

- Pouring of concrete into standing water within excavations will not be undertaken.
- Excavations will be prepared before pouring of concrete by pumping standing water out of excavations to the treatment train and buffered surface water discharge systems in place.
- Any required shuttering installed to contain the concrete during pouring will be installed to a high standard with minimal potential for leaks. Additional measures will be taken to ensure this, for example the use of plastic sheeting or other sealing products at joints.
- No surplus concrete will be stored or deposited anywhere on site. Such material will be returned to the source location or disposed of off-site appropriately at a suitable licensed facility. Concrete washing will be contained and managed similarly.
- Designated washout of concrete trucks shall be strictly confined to the batching facility and will not be located within the vicinity of watercourses or drainage channels. Only the chutes will be cleaned prior to departure from Site and this will take place at a designated area at the Temporary Construction Site Compound. The contents will be allowed to settle and the supernatant will be removed off site by licenced generator to a licenced waste water treatment plant.
- Temporary storage of cement bound sand (if required for construction of the substation building) will be on hardstand areas only where there is no direct drainage to surface waters and where the area has been bunded e.g., using sand-bags and geotextile sheeting or silt fencing to contain any solids in run-off.
- Ground crew will have a spill kit readily available, and any spillages or deposits will be cleaned/removed as soon as possible and disposed of appropriately.

9.9 CLEAR FELL OF FORESTRY

No new impacts or remediation measures are associated with forestry activities. However, good practices working in specific environments such as forested areas will be adhered to including working outside of surface water or other buffer zones, and risk assessing on a case by case basis in terms of drainage intercepting run off, ecological sensitivities, etc.

Further mitigation measures regarding the management of forestry operations which will be implemented include:

- Phased felling approach
- Minimising erosion by use existing tracks and use of brash for off track areas.

- Felling and extraction, if economical, of timber will, as far as possible, be undertaken at the same time as currently licensed extraction activities in order to minimise extra traffic and noise disturbance.
- Felling and extraction of timber will, as far as possible, be undertaken in dry weather conditions.
- All Forest Service guidelines will be adhered to during all harvesting activities.
- All relevant forestry guidance and policies as follows:
    - Forestry Service (2015) Forestry Standards and Procedures Manual
    - Forestry Service (2002) Forest Protection Guidelines
    - Forestry Service (2018) Forests & Water - Achieving Objectives under Ireland's River Basin Management Plan 2018-2021
    - Forestry Service (2000) Forests & Water Quality Guidelines
    - Forestry Service (2000) Forest Harvesting and Environmental Guidelines
    - Forestry Service (2018) Forestry and Freshwater Pearl Mussel Requirements - Site Assessment and Mitigation Measures DRAFT
    - Forestry Service (2000) Forest Biodiversity Guidelines
    - Forestry Service (2000) Forestry and The Landscape Guidelines
    - Forestry Service (2000) Forestry and Archaeology Guidelines
- It should be noted that the clear-felling of trees in the State requires a felling licence.
- All drains, either mound drains, culverts, water crossings crossed during extraction, if necessary, will be cleared of any debris to ensure no drainage issues will occur for the remining trees, which can be a major attributor to windblow.
- Felling and extraction of timber will be undertaken in dry weather conditions.
- Harvesting operations will be scheduled according to the nature of the soil seasonally, depending on ground conditions. Mechanised harvesting operations will be suspended during and immediately after periods of particularly heavy rainfall. Waterways are particularly vulnerable to the effects of harvesting as silt from the movement of machinery can enter streams and rivers causing blockage of gravels which affects insect and fish life. Also nutrients released from decaying branches, particularly from large clear felled sites, can cause enrichment of the waters which in turn causes pollution. To counteract these effects careful planning is required in carrying out harvesting operations. The following measures to avoid impacts will be implemented:
    - Limiting the size of the areas to be felled which reduces the amount of nutrients and silt released.
    - Minimising the crossing of drains and streams, but where necessary installing temporary structures (log bridges, pipes etc) to avoid machines entering the water;

- Establishing buffer zones around waterways from which machines are excluded and riparian zones maintained.

9.9.1.1 *Watercourse Crossings Proposed Mitigation Measures*

The Project includes the construction of three (3 No.) clear-span bridge watercourse crossings (**Figure 9.7**). The Grid Connection Route will encounter 113 No. Culvert crossings, 3 no. watercourse crossings and 6 no. service crossings (**Appendix 2.4**). These crossings require detailed planning and consideration to ensure potential impacts are assessed adequately and in turn mitigated against.

The proposed watercourse crossings are relatively near the head waters of the surface water network therefore, bridge or culvert specification and construction are envisaged to be of relatively low significance in terms of expected flow, etc. However, all watercourse crossings will be designed to facilitate peak, or storm discharge rates so as to avoid localised flooding and associated issues during storm events. Data presented in **Table 4.4** and **Table 4.5** of **Appendix 9.1 – IWF Flood Risk Assessment,** indicate potential surface water discharge rates during a 1-hour storm event and a 24 hour storm event with a 1 in 100 year return period. Upstream catchment areas are estimated and delineated by assessment of mapped catchment boundaries, topographical contours and existing infrastructure and associated drainage.

The above assessment is a conservative estimation which does not consider evapotranspiration or recharge to ground, or base flow and groundwater discharge to the respective surface water features.

In relation to the design and construction of watercourse crossings risk assessment and prescription of mitigation measures have been designed in accordance with relevant guidance and reference documents **(Section 9.3).**

Regulation 50 of the European Communities (Assessment and Management of Flood Risks) Regulations 2010 SI 122 of 2010 requires that: "No Person, including a body corporate, shall construct any new bridge or alter, Reconstruct, or restore any existing bridge over any watercourse without the Consent of the Commissioners or otherwise than in accordance with plans previously approved of by the Commissioners."

The word "watercourse" includes rivers, streams, and other natural watercourses, and also canals, drains, and other artificial watercourses.

The word "bridge" includes a culvert or other like structure.

The OPW is responsible for the implementation of the regulations and consent to construct any bridge will be sought from the OPW via their application process. Details on the application process and guidance / requirements of the bridge design and considerations in terms of flow can be found in the OPW guide Construction, Replacement, or Alteration of Bridges and Culverts (A Guide to Applying for Consent under Section 50 of the EU (Assessment and Management of Flood Risks) Regulations SI 122 of 2010 and Section 50 of The Arterial Drainage Act, 1945). The requirements of OPW have been incorporated into the design of the proposed watercourse crossings. Preliminary design details are included in **Drawings ref. 6226-PL-WC 1-3.**

All crossings will have clear span structures.

Single span structures are structures which span the width of the channel with no associated instream support and do not affect the bed of the river or water body. This ensures that the bank and instream habitats are maintained and the riverbed is not impacted.

The decision to use single span structures is in accordance with Engineering in the water environment: Good Practice Guide – River Crossings (SEPA, 2010) and Guidelines for the Crossing of Watercourses During the Construction of National Road Schemes (NRA, 2008) for river waterbodies in upland or transitional river segments.

With reference to **EIAR Chapter 6 – Aquatic Ecology**, none of the proposed watercourse crossing locations are associated with areas, or immediately proximate to surface water features with significant ecological sensitivity or importance. The principal risk to ecological sensitivities associated with proposed watercourse crossing works is the potential for adverse impacts to water quality downstream of the Site, namely the potential for mobilisation of solids. It is also noted that watercourse crossing methodologies employed will ensure potentially long term / permanent impacts downstream (e.g. scouring etc) or upstream (e.g. passage of fish) will be avoided, in line with 'good practice' defined by SEPA.

Considering all of the above and considering baseline conditions – including ecological sensitivity and importance of surface water features associated with each of the watercourse crossings, all crossings will be Clear Span Bridges.

This is in line with good practice as defined by relevant guidance (SEPA, 2010) whereby; the course of action serves a demonstrated need, minimises the potential for ecological harm.

- Considering the width of all waterbodies associated with crossings discussed here (<2 m width) in stream supports will not be required for the construction of single span structures.
- The design facilitates adequate hydraulic capacity (**Management Plan 3 of Appendix 2.1**). This ensures that the design will maintain the existing channel and will facilitate peak discharge events (storm events) without flow being constrained and contributing to flooding or other issues. Values presented **Appendix 9.1 – SFRA** indicate the potential discharge rate associated with each watercourse crossing during a 1 in 100-year storm event. For existing crossings, the channel width will be maintained.
- In line with the above design consideration, allowance will be made for the transport of sediment through the crossing, not just hydraulic capacity.
- The design facilitates adequate freeboard to OPW requirements. The design facilitates passage of woody debris. Freeboard to facilitate navigation and recreation is not applicable in relation to the development and associated surface water features.
- For single span structures, abutments will be set back from the river channel (**Appendix 9.6 – Tile 15**) and banks to allow the continuation of the riparian corridor underneath the structure. This helps to minimise or prevent the need for bed and bank reinforcement, reduces the risk of creating a barrier to fish passage and allows mammal passage under the structure. The distance between the bridge abutments will be as wide as possible and will maintain the bank habitat, maximising the riparian corridor and allowing the river some space to move. Foundations (of abutments) will be deep enough to minimise or prevent the need for bed or bank reinforcement or bridge weirs or aprons. This will maintain the natural bed material and bed levels, protecting habitat and allowing fish passage. Foundations will be buried deep enough to allow for scour during high flows. Construction will be supervised by a suitably qualified engineer who will confirm that the depth is as per the design.
- The design minimises the potential for localised bank and bed erosion, refer to **Planning Drawing No. 6226-PL-WC-01, 6226-PL-WC-02, 6226-PL-WC-03.**

9.9.1.1.1 Culverts & Instream Works

Infrastructure such as culverts and non-mapped drainage features will require instream works. Where culverts are required and the subsequent in-stream works are necessary, the following will be implemented:

- Relevant guidance referenced is presented in **Section 9.3**. Method statements will be included in the CEMP, **Appendix 2.1.**
- The construction area will be isolated, this means; the water feature (streams / drains) will be temporarily dammed upstream of the watercourse crossing and flow will be diverted by means of a flume / pipe by gravity or pumped (this is referred to as over pumping, **Appendix 9.6 – Tile 1**) downstream of the watercourse crossing and construction area. Following the successful upstream damming, a downstream dam or barrier will also be established. The downstream barrier will ensure contaminated runoff in the isolated work area can be contained and managed and will block surface water back flow in lower lying or flatter areas. **Appendix 9.6 – Tile 1** presents a conceptual plan view of an isolated construction area within a surface water feature. Over pumping of a surface water feature is considered diversion of water runoff only and therefore considered similar to discharge of storm water runoff only to sewer (exempt from licensing), however it is imperative that controls are in place to ensure environmental impacts are minimised, particularly in relation to ecological sensitivities.
- In order to ensure isolation and over pumping is carried out effectively, the methodology will ensure that dams are secure / sufficiently supported, and that pumping of water can continue uninterrupted and that pumps are capable of keeping up with the discharge rate of the surface water feature. Pumping systems will require backup and fail-safe protocols e.g., backup pumps and generator. At significant surface water features e.g., non-mapped streams, isolation and diversion of drainage will be implemented.
- Provided the construction water within the isolation area is managed effectively, over pumping of the surface water feature does not pose a significant risk to surface water quality downstream of the watercourse crossing. With reference to **Section 6.4.2 of Chapter 6: Aquatic Biology,** clear span design of the bridges/crossings will not affect instream aquatic habitat or interfere with the passage of fish or aquatic fauna.
- Water ingress into the construction area will be managed and collected by established sumps immediately downstream of the works (upstream of the downstream barrier) (**Appendix 9.6 – Tile no. 1**). Runoff within the construction area will likely be heavily laden with suspended solids. Where required, dewatering (pumping out or extracting) of such waters will be discharged to an inline settlement tank, or preestablished stilling pond to remove suspended solids before being discharged (**Appendix 9.6 Tiles 8 and 9**). The quality of the water being discharged will be monitored. If discharge water quality is poor (e.g., >25 mg/L) additional measures will be implemented, for example treating construction water by dosing with coagulant to enhance the settlement of finer solids – this can be done in a controlled manner by means of a suitably equipped settlement tank. Collected and treated construction water will be discharged by gravity

/ pump to a vegetated area of ground within the Site (an example is provided in **Appendix 9.6 – Tile 12**). Silt fences (**Appendix 9.6 – Tile 14**), will be established at the discharge area to ensure potential residual suspended solids are attenuated and the potential for erosion is reduced. The discharge area will be outside of the surface water buffer areas (similar to dewatering of excavations). For further details refer to **Appendix 9.6 – Tiles 6 to 9.**

- Discharging of construction water (trade effluent) directly to surface waters is a licenced activity. No extracted or pumped or treated construction water from the isolated construction area will be discharged directly to the surface water network associated with the Site (This is in accordance with Local Government (Water Pollution) Act, 1977 as amended). It is noted that all runoff on the site will eventually discharge to the receiving surface water network, however with appropriate management the quality of runoff discharging to the surface water network will be acceptable e.g., <25 mg/L Suspended Solids.
- Operation of machinery in-stream will be kept to an absolute minimum and avoided where possible. Where in stream works are required, the area will be isolated by means of over pumping or drainage diversion (**Appendix 9.6 Tile 1**), discussed further below.
- Works in relation to watercourse crossings will be carried out during periods of sustained dry meteorological conditions and will not commence if sustained wet conditions or if wet conditions are forecast (**Section 9.6.2.1**).
- Works in relation to watercourse crossings will be planned and carried out as efficiently as possible. This means work plans are agreed fully and all equipment and materials are prepared fully before in stream works commence. Works will be completed as quickly as possible and will not pause for the duration of the in stream works e.g., Installation of culverts (24 hour as necessary), with the exception of circumstances related to meteorological and/or health and safety conditions.
- Only precast concrete will be used for in stream works.
- Precautions will be made to mitigate the potential risk of a hydrocarbon spill. Further to measures outlined in **Section 9.5.3.2**, settlement tanks (will be adequately equipped with hydrocarbon removal functionality on standby, for example hydrocarbon absorbent booms, oil skimmers, and GAC (granulated activated carbon) filters, should they become necessary (**Appendix 9.6 – Tile 8**).

9.9.1.1.2 Diversion of Drainage

Diversion of artificial drainage channels will be required at locations where the development layout intercepts existing artificial drainage networks (**Figure 9.7a**).

Diversion of drainage will be done under similar conditions to that described above for instream works. Many of the existing constructed drainage channels are observed to be dry during sustained dry meteorological conditions which implies that over pumping or diverting of water flow may not be necessary, nonetheless the methodology described for instream works will be implemented to mitigate the risk of any flow through the construction area or for unforeseen wet meteorological events.

Any newly installed drain will be fully formed prior to the diversion of existing drainage.

Erosion control will be incorporated into the design (**Appendix 9.6– Tile 2**), this requires minimising the area of exposed soil in existing and newly established channels. This will include a combination of the use of coarse aggregate / crushed rock (non-friable / non-weak), engineered solutions and/or revegetation.

A series of temporary silt fences (**Appendix 9.6– Tile 14)** will be installed to mitigate against the entrainment and mobilisation of solids during key events during the construction process, for example, the initial use of the new diverted channel, or the infilling of the original channel made redundant (**Management Plan 3, Appendix 2.1).** The use of silt screens as a form of mitigation during watercourse crossing works is considered a precautionary measure. Refer to **Appendix 9.6 – Tile 2** for further information on the recommended ordering of control measures.

9.9.1.2 Groundwater Contamination Proposed Mitigation Measures

A combination of the underlying bedrock geology, the associated aquifer potential, low permeability soils/peat and low recharge rates has resulted in the risk posed to groundwater quality by the Project being considered as low risk. Nevertheless, mitigation measures to reduce potential risks to groundwater will be implemented as a precautionary approach. A primary risk to the underlying groundwater quality would be through the accidental release of hydrocarbons from fuels or oils during the construction phase of the Project. In order to mitigate against potential groundwater contamination by hydrocarbons, the following measures will be implemented:

- In the first instance, no fuel storage will occur at the Site whenever feasible and refuelling of plant and equipment will occur off Site at a controlled fuelling station.
- In instances where on Site refuelling is unavoidable, then the bunded on Site designated refuelling area will be used. The designated refuelling area must be bunded to 110% volume capacity of fuels stored at the Site. **(Appendix 9.6 – Tile 19)**

- The bunded area will be drained by an oil interceptor that will be controlled by a pent stock valve that will be opened to discharge storm water from the bund.
- Management and maintenance of the oil interceptor and associated drainage will be carried out by a suitably licensed contractor on a regular basis.
- Any oil contaminated water will be disposed of at an appropriate oil recovery plant.
- Any minor spillage during this process will be cleaned up immediately.
- Vehicles will not be left unattended whilst refuelling.
- For large machinery such as cranes, a drip tray will be used and spill kits will be on hand.

The following mitigation measures will be implemented in relation to non-hydrocarbon potential contamination of groundwater:

- All other liquid-based chemicals such as paints, thinners, primers and cleaning products etc. will be stored in locked and labelled bunded chemical storage units.
- Sanitation facilities used during the construction phase will be self-contained and supplied with water by tank trucks. These facilities will not interact with the existing hydrological environment in any way and they will be maintained and serviced throughout the construction phase.
- The controlled attenuation of suspended solids in settlement ponds and check dams etc. will result in inorganic nutrients (if present in elevated concentrations) such as phosphorus and nitrogen being absorbed and retained by the solids in the water column. This will allow for a reduction of peak inorganic discharges in a controlled and stable run off rate. It is noted that the presence of elevated contaminants were detected during the four surface water quality monitoring rounds.
- It is considered that there is a low risk of mobilising trace metals that may naturally be present in low concentrations in the baseline environment. The potential for mobilising trace metals is most likely to result from enhanced water percolation associated with excavated bedrock substrate. To mitigate against this potential impact, water quality should be monitored for trace metal concentrations prior to, during and after the construction phase.
- The potential for livestock such as cattle and sheep which have been observed grazing in the vicinity of the Site to cause bacteriological contamination of groundwater will be controlled through the implementation of strict grazing control zones, Site perimeter fencing and exclusion zones around all open excavations.

9.9.1.3 Site and Water Quality Monitoring

9.9.1.3.1 Defining Monitoring Roles and Responsibilities

An Environmental Clerk of Works (EnvCoW) will be appointed during the construction and operational phases of the Project, to ensure sensitive areas outlined in this EIAR are prioritised and to ensure mitigation measures are followed to protect these sensitive areas. It is often compulsory as part of the planning conditions to have an EnvCoW present during works. Local Authorities will often define what role the EnvCoW has, for example; an advisory capacity, an audit capacity, for ecological work or an all-encompassing environmental role. For the Project, the EnvCoW will incorporate, where relevant, mitigation and monitoring responsibilities set out here width. The EnvCoW ensures compliance with the method statements and management plans, in turn in line with environmental and mitigation objectives outlined in this report, and will relay advice, information and instruction to the appointed contractors during the construction and operational phases of the Project.

9.9.1.3.2 Wind Farm Site

Monitoring of peat, subsoils, bedrock and material management during the construction phase of the Project will be fundamentally important in ensuring that potential suspended solid entrainment in surface waters is minimised. With comprehensive planning and preparation, and implementation of relevant mitigation measures contained in the CEMP, the potential for elevated suspended solids to be released to surface waters via runoff is likely to be minimal.

To ensure effective implementation of mitigation measures, environmental auditing, and monitoring of environmental obligations of the Developer, an Environmental Clerk of Works (EnvCoW) will be assigned by the Developer to carry out monitoring at the Site during the construction and operational phases of the Project. The role of the EnvCoW will be to actively and continuously monitor site conditions and advise on environmental issues and monitoring compliance. The EnvCoW will have the authority to temporarily stop works in a particular area of the Site to ensure corrective measures are implemented and adverse environmental impacts are minimised if not avoided. The following wind farm Site monitoring measures will be undertaken by the EnvCoW, to mitigate against potential impacts on the surface water and groundwater receiving environment:

- During the construction phase, daily inspection of silt traps, buffered outfalls and drainage channels, in conjunction with daily measurement of total suspended solids, electrical conductivity, and pH at selected water monitoring locations on the Site (locations close to active working zones). Monitoring of same features, parameters and locations during times when excavations are being dewatered (likely high in solids) will be done in real time. In this regard, physiochemical properties will be monitored in real time by means of alarmed telemetry e.g., telemetric monitoring at baseline sampling locations and alarm thresholds established in line with water quality reference concentrations/limits which will be set using relevant instruments for example, Surface Water Quality Regulations, <25 mg/l Total Suspended Solids (TSS). This threshold can be described as one of the environmental and mitigation objectives set for the Development.

- Continuous Monitoring will be carried out as part of Active Management of construction water management and treatment (**Appendix 9.6**). These monitoring systems will travel with remain with the Active Management infrastructure. The purpose of this is to recycle water if quality is unfavourable and adjust the dewatering and treatment train accordingly until discharge quality is observed to be acceptable. A small degree of tolerance above reference concentrations is acceptable at this location but only if the discharge from the Active Management train discharges to another Passive Management system or to a non-sensitive vegetated area. If discharging within sensitive areas or buffer zones, the quality of discharge from the Active Management train will be in line with prescribed reference limits (e.g., 25 mg/l TSS)
- Continuous Monitoring at designated downstream Baseline SW Locations (**Figure 9.7b**) will be carried out using telemetry during the construction phase. Exceedance of thresholds at these locations will trigger emergency response and escalation of measures including immediate full Site inspection to ascertain the potential unknown source (bearing in mind that the quality of managed runoff will be known by means of live telemetry and handheld meters). Monitoring at Baseline SW Locations will continue into the operational phase until such time that it is confirmed that the construction phase is complete, that there are no further construction activities required on site, and when stable conditions are observed i.e. stable conditions in line with baseline conditions observed for 2 months following the completion of the construction phase.
- Post construction: inspection of silt traps, buffered outfalls and drainage channels, measurement of total suspended solids, electrical conductivity, and pH at selected water monitoring locations at the Site will be carried out at a reasonable frequency (weekly initially gradually reduced based on observed stability of conditions) and will also be scheduled following extreme metrological events. During the operational phase of the project the stilling ponds and buffered outfalls will be periodically inspected e.g., weekly during maintenance visits to the Site initially and gradually reduced based on observed stability of conditions.
- During the construction phase of the Project, the areas or works will be monitored daily for evidence of groundwater seepage, water ponding and wetting of previously dry

spots, and visual monitoring of the effectiveness of the constructed drainage and attenuation systems so that it does not become blocked, eroded or damaged during the construction process. This monitoring will continue at a reasonable frequency (weekly initially, gradually reduced based on observed stability of conditions) during the operational phase of the Project, any potential issues in this regard will be identified and rectified during the construction phase.

- During both the construction and operational phases of the Project, watercourse crossings will be monitored frequently (daily during construction and intermittently during operational phase i.e., weekly / monthly inspections) and reduced gradually in line with observed stability and confidence in data obtained over time. Monitoring will include structural integrity and the impact on respective watercourses (i.e., erosion, siltation).
- A detailed inspection and continuous monitoring regime is specified in the CEMP, **Appendix 2.1**. This includes an environmental risk register e.g., constraints linked to the development construction schedule, routine reporting on the performance and effectiveness of drainage and attenuation infrastructure, and any actions taken to rectify or enhance the system. This also includes Site water runoff quality instructions at all designated downstream SW locations. Continuous Monitoring Locations or Telemetric Monitoring Stations (TMS) will use probes to monitor the following parameters:
    - Electrical Conductivity
    - Turbidity (Data obtained can be equated to estimated Total Suspended Solids (TSS) through calibration)
    - pH
    - Temperature
    - Capacity for additional probes.
    - TMSs will be self-powered and will be comprised of the following components at a minimum:
    - Remote Telemetry Unit (RTU) – Modem / data hub and transmission.
    - Solar panel
    - Sensor – pH
    - Sensor – Turbidity
    - Sensor – Electrical Conductivity
    - Sensor Cleaning Device (SCD)(Turbidity probe)
    - Power Management Unit (PMU)
    - Power Bank (PB)
    - Website – presenting data trends over time.
    - Metal stand / frame and protective fencing.

- The TMS will have capacity for additional parameters.

- Telemetric continuous monitoring sampling frequency is generally set at one data point per 15 minutes, however considering the intensive nature of the proposed works, particularly drilling activities, if possible it is recommended that sampling frequency is set at 5 minutes or less with a view to escalating responses to potential discharge quality issues in good time. Data is transmitted to a project website which will display data trends over time. Access to the website can be gained and shared via a website link by the designated EnvCoW.
- Telemetric Monitoring Systems will be used a key part of Active Management of runoff and construction water at the Site, as presented in **Appendix 9.6 – Tiles no. 7 to 9.**
- A handheld turbidity meter will be available and used to accurately measure the quality of water discharging from the Site at any particular location. The meter will be maintained and calibrated frequently (per the particular unit's calibration requirements / user manual) and will also be used to check and calibrate remote sensors if they are employed. Quality thresholds have been established for the purposes of escalating water quality issues as they arise.
- Rainfall will be monitored (1 no. rainfall gauge required). This unit will be connected with and displayed with other site water quality telemetry data via the telemetry website.
- Surface water runoff control infrastructure will be checked and maintained on an ongoing basis, and stilling ponds and check dams will be maintained (de-sludge / settle solids removed by vacuum) on an ongoing basis, particularly during the construction phase of the Project. It is important to minimise the agitation of solids during these works, otherwise it will likely lead to an acute significant loading of suspended solids in the drainage network. This can be achieved by temporarily reducing or blocking incoming flow and vacuum extracting settled solids or sludge. Where the drainage feature poses relatively significant flow rates, isolating and over pumping is the best course of action. As part of the CEMP, **Appendix 2.1** regular checking and maintenance of pollution control measures are required (in line with frequencies outlined above), with an immediate plan for repair or backup if any breaches of design occur. In the event that established infrastructure and measures are failing to reduce suspended solids to an acceptable level, construction works will cease until remediation or upgrading works are completed.
- All details in relation to monitoring will be included in the Surface Water Management Plan (**Appendix 2.1**).

Monitoring the potential hydrological impact of the Project, particularly during the operational phase will be inherently linked to the ecological health of the blanket peat (as a functioning ecosystem) and therefore both hydrology and ecology will be considered, and monitored in tandem. For example, impacts to the hydrological regime at the Site can potentially impact on the ecological health or characterisation of the Site, and vice versa. Ecological indicators can potentially provide useful data in relation to the long-term impact of changes to the hydrological regime at the Site. However, as discussed in earlier sections of this report, changes to the management of runoff and in turn the hydrological regime at the Site will lead to a positive impact overall when compared to the baseline conditions associated with the Site e.g. introduction of intermittent buffered outfalls along the length of the drainage network is in contrast to baseline, this will promote a more even distribution runoff, attenuate runoff and reduce the hydrological response to rainfall, enhanced potential for recharge to ground, and in turn raising bog water levels resulting in wetting of peatlands at the Site.

9.9.1.3.3 Grid Connection Route and Turbine Delivery Route

Monitoring will be carried out at each significant construction location (HDD, any excavation >2.0 m) and at significant environmental receptors including the following Environmental Monitoring Locations:

- Upstream and downstream of surface water crossings on mapped rivers.
- Operational wells within groundwater buffer zones associated with significant construction locations (namely SW Crossings).
- Groundwater abstraction points within buffer zones (mapped wells, source protection areas, and/or associated Regionally Important Karst Aquifer).

Monitoring proposed will be specified relative to the particular activity and associated risk at respective locations.

9.9.1.3.4 Monitoring Under License

Where a discharge licence is required, the conditions of the licence will stipulate monitoring requirements in line with licence parameters with associated emission limit values. The frequency of sampling will likely be daily or weekly. Sampling will include obtaining physical samples at an agreed discharge sampling point and will be sent an accredited laboratory for analysis. Where discharge licence is required, monitoring in line with the licence will be done in addition to the other monitoring regimes undertaken as described in sections above. Monitoring under licence conditions will not negate the requirement for the other regimes described.

9.9.1.3.5 Tailoring Monitoring Requirements

The baseline monitoring undertaken at the Site as part of this study will be repeated periodically before, during and after the construction phase of the Project to monitor any deviations from baseline hydrochemistry that occur at the Site. This monitoring along with the detailed monitoring outlined below will help to ensure that the mitigation measures that are in place to protect water quality are working. Specifically, a construction period and post construction monitoring programme for the Development should include the following:

- During the construction phase, daily inspection of silt traps, buffered outfalls and drainage channels and daily measurement of total suspended solids, electrical conductivity, and pH at selected water monitoring locations on the site. Monitoring of same during times when excavations are being dewatered (likely high in solids) should be done in real time.
- Post construction: at a reasonable frequency inspection of silt traps, buffered outfalls and drainage channels, measurement of total suspended solids, electrical conductivity, and pH at selected water monitoring locations at the Site. During the operational phase of the project the stilling ponds and buffered outfalls will be periodically inspected during maintenance visits to the Site.
- During the construction phase of the project, development areas should be monitored daily for evidence of groundwater seepage, water ponding and wetting of previously dry spots, and visual monitoring of the effectiveness of the constructed drainage and attenuation system so that it does not become blocked, eroded or damaged during the construction process.
- During both the construction and operational phases of the project, watercourse crossings should be monitored frequently (daily during construction and intermittently during operational phase). The water course crossings should be monitored in terms of structural integrity and in terms of their impact on respective watercourses.
- A detailed inspection and monitoring regime, including frequency has been specified in the Construction and Environmental Management Plan (CEMP, **Appendix 2.1**).

9.9.1.4 Emergency Response

Monitoring of the development during the construction and operational phase will potentially indicate weaknesses of the drainage and attenuation design, and/or the potential for excessive loading at particular locations etc. In such instances corrective actions will be taken to mitigate against any potential adverse impacts. Depending on the severity of the issue there is the potential that immediate action will be required, for example the introduction of straw bales to reduce flow / enhance attenuation at a particular location, erect silt fences etc., however such measures will be temporary. Any issue observed will require assessment by a specialist consultant and alternative mitigation design (in line with measures described in this EIAR) will be implemented to ensure the efficacy of the system during both the construction and operational phases of the Development. Scenarios where corrective action will be required, and proposed corrective mitigation measures include:

- Potential issue; Elevated concentrations of suspended solids in runoff during excavation activities during an unforeseen or low probability storm event, for example a 1 in 100-year event. Proposed measure that will be implemented; Cover exposed stockpiles in plastic sheeting and placement of straw bales and silt fences in associated drainage channels.
- Potential issue; Failure or degradation of stone check dam during a storm event with associated elevated runoff volumes. Proposed measure that will be implemented; Introduction of straw bales and silt fences in order to regain attenuation capacity of the drainage channel until the maintenance can be completed.
- Potential issue; Localised peat stability issue leading to deposit of peat within an active drainage channel. Proposed measure that will be implemented; Introduction of straw bales and silt fences directly downstream, of the area in order to attenuate gross solids isolate the area and over pump until remedial works and maintenance can be completed, divert all runoff from the area to Active Management area of the treatment train (**Appendix 9.6 – Tile no. 7 to 9**).
- Potential issue; Management of unexpected runoff patterns leading to excessive drying or wetting in a particular area, potentially leading to enhanced erosion and / or adversely impacting on the ecological health of peat ecosystems. Proposed measure; This type of issue will require assessment on a case by case basis. Solutions might include; decommission, modification, introduction or relocation of buffered outfall, or diversion of runoff volumes to or away from the area. In regard to the potential for erosion and similar physical processes, any such issues will become apparent through monitoring relatively rapidly, whereas impacts to ecological sensitivities will become apparent relatively slowly in comparison. It is noted that much of the Site is impacted as part of baseline, (**Section 9.4.6**) in this regard e.g., extensive existing artificial drainage networks.

Prior to commencement of construction, the Environmental Clerk of Works will prepare a register of corrective action and emergency response sub-contractors that can be called upon in the event of an environmental incident, and/or to give training on escalating incident where useful, including e.g., specialist hydrocarbon spill response, specialist hydrological and/or water quality response.

Mitigations measures as outlined in the previous sections will reduce the potential for contamination of waters during the construction phase of The Development, however there remains the risk of accidental spillages and or leaks of contaminants, and excessive loading of surface water mitigation infrastructure.

Emergency responses to potential contamination incidents will be established and form part of the CEMP, **Appendix 2.1**, Management Plan 1. Potential emergencies and respective emergency responses include:

- Hydrocarbon spill or leak – Hydrocarbon contamination incidents will be dealt with immediately as they arise. Hydrocarbon spill kits will be prepared and kept in vehicles associated with the construction phase of The Development. Spill kits will also be established at proposed construction areas, for example, a spill kit will be established and mobilised as part of the turbine erection materials and equipment. Suitable receptacles for hydrocarbon contaminated materials will also be at hand.
- Significant hydrocarbon spill or leak – In the event of a significant hydrocarbon spillage, emergency responses will be escalated accordingly. Escalation will include measures such as installation of temporary sumps, drains or dykes to control the flow or migration of hydrocarbons and contaminated runoff will be contained, managed and pumped to a controlled area in line with Active Management including treatment through a suitably equipped treatment tank and Granular Activate Carbon (GAC) vessels. This process will be managed by the Environmental Clerk of Works (EnvCoW) in conjunction with a preidentified consultant (Environmental Clerk of Works (EnvCoW) specialist register) in regard to effective remediation, treatment and removal of hydrocarbon contaminated water and soils Excavation and appropriate disposal of contaminated soils will be required in this instance.
- If a significant hydrocarbon spillage does occur, the contractor on behalf of the developer will have an approved and certified clean-up consultancy available on 24-hour notice to contain and clean-up the spill. The faster the containment or clean-up starts, the greater the success rate, the lower the damage caused and the lower the cost for the clean-up.
- Cementitious material – Cement / concrete contamination incidents will be dealt with immediately as they arise. Spill kits will also be established at proposed construction areas, for example a spill kit will be established and mobilised as part of the turbine erection materials and equipment. Suitable receptacles for cementitious materials will also be at hand.

In the event of a significant contamination or polluting incident the relevant authorities will be informed immediately.

With reference to **Appendix 8.1**, localised stability issues are to be anticipated. In close proximity to surface water receptors this represents an acute risk to river water with potentially catastrophic impacts to downstream ecological attributes if not managed and isolated sufficiently.

9.9.1.5 *Managing & Reporting Environmental Incidents*

Environmental incidents including accidental spillages on soils (e.g., fuel), breeches of licence limits if applicable (discharge of trade effluent), and significant environmental incidents (e.g., landslide) will be reported to the Local Authority as part of emergency responses to such incidents. Incident notification will be escalated to relevant third parties where relevant e.g., Inland Fisheries Ireland (IFI) if surface water receptors are intercepted.

9.9.1.6 *Construction Phase Residual Impacts*

The residual impact on the surface water receiving environment resulting from the construction phase of the Project is anticipated to be a limited temporary decrease in water quality. A limited temporary decrease in water quality may arise due to a release of suspended solids and sediments to surface waters during excavations at the Site. The potential for release of elevated suspended solids is likely to be exacerbated following heavy rainfall events which occur after sustained dry periods. Any localised reduction in water quality will be mitigated against by the extensive control measures outlined in this chapter and also by natural dilution as distance from the point or diffuse source of contamination increases with distance from the Site.

Mitigation by avoidance and the implementation of physical control measures will ensure that contaminant concentrations, particularly elevated suspended solids entrained in run-off are reduced to below the relevant legislative screening criteria. The overall impact is anticipated to be **direct, negative, imperceptible**, and **temporary**.

Mitigation measures outlined in this report lay down the framework to reduce all potential impact of Project on Hydrological and Hydrogeological receptors. The Mitigated Potential Impacts lay down the achievable benchmarks provided measures are considered and implemented adequately.

9.9.2 Operational Phase

9.9.2.1 Increase in Hydraulic Loading Proposed Mitigation Measures

The principles of the mitigation measures described under **Section 9.6.1.2** (check dams, stilling ponds, attenuation lagoons etc.) are based on the control and management of runoff discharge rates, which ensure the regulating the speed of runoff within the drainage network, buffering the discharge from the drainage network where possible, and maintaining the natural hydrological regime. As such, the measures described with a view to controlling the release of suspended solids also mitigate against the potential for rapid runoff and rapid hydrological responses to rainfall potentially leading to flooding and erosion of the drainage network or downstream of the Wind Farm Development.

The same measures will be implemented with a view to mitigating against net increase surface water runoff arising from the development. For example, the following conceptual model will be applied at a proposed turbine hardstand location:

- Collector drains; allowing for 0.5 m depth, 1.0 m width, presume semi-circular, sectional area; c. 0.4 m^2. Presume 100 m length of collector drain; up to 40 m^3 capacity per 100 m, by 50% allowing for gradient equates to 20 m^3. Collector drains are not intended to store runoff, however the in line attenuation features, such as check dams and flow regulators will serve to reduce discharge rates dramatically, effectively backing up water and regulating the rate of discharge. The actual attenuation capacity of the drainage network and treatment trains will be calculated during the detailed design phase of the development.
- Check dams at regular intervals throughout the drainage network (existing, new clean collector and new dirty collector drains) will attenuate runoff intercepted by respective drainage channels.
- Dirty water collector drains (associated with construction areas) will direct runoff to established stilling ponds. Stilling ponds will reduce the velocity of runoff, further reducing the hydrological response to rainfall.
- Buffered outfalls to vegetated areas will utilise the infiltration capacity of the ground prior to the rejected rainfall eventually being intercepted by the receiving surface water system.
- Clean water collector drains will intercept clean runoff (upgradient of construction areas) and will direct runoff around construction areas. The runoff will be attenuated by means of check dams and intermittent buffered outfalls (**Appendix 9.6 – Tile 7**).

The Project will lead to an increase in impermeable surface area through the construction of hardstand areas within the Site. This in turn will lead to an increase in hydraulic loading by surface water runoff. Preliminary water balance calculations indicate that the worst-case net increase in surface water runoff volumes will be approximately 0.253 m^3/second (or 2.06%) relative to the area of the Site. The potential combined attenuation capacity of the proposed drainage infrastructure, checked dams, stilling ponds, etc. (**Appendix 2.1**) has been designed to attenuate net increase in water runoff during extreme storm events i.e., 1 in 100-year storm event plus a 20% allowance for global warming, as set out in **Appendix 9.1**.

9.9.3 Development Decommissioning and Restoration Phase/s

9.9.3.1 Decommissioning of Infrastructure

As discussed in Section 9.5.7, no new significant effect on the surface water and groundwater receiving environment are anticipated during the Decommissioning phase of the project. The Decommissioning phase of the project, as outlined in **Management Plan 6 -Decommissioning Plan, Appendix 2.1**, details the removal of Site infrastructure such as wind turbine and concrete plinths, removal of permanent met mast and the removal of all associated underground electrical and communications cabling.

The excavation of peat is expected during the Decommissioning phase, but, however, to a far less extent when compared to that of the construction phase. For instance it is proposed the turbine foundations will remain in situ and upon turbine dismantling, redressed with peat. Similarly, the movement of plant, vehicles and equipment is expected to be required during the Decommissioning phase, but to a far less extend than during the construction phase. As a result, there remains a risk of elevated suspended solids being discharged in surface water run-off to the downstream receiving environmental during the decommissioning phase. Additionally, the potential risk remains for spills of fuels hazardous chemicals which is a common risk to all developments. The mitigation measures outlined in this chapter will be implemented during the Decommissioning phase, as well as those outlined in the Decommissioning Plan (**Appendix 2.1**), to reduce the potential for such impacts.

In regard to cable ducting, for the Grid Connection route, it is envisaged cable joint bays will be left in-situ and cabling on site will be removed from the cable bays. The ground above original pulling pits/joint bays will be excavated to access the cable ducts using a mechanical excavator and will be fully re-instated once the cables are removed. Excavated material will be temporarily stored adjacent to the site of excavation at a height of less than 1 m and outside of any surface water buffer zone, and will be removed from the site appropriately for reuse elsewhere on site, reused on another site or disposed of as a waste (through appropriate classification and assessment).

9.9.3.2 Reinstatement of Hardstand Areas

In order to reduce the potential impact of excavating and removing the entirety of the crane hardstand areas, it is proposed that the majority of the stone structure of the individual crane hard- stands will be left in place, with topsoil and or peat being spread on top of the hardstand to form a vegetated surface layer. The top layer of the crane hardstand areas will have the rock/stone dug out and be left to revegetate naturally. Any reinstatement of topsoil and the restoration of vegetation will be kept consistent and compatible with surrounding vegetation, and will be agreed with the Environmental Engineer in advance of commencement. Reinstatement of Turbine Hardstand areas during the Decommissioning phase has the potential to result in soil creep, associated erosion and potential entrainment of elevated suspended solids in surface water run-off. This in turn has the potential to impact on the receiving surface water environment.

- A site specific Decommissioning Pan has also been developed prior to the commencement of any Decommissioning activities.
- Mitigation measures described in this chapter to reduce the potential for run-off of elevated suspended solids will be implemented.
- It is proposed that silt/sediment fences will be implemented along the perimeter of all access tracks and hardstand areas prior to decommissioning works and for the during the reinstatement works.
- Additional precautions such as the implementation of check dams, secured straw bales, sandbags, or settlement ponds should be implemented at areas where surface water runoff is likely to be intercepted by both natural and artificial drainage features.
- Any drains or outfalls which have the potential to draw water from reinstatement areas, or promote preferential surface water runoff flow paths through reinstatement areas will be removed, blocked or decommissioned as deemed required by the Environmental Engineer.
- The mitigation measures for the preparation of the hardstand area surfaces prior to material being deposited discussed in **Chapter 8: Soils and Geology** will be implemented.
- It is proposed that monitoring and maintenance of the reinstated areas will be conducted regularly following the initial stages of establishment to ensure that the potential for excessive surface water runoff eroding deposited material along preferential pathways is minimised.

It is proposed that the Site Access Tracks and associated drainage systems will serve ongoing forestry and agriculture activity in the area.

9.9.3.3 Reinstatement Residual Impacts

It is anticipated that the appropriate reinstatement of redundant hardstand areas will result in a net beneficial impact. This will be achieved through passive continuous improvements at the areas in question. Over time, the reinstated areas will become revegetated and will recover to become similar in appearance to the surroundings of the wider Site. The reinstatement of the Site areas will likely result in enhanced peatland/bog water levels at the Site. This will occur through the reintroduction of permeable layers at former hardstand areas which will in turn promote the filtration of potentially contaminated surface water runoff which may originate from reinstated areas. Therefore, the residual impact of reinstatement at site access tracks and former Turbine Hardstand areas is considered to be a **positive, localised and permanent** impact of the Development. However, it is important to note that reinstatement will be required to be managed similar to the construction phase, including appropriate construction phase mitigation and monitoring.

9.9.3.4 Development Decommissioning and Restoration Phase – Physical Infrastructure

No significant excavations will occur during the decommissioning phase, therefore, no new impacts are anticipated during the decommissioning phase of the Project on the hydrological and hydrogeological environment therefore no additional mitigation measures are required.

Deconstruction works during the Decommissioning phase of the Project pose similar hazards and risks associated with the construction phase but to a far lesser extent, for example, the potential for fuel spills from vehicles is valid but there will likely be less vehicles required. The principle mitigation measures described in this EIAR chapter will be implemented by means of the Decommissioning Plan **Appendix 2.1.**

9.9.4 Cumulative Effects

9.9.4.1 Water Quality

The phasing/commencement of any other permitted developments in the locality (**Appendix 2.2: Wind Farms within 20 km of the Development** and **Appendix 2.4: List of Projects for Cumulative Assessment)** could potentially result in the scenario where a number of other construction sites are in operation at the same time as the Project.

Considering cumulative effects of a range of pressures on the surface water network on a national scale, if an accidental release of contaminants were to occur, there is a potential to temporarily effect surface waterbodies in the catchment. However, the objectives of the outlined mitigation measures in this chapter and in the Flood Risk Assessment

(FRA) (**Appendix 9.1**), are to reduce any potential effect to acceptable levels, and to strive for net gains where possible. Therefore, the Project is not considered likely to significantly contribute to cumulative effects in terms of water quality nor flood risk.

With respect to hydrogeology, and the potential effects of the Project having been assessed as likely being to be minor and temporary, for example; in the event of a minor spill of fuel / hydrocarbons, the spill will be contained and remediated efficiently. Therefore, the development is not likely to contribute significantly to cumulative effects on groundwater quality, but the residual risk even if small in scale is important to consider in the context of the elevated sensitivity and importance of the receptor i.e. groundwater designated as drinking water on a national scale.

With the adequate application and execution of mitigation measures and achievement of mitigation objectives, the Project is not considered to contribute to cumulative surface water or groundwater effects potentially significantly.

In the event of accidental or temporary contamination incidents, water quality in downstream receptors can potentially be adversely impacted, particularly during the construction phase. Such incidents will detected quickly through ongoing monitoring and trigger an emergency response on site and escalation of Active Management on site (**Appendix 9.6 Tiles 7 – 9).** Assuming other, similar developments, construction activities and potential adverse impacts in the area, there is the potential for such incidents to have a cumulative impact on water quality to some degree if such incidents occur on multiple sites in a short period of time and within the same hydrological catchments. However, it must be noted that similar sporadic natured impacts are part of baseline conditions at the site, including, land reclamation, excavation of drainage, commercial forestry, agricultural practices.

Allowing for worst case whereby a contamination incident occurs, the incident will likely be minor and temporary and therefore will unlikely contribute significantly to cumulative effects in the associated surface water network. The risk of a major landslide or mass movement to occur as a function of the Project is generally low (**Appendix 8.1**).

9.9.4.2 Hydraulic Loading

Due to a net increase in impermeable surface at the Site as part of the Project a reduction in recharge to groundwater, and rapid transmission of runoff to surface water systems has the potential to significantly contribute to the cumulative / catchment of adverse impacts imposed on the surface water network in the catchments associated with the Project and the hydrological response to rainfall, (refer to Appendix 2.3 for permitted and operational wind farms within 20 km of the proposed Site). However, considering the pre-existing "Good" WFD status of the surface waters surrounding the Project, and the generally high-quality baseline water quality results outlined in **Section 9.4.8**, the potential for the Project to have adverse cumulative impacts on hydrology is limited to the construction phase. Considering cumulative impacts of pressures on the surface water network, if an accidental release of contaminants were to occur, there is a potential to temporarily impact surface waterbodies in the catchment. However, the objectives of the outlined mitigation measures in this chapter and in the Flood Risk Assessment (FRA), **Appendix 9.1**, are to reduce any potential impact to acceptable levels. Therefore, the Project is not considered likely to significantly contribute to cumulative effects in terms of water quality nor flood risk.

With respect to hydrogeology, and the potential effects of the Project having been assessed as being localised due to the overlying peat, slow recharge rates, high run-off rates and poor yielding underlying groundwater aquifer except for local zones, the Project is not considered to potentially significantly contribute to cumulative effects.

9.10 SUMMARY OF SIGNIFICANT EFFECTS

This chapter comprehensively assesses all scenarios within the Turbine Range which is described in **Section 9.2.1,** and a summary of unmitigated and mitigated impacts are presented in **Table 9.13: Summary of Potential Impacts on receiving environment from the Project in the absence of and with mitigation measures.**

There will be no change to the potential impacts or predicted effects irrespective of which turbine is selected within the Turbine Range because of the design phase mitigation measures which will be implemented prior to construction. All works will be outside of the 65 m buffer from watercourses and 20 m buffer from drains, where possible. Where this is not possible, additional mitigation measures such as increased use of Sustainable Drainage Systems (SuDS), will be implemented. Additionally, all temporary stockpiles will be at no less than 25 m from watercourses. This will be implemented regardless of the volume of excavated materials created as a result of the Turbine Range.

During both the construction and operational phases of the Project, activities will take place at the Site that will have the potential to significantly affect the hydrological regime and surface water quality at the Site or its vicinity. The significant potential impacts that could generally arise during the construction of infrastructure elements including the excavation activities associated with turbine foundations, cable trenches and, and works in close proximity to surface water or drainage network including watercourse crossings and culverts, as well as Operational and Decommissioning phases relate to sediment input from runoff and other pollutants such as hydrocarbons and cementitious substances, with hydrocarbons or chemicals spills to surface waters having the most potential for impact. There will be no change to the potential impacts or predicted effects irrespective of which turbine is selected within the Turbine Range.

This chapter identified the likely hydrological, and hydrogeological impacts of the Project. By summarising relevant guidance and legislation and outlining baseline information, it allowed for the assessment of the potential effects to be identified and their significance rated.

Elements of the design, construction, and operation of the Project that may potentially impact on the hydrogeological and water environment receptors have been identified and their pathways for impacts have been assessed. It has been determined that without mitigation, the Project would likely cause adverse impacts ranging from moderate to profound significance due to the sensitivity of the SAC hydrologically linked to elements of the Project, including the Grid Connection Route.

However, the implementation of mitigation through avoidance principles, pollution control measures, surface water drainage measures and other preventative measures have been incorporated into the Project design in order to minimise potential significant adverse impacts on water quality at the Site. A self-imposed 50 m stream buffer zone will be implemented at the Site which will result in the avoidance of sensitive hydrological features. Direct discharges to surface waters of dewatered loads will not be permitted under any circumstances. This in turn will reduce the potential for adverse impacts on downstream designated Sites. Layout design amendments along with the application of the specified mitigation during each phase of the Project have reduced the potential significance to all receptors related to the Project to **'neutral' or 'positive'**. The Project will not impact upon any surface water or groundwater body as it will not cause a deterioration of the status of the body and/or it will not jeopardise the attainment of a WFD 'Good' status. The Project will not cause it to deteriorate and will not in any way prevent it meeting the biological and chemical characteristics for WFD 'Good' status.

The drainage plan (Surface Water Management Plan) for the Site will be a key method through which sediment runoff arising from construction activities will be reduced and through which runoff rates will be controlled.

Overarching objectives of the CEMP and SWMP will be to adopt and implement Nature Based Solutions including the provision of extensive Sustainable Drainage System (SuDS) features. This approach will be adopted to the extent that mitigating against likely impacts such as net increase in surface water runoff and potential adverse impacts to surface water quality, will overshoot net adverse losses and provide beneficial impacts compared to baseline conditions.

Implementation of the control measures outlined in this EIAR are considered to result in a robust environmental management plan which will target and mitigate likely sources and pathways of contaminant arising at the site, and to actively manage and monitor systems on site to achieve no impact to the receiving surface water network. Short term minor releases are still possible, however with the monitoring and management, any potential issue arising will be addressed immediately and remedied in good time.

The Project as a whole, including the Turbine Delivery Route and Grid Connection Route are not likely to significantly impact groundwater quantities, quality or availability. The principal residual risk to groundwater posed by the Project is the use, storage and transfer of hydrocarbons (fuel) on site for plant equipment. In the unlikely event a spill occurs, the contaminant will be contained, managed and removed in good time.

Preliminary assessments conclude that the likelihood of exacerbating flood risk or behaviours at the site is very low, and the potential to exacerbate impacts on local receptors including dwellings is very low.

Table 9.13: Summary of Potential Impacts on receiving environment from the Project in the absence of and with mitigation measures.

		Qualifying Criteria Pre-Mitigation									Qualifying Criteria With Mitigation	
Effect / Impact Description	Phase	Type	Quality	Scale	Significance	Extent	Context	Probability	Duration / Frequency	Mitigation Applied	Quality	Significance
Earthworks	Construction	Direct and Indirect *	Adverse	Large	Moderate to Profound	Development Footprint	Conforms to baseline e.g. Agri/forestry tracks or operations)	Unavoidable	Temporary	Yes	Adverse	Neutral to Slight
Release of Suspended Solids	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Conforms to baseline e.g. forestry tracks or operations)	Unavoidable	Temporary	Yes	Adverse	Neutral to Slight
Vehicular Movements	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Conforms to baseline e.g. forestry tracks or operations)	Unavoidable	Temporary	Yes	Adverse	Neutral to Slight
Release of Hydrocarbons (SW)	Construction	Direct and Indirect *	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Likely	Permanent but Reversible	Yes	Adverse	Neutral to Slight
Release of Hydrocarbons and Storage (GW)	Construction	Indirect	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Likely	Permanent but Reversible	Yes	Adverse	Neutral to Slight

		Qualifying Criteria Pre-Mitigation									Qualifying Criteria With Mitigation	
Effect / Impact Description	Phase	Type	Quality	Scale	Significance	Extent	Context	Probability	Duration / Frequency	Mitigation Applied	Quality	Significance
Release of Horizontal Directional Drilling Materials	Construction	Direct	Adverse	Small	Slight	Localised (Potentially Regional)	Contrast to Baseline	Likely	Long Term to Permanent	Yes	Adverse	Neutral to Slight
Release of Drill Arisings	Construction	Direct and Indirect *	Adverse	Small	Moderate to Significant	Localised (Potentially Regional)	Contrast to Baseline	Likely	Temporary to Long Term Reversible	Yes	Adverse	Neutral to Slight
Release of Wastewater Sanitation Contaminants	Construction	Direct and Indirect *	Adverse	Small	Moderate to Significant	Localised (Potentially Regional)	Contrast to Baseline	Likely	Temporary to Long Term Reversible	Yes	Adverse	Neutral to Slight
Release of Construction or Cementitious Materials	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Significant	Localised (Potentially Regional)	Contrast to Baseline	Likely	Temporary to Medium Term	Yes	Adverse	Neutral to Slight
Hydrologically Connected Designated Sites	Construction	Indirect	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Conforms to baseline e.g. cumulative upstream impacts	Likely	Temporary to Long-term	Yes	Adverse	Neutral to Slight
Local Groundwater Supplies (Wells)	Construction / Operational	Direct and Indirect *	Adverse	Small	Slight	Localised	Conforms to Baseline e.g. other shallow excavations	Unlikely	Temporary	Yes	Neutral	Neutral

		Qualifying Criteria Pre-Mitigation									Qualifying Criteria With Mitigation	
Effect / Impact Description	Phase	Type	Quality	Scale	Significance	Extent	Context	Probability	Duration / Frequency	Mitigation Applied	Quality	Significance
Groundwater or Bog Water Associated with Wind Farm	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Significant	Localised	Conforms to Baseline e.g. agri / peat drains / forestry drains.	Likely	Permanent / Reversible	Yes	Slight Adverse / Small Beneficial	Slight / Neutral / Beneficial
Groundwater and Surface Water Associated with Grid Connection Cable Works	Construction	Direct and Indirect *	Adverse	Small	Slight	Localised (Potentially Regional)	Conforms to Baseline e.g. public roads and services	Likely	Temporary	Yes	Adverse	Neutral to Slight
Excavation Dewatering & Construction Water	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Likely	Temporary to Permanent	Yes	Adverse	Neutral to Slight
Diversion and Enhancement of Drainage	Construction	Direct and Indirect *	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Conforms to Baseline e.g. Agri / peat drains / forestry drains.	Unavoidable	Permanent	Yes	Adverse	Slight
Watercourse Crossings - Mapped Rivers	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Conforms to Baseline e.g. existing bridges and roads in area.	Unavoidable	Permanent	Yes	Adverse	Slight
Watercourse Crossings - Drainage Features	Construction	Direct and Indirect *	Adverse	Small to Moderate	Moderate to Profound	Localised (Potentially Regional)	Conforms to Baseline e.g. Agri / peat drains / forestry drains.	Unavoidable	Permanent	Yes	Adverse	Slight

		Qualifying Criteria Pre-Mitigation									Qualifying Criteria With Mitigation	
Effect / Impact Description	Phase	Type	Quality	Scale	Significance	Extent	Context	Probability	Duration / Frequency	Mitigation Applied	Quality	Significance
Watercourse Crossings - Grid Connection Route (HDD)	Construction	Direct and Indirect *	Adverse	Small	Moderate to Profound	Localised (Potentially Regional)	Contrast to Baseline	Unavoidable	Permanent	Yes	Adverse	Slight
Increased Hydraulic Loading & Flood Risk	Operational	Direct and Indirect *	Adverse	Small	Slight	Localised (Potentially Regional)	Conforms to Baseline e.g. existing forestry tracks.	Unavoidable	Permanent	Yes	Neutral to Beneficial	Neutral to Beneficial

Note:
*** Includes Indirect / Secondary impacts to receptors downstream of the Project. For example: Contaminants intercepted by surface water features or groundwater bodies can have a potential effect on downstream sensitive receptors or regional groundwater aquifers depending on the environmental circumstances.**

9.11 REFERENCES

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10 AIR QUALITY AND CLIMATE

10.1 INTRODUCTION

This chapter assesses the impacts of the Project (**Figure 1.2**) on air and on climate in Section 10.2 and 10.3 respectively. The Project refers to all elements of the application for the construction of Inchamore Wind Farm (**Chapter 2: Project Description**). Where negative effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment considers the potential effects during the following phases of the Project:

- Construction of the Project;
- Operation of the Project, and
- Decommissioning of the Project.

Common acronyms used throughout this EIAR can be found in **Appendix 1.2.** This chapter of the EIAR is supported by Figures provided in Volume III and by the following Appendix documents provided in Volume IV of this EIAR:

- **Appendix 10.1 Scottish Government – Carbon Calculator Input and Output Data**

10.1.1 Statement of Authority

This chapter has been prepared by Jennings O'Donovan & Partners Limited. It was prepared jointly by Mr. David Kiely and Ms. Sarah Moore, with the assistance of Ms. Shirley Bradley.

Mr. David Kiely has undertaken EISs/ EIARs for wind farms throughout Ireland. He has 39 years' experience in the civil engineering and environmental sector and has obtained a Bachelor of Engineering Degree in Civil Engineering and a Master of Science degree in Environmental Protection. David has overseen the development of over 50 wind farms from feasibility, planning and environmental assessment through to construction including air and climate assessments for other wind farms.

Ms. Sarah Moore is a Senior Environmental Consultant and holds a Bachelor (Hons.) Degree in Environmental Science from University of Limerick and a MSc (Dist) in Environmental Engineering from Queen's University, Belfast. She has worked in environmental consultancy for over fourteen years and has prepared AA Screenings, Environmental Reports and EIARs and air and climate assessments for other wind farms.

Ms. Shirley Bradley is a Graduate Environmental Scientist with a First-Class Honours Degree (BSc. Hons) in Environmental Science from the Institute of Technology, Sligo. She was also awarded with the Governing Body award for a BSc in Environmental Protection. Shirley's key capabilities are in report writing, assisting Senior Consultants and GIS.

10.1.2 Assessment Structure

In line with the revised EIA Directive and current EPA guidelines listed in **Chapter 1, Section 1.6** the structure of this Air and Climate chapter is as follows:

- Assessment Methodology and Significance Criteria;
- Description of baseline conditions at the Site;
- Identification and assessment of impacts to air and climate associated with the Project, during the construction, operational and decommissioning phases of the Project;
- Mitigation measures to avoid or reduce the impacts identified;
- Identification and assessment of residual impact of the Project considering mitigation measures, and
- Identification and assessment of cumulative impacts if and where applicable.

The desktop study as outlined in Section 10.2 and 10.3 together with the other assessments detailed in this chapter are considered adequate to allow the Local Authority to carry out an adequate assessment of the Project.

10.2 AIR QUALITY

10.2.1 Assessment Methodology

This assessment of air quality involved the following:

- A desk study of the air quality baseline in the area of the Project and nationally;
- An evaluation of potential effects;
- An evaluation of the significance of effects, and
- The identification of measures to avoid and mitigate potential effects.

10.2.2 Relevant Legislation and Guidance

The Ambient Air Quality and Clean Air for Europe (CAFE) Directive (Directive 2008/50/EC) incorporates revised provisions for sulphur dioxide (SO_2), lead (Pb), nitrogen dioxide (NO_2), ozone (O_3), particulate matter (PM_{10} and $PM_{2.5}$), benzene (C_6H_6) and carbon monoxide (CO). This replaced the Air Quality Framework Directive (96/62/EC) and first three Daughter Directives (1999/30/EC, 2000/69/EC, 2002/3/EC). The Fourth Daughter Directive (2004/107/EC) will be incorporated into the CAFE Directive at a later date and stands alone as a separate EU Directive.

The Fourth Daughter Directive (2004/107/EC) relates to arsenic (As), cadmium (Cd), nickel (Ni), and mercury (Hg)_and polycyclic aromatic hydrocarbons (PAH) in ambient air and has been transposed into Irish legislation by the 'Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations 2009 (S.I. No. 58 of 2009)'.

The CAFE Directive was transposed into Irish legislation by the Air Quality Standards Regulations 2011 (S.I. No. 180 of 2011) as amended by the Air Quality Standards (Amendments) and Arsenic, Cadmium, Mercury, Nickel and Polycyclic Aromatic Hydrocarbons in Ambient Air Regulations, 2016 (S.I. 659 2016).

The Clean Air for Europe (CAFE) Directive (Directive 2008/50/EC on ambient air quality), (as amended by Directive EU 2015/1480) 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 particulate matter) 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.

The limit values of the CAFE Directive are set out in **Table 10.1.** Limit values are presented in micrograms per cubic metre (µg/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.

Table 10.1: Limit values of CAFE Directive 2008/50/EC (Source: EPA)

Pollutant	Limit Value Objective	Averaging Period	Limit Value (µg/m^3)	Limit Value (ppb)	Basis of Application of Limit Value
Sulphur Dioxide (SO_2)	Protection of human health	1 hour	350	132	Not to be exceeded more than 24 times in a calendar year
Sulphur Dioxide (SO_2)	Protection of human health	24 hours	125	47	Not to be exceeded more than 3 times in a calendar year
Sulphur Dioxide (SO_2)	Protection of vegetation	Calendar Year	20	7.5	Annual mean

Pollutant	Limit Value Objective	Averaging Period	Limit Value (μg/m³)	Limit Value (ppb)	Basis of Application of Limit Value
Sulphur Dioxide (SO_2)	Protection of vegetation	1 Oct to 31 Mar	20	7.5	Winter mean
Nitrogen dioxide (NO_2)	Protection of human health	1 hour	200	105	Not to be exceeded more than 18 times in a calendar year
Nitrogen dioxide (NO_2)	Protection of human health	Calendar year	40	21	Annual mean
Nitric oxide (NO) + Nitrogen dioxide (NO_2)	Protection of ecosystems	Calendar year	30	16	Annual mean
PM_{10}	Protection of human health	24 hours	50	-	Not to be exceeded more than 35 times in a calendar year
PM_{10}	Protection of human health	Calendar year	40	-	Annual mean
$PM_{2.5}$ - Stage 1	Protection of human health	Calendar year	25	-	Annual mean
$PM_{2.5}$ - Stage 2	Protection of human health	Calendar year	20	-	Annual mean
Lead (Pb)	Protection of human health	Calendar year	0.5	-	Annual mean
Carbon Monoxide (CO)	Protection of human health	8 hours	10,000	8620	Not to be exceeded
Benzene (C_6H_6)	Protection of human health	Calendar year	5	1.5	Annual mean

Table 10.2 presents the limit and target values for ozone as per the Ambient Air Quality and Cleaner Air for Europe (CAFÉ) Directive (2008/50/EC).

Table 10.2: Target values for Ozone Defined in Directive 2008/50/EC

Objective	Parameter	Target Value from 2010	Target Value from 2020 onwards
Protection of human health	Maximum daily 8- hour mean	120 µg /m^3 not to be exceeded more than 25 days per calendar year averaged over 3 years	120 µg /m^3
Protection of vegetation	*AOT_{40} calculated from 1 hour values from May to July	18,000 µg /m^3 h^{-1} averaged over 5 years	6,000 µg /m^3 h^{-1}
Information Threshold	1-hour average	180 µg /m^3	180 µg /m^3
Alert Threshold	1-hour average	240 µg /m^3	240 µg /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.

10.2.3 Air Quality & Health

Environmental Protection Agency (EPA, 2020)[1], European Environmental Protection Agency (EEA, 2020)[2] and World Health Organisation (WHO, 2014) reports estimate that poor air quality accounted for premature deaths of approximately 600,000 people in Europe in 2012, with 1,300 Irish deaths predominantly due to fine particulate matter ($PM_{2.5}$) in 2020 and 30 Irish deaths attributable to Ozone (O_3) in 2016[34]. Fine particulate matter, ozone, along with others including carbon dioxide (CO_2), nitrogen oxides (NO_x) and sulphur oxides (SO_x) are produced during the burning of fossil fuels for energy generation, transport or home heating. There are no such emissions associated with the operation of wind turbines. Therefore, the construction of wind turbines such as in the Development will result in lower environmental levels of such parameters, and consequential beneficial effects on human health.

[1] Ireland's Environment – An Integrated Assessment 2020, EPA, 2020, accessed 04th July 2021
[2] EEA (European Environment Agency), 2020b. Air Quality in Europe 2020. EEA Report No. 09/2020. EEA, Copenhagen, accessed 04th July 2021
[3] https://www.euro.who.int/en/health-topics/environment-and-health/air-quality/news/news/2014/03/almost-600-000-deaths-due-to-air-pollution-in-europe-new-who-global-report, [Accessed 19/11/2022
[4] Irelands Environment 2016 – An Assessment', EPA, 2016, [Accessed 19/10/2022]

10.2.4 Air Quality Zones

The EPA has designated four Air Quality Zones for Ireland:

- Zone A: Dublin City and environs
- Zone B: Cork City and environs
- Zone C: 16 urban areas with population greater than 15,000
- Zone D: Remainder of the country

These zones were defined to meet the criteria for air quality monitoring, assessment and management described in the Framework Directive and Daughter Directives. The Development lies within Zone D, which represents rural areas located away from large population centres.

10.2.5 Existing Air Quality Conditions

Generally, Ireland is recognised as having some of the best air quality in Europe. However, from time to time, and under certain weather conditions, it is possible to experience some air pollution in the larger towns and cities. The most recent published report on air quality in Ireland is the 'Air Quality in Ireland 2021' report published by the EPA in 2022[5]. This report provides an overview of the ambient air quality in Ireland in 2020. It is based on monitoring data from 87 stations across Ireland. The measured concentrations are compared with both EU legislative standards and WHO air quality guidelines[6] for a range of air pollutants. The closest monitoring site to the Project within the same air quality zone is Macroom. Macroom was one of nine EU monitoring sites brought online in 2019. Results from the monitoring campaign during 2021 show:

- No levels above the EU limit value (in **Table 10.1**) were recorded at any of the ambient air quality network monitoring sites in Ireland in 2021.
- WHO guideline values were exceeded at a number of monitoring sites for PM_{10}, $PM_{2.5}$, ozone (O_3), NO_2, sulphur dioxide (SO_2) and PAHs.
- The annual mean PM_{10} and $PM_{2.5}$ levels for Macroom were 14 μg/m^3 and 9 μg/m^3 respectively. These values are below the limit values set out by Directive 2008/50/EC as per **Table 10.1**. However, the $PM_{2.5}$ is above the World Health Organization (WHO) guideline[7] of 5 μg/m^3 annual mean for $PM_{2.5}$.

[5] https://www.epa.ie/publications/monitoring--assessment/air/EPA-Air_Quality_in-Ireland-Report_2021_-interactive-pdf.pdf [Accessed 19/11/2022]
[6] https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health [Accessed 19/11/2022]
[7] https://www.who.int/news-room/fact-sheets/detail/ambient-(outdoor)-air-quality-and-health [Accessed 14/11/2022]

10.2.6 Do Nothing Impact

If the Project was not to proceed, the opportunity to reduce emissions of carbon dioxide (CO_2), nitrogen oxides (NO_x), and sulphur dioxide (SO_2) to the atmosphere would be lost due to the continued dependence on electricity derived from coal, oil and gas-fired power stations, rather than renewable energy sources such as the Project. This would result in an indirect, negative impact on air quality.

10.2.7 Potential Impacts of the Project

10.2.7.1 Construction Phase

Dust Emissions

The main potential source of impacts on air quality during construction is dust. There is potential for the generation of dust from excavations and from construction including construction of access roads and hardstands and the trench for the cable ducting for the grid connection.

The potential nuisance issues arising from this are dependent on the terrain, weather conditions, (i.e., dry and windy conditions), and the proximity of receptors. Dust from cement can cause ecological damage if allowed to migrate to water courses, though it is proposed that ready-mix concrete will be used with no on-site batching taking place. Therefore, this will not be a potential source of emissions. Potentially dust generating activities are as follows:

- Earth moving and excavation plant and equipment for handling and storage of soils and subsoils.
- Transport and unloading of stone materials for access track construction.
- Rock that is suitable will be extracted from borrow pit, turbine foundation areas and the sub-station and this will be used in the construction of tracks and hardstands.
- Vehicle movements over dry surfaces such as access tracks and public roads.

The potential impact from dust becoming friable and a nuisance to workers and local road users, if unmitigated, is considered, a slight, negative, short-term, direct impact during the construction phase.

Friable dust cannot remain airborne for a very long time. The distance it can travel depends on the particle sizes, disturbance activities and weather conditions. Larger dust particles tend to travel shorter distances than smaller particles. Particle sizes greater than 30 μm will generally deposit within approximately 100 m of its source, while particles between 10-30 μm travel up to approximately 250-500 m and particle sizes of less than 10 μm can travel up to approximately 1 km [8].

Generally, (depending on the conditions outlined), dust nuisance is most likely to occur at sensitive receptors within approximately 100 m of the source of the dust. It is considered that the principal sites of friable dust generation will be the turbine bases and hardstands, and also along new access roads. All turbines are situated greater than 740 m away from inhabited dwelling houses and therefore these principal sites of dust generation are greater than 100 m distant from these sensitive receptors. In addition, vegetation such as trees and hedgerows in the vicinity will help to mitigate any airborne dust migrating off the Site. Any effects of dust on vegetation will be confined to the construction and possibly the decommissioning phases and be short-term, slight, negative impact.

If unmitigated, there would also be dust deposition arising from mud on public roads, resulting from traffic leaving the construction site. Impacts from dust deposition at sensitive receptors would give rise to nuisance issues for residents of those properties. The impact would be short-term, temporary and slight negative impact on sensitive receptors.

Exhaust Emissions

Emissions from plant and machinery, including trucks, during the construction of the Project are a potential impact. The engines of these machines produce emissions such as carbon dioxide (CO_2), carbon monoxide (CO), Nitrogen Oxides (NO_x), and Particulate Matter (PM_{10} and $PM_{2.5}$).

Particulate Matter ("PM") less than ten micrometres in size (PM_{10}) can penetrate deep into the respiratory system increasing the risk of respiratory and cardiovascular disorders. PM_{10} arises from direct emissions of primary particulate such as black smoke and formation of secondary Particulate Matter in the atmosphere by reactions of gases such as sulphur dioxide (SO_2) and ammonia (NH_3). The main sources of primary PM_{10} are incomplete burning of fossil fuels such as coal, oil and peat and emissions from road traffic, in particular diesel engines. Other sources of particulates include re-suspended dust from roads. Natural Particulate Matter includes sea-salt and organic materials such as pollens.

Nitrogen oxides (NO_x), include the two pollutants, nitric oxide (NO) and nitrogen dioxide (NO_2). Anthropogenic (human) activities such as power-generation plants and motor vehicles are the principal sources of nitrogen oxides through high temperature combustion.

[8] http://www.dustscan.co.uk/Dust-Info/Definitions [Accessed 14/11/2022]

Nitrogen oxides are an important air pollutant by themselves but can also react in the atmosphere to contribute to the formation of tropospheric ozone (ozone in the air we breathe) and acid rain. Short-term exposure to nitrogen dioxide is associated with reduced lung function and airway responsiveness, and increased reactivity to natural allergens. Long-term exposure is associated with increased risk of respiratory infection in children.

The construction phase is likely to result in an increase in exhaust emission from construction vehicles and transport vehicles associated with the site works. The impact on air quality from an increase in exhaust emissions will be a short-term, slight negative impact.

10.2.7.2 Operational Phase

Dust Emissions

There will be a small number of light vehicles accessing the Site during the operational phase. This could lead to some localised dust being generated, though this will be small and sporadic as only approximately one to two site visits per week will occur at the Development. In the unlikely event that a turbine or elements of a turbine need to be replaced during the lifetime of the wind farm, there would be significantly less traffic than during the initial construction phase. There would only be one turbine delivered, compared to five turbines and the Site Access Roads and other site infrastructure will already have been established. Therefore, the operational phase will have an imperceptible negative impact.

10.2.7.3 Decommissioning Phase

Impacts during the decommissioning phase of the Project are anticipated to be less than those arising during the construction phase. The decommissioning phase will be as follows:

- Removal of five wind turbines and concrete plinths.
- Removal of permanent meteorological mast.
- Removal of all associated underground electrical and communications cabling connecting the wind turbines to the wind farm substation. Ducting is to remain *in-situ.*

All other elements of the Project will remain in-situ. The Site Access Roads and associated drainage systems will serve ongoing forestry and agriculture activity in the area. All other hard surfaced areas will be allowed to revegetate naturally.

The decommissioning phase would be expected to last approximately 2-3 months, and any air quality impacts would be predicted to be imperceptible.

10.2.8 Mitigation Measures and Residual Effects

10.2.8.1 Construction Phase Mitigation

The main potential impact during the construction phase of the Project will be from dust nuisance at sensitive receptors close to the Site. Good practice site procedures will be followed by the appointed contractor to prevent dirt and dust being transported onto the local road network. Good practice site control measures will comprise the following:

- Site Access Roads will be upgraded and built in the initial construction phases. These roads will be finished with graded aggregate which compacts, preventing dust.
- Approach roads and construction areas will be cleaned on a regular basis to prevent build-up of mud and prevent it from migrating around the Site and onto the public road network.
- Wheel wash facilities will be provided near the Site entrance to prevent mud/dirt being transferred from the site to the public road network.
- Public roads along the construction haul route will be inspected and cleaned daily. In the unlikely event that dirt/mud is identified on public roads, the roads will be cleaned. The wheel wash facility will be investigated, and the problem fixed to prevent this from happening again.
- During periods of dry and windy weather, there is potential for dust to become friable and cause nuisance to nearby residences and users of the local road network. This requires wetting material and ensuring water is supplied at the correct levels for the duration of the work activity. The weather will be monitored so that the need for damping down activities can be predicted. Water bowsers will be available to spray work areas (wind turbine area and grid connection route) and haul roads to suppress dust migration from the Site.
- Vehicles delivering materials to the site will be covered appropriately when transporting materials that could result in dust, e.g., crushed rock or sand.
- Exhaust emissions from vehicles operating within the site, including trucks, excavators, diesel generators or other plant equipment, will be controlled by the Contractor by ensuring that emissions from vehicles are minimised through regular servicing of machinery.
- All machinery when not in use will be turned off.
- Ready-mix concrete will be delivered to the Site and no batching of concrete will take place on the Site. Only washing out of chutes will take place on site and this will be undertaken at a designated concrete washout facility at the contractor's compound. The concrete wash water will be disposed of at a licensed facility as outlined in the Construction Environment Management Plan (CEMP) – Management Plan 5 Waste Management Plan (**Appendix 2.1**)

- Speed restrictions of 15 km/h on access roads will be implemented to reduce the likelihood of dust becoming airborne. Consideration will be given to how on-site speed limits are policed by the Contractor and referred to in the toolbox talks.
- Stockpiling of materials will be carried out in such a way as to minimise their exposure to wind. Stockpiles will be covered with geotextiles layering and damping down will be carried out when weather conditions require it.
- Earthworks and exposed areas/soil stockpiles will be re-vegetated to stabilise surfaces as soon as practicable.
- An independent, qualified Geotechnical Engineer will be contracted for the detailed design stage of the project and geotechnical services and will be retained throughout the construction phase, including monitoring and supervision of construction activities on a regular basis. The methodology statement will be signed off by a suitably qualified Geotechnical Engineer.
- A complaints procedure will be implemented on site where complaints will be reported, logged and appropriate action taken.

10.2.8.2 Operational Phase Mitigation

As the operation of the proposed wind farm will have positive impacts on air quality, mitigation measures are considered unnecessary. Where turbine components are being replaced the same mitigation measures as per the construction phase will apply.

10.2.8.3 Decommissioning Phase Mitigation

Mitigation measures during the decommissioning phase will be similar to those employed during the construction phase as outlined above.

10.2.9 Cumulative Effects

In terms of cumulative impacts, negative cumulative impacts in relation to air quality would only occur if a large development was located in the vicinity of the Site and in the process of construction at the same time as the Project. The developments considered as part of the cumulative effect assessment are described in **Appendix 2.3** and **Appendix 2.4**. There are a number of existing, consented and proposed wind energy developments within 20 kilometres of the Site as listed in **Appendix 2.3**.

In a worst-case scenario cumulative air impacts may arise if the construction, operational and maintenance period and decommissioning of any of the projects listed in **Appendix 2.3** occur simultaneously with the construction of the Project. The existing and consented wind energy developments within 20 kilometres of the Site as listed in **Appendix 2.3** have been considered for cumulative air quality effects. Only those wind energy developments that would be under construction at the same time as the Project are relevant in the context of cumulative effect.

The consented (not yet built) and the proposed wind energy developments within 20 kilometres of the Site:

- Coolea (consented);
- Coolknoohil Inchee (consented);
- Cummeennabuddoge (proposed);
- Dereenacrinnig (consented);
- Gneeves Milstreet (consented);
- Gortnakilla, Clonkeen Killarney (consented);
- Gortyrahilly (proposed); and
- Knocknamork (consented).

These wind energy developments range from 1.9 km to 14.9 km distance from the Development. Given the distances from the Site, they are not in the direct vicinity of the Development. Even if construction of these wind energy developments was to take place at the same time as construction of the Project, given the distances from the Site, there would not be any cumulative air quality effects.

During the operational phase emissions of carbon dioxide (CO_2), nitrogen oxides (NO_x), and sulphur dioxide (SO_2) or dust emissions from the Development and other projects listed in **Appendix 2.3**, will result from the operation and maintenance vehicles onsite. However, these emissions will be minimal. Therefore, there will be a long-term imperceptible negative cumulative impact on air quality and climate.

Cumulative impacts during the decommissioning phase will be similar to the construction phase although slightly less as a result of the reduced works required during the decommissioning phase as some infrastructure will be left in-situ e.g., Turbine Foundations and the Site Access Roads.

The nature of the Project and other energy developments within 20 kilometres are such that, once operational, they will have a cumulative long-term, significant, positive effect on the air quality.

10.2.10 Residual Impacts of the Project

The use of plant and machinery during the construction phase is not likely to have a significant impact on air quality in the area, both in terms of dust generation and exhaust emissions. Overall, with mitigation in place this impact is assessed as slight/imperceptible, negative, direct and temporary/short-term in nature.

During the operational phase of the Project exhaust emissions will arise from occasional machinery use and Light-Good Vehicles (LGV) that will be required for occasional onsite maintenance works. The impact will be a Long-term imperceptible negative.

However, the wind energy created by the Project will avoid the production of electricity from coal, oil or gas-fired power stations resulting in emission savings of carbon dioxide (CO_2), nitrogen oxides (NO_x), and sulphur dioxide (SO_2). This will lead to a Long-term Significant Positive Impact on air quality.

The decommissioning phase impacts and consequential effects will be similar to the construction stage, albeit of less impact as the works required will be less as described in **Chapter 2: Project Description**. For example, the turbine foundations will remain in-situ and will be covered with earth and reseeded as appropriate. The substation building will also be left in-situ. This means there will be no additional excavation works required for the decommissioning of the turbine foundations and the substation and there will be no additional truck movements that would be required for the demolition and removal of these pieces of infrastructure. The mitigation measures outlined for the construction phase of the Project will be implemented during the decommissioning phase thereby minimising any potential impacts.

10.2.11 Summary of Significant Effects

This assessment has identified no potentially significant effects, given the mitigation measures embedded in the design which will be implemented in the Project.

10.2.12 Statement of Significance

The Project has been assessed as having no significant direct or indirect effects on air quality during the construction, operation or decommissioning phases of the Project.

10.3 CLIMATE AND GREENHOUSE GASES

Greenhouse gases, if released in excessive amounts, can lead to increases in global temperatures known as 'global warming' or the 'greenhouse effect' which can influence the climate.

There are a wide range of gases known as greenhouse gases. The most critical greenhouse gases are carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). There are also other greenhouse gases known as F-Gases, man-made gases used in refrigeration and air conditioning appliances. Greenhouse gases produced by human activities are changing the composition of the earth's atmosphere. Human activities that produce greenhouse gases include:

- Carbon dioxide emissions through burning fossil fuels such as coal, oil and gas and peat
- Methane and nitrous oxide emissions from agriculture
- Emissions through land use changes such as deforestation, reforestation, urbanization, desertification

Current projections indicate that continued emissions of greenhouse gases, including the burning of fossil fuel to produce electricity, will cause further warming and changes to our climate. Climate is predicted to have indirect and direct impacts on Ireland including:

- Rising sea-levels threatening habitable land and particularly coastal infrastructure;
- Extreme weather, including more intense storms and rainfall affecting our land, coastline and seas;
- Further pressure on our water resources and food production systems with associated impacts on fluvial and coastal ecosystems;
- Increased chance and scale of river and coastal flooding;
- Greater political and security instability;
- Displacement of population and climate refugees;
- Heightened risk of the arrival of new pests and diseases;
- Poorer water quality, and
- Changes in the distribution and time of lifecycle events of plant and animal species on land and in the oceans[9]

Climate change means a significant change in the measures of climate, such as temperature, rainfall, or wind, lasting for an extended period – decades or longer. Earth's climate has changed naturally many times during the planet's existence. However, currently

[9] Climate Action Plan 2019 – To Tackle Climate Breakdown, Department of Environment, Climate and Communications, https://www.gov.ie/en/publication/ccb2e0-the-climate-action-plan-2019/, [Accessed 14/11/2022]

human activities are significantly contributing to climate change through greenhouse gas emissions. The global average temperatures have now increased by more than 1°C since pre-industrial times.

At the Paris climate conference (COP21) in 2015, 195 countries adopted the first-ever universal, legally binding global climate deal. The agreement sets out a global action plan to put the world on track to avoid dangerous climate change by limiting global warming to below 2°C above pre-industrial levels and to limit the increase to 1.5°C. Under the agreement, Governments also agreed on the need for global emissions to peak as soon as possible, recognising that this will take longer for developing countries and to undertake rapid reductions thereafter in accordance with the best available science.

The Glasgow Climate Pact (COP26) of 2021 aims to limit the rise in global temperature to 1.5°C and finalise the outstanding elements of the Paris Agreement. The Glasgow Climate Pact is manifested across three United Nations climate treaties, including the United Nations Framework Convention on Climate Change (the COP), the Kyoto Protocol (the CMP), and the Paris Agreement (the CMA).

The United Nations Climate Change Conference (COP27) held in November 2022 resulted in countries delivering a package of decisions that reaffirmed their commitment to limit global temperature rise to 1.5°C above pre-industrial levels. The package also strengthened action by countries to cut greenhouse gas emissions and adapt to the inevitable impacts of climate change, as well as boosting the support of finance, technology and capacity building needed by developing countries. Governments took the ground-breaking decision to establish new funding arrangements, as well as a dedicated fund, to assist developing countries in responding to loss and damage.

The Climate Action Plan 2021 as set out by the Department of the Environment, Climate and Communications provides a detailed plan for Ireland. It plans for taking decisive action to achieve a 51% reduction in overall greenhouse gas emissions by 2030 and setting us on a path to reach net-zero emissions by no later than 2050, as committed to in the Programme for Government and set out in the Climate Act 2021. This Plan makes Ireland one of the most ambitious countries in the world on climate.

The provision of the Project will have a long-term positive impact by providing a sustainable energy source. Should the Project not proceed, fossil fuel power stations will be the primary alternative to provide the required quantities of electricity. This will further contribute to greenhouse gas and other emissions. It will also hinder Ireland in its commitment to meet its target to increase electricity production from renewable sources and to reduce greenhouse gas emissions as agreed at the Paris climate conference (COP21) in 2015 and Glasgow Climate Pact (COP26) in November 2021.

10.3.1 Relevant Legislation and Guidance

Greenhouse gases are the subject of international agreements, such as the United Nations Framework Convention on Climate Change, Kyoto Protocol and the Paris Agreement. The Glasgow Climate Pact is manifested across these three United Nations climate treaties. These agreements along with International and National Policy and Legislation are discussed in the **Planning Statement**. This section will examine the Carbon losses and savings from this Project and its impact on the Climate.

10.3.2 Assessment Methodology

This assessment of climate involved the following:

- A desk study of the climate baseline in the area of the Project and nationally;
- Evaluation of potential effects;
- Evaluation of the significance of effects, and
- Identification of measures to avoid and mitigate potential effects.

10.3.3 Existing Climate

The Köppen climate classification divides regions of the globe based on seasonal precipitation and temperature patterns. The five main groups are tropical, dry, temperate, continental, and polar. The Irish climate is defined as a temperate oceanic climate on the Köppen climate classification system[10]. Ireland's climate is mild, moist and changeable with abundant rainfall and a lack of temperature extremes. The country generally receives cool summers and mild winters and it is considerably warmer than other areas on the same latitude. Ireland's land mass is warmed by the North Atlantic Current all year and as a result does not experience a great annual range of air temperatures.

Nationally, the mean air temperature is generally between 9 and 11 °C. Annual rainfall totals on the west coast generally average between 1,000 mm and 1,400 mm with the wettest months being December and January and April being the driest month. The prevailing wind direction is between south and west. Average wind speed ranges from 3 m/s in south Leinster to 8 m/s in the extreme north of the country.

[10] https://www.britannica.com/science/Koppen-climate-classification/World-distribution-of-major-climatic-types. [Accessed 14/11/2022]

For the purpose of the assessment of changes to the climate, meteorological data from the nearest meteorological station to the Project, Cork Airport monitoring station, over a period of 1991-2021 is shown in **Table 10.3**. Cork Airport is located 51 km south-east of the Project and is the closest Met Éireann climate station.

The mean annual air temperature as shown in **Table 10.3** between 1991 and 2021 was 9.975°C. Mean monthly temperatures ranged from 5.8°C in January to 15.2°C in July. Mean annual rainfall over this period was 1240.7 mm, with a maximum monthly mean rainfall of 136.3 mm in December and a minimum monthly mean rainfall of 82 mm in June[11].

[11] https://www.met.ie/climate/30-year-averages, [Accessed 14/11/2022]

Table 10.3: Cork Airport Meteorological Station Data Averages (1991- 2021)

Month	Mean Air Temperature (°C)	Maximum Air Temperature (°C)	Minimum Air Temperature (°C)	Mean Maximum Temperature (°C)	Mean Minimum Temperature (°C)	Precipitation Amount (mm)	Grass Minimum Temperature (°C)	Mean Wind Speed (knot)	Highest Gust (knot)	Sunshine Duration (hours)
January	5.8	12.2	-1.8	8.3	3.2	130.4	-6.1	10.9	53.9	62.0
February	5.9	12.3	-1.5	8.6	3.1	103.1	-5.7	11.0	51.0	73.9
March	6.9	14.2	-1.1	9.9	3.8	91.1	-5.3	10.5	49.3	109.3
April	8.5	16.6	0.3	12.0	5.1	84.4	-4.3	9.8	45.3	162.0
May	10.9	20.1	2.8	14.5	7.3	83.3	-1.3	9.4	41.1	191.2
June	13.5	22.0	6.0	17.1	9.9	82.0	1.7	8.9	37.6	184.0
July	15.2	22.9	8.0	18.7	11.6	85.5	3.9	8.5	35.7	165.0
August	15.0	22.5	7.9	18.5	11.5	95.2	3.6	8.5	37.8	158.6
September	13.3	20.6	5.9	16.6	10.1	90.7	1.3	8.8	40.0	127.5
October	10.6	16.9	2.9	13.5	7.7	134.3	-1.4	9.7	48.8	99.1
November	7.8	14.1	0.3	10.4	5.2	124.4	-3.8	10.1	48.9	75.1
December	6.3	12.4	-0.9	8.7	3.9	136.3	-4.7	10.9	52.6	54.4

10.3.4 Calculating Carbon Losses and Savings

10.3.4.1 Carbon Calculator

To assess the impact of the Project on the climate, the carbon emitted or saved as a result of the Project was determined using a carbon calculator. The Scottish Government have produced an online carbon calculator which aims to assess, in a comprehensive and consistent way, the carbon impact of wind farm developments. This is done by comparing the carbon costs of wind farm developments with the carbon savings attributable to the wind farm. The carbon calculation takes into account the carbon released from a number of sources during the construction, operational and decommissioning stages. These include the effects of drainage works on peat soils, forestry felling, losses associated with harvesting and transport of felled trees, changes in land use and wind turbine manufacture, transportation and construction. Also included in the assessment tool is the assessment of peat disturbance. The Scottish calculator is used as no carbon calculator specific to Ireland has been developed and the peat habitat of Scotland is similar to Ireland.

Assessments are also carried out to estimate the carbon saving over the lifetime of the wind farm, compared to electricity produced using fossil fuel. The assessment of carbon savings relates to the capacity of the wind farm over the number of years for which it is operational, site improvement works, (i.e., peatland improvement, habitat creation, etc.), forestry felling, and site restoration works, (i.e., removal of infrastructure and restoration of previous site conditions), when the wind farm will be decommissioned.

The completed worksheet, including the assumptions used in the model, is provided in **Appendix 10.1** of this EIAR. The model calculates the total carbon emissions associated with the Project including manufacturing of the turbine technology, transport, construction of the Project and tree felling. The model, which is assessed for both the lower range (5.6 MW) and the higher range (6.6 MW) of turbine, accounts for improvement works (see **Appendix 5.5 Habitat Enhancement Plan**) and the years taken for the site to return to its original characteristics but does not factor in the potential re-use of turbine components. All metal components can be recycled, while there is limited potential for the recycling/reuse of the fibreglass blades.

The model also calculates the carbon savings associated with the Project against three comparators:

i. Coal fired Electricity Generation;
ii. Grid mix of Electricity Generation, and

iii. Fossil fuel mix of Electricity Generation (oil, gas and coal)[12].

This is to compare this renewable source of electricity generation to traditional methods of electricity generation to assess the carbon savings and losses.

10.3.4.2 Carbon Losses

The potential carbon losses were assessed for the Project.

The main CO_2 losses due to the Project are summarised in **Table 10.4**. A copy of the input and output data is provided in the completed worksheet in **Appendix 10.1**.

Table 10.4: Carbon Losses

Origin of Losses	Total CO_2 Losses (tonnes CO_2 equivalent)	
	Lower Range Output	Higher Range Output
Turbine manufacture, construction and decommissioning	25,341	30,013
Losses due to Backup	18,543	21,854
Losses due to reduced carbon fixing potential	731	731
Losses from soil organic matter	14,691	14,691
Losses due to Dissolved Organic Carbon (DOC) and Particulate Organic Carbon (POC) leaching	2,216	2,216
Felling of Forestry	11,074	11,074
Total Expected Losses	72,597	80,580

The worksheet model calculated that the Project is expected to give rise to 72,597 tonnes of CO_2 equivalent losses at the lower range (5.6 MW) and 80,580 tonnes of CO_2 equivalent losses at the higher range (6.6 MW) over its 35-year life. Of this total figure, the proposed wind turbines directly account for tonnes, or 35% at the lower range and tonnes, or 37% at the higher range. Losses due to backup account for 18,543 tonnes, or 25% at the lower range and 21,854 tonnes or 27% at the higher range.

[12] Ireland's energy imports comprise oil (56%), gas (31%) and coal (10%). http://ireland2050.ie/present/oil-and-gas/?q=where-does-ireland-get-its-electricity#:~:text=Ireland%20has%20only%20small%20proven,%25)%20and%20coal%20(10%25, [Accessed 14/11/22]

Losses from soil organic matter, reduced carbon fixing potential, DOC and POC leaching and the felling of forestry accounting for the remaining 39% or 28,712 tonnes at the lower range and 36% or 28,712 tonnes at the higher range. The figure tonnes of CO_2 arising from ground activities associated with the Project is calculated based on the entire Project footprint being "Acid Bog", as this is one of only two choices, the other being Fen. The habitat that will be impacted by the Project footprint comprises predominantly agricultural land and commercial forestry rather than the acid bog assumed by the model that gives rise to the tonnes (lower and higher range) and therefore the actual CO_2 losses are expected to be lower than this value.

The figures discussed above are based on the assumption that the hydrology of the Site and habitats within the site are not restored on decommissioning after its expected 35-year useful life. However, at the end of the 35-year lifespan of the Project, the turbines may be replaced with newer models subject to a consent for the same being obtained. This would mean the carbon losses associated with not restoring the habitats hydrology at the Site would be offset by the carbon-neutral energy that the new turbines would generate.

10.3.4.3 Carbon Savings

The carbon calculator assessed the carbon savings of the Project for habitat improvement works as 5,709 tonnes of CO_2 per year at the higher and lower range. However, the carbon calculator is pre-loaded with information specific to the CO_2 emissions from the United Kingdom's electricity generation plant, which is used to calculate emissions savings from proposed wind farm projects in the UK and similar data was not available for the Irish electricity generation plant. Therefore, these CO_2 emissions savings from the Project were calculated separately from the worksheet.

According to the model described above, the Project will give rise to total losses of 72,597 tonnes (lower range) or 80,580 tonnes (higher range) of carbon dioxide.

A simple formula is used to calculate carbon dioxide emissions reductions resulting from the generation of electricity from wind power rather than from carbon-based fuels such as peat, coal, gas and oil.

The formula is:

$$CO_2 \text{ (in tonnes)} = \frac{(A \times B \times C \times D)}{1000}$$

where:

A = The maximum capacity of the wind energy development in MW

B = The capacity or load factor, which takes into account the availability of wind turbines and array losses etc.

C = The number of hours in a year

D = Carbon load in grams per kWh (kilowatt hour) of electricity generated and distributed via the national grid.

For the purposes of this calculation, the rated capacity of the Project is assumed to be approximately 28 MW at the lower range and 33 MW at the higher range. A load factor of 0.35 (or 35%) has been used for the Project.

There has been a strong reduction in the CO_2 emissions intensity of electricity generation, especially after 2016, with intensity falling below 300 g CO_2/kWh for the first time in 2020. It is now less than a third of its 1990 value[13]. These falls are due to increased use of higher-efficiency gas turbines, increased electricity generated from zero-carbon renewable sources, especially wind. The most recent data for the carbon load of electricity generated in Ireland is for 2021 and was published in Sustainable Energy Authority Ireland's (SEAI) December 2022 report, Energy in Ireland. The emission factor for electricity in Ireland in 2021 was 348 g CO_2/kWh. The number of hours in a year is 8,760.

[13] Energy-Related CO_2 Emissions in Ireland 2020 Companion Note to 2020 National Energy Balance October 2021, Sustainable Energy Authority of Ireland
Online: https://www.seai.ie/publications/Energy-CO2-emissions-2020-Short-Note-FINAL.pdf [Accessed 14/11/2022]

The calculation for carbon savings at the lower range and higher range are therefore as follows:

$$CO_2 \text{ (in tonnes)} = \frac{(28 \times 0.35 \times 8{,}760 \times 348)}{1000}$$

= 29,875 tonnes per annum at the lower range

$$CO_2 \text{ (in tonnes)} = \frac{(33 \times 0.35 \times 8{,}760 \times 348)}{1000}$$

= 35,210 tonnes per annum at the higher range

Based on this calculation, approximately 29,875 (lower range) or 35,210 (higher range) tonnes of carbon dioxide will be displaced per annum from the largely carbon-based traditional energy mix by the Development.

Therefore, including the carbon savings for the habitat improvements works 5,709 tonnes (lower range) and 5,709 tonnes (higher range) it is estimated that 1,051,334 tonnes (lower range) or 1,238,059 tonnes (higher range) of carbon dioxide will be displaced over the proposed 35 year lifetime of the wind farm.

The Scottish Government carbon calculator as presented above calculated 72,597 (lower range) and 80,580 (higher range) tonnes of CO_2 will be lost to the atmosphere due to changes in the peat environment and due to the construction and operation of the Project. This represents 7% (lower range) and 7% (higher range) of the total amount of carbon dioxide emissions that will be offset by the Project. The 72,597 (lower range) and 80,580 (higher range) tonnes of CO_2 that will be lost to the atmosphere due to changes in the peat environment and due to the construction and operation of the Project will be offset by the Project in approximately 29 months of operation at the lower range and 27 months of operation at the higher range.

10.3.5 Do Nothing Impact

If the Project was not to proceed, greenhouse gas emissions, e.g., carbon dioxide, carbon monoxide and nitrogen oxides associated with construction and decommissioning works would not arise. However, the greenhouse gas savings that would arise from the operation of the Project would also be lost leading to a long-term, moderate, negative impact.

10.3.6 Potential Impacts of the Project

10.3.6.1 Construction Phase

Greenhouse gas emissions, e.g., carbon dioxide (CO_2), carbon monoxide (CO) and nitrogen oxides (NO_x) are associated with vehicles and plant utilised for construction activities. This potential impact will be slight, given the insignificant quantity of greenhouse gases that will be emitted, and will be restricted to the duration of the construction phase. Therefore, this is a short-term, slight, negative impact. Mitigation measures to reduce this impact are outlined in **Section 10.2.9**.

10.3.6.2 Operation Phase

The Project is a renewable energy project in that it will generate electricity from a renewable source. This energy generated will be in direct contrast to traditional energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a positive impact on the climate. The Project will displace carbon dioxide from fossil fuel-based electricity generation, over the proposed 35-year lifespan of the Project. The Project will assist in reducing carbon dioxide (CO_2) emissions (30,038 tonnes per annum at the lower range or 35,373 tonnes per annum at the higher range) that would otherwise arise if the same energy that the Project will generate were otherwise to be generated by conventional fossil fuel plants. This is a long-term, moderate, positive effect on the climate.

10.3.6.3 Decommissioning Phase

Any impacts that occur during the decommissioning phase are similar to that which occur during the construction phase. The mitigation measures prescribed for the construction phase of the Project will be implemented during the decommissioning phase thereby minimising any potential impacts.

10.3.7 Mitigation Measures

It is considered that the Project will have an overall positive impact in terms of carbon reduction and climate.

The Project will assist Ireland in meeting a 51% reduction in overall greenhouse gas emissions by 2030. Also, it will aid in increasing the onshore wind capacity, as per the Climate Action Plan 2023 (CAP2023). The CAP 2023 commits Ireland to installing up to 9 GW of onshore wind capacity by 2030, in order to support the reduction in Ireland's greenhouse gas emissions.

10.3.7.1 Construction Phase

All construction vehicles and plant will be maintained in good operational order while onsite, thereby minimising any emissions that arise.

10.3.7.2 Operation Phase

The operation phase of the Project will have a positive impact on the climate due to the displacement of fossil fuels and therefore no mitigation is necessary for this phase.

10.3.7.3 Decommissioning Phase

Mitigation measures during the decommissioning phase will be similar to those employed during the construction phase as outlined above.

10.3.8 Cumulative Effects

Potential cumulative effects on the climate between the Project and other developments in the vicinity were also considered as part of this assessment. The other developments considered as part of the cumulative effects assessment are described in **Appendix 2.4.**

During the construction phase of the Project and other developments within 20 kilometres of the proposed turbines that are yet to be constructed, there will be minor exhaust emissions from construction plant and machinery and dust emissions from construction activities. In a worst-case scenario if any of these developments were constructed at the same time as this Project there will be short-term slight negative cumulative impact on climate due to exhaust and dust emissions.

The nature of the Project is such that, once operational, it will have a long-term, moderate, positive impact on the air climate. It is considered that the cumulative impact will be positive in terms of carbon reduction and the climate also.

During the operational phase emissions of carbon dioxide (CO_2), nitrogen oxides (NO_x), and sulphur dioxide (SO_2) or dust emissions from the Project and other projects listed in **Appendix 2.2** and **Appendix 2.4**, will result from the operation and maintenance vehicles onsite. However, these emissions will be minimal. Therefore, there will be a long-term imperceptible negative cumulative impact on the climate.

Cumulative impacts during the decommissioning phase will be similar to the construction phase although slightly less as a result of the reduced works required during the decommissioning phase as some infrastructure will be left in-situ e.g., turbine foundations and the site roads.

The nature of the Project and other energy developments within 20 kilometres are such that, once operational, they will have a cumulative long-term, significant, positive effect on climate.

10.3.9 Residual Impacts of the Project

10.3.9.1 Construction Phase

There will be a short-term imperceptible negative impact on Climate as a result of greenhouse gas emissions.

10.3.9.2 Operational Phase

There will be a long-term, moderate, positive impact on Climate as a result of reduced greenhouse gas emissions.

10.3.9.3 Decommissioning Phase

Any impacts and consequential effects that occur during the decommissioning phase are similar to that which occur during the construction phase, albeit of less impact. For example, turbine foundations and site roads will be left in-situ. No forest felling will take place during the decommissioning phase.

10.3.10 Summary of Significant Effects

This assessment has identified no potential significant effects, given the mitigation measures embedded in the design and recommended for the implementation of the Project.

10.3.11 Statement of Significance

It is estimated that 1,051,334 tonnes (lower range) or 1,238,059 tonnes (higher range) of carbon dioxide will be displaced over the proposed 35-year lifetime of the wind farm. The Project has been assessed as having the potential to result in a short-term imperceptible, negative impact on Climate during construction. There will be long-term moderate, positive impact on Climate as a result of reduced greenhouse gas emission during the operational phase.

Potential cumulative impact of the Project with other energy developments including wind and solar within 20 kilometres on climate was assessed as having a long-term, significant, positive impact on the Climate.

11 NOISE AND VIBRATION

11.1 INTRODUCTION

This chapter of the EIAR assesses the effects of the Project in terms of noise and vibration impacts. The Project refers to all elements of the Development, the Grid Connection Route and the Turbine Delivery Route (see **Chapter 2: Project Description**).

The assessment will consider the potential effects during the following phases of the Development:

- Construction of the Project;
- Operation of the Project, and
- Decommissioning of the Project.

Any effects arising as a result of the future decommissioning of the Project, are considered to be no greater than the effects arising during construction.

Common acronyms used throughout this EIAR can be found in **Appendix 1.2.** This chapter of the EIAR is supported by the **Figures 1, 2 and 3** in **Volume III** and the following Appendices documents provided in Volume IV of this EIAR:

- **Appendix 11.1**: Photos of noise monitors in-situ
- **Appendix 11.2**: Methodology for calculating wind shear from different hub heights, calculating to hub height and standardising to 10 m height wind speed
- **Appendix 11.3**: Calibration certificates of noise instruments
- **Appendix 11.4**: Candidate turbine manufacturer's noise emission data
- **Appendix 11.5**: Predicted noise levels for 102.5 m hub height

11.1.1 Statement of Authority

This section of the EIAR has been prepared by Brendan O'Reilly of Noise and Vibration Consultants Ltd and Shane Carr of Irwin Carr Ltd. Brendan has a Master's degree in noise and vibration from Liverpool University and over 40 years' experience in noise and vibration control (including many years' experience in preparation of noise impact statements) and has been a member of a number of professional organisations including the SFA, ISEE and IMQS. Brendan was an associate consultant in the EPA, 2003 'Environmental Quality Objectives, Noise in Quiet Areas'. Brendan has considerable experience in the assessment of noise impact and has compiled studies for more than 100 wind farm developments. Brendan carried out the baseline study and contributed to the report.

Irwin Carr Consulting is based in Northern Ireland. The company has a proven track record in noise impact assessments throughout the UK and Ireland, with extensive knowledge of the issues in relation to noise from wind energy developments.

Shane Carr carried out the noise modelling in this assessment and contributed to the report. Shane is a Director in Irwin Carr Consulting, primarily responsible for environmental noise and noise modelling. He has over 25 years' experience working in both the public and private sectors having previously obtained a BSc (Hons) Degree in Environmental Health and a Post-Graduate Diploma in Acoustics. Shane has been responsible for undertaking and reviewing noise impact assessments on numerous large scale wind farms throughout the UK and Ireland.

11.1.2 Assessment Structure

This Chapter contains the following sections:

- Assessment Methodology and Significance Criteria – a description of the methods used in the baseline surveys and in the assessment of the significance of effects.
- Baseline Description - a description of the noise baseline of the receiving environment based on the results of surveys, desk information and consultations, and a summary of any information required for the assessment that could not be obtained.
- Assessment of Potential Effects - identifying the ways in which noise receptors could be affected by the Project, including a summary of the measures taken during design to minimise noise and vibration effects.
- Mitigation Measures and Residual Effects - a description of measures recommended to off-set potential negative effects and a summary of the significance of the effects of the project after mitigation measures have been implemented.
- Cumulative Effects – identifying the potential for effects of the EIA Development to combine with those from other wind farm developments.
- Summary of Significant Effects.
- Statement of Significance.

11.1.3 Acoustic Terminology

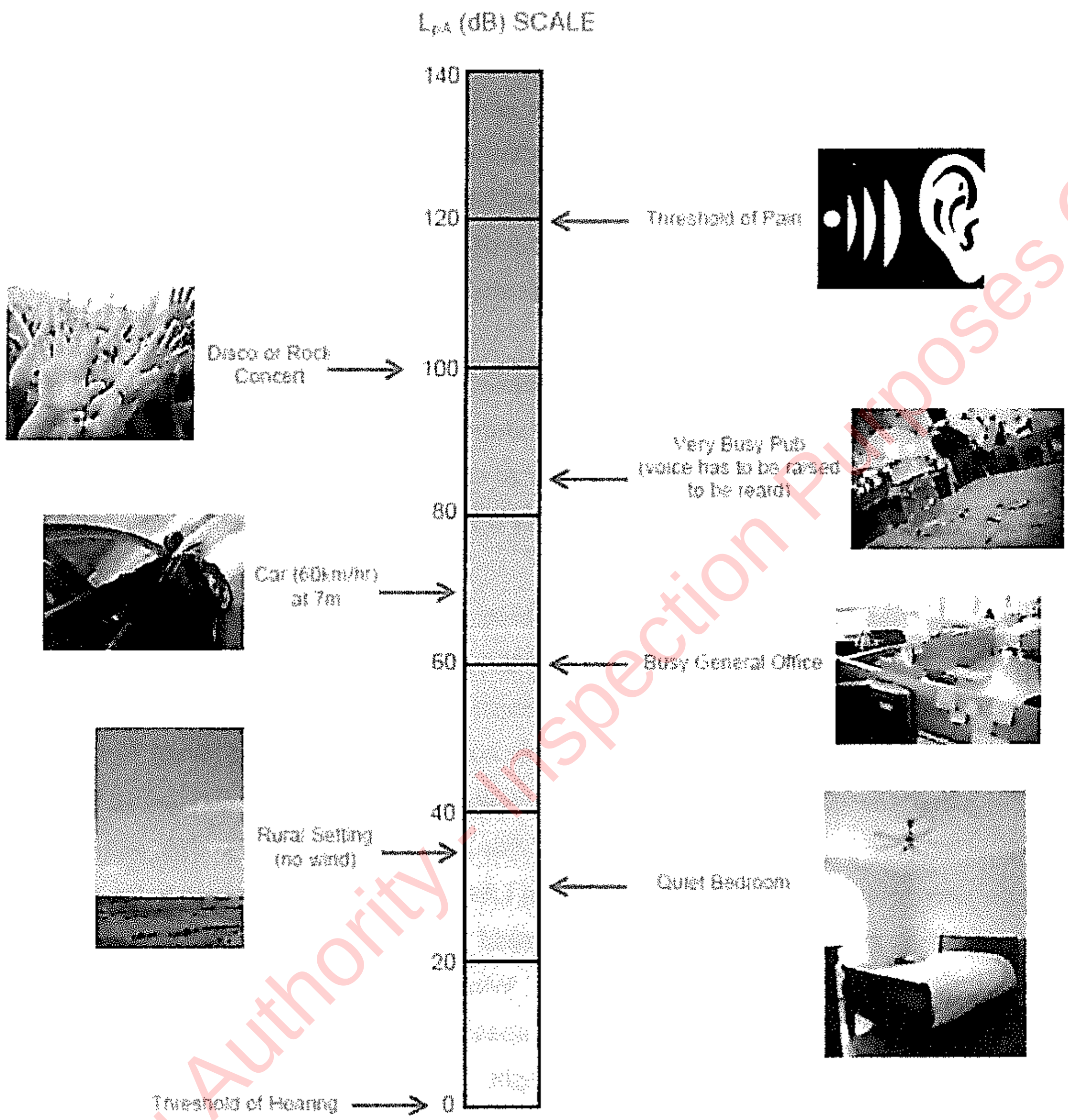
Sound is simply the pressure oscillations that reach our ears. These are characterised by their amplitude, measured in decibels (dB), and their frequency, measured in Hertz (Hz). Noise is unwanted or undesirable sound, it does not accumulate in the environment, is transitory, fluctuates, and is normally localised. Environmental noise is normally assessed in terms of A-weighted decibels, dB (A), when the 'A weighted' filter in the measuring device elicits a response which provides a good correlation with the human ear. The criteria for environmental noise control are of annoyance or nuisance rather than damage. In general, a noise level is liable to provoke a complaint whenever its level exceeds by a certain margin, the pre-existing noise level or when it attains an absolute level. A change in noise level of 3 dB (A) is 'barely perceptible', while an increase in noise level of 10 dB (A) is perceived as a twofold increase in loudness. A noise level in excess of 85 dB (A) gives a significant risk of hearing damage. Construction and industrial noise sources are normally assessed and expressed using equivalent continuous levels, LAeq[1]. Wind turbine source noise is generally expressed in Leq dBA in sound power levels (L_{WA} dB).

Sound Power Level (L_{WA} dB) is a measure of the acoustic energy emitted from a source of noise, expressed in decibels. Sound power level refers to the source and sound pressure level is measured by a sound level meter at a distance from a source. Sound power is distance independent, whereas sound pressure is the distance-dependent effect.

Operational wind turbine noise is assessed using the LA90[2] descriptor, which allows reliable measurements to be made without corruption from relatively loud transitory noise events from other sources. The LA90 should be used for assessing both the wind energy development noise and background noise as stated in the Wind Energy Development Guidelines, Guidelines for Planning Authorities June 2006. As discussed in ETSU-R-97[3] the LA90 is 1.5-2.5dBA less than the LAeq measured over the same period. In this assessment, the difference between LAeq and LA90 is assumed to be 2dBA, which is the value most commonly applied in wind farm assessments and is accepted under best practice guidelines (Section 11.4). Wind turbine noise levels are given as sound power levels (LWA) in dB at integer wind speeds up to maximum LWA levels which is no more than 10 m/s wind speed at 10 m height. The EPA gives a dBA scale and indicative noise levels, (EPA 2016[4]). The L_{PA} (dB) scale denotes sound pressure level in dBA. **Table 11.1** gives L_{PA} (dB) scale and indicative noise levels.

[1] L_{Aeq} is defined as being the A-weighted equivalent continuous steady sound level that has the same sound energy as the real fluctuating sound during the sample period and effectively represents a type of average value.
[2] LA90, or L90dBA is defined as the noise level equaled or exceeded for 90% of the measurement interval and with wind farm noise the interval used is 10 minutes.
[3] ETSU-R-97, The Assessment & Rating of Noise from Wind Farms, June 1996
[4] EPA Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4)

Table 11.1: L_{PA} (dB) scale and indicative noise levels



11.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

11.2.1 Assessment Methodology

This assessment has involved the following elements, further details of which are provided in the following sections:

- Legislation and guidance review
- Desk study, including review of available maps and published information
- Field work;
- Description of effects for construction, operation and decommissioning phases;

11.3 DESCRIPTION OF EFFECTS

The significance of effects of the Project is described in accordance with the EPA guidance document '*Guidelines on the information to be contained in the Environmental Impact Assessment Reports (EIAR), EPA May 2022*'. The details of the methodology for describing the significance of effects are provided in Table 3.4: Section 3.7.3 of the EPA 2022 document.

11.4 RELEVANT LEGISLATION AND GUIDANCE REVIEW

The noise assessment is carried out in accordance with the guidance and consideration of the following documents, with references given where relevant in the various Sections of the report:

- Wind Energy Development Guidelines[5] (the 2006 Guidelines);
- ETSU-R-97[6]: The Assessment & Rating of Noise from Wind Farms (ETSU-R-97);
- The Institute of Acoustics (IOA) Good Practice Guide (GPG) to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise including Supplementary Guidance Note 4: Wind Shear'[7] (the IOA GPG);
- ISO 1996[8]Acoustics-Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures (ISO 1996);
- WHO 2018 Environmental Noise Guidelines for European Region (WHO 2018).
- Draft Revised Wind Energy Development Guidelines December 2019 (DRWEDG, 2019);
- National Roads Authority (NRA) Guidelines for Treatment of Noise and Vibration in National Road Schemes, 2004.

A discussion on interrelationship between the Wind Energy Development Guidelines 2006, the WHO 2018 document and the Draft Revised Wind Energy Development Guidelines December 2019, is provided below.

11.4.1 Wind Energy Development Guidelines 2006

The following are a number of key extracts from the 2006 Guidelines in relation to noise impact:

[5] Department of Environment, Heritage and Local Government: Wind Energy Development Guidelines, Guidelines for Planning Authorities 2006 Energy
[6] ETSU-R-97: Acoustics-The Assessment & Rating of Noise from Wind Farms: ETSU for the DTI, UK, 1996
[7] Institute of Acoustics (2013) A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise
[8] ISO 1996/1- Acoustics-Description and Measurement of Environmental Noise - Part 1: Basic Quantities and Procedures

General Noise Impact

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

"Separate noise limits should apply for day-time and for night-time"

"Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed."

Measurement Units

"The descriptor [LA90 10min] which allows reliable measurements to be made without corruption from relatively loud transitory noise events from other sources, should be used for assessing both wind energy development noise and background noise."

Specific Noise Limits

"Noise limits should be applied to external locations and should reflect the variation in both turbine source noise and background noise with wind speed."

"In general, a lower fixed limit of 45 dB(A) or a maximum increase of 5 dB(A) above background noise at nearby noise sensitive locations is considered appropriate to provide protection to wind energy development neighbours.

However, in very quiet areas, the use of the margin of 5 dB(A) above the background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments. Instead in low noise environments where background noise is less than 30 dB(A), it is recommended that the daytime level of LA90,10min of the wind energy development noise should be limited to an absolute level within the range 35-40 dB(A)".

"During the night the protection of external amenity becomes less important and the emphasis should be on preventing sleep disturbance. A fixed limit of 43 dB(A) L90,10min which will protect sleep inside properties during the night"

The 2006 Guidelines do not specify daytime or night-time hours. However, it is considered good practice to follow the framework given in ETSU-R-97 and IOA Good Practice Guide where daytime and night-time hours are specified. The limits are based on the prevailing background noise level for 'quiet daytime' periods, defined in ETSU-R-97 as:

- Quiet waking hours or quiet day-time periods are defined as:
- All evenings from 18:00 to 23:00hrs
- Saturday afternoon from 13:00 to 18:00hrs and all-day Sunday 07:00 to 18:00hrs
- Night-time is defined as 23:00 to 07:00hrs

Recent An Bord Plenala Decision (September 2022, ABP-309306-21) has included an additional limit of *40 dB(A) L90,10min for wind speeds of less than 5 m/s at 10 m height.*

11.4.2 WHO 2018

The most recent WHO 2018 Guidelines: 'Environmental Noise Guidelines for the European Region' gives a conditional recommendation requiring substantial debate with a limit of 45 dB Lden which is based on low quality evidence. This is an annual average noise level, based on wind speed and direction in the vicinity of the SiteS with no specific limits for night.

11.4.3 DRWEDG 2019

Draft Revised Wind Energy Development Guidelines December 2019 (DRWEDG 2019)

There have been a number of draft guidelines over the years with the latest one being the *Draft Revised Wind Energy Guidelines December 2019.* These guidelines are currently subjectsubject to review and are liable to change. This assessment is based on the current guidance and best practice outlined in **Section 11.4.1.**

11.5 DESKTOP STUDY

The Study Area has been defined such that the predicted noise results have been included for all the residential receptors within 2 km of the wind farm. Where the noise levels meet the relevant noise limits at the nearest locations, it will also meet the relevant noise limits at more distant residential locations. On this basis four locations for noise monitoring were selected by inspection of site maps and by identifying the nearest receptors surrounding the wind turbines. The validation of selected locations was made with a visit to the Noise Study Area. The locations selected are considered representative of the local noise environment and are as shown in **Figure 11.1.**

11.6 ACQUISITION AND ANALYSIS OF BACKGROUND NOISE DATA

The 2006 Guidelines, ETSU-R-97 and the IOA Good Practice Guide recommend the measurement and use of wind speed data, against which background noise measurements are correlated. The IOA Good Practice Guide Supplementary Guidance Note 4[9] (**Appendix 11.2**) gives the methodology to account for wind shear, calculation to hub height and to standardise 10 m height wind speed.

A wind meteorological mast centrally located within the Site during the noise survey was used for wind data measurements at hub heights of 80 m and 110 m with wind shear derived

[9] IOA, A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise- Supplementary Guidance Note 4: Wind Shear

and used to calculate the proposed hub height wind speeds of 110.5 m and 102.5 m (refer to **Appendix 11.5** for prediction using a 102.5 m hub height). The derived charts provided analysis of the baseline noise data which was carried out using the 110.5 m hub height.

For each 10-minute interval the mean wind speed was calculated to the 110.5 m hub height using a specified procedure which takes account of wind shear, with the result then standardised to 10 m height wind speed. A plot of standardised wind speed is made against background noise levels acquired in the noise survey to derive a best-fit polynomial line /curve. From this polynomial line / curve noise levels are derived for integer wind speeds between 3 and 12 m/s.

The procedures to calculate wind shear hub height wind speed and to calculate standardised 10 m height wind speed is undertaken according to the method given in the Supplementary Guidance Note 4[10].

11.7 PREDICTION OF WIND TURBINE NOISE LEVELS

The predicted noise levels are based on the methodology given in the IOA Good Practice Guide. Noise level calculations are based on ISO 9613-2[11] which provides a prediction of noise levels likely to occur under worst-case down-wind conditions.

SoundPLAN version 8.2 software package, produced by Braunstein & Berndt GmbH was used to calculate the noise level at the receptors. The propagation model calculates the predicted sound pressure levels by taking the source sound power level for each turbine in their respective octave bands and subtracting a number of attenuation factors according to the following formulae:

Predicted Octave Band Noise level = $LW + D - (A_{geo} + A_{atm} + A_{gr} + A_{br} + A_{mis})$

The predicted octaves from each of the turbines are summed to give the predicted noise level expressed as dBA.

No allowance has been made for the character of noise emitted by the turbines, however in general the emissions from wind turbines are broadband in nature. In the unlikely event of a turbine exhibiting clearly tonal components at any receptor, the turbine will be turned down or stopped until such tonality is ameliorated. A guarantee will be sought in the procurements

[10] IOA, A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise- Supplementary Guidance Note 4: Wind Shear

[11] ISO 9613-2 Acoustics -Attenuation of sound during propagation outdoors, Part 2: General Method of Calculation

of the turbine to be used onsite, stating that there will be no clearly tonal or impulsive components audible at any noise sensitive receptor location.

A_{geo} –Geometric Spreading

Geometric (spherical) spreading from a simple free-field point source result in attenuation over distance according to:

$Lp = Lw - (20 \log R + 11)$

Where:

Lp = sound pressure level

Lw = sound power level

R = distance from the turbine to receiver

D – Directivity Factor

The directivity factor allows for adjustment where the sound radiated in the direction of the receptor is higher than that for which the sound power level is specified. In this case, the sound power levels are predicted as worst case propagation conditions, i.e. all receptors are assumed to be in downwind conditions.

A_{gr} - Ground Effects

Ground effect is the result of sound reflected by the ground interfering with the sound propagating directly from the turbine to receiver. The prediction of ground effects is complex and depends on the source height, receiver height, propagation height between the source and receiver and the intervening ground conditions.

Ground conditions are described according to a variable defined as G, which varies between 0 for hard ground and 1 for soft ground. Although in reality the ground is predominately porous, it has been modelled as mixed 50% hard and 50% porous corresponding to a ground absorption coefficient of 0.5. Our predictions have been carried out using a source height corresponding to the proposed height of the turbine nacelle, a receiver height of 4 m and an assumed ground factor of G=0.5 as recommended in the IOA Good Practice Guide.

A_{bar}- Barrier Attenuation

The effect of a barrier (including a natural barrier) between a noise source and receptor is that noise will be reduced according to the path difference (difference between the direct distance between source to receptor and distance between source and receptor over the barrier). The reduction is relative to the frequency spectrum of the sound and may be predicted according to the method given in ISO 9613. In practice, barriers can become less effective in downwind conditions. A barrier can be very effective when it lies within a few metres of the receptor. In the prediction model, zero attenuation is given for barrier effects, which is a worst-case scenario setting.

A_{atm} - Atmospheric Absorption

Sound emergency through the atmosphere is attenuated by conversion of sound energy to heat. This energy is dependent on the temperature and relative humidity of the air, but only weakly on ambient pressure through which the sound is travelling and is frequency dependent with increasing attenuation towards higher frequencies. The attenuation by atmospheric absorption A_{atm} in decibels during propagation through distance in metres is given by:

$A_{atm} = d \times \alpha$,

α = atmospheric absorption coefficient in dBm^{-1}

d = distance from turbine

Values of α from ISO 9613 Part 1, corresponding to a temperature of 10^0C and a relative humidity of 70% has been used for these predictions and are given in **Table 11.2** below. These values are recommended in the IOA Good Practice Guide.

Table 11.2: Frequency dependent atmospheric attenuation coefficients (dB/m)

Octave Band Centre Frequency (Hz)	63	125	250	500	1k	2k	4k	8k
Atmospheric Absorption Coefficient (dB/m)	0.0001	0.0004	0.001	0.0019	0.0037	0.0097	0.0328	0.117

A_{misc} – Miscellaneous Other Effects

ISO 9613 includes effects of propagation through foliage, industrial plants and housing as additional attenuation effects. These have not been included here and any such effects are unlikely to significantly reduce noise levels below those predicted.

The ISO 9613-2 standard calculates under downwind propagation conditions and therefore predicts the average downwind sound pressure level at each dwelling. The model assumes that the wind is directly downwind from each turbine to each dwelling. The prediction model is calculated as a worst-case scenario.

The predicted noise levels $L_{Aeq\ 10min}$ are converted to the required $L_{A90,10min}$ by subtracting 2 dBA.

11.8 AERODYNAMIC MODULATION OR AERODYNAMIC NOISE

Aerodynamic noise originates from the flow of air over, under and around the blades and is generally broadband in character. It is directly linked to the movement of the rotors through the air and will occur to varying degrees whenever the turbine blades move. Aerodynamic noise is generally both broadband i.e., it does not contain a distinguishable note or tone, and of random character, although the level is not constant and fluctuates in time with the movement of the blades. The dominant character of such aerodynamic noise is therefore normally a 'swish' type of sound, which is familiar to most people who have stood near to a large wind turbine.

The sound level of aerodynamic noise from wind turbine blades is not completely steady but is modulated (fluctuates) in a cycle of increased and then reduced level, sometimes called "*blade swish*", typically occurring in step with the angle of rotation of the blades and so being periodic at the rotor's rotational speed. For typical commercial turbines, this is at a rate of around once or twice per second. This phenomenon is known as Amplitude Modulation of Aerodynamic Noise or more succinctly by the acronym AM.

In early wind turbine designs, where the rotor was positioned downwind of the tower, a pronounced 'beat' was audible as each blade passed through the turbulent wake shed from the tower. However, this effect does not exist for the upwind rotor designs found on the majority of modern wind farms including the proposed wind farm where the air flow to the blades is not interrupted by the tower structure. Instead, it seems that aerodynamic modulation is due to fluctuation of the primary mechanisms of aerodynamic noise generation i.e., the blade swish mentioned above.

The Temple Group[12] undertook a review of Renewable UK's Research into Amplitude Modulation and concluded the following:

The distinction between normal AM i.e., blade swish (NAM) and other AM (OAM) is important as they are caused by different mechanisms and have separate impacts. Normal AM (NAM) is a commonly occurring typical characteristic of wind turbine noise that occurs persistently for long periods. NAM or "swish" usually disappears at around 3 to 4 rotor lengths from the turbines, except in crosswind conditions.

[12] Report for Renewable UK by Temple Group (Dani Fiumicelli). *Summary of Research into Amplitude Modulation of Aerodynamic Noise from Wind Turbines*, Wind Turbine Amplitude Modulation: *Research to Improve Understanding as to the cause and Effect*, Dec 2013.

Based on the evidence available, it was recognised that even at those wind farm sites where OAM has been reported to be an issue, its occurrence may be relatively infrequent.

The study reports that the occurrence and intensity of OAM is dependent on a number of interacting factors that are specific to a location and it is not feasible to reliably predict the occurrence of OAM at another location simply by cross checking whether similar conditions that arise at a location where OAM has occurred might arise at the new location.

Normal Amplitude Modulation (NAM) is a fundamental component of wind turbine noise and can be heard in proximity to virtually all wind turbine installations. The 2007[13] Salford University Report found instances of "enhanced" AM which occurred at larger distances, but relatively infrequently and at only a small minority of sites. These characteristics are consistent with and can be explained by OAM.

As described previously, many risk factors have been considered for OAM. However, no single item or specific combination of items have been found to be the controlling factors whereby the occurrence, duration and intensity of OAM at a particular location can be reliably predicted in advance of a wind turbine or wind farm being installed. In the very unlikely event that OAM arises, mitigation measures will be put in place appropriate to the cause and effect of OAM.

Salford University in 2007, found that out of 133 operational wind farms investigated, 27 were associated with noise complaints, but OAM was considered to be a factor in noise complaints at only four sites and a possible factor in a further eight locations. The research has shown that OAM is a rare and unlikely occurrence at operational wind farms.

11.9 LOW FREQUENCY NOISE AND VIBRATION

There is always low frequency (or infrasound) noise present in the ambient quiet background. It is generated by natural sources such as distant road traffic, wind effects through air and vegetation, wave motion, water flow in streams and rivers. There are also low frequency emissions from many sources found in modern life, such as household appliances (e.g. washing machines, air conditioners, fridges, heating systems, extraction systems, electric or battery clocks), water flowing through pipes within the home and in water flow from municipal water supply. Vibration of elements of structures (low frequency) is generated in one's home by way of normal routine activity, like climbing stairs, closing doors, traveling in a car, etc.

[13] Research into Aerodynamic Modulation of Wind Turbine Noise. Report by University of Salford

The frequency range of audible noise is in the range of 20 to 20,000Hz and low frequency noise is generally from about 2 to 200Hz with infrasound typically of frequencies below 20Hz. There appears to be little or no agreement about the biological effects of low frequency noise on human health and there is evidence to suggest that there are no serious consequences to people's health from infrasound exposure.

A study of low frequency noise (infrasound) and vibration around a modern wind farm was carried out for ETSU and reported in ETSU W/13/00392/REP – '*Low Frequency Noise and Vibration Measurements at a Modern Wind Farm*'[14]. The results showed levels of infrasound to be below accepted thresholds of perception even on the Site. Furthermore, a document prepared for the World Health Organisation, states that '*there is no reliable evidence that infrasound below the hearing threshold produce physiological or psychological effects*'.

Significant research carried out on low frequency noise has been in the area of blasting (air overpressure) which falls into a very low frequency range (2-40Hz), although with a considerably higher magnitude – typically in a range of 110-125dB. Interestingly most microphones recording air-overpressure (low frequency sound) is linear down to 2Hz with a range that does not go below 88dB, as below that value trigger will occur by relatively low wind speeds (a gust of wind at 9 m/s equates to an air overpressure of 133dB). Wind in the natural environment, along with streams and rivers, generates elevated levels of low frequency (infrasound) yet nobody complains about these sources. Low frequency sound is generated from wind effects on vegetation close to receptors in the wind speed range that turbines operate in, yet nobody complains about wind (or rivers or streams) being the cause of sickness.

South Australian Environment Protection Authority (EPA) Infrasound Study

A report released in January 2013 by the South Australian EPA[15] found that the level of infrasound from wind turbines is insignificant and no different to any other sources of noise, and that the worst contributors to household infrasound are air-conditioners, traffic and noise generated by people. The study included several houses in rural and urban areas, houses both adjacent to a wind farm, away from turbines and measured the levels of infrasound with the wind farms operating and also switched off. There were no noticeable differences in the level of infrasound under all these different conditions. In fact, the lowest levels of infrasound were recorded at one of the houses closest to a wind farm, whereas the highest levels were found in an urban office building. The South Australian study found: '*the contribution of wind turbines to the measured infrasound levels is insignificant in comparison with the background level of infrasound in the environment*'.

[14] ETSU W/13/00392/REP – '*Low Frequency Noise and Vibration Measurements at a Modern Wind Farm*'.
[15] http://www.epa.sa.gov.au/environmental_info/noise/wind_farms

Massachusetts Institute of Technology (MIT)

A report by an Independent Expert Panel prepared for Massachusetts Department of Health (2012)[16] which consisted of a panel that included seven individuals with backgrounds in public health, epidemiology, toxicology, neurology and sleep medicine, neuroscience, and mechanical engineering, all considered independent experts from academic institutions. The report found that *'there is insufficient evidence that the noise from wind turbines is directly (i.e., independent from an effect on annoyance or sleep) causing health problems or disease'* and *'available evidence shows that infrasound levels near wind turbines cannot impact the vestibular system'*.

Technical Research Centre of Finland

A long-term study into so-called "wind turbine syndrome"[17] health problems supposedly caused by low-frequency sound from spinning blades has concluded that this "infrasound" has absolutely no physical impact on the human body.

The study conducted by the Technical Research Centre of Finland (VTT) and others, commissioned by the Finnish government, found that infrasound sound waves with frequencies below the range of human hearing cause no measurable changes in the human body, and cannot in any way be detected by the human ear.

Infrasound measurements were taken inside and outside local dwellings near two Finnish wind farms, as well as inside the facilities and beyond them, for 308 days.

"Infrasound samples representing the worst-case scenarios were picked out from the measurement data and used in the listening tests," said VTT.

"The participants in the listening tests were divided into two groups based on how they reported wind turbine infrasound related symptoms: people who suffered from those and people who never had symptoms.

"The participants were unable to make out infrasonic frequencies in wind turbine noise, and the presence of infrasound made no difference to how annoying the participants perceived the noise, and their autonomous nervous system did not respond to it. There were no differences between the results of the two groups". "No evidence of health effects of wind turbine infrasound was found."

[16] A Wind Turbine Health Impact Study: Report of Independent Expert Panel in January 2012 prepared for the Massachusetts Department of Environmental Protection, Massachusetts Department of Health

[17] Infrasound Does Not Explain Symptoms Related to Wind Turbines, Finnish Government, June 2020, https://www.vttresearch.com/en/news-and-ideas/vtt-studied-health-effects-infrasound-wind-turbine-noise-multidisciplinary.

11.10 FIELD WORK

Baseline noise monitoring was undertaken at four locations between 14th October and 9th November 2020. The Lidar system which monitored wind speed and direction recorded continuously between 14th October and 29th October 2020 at the same 10-minute intervals, so noise analysis was confined to this period. Noise data was recorded for a representative range of wind speeds during the period.

11.11 CONSULTATION

Consultation was initiated by the Developer's Community Liaison Officer with local residents to obtain permission to install noise monitors at four locations for baseline noise monitoring. Access to the nearest dwellings was carried out with permission from the householders and landowners.

11.12 NOISE ASSESSMENT METHODOLOGY

In summary, the assessment process comprises:

- Identification of potential receptors, i.e., houses and other potentially noise-sensitive locations;
- Measurement of existing background noise levels at representative locations close to the Site;
- Prediction of the likely noise levels of wind turbines at each receptor;
- Comparison of the predicted levels with noise limits, and
- Description of effects of construction and operation

The 38kV substation is considered. However, it is discounted from the noise assessment as the noise emissions are very low compared to the wind turbines i.e., less than 25dBA at 150 m and will have negligible impact at the nearest noise sensitive receptor H2 which is 641 m away.

Potential receptors in the area surrounding the Project were initially identified from Ordnance Survey maps, google maps, EPA maps and Site visits. Background measurements were carried out at four locations as detailed in **Table 11.12**.

The method of measuring background noise is described in ISO 1996 and ETSU-R-97. In practice, it means carrying out continuous monitoring of background noise levels at receptors for a period that includes a range of wind speeds which at minimum correspond to the maximum sound power of the candidate turbines being proposed which is usually a 2 to 4 weeks duration. The candidate turbine assessed reaches maximum sound power level at a mean wind speed of 5 m/s at 10 m height. The maximum sound power level does not increase above 5 m/s.

The method of predicting noise levels of wind turbines at receptors is discussed in **Section 11.7**. This method was applied to the calculations for both contour plots and individual receptor predictions.

There are a range of turbines that fit within the proposed Turbine RangeR (**Chapter 2: Project Description**) available on the market. The final turbine choice will be made through a commercial tender process. For EIA noise assessment purposes, a hypothetical candidate turbine, the Nordex N149 has been selected as it reflects a worst-case scenario for the technical assessment as it generates the highest sound power levels of all turbines within the proposed range being considered. This chapter comprehensively assesses all scenarios within the Turbine Range as well as all associated works.

A variation in hub height will not change the maximum sound power level of a turbine. However, a hub height wind speed of 110.5 m for the N149 when calculated to a 10 m height wind speed will give marginally different noise levels at the low wind speeds of 3 m/s and 4 m/s (10 m height) than if calculated from a hub height wind speed of 102.5 m. The marginal variation for the N149 is in the order giving lower levels of 0.8 dB at 3 m/s and 0.7 dB at 4 m/s for the hub height of 102.5 m. At 5 m/s (10 m height) and above the maximum sound power level does not change. A difference in sound power levels less than 1 dB are negligible to the human ear. All turbines to be used will have as best practice Serrations Trailing Edge (STE) fitted as standard, which reduces the sound power levels of each turbine. **Table 11.3** provides details of the candidate turbine used for the noise assessment.

A copy of the manufacturer's noise specification of the turbine used in the assessment are given in the **Appendix 11.4**.

Table 11.3: Candidate Turbine Assessed

Turbine Manufacturer	Model	Turbine Output (MW)	Sound Power Level at Source dB LWA
Nordex	149-Mode 0	5.X	105.6

The Nordex N149 turbine has a range of hub heights, however the proposed hub heights range between 102.5 m and 110.5 m. A wind farm noise assessment is based on a standardised noise level referenced to a wind speed at 10 m height. The change in hub height does not therefore change the maximum sound power level of any specific turbine.

The maximum sound power level of the Nordex 149 in Mode 0 is similar for hub heights of 102.5 m and 110.5 m at 105.6 dBA. At lower wind speeds there is a small variation in the sound power levels due to variation in hub height when it is standardised to a 10 m wind speed. The manufacturer's data gives the sound power levels at hub height and at varying wind speeds. **Table 11.4** and **Table 11.5** give the sound power levels at varying wind speeds at standardised 10 m height wind speed for hub heights of 102.5 m and 110.5 m using the methodology in the IOA Good Practice Guide and given in **Appendix 11.2**.

The prediction modelling is based on all the turbines operating at full power (maximum sound power output) in standard Mode 0. The IOA Good Practice Guide recommends that an uncertainty value is required to be added to the turbine emission data prior to modelling. Depending on the type of manufacturer's data, the uncertainty value will range from 0 to 2 dBA. However, for the Nordex N149 in Mode 0 an uncertainty value of 2 dBA is added in line with guidance. **Table 11.4** gives the maximum sound power levels at varying wind speeds (presented at standardised 10 m height) for the Nordex N149 with a hub height of 110.5 m.

Table 11.4: Noise Emission Levels, Nordex N149 with STE in Mode 0

Standardised 10 m height Wind Speed, ms^{-1}	3	4	5	6	7	8	9+
Sound Power Level, dB LWA, derived from 110.5 m hub height	97.4	103.8	105.6	105.6	105.6	105.6	105.6
Uncertainty added and conversion of LAeq to LA90 made	97.4	103.8	105.6	105.6	105.6	105.6	105.6

Table 11.5 gives the maximum sound power levels at varying wind speeds presented at standardised 10 m height for the Nordex N149 with a hub height of 102.5 m.

Table 11.5: Noise Emission Levels, Nordex N149 with STE in Mode 0

Standardised 10 m height Wind Speed, ms^{-1}	3	4	5	6	7	8	9+
Sound Power Level, dB LWA, derived from 102.5 m hub height	96.6	103.1	105.6	105.6	105.6	105.6	105.6

Uncertainty added and conversion of LAeq to LA90 made	96.6	103.1	105.6	105.6	105.6	105.6	105.6

The standardised sound power level at the lowest hub height (102.5 m) is 0.8 dB lower at 3 m/s and 0.7 dB lower at 4 m/s. At 5 m/s and above there is no change in the maximum sound power level in either turbine due to hub height (see **Table 11.4** and **Table 11.5**).

The octave band values at maximum sound power levels are given in **Table 11.6** with uncertainty values of 2 dB added and conversion of LAeq to LA90 added as input to the prediction model which is best practice.

Table 11.6: Octave Band Spectrum of Nordex N149 with STE in Mode 0

Octave Band Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power Level, dB LWA 8 ms^{-1}	86.9	93.5	97.2	99.3	100.6	98.7	89.1	81.2
Uncertainty added to octaves and conversion of LAeq to LA90	86.9	93.5	97.2	99.3	100.6	98.7	89.1	81.2

11.12.1 Cumulative Assessment

Cumulative effects from any existing, consented or application-stage wind farms within 3 km of identified noise-sensitive receptors have been taken into consideration as the potential for cumulative effects beyond this distance is considered negligible. On this basis, the cumulative effect of 9 no. wind farms located west to south-west of the Project are assessed. The wind farms comprise Vestas V90 each rated at 3MW and the Kilgarvan Wind Farm which comprises V52's each rated at 0.85MW.

The octave band spectrum of the Vestas V90, 3.0MW wind turbines (80 m HH) is given in **Table 11.7**.

Table 11.7: Octave Band Spectrum of Vestas V90 3MW at maximum LWA

Standardised 10 m height Wind Speed, ms^{-1}	4	5	6	7	8	9	10	10+
Sound Power Level, dB LWA 8 ms^{-1}	97.9	100.9	104.2	106.1	107	106.9	105.6	105.2
Uncertainty added and conversion of LAeq to LA90	97.9	100.9	104.2	106.1	107	106.9	105.6	105.2

The octave band values are given in **Table 11.7** with uncertainty values added and conversion for LAeq to LA90 made for input to the prediction model.

Table 11.8: Octave Band Spectrum of Vestas V90-3MW

Octave Band Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power Level, dB LWA 8 ms^{-1}	92.0	94.1	97.2	99.6	101.8	100.5	95.7	86.7
Uncertainty added to octaves and conversion of LAeq to LA90	92.0	94.1	97.2	99.6	101.8	100.5	95.7	86.7

The octave band values for the Vestas V52 are given in **Table 11.9** with uncertainty values and conversion for LAeq to LA90 added as input to the prediction model.

Table 11.9: Octave Band Spectrum of Vestas V52-0.85MW

Octave Band Frequency (Hz)	63	125	250	500	1000	2000	4000	8000
Sound Power Level, dB LWA 8 ms^{-1}	80.8	87.8	94.5	100.1	99.8	95.9	89.5	79.3
Uncertainty added to octaves and conversion of LAeq to LA90	80.8	87.8	94.5	100.1	99.8	95.9	89.5	79.3

11.13 NOISE LIMITS

The method of deriving operational noise limits is described in **Section 11.2.3** and is based on the current 2006 guidelines, background noise levels and recent 2022 An Bord Pleanála noise limits listed in planning decision conditions. The 2022 An Bord Pleanála decision (26th September 2022- 309306-21) introduced an additional limit of 40 dBA for wind speeds below 5 m/s. The noise limits proposed for the Inchamore Wind Farm is:

'Wind turbine noise arising from the proposed development, by itself or in combination with other existing or permitted wind energy development in the vicinity, shall not exceed:

- 43 dB(A) L90,10min limit for all wind speeds at 5 m/s and above and,
- 40 dBA L90,10min limit for wind speeds below 5 m/s. A 43 dB(A) L90,10min limit protects sleep at night.

11.14 CONSTRUCTION ASSESSMENT METHODOLOGY

11.14.1 Relevant Guidance

There is no published national guidance relating to the maximum permissible noise level that may be generated during the construction phase of a project. However, the National Roads Authority (NRA) give limit values which are deemed acceptable (the NRA Guidelines)[18]. Guidance to predict and control noise is also given in BS 5228:2009-1+A1:2014[19].

11.14.2 NRA Guidelines for the Treatment of Noise and Vibration in National Road Schemes

The NRA Guidelines provide noise limits which are acceptable and states that where it is deemed necessary to predict noise levels associated with construction noise that this should be done in accordance with BS 5228:2009-1+A1:2014.

11.14.3 BS 5228;2009-1+A1 ;2014 Code of Practice for Noise and Vibration Control on Construction and Open Sites

Part 1 of BS5228 deals with noise prediction and control. It recommends procedures for noise control in respect of construction operations. The standard stresses the importance of community relations, and states that early establishment and maintenance of the relations throughout the carrying out of Site operations will go some way towards allaying people's concerns. Some of the more relevant factors that are likely to affect the acceptability of construction noise are:

- The attitude of local receptors to the Development;
- Site location relevant to noise sensitive receptors;
- Duration of Site operations;
- Hours of work, and
- The characteristics of the noise produced.

[18] National Roads Authority, *Guidelines for Noise and Vibration in National Road Schemes, October 2004.*
[19] BS 5228-1: 2009 Code of Practice for Noise and Vibration Control on Construction and Open Sites: *Code of Practice for Basic Information and Procedures for Noise Control.*

Recommendations are made regarding the supervision, planning, preparation and execution of works, emphasising the need to consider noise at every stage of the activity. Measures to control noise are described including:

- Control of noise at source by:
- Substitution of plant or activities by less noisy ones;
- Modification of plant or equipment by less noisy ones;
- Using noise control enclosures;
- Siting of equipment and its method of use;
- Maintenance of equipment, and
- Controlling the spread of noise by increasing distance between plant and receptors, or by the provision of acoustic screening.

Methods of calculating the levels of noise resulting from construction activities are provided, as are updated source levels for various plant, equipment and construction activities in Section 11.16.1.

11.14.4 Construction and Decommissioning Noise Assessment Methodology

The NRA guidelines for construction noise which are considered acceptable are given in **Table 11.10**.

Table 11.10: Noise levels that are acceptable based on the NRA Guidelines

Day / Times	Guideline Limits
Monday to Friday 07:00 – 19:00hrs 19:00 – 22:00hrs	 70dB LAeq, (1h) and LAmax 80dB *60dB LAeq, (1h) and LAmax 65dB*
Saturday 08:00 – 16:30hrs	 65dB LAeq,1h and LAmax75dB
Sunday and Bank Holidays 08:00 – 16:00hrs	 *60dB LAeq,1h and LAmax 65dB*

*Construction at these times, other than required by an emergency works, will normally require explicit permission from the relevant local authority.

<u>Construction Times for Development</u>

Except for emergencies, delivery of concrete for foundations, or delivery of turbines, the normal construction times for the Project are:

Monday to Friday: 07.00 to 19.00hrs, Saturday 08.00 to 13.00hrs with no work on Sunday, or Bank Holidays

Part 1 of BS 5228 also provides example criteria which have been applied in this assessment for the significance of noise effects from construction activities. Noise levels generated by construction activities are considered significant if:

- The LAeq, period level of construction noise exceeds lower threshold values of 65dB during daytime, 55dB during evenings and weekends or 45dB at night.

Construction noise from wind farm development, or decommissioning is not considered an intensive activity. The main noise sources will be associated with the excavation of the borrow pit which includes blasting and crushing, construction of the turbine foundations, and hardstands, while lower levels are generated by activity such as access roads and the 38kV Substation (construction of the Substation will generate no more noise than construction of a bungalow). Grid connection from the substation will involve cable being laid underground along the grid route. A temporary construction compound will also be put in place.

Decommissioning will be in the same order but less intensive than construction activity and will have similar potential effects.

Significant quantity of material for Site Access Roads, turbine bases and turbine hardstands will be taken from the sites borrow pit, thereby reducing the local traffic flow due to the reduction of material imported. Imported materials to site will be along the local roads with the most intensive trucking (and highest noise levels) being generated by delivery of concrete for turbine foundations – this activity will be over a short period of 5 days duration.

11.14.5 Blasting Vibration in Borrow Pit

Rock material for the Project Infrastructure will be sourced from a borrow pit on Site which will require blasting. Material excavated in the borrow pit will be used within the Site (refer to **Chapter 2: Projection Description**). The main use of excavated material will be for new Site Access Roads, Turbine Hardstands and Turbine Foundations. Most blasts will be of duration of less than 1 second with maximum duration less than 1.5 seconds.

Ground Vibration

Ground vibration is caused by the imperfect utilisation of the explosive energy released from the fragmentation of rock during blasting operations. The energy that is unused in the fragmentation of rock propagates as an elastic disturbance away from the shot area as seismic waves. These waves, which radiate in a complex manner, diminish in strength with distance from the source. The theory relative to this motion is based on an idealised (sinusoidal) vibratory motion. When these waves come into contact with a free face, physical motion results as the energy induces oscillation in the ground surface. Blasting vibration is a surface wave type, which incorporates components of both body and surface motion.

Ground vibration itself is in-audible, however air vibrations (air overpressure) both audible and sub-audible usually accompany it. The resulting impacts of blasting vibration are often characterised as being impulsive and of short duration, usually less than 2 seconds. It is difficult for the average lay person to differentiate between the various types of vibrations (ground vibration and air overpressure) as humans commonly associate the level of vibration with the 'loudness' of a blast. Ground vibration from blasting at any receptor point is influenced in the main by:

- the maximum instantaneous charge of explosives usually referred to as MIC;
- the medium between blast source and receptor point and,
- the distance between the receptor point and the blast source.

Ground vibration control is based on reducing and controlling the weight of explosives detonated per delay. In any given situation large amounts of explosives can be detonated using time delay intervals (greater than 8millie-second) between specific charges within the overall blast. The level of ground vibration is directly related to the maximum charge weight per delay (MIC) and numerous studies have shown that peak particle velocity (PPV) is directly related to the MIC.

<u>Air Overpressure Noise</u>

A blast causes a diverging shock-wave front that quickly reduces to the speed of sound, and an air blast is then propagated through the atmosphere as sound waves. Air blast or air overpressure is the term used to describe the low frequency high energy air vibrations generated by blasting detonation. Just as with ground vibration, these pressure waves can be described with time histories where the amplitude is air pressure instead of particle velocity. Air blasts are characterised by containing a larger proportion of its energy in the sub-audible spectrum, below 20 Hz. Because the waves associated with air blasts are essentially outside the audible spectrum (below 20 Hz), a separate unit of measure, pressure is reported.

Air overpressure (sound waves) can be reported in two distinct units of measurements, pressure (psi) or decibels (dB). A wind speed of 9 /s produces a pressure equal to 133.7 dB (0.014 psi). Although such wind is comparable in amplitude to a strong air-blast, its effects are not as noticeable because of the relatively slow rate of wind speed change and the corresponding minor or non-existent rattling, compared with the rapid rise time (impulsive) of an air blast transient. The principal factors governing air blasts are:

(a) the type and quantity of explosives;
(b) the degree and type of confinement (stemming);
(c) the method of initiation (not-use of exposed detonating cord etc.);
(d) local geology, topography and distance, and
(e) atmospheric conditions.

Lowering the MIC, use of chipping as stemming, not using exposed detonating cord (which is now best practice) and large distance from blasts to receptors are factors which reduce ground vibration and air-overpressure. Atmospheric conditions can partly be controlled by blasting in mid-day when temperature inversions are more infrequent.

11.14.5.1 Ground Vibration and Air Overpressure Guidelines

There are many different standards and recommendations being used internationally, however, most of these standards and recommendations are derived from the considerable work carried by the US Bureau of Mines (USBM). The USBM Report of Investigation 8507[19] gives practical safe criteria for blasts that generate low frequency ground vibrations (<40Hz). These are 19 mm/sec for modern houses and 12.7 mm/sec for older houses. Since 1993 British Standards Institute have adopted BS 7385 Part 2: 1993[20] this is based predominately on a literature review of the considerable work of the USBM. 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. The guidelines relate to relatively modern buildings and should be reduced to 50% or less for more critical buildings (residential buildings do not constitute critical buildings in this context)'. The NRA published guidelines also contains information on permissible construction ground vibration levels and are given in **Table 11.11**.

[19] Siskind, D. E, Stagg, M. S., Kopp, and Dowding, C. H. (1980) *'Structure Response and Damage Produced by Ground Vibration From Surface Mine Blasting'* U .S Bureau of Mines RI 8507
[20] British Standard BS 7385-1:1993- Evaluation and Measurement for vibration in buildings-Part 2: Guide to damage levels from ground borne vibration

Table 11.11: Allowable Vibration During Road Construction in order to minimise the Risk of Building Damage

Allowable vibration velocity (Peak Particle Velocity) at the closest part of any sensitive property to the source of vibration at a frequency of		
Less than 10Hz	10 to 50Hz	50 to 100Hz+
8 mm/s	12.5 mm/s	20 mm/s

The guidance does not give limits for air overpressure; however limits are given by the EPA[21] which states:

'The air overpressure arising from the blasts shall not exceed 125dB (lin) max peak with a 95% confidence limit when measured outside the nearest house to the blast'.

11.14.6 Evaluation of Potential Effects

The potential effects of construction are evaluated by comparing the predicted noise levels against the guideline limits given in **Table 11.10, Table 11.11** and sample criteria in Part 1 of BS 5228 in **Section 11.14.4.**

The potential operational effects are evaluated by comparing the predicted noise levels against the day and night-time noise limit given in **Section 11.15.5**. The predicted noise levels are carried out according to the IOA Good Practice Guide as detailed in **Section 11.7** and potential impacts are assessed against the noise limits at the nearest receptors.

11.14.6.1 Sensitivity

The sensitivity of the Project during construction is based on the guideline values in **Table 11.10, Table 11.11** and sample criteria in Part 1 of BS 5228. The sensitivity of the Development during operation is based on the noise limits in **Section 11.15.5.**

11.14.6.2 Magnitude

The magnitude of potential effects of construction is based on the values in **Table 11.16.** The magnitude of the potential effects of the Project during operation is based on the values in **Table 11.17** and **Table 11.19.**

11.14.6.3 Significance Criteria

The significance of construction is based on the potential effects based on the predicted values and compliance with the guideline limits in **Table 11.10, Table 11.11** and sample criteria of in Part 1 of BS 5228.

[21] EPA 2006, Environmental Management Guidelines-Environmental Management in the Extractive Industry (Non-Scheduled Industry)

The significance of the potential effects of the Project have been assessed by taking into account the noise limits at receptors and the degree to which compliance has been met.

11.15 BASELINE DESCRIPTION

11.15.1 Identification of Potential Receptors

A number of predictions were prepared for the layout of the proposed 55 turbine wind farm. Based on the initial layout, potential noise-sensitive receptors (which included occupied and un-occupied properties) were identified from maps. Receptor locations were verified through aerial mapping, Eircode searches and specific site visits.

11.15.2 Selection of Baseline Noise Survey Locations

Four baseline noise survey locations were selected on the basis of their location relative to the proposed 5 turbine locations and are shown in **Table 11.12**. **Figure 11.1** shows the four noise monitoring locations in relation to the Project.

Baseline Noise Survey

Baseline noise measurements were analysed for the period 14th to 29th October 2020 at locations given in **Table 11.12** and shown in **Figure 11.1**. The baseline survey monitoring locations were carried out at receptor houses H2, H3, H4 and H18 (photos of monitors in-situ in **Technical Appendix 11.1**.

Table 11.12: Baseline Noise Survey

Location	ITM Reference	Description of Location
H2	513445, 578031	Microphone 1.2-1.5 m height, front garden facing Site
H3	513072, 579801	Microphone 1.2-1.5 m height, 40 m from dwelling facing Site
H4	514329, 579384	Microphone 1.2-1.5 m height, side of dwelling facing Site
H18	511689, 577885	Microphone 1.2-1.5 m height, at side dwelling facing Site

The survey was carried out in accordance with ISO 1996, ETSU-R-97 and the IOA Good Practice Guide with the following implemented:

- Measurement of background noise levels at 10-minute intervals was undertaken using Type 1 instruments.
- Concurrent measurements of 10-minute interval mean wind speed / direction were recorded from the existing met mast located on the sites. The methodology is given in **Section 11.6.**

- The background noise measurement recorded continuously included 10-minute intervals, as LA90, 10min along with a series of other parameters including LAeq,10min.
- Noise measurements were recorded at a height of 1.2-1.5 m above ground level and more than 5 m from any reflective surface other than the porous ground.
- An electronic rain gauge was installed at receptor H2 to monitor rainfall at 10-minute intervals over the duration of the noise survey. Rain data which impacted on noise levels were removed from the noise data set prior to analysis.
- The wind speed was taken from the Lidar (located onsite which had measurements at 110 m and 80 m height.
- Wind shear calculated from the two different wind speed heights at 10 min intervals was used to extrapolate to the hub height wind speed followed by calculation to standardised 10 m height using the methodology given in the IOA Supplementary Guidance Note 4.
- The standardised 10 m wind speed was plotted against the background noise levels using a best-fit polynomial line.

Instrumentation Used

The following instrumentation was used in the baseline survey measurements:

- Four Larson Davis Precision Integrating Sound Level Analyser/Data logger with 1/2" Condenser Microphones. All microphones were fitted with double skin windscreens based on that specified in W/31/00386/REP22'.
- Calibration Type: Larson Davis Precision Acoustic Calibrator
- Rain Gauge Type: Davis Instruments Vantage Pro2 weather station.

All acoustic instrumentation was calibrated before and after each survey and the drift of calibration was less than 0.2dB. Survey measurement data and calibration certificates of the acoustic instruments are included in **Appendix 11.4**.

11.15.3 Prevailing Background Noise Levels

Table 11.13 gives the background noise levels obtained for daytime, night-time and background plus 5 at the four baseline measurement locations.

The WEDG06 states:

[22] W/31/00386/REP 'Noise Measurements in Windy Conditions'.

In general, a lower fixed limit of 45 dB(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. However, in very quiet areas, the use of a margin of 5dB(A) above background noise at nearby noise sensitive properties is not necessary to offer a reasonable degree of protection and may unduly restrict wind energy developments which should be recognised as having wider national and global benefits. Instead, in low noise environments where background noise is less than 30 dB(A), it is recommended that the daytime level of the LA90, 10min of the wind energy development noise be limited to an absolute level within the range of 35-40 dB(A).

The daytime background noise levels are above LA30dB at all locations above wind speed of 5 m/s, therefore the site was not considered a low noise environment.

Table 11.13: Prevailing Background Noise Levels

Monitoring Location	Prevailing Background (B/G) noise levels LA90dB, 10min Standardised Mean 10 m Height Wind Speed, (m/s)									
		4	5	6	7	8	9	10	11	12
H4	Day	31.0	30.9	31.6	33.1	35.0	37.1	39.2	41.0	42.3
	B/G+5	36.0	35.9	36.6	38.1	40.0	42.1	44.2	46.0	47.3
H4	Night	28.2	27.5	28.1	29.4	31.5	33.9	36.6	39.3	41.7
	B/G+5	33.2	32.5	33.1	34.4	36.5	38.9	41.6	44.3	46.7
H3	Day	26.8	28.2	30.8	33.9	37.2	40.1	42.0	42.6	41.3
	B/G+5	31.8	33.2	35.8	38.9	42.2	45.1	47.0	47.6	46.3
H3	Night	25.8	26.9	28.7	31.0	33.6	36.4	39.0	41.3	43.1
	B/G+5	30.8	31.9	33.7	36.0	38.6	41.4	44.0	46.3	48.1
H2	Day	31.5	31.6	32.1	33.0	34.4	36.3	38.8	41.9	45.6
	B/G+5	36.5	36.6	37.1	38.0	39.4	41.3	43.8	46.9	50.6
H2	Night	29.5	29.2	29.9	31.4	33.5	36.0	38.6	41.1	43.3
	B/G+5	34.5	34.2	34.9	36.4	38.5	41.0	43.6	46.1	48.3
H18	Day	29.9	30.6	31.5	32.6	34.0	35.4	36.9	38.4	39.8
	B/G+5	34.9	35.6	36.5	37.6	39.0	40.4	41.9	43.4	44.8
H18	Night	27.3	26.8	27.8	29.7	32.4	35.4	38.4	41.1	43.2
	B/G+5	32.3	31.8	32.8	34.7	37.4	40.4	43.4	46.1	48.2

LOCATION H4

The house is located on the side of a slope approximately 330 m from the N22 Road. The noise monitor was located at the side of the house facing towards the Project. The main noise sources would have been from the N22 and small nearby streams. Because of the pandemic the N22 traffic flow was very low and this was due to travel restrictions in place.

LOCATION H3

The house is located on the top of elevated ground. The noise monitor was located approximately 30 m from the side of the house facing towards the Project. The main noise sources were domestic activity, distant road traffic and sheep in the field.

LOCATION H2

The house is located on relatively flat ground. The noise monitor was located in the front of the house facing towards the Project and away from locations where local sheep were roaming freely. The main source of noise was from domestic activity and sheep.

LOCATION H18

The house is located cut into the side of a slope with little vegetation close by. The noise monitor was located at the back of the house facing towards the Project. The main source of noise was from local domestic fowl.

11.15.4 Noise Assessment Locations

The nearest receptors to the Project were selected for assessment and represent the properties most likely to be affected by potential effects. Measured background noise levels are representative of the background noise environments surrounding the development.

Should the predicted operational noise levels from the Project comply with the requirements of the WEDG06 at the closest receptors, it may be assumed that the predicted noise levels at receptors further away from the Project will also comply, due to the attenuation of turbine noise levels with distance. The locations are given in **Table 11.10**.

11.15.5 Noise Limits

The noise limits for the Project are based on the limits contained within the Wind Energy Development Guidelines 2006 and the background levels obtained in **Table 11.13.** A lower fixed limit of 45 dBA for daytime could be applied, however a more stringent limit is applied with the lowest background noise levels obtained at location H3 used as the basis for the assessment at all receptors with a limit of 43 dBA being applied for day and night at all wind speeds at 5 m/s and above, with a limit of 40 dBA applied for wind speeds of less than 5 m/s. **Table 11.14** gives the derived noise limits.

In summary, the assessment is made against a 43 dB(A) L90,10min limit for all wind speeds at 5 m/s and above and 40 dBA L90,10min limit for wind speeds below 5 m/s.

Table 11.14: Derived Background Noise Levels Used in Assessment

Monitoring Location	Prevailing Background (B/G) noise levels LA90dB, 10min Standardised Mean 10 m Height Wind Speed, (m/s)									
		4	5	6	7	8	9	10	11	12
H3	Day	27	28	31	34	37	40	42	43	41
	B/G+5	32	33	36	39	42	45	47	48	46
Noise Limit		40	43	43	43	43	43	43	43	43
H3	Night	26	27	29	31	34	36	39	41	43
	B/G+5	31	32	34	36	39	41	44	46	48
Noise Limit		40	43	43	43	43	43	43	43	43

11.15.6 Development Design Mitigation

The preferred turbine model, yet to be decided, will be fitted with Serrated Trailing Edge (STE) as is best practice. A serrated extension of the trailing edge to the rotor blades mitigates noise emission by effectively breaking up the turbulence on the tooth flanks into smaller eddies. The intensity of the pressure fluctuations is reduced which mitigates the noise emissions. Since the intensity of the noise emissions is largely dependent on the flow speed, STE is only installed on the outer rotor blade area where the rotary speed is highest. Typically, STE will reduce the noise levels by 2-3dBA.without reduction of energy output.

11.16 ASSESSMENT OF POTENTIAL EFFECTS

11.16.1 Construction and Decommissioning Noise Levels

As has been previously stated, the construction process associated with wind farms is not considered intensive and is temporary works most of which is carried out a considerable distance from receptors (**Table 11.16**). The main noise sources will be associated with the construction of the turbine foundations, turbine hardstands, grid connection, extraction and processing in the borrow pit location, with lesser sources being site access roads, construction of a 38kV substation, compound and the widening of a road along the turbine delivery route. Accessing stone material from the borrow pit will significantly reduce road traffic flow on local roads. The maximum noise levels from construction traffic to Site will be due to a very short period when ready-mix trucks deliver concrete for the turbine bases. The delivery of turbines by large trucks travelling at very low speed will generate very low levels of noise.

Table 11.15 indicates typical construction range of noise levels for these types of activity (levels from author's database and BS 5228). Predictions are made for receptors nearest to the borrow pit processing, turbine bases / hardstands activity and for receptors at varying distance from the grid connection route. The construction of a substation is considerably less intensive and will generate lower levels than the construction of a small bungalow.

Table 11.15: Typical Noise Levels from Construction Works

Activity	L_{Aeq} at 10 m
Foundation works: trucks pouring concrete, tracked excavator operating	70-84dBA
Large tracked excavator removing topsoil, subsoil for foundation.	80- 87dBA
Rock breaker, vibrating rollers, trucks loading and tipping material	76-89dBA
Grid Connection: Trenching: Tracked excavator 14t, pneumatic breaker, vibratory roller 4t, truck loading	71-74dBA
Horizontal Directional Drilling: Rig HPU* (diesel), mud pump, diesel generator and tractor.	70-75dBA
Construction of compound (Loading / tipping, excavator and Vibratory roller	80- 87dBA
Borrow Pit Processing (Portable crusher, screener, truck loading by excavator, front end loader, dump truck)	78-86dBA
Material spreading in Borrow Pit (Tipping, excavator, dumper)	70-83dBA
Felling of trees in Forest- Chain-saw cutting trees[20]	60-66dBA
Road widening for Turbine delivery: excavator dump truck, lorry tipping, roller	82-87dBA

* Hydraulic power unit (measurements taken on 22nd March 2022 with HDD giving 71dBA without tractor).
NB: Predicted noise levels assumes that there are no barrier/berm attenuation effects.

The difference in noise levels between two locations can be calculated as:

$L_{p2} - L_{p1} = 10 \log (R_2 / R_1)^2 - (A_{atm} + A_{gr} + A_{br} + A_{mis})$

[20] Inac TAS, Abdulllah E, AKAY, 2018, Bursa Technical University, Bursa Turkey Analysis of Noise level caused by a chainsaw during tree felling operations, IARC

$$= 20 \log (R_2 / R_1) - (A_{atm} + A_{gr} + A_{br} + A_{mis})$$

where:

L_{p1} = sound pressure level at location 1

L_{p2} = sound pressure level at location 2

R_1 = distance from source to location 1

R_2 = distance from source to location 2

and where:

A_{atm} = Attenuation due to air absorption

A_{gr} = Attenuation due to ground absorption

A_{br} = Attenuation provided by a barrier

A_{mis} = Attenuation provided by miscellaneous other effects

In the calculation attenuation by A_{atm}, A_{gr} and A_{mis} is assumed as 0.

Table 11.16 gives the noise levels predicted from construction activity at the nearest receptors. The maximum construction noise levels are at receptors listed in **Table 11.16.** At receptor locations further away, noise levels will be less than that predicted.

Table 11.16: Predicted Construction Noise Levels

Nearest Receptor	Activity	Distance to Activity (m)	LAeq dB 1hr range
H1H1	Foundation works: trucks pouring concrete, tracked excavator operating	753	30-44
H1H1	Rock breaking, vibratory roller, trucks loading/tipping	753	40-47
H6	Borrow Pit Spreading/tipping peat	600	39-47
H6	Borrow Pit Processing (Portable crusher, screener, truck loading by excavator, front end loader, dump truck)	600	47-50
Grid connection Receptor	Excavator 14t, pneumatic breaker pneumatic breaker, vibratory roller 4t, truck loading.	166	44-47

Nearest Receptor	Activity	Distance to Activity (m)	LAeq dB 1hr range
Horizontal directional drilling (HDD)			
Stream 1	Rig HPU* (diesel), Mud Pump,	3,767	15-20
N22 crossing	Diesel generator, tractor, dumper	777	41-46
Stream 2		2,877	18-23
Stream 3		2,880	18-23
H3	Construction of compound (Loading / tipping, excavator, Vibratory roller	541	42-49
Nearest receptor	Road widening for turbine delivery: Excavator dump truck, lorry tipping, vibratory roller	434434	4545-50
H1	Felling of trees in forest	472	22-28

The predicted noise levels in **Table 11.16** are well below the guideline values given in **Table 11.10** at the nearest receptors and accordingly at all other receptors further away.

Construction Traffic

The delivery of turbines to the site will generate low level traffic noise as the vehicles carrying the turbines will move slowly along the local roads where impact is expected to be greatest. The main (maximum) construction noise generated by traffic to the Site will be due to ready-mix trucks delivering concrete for the foundation of the turbines. The concrete pour for each individual turbine will be required to be completed in a short a period as possible (usually within 10 hours). For five turbines the concrete pour will last for a total of five days.

Each turbine will require a pour of 900 m^3 of concrete while each ready-mix truck has a capacity of 8 m^3. For delivery of concrete the timeframe envisaged for each turbine concrete pour is taken as 10 hrs. This equates to an average of 36.4 movements per hour on local roads (37 movements used in calculations).

The general expression for predicting the 1 hr LAeq alongside a haul road used by single engine items of mobile plant is:

$$L_{Aeq} = L_{WA} - 33 + 10\log_{10}Q - 10\log_{10}V - 10\log_{10}d \text{ where:}$$

L_{WA} is the sound power level of the truck, in decibels (dB);

Q is 37, the number of vehicles per hour;

V is 50, the average vehicle speed, in kilometres per hour (km/h);
d is the distance of receiving position at 20 m from the centre of haul road, in metres (m).

LAeq = 105-33 + 10log 37 – 10log50 – 10log20 = 57.7 LAeq 1hr.

At 10 m from the roadside the noise levels from delivery trucks equate to 60.7 LAeq 1hr. The trucking for the concrete pour will extend for a total of 5 days (1 day for each turbine). In practice the levels generated by truck movement should be lower than predicted due to the smooth surface on the local roads. The maximum noise levels from temporary construction traffic is within the guidelines givenn in **Table 11.10.**

Grid Connection-Cable laying by trenching

Cable laying and trenching will move along the grid route from the substation on site to the Ballyvouskill 220kV Substation. The maximum noise levels will pertain for no more than 0.5 days equivalent (4 hours) at any single receptor along the route except where HDD is required. Construction noise levels are based on continuous operation. In practice most plant will operate at a maximum level for short intervals. The nearest receptor is located 166 m from the grid route therefore mitigation will not be required. The grid route (trenching) will progress at a rate between 100-200 m each day so duration of maximum levels will be no more than 4 hours at any location.

Grid Connection- Horizontal Drilling

Horizontal or directional drilling is required at four locations where the grid connection requires undergrounding. The nearest receptor to horizontal drilling activity is 777 m from the N22. The noise levels predicted at all locations are well within the NRA construction guidelines without any amelioration required. The works associated with this activity is temporary and expected to continue for no more than a couple of weeks. All drilling activity will be carried out during daytime.

The predicted construction noise levels are well within the NRA guidelines for daytime for all activity and within the lower threshold of 65 dBA, as defined in BS 5228-1:2009, the noise levels from this temporary activity are therefore considered as not significant.

11.16.2 Assessment of Construction and Decommissioning Noise

The maximum predicted site construction noise levels are at H1, H3, H6, H19 and at receptors along the Grid Route. The nearest receptor to the road widening for the turbine delivery route is 434 m away with the nearest receptor to HDD activity at 777 m. The maximum predicted noise levels will exist for no more than one week equivalent (12 hours x 5 days) at all receptors except along the grid route when duration will be no more than 4 hours at any receptor. The maximum predicted noise levels from traffic delivering materials including trucking along the grid route will be below the predicted levels from concrete delivery for turbine bases.

The predicted noise levels are well within the NRA guidelines given as acceptable and below the lower threshold of 65 dBA, as defined in BS 5228-1 and therefore these temporary works are considered not significant.

Ground vibration from rock breaking will be below the threshold of sensitivity to humans of 0.2 mm/s peak particle velocity at all receptors[23] due to distances to nearest receptors.

The effects of noise and vibration from onsite construction activities are therefore considered not significant. The effects for Decommissioning will be similar to construction, but of shorter duration as significant elements of the Project will be left in place such as access roads, turbine foundations and the substation building (Refer to **Section 11.6.5**).

11.16.3 Description of Effects

The criteria for description of effects for all construction noise activity and the potential worst-case effects, at the nearest receptors is given below.

Quality	Significance	Duration
Negative	Not Significant	Temporary

11.16.4 Assessment of Blasting Ground Vibration and Air Overpressure

Blasting in the borrow pit location is in excess of 600 m from the nearest receptor. Ground vibration levels are controlled by the maximum charge weight of explosives per delay used in a blast and will easily be kept below the lower guideline values of 8 mm/sec peak particle velocity given in **Table 11.11.** Blasting, including design is only carried out by suitable qualified certified personnel. The levels of air overpressure will be kept within the EPA's guidance value of 125 dB (lin).

The effects of blasting vibration and air overpressure from the project is at a distance greater than 600 m and is therefore considered not significant and will be kept well within the recommended guidelines described in **Section 11.14.5.1**.

[23] Wiss, J. F., and Parmelee, R. A.. (1974) Human Perception of Transient Vibrations, "*Journal of Structural Division*", ASCE, Vol 100, No. S74, PP. 773-787

The criteria for description of effects for vibration (blasting) and the potential worst-case effects, at the nearest receptors is given below.

Quality	Significance	Duration
Negative	Not significant	Momentary

11.16.5 Decommissioning

Noise effects during decommissioning of the Project are likely to be of a similar nature to that during construction. It is likely that the duration of decommissioning will be shorter than that during construction and there will be no blasting. Decommissioning will involve the removal of five wind turbines. Turbine bases (excluding plinths) will be left in place and revegetated. It is proposed to leave roadways and drainage in place. Meteorological mast structure and the underground electrical and communications cabling connecting the wind turbines to the wind farm substation will be removed. All other elements of the proposed development including the on-site substation and site ducting, will remain in-situ. The Site Access Roads and associated drainage systems will serve ongoing forestry and agriculture activity in the area. All other hard surfaced areas will be allowed to revegetate naturally.

Any legislation, guidance or best practice relevant at the time of decommissioning will be complied with.

11.16.6 Predicted Operational Noise Levels

Table 11.17 gives the predicted noise levels at all locations within 2 km of the Development at varying wind speeds for each receptor location at a hub height of 110.5 m. The predicted noise levels for a turbine hub height of 102.5 m is given in **Appendix 11.5.** A noise contour map of the 5 turbine Development at maximum sound power output at a wind speed of 8 m/s at 10 m height is presented in **Figure 11.2**. The noise contour map in **Figure 11.2** assumes that all turbines are simultaneously downwind at the same time to each location which results is an overprediction of the noise levels.

Table 11.17: Predicted Noise Levels at Varying Wind Speeds for Hub Height of 110.5 m Standardised 10 m Height Wind Speed

	ITM	ITM	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA	dBA
H1	512160	578211	31.5	37.9	39.7	39.7	39.7	39.7	39.7
H2	513445	578031	31.9	38.3	40.1	40.1	40.1	40.1	40.1

House ID	ITM Easting	ITM Northing	3m/s dBA	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9+m/s dBA
H3	513072	579801	31.2	37.6	39.4	39.4	39.4	39.4	39.4
H4	514329	579384	30.8	37.2	39	39	39	39	39
H5	514339	577982	29.0	35.4	37.2	37.2	37.2	37.2	37.2
H6	514756	578856	28.8	35.2	37	37	37	37	37
H7	513435	577744	29.4	35.8	37.6	37.6	37.6	37.6	37.6
H8	512511	577570	27.7	34.1	35.9	35.9	35.9	35.9	35.9
H9	513762	577696	28.4	34.8	36.6	36.6	36.6	36.6	36.6
H10	513449	577603	28.2	34.6	36.4	36.4	36.4	36.4	36.4
H11	513566	577655	28.4	34.8	36.6	36.6	36.6	36.6	36.6
H12	514700	579510	27.1	33.5	35.3	35.3	35.3	35.3	35.3
H13	513505	577609	28.1	34.5	36.3	36.3	36.3	36.3	36.3
H14	513565	577612	28.1	34.5	36.3	36.3	36.3	36.3	36.3
H15	512009	577691	26.7	33.1	34.9	34.9	34.9	34.9	34.9
H16	513794	577514	26.9	33.3	35.1	35.1	35.1	35.1	35.1
H17	511756	577894	26.6	33	34.8	34.8	34.8	34.8	34.8
H18	511689	577885	26.1	32.5	34.3	34.3	34.3	34.3	34.3
H19	513838	580300	26.0	32.4	34.2	34.2	34.2	34.2	34.2
H20	513548	577431	26.7	33.1	34.9	34.9	34.9	34.9	34.9
H21	514950	577873	24.4	30.8	32.6	32.6	32.6	32.6	32.6
H22	515053	579406	24.9	31.3	33.1	33.1	33.1	33.1	33.1
H23	513747	577308	25.5	31.9	33.7	33.7	33.7	33.7	33.7
H24	514759	577513	23.7	30.1	31.9	31.9	31.9	31.9	31.9
H25	513572	577269	25.5	31.9	33.7	33.7	33.7	33.7	33.7
H26	513974	577197	24.4	30.8	32.6	32.6	32.6	32.6	32.6
H27	515322	579275	23.4	29.8	31.6	31.6	31.6	31.6	31.6
H28	513631	577179	24.8	31.2	33	33	33	33	33
H29	515488	579130	22.6	29	30.8	30.8	30.8	30.8	30.8
H30	514568	577209	22.8	29.2	31	31	31	31	31
H31	514413	577149	23.0	29.4	31.2	31.2	31.2	31.2	31.2
H32	511831	577246	23.3	29.7	31.5	31.5	31.5	31.5	31.5
H33	515603	579094	21.9	28.3	30.1	30.1	30.1	30.1	30.1
H34	512444	580689	23.5	29.9	31.7	31.7	31.7	31.7	31.7
H35	515614	578103	21.3	27.7	29.5	29.5	29.5	29.5	29.5
H36	515672	578122	21.0	27.4	29.2	29.2	29.2	29.2	29.2
H37	515646	578046	21.0	27.4	29.2	29.2	29.2	29.2	29.2
H38	515525	579630	21.5	27.9	29.7	29.7	29.7	29.7	29.7
H39	515332	577403	20.7	27.1	28.9	28.9	28.9	28.9	28.9

11.16.7 Operational Noise Assessment

An assessment was made of the predicted operational noise levels from the Development against noise limits in the Wind Energy Development Guidelines 2006, background noise level and the recent September 2022 ABP decision discussed above. All predicted noise levels are within limits. **Table 11.18** gives the difference (margin) between the predicted noise level in **Table 11.17** and noise limits for each receptor. A negative margin indicates that the predicted noise levels are within the lower 40 dBA at wind speeds below 5 m/s and below 43 dBA all other wind speeds.

As can be seen from **Table 11.18** the predicted noise levels at all receptors are lower than the noise limits in all cases, at all wind speeds, and are therefore compliant with the noise limits and are not significant in terms of EIAR Regulations. The predicted noise levels assume that all 55 turbines are directly down-wind and the potential for negative impacts is negligible.

Table 11.18: Margin between predicted noise levels, LA 90, 40dB limit for wind speeds less than 5 m/s and LA90, 43dB at all other wind speeds

	ITM	ITM	3m/s	4m/s	5m/s	6m/s	7m/s	8m/s	9+m/s
House ID	Easting	Northing	dBA	dBA	dBA	dBA	dBA	dBA	dBA
H1	512160	578211	-8.5	-2.1	-3.3	-3.3	-3.3	-3.3	-3.3
H2	513445	578031	-8.1	-1.7	-2.9	-2.9	-2.9	-2.9	-2.9
H3	513072	579801	-8.8	-2.4	-3.6	-3.6	-3.6	-3.6	-3.6
H4	514329	579384	-9.2	-2.8	-4	-4	-4	-4	-4
H5	514339	577982	-11.0	-4.6	-5.8	-5.8	-5.8	-5.8	-5.8
H6	514756	578856	-11.2	-4.8	-6	-6	-6	-6	-6
H7	513435	577744	-10.6	-4.2	-5.4	-5.4	-5.4	-5.4	-5.4
H8	512511	577570	-12.3	-5.9	-7.1	-7.1	-7.1	-7.1	-7.1
H9	513762	577696	-11.6	-5.2	-6.4	-6.4	-6.4	-6.4	-6.4
H10	513449	577603	-11.8	-5.4	-6.6	-6.6	-6.6	-6.6	-6.6
H11	513566	577655	-11.6	-5.2	-6.4	-6.4	-6.4	-6.4	-6.4
H12	514700	579510	-12.9	-6.5	-7.7	-7.7	-7.7	-7.7	-7.7
H13	513505	577609	-11.9	-5.5	-6.7	-6.7	-6.7	-6.7	-6.7
H14	513565	577612	-11.9	-5.5	-6.7	-6.7	-6.7	-6.7	-6.7
H15	512009	577691	-13.3	-6.9	-8.1	-8.1	-8.1	-8.1	-8.1
H16	513794	577514	-13.1	-6.7	-7.9	-7.9	-7.9	-7.9	-7.9
H17	511756	577894	-13.4	-7	-8.2	-8.2	-8.2	-8.2	-8.2
H18	511689	577885	-13.9	-7.5	-8.7	-8.7	-8.7	-8.7	-8.7

House ID	ITM Easting	ITM Northing	3m/s dBA	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9+m/s dBA
H19	513838	580300	-14.0	-7.6	-8.8	-8.8	-8.8	-8.8	-8.8
H20	513548	577431	-13.3	-6.9	-8.1	-8.1	-8.1	-8.1	-8.1
H21	514950	577873	-15.6	-9.2	-10.4	-10.4	-10.4	-10.4	-10.4
H22	515053	579406	-15.1	-8.7	-9.9	-9.9	-9.9	-9.9	-9.9
H23	513747	577308	-14.5	-8.1	-9.3	-9.3	-9.3	-9.3	-9.3
H24	514759	577513	-16.3	-9.9	-11.1	-11.1	-11.1	-11.1	-11.1
H25	513572	577269	-14.5	-8.1	-9.3	-9.3	-9.3	-9.3	-9.3
H26	513974	577197	-15.6	-9.2	-10.4	-10.4	-10.4	-10.4	-10.4
H27	515322	579275	-16.6	-10.2	-11.4	-11.4	-11.4	-11.4	-11.4
H28	513631	577179	-15.2	-8.8	-10	-10	-10	-10	-10
H29	515488	579130	-17.4	-11	-12.2	-12.2	-12.2	-12.2	-12.2
H30	514568	577209	-17.2	-10.8	-12	-12	-12	-12	-12
H31	514413	577149	-17.0	-10.6	-11.8	-11.8	-11.8	-11.8	-11.8
H32	511831	577246	-16.7	-10.3	-11.5	-11.5	-11.5	-11.5	-11.5
H33	515603	579094	-18.1	-11.7	-12.9	-12.9	-12.9	-12.9	-12.9
H34	512444	580689	-16.5	-11.1	-11.3	-11.3	-11.3	-11.3	-11.3
H35	515614	578103	-18.7	-12.3	-13.5	-13.5	-13.5	-13.5	-13.5
H36	515672	578122	-19.0	-12.6	-13.8	-13.8	-13.8	-13.8	-13.8
H37	515646	578046	-19.0	-12.6	-13.8	-13.8	-13.8	-13.8	-13.8
H38	515525	579630	-18.5	-12.1	-13.3	-13.3	-13.3	-13.3	-13.3
H39	515332	577403	-19.3	-12.9	-14.1	-14.1	-14.1	-14.1	-14.1

Charts 11.1 to **11.8** (outlined below) of this section plot the derived background noise, background + 5dBA levels and noise limits.

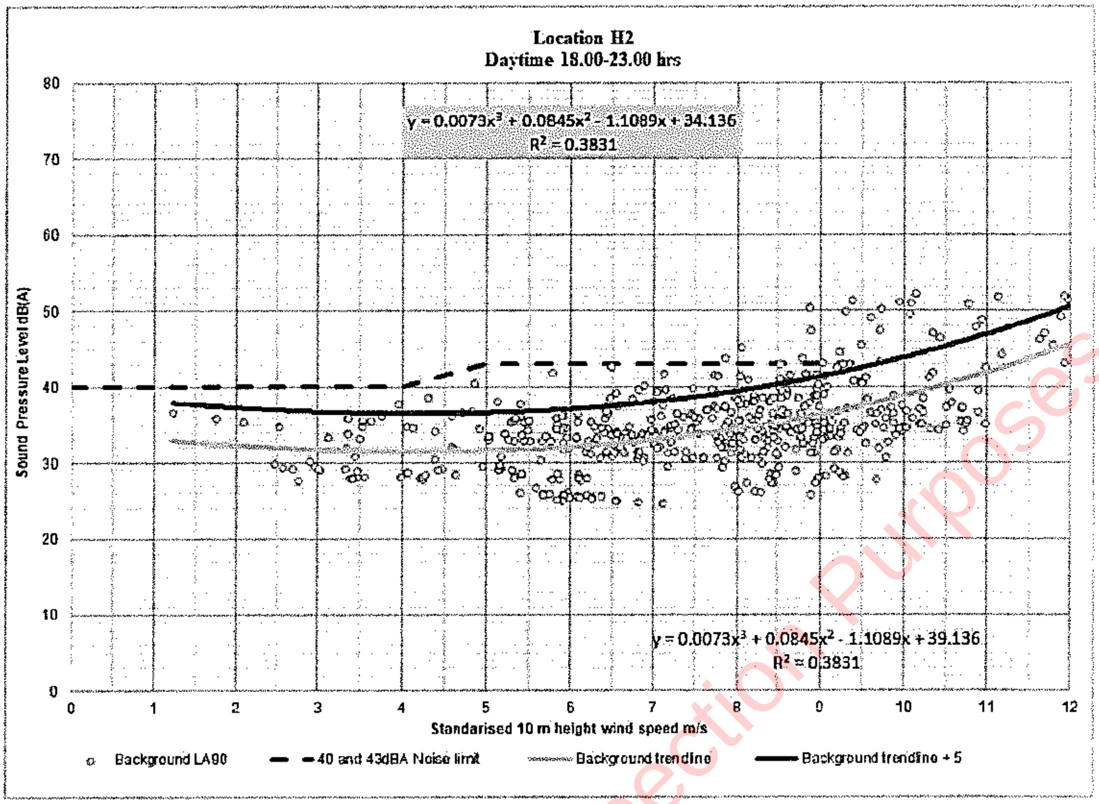


Chart 11.1: Quiet Daytime derived background for House H2

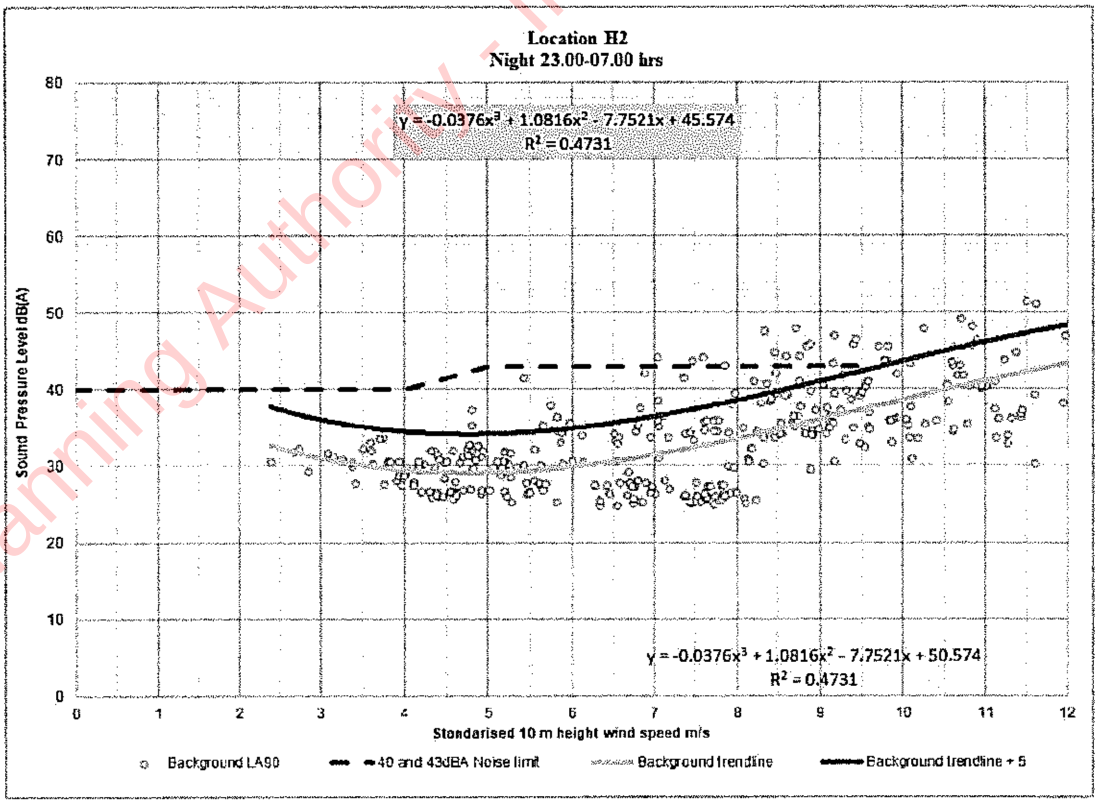


Chart 11.2: Night-time derived background for House H2

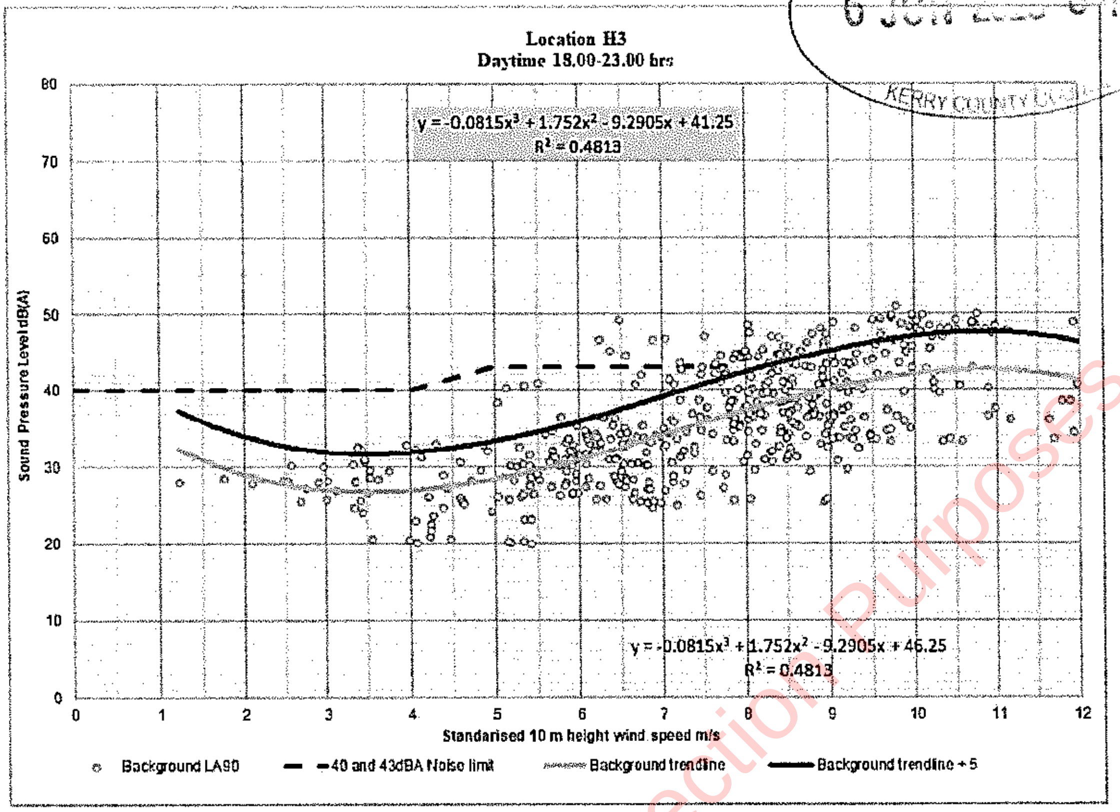


Chart 11.3: Quiet Daytime derived background for House H3

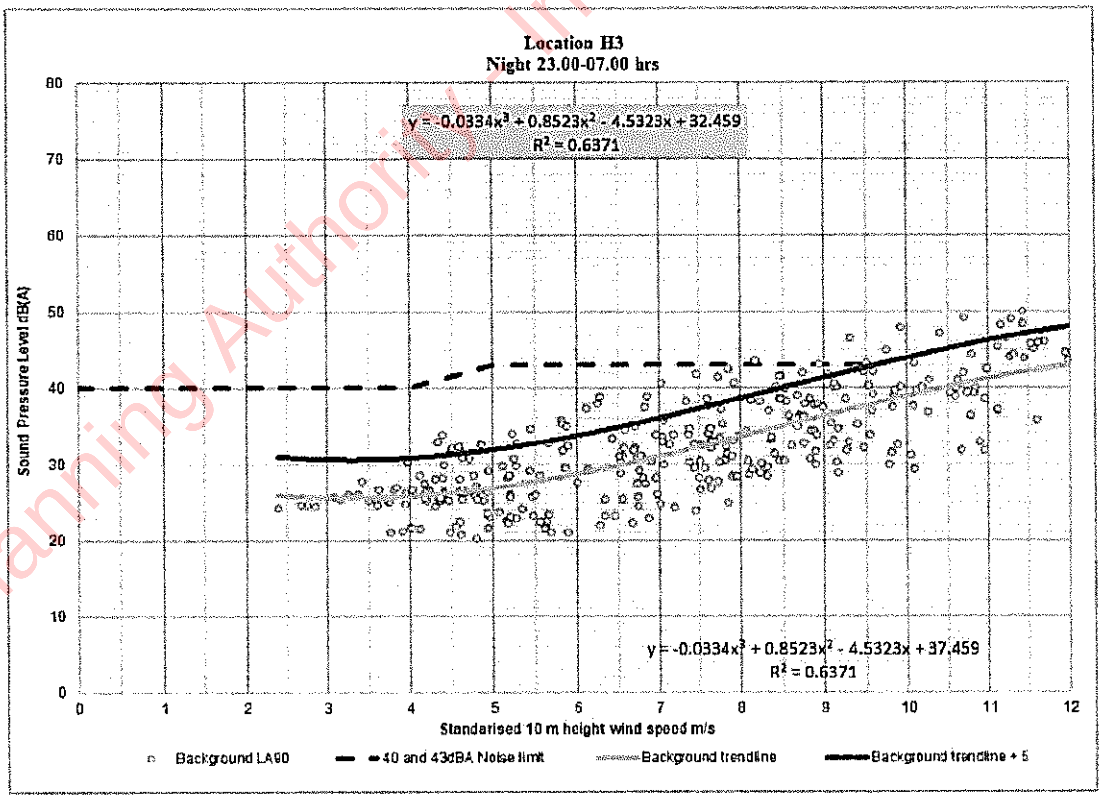


Chart 11.4: Night-time derived background for House H3

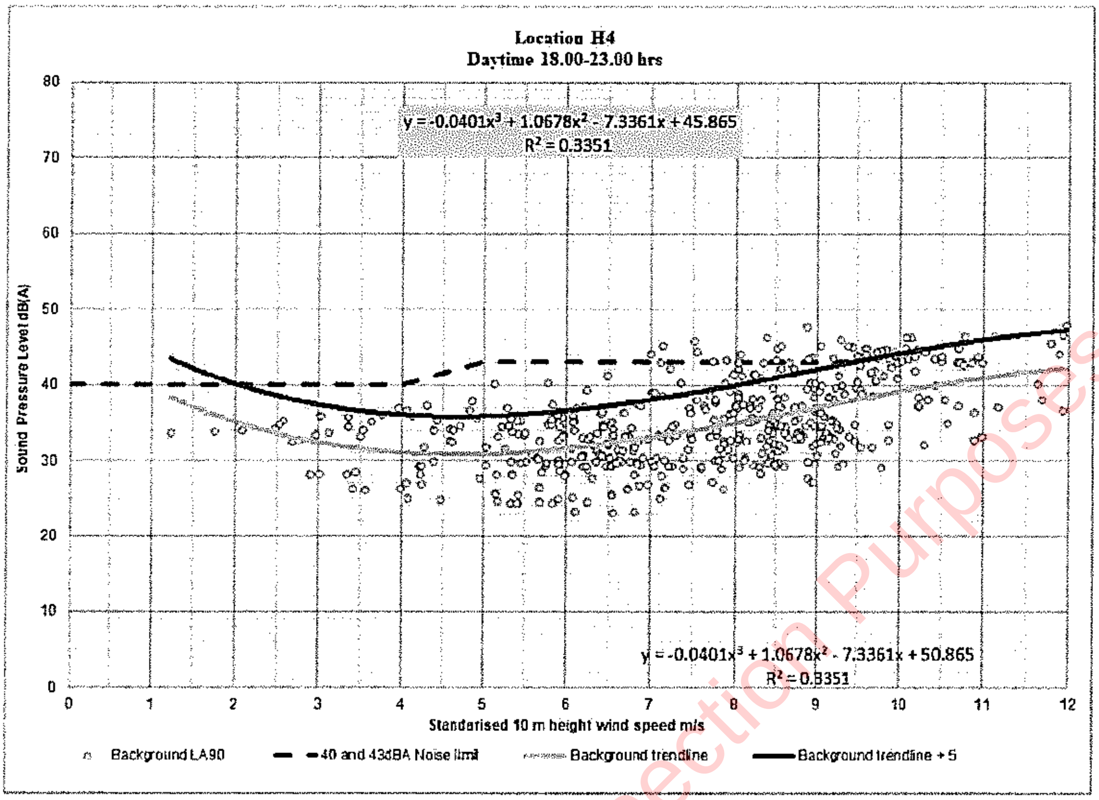


Chart 11.5: Quiet Daytime derived background for House H4

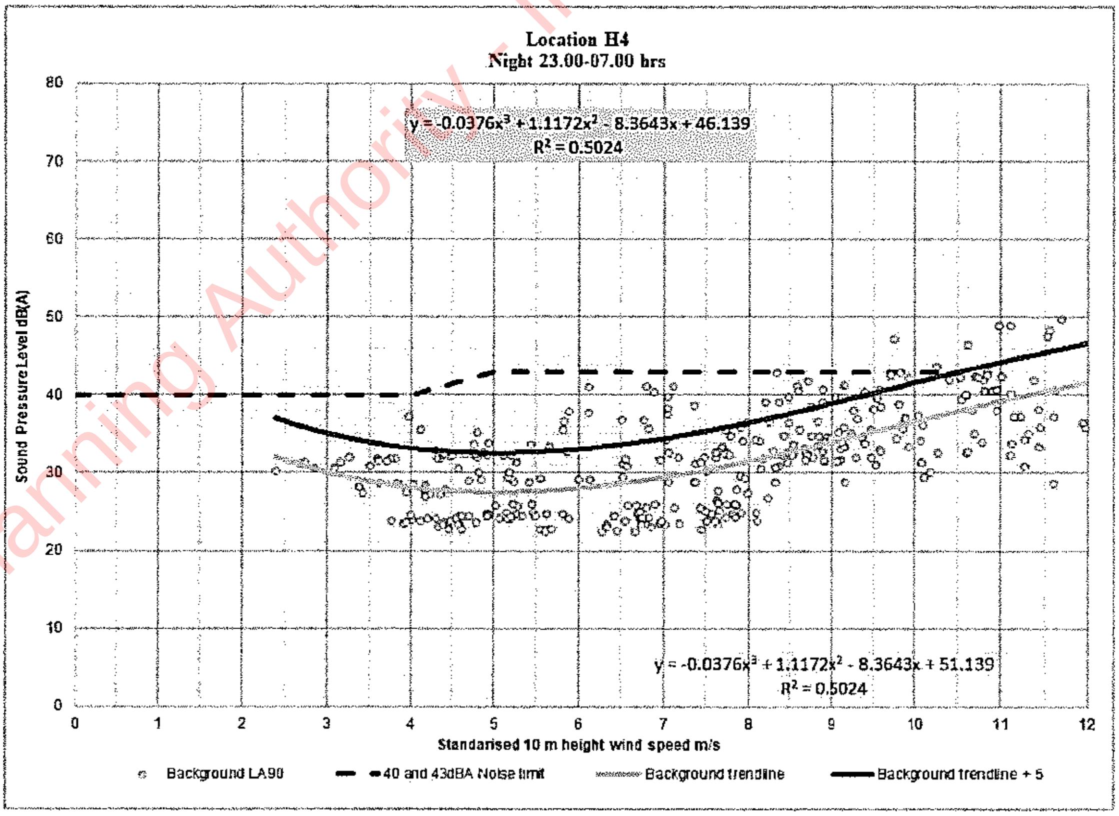


Chart 11.6: Night-time derived background for House H4

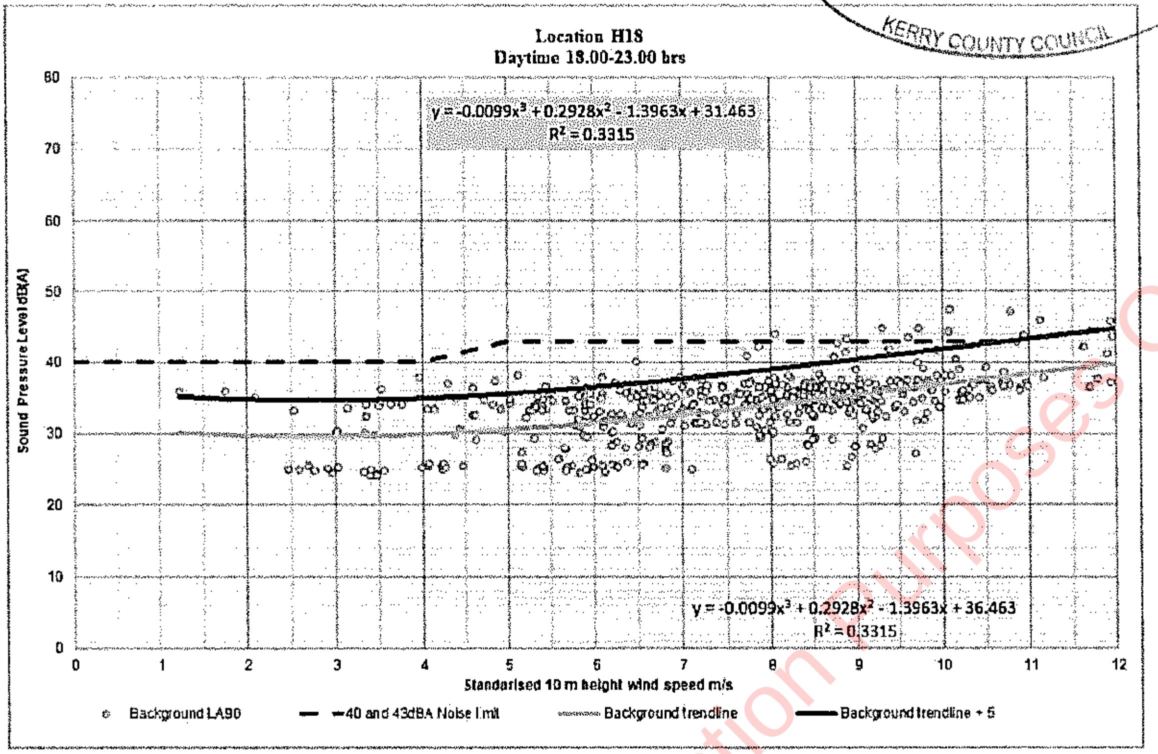


Chart 11.7: Quiet Daytime derived background for House H18

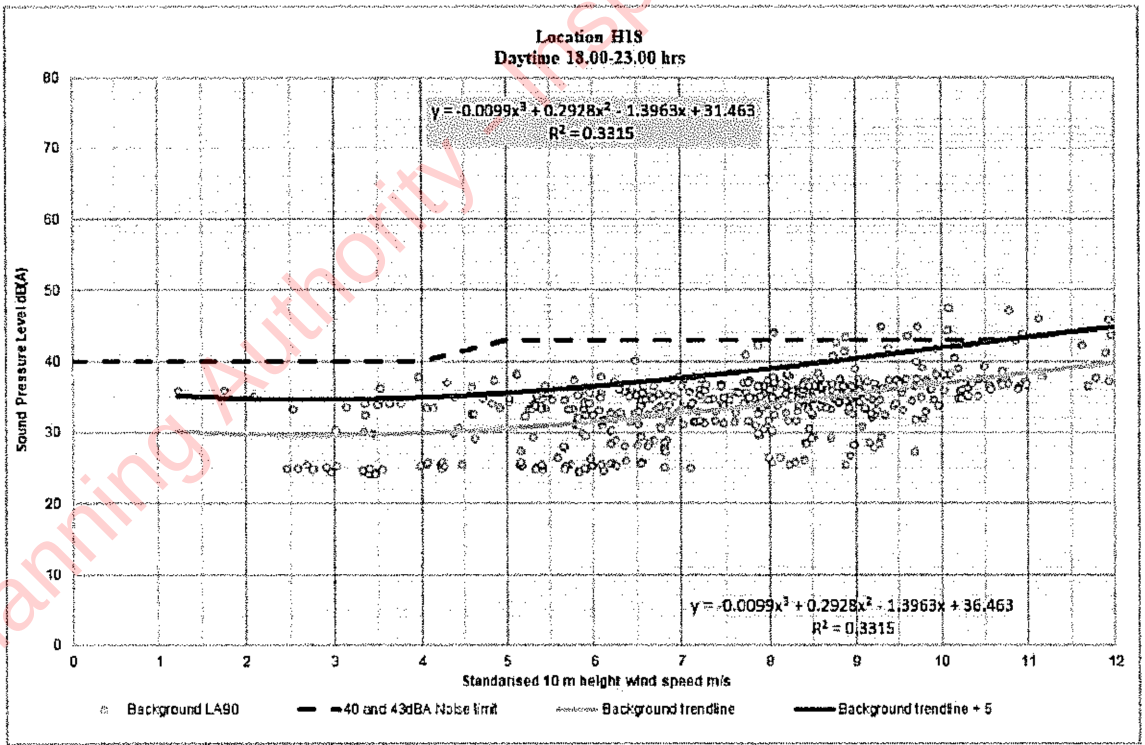


Chart 11.8: Night-time derived background for House H18

11.16.8 Cumulative Effects Assessment

There are 27 No. wind farms within a 20 km radius of the Development (detailed in **Appendix 2.2**). An assessment of these wind farm locations with regards to wind direction was completed to determine which have the potential for cumulative noise effects. The identified wind farms which were then assessed for cumulative effects are:

- Coolea (single turbine)
- Coolknoohil Inchee (2 turbines)
- Coolknoohil (11 turbines)
- Coomagearlahy Kilgarvan (15 turbines)
- Glanlee I (6 turbines)
- Gortnakilla, Clonkeen (4 turbines)
- Inchee, Poulbatha & Foilgreana (6 turbines)
- Inchincoosh Kilgarvan (6 turbines)
- Rosseigtragh, Lettercannon, Kilgarvan (7 turbines)

An assessment of the cumulative effects of noise from Inchamore wind farm together with the cumulative turbines of the aforementioned wind farms in the vicinity has been undertaken (see **Figure 11.3**).

11.16.8.1 Cumulative Assessment locations

The same receptor locations are considered in the cumulative assessment. The assessment is a worst-case scenario with the assumption made that the predicted noise levels to receptors are downwind from all wind farms and individual turbines at the same time, a scenario that cannot occur in practice.

11.16.8.2 Noise Limits

The noise limits are the same as that used for Inchamore Wind farm.

11.16.8.3 Cumulative Noise levels

Table 11.19 gives details of the predicted cumulative noise levels for the nearest receptors with the highest predicted noise levels. The receptor locations are the same as used in **Table 11.17.**

Table 11.19: Predicted cumulative noise levels at varying standardised 10 m height wind speed

House ID	ITM Easting	ITM Northing	3m/s dBA	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9+m/s dBA
H1	512160	578211	32.8	38.2	40.2	40.7	41.1	41.3	41.3
H2	513445	578031	32.4	38.4	40.2	40.4	40.6	40.7	40.7
H3	513072	579801	31.5	37.7	39.5	39.6	39.7	39.8	39.8
H4	514329	579384	30.9	37.2	39.0	39.1	39.1	39.1	39.1
H5	514339	577982	29.4	35.5	37.3	37.5	37.6	37.7	37.7
H6	514756	578856	28.9	35.2	37.0	37.1	37.1	37.1	37.1
H7	513435	577744	30.3	36.0	37.9	38.2	38.5	38.7	38.7
H8	512511	577570	30.1	34.8	36.8	37.7	38.4	38.8	38.8
H9	513762	577696	29.2	35.0	36.9	37.2	37.5	37.7	37.6
H10	513449	577603	29.3	34.9	36.8	37.2	37.6	37.8	37.8
H11	513566	577655	29.4	35.0	36.9	37.3	37.6	37.8	37.8
H12	514700	579510	27.3	33.5	35.3	35.4	35.5	35.5	35.5
H13	513505	577609	29.2	34.8	36.7	37.1	37.4	37.7	37.6
H14	513565	577612	29.1	34.8	36.6	37.1	37.4	37.6	37.6
H15	512009	577691	30.6	34.3	36.5	37.9	38.9	39.4	39.4
H16	513794	577514	28.1	33.6	35.5	36.0	36.3	36.6	36.5
H17	511756	577894	31.2	34.6	36.8	38.4	39.5	40.1	40.0
H18	511689	577885	31.3	34.3	36.6	38.3	39.5	40.2	40.1
H19	513838	580300	26.3	32.5	34.3	34.4	34.5	34.5	34.5
H20	513548	577431	28.2	33.5	35.4	36.0	36.4	36.7	36.7
H21	514950	577873	24.8	30.9	32.7	32.9	33.0	33.1	33.1
H22	515053	579406	25.1	31.3	33.2	33.2	33.3	33.3	33.3
H23	513747	577308	27.1	32.3	34.3	35.0	35.4	35.7	35.7
H24	514759	577513	24.5	30.3	32.2	32.5	32.7	32.9	32.9
H25	513572	577269	27.3	32.4	34.4	35.1	35.7	36.0	36.0
H26	513974	577197	26.2	31.3	33.2	34.0	34.5	34.8	34.8
H27	515322	579275	23.5	29.8	31.6	31.7	31.7	31.7	31.7
H28	513631	577179	26.9	31.8	33.8	34.6	35.2	35.5	35.5
H29	515488	579130	22.6	29.0	30.8	30.8	30.8	30.8	30.8
H30	514568	577209	24.3	29.6	31.5	32.1	32.6	32.8	32.8
H31	514413	577149	24.6	29.8	31.8	32.4	32.9	33.2	33.2
H32	511831	577246	30.5	32.6	35.1	37.4	38.8	39.5	39.4
H33	515603	579094	22.0	28.3	30.1	30.1	30.1	30.1	30.1
H34	512444	580689	24.7	30.2	32.1	32.5	32.8	33.1	33.0
H35	515614	578103	21.4	27.7	29.5	29.5	29.5	29.5	29.5

House ID	ITM Easting	ITM Northing	3m/s dBA	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9+m/s dBA
H36	515672	578122	21.1	27.4	29.2	29.2	29.2	29.2	29.2
H37	515646	578046	21.1	27.4	29.2	29.2	29.2	29.2	29.2
H38	515525	579630	21.6	27.9	29.7	29.7	29.7	29.7	29.7
H39	515332	577403	21.0	27.2	29.0	29.1	29.2	29.3	29.2

A noise contour map of the cumulative effects of all turbines is presented with a maximum sound power output at a wind speed of 8+ms^{-1} at 10 m height in **Figure 11.3**. The contour map in **Figure 11.3** assumes that all turbines are simultaneously downwind at the same time to each location which results in an overprediction of the noise levels.

11.16.8.4 Cumulative Noise Assessment

Table 11.20 gives the difference (margin) between the predicted noise level in **Table 11.19** and noise limits for each receptor. A negative margin indicates that the predicted noise levels are within the lower 40 dBA L90 limit at wind speeds below 5 m/s and within the 43 dBA L90 limit at all other wind speeds.

Table 11.20: Margin between predicted cumulative noise levels, LA 90, 40 dB limit at wind speeds less than 5 m/s and LA90, 43 dB for all other Wind Speeds

House ID	ITM Easting	ITM Northing	3m/s dBA	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9+m/s dBA
H1	512160	578211	-7.2	-1.8	-2.8	-2.3	-1.9	-1.7	-1.7
H2	513445	578031	-7.6	-1.6	-2.8	-2.6	-2.4	-2.3	-2.3
H3	513072	579801	-8.5	-2.3	-3.5	-3.4	-3.3	-3.2	-3.2
H4	514329	579384	-9.1	-2.8	-4.0	-3.9	-3.9	-3.9	-3.9
H5	514339	577982	-10.6	-4.5	-5.7	-5.5	-5.4	-5.3	-5.3
H6	514756	578856	-11.1	-4.8	-6.0	-5.9	-5.9	-5.9	-5.9
H7	513435	577744	-9.7	-4.0	-5.1	-4.8	-4.5	-4.3	-4.3
H8	512511	577570	-9.9	-5.2	-6.2	-5.3	-4.6	-4.2	-4.2
H9	513762	577696	-10.8	-5.0	-6.1	-5.8	-5.5	-5.3	-5.4
H10	513449	577603	-10.7	-5.1	-6.2	-5.8	-5.4	-5.2	-5.2
H11	513566	577655	-10.6	-5.0	-6.1	-5.7	-5.4	-5.2	-5.2
H12	514700	579510	-12.7	-6.5	-7.7	-7.6	-7.5	-7.5	-7.5
H13	513505	577609	-10.8	-5.2	-6.3	-5.9	-5.6	-5.3	-5.4
H14	513565	577612	-10.9	-5.2	-6.4	-5.9	-5.6	-5.4	-5.4

House ID	ITM Easting	ITM Northing	3m/s dBA	4m/s dBA	5m/s dBA	6m/s dBA	7m/s dBA	8m/s dBA	9+m/s dBA
H15	512009	577691	-9.4	-5.7	-6.5	-5.1	-4.1	-3.6	-3.6
H16	513794	577514	-11.9	-6.4	-7.5	-7.0	-6.7	-6.4	-6.5
H17	511756	577894	-8.8	-5.4	-6.2	-4.6	-3.5	-2.9	-3.0
H18	511689	577885	-8.7	-5.7	-6.4	-4.7	-3.5	-2.8	-2.9
H19	513838	580300	-13.7	-7.5	-8.7	-8.6	-8.5	-8.5	-8.5
H20	513548	577431	-11.8	-6.5	-7.6	-7.0	-6.6	-6.3	-6.3
H21	514950	577873	-15.2	-12.1	-10.3	-10.1	-10.0	-9.9	-9.9
H22	515053	579406	-14.9	-8.7	-9.8	-9.8	-9.7	-9.7	-9.7
H23	513747	577308	-12.9	-7.7	-8.7	-8.0	-7.6	-7.3	-7.3
H24	514759	577513	-15.5	-9.7	-10.8	-10.5	-10.3	-10.1	-10.1
H25	513572	577269	-12.7	-7.6	-8.6	-7.9	-7.3	-7.0	-7.0
H26	513974	577197	-13.8	-8.7	-9.8	-9.0	-8.5	-8.2	-8.2
H27	515322	579275	-16.5	-10.2	-11.4	-11.3	-11.3	-11.3	-11.3
H28	513631	577179	-13.1	-8.2	-9.2	-8.4	-7.8	-7.5	-7.5
H29	515488	579130	-17.4	-11.0	-12.2	-12.2	-12.2	-12.2	-12.2
H30	514568	577209	-15.7	-10.4	-11.5	-10.9	-10.4	-10.2	-10.2
H31	514413	577149	-15.4	-10.2	-11.2	-10.6	-10.1	-9.8	-9.8
H32	511831	577246	-9.5	-7.4	-7.9	-5.6	-4.2	-3.5	-3.6
H33	515603	579094	-18.0	-11.7	-12.9	-12.9	-12.9	-12.9	-12.9
H34	512444	580689	-15.3	-9.8	-10.9	-10.5	-10.2	-9.9	-10.0
H35	515614	578103	-18.6	-12.3	-13.5	-13.5	-13.5	-13.5	-13.5
H36	515672	578122	-18.9	-12.6	-13.8	-13.8	-13.8	-13.8	-13.8
H37	515646	578046	-18.9	-12.6	-13.8	-13.8	-13.8	-13.8	-13.8
H38	515525	579630	-18.4	-12.1	-13.3	-13.3	-13.3	-13.3	-13.3
H39	515332	577403	-19.0	-12.8	-14.0	-13.9	-13.8	-13.7	-13.8

It can be seen from **Table 11.19** and **Table 11.20** that the predicted cumulative impact does not exceed the lower 40dBA L90 limit at wind speeds below 5 m/s or the 43dBA L90 limit at all other wind speeds.

11.17 MITIGATION MEASURES AND RESIDUAL EFFECTS

11.17.1 Construction Noise Mitigation

No significant construction noise effects have been identified. Therefore, no specific mitigation measures are required. General guidance for controlling construction noise through the use of good practice given in BS 5228 will be followed. During construction of the Project activity shall be limited to working times, except where delivery of large transport loads such as the turbines, where it may be necessary to transport outside of daytime hours.

During decommissioning noise levels are likely to be no more than predicted in **Table 11.15** as similar plant will be utilised. Any legislation, guidance or best practice relevant at the time of decommissioning will be complied with. All construction is a temporary day time activity.

11.17.2 Residual Construction and Decommissioning Effects

The residual effects are the same as the construction and decommissioning effects identified in this assessment.

11.17.3 Operational Noise Mitigation

The Project has been designed to comply with best practice, the Wind Energy Development Guidelines 2006 and recent September 2022 ABP noise limits.

All 5 turbines will have as standard STE fitted as best practice to reduce noise levels so no mitigation is required.

A warranty will be provided from the manufacturer of the turbine selected for the Project in order to ensure that the turbine selected does not require a tonal noise correction.

11.17.4 Residual Operational Effects

The residual effects are the same as the operational effects identified in this assessment.

11.17.5 Cumulative Effects

An assessment of the cumulative effects of noise from the Project together with the cumulative turbines in the nine wind farms in the vicinity have been predicted and assessed and found to be in compliance with the noise limits set in the Wind Energy Development Guidelines 2006.

11.18 SUMMARY OF SIGNIFICANT EFFECTS

Table 11.21 below summarises the effects.

Table 11.21: Summary of Effects

	Quality	Significance	Duration
Construction noise	Negative	Not significant	Temporary
Blasting Vibration	Negative	Not Significant	Momentary
Operational Noise	Negative	Not Significant	Long Term

11.19 STATEMENT OF SIGNIFICANCE

This Section has assessed the significance of the potential effects of the Project during operation, construction and decommissioning.

The effects of noise from the operation of the Project have been assessed using the methodology in the 2006 Guidelines, the methodology described in ETSU-R-97 and the IOA Good Practice Guide. Noise levels during operation of the Project have been predicted using the best practice calculation technique and compared with the noise limits in the 2006 Guidelines.

The draft 2019 Wind Energy Development Guidelines are subject to review and are liable to be changed.

It is understood that there are likely revisions to the draft consultation documents, however a mitigation strategy to incorporate a reduction in sound power level outputs with respect to directionality can be put in place to comply with any specific variation in noise limit levels if new guidelines are adopted. All turbines have software control incorporated so that the sound power levels can be reduced by direction and energy output.

Noise and vibration during construction and operation will comply with the guidelines already given. Noise and vibration during decommissioning of the wind farm will be managed to comply with best practice, legislation and guidelines current at that time so that effects are not significant.

12 LANDSCAPE AND VISUAL AMENITY

12.1 INTRODUCTION

This chapter assesses the impacts of the Project on landscape and visual amenity. The Project refers to all elements of the application for the proposed Inchamore Wind Farm (see **Chapter 2: Project Description**). The assessment will consider the potential effects during the following phases of the Development:

- Construction of the Project;
- Operation of the Project, and
- Decommissioning of the Project.

Common acronyms used throughout this EIAR can be found in **Appendix 1.2.** This chapter of the EIAR is supported by Figures provided in Volume III and by the following Appendix documents provided in Volume IV of this EIAR:

- **Appendix 12.1 – Visual Impact Assessments at Selected Viewpoints**
- **Appendix 12.2 – Cumulative Impact Analysis at Selected Viewpoints**

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

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

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

This Landscape and Visual Impact Assessment (LVIA) uses methodology as prescribed in the following guidance documents:

- Environmental Protection Agency publication 'Guidelines on the Information to be contained in Environmental Impact Assessment Reports (2022) and the accompanying Advice Notes on Current Practice in the Preparation of Environmental Impact Statements (Draft 2015).
- Landscape Institute and the Institute of Environmental Management and Assessment publication entitled Guidelines for Landscape and Visual Impact Assessment (GLVIA) – Third Edition (2013).
- Scottish Natural Heritage Guidance Note: Cumulative Effect of Wind Farms (2012).
- Department of the Environment, Heritage and Local Government Wind Energy Development Guidelines (2006).
- Scottish Natural Heritage Visual representation of wind farms: Best Practice Guidelines (version 2.2 - 2017).

12.1.1 Statement of Authority

This Landscape and Visual Impact Assessment was prepared Richard Barker, Principal Landscape Architect at Macro Works Ltd, a specialist LVIA company with over 20 years' experience in the appraisal of effects from a variety of energy, infrastructure and commercial developments. Relevant experience includes LVIA work on over 140 on-shore wind farm proposals throughout Ireland, including six Strategic Infrastructure Development (SID) wind farms. Macro Works and its senior staff members are affiliated with the Irish Landscape Institute.

12.1.2 Description of the Project

The full description of the Project assessed hereunder is contained in Chapter 2 of the EIAR Project Description.

12.1.3 Definition of Study Area

The Wind Energy Development Guidelines published by the Department of the Environment, Heritage and Local Government (current 2006 and Draft Revised 2019) specify different radii for examining the Zone of Theoretical Visibility (ZTV) of proposed wind farm projects. The extent of this search area is influenced by turbine height, as follows:

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

In the case of this Project, the blade tips will range between 177 m and 185 m high. Thus, the minimum ZTV radius recommended is 20 km from the outermost turbines of the scheme. There are not considered to be any sites of national or international importance between 20 – 25 km and thus, the radius of the study area is considered acceptable at 20 km. Notwithstanding the full 20 km extent of the LVIA study area, there will be a particular focus on receptors and effects within the central study where there is higher potential for significant impacts to occur due to closer proximity to the proposed wind farm. When referenced within this assessment, the 'central study area' is the landscape within 5 km of the Site.

12.1.4 Assessment Structure

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

- Assessment of landscape value and sensitivity;
- Assessment of the magnitude of landscape effects;
- Assessment of the significance of landscape impacts;
- Assessment of visual receptor sensitivity;
- Assessment of visual impact magnitude at representative viewpoint locations (using photomontages);
- Assessment of visual impact significance, and
- Assessment of cumulative landscape and visual impacts.

12.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

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

12.2.1 Desktop Study

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

12.2.2 Fieldwork

- Recording of a description of the landscape elements and characteristics within the Study Area.
- Selection of a refined set of viewpoints for assessment based on relevance and the degree of intervening screening. This includes the capture of reference images and grid reference coordinates for each VRP location for the visualisation specialist to prepare photomontages.

12.2.3 Appraisal

- Consideration of the receiving landscape with regard to overall landscape character as well as the salient features of the study area including landform, drainage, vegetation, land use and landscape designations.
- Consideration of the visual environment including receptor locations such as centres of population and houses; transport routes; public amenities and facilities and; designated and recognised views of scenic value.
- Consideration of design guidance and planning policies.
- Consideration of potentially significant effects and the mitigation measures that could be employed to reduce such effects.
- Consideration of the significance of residual landscape impacts.
- Consideration of the significance of residual visual impacts aided by photomontages prepared at the selected viewpoint locations.
- Consideration of cumulative landscape and visual effects in combination with other surrounding developments that are existing, permitted or proposed (in planning awaiting a decision or pre-planning/concept – where information is publicly available).

12.2.4 Assessment Criteria for Landscape Impacts

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

- Landscape character, value and sensitivity;
- Magnitude of likely impacts; and
- Significance of landscape effects.

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

Value and Sensitivity is classified using criteria derived for the Guidelines for Landscape and Visual Impact Assessment in **Table 12.1**.

Table 12.1: Landscape Value and Sensitivity

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

The magnitude of a predicted landscape impact is a product of the scale, extent or degree of change that is likely to be experienced as a result of the Project. The magnitude takes into account whether there is a direct physical impact resulting from the loss of landscape components and/or a change that extends beyond the proposal Site boundary that may have an effect on the landscape character of the area, as outlined in **Table 12.2** below derived for the Guidelines for Landscape and Visual Impact Assessment.

Table 12.2: Magnitude of Landscape Impacts

Sensitivity	Description
Very High	Change that would be large in extent and scale with the loss of critically important landscape elements and features, that may also involve the introduction of new uncharacteristic elements or features that contribute to an overall change of the landscape in terms of character, value and quality.
High	Change that would be more limited in extent and scale with the loss of important landscape elements and features, that may also involve the introduction of new

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

The significance of a landscape impact is based on a balance between the sensitivity of the landscape receptor and the magnitude of the impact. The significance of landscape impacts is arrived at using **Table 12.3** below.

Table 12.3: Impact Significance Matrix

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

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

12.2.5 Assessment Criteria for Visual Impact

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

12.2.5.1 Visual Sensitivity

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

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

Susceptibility of receptor group to changes in view

This is one of the most important criteria to consider in determining overall visual sensitivity because it is the single category dealing with viewer susceptibility. In accordance with the IEMA Guidelines for Landscape and Visual Assessment (3rd edition 2013) visual receptors most susceptible to changes in views and visual amenity are:

- Residents at home;
- People, whether residents or visitors, who are engaged in outdoor recreation, including use of public rights of way, whose attention or interest is likely to be focussed on the landscape and on particular views;
- Visitors to heritage assets, or to other attractions, where views of the surroundings are an important contributor to the experience;
- Communities where views contribute to the landscape setting enjoyed by residents in the area; and
- Travellers on road rail or other transport routes where such travel involves recognised scenic routes and awareness of views is likely to be heightened.

Visual receptors that are less susceptible to changes in views and visual amenity include:

- People engaged in outdoor sport or recreation, which does not involve or depend upon appreciation of views of the landscape; and
- People at their place of work whose attention may be focussed on their work or activity, not their surroundings and where the setting is not important to the quality of working life.

12.2.5.1.1 Values typically associated with Visual Amenity

Recognised scenic value of the view

These are usually represented by County Development Plan designations, guidebooks, touring maps, postcards. These represent a consensus in terms of which scenic views and routes within an area are strongly valued by the population because in the case of County Development Plans, at least, a public consultation process is required;

Views from within highly sensitive landscape areas. Again, highly sensitive landscape designations are usually part of a county's Landscape Character Assessment, which is then incorporated with the County Development Plan and is therefore subject to the public consultation process. Viewers within such areas are likely to be highly attuned to the landscape around them;

Intensity of use, popularity.
Whilst not reflective of the amenity value of a view, this criterion relates to the number of viewers likely to experience a view on a regular basis and whether this is significant at county or regional scale;

Connection with the landscape.
This considers whether or not receptors are likely to be highly attuned to views of the landscape i.e., commuters hurriedly driving on busy national route versus hill walkers directly engaged with the landscape enjoying changing sequential views over it;

Provision of elevated panoramic views.
This relates to the extent of the view on offer and the tendency for receptors to become more attuned to the surrounding landscape at locations that afford broad vistas;

Sense of remoteness and/or tranquillity.
Remote and tranquil viewing locations are more likely to heighten the amenity value of a view and have a lower intensity of development in comparison to dynamic viewing locations such as a busy street scene, for example;

Degree of perceived naturalness.
Where a view is valued for the sense of naturalness of the surrounding landscape it is likely to be highly sensitive to visual intrusion by obvious human interventions;

Presence of striking or noteworthy features.
A view might be strongly valued because it contains a distinctive and memorable landscape feature such as a promontory headland, lough or castle;

Historical, cultural or spiritual value.
Such attributes may be evident or sensed at certain viewing locations that attract visitors for the purposes of contemplation or reflection heightening the sense of their surroundings;

Rarity or uniqueness of the view.

This might include the noteworthy representativeness of a certain landscape type and considers whether other similar views might be afforded in the local or the national context;

Integrity of the landscape character in view.

This criterion considers the condition and intactness of the landscape in view and whether the landscape pattern is a regular one of few strongly related components or an irregular one containing a variety of disparate components;

Sense of place.

This criterion considers whether there is special sense of wholeness and harmony at the viewing location; and

Sense of awe.

This criterion considers whether the view inspires an overwhelming sense of scale or the power of nature.

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

12.2.5.2 Visual Impact Magnitude

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

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

For wind energy developments, a strong visual presence is not necessarily synonymous with adverse impact. Instead, the 2012 Fáilte Ireland survey entitled 'Visitor Attitudes On The Environment – Wind Farms' found that *"Compared with other types of development in the Irish landscape, wind farms elicited a positive response when compared to telecommunication masts and steel electricity pylons"*.... and that *"most* (tourists) *felt that their presence did not detract from the quality of their sightseeing, with the largest proportion (45%) saying that the presence of the wind farm had a positive impact on their enjoyment of sightseeing…"*.

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

It should be noted that as a result of this two-sided analysis, a high order visual presence can be moderated by a low level of effect on visual amenity and vice versa. Given that wind turbines do not represent significant bulk, visual impacts result almost entirely from visual 'intrusion' rather than visual 'obstruction' (the blocking of a view). The magnitude of visual impacts classified in **Table 12.4** derived from the Guidelines for Landscape and Visual Impact Assessment:

Table 12.4: Magnitude of Visual Impacts

Sensitivity	Description
Very High	The proposal intrudes into a large proportion or critical part of the available vista and is without question the most noticeable element. A high degree of visual clutter or disharmony is also generated, strongly reducing the visual amenity of the scene
High	The proposal intrudes into a significant proportion or important part of the available vista and is one of the most noticeable elements. A considerable degree of visual clutter or disharmony is also likely to be generated, appreciably reducing the visual amenity of the scene
Medium	The proposal represents a moderate intrusion into the available vista, is a readily noticeable element and/or it may generate a degree of visual clutter or disharmony,

Sensitivity	Description
	thereby reducing the visual amenity of the scene. Alternatively, it may represent a balance of higher and lower order estimates in relation to visual presence and visual amenity
Low	The proposal intrudes to a minor extent into the available vista and may not be noticed by a casual observer and/or the proposal would not have a marked effect on the visual amenity of the scene
Negligible	The proposal would be barely discernible within the available vista and/or it would not detract from, and may even enhance, the visual amenity of the scene

12.2.6 Visual Impact Significance

As stated above, the significance of visual impacts is a function of visual receptor sensitivity and visual impact magnitude. This relationship is expressed in the same significance matrix included for Landscape Impact Significance at **Error! Reference source not found.**

12.2.7 Quality and Duration of Effects

In addition to assessing the significance of landscape effects and visual effects, EPA Guidance (2022) requires that the quality of the effects is also determined. This could be negative/adverse, neutral, or positive/beneficial.

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

The same EPA guidelines also set out categories of impact duration:

- Temporary – Lasting for one year or less;
- Short Term – Lasting one to seven years;
- Medium Term – Lasting seven to fifteen years;
- Long Term – Lasting fifteen years to sixty years; and
- Permanent – Lasting over sixty years.

In the case of commercial wind energy developments and the associated introduction of new moving structures within rural and upland areas, the quality of landscape and visual effects will almost always be negative, rather than positive or even neutral. Unless otherwise stated, the quality of landscape and visual effect judgements herein can be taken as negative.

In terms of duration, the proposed turbines will have a Long Term impact as the permission is being sought for a 35 year period after which the turbines will be decommissioned. Some other elements of the Project relating to access tracks and elements of the grid connection will remain in perpetuity and will therefore have Permanent effects.

12.2.8 Assessment Criteria for Cumulative Effects

The Scottish Natural Heritage Guidance relating to 'Assessing the Cumulative Effects of Onshore Wind Farms (2018) identify that cumulative impacts on visual amenity consist of combined visibility and sequential effects. The same categories have also been adopted in the Landscape Institute's 2013 revision of the Landscape and Visual Impact Assessment Guidelines. The principal focus of wind energy cumulative impact assessment guidance relates to other wind farms - as opposed to other forms of development. This will also be the main focus herein, albeit with a subsequent consideration of cumulative impacts with other forms of notable development (existing, permitted or proposed), particularly within the central study area.

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

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

Cumulative impacts of wind farms tend to be adverse rather than positive as they relate to the addition of moving manmade structures into a landscape and viewing context that already contains such development. Based on guidance contained within the SNH Guidelines relating to the Cumulative Effects of Wind Farms (2012) and the DoEHLG Wind Energy Guidelines (2006), cumulative impacts can be experienced in a variety of ways.

Table 12.5 provides Macro Works' criteria for assessing the magnitude of cumulative impacts, which are based on the SNH Guidelines (2018).

Table 12.5: Magnitude of Cumulative Impacts

Magnitude of Impact	Description
Very High	• The proposed wind farm will strongly contribute to wind energy development being the defining element of the surrounding landscape. • It will strongly contribute to a sense of wind farm proliferation and being surrounded by wind energy development. • Strongly adverse visual effects will be generated by the proposed turbines in relation to other turbines.
High	• The proposed wind farm will contribute significantly to wind energy development being a defining element of the surrounding landscape. • It will significantly contribute to a sense of wind farm proliferation and being surrounded by wind energy development. • Significant adverse visual effects will be generated by the proposed turbines in relation to other turbines.
Medium	• The proposed wind farm will contribute to wind energy development being a characteristic element of the surrounding landscape. • It will contribute to a sense of wind farm accumulation and dissemination within the surrounding landscape. • Adverse visual effects might be generated by the proposed turbines in relation to other turbines.
Low	• The proposed wind farm will be one of only a few wind farms in the surrounding area and will be viewed in isolation from most receptors. • It might contribute to wind farm development becoming a familiar feature within the surrounding landscape. • The design characteristics of the proposed wind farm accord with other schemes within the surrounding landscape and adverse visual effects are not likely to occur in relation to these.
Negligible	• The proposed wind farm will most often be viewed in isolation or occasionally in conjunction with other distant wind energy developments. • Wind energy development will remain an uncommon landscape feature in the surrounding landscape. • No adverse visual effects will be generated by the proposed turbines in relation to other turbines.

12.3 BASELINE DESCRIPTION

12.3.1 Landscape Baseline

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

A description of the landscape context of the Project and wider study area is provided below. Additional descriptions of the landscape, as viewed from each of the selected viewpoints, are provided under the detailed assessments later using a similar structure. Although this description forms part of the landscape baseline, many of the landscape elements identified also relate to visual receptors i.e., places and transport routes from which viewers can potentially see the Project. The visual resource will be described in greater detail in **Section 12.4** below.

12.3.1.1 Landform & Drainage

Overall, the study area is characterised by a notable variance of landform, which arises from wide, lowland valleys less than 100 m AOD, to mountain tops over 800 m AOD; ranges mostly angled in a north-east/south-west direction. In terms of drainage, there is an abundance of rivers, streams and, to a lesser extent, loughs and lakes throughout the study area.

<u>The Site</u>

Landform within the Site is notably upland and sloping, with considerable variance in terrain elevation. The Derrynasaggart ridgeline marks the Site's northern/ north-western boundary, peaking at 460 m AOD with the lowest terrain of the Site dropping to approx. 270 m AOD. In the east of the Site, two small streams flow north-south to drain a bowl-like, upland tributary valley, while in the west of the Site are a further three streams. All five of these streams feed into the Inchamore Stream, which in turn flows into the Bardinch and Sullane Rivers flowing east towards Ballyvourney.

Plate 12.1: Bowl-like, upland tributary valley in the east of the Site

Central study area:

The principle landform within the Site and its immediate vicinity, as well as the central study area, is that of the Derrynasaggart Mountains that align a section of the mid Cork-Kerry border, and which reach 694 m AOD at their highest. The central study area is characterised by mountains and hillscapes with relatively narrow, visually enclosed valleys between these elevations. Within approx. 700 m west of the Site is Coomagearlahy Mountain (506 m AOD.) In the north of the central study area is the Owengarve and Clydagh Rivers, north of which are the various foothills that ascend towards the Paps of Anu, approx. 6.5 km north of the Site: a pair of similarly-shaped mountains adjacent to each other, both between 690-694 m AOD. Along or near such ridgelines are multiple corrie lakes and/or small mountain loughs. In the south of the central study area, landform is marginally lower, with it gravitating between 400-500 m AOD at hill tops in the south-western quadrant, before largely dropping between 200-300 m AOD in the south-east and east of the central study area, particularly along the wider, U-shaped valley carved out by the Sullane River.

5-10 km away:

Between 5-10 km from the Site, there are also several notable mountains, aside from the aforementioned Paps. These include Caherbarnagh (681 m AOD) and Mullaghanish (649 m AOD) in the northeast and Crohane (656 m AOD) in the northwest, while in the south, the landform is marginally less dramatic, excepting summits such as Mweelin (487 m AOD) and Carrigalougha (423 m AOD), approx. 7 km south of the Site. To the east and southeast, topography mostly lowers to less than 250 m AOD, with increasingly wider, lower valleys. The Sullane River is dominant in this section, fed by its tributary, the River Douglas. Other rivers of note 5-10 km from the Site include the Toon (southeast), the Roughty (southwest) and the Owenskeagh (north).

10-20 km away:

Between 10-20 km from the Site, there is considerably greater diversity in landform. In terms of scale, the most apparent is Mangerton (843 m AOD), followed by Torc Mountain (535 m AOD), which lie 14-15 km west of the Site. Carran (604 m AOD) and Coomataggart (530 m AOD) are located in the south-west. More than 15 km to the south is Carrigmount (546 m AOD), Douce (476 m AOD) and Doughhill (471 m AOD) mountains, though terrain is considerably lower in the south-eastern quadrant. Beyond 10 km to the north and north-east, terrain is distinctively lower than that of the Paps, rarely lifting above 200 m. However, more than 10 km due east of the Site, land lifts to 497 m AOD at the summit of Musherbeg.

In terms of watercourses, more than 10 km from the Site is the Blackwater, Beheenagh and Awnaskirtaun Rivers in the north and northwest, as well as the Foherish, Garrane and Keel Rivers in the east of the study area. The Bunsheelin, Owengariff and Lee Rivers are found in the south, with the Slaheny River, the Roughty River and its tributary, the Owbeg, in the south-west. In addition, larger lakes can be found within the study area. Lough Allua in the south and Gougane Barra in the south-west are well known, but the largest lakes of the study area reside in the north-west: Lough Guitane, Muckross Lake and Lough Leane.

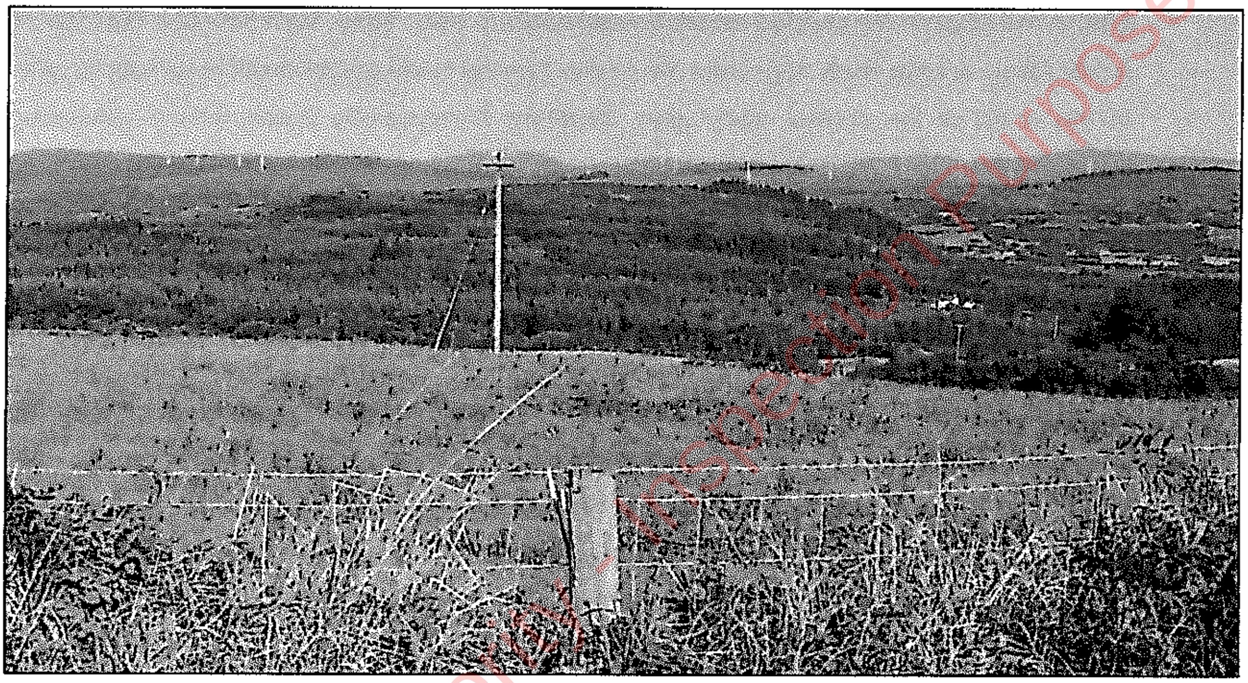


Plate 12.2: Landform in the south of the Study Area

Plate 12.3: Mountainous profile within the Study Area

12.3.1.2 Vegetation & Land Use

There is considerable variance of vegetation and land use across the study area, ranging from intensive pastoral agriculture upon the lowlands, to more marginal agriculture and commercial forestry in more elevated, yet accessible lands, to unmanaged upland and mountain heath and bog.

The Site:

The Site spans approx. 4 km in a northeast-southwest direction, covering a variety of land uses with an evident anthropocentric imprint. In the east of the Site, within the aforementioned bowl-like valley, commercial conifer plantations at various stages of the maturation/harvesting cycle are prevalent on the upper slopes. Marginal, rush-infested, pastoral agriculture is dominant in the floor of this tributary valley. Although an upland, marginal context, there is considerable evidence of a strong anthropocentric imprint along these upland slopes, in the form of drainage excavations and multiple vehicular tracks, of various ages and conditions.

In the central south of the Site, a large, triangular block of commercial forestry is present, immediately north of which are a derelict building and numerous vehicular tracks ascending up the hillside. Upland heath dominates the upper slopes, as it scales up to the ridgeline of the range, which marks the Site's northern/ north-western boundary as well as the Cork/ Kerry border. Here there is evidence of considerable drainage excavations and multiple vehicular tracks.

The south-western part of the Site is also dominated by commercial conifer plantations at various stages of the maturation/harvesting cycle. However, a wide, private vehicular track passes through this segment of the Site, and appears to be connecting wind turbines on adjacent lands to the Site.

Central study area:

While pastoral agriculture is prevalent in the south-eastern quadrant of the central study area, most other areas of agriculture tend to be marginal pasture in a small, sometimes poorly drained fields. More patent is the uplands/mountains that share a combination of commercial conifer plantations and upland/mountain heath, with evidence of multiple wind farms along or below ridgelines within, or close to, the central study area. Immediately adjoining the western perimeter of the Site, in County Kerry, is the Coomagearlahy Wind farm, with at least one turbine located within 250 m of the Site boundary, and just to the south of that is the Glanlee (Midas) wind farm.

Within the relatively narrow, visually enclosed, lowland valleys between the high hills and mountains, there is some evidence of intensive pastoral practises in medium-sized fields. In addition, there are roads and just one settlement: the village of, located approx. 3 km south-east of the Development.

Plate 12.4: Coolea village within the central Study Area

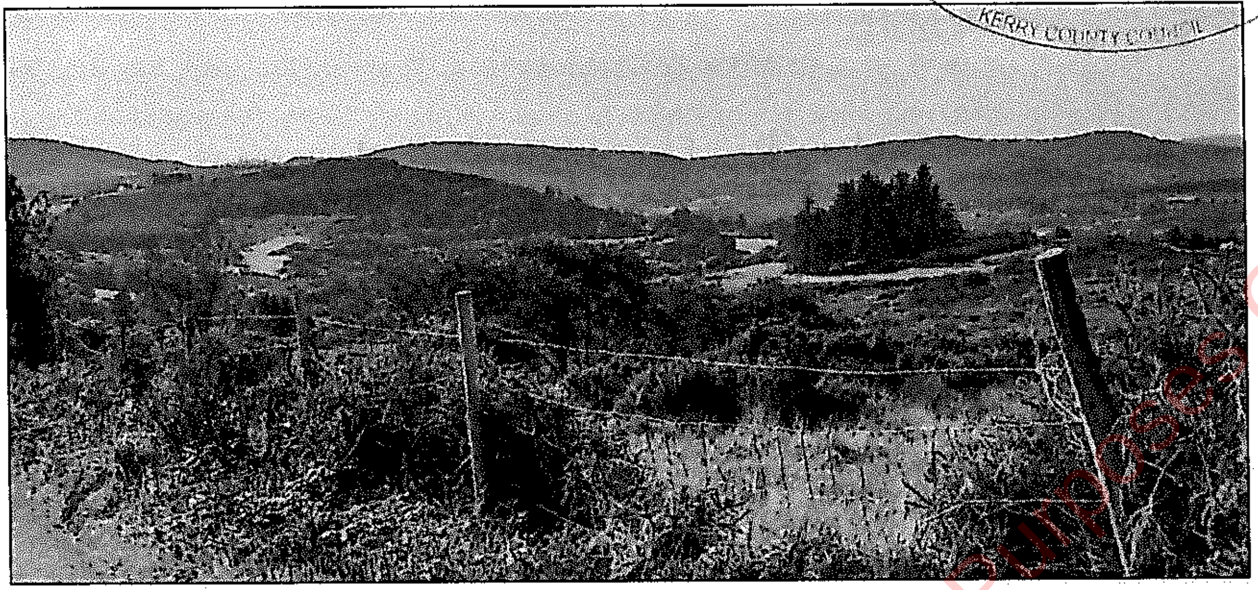


Plate 12.5: Wind farms across ridgelines within or close to the Study Area

Wider study area (i.e. 5-20 km away):

The variance of vegetation and land use in the wider study area broadly mirrors that of the central study area. However, in the south-east quadrant and more than 10 km north of the Site, intensive, lowland agricultural practises are dominant, in medium-sized fields with often low or mid-height hedgerows serving as field boundaries. Representative of land uses in such elevated terrain across the province and country, the multiple mountains and high hillscapes found throughout the wider study area are mostly a mix of commercial conifer plantations with upland/mountain heath. This includes Killarney National Park in the north-west and Gougane Barra Forest Park in the south-west, as well as mountains such as Mangerton or the Paps.

Plate 12.6: Intensive agricultural practises in the south-eastern quadrant of the Study Area

While wind energy developments are visible across much of the study area, they are not as apparent as within or close to the central study area. There is also some evidence of quarrying and/or extractive land use in the north and northeast. Lastly, there are numerous settlements, residences and roads in the study area, as well as lakes/loughs, particularly in the north-western quadrant.

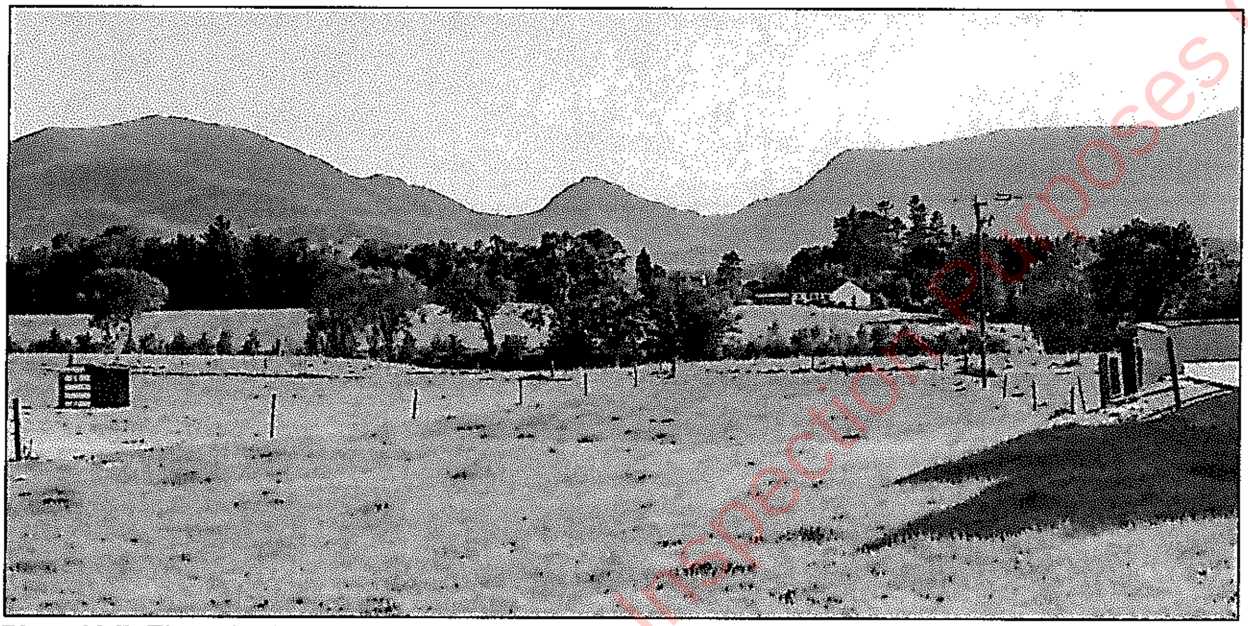


Plate 12.7: The ridgelines above Killarney National Park, in the north-east of the Study Area

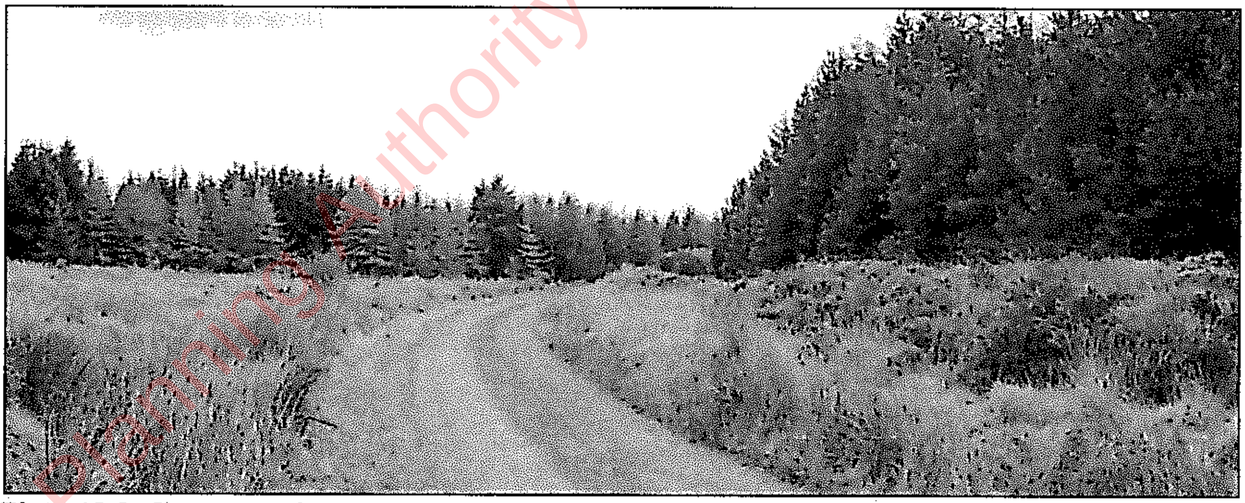


Plate 12.8: Commercial conifer plantations across a hillscape of the Study Area

12.3.2 Planning Policy Context

12.3.2.1 Department of Environment, Heritage and Local Government Wind Energy Development Guidelines (current 2006, Draft Revised 2019)

In December 2019 the Department of Housing, Planning and Local Government issued the Draft Revised Wind Energy Development Guidelines. Following consultation and review, these draft revised guidelines intend to supersede the current 2006 Wind Energy Development Guidelines, once fully adopted. With regards to LVIA, the one difference between the Draft Revised Wind Energy Development Guidelines (2019) and the current 2006 Wind Energy Development Guidelines, is the incorporation of minimum residential 'Setback', which is not contained in the current 2006 Wind Energy Development Guidelines.

'Setback'

Section 6.18 of the 2019 Draft Revised Guidelines refers to "siting in relation to individual properties," which is colloquially known as "setback." This is understood to be the only landscape and visual related change to the 2006 guidelines that is of potential relevance to the Project. The only SPPR (Specific Planning Policy Requirement) that applies to "setback" in the revised Guidelines is:

SPPR 2- "With the exception of applications where reduced setback requirements have been agreed with relevant owner(s) as outlined at 6.18.2 below, planning authorities and An Bord Pleanála (where relevant), shall, in undertaking their development planning and development management functions, ensure that a setback distance for visual amenity purposes of 4 times the tip height of the relevant wind turbine shall apply between each wind turbine and the nearest point of the curtilage of any residential property in the vicinity of the proposed development, subject to a mandatory minimum setback of 500 metres from that residential property. Some discretion applies to planning authorities when agreeing separation distances for small-scale wind energy developments generating energy primarily for onsite usage. The planning authority or An Bord Pleanála (where relevant), shall not apply a setback distance that exceeds these requirements for visual amenity purposes."

There are no inhabited dwellings contained within the specified setback distance of 4 times the tip height of the relevant wind turbine (740 m) as listed in the Draft Revised Wind Energy Development Guidelines (2019) for the tip height of the proposed turbines.

The current 2006 and Draft Revised Wind Energy Development Guidelines (2019) both provide the same guidance on wind farm siting and design criteria for a number of different landscapes types. It is not considered that the Project is contained wholly within one of these particular landscape types. Rather, there are three landscape types that would appear most applicable:

- 'Mountain Moorland';
- 'Transitional Marginal landscape', and
- 'Hilly & flat farmland'.

Mountain Moorland:

Location – *"It may be acceptable to locate wind energy developments on ridges and peaks. They may also be appropriate, in certain instances, in a saddle between two peaks where they will be partially contained or "framed." A third acceptable location is lower down on sweeping mountainside."*

Spatial extent - *"Given the typical extensive areas of continuous unenclosed ground, larger wind energy developments can generally be accommodated because they correspond in terms of scale..."*

Spacing - *"All spacing options are usually acceptable. Where a wind energy development is clearly visible on a crest or ridge there is considerable scope to vary the rhythm, though on simple ridges, regular spacing may be more appropriate."*

Layout - *"All layout options are usually acceptable. However, the best solutions would either be a random layout, and clustered where located on hills and ridges … or a grid layout on sweeping and continuously even areas of moorland or plateaux…"*

Height - *"There would generally be no height restrictions on mountain moorlands as the scale of landscape is so great…"*

Cumulative - *"The open expanse of such landscapes can absorb a number of wind energy developments, depending on their proximity. The cumulative impact will also depend on the actual visual complexity of landform, whether steeply rolling, undulating or gently sweeping. The more varied and undulating an area is topographically, the greater its ability to absorb and screen wind energy developments. The aesthetic effect of wind energy developments in these landscapes is acceptable where each one is discrete, standing in relative isolation."*

Transitional Marginal Landscapes:

Location - *"As wind energy developments, for reasons of commercial viability, will typically be located on ridges and peaks, a clear visual separation will be achieved from the complexity of lower ground. However, wind energy developments might also be located at lower levels in extensive areas of this landscape type, where they will be perceived against a relatively complex backdrop. In these situations it is important to minimise visual confusion such as the crossing by blade sets of skylines, buildings, utility lines and varied landcover."*

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

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

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

Height - *"…where the upper ground is relatively open and visually extensive, taller turbines may be more appropriate. In terms of perceived height, the profile can be even or uneven, depending on the profile and visual complexity of the terrain involved. The more rugged and undulating, the greater the acceptability of an uneven profile provided it does not result in significant visual confusion and conflict."*

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

Hilly and Flat Farmland:

Location - *"Location on ridges and plateaux is preferred … Elevated locations are also more likely to achieve optimum aesthetic effect."*

Spatial extent - *"This can be expected to be quite limited in response to the scale of fields and such topographic features as hills and knolls."*

Spacing -*"The optimum spacing pattern is likely to be regular, responding to the underlying field pattern."*

Layout - *"The optimum layout is linear, and staggered linear on ridges (which are elongated) and hilltops (which are peaked), but a clustered layout would also be appropriate on a hilltop."*

Height - *"Turbines should relate in terms of scale to landscape elements and will therefore tend not to be tall. However, an exception to this would be where they are on a high ridge or hilltop of relatively large scale. The more undulating the topography the greater the acceptability of an uneven profile, provided it does not result in significant visual confusion and conflict."*

Cumulative - *"It is important that wind energy development is never perceived to visually dominate. However, given that these landscapes comprise hedgerows and often hills, and that views across the landscape will likely be intermittent and partially obscured, visibility of two or more wind energy developments is usually acceptable."*

It is considered that there is a fairly mixed combination of guidance outlined above for the various landscape types, which make up the setting of the Project. However, all of it promotes a site-specific design response.

In terms of location, the combined guidance suggests suitability for elevated/hilltop ridges or peaks that are considered sufficiently distant to ensure a distinct separation from villages and towns in the study area.

In terms of spatial extent, the combined guidance leads towards larger wind energy developments that can be accommodated, but which achieve a balance with their surrounds. However, on lower slopes development is expected to be more limited, in relation to topographic features.

The combined guidance in relation to turbine spacing and layout leads towards the summation that all design options are potentially acceptable depending on the nature of the Site and its immediate surrounds.

Various turbine height options may be acceptable according to the combined guidance, though taller turbines may be more appropriate. At an overall height of between 177 m and 185 m inclusive, the proposed turbines are typical of current trends for recent planning applications and permissions.

In terms of cumulative effect, the combined guidance suggests that while some reasonable caution should be expressed, the undulating nature of this landscape can absorb a number of wind energy developments as long as that development is not perceived to visually dominate. Crucially, such a topographically varied and undulating area has a greater ability to absorb and/or screen wind energy developments; a critical reason as to why there are several wind farms contained within, and in the vicinity of, the central study area.

Overall, it is considered that the Project design is in accordance with the guidance for this varied landscape setting and does not conflict with it.

12.3.2.2 Cork County Development Plan 2022-2028

Cork County Council recently adopted a new County Development Plan for the period 2022-2028. It should be noted that the same Landscape Character Assessment prepared for County Cork in 2007 (Appendix F) remains the basis of landscape policy and the same scenic designations have carried over from the 2014-2020 Plan into the 2022-2028 Plan.

The Development Plan includes Chapter 14 'Green Infrastructure and Recreation', within which, sub-section 14.7 relates to landscape. A number of general objectives relating to landscape are noted within this chapter and are included below.

GI 14-9: Landscape:

a) *Protect the visual and scenic amenities of County Cork's built and natural environment.*

b) *Landscape issues will be an important factor in all land-use proposals, ensuring that a pro-active view of development is undertaken while maintaining respect for the environment and heritage generally in line with the principle of sustainability.*

c) *Ensure that new developments meet high standards of siting and design.*

d) *Protect skylines and ridgelines from development.*

e) *Discourage proposals necessitating the removal of extensive amounts of trees, hedgerows and historic walls or other distinctive boundary treatments.*

GI 14-10: Draft Landscape Strategy:

"Ensure that the management of development throughout the County will have regard for the value of the landscape, its character, distinctiveness and sensitivity as recognised in the Cork County Draft Landscape Strategy and its recommendations, in order to minimize the visual and environmental impact of development, particularly in areas designated as High Value Landscapes where higher development standards (layout, design, landscaping, materials used) will be required."

A Landscape Character Assessment was undertaken as part of the Draft Cork Landscape Strategy (2007). This has been incorporated within the current Development Plan and divides the county into 16 No. Landscape Character Types (LCTs). The Site and most of the central study area (within County Cork) is contained in LCT15b 'Ridged and Peaked Upland'. Also within the southeast portion of the central study area is the LCT12a 'Rolling Marginal and Forested Middleground (see **Figure 12.1**).

<u>LCT15b 'Ridged and Peaked Upland':</u>

Within the Draft Cork Landscape Strategy (2007), LCT15b - 'Ridged and Peaked Upland' is described as having:

- Landscape Value: Medium
- Landscape Sensitivity: Medium
- Landscape Importance: County

Its 'Landscape Description' entails:

"Ridged, peaked and forested upland landscape type which is located south of Millstreet town, includes much of the Millstreet to Macroom road (R582) and swings south west towards the county boundary west of Ballyvourney. This landscape type has been glaciated and comprises a fairly rugged and rolling mountainous topography at a relatively high elevation. The area around the Boggeragh Mountains provides a good example of this landscape type ... The landscape, with its rapid and steep rising and falling, seems to tumble down along the valleys. The rugged and diverse landcover, involving moorland, heath and scrub, lends a strong sense of the naturalistic."

Its 'Key Characteristics' include:

- *"Comprises a rolling mountainous topography at a relatively high elevation and includes the southern slopes of the Boggeragh Mountains.*
- *Soils are of low fertility and experience relatively high levels of rainfall due to its elevation, resulting in poor growing conditions and limited vegetation including moorland, heath and scrub.*
- *Isolated or clusters of fields, are scattered along lower slopes, giving this landscape type a small scale dimension, to the otherwise open moorland.*
- *Large tracks of coniferous forestry evident particularly in upland areas.*
- *There are patches of fertile land within the landscape*
- *The main agricultural practice in these upland areas is sheep farming.*
- *Field boundaries comprise mainly stonewalls and low hedges.*
- *With forestry over the landscape (not blocks as in other areas). Delineated by tight gorse hedgerows, walls, banks or post and wire fencing and punctuated by a coniferous or broadleaf shelterbelts around small farmsteads."*

Aspects of its 'Built Environment' include:

> *"There is a remote feel to the area with few houses mainly farm buildings."*

Within 'Pressure for change' in this LCT (i.e. Page 117 of the Draft Cork Landscape Strategy 2007):

> *"Windfarms can be seen off in the distance from certain elevated views within this landscape type. While their presence is noted, their visual impact is not major but an accumulation of more windfarms could have a more intolerable visual impact in the future."*

The 'Recommendations' that are of relevance to the Site include:

"Protect the high ridges and mountainous peaks, particularly to the south west of Millstreet town (Claragh Mountain). These upland areas are predominant components of this landscape type."

Four Landscape Character Areas occur within LCT15b 'Ridged and Peaked Upland', with the Site being located within Landscape Character Area 2 'Derrynasaggart Pass', which is described as a 'Composite Moorland Upper Valley.'

In addition, the 'Rolling Marginal and Forested Middleground' (South)' LCT, located more than 2 km from the Site in the east of the central study area, is described as having:

- *Landscape Value: Medium*
- *Landscape Sensitivity: Medium*
- *Landscape Importance: Local*

It should be noted that the Site is not situated in an area recognised as a 'High Value Landscape' (HVL) and the nearest HVL designation relates to the area within and surrounding Gougane Barra, which is located more than 12 km southwest of the Site.

<u>Scenic Designations</u>

According to Section 14.9.1 of the CDP:

"The County contains many vantage points from which views and prospects of great natural beauty may be obtained over both seascape and rural landscape. This scenery and landscape is of enormous amenity value to residents and tourists and constitutes a valuable economic asset. The protection of this asset is therefore of primary importance in developing the potential of the County. Therefore, the plan identifies specific Scenic Routes consisting of important and valued views and prospects within the County."

According to Section 14.9.2 of the CDP:

"It is important to protect the character and quality of those particular stretches of scenic routes that have special views and prospects particularly those associated with High Value Landscapes."

According to GI 14-11[1] of the CDP:

"Whilst advocating the protection of such scenic resources the plan also recognises the fact that all landscapes are living and changing, and therefore in principle it is not proposed that

[1] The following scenic route text appears to have been misplaced from the previous CDP into a landscape related objective (GI 14-11)

this should give rise to the prohibition of development along these routes, but development, where permitted, should not hinder or obstruct these views and prospects and should be designed and located to minimise their impact."

According to Section 14.9.3 of the CDP:
"All proposals should be assessed on their merits taking into account the overall character of the scenic route including the elements listed in Volume 2 Heritage and Amenity Chapter 5 Scenic Routes of the plan and the Landscape Character Type through which the route passes…"

With regards to the "elements listed in Volume 2 Heritage and Amenity Chapter 5 Scenic Routes," please note that the relevant designated scenic routes within the study area will be addressed later in this chapter in **Section 12.4.3.1**, in relation to visual receptors. Within the study area there are 17 No. County Cork designated scenic routes (**see Figure 12.2**).

In the central study area, there are three Co. Cork scenic routes:

- "Scenic Route S23: Road between Macroom and Derrynasaggart Mountains," located approx. 1.1 km northeast of the location of the nearest turbine.
- "Scenic Route S24: Road between Coolea and Coom," located within approx. 2.8 km south of the location of the nearest turbine.
- "Scenic Route S25: Winding road joining Coolea - Coom road to Lissacresig road," located approx. 4.7 km south of the location of the nearest turbine.

5-10 km from the Site, there are a further two additional Co. Cork scenic routes as well as Scenic Route S23, S24 and S25 extending from the central study area:

- "Scenic Route S22: Road from Ballyvourney to Mullaghanish to Caherdowney."
- "Scenic Route S26: Road between Lissacresig and the Mouth of the Glen."

10-20 km from the Site, there are a further eight Co. Cork scenic routes:

- "Scenic Route S20: Roads at Mushera in the boggeragh Mountains and roads from Mushera to Ballynagree, Lackdoha and Rylane Cross"
- "Scenic Route S21: Road at Carriganima"
- "Scenic Route 27: Road between Gougane Barra and the Mouth of the Glen"
- "Scenic Route S28: Scenic road at the Pass of Keimaneig to Gougane Barra"
- "Scenic Route S32: South Lake Road - Inchigeela and Ballingeary to Keimaneigh"
- "Scenic Route S33: Road between Ballingeary - branch off S. Lake Road - and Kealvaugh"
- "Scenic Route S34: Road between Inchigeela and Ballingeary to Keimaneigh"

- "Scenic Route S35: Road Between Dromcarra and Rossmore"
- With Scenic Route S22 and S23 extending from within 10 km of the Site.

Relevant planning objectives relating to the protection of 'Landscape Views and Prospects' within this chapter entail:

GI 14-12: General Views and Prospects:
"Preserve the character of all important views and prospects, particularly sea views, river or lake views, views of unspoilt mountains, upland or coastal landscapes, views of historical or cultural significance (including buildings and townscapes) and views of natural beauty as recognized in the Draft Landscape Strategy."

GI 14-13: Scenic Routes:
"Protect the character of those views and prospects obtainable from scenic routes and in particular stretches of scenic routes that have very special views and prospects identified in this plan."

GI 14-14: Development on Scenic Routes:
"a) Require those seeking to carry out development in the environs of a scenic route and/or an area with important views and prospects, to demonstrate that there will be no adverse obstruction or degradation of the views towards and from vulnerable landscape features. In such areas, the appropriateness of the design, site layout, and landscaping of the proposed development must be demonstrated along with mitigation measures to prevent significant alterations to the appearance or character of the area."

<u>Wind Energy Strategy</u>
In relation to Cork County's Wind Energy Strategy, the Site is within a broad area that is deemed to be 'Open to consideration' (i.e. neither 'Normally discouraged' nor 'Acceptable in principle' nor an 'Urban Area'). According to the strategy:

> *"This area comprises almost 50% of the County area. Within these areas there are locations that may have potential for wind farm developments but there are also some environmental issues to be considered. This area has variable wind speeds and some access to the grid…"*

ET 13-7: Open to Consideration (CDP Objective)
"Commercial wind energy development is open to consideration in these areas where proposals can avoid adverse impacts on:

- *Residential amenity particularly in respect of [...] visual impact;*
- *Visual quality of the landscape and the degree to which impacts are highly visible over wider areas."*

12.3.2.3 Kerry County Development Plan 2022-2028

Immediately adjacent to the north of the Site, County Kerry occupies nearly half of the central study area and the wider study area. It is, therefore, important to consider landscape designations in the current Kerry County Development Plan (CDP).

A landscape review has been included as part of the Kerry County Development Plan 2022-2028. Within this, the landscape is classified by landscape types and landscape character areas. The parts of County Kerry located within the study area are predominantly contained within the landscape 'Type A – Mountains', 'Type B – Pasture with Drystone Walls and Hedgebanks' and 'Type D - Coniferous Plantation'. The nearest and most relevant landscape character areas are 'LCA 27 – Clydagh River, The Paps and the Derrynasaggart Mountains' and 'LCA 40 Bonane and Sheen River Valley'. Both of these landscape character areas have been classified with an overall sensitivity of 'medium / high'.

Chapter 11 Environment' of the Kerry CDP contains two relevant objectives under the heading 'Landscape Sensitivity'.

KCDP 11-70: *Protect the landscape of the County as a major economic asset and an invaluable amenity which contributes to the quality of people's lives.*

KCDP 11-71: *Protect the landscapes of the County by ensuring that any new developments do not detrimentally impact on the character, integrity, distinctiveness or scenic value of their area. Any development which could unduly impact upon such landscapes will not be permitted*

The entirety of the landscape within County Kerry that falls within the central study area has been designated as 'Visually Sensitive Area'. This designation, which appears to have collated the Rural Prime and Rural Secondary Amenity Areas from the previous CDP, covers much of the upland and coastal rural landscapes of the County. The remainder of the County is designated 'Rural General'.

<u>Views & Prospects</u>

There are numerous Co. Kerry scenic designations within the study area (see **Figure 12.2**). Section 11.6.5 of the current Kerry CDP pertains to views and prospects. It states:

"County Kerry contains areas of outstanding natural beauty which are recognised internationally. There is a need to protect and conserve views and prospects adjoining public roads throughout the County. These views and prospects are important to the amenity of the County and to its tourist industry...

Relevant objectives relating to views and prospects include:

KCDP 11-72 - *Preserve the views and prospects as defined on Maps contained in Volume 4.*

KCDP 11-74 - *Prohibit developments that have a material effect on views designated in this plan from the public road or greenways towards scenic features and/or public areas.*

The scenic designation maps clearly indicate the presence and exact location of these Co. Kerry designated views and prospects, as well as which ones have designated views in both directions (of the route) and which have designated views in just one direction, as well as the orientation of that view. However, they do not identify the name or code number for these views and prospects, or any further information. Be that as it may, the mapping reveals that:

- In the central study area, there is one Co. Kerry designated view/prospect 1.4 km, at its closest point, north of the location of the nearest turbine.
- 10-20 km from the Site, there are four further Co. Kerry designated views/prospects, ranging from 8-16 km from the location of the nearest turbine.

Kerry Wind Energy Strategy:

The Wind Energy Strategy in the closest portion of County Kerry to the Site was altered twice in the context of the consultation and review process of the recently adopted 2022-2028 CDP. Areas that had previously not been subject to a specific wind deployment zone (and therefore defaulted to 'Unsuitable for Wind Energy Development') were briefly designated as 'Open to Consideration' for wind energy development, but reverted to undesignated (unsuitable) in the final adopted iteration. The area in question lies adjacent to the northeast of existing wind energy areas that have been designated for 'Repowering' (See Figure 12.11).

12.3.2.4 International and National Ecological Designations

European ecological designations such as Special Areas of Conservation (SACs), Special Protection Areas (SPAs), Natural Heritage Areas (NHAs) and proposed Natural Heritage

Areas (pNHAs) are relevant to the landscape and visual assessment as they can identify areas that are likely to exhibit naturalistic character and low levels of built development. They also highlight areas to which landscape conservation values are attached and they are often associated with outdoor amenity facilities where people go to enjoy the landscape setting. Where these occur in the central study area, they have the potential to inform the landscape character of the central study area.

In this instance, there are two overlapping ecological designations within the central study area, listed below, though the scale and size of these are substantial (i.e. stretching over 70 km in a north-east/south-west alignment):

- SAC & pNHA: Killarney National Park, Macgillycuddy's Reeks And Caragh River Catchment – approx. 2.6 km north of the Site, at its nearest point

However, in the wider study area it should be noted that there are multiple, distinct designations, including venerated sites such as the Killarney National Park.

12.3.3 Visual Baseline

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

12.3.3.1 Zone of Theoretical Visibility (ZTV)

Computer generated Zone of Theoretical Visibility (ZTV) maps have been prepared to illustrate where the Project is potentially visible from. These are produced for a tip height of 177 m and 185 m in order to cover the range of potential turbines being assessed (the difference is fractional). The ZTV maps are based solely on terrain data (bare ground visibility), and ignore features such as trees, hedges or buildings, which may screen views. Given the complex vegetation patterns within the Study Area, the main value of this form of ZTV mapping is to determine those parts of the landscape from which the Development will definitely not be visible, due to terrain screening within the 20 km Study Area (see **Figure 12.3**).

The following considerations can be derived from the ZTV mapping:

- Approximately 50% of the overall study area is afforded potential views of the Project and much of that indicates partial visibility of 1-2 turbines or 3-4 turbines Given the undulating nature of the study area and the 'concentric - tidal' ZTV pattern, Much of the visibility also appears to relate to partial blade sets and blade tips rather than full visibility of the proposed turbines.

- The south facing slopes of the Mangerton range show fairly comprehensive visibility, which contrasts with the northern slopes where views are fully screened. There are two splays of visibility that occur within County Kerry beyond the Mangerton range and these indicate partial views through two of the more deeply incised valleys. The splay to the northwest takes in the eastern outskirts of Killarney.
- Whilst there is fairly comprehensive theoretical visibility within the central study area this dissipates throughout the southern quarters due to screening from undulating hills. The sand ripple pattern indicates visibility from only upper slopes and ridge, whereas most receptors (roads and settlements) are contained within lower ground.
- The important heritage site of Gougane Barra is not contained within the ZTV pattern and indicated no potential for visibility other than for some of the peaks that surround the iconic glaciated valley.

12.3.3.2 Scenic Designations

Views of recognised scenic value are primarily indicated within County Development Plans in the context of scenic views/routes designations, but they might also be indicated on touring maps, guidebooks, roadside rest stops or on post cards that represent the area. Those contained within the relevant County Development Plans are detailed in **Section 12.3.2** – Planning Context and have been combined into a single map of scenic routes for the study area (see **Figure 12.2**)

All of the scenic routes where the ZTV indicates potential visibility were investigated during fieldwork to determine whether actual views of the Project might be afforded. Where visibility may occur, at least one viewpoint has been selected for use in the visual impact appraisal later in this chapter (see **Figure 12.9**).

12.3.3.3 Centres of Population and houses

This is not a heavily populated study area and there are few settlements within close proximity to the Site. The nearest include the village of Coolea approximately 3 km to the southeast and the more substantial sized settlement of Ballyvourney, which hugs the N22 approximately 5.5 km to the east. The elevated village of Kilnamartyra is approximately 12 km to the east of the Site and has potential for visibility of the Project. The settlements of Inchigeelagh and Ballingeary lie on the R584 to the south of the Site (9 km and 5 km away respectively) but have no potential for visibility of proposed turbines as they lie in the base of a valley.

Macroom is a relatively large settlement on the N22 near the south-eastern edge of the study area. Kilgarvan and part of Killarney are in the outer western and north-western portions of the study area respectively, albeit the ZTV pattern only indicates potential for visibility of the Project from the outskirts of the latter.

12.3.3.4 Transport Routes

The main transport route in relation to the Project is the N22 national road that runs between Cork and Killarney. Much of it is designated as a scenic route and is at its nearest to the Development as it approaches the Kerry border approximately 1 km to the northeast. There is a national secondary route within the study area and this is the N72 that heads east from Kilarney. It is approximately 12 km northwest of the Site at its nearest point.

The R569 regional road links between the N22 and Kilgarvan and is approximately 4.5 km to the northwest of the Site at its nearest point. The R584 regional road runs through the southern portion of the study area and is approximately 11 km from the Site at its nearest point.

Within and around the central study area, the road network consists of narrow local roads, private driveways and forest tracks.

12.3.3.5 Tourism Amenity and Heritage Features

Whilst not as synonymous with tourism heritage and recreation as the area around Killarney Lakes and the MacGillycuddy Reeks (to the west / north-west) or along the coastline of west Cork (to the south), there are some notable draws for tourists and recreationalists contained within the study area. Chief among these is the enclosed setting of Gougane Barra, which hosts St Finbarr's Oratory in the middle of Gougane Barra Lake in a strikingly scenic setting. The head of the Gougane Barra valley has also been extensively developed for forest / hill walking by Coillte. The 'Slí Gaeltacht Mhúscraí (Beara Breifne Way) is a long distance way marked trail that also passes through the Gougane Barra valley on its winding south-west to north-east route through the study area. It passes approximately 5 km to the southeast of the Site at its nearest point. The Beara Gougane Barra Cycling route from Cork City to Gougane Barra also passes through the southern study area and the Sheeps Head Way and Beara Way both flirt close to the southwestern perimeter of the study area without entering it.

The Kerry Way – another long distance waymarked trail runs along the northern slopes of the Derrynasaggart Mountains in an east-west orientation, where views are obscured by the mountains, as can be seen in the ZTV. Other shorter trails and loop walks include, Rossacroo Wood - Millennium Park Trail, which is a short Coillte Recreational Trail situated just over 7 km west of the Site. Danú Mountain Trail is a route to the summit of Danu Mountain / The Paps. Only the upper part of the route, close to the summit, lies within the ZTV pattern. The 'Paps of Anu' are twin peaks with Iron Age cairns at their summits.

Killarney Lakes National Park lies within the outer north-western portion of the study area and surrounds the popular tourist centre of Killarney. Aside from being just outside of the study area, these features are also screened from the Project by the Mangerton mountain range. The Mangerton Range itself has several notable peaks such as Mangerton Mountain and Crohane and is a popular destination for hill walkers. The most renowned walking route, the Devil's Punchbowl Loop, begins on the Killarney side and circumnavigates a corrie lough taking in Mangerton Mountain.

The Gearagh Meadowlands and associated walking loop are located within the 'LCT 8- Hilly River and Reservoir Valleys' and its associated High Value Landscape zoning. However, this is near the south-eastern outskirts of the study area where the ZTV maps indicate no potential for turbine visibility. Likewise, Lough Guitane is a highly scenic setting in the north-western extremities of the study area, but it too is shown not to have any potential for turbine visibility by the ZTV maps.

12.3.4 Route Screening Analysis (RSA)

Whilst the standard ZTV map outlines baseline theoretical visibility within the study area, it can considerably overestimate the actual degree of visibility as it does not take existing hedgerows, woodland and large areas of forestry into account, which, in this case will offer a notable degree of screening in the direction of the Project.

Route Screening Analysis, as its name suggests, considers actual visibility of the proposed wind farm from surrounding roads using recently captured, highly accurate Digital Surface Model (DSM) data that includes for all existing forms of land cover including vegetation. Route Screening Analysis bridges the gap between the bare-ground theoretical visibility modelling (e.g., ZTV maps) and the actual nature of visibility in a given area. In order to get a clearer understanding of visibility within the central study area, Route Screening Analysis (RSA) was undertaken for every public road within a 5 km radius of the proposed turbines using a Digital Surface Model (DSM) and sample points every 25 m along each public road/waymarked route.

The RSA consists of three visibility scenarios: open visibility; partial visibility; and fully screened. In this instance, 'open visibility' is very conservatively judged to occur if the view of a full blade rotation of any one single turbine is afforded. 'Partial visibility' occurs when there is view of less than a full blade rotation of any particular turbine/s occurs. For analysis purposes, the RSA data is broken down into concentric 1 km distance bands i.e., 0 to 1 km, 1 km to 2 km and so on out to 5 km. See Standard RSA Map (**Figure 12.4**)

12.3.4.1 RSA Results

The RSA map (**Figure 12.4**) and associated analysis graph illustrates a notable degree of wind farm screening from the surrounding local road network. 'Open Views' (needs clear visibility of only one blade set) predominate within the nearest 1 km, but as can be seen from the map, this relates a to a single sparsely populated local road that runs directly up the valley towards the wind farm. By the 1-2 km band Partial Views prevail (58%) and much of these come from the local road that runs along the upland valley to the southwest of the Site where views of less than full blade sets are likely above an intervening spur ridge. Beyond 1-2 km fully screened views dominate by a considerable margin and by the 4-5 km band approximately 84% of road sections are screened.

In terms of the RSA map, it is clear that nearly all of the open visibility of the proposed wind farm comes from roads to the southeast of the Site that are contained in the same drainage and visual catchment of Coolea Village. There is also very few roads at all within the elevated western quarters of the RSA study area. Outside of the upland catchment that contains the Site, very limited visibility exists from the road network, and by default most of the roadside dwellings.

What is very clear from the RSA graph is that screened views have a consistent and rapid increase across the distance bands from less than 9% in the nearest 1 km to over 80% by the 4-5 km band. Whilst this is typical of other RSA studies, Open Views usually have a distinct and opposite pattern reducing at a similar rate across the distance band and with all three categories at similar levels in the 2-3 km range. This usually indicates the threshold at which intervening terrain and vegetation screening becomes an effective screen for the progressively more distant turbines. However, it is a simple pattern that has become familiar in flat midland sites. In this instance Open Views drop away sharply to less than 20% by the 1-2 km range and remain there, albeit fluctuating all the way to the 4-5 km band. This highlights the complexity of the terrain and vegetation patterns in this knotty landscape and the effective screening provided within relatively short distances.

In terms of receptors, there is a relatively high proportion of Open and Partial visibility of turbines from within and around the village of Coolea and scenic route S24 that leads west from the village.

12.3.4.2 Additional 'Open View' analysis

As the methodology used for the RSA requires only a view of the full blade set of one turbine to record an 'open view' of the Project, it is useful to analyse the 'open view' set in more detail to establish how many turbines are actually visible in each instance (see the 'Open View' Refinement map - **Figure 12.5**)

The results for the finer grained analysis of the 'Open View' RSA class are intriguing as it appears that the closer the viewer is to the wind farm the fewer turbines, they are likely to see. In the nearest 1 km to the Site, where there is a view of turbines, for more than 90% of the road sections, less than 10% of this relates to a view of all 5 turbines. Views of all5 of the turbines is still the least common scenario in the 1-2 km and 2-3 km distance bands (7-8%) where views of only 1-2 turbines is the prevailing scenario (52% to 68%). However in 3-4 km band views of 5 turbines is more likely (18%), but remains subordinate to views of on 1-2 turbines at approximately 55%. By the 4-5 km distance band views of just 1-2 turbines occurs for nearly 80% of the road section that have some open visibility of the Project.

The finer grained analysis of the Open Visibility class further reinforces that there is not a clear and concentric (relating simply to viewing distance) pattern when it comes to the nature of visual exposure of the proposed turbines from the road network within 5 km of the Site. Instead, it highlights a generally high degree of screening where even if turbines are visible, it is least likely to be all of them visible at once and most likely just 1 or 2 of the five.

12.3.5 Identification of Viewshed Reference Points as a Basis for Assessment

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

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

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

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

Key Views

These viewpoints are at features or locations that are significant at the national or even international level, typically in terms of heritage, recreation or tourism. They are locations that attract a significant number of viewers who are likely to be in a reflective or recreational frame of mind, possibly increasing their appreciation of the landscape around them. The location of this receptor type is usually quite specific. In this instance the Paps of Anu could be considered a key receptor under this category, but do not attract a high number of visitors. They have been included as a 'heritage and amenity' feature in the visual impact conclusions and the assigned category of assessment has no bearing on the assessment itself.

Designated Scenic Routes and Designated Views

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

Local Community Views

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

Centres of Population

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

Major Routes

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

Amenity and Heritage Features

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

The Viewshed Reference Points selected in this instance are set out in **Table 12.6** and shown on the VP selection Map at **Figure 12.6**.

Table 12.6: Viewpoint Selection

VP No.	Location	Receptor	Direction of View
VP1	Local Road at Gortnagross	• Local Community Views	SW
VP2	Local Road at Coolea Village	• Local Community Views	NW
VP3	Local road west of Coolea	• Designated Scenic Route • Local Community Views	NW
VP4	Local road at Lumnagh	• Designated Scenic Route • Local Community Views	N
VP5	Local road at Inchamore	• Local Community Views	NE
VP6*	Local road at Laharan East	• Designated Scenic Route • Local Community Views	N
VP7	Local road at Caraghnacaha	• Designated Scenic Route • Local Community Views	N
VP8	Local road at Milleeny	• Local Community Views	N
VP9	Local road at Bardinch	• Local Community Views	N
VP10	Summit of Crohane Mountain	• An Amenity Feature	SE
VP11	N22 at Derrynasaggart	• Designated Scenic Route • Major route	SW
VP12	Local road at Coomnagire	• Designated Scenic Route	W
VP13	Western Summit of 'the Paps of Anu'	• An Amenity and Heritage Feature	S
VP14	Summit of Mangerton Mountain	• An Amenity Feature	SE

VP No.	Location	Receptor	Direction of View
VP15	N72	• Major Route	NE
VP16	Local road at Coumaclovane	• Local Community Views	NE
VP17	Local road at Gortnahoughtee	• Designated Scenic Route	NW
VP18	Local road at Kilbarry	• Designated Scenic Route	NW
VP19	N22 at Ballymakeery	• Designated Scenic Route • Centre of Population	NW
VP20	N22 at Inchinlinane	• Designated Scenic Route • Major route	NW
VP21	Local road near Kilnamartyra	• Centre of population	NW
VP22	R582 at Gortavranner	• Designated Scenic Route • Major route	SW
VP23	Local road at Dangansallagh	• Designated Scenic Route • Centre of population	NW
VP24	Local road at Reananerree	• Local Community Views	SW

ASSESSMENT OF POTENTIAL EFFECTS

Do Nothing Effects

In this instance, the existing forestry plantations contained within the Site would continue to [be] planted and felled in rotation in the do-nothing scenario. As this aligns with the current [sce]nario, no additional landscape or visual impacts are likely to occur.

12.4.[…] [Landsc]ape Effects

[Landscap]e impacts are assessed on the basis of landscape sensitivity weighed against the [magnitude o]f physical landscape effects within the Site and effects on landscape character [of the wid]er landscape setting. This wider setting is considered in respect of the immediately surrounding landscape (central study area <5 km) as well as the broader scale of the Wider Study Area (5-20 km).

12.4.2.1 Landscape Character, Value and Sensitivity

Central Study Area (<5 km from the Development)

The Site and central study area are contained within a rugged and marginal landscape that serves as something of a threshold of transition between a gently rolling and settled farming landscape to the south-east and the taller moorland covered peaks and ridges of the Derrynasaggart range immediately to the north and the more dramatic Mangerton range to the north-west. Indeed, the Site is contained on the southern slopes of the Derrynasaggart range which define the border between County Cork and County Kerry. The central study area is sparsely populated with farmsteads and rural dwellings and small and dispersed villages such as Coolea, Ballingeary and Reananerree. The landcover is a consistent combination of improved and marginal grazing in the valley floors and lower slopes, with scrub and scrubby woodland emerging on steeper slopes along with broad tracts of coniferous plantation forestry. The nearest turbines of the Coomagearlahy and Kilgarvan Wind Farm occur 3 km to the southwest of the Site just over the Kerry border. The Derragh and Cleanrath Wind Farms are also recent additions to the south and visible from the central study area. This is a productive rural landscape but characterised by extensive and low intensity land uses and despite consisting of tall moving structures, wind energy development is included in this characterisation.

There is some scenic amenity within the central study area, which is reinforced by a number of scenic route designations. Some of these clearly relate to broad elevated vistas, whereas others are more tranquil and enclosed or were designated at a time when forestry plantations were at the beginning of a rotation. In terms of landscape designations, the Site and most of the central study area (within County Cork) is contained in LCT15b 'Ridged and Peaked Upland' which is considered to be of 'Medium' landscape value, 'Mediu[m' landscape sensitivity and a 'County' level of importance (the median category). Notably, t[his] Landscape Character Type and those that surround it are not considered to achiev[e] separate and distinct status of a High Value Landscape (HVL).

It is considered that the central study area has landscape values that are relative[ly] balanced between productivity and sustaining the rural lifestyle in this area as sense of remoteness and tranquillity and a rugged sense of scenic amenity. and for these reasons, the Site and central study area (within 5 km) is deem[ed] landscape sensitivity of **Medium-low.**

Wider Study Area (5 km – 20 km from the Development)

For the wider study area there is a broader diversity of landscape character types and equally broad set of landscape values associated with them. The upland area to the south-west becomes more rugged and remote than the central study area and contains the highly sensitive landscape setting of Gougane Barra with its associated sense of heritage and wealth of recreational amenity. This area includes the High Value Landscape designations associated with both LCT '16a – Glaciated Cradle Valleys' and a small inland portion of LCT '4 – Rugged Ridge Peninsulas'.

To the south-east is a lower and more gently rolling landscape that is contained in productive farming. However, it also contains the elongated and naturalistic Lough Allua and the associated corridor of the River Lee. The High Value Landscape designation associated with LCT 8 – Hilly River and Reservoir Valleys' is also contained in this portion of the outer study area.

The northern portion of the wider study area is dominated in the first instance by the mountainous spine of the Mangerton range. This forms a northern backdrop to the central study area as well as physically, visually and perceptually dividing it from the lower lying landscape around the important tourist centre of Killarney and the Killarney Lakes National Park.

To the northeast is an extension of the Derrynasagart range, which has some of its extent contained within the north-central study area, whilst to the west of the central study area in the direction of Kilgarvan are similar landscape types to the central study area. This transitional east to west band across the study area is characterised by the same combination of marginal upland farming, forestry and wind energy developments and is considered to be generally robust.

Overall, it is considered that the wider study area is more diverse than the central study area and has areas and features that are of high or even very high landscape sensitivity, but also areas that are of a similar nature and sensitivity. Thus, it is also considered to have a general **Medium-low** sensitivity but with the acknowledgment that the Mangerton range to the north has a **High** sensitivity and Gougane Barra to the south-west has a **Very High** sensitivity, particularly within the heart of the valley in the vicinity of St Finbarr's Oratory.

12.4.2.2 Magnitude of Landscape Effect

The physical landscape as well as the character of the Project and its central study area (<5 km) is affected by the proposed wind turbines as well as ancillary development such as access and circulation roads, areas of hard standing for the turbines, borrow pits, grid connection and the substation compounds. By contrast, for the wider landscape of the study area, landscape impacts relate exclusively to the influence of the proposed turbines on landscape character. The aspects of the Project that are likely to have an impact on the physical landscape and landscape character are described in **Chapter 2: Project Description** with construction processes described in the Construction and Environmental Management Plan (CEMP) at **Appendix 2.1**.

Construction Stage

It is considered that the Project will have a modest physical impact on the landscape within the Site as none of the Project features have a large 'footprint' and land disturbance/vegetation clearing will be relatively limited and dispersed across a wide area. These effects are similar in nature and scale to forest harvesting activities with hardstand areas being akin to forestry skid/landing sites i.e. where the logs are hauled to for processing and collection. The topography and land cover of the Site will remain largely unaltered with construction being limited to tracks, areas of hard standing for the turbines, the on-site substation compound, temporary site construction compound, proposed met masts, drainage works and an on-site borrow pit. Excavations will tie into existing ground levels and will be the minimum required for efficient working. Any temporary excavations or stockpiles of material will be re-graded to marry into existing site levels and reseeded appropriately in conjunction with advice from the Project ecologist as detailed in **Section 5.9.1 of Chapter 5: Terrestrial Ecology.**

The finalised internal road layout has been designed to avoid environmental constraints, and every effort has been made to minimise the length of necessary roadway by utilising and upgrading existing forestry tracks. Furthermore, the road layout has been designed to follow the natural contours of the land wherever possible reducing potential for areas of excessive 'cut and fill'. There will be an intensity of construction stage activity associated with the access tracks and turbine hardstands consisting of the movement of heavy machinery and materials, but this will be temporary in duration and transient in location. The construction stage effects on landscape character from these dispersed activities will be minor.

There will be one 38 kV Onsite Substation with an associated Control Building constructed to collect the generated power from the Project before distributing it to the existing network substation at Ballyvouskill. The 38 kV on-site substation will be located in an area of farmland within the heart of the Site and will have a footprint of 1,314 m^2. The proposed sub-station compound will comprise of a single storey building with a pitched roof and will have a concrete render finish. The proposed substation compound, which will be enclosed by a 2.65-metre-high steel palisade fence, will be well contained by the surrounding terrain and is of a modest scale. The most notable construction stage landscape impacts resulting from the proposed on-site substation relate to the levelling of the Site using a balance of cut and fill to form a level platform. There will also be construction of concrete foundations to facilitate the substation building. Overall, these construction stage effects are relatively minor and compare to the construction of an industrial farm shed and yard, albeit on sloping ground requiring cut and fill earthworks.

All internal site cabling will be underground and will follow Site Access Roads without the need for trenching through open ground. Indeed, the land cover of the Site will only be interrupted as necessary to build the structures of the proposed wind farm and to provide access. Impacts from land disturbance and vegetation loss at the Site are considered to be modest in the context of this landscape setting. Some forest felling will be necessary to accommodate the construction of some turbines (T2, T4, and T5), hardstands, crane pads, access tracks and the proposed onsite substation. All forestry that is permanently removed will be subject to forest replanting provisions.

A permanent meteorological (Met) mast will be erected on site and will comprise of a 110 m high lattice steel mast and 4 m lightening rod (114 m overall height) with a shallow concrete foundation. The most notable construction stage effects will relate to the minor amount of ground excavation required to facilitate the shallow foundations for the steel mast structure. The Project also includes the upgrade of 3.4 km of existing forest tracks and construction of 3.8 km of new tracks that shall be used for construction and ongoing operational and maintenance activities.

The 38 kV grid connection cabling will run from the onsite substation across a combination of private lands and public roads generating land disturbance and associated movement of machinery and stockpiling of materials. The proposed grid connection route will include three watercourse crossings. No overhead lines are required for this connection. Connection works will involve the installation of ducting, joint bays, drainage and ancillary infrastructure and the subsequent running of cables along the existing road network. This will require delivery of plant and construction materials, followed by ground excavation laying of cables and subsequent reinstatement of trenches, and will result in minor and very localised construction stage landscape effects.

Site activity will be at its greatest during the construction phase due to the operation of machinery on site and movement of heavy vehicles to and from the Site. This phase will have a more significant impact on the character of the Site than the operational phase, but it is a 'short-term' impact that will cease as soon as the Project is constructed and becomes operational (approximately 21 months from the commencement of construction).

There will be some long term/permanent construction stage effects on the physical landscape in the form of turbine foundations and hardstands, access tracks and borrow pit. At decommissioning it is proposed to remove wind farm structures including, turbines, cabling and monitoring mast, but to leave roads and associated drainage works in place. Hardstanding areas will be allowed to regenerate naturally, as will turbine foundations once the plinths have been removed. Thus, the construction stage landscape effects of the Project are largely reversible.

There will be some construction stage effects on landscape character generated by the intensity of construction activities (workers and heavy machinery) as well as areas of bare-ground and stockpiling of materials as identified in the Construction and Environmental Management Plan (CEMP in **Appendix 2.2**). Such effects will be temporary/short term in duration and are, therefore, not considered to be significant. Overall, construction stage landscape effects are considered to be of a High-medium magnitude within the Site and its immediate surrounds and reducing with distance from the Site.

Operation and Decommissioning Stage Effects on Landscape Character

For most commercial wind energy developments, the greatest potential for landscape impacts to occur is as a result of the change in character of the immediate area due to the introduction of tall structures with moving components. Thus, wind turbines that may not have been a characteristic feature of the area become a new defining element of that landscape character. In this instance, wind turbines are a characteristic feature of the central and wider study area, most notably to the west and south of the Site where several existing commercial-scale wind energy developments occur (Coomagearlahy Kilgarvan, Derragh and Cleanrath - see locations on **Figure 12.7**). Considerable existing wind energy development is also located to further southwest of the Site at distances between 5 and 10 km, where there is in the order of 100 turbines spread between eight developments. The effect, therefore, is one of intensification and extension of an established land use in this landscape and not the introduction of a new and unfamiliar feature.

In terms of scale and function, the proposed wind farm is well assimilated within the context of the central study area. This is due to the broad scale of the landform, landscape elements and land use patterns. These attributes prevent the height and extent of the proposed wind farm causing the type of scale conflict that can occur in more intricate landscape areas. The rugged hills and ridges in the immediate surrounds of the Site have a notable utilitarian character due to the presence of the existing wind energy developments, in addition to extensive tracts of commercial conifer plantation. Although the Project represents a stronger human presence and level of built development than currently exists on the Site, it will not detract significantly from its productive upland rural character, which wind turbines are already a key component of.

It is important to note that in terms of duration, this Project proposal represents a long term, but not permanent impact on the landscape and is reversible. The lifespan of the Project is 35 years, after which time the turbines will be dismantled and the landscape reinstated / allowed to regenerate to prevailing conditions. Within 2-3 years of decommissioning there will be little evidence that a wind farm ever existed on the Site, albeit the proposed on-site substation will remain in perpetuity as part of the national grid infrastructure, in addition to access tracks.

The decommissioning phase will have similar temporary impacts as the construction phase with the movement of large turbine components away from the Site. There may be a minor loss of roadside and trackside vegetation that has grown during the operation phase of the Project. It is expected that the decommissioning phase would be completed within a period of 3-6 months. During this temporary period, landscape impacts are deemed to be High-medium within the Site and its immediate surrounds but reducing with distance from the Site.

In summary, there will be physical impacts on the land cover of the Site as result of the Project during the operational phase, but these will be relatively minor in the context of this productive rural landscape that comprises of existing wind energy developments and extensive areas of commercial conifer forest. The scale of the Project will be well assimilated within its landscape context without undue conflicts of scale with underlying land form and land use patterns. For these reasons the magnitude of the landscape impact is deemed to be **High-medium** within the Site and its immediate environs (c.1 km) reducing to **Medium** and then **Medium-low** for the remainder of the central study area. Beyond 5 km from the Site, the magnitude of landscape impact is deemed to reduce to **Low** and **Negligible** at increasing distances as the wind farm becomes a proportionately smaller and integrated component of the overall landscape fabric.

12.4.2.3 Significance of Landscape Effects

The significance of landscape impacts is a function of landscape sensitivity weighed against the magnitude of the landscape impact. This is derived from the significance matrix (**Table12.3**) used in combination with professional judgement. Based on the assessment in **Section 12.3**, the significance of landscape impact is considered to be **Substantial-moderate** within the Site and its immediate environs reducing to **Moderate** and **Moderate-slight** throughout the remainder of the Central Study Area. This is deemed to be the same for the construction stage, operational stage and decommissioning.

For the wider study area (beyond 5 km from the Site), landscape impact significance is not considered to exceed **Slight** at any of the stages of the Project and will reduce to Slight and Imperceptible at increasing distances as the Project becomes a progressively smaller component of the wider landscape fabric even in the context of higher sensitivity landscape units / features.

12.4.3 Visual Effects

In the interests of brevity and so that this chapter remains focussed on the outcome of the visual assessment (rather than a full documentation of it), the visual impact assessment at each of the 30 selected representative viewpoint locations has been placed into **Appendix 12.1**. This section should be read in conjunction with both **Appendix 12.1** and the associated photomontage set contained in **Volume III**. A summary table is provided below, which collates the assessment of visual impacts (**Table 12.7**). A discussion of the results is provided thereafter.

Table 12.7: Summary of Visual Impact Assessment at Representative Viewpoint Locations (Appendix 12.1)

VP no.	Distance to nearest turbine (km)	Visual Receptor Sensitivity	Visual Impact Magnitude	Significance of effect
VP1	5.4	Medium	Medium-low	**Moderate-slight/ Negative/ Long-term**
VP2	3.2	Medium	Medium	**Moderate/ Negative/ Long-term**
VP3	3.0	High-medium	Medium-low	**Moderate/ Negative/ Long-term**
VP4	3.4	High-medium	Medium-low	**Moderate/ Negative/ Long-term**

VP no.	Distance to nearest turbine (km)	Visual Receptor Sensitivity	Visual Impact Magnitude	Significance of effect
VP5	1.2	Medium-low	Medium	**Moderate/ Negative/ Long-term**
VP6	N/A	Medium-low	Negligible	**Imperceptible/ Neutral**
VP7	6.8	High-medium	Low-negligible	**Slight-imperceptible/ Negative/ Long-term**
VP8	0.8	Medium-low	High-medium	**Moderate/ Negative/ Long-term**
VP9	0.8	Medium-low	Medium	**Moderate-slight/ Negative/ Long-term**
VP10	2.3	Very High	Low-negligible	**Moderate-slight/ Negative/ Long-term**
VP11	8.4	High-medium	High-medium	**Substantial-moderate/ Negative/ Long-term**
VP12	1.2	High	Low	**Moderate-slight/ Negative/ Long-term**
VP13	6.2	Very high	Low	**Moderate/ Negative/ Long-term**
VP14	6.5	Very High	Low-negligible	**Moderate-slight/ Negative/ Long-term**
VP15	14.5	Medium	Low	**Slight/ Negative/ Long-term**
VP16	13.9	Medium-low	Medium	**Moderate-slight/ Negative/ Long-term**
VP17	3.1	High	Low-negligible	**Slight/ Negative/ Long-term**
VP18	16.4	High	Low-negligible	**Slight/ Negative/ Long-term**
VP19	16.6	Medium-low	Low	**Slight/ Negative/ Long-term**
VP20	7.9	Medium	Negligible	**Imperceptible/ Neutral**

VP no.	Distance to nearest turbine (km)	Visual Receptor Sensitivity	Visual Impact Magnitude	Significance of effect
VP21	N/A	Medium	Low	**Slight/ Negative/ Long-term**
VP22	13.1	High-medium	Negligible	**Imperceptible/ Neutral**
VP23	15.9	Medium-low	Low-negligible	**Slight-imperceptible/ Negative/ Long-term**
VP24	11.9	Medium	Negligible	**Imperceptible/ Neutral**

12.4.3.1 Impacts on Designated View

There is a series of designated scenic routes in relatively close proximity to the Development. The nearest is S23 from the Cork County Development Plan, which runs along the N22 to the northeast of the Site also becoming a scenic route on the Kerry side of the county border. There are three scenic routes to the south and southeast of the Site (S24, S25 and S26) and also more distant ones to the east (S21 and S22). These have been well covered by representative viewpoints in the visual impact assessment including 'illustrative views' where the absence of effect is what is being illustrated.

Scenic Route S24 is covered by VP2, VP3 and VP4 and this receptor affords some of the clearest views of the Project within its upland rural setting from relatively close distances. The proposed turbines improve in their legibility as the viewer moves west between VP2 at the outskirts of Coolea village, first passing VP3 and then VP4. At the peri-urban VP2 the turbine layout is uneven and result in some visual clutter from overlapping. The turbines become more evenly spread and are seen in an open and simple rural context by VP3 and by VP4 the layout is exemplary for this setting. However, the Development also increases in visual prominence from VP2 to VP4 and so does visual receptor sensitivity resulting in the same 'Moderate' significance at all three of these viewpoints which also represent the Local Community Views viewpoint category.

Scenic Route S23 is covered by VP11, VP19 and VP20 as it traces the N22 between Macroom and the Kerry border within the Derrynasaggart range. The nearest of these to the Site is VP11 where there is a partial view of turbine blade sets rotating above the near forested ridge to the southwest. However, it is the broad down-valley views to the southeast that appear to be the reason for this scenic route designation and the turbines will be only a peripheral component of that vista. Views from lower down the valley that is traversed by the N22 scenic route are much more restricted by enclosing terrain and vegetation.

Consequently, the significance of impact at VP19 and VP20 is deemed to be Slight and Imperceptible respectively.

Scenic route S22 from within the Derrynasaggart range to the east of the N22 road is represented by VP12 where the turbines are openly visible as a tight cluster rising above a middle distance ridge to the west. However, as with VP11, the turbines will be peripheral features of broad downhill views to the south, which also contain wind turbines. Thus, the significance of effect is deemed to be Modern-slight.

Scenic route S25 is covered by VP6 and VP7 but as it is currently shrouded in forestry and previously appears to have been designated for easterly and southerly vistas, rather than north towards the Site, the Project will not be readily visible from this designation. Significance was deemed to be Imperceptible and Slight-imperceptible from VP6 and VP7 respectively. Likewise, VP24 which represents scenic route S26 to the southeast of the Site affords no visibility of the Project. A potential long distance glimpse of turbine blades is afforded from VP22, which represents scenic route S21, but this is of no consequence to visual amenity.

12.4.3.2 Impacts on Local Community Views

This is a relatively sparsely populated area with small dispersed rural villages and a scattering of farmsteads and rural dwellings that tend to be well contained and sheltered within the upland valleys. There are also some more elevated road sections (often designated scenic views) with the local dwellings that align them enjoying more extensive views. Local community views are generally considered to be those which represent the people who live, work and move around the area within 5 km of the Site. In this instance there were nine such views used for the visual impact assessment (VP1, VP2, VP3, VP4, VP5, VP8, VP9, VP11 and VP16). Eight of these are contained on scenic routes and have already been discussed in **Section 12.4.3.1** above. The remainder will be summarised below.

Of the local community views that are not also within the scenic designation set, VP1 is the most elevated and extensive view. It has many of the attributes of the other scenic views (more than some) and has duly been accorded a Medium receptor sensitivity rating, whereas most of the other more enclosed local community views are attributed Medium-low sensitivity. From VP1, all of the proposed turbines are clearly visible at a reasonable scale, but in an exemplary and highly legible manner that assimilates well with the scale and nature of the underlying terrain and land use pattern. Consequently, the significance of effect is Moderate-slight despite clear and relatively close visibility. It should be noted that there are no dwellings afforded this particular view as the nearest houses are located on more sheltered lower slopes below the viewpoint.

For VP5, VP8, and VP16 the viewing scenario is more typical of the settled valley context of the central study area. From VP5 and VP16 the proposed turbines tend to be visible as only blade sets and partial blade sets rising above the enclosing forested (VP5) and rugged moorland (VP16) ridgelines. In both cases the visible components are seen at a prominent scale, but in a less than ideal aesthetic scenario with turbine blades cutting against the intervening ridgeline. However, they are not out of keeping with the productive upland setting and do not appear over-scaled relative to the underlying landform and land cover patterns. VP8 is a much clearer view of the scheme where the turbines are prominent and broadly dispersed across the view, but they are substantially visible in a legible manner. The significance of effect ranges between Moderate and Moderate-slight for these three local community views with the nearer VP5 and VP8 registering Moderate for differing reasons relating to the balance between the reduced degree of visual exposure at the former and the better visual legibility at the latter. The slightly greater viewing distance for VP16 was responsible for it only registering a Moderate-slight significance. The nature of visibility from within the local area is well represented in the Route Screening Assessment particularly **Figure 12.4.** This indicates that most of the open visibility within the central study area occurs within the same valley as the turbines to the southeast in the vicinity of the village of Coolea. Beyond this physical and visual catchment, the visibility from roads within the local area (5 km) become sporadic with 'Screened views' being a much more likely scenario beyond the 2-3 km distance band.

12.4.3.3 Impacts on Centres of Population

There are few substantial centres of population within the study area and even fewer that will be notably impacted by views of the proposed wind farm. Coolea is the most impacted and this is represented by VP2, which is discussed in relation to scenic routes as the S24 scenic route starts here and travels west. The selected viewpoint also represents something of a worst-case-scenario in terms of views from the village as clear visibility towards the Project is not readily available from within the core of the village.

The settlements of Ballyvourney to the east and Ballingeary to the south are not affected to any material degree by the Project as they are enclosed by other nearer ridges than that containing the Site. The small settlement of Reanree to the southeast of the Site is also not materially affected by the Project. Scenic Route S26 is represented by VP24 close to the settlement, but there will be no visibility of turbines.

Further afield to the south east, the elevated village Kilnamartyra affords clear, but distant views of the Project, where it appears in a legible manner (VP21). The significance of effect is deemed to be Slight at this settlement.

12.4.3.4 Impacts on Major Routes

The only major route within the study area with any reasonable potential for visual impacts is the N22 national road from Macroom to Killarney. This is a designated scenic for the entire portion of the study area where effects could be experienced and hence it has been discussed in the context of scenic designations (**Section 12.4.3.1** above) specifically in respect of VP11, VP19 and VP20.

Of particular note is that the N22 Ballyvourney Bypass was completed in December 2022 and runs upslope to north of the settlement. In early-stage consultation with Cork County Council it was recommended that potential views from the new road alignment should also be considered. VP25 was selected for this purpose and illustrates that the Project will be clearly visible above a middle distance ridge, but at a modest scale and in a clear and unambiguous manner (Slight significance of impact).

12.4.3.5 Impacts on Tourism, Heritage and Amenity Features

There is one particular viewing context of relevance to this category of receptor, which tend to be attributed High or Very High Sensitivity. These include summit views from the Derrynasaggart / Mangerton mountain ranges. The 'Beara to Breifne Way', a long distance way-marked walking route, also passes though the Gougane Barra glaciated valley and just to the south of the central study area on its northward journey.

From the Derrynasaggart / Mangerton mountain ranges, three summit viewpoints were selected; VP13 – The Paps of Anu; VP10 Crohane Mountain; and VP14 Mangerton Mountain. The nature of the view is very similar from all of these highly elevated vantage points, which are generally obtained by only fit and experienced hill walkers as opposed to attracting high numbers of visitors and tourists. The vast 360° views take in a range of dramatic and naturalist mountain areas and lakes, including the Derrynasaggart and Mangerton ranges themselves, the McGillycuddy Reeks, Lough Guitane and the Killarney Lakes. They also take in views of more settled and productive landscapes. In the direction of the Site, the landscape is a consistent mix of upland farming, conifer plantations, scrubby woodland and moorland with a generous scattering of wind turbines in concentrated, but contiguous groups. The main body of these are contained between 5 km and 10 km southwest of the Site and also further distant to the east in the direction of Millstreet.

The proposed turbines will be clearly and legibly visible from all of these locations in clear viewing conditions, albeit as small scale distant features of vast 360 views. However, it is not the view of the proposed turbines in their own right that is the key issue here. It is the cumulative effect and whether the proposed turbines cause the absorptive capacity threshold of this landscape for wind turbines, to be crossed. i.e., does this go from a rural upland area where wind turbines are one of a balanced few characteristic features to becoming a landscape that is principally defined by wind energy development. It is these elevated contextual views from which the cumulative effect is most noticeable, as it is far less noticeable from in and around the enclosed setting of the central study area. It is considered that the proposed wind farm makes a modest contribution to the quantum and extent of wind energy development in this area, but its main contribution is to serve as a perceptual link development between the Kilgarvan Cluster of wind farms and the Millstreet cluster of wind farms. Nonetheless, it maintains a generous buffer to each of these concentrations of wind farm developments and the link effect is only noticeable within the broad southerly views in question. It is therefore not considered to push the threshold of significant cumulative effects from these mountain top views and the significance is considered to range between Moderate (VP13) and Moderate-slight (VP10, VP14) and this is principally a factor of the high and Very High sensitivity of these receptors rather than the magnitude of impact.

The Beara to Breifne Way is represented by VP1 which is discussed in the context of Local Community views in **Section 12.4.3.2**. It is also closely represented by VP12 which is slightly uphill from it but with a similar viewing context. VP12 has been discussed in the context of Designated Scenic Route S22 in **Section 12.4.3.1**. Like all national way-marked routes, it passes through a diverse range of landscapes and includes road sections, forest tracks and trails. Such routes are designed to be accessible to a broad spectrum of the population and seldom entail difficult or dangerous upland sections. They represent an explorative journey through the landscape of a region showcasing not only naturalistic and scenic areas, but productive working landscapes and even townscapes. Whilst the proposed wind farm might be occasionally openly visible from the Beara to Breifne Way, it is just one feature amongst a vast array of other natural and man-made features that walkers will encounter along the way and it is a familiar form of development in this area without being a relentless one for this walking route.

12.4.3.6 Consideration of turbine dimension range

The Turbine parameters as described in Table 2.2 of this EIAR and all scenarios within the parameters have been fully considered in this chapter. For the landscape and visual assessment, the pertinent aspect of the design envelope relates to the turbine dimensions used to prepare the photomontages, upon which, the visual impact assessment is based.

There is some conjecture as to whether turbines with the same tip height, but varying hub height to rotor diameter ratios have a comparable visual impact. In the case of a higher hub and smaller rotor diameter, there is greater potential to see the hub, being the key component and figurative centre of the turbine, above surrounding ridgelines than for a lower hub / larger rotor scenario. However, the latter scenario represents a greater 'swept area' for the blades and potentially a stronger visual presence. In this instance, a balanced approach was taken where the specimen turbine used for the photomontages that informed the main visual impact assessment employed the maximum tip height dimension of 185 m with a median hub height of 107.5 m and maximum rotor diameter of 155 m. The reason for this approach is that any variation from this specimen turbine, in the form of an adjusted rotor diameter / hub height ratio, will see a minimal departure from the specimen turbine dimensions and consequently, less variation from the results of the visual impact assessment.

In order to examine the full range of potential turbine dimensions and to illustrate the potential variation in impact, Macro Works prepared comparative photomontages at three of the previously selected viewpoints (VP2, VP3 and VP4) to represent short and mid-distance views of the Project in differing contexts. It was not considered necessary to use long distance views (10 km+) for this comparative exercise as any variation in turbine dimensions are even less likely to be read at longer distances. The comparative scenarios used include:

- Specimen Turbine – 107.5 m hub, 155 m rotor diameter, 185 m tip height (as used for the visual impact assessment herein)
- Alternative Scenario 1 – 102.5 m hub, 149 m rotor diameter, 177 m tip height (lowest hub height)
- Alternative Scenario 2 – 110.5 m hub, 149 m rotor diameter, 185 m tip height (highest hub height, shortest rotor diameter)

As can be seen from the comparative photomontages (contained at the end of the Photomontage Volume) the variation in turbine dimensions is very difficult to discern across the three scenarios even with considerable scrutiny. This is unsurprising as the variation in hub height is 6 m from the specimen turbine position. There is also a potential 8 m departure from the specimen turbine in terms of tip height, but this would result a reduction in overall height (i.e. the visual impact would not increase). Whilst the variation in rotor dimeter is 6 m between the specimen turbine and Alternative scenario 2, this only translates as a variation of 3 m in blade length.

Regardless of whether the difference between the alternative turbine dimensions presented in the comparative photomontages can be discerned or not, it is clear that there is not a material difference in the level of visual impact between them and certainly not a higher impact than the base-case used for the submitted LVIA. Thus, the submitted LVIA is deemed to comfortably cover the range of potential turbine dimension options proposed and it is not considered necessary to prepare separate photomontages / assessments at all viewpoints for all possible turbine dimensions within the range.

12.4.3.7 Summary of Visual Effects

The proposed wind farm will give rise to a range of effects when considered in relation to different receptor types. There are very few notable impacts at centres of population and along major routes, which are the receptor types that usually harbour the greatest numbers of receptors (people). Compared to many other wind energy developments, the effects on local community views, one of the more susceptible receptor types and closest to the Project, are generally in the mid-range (Moderate and Moderate-slight) rather than higher end of the spectrum. This is less to do with the low population density and more to do with the enclosed nature of the rugged landscape in the central study area. Also, when broad elevated views are presented (VP11, VP12) they tend to be oriented away from high ground towards lower lying areas with the wind farm peripheral or even behind the viewer.

The most impacted receptor types were designated scenic routes as there is a high density of them within the central and wider study area and they often represented Local Community views as well (those within 5 km). On the basis that the scheme is of a modest overall scale and extent and is viewed within designated scenes that include broad scale forestry farming and wind energy developments, it appears well assimilated in terms of both scale and function in such views.

There are occasions where the five turbines appear somewhat cluttered with several instances of turbine overlap. However, these are at least matched by occasions when the layout is exemplary in terms of the relevant siting and design guidance from the Wind Energy Development Guidelines with an even spacing and gently undulating ridgetop profile that matches the underlying terrain. Such instances tend to occur to the south of the array and include VP1, VP4 and VP6.

For the reasons summarised above and detailed through this chapter, it is considered that the proposed Inchamore Wind Farm will give not give rise to any significant impacts.

12.5 CUMULATIVE EFFECTS

There are 24 separate wind farm developments within the wider study area that are either existing or permitted along with one in-planning development (Gortyrahilly Wind Farm) and one planned development (Cummeenabuddoge Wind Farm) (see **Figure 12.7** and the **Appendix 12.3**). It is important to note that because many of the other developments are existing, they have already been integral to the landscape and visual impact assessment contained within the preceding sections of this chapter.

Whilst the **Figure 12.7** map view of cumulative wind farms within the study area implies a dense accumulation of turbines in some portions of the landscape, the rugged nature of this landscape generally has the ability to absorb developments within discrete visual catchments. The exception to this is when the landscape is viewed from elevated locations within the Derrynasaggart and Mangerton mountain ranges to the north.

The nature of cumulative visibility is indicated on the Cumulative ZTV map (**Figure 12.7**). This indicates the following key points:

- There is only a very small proportion of the study area (2.1%) that will have a theoretical 'bare-ground' view of the proposed Inchamore turbines in isolation. These areas occur immediately to the north of the Site and also as two splays through saddles in the Mangerton range to the north.
- The main areas of combined visibility of the Project in conjunction with other developments contained within the study area (purple ZTV pattern) are within the central study area and then extending eastwards to approximately 10 km from the Site where cumulative visibility becomes more sporadic corresponding with higher ground only. There is also a sporadic band of combined visibility that runs along the peaks of the Mangerton and Derrynasaggart ranges to the north and north-west. It is notable that these areas generally have the lowest stocking of wind energy developments within the study area. In terms of the areas that will not have combined visibility with the Project, these tend to be large areas in the outer northeast, south and southwest of the study area (contained in green ZTV pattern).

There is one permitted wind farm (permitted Gortahilla) within the central study area as well as the edge of a large cluster of other existing wind farms stretching from just inside the Kerry border westwards into the Derrynasaggart range to the south of Kilgarvan. For the purposes of the cumulative impact assessment, that cluster of developments is going to be collectively referred to as the 'Kilgarvan cluster' and addressed in the context of the broader study area.

12.5.1 Cumulative Landscape Effects

From a landscape fabric / landscape character perspective, the proposed turbines will introduce wind energy development into a section of the landscape where wind turbines feature as partially revealed background features above and beyond containing ridgelines to the southwest (Kilgarvan cluster) and the south (Derragh and Cleanrath). Consequently, it is not a local landscape that is notably characterised by wind energy development, but the permitted Gortahilla Wind Farm (4 turbines) c. 2.5 km to the west will make wind turbines a more familiar feature. The proposed turbines will contribute to wind energy development becoming a more characteristic feature of the central study area, but far from the defining one.

Within the context of the wider study area, the proposed turbines will make less of a proportional contribution to the volume of turbines that already exist there or are currently permitted or in-planning. Wind farms are already a characteristic, but not a defining component of this upland rural and moorland landscape context and they will not become the defining feature with the addition of the Project. Instead, the contribution of the Project in that wider context is the infilling of a small pocket of landscape that heretofore had not been a focus for wind energy development in the same manner that the north-easterly and south-westerly extents of the Derrynasaggart range have been.

12.5.2 Cumulative Visual Effects

From a cumulative visual perspective, the proposed turbines are most commonly seen with other existing permitted or in-planning turbines in three main scenarios. The first of these is with the turbines from the permitted Gortahilla and predominantly existing Kilgarvan cluster featuring as small and partially exposed background features relative to the proposed turbines when seen from local views to the southeast of the Site. These include VP1, VP2, VP3 and VP4 from Coolea and the S24 scenic route running westwards out of Coolea village, but less so from close views to the Site where intervening ridges serve as a stronger screen.

The second scenario relates to elevated views from the south and southeast where the proposed turbines will be visible as a smaller scale development beyond and to the north of the existing Derragh and Cleanrath turbines as well as the in-planning Gortyrahilly turbines, should they be consented. Such views include VP17, VP18 and VP21 and notably the Kilgarvan cluster of turbines tends not to be visible from these locations due to screening by the primary ridge that forms the Cork / Kerry border.

The other notable cumulative visibility scenario relates to the views from the peaks within the Mangerton range including, VP12, VP13 and VP14 where the proposed turbines are seen in the context of a large number of cumulative wind farms dispersed in groups across the study area. In this context the large Kilgarvan cluster of turbines can be seen to the south and the similarly broad Millstreet Cluster can be seen further to the east. The proposed Inchamore turbines will site discretely between these larger areas of wind energy development avoiding detracting aesthetic effects with other turbines such as visual stacking or scale confusion / conflict with smaller earlier generation turbines. However, the proposed turbines serve as something of a visual link that could be perceived to link between the larger concentrations of turbines to the northeast and southwest of the Site. However, there is a limit to the degree that a five turbine wind farm could do that and maintaining a buffer to particularly the nearer Kilgarvan cluster of turbines was part of early stage design refinement from a substantially larger initial scheme. It is considered that element of mitigation has been successful in avoiding significant cumulative impacts.

On the basis of the reasons outlined above, the contribution of the Project to cumulative impact is deemed to be Low in accordance with the criteria contained in **Table 12.5**.

12.6 MITIGATION MEASURES AND RESIDUAL EFFECTS

Macro Works have been involved with this Project since undertaking a feasibility study in 2018, wherein potential constraints were refined and design optimisation measures were recommended. At that initial feasibility stage, the Project consisted of 15 turbines which stretched further to the west in the direction of the Kerry border. There were also outlying turbines surrounding the same upland basin that contains the current Site. It was considered preferable to reduce the overall extent and scale of the Project to reduce localised impacts and also to maximise the buffer to the nearest large cluster of Kilgarvan wind farms. This was done in the interests of reducing cumulative impacts and the benefits of this are apparent in the photomontage set. The result is that a much more consolidated and discrete turbine array has been brought to planning application stage than was originally considered at feasibility stage (see **Figure 12.8**).

Aside from these design iterations, which are embedded in the assessed Project, other specific landscape and visual mitigation measures are not considered necessary / likely to be effective. Thus, the impacts assessed in **Section 12.4 and 12.5** are the equivalent of residual impacts in this instance.

12.6.1 Decommissioning Phase

The decommissioning phase will see a similar nature of effects to the construction stage due to the movement of heavy machinery within the Site and to and from the Site removing turbine components. However, such effects will be temporary in duration and decreasing in scale as turbines are removed from view and the landscape is substantially reinstated to former uses (with the likely exception of the Substation infrastructure). Structures and cabling will be removed and hardstands and turbine foundations will be allowed to regenerate naturally. Roads and associated drainage will remain in place. As with construction stage landscape and visual impacts, decommissioning stage effects are not considered to be significant.

12.7 SUMMARY OF SIGNIFICANT EFFECTS

It is not considered that there will be any significant effects arising from the proposed Inchamore Wind Farm.

12.8 STATEMENT OF SIGNIFICANCE

Based on the landscape, visual and cumulative assessment contained herein, it is considered that there will not be any significant effects arising from the proposed Inchamore Wind Farm.

13 MATERIAL ASSETS AND OTHER ISSUES

13.1 INTRODUCTION

This chapter assesses the impacts of the Project on material assets. The Project refers to all elements of the application for Inchamore Wind Farm (**Chapter 2: Project Description**). The assessment will consider the potential effects during the following phases of the Project:

- Construction of the Project
- Operation of the Project
- Decommissioning of the Project

Common acronyms used throughout this EIAR can be found in **Appendix 1.2.** This chapter of the EIAR is supported by Figures provided in Volume III and by the following Appendix documents provided in Volume IV of this EIAR:

- **Appendix 13.1 Ai Bridges Telecommunications Impact Study**
- **Appendix 13.2 PUNCH Civil & Structural Due Diligence Report**
- **Appendix 13.3 Ai Bridges Aviation Review Statement**

13.2 STATEMENT OF AUTHORITY

This chapter has been prepared by Ms. Sarah Moore of Jennings O'Donovan & Partners Limited. The with the assistance of Ms. Shirley Bradley of Jennings O'Donovan & Partners Limited. The Telecommunications Impact Survey (**Appendix 13.1**) and the Aviation Review Statement (**Appendix 13.3**) were carried out by Kevin Hayes, David McGrath, Patrick Tinney and Karla Chagas in Ai Bridges Ltd.

Ms. Sarah Moore is a Senior Environmental Consultant and holds a Bachelor (Hons.) Degree in Environmental Science from University of Limerick and a MSc (Dist) in Environmental Engineering from Queen's University, Belfast. She has worked in environmental consultancy for over fourteen years and has prepared AA Screenings, Environmental Reports and EIARs.

Ms. Shirley Bradley is a Graduate Environmental Scientist with a First-Class Honours Degree (BSc Hons) in Environmental Science from the Institute of Technology, Sligo. She was also awarded with the Governing Body award for a BSc in Environmental Protection. Shirley's key capabilities are in report writing, assisting Senior Consultants and GIS.

Kevin Hayes is the Founding Director and Engineering Contracts Manager in Ai Bridges Ltd. Kevin has over 20 years' experience in Telecommunications Network Design and

Project Management. Kevin has a B.Eng Hons in Electronic Engineering – Communications & Industrial Automation and M.Eng Hons in Electronic Engineering- Communications & Communications Engineering. He also managed and designed the software prediction model for the TVI & Broadband EMI Interference Studies for Wind Farms.

David McGrath is a Radio Planning Engineer in Ai Bridges Ltd. David has a Bachelor of Science degree in Computing and has received a Bachelor of Engineering in Electronic Engineering. David has experience in analysing Radio Frequency issues, research and development in varying wireless network projects and supervision of Dublin Institute of Technology Master's degree students.

Patrick Tinney is a Communications Engineer in Ai Bridges Ltd. with a B.Eng. in Electronics, Occupational First Aid and 3 years' experience as a Health and Safety representative. He has received a B.Eng. in Computer and IT Systems. Patrick has experience in conducting site surveys and RF. He provides on-site support for the roll-out of fixed wireless access in Ireland.

Karla Chagas is a Software Engineer in Ai Bridges Ltd. with over 14 years' experience working in radar, telecommunications and radio related interference and telecommunications modelling projects. Karla has over 4 years' experience working with aviation, telecommunications and EMI interference and remediation projects. She has received a M.Sc. in Electrical Engineering and is currently undertaking a Ph.D. in Computer Engineering.

Further details and biographies/CVs of those involved in the development of each chapter have been included in **Chapter 1: Introduction (Section 1.9)**.

13.3 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

Following preliminary consultations with key consultees during the scoping process, desk-based assessments, site visits and field surveys were undertaken. In line with the EIA Directive 2011/92/EU as amended by EIA Directive 2014/52/EU and current EPA Guidelines, this chapter of the EIAR focuses the assessment solely on those elements likely to have a significant effect on the environment. 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 8: Soils and Geology, Chapter 9: Hydrology and Hydrogeology,** and **Chapter 10: Air and Climate**. Peat and spoil are assessed in **Chapter 8: Soils and Geology**. Amenity resources and tourism are addressed in **Chapter 4: Population and Human Health.** The cultural assets of Archaeology and Cultural Heritage are addressed in **Chapter 14: Cultural Heritage** and traffic is addressed in **Chapter 15: Traffic and Transportation.** Utilities such as water, wastewater and waste services are addressed in this chapter and in **Chapter 2: Project Description.**

The material assets considered in this chapter include:

- Land Use – Agriculture;
- Land Use – Forestry;
- Telecommunications;
- Air Navigation;
- Quarries, and
- Utilities (gas, water, waste)

13.4 LAND USE - AGRICULTURE

13.4.1 Baseline Environment

The Site, located 5.9 km west of Ballyvourney, is characterised as being generally commercial forestry and rural, agricultural land. There are also a number of residential properties and established wind farms in the region. The Site as a whole is characterised by elevations of between 350 m and 460 m AOD and a spatial area of 170.1 hectares.

The agricultural land is predominantly utilised for sheep and cattle grazing. The commercial forestry is mainly made up of Sitka Spruce and is further detailed in **Section 13.5.**

13.4.2 Assessment of Potential Effects

The total land-take of the Development, including the Site Access Roads, Turbine Hardstands, Turbine Foundations, Grid Connection Route, Turbine Delivery Route nodes, borrow pit, met mast and sub-station is 19.6 hectares. There are 170.1 hectares within the Red Line Boundary therefore the total land take is 12% of the Site. The proposed Site Access Roads and upgrade to existing roads will improve access for surrounding agricultural use.

The construction, operational and decommissioning phase of the Project will result in a change of 4.32 hectares of agricultural land use in areas where new Site Access Roads, wind turbine bases, hardstanding areas, Met Mast, the Onsite Substation and Control Building and associated drainage infrastructure will be located.

The construction of the Grid Connection Route and Turbine Delivery Route will only require relatively localised excavation works within and adjoining the public roads, with some works in private lands and the Site Boundary and will be reinstated upon installation of cables.

There will be two turbines located on or partly on agricultural lands. This will result in the change of use from agricultural pastureland to wind farm use. This will have a long-term slight, negative impact on agricultural land use due to the removal of grazing lands for the duration of the construction and operation phases.

The approach proposed for decommissioning is one of minimal intervention:

- Decommissioning works will be limited to action necessary to remove the wind farm structures, i.e., removal of turbines and monitoring mast, extraction of cables but leaving ducting *in-situ*.
- Roads and associated drainage systems will remain in place to serve ongoing forestry and agriculture activity.
- Hardstanding areas will be allowed to revegetate naturally.
- Turbine plinths will be removed, and the hardcore covering turbine foundations will be allowed to revegetate naturally.
- Soil disturbance will be avoided as much as possible.

Therefore, the effects of the decommissioning phase on agriculture will be less than those during the construction phase and not significant.

13.4.3 Mitigation Measures

A process of "Mitigation by Avoidance" to avoid or minimise impacts on agricultural land use has been incorporated into the design stage. The construction and operational footprint of the Project has been kept to the minimum necessary to avoid impact on existing land uses and existing tracks have been used where possible.

These mitigation measures will allow for the prevention of unnecessary or inappropriate ground works or land use alterations to occur and will avoid unnecessary soil compaction.

13.4.4 Residual Effects

Implementation of the mitigation measures, outlined in **Section 13.4.3**, at the design stage will ensure that residual impacts will be slight negative for the duration of the construction and negligible for the operational lifespan of the Project.

All existing access points (i.e., to domestic premises, business, farms) will be accessible during construction, operation and decommissioning stages. This is to maintain local access and avoid impacts on other various land uses. **Chapter 15: Traffic and Transportation** details all of the proposed works and deliveries along the turbine delivery route. The works have been designed to avoid undue impact to adjacent land uses. The traffic impact to adjacent land users was also considered during the design of the Project for the decommissioning phase for which traffic will be required along the Construction Haul Route. The Turbine Delivery Route will no longer be needed post construction. This is further detailed in **Chapter 2: Project Description.** Thus, the residual impact on surrounding agricultural land uses is negligible during construction, operation and decommissioning.

13.4.5 Cumulative Effects

Due to the localised nature of the proposed construction/decommissioning works, there is no potential for significant cumulative effects in-combination with other local developments on the agricultural land use apart from some small sections of the Turbine Delivery Route, all effects are directly within the Red Line Boundary.

Other projects outside the Development do not have the potential to reduce or increase the magnitude of effects on land use within the Site. Therefore, this will not contribute to any significant cumulative effects during the construction/decommissioning or operational phases.

Land management practices in the wider area which are considered to have potential for cumulative effects with the Project are agriculture and forestry. All existing and approved projects in **Appendix 2.4** were considered. There are no applications for large-scale commercial or industrial activities near the Site. Minor domestic and agricultural development will not introduce potential for cumulative effects during the construction, operational or decommissioning phases as the impacts will be localised and not significant.

The nearest operational wind farm is located 2.7 km to the south-west of the Development (Coomagearlahy Kilgarvan Wind Farm). Surrounding agricultural activities can and will continue during the construction, operational and decommissioning phases of the Development when fencing has been fully established.

13.4.6 Statement of Significance

No significant impacts are predicted on agricultural land use.

13.5 LAND USE - FORESTRY

13.5.1 Baseline Environment and Description of Development

Permission is being sought by the Developer for the construction of five (5 No.) Wind Turbines, a meteorological mast, an on-site substation, all ancillary works and upgrade works along the site access road from the N22. A full description of the Project can be found in **Chapter 2: Project Description**.

The Site contains 145.4 hectares of forestry which is classified as commercial forestry. The proposed windfarm infrastructure layout (i.e., roads, Turbine Hardstands, etc.) affects forestry with four (4 No.) turbines located within forestry. A summary of the forestry affected is provided in **Table 13.1** with Site Access Roads and the site compound also cutting through some of these plots.

Table 13.1: Summary of Removal of Forestry to facilitate the Project

Infrastructure	Area of forestry lost (Ha)	Species present
Turbines 2-5	12.77	Sitka spruce
Substation	0.64	Sitka spruce
Borrow Pit	3.53	Sitka spruce
Access Roads	7.25	Sitka spruce
Met Mast and Turning Head	1.11	Sitka spruce
Compound	0.58	Sitka spruce
T5 Turning Head	0.56	Sitka spruce
Total	**26.43**	

Detailed consideration of the approach to afforestation requirements associated with the Development is included in **Appendix 2.5**. It should be noted that the clearfelling of trees in the State requires a felling licence. The associated afforestation of alternative lands equivalent in area to those lands being permanently clearfelled is also subject to licensing ('afforestation licensing'). The Forest Service of the Department of Agriculture, Food & the Marine is Ireland's national forest authority and is responsible for all forest licensing. In light of the foregoing and for the purposes of this Project, the Developer commits that the location of any replanting (alternative afforestation) associated with the Project will be greater than 10 km from the wind farm site and also outside any potential hydrological pathways of connectivity i.e., outside the catchment within which the Development is located. On this basis, it is reasonable to conclude that there will be no more than imperceptible, indirect or in-combination effects associated with the replanting. In addition, the developer commits to not commencing the Project until both felling and afforestation licences are in place and this ensures the afforested lands are identified, assessed and licenced appropriately by the relevant consenting authority.

13.5.2 Assessment of Potential Effects

The lands affected by the Project are currently in use for commercial forestry and agriculture.

Arc GIS Pro was used to calculate areas of forestry within the surrounds of the Development. Inchamore was calculated to have 174 ha and Milleeny was calculated to have 271 ha. The majority of the forestry within the surrounds of the Development was classed as 'Coniferous forest' according to CORINE Land Cover (Copernicus)[1].

The removal of 26.43 ha (18.2%) of 145.4 ha commercial forestry lands within the Site will have a permanent slight, negative impact on the existing forestry land use during the construction, operation and decommissioning of the Project.

13.5.3 The 'Do-Nothing' Impact

If the Project does not proceed, lands in the vicinity of the Site will continue to be used for forestry and agricultural purposes. This would have a neutral effect.

13.5.4 Mitigation Measures

Existing forestry tracks have been incorporated into the design to minimise the construction of new Site Access Roads and minimise the removal of forested areas. New Site Access Roads have been sensitively designed to minimise impact on forestry. Electricity cables will be installed underground in or alongside Site Access Roads to avoid and minimise negative impact. The construction and decommissioning works will be planned and managed by a Construction and Environmental Management Plan (CEMP) (**Appendix 2.1**). This provides details on day to day works and methodologies. As part of these works, the public and other stakeholders will be provided with updates on construction activities which will affect access to surrounding lands. This will be communicated to members of the public through a community liaison officer employed for the duration of the construction period.

[1] Environmental Protection Agency Maps https://gis.epa.ie/EPAMaps/ [Accessed Online_22/06/2022]

13.5.5 Residual Effects

The impact on land take during construction/decommissioning is likely to have a permanent slight, negative impact on the forestry, in that it alters the character of the environment, albeit in a manner consistent with existing and emerging wind farm trends in the surrounding area. Implementation of the measures outlined in **Section 13.5.4** will ensure that any residual impacts will be slight negative and short term in duration.

During the operational phase, the impact on forestry land take is likely to have a moderate negative permanent impact on the environment of the area (in that it alters the character of the environment); however, this change is consistent with existing and emerging trends. There are no predicted residual impacts, with respect to forestry land use, arising from the operational phase.

13.5.6 Cumulative Effects

Due to the localised nature of the proposed construction/decommissioning works which will be kept within the Site Boundary, there is no potential for significant cumulative effects in-combination with other local developments on commercial forestry as all effects are directly within the Site.

The surrounding commercial forested area of the Development will continue its ongoing commercial maintenance, felling and replanting schedule throughout the operational life of the Project.

As forestry activity is expected to continue on surrounding lands throughout the lifespan of this Project, no potential significant cumulative effects are considered likely.

13.5.7 Statement of Significance

No significant impacts are predicted on commercial forestry.

13.6 TELECOMMUNICATIONS

Microwave links need an unobstructed line of sight from end to end as blocked links will perform inadequately. It is therefore necessary to ensure tall wind turbines will not interrupt links. Impacts can include reflection, diffraction, blocking and radio frequency interference.

During operation, wind turbines have the potential to interfere with electromagnetic signals passing above the ground due to the nature and size of the wind farm.

Ireland saw the roll out of Digital Terrestrial Television, locally known as Saorview TV, in October 2010, incorporating the switchover from analogue to digital television. According to Ofcom (a regulatory UK body) (2009), *digital television signals are much better at coping with signal reflections, and digital television pictures do not suffer from ghosting*[2]. Ghosting is the replica of a transmitted image which is offset in position and is superimposed on top of the main image.

Since digital switchover, there have been very few reported cases of wind turbine interference with domestic analogue reception. Modern turbine blades are also typically made of synthetic materials which have a minimal impact on the transmission of electromagnetic radiation. Therefore, potential effects on television and radio signals from the Project will be negligible and are not considered further, given the advancements in technology.

13.6.1 Guidance

Potential telecommunication effects generated by the Project have been assessed with reference to the following documents.

- Cork County Development Plan, 2022 - 2028
- 'Best Practice Guidelines for the Irish Wind Energy Industry', published by the Irish Wind Energy Association (2012).
- Information about Electric & Magnetic Fields and the Electricity Transmission System in Ireland, EirGrid[3]
- Wind Energy Development Guidelines: Planning Guidelines, Department of Environment, Heritage and Local Government (DHPLG) 2006[4]

13.6.2 Scoping and Consultation

Telecommunications providers were consulted about the Project. A summary of responses is outlined in **Table 13.2** and **Appendix 1.1** outlines full consultation responses.

[2] Ofcom (2009) *Tall Structures and Their Impact on Broadcast and Other Wireless Services*, OFCOM, United Kingdom. Available online at: https://www.ofcom.org.uk/__data/assets/pdf_file/0026/63494/tall_structures.pdf [Accessed 14/11/2019]
[3] Eirgrid (2014) *Information on Electric and Magnetic Fields*. Available online at : http://www.eirgridgroup.com/site-files/library/EirGrid/Information%20on%20Electric%20and%20Magnetic%20Fields.pdf [Accessed on 18/11/2019]
[4] Department of Housing, Planning, Community and Local Government (2006) Planning Guidelines. Available online at: https://www.gov.ie/en/publication/f449e-wind-energy-development-guidelines-2006/ [Accessed 25/02/2021]

Table 13.2: Summary of Consultations

Consultee	Response Date	Response
RTÉ Donnybrook Dublin 4 *(2RN is the trading name of RTÉ Transmission Network DAC)*	17/11/2020	*"The site will not affect 2RN's fixed linking, the nearest link is 750 m to the south if T6. There is however a risk that the site could cause interference to Digital Terrestrial Television (DTT) viewers receiving from our site at Mullaghanish. We would therefore ask that a protocol be signed between 2RN and the Developers should the site go ahead."*
Virgin Media Television Westgate Business Park Ballymount Dublin 24	Na	No response received
Vodafone Netshare Ireland Iveagh Buildings Carrickmines Dublin 18	15/02/2021	Highlighted links that will be affected, namely KYIHE-CKMGH.
Tetra Ireland	09/12/2020	*"We anticipate no impact from the development as proposed."*
ENET	19/02/2021	Highlighted links close to turbines

13.6.3 Assessment Methodology

Following scoping, AI Bridges were commissioned to undertake a telecommunications impact assessment of the operational phase of the Development, which is attached as **Appendix 13.1**.

There are four primary stages in preparing and compiling a communication impact study:

- Telecom Operator Consultations;
- Field Surveys;
- Desktop Survey Network Modelling and Analysis, and
- Report Generation.

AI Bridges assessed the impact of the Development on two Vodafone communication links, using 3D network modelling which were highlighted in the scoping responses from Vodafone and Enet as listed in Table 13.2.

13.6.4 Assessment of Potential Effects

All potential effects, which are associated with the operational phase of the Project, are classified as long-term effects. It is predicted there will be no impact to the two Vodafone links and that highlighted by ENET as the links are sufficiently far from the nearest turbine that the operation of the link will not be impacted. There is potential that RTE DTT viewers receiving from Mullaghanish could experience interference. A detailed assessment of the effects of the Project on telecommunications can be found in **Appendix 13.1: Telecommunications Impact Study**.

13.6.4.1 *The 'Do-nothing Impact'*

If the Project does not proceed, there will be neutral impacts on telecommunications. This 'do-nothing' scenario would result in no interference in electromagnetic signals subject to the continuation of current activities and practices which are expected to continue.

13.6.4.2 *Construction Phase*

During the construction phase, there are likely to be several sources of temporary electromagnetic emissions. Chief among these will be the brief use of electrical power tools and the use of electrical generators which may be brought onsite before mains electricity is provided. These devices are required by Irish and European law to comply with the EMC Directive 2014/30/EU. Compliance with this Directive will mean that the electromagnetic emissions from these devices will not cause interference to other equipment.

Other potential effects during the construction phase are likely to be as a result of tall cranes used for constructing the turbines. These cranes will be beside the proposed turbines. Any interference effects are likely to be similar to those arising during the operational phase of the Project. This is further detailed in **Appendix 2.1**.

13.6.4.3 *Operational Phase*

There is potential RTÉ DTT viewers receiving from Mullaghanish could experience interference.

13.6.4.4 *Final Decommissioning Phase*

When decommissioning of the Project takes place, effects associated with this phase on telecommunications will be similar to those at the construction phase.

13.6.5 Mitigation Measures

All electrical elements of the Development are designed to ensure compliance with electro-magnetic fields (EMF) standards for human safety.

Mitigation measures were undertaken in the design phase through mitigation by avoidance i.e., the known routes of the telecommunication links were plotted and a buffer was applied to them, outside of which the proposed turbines were located. Compliance with the EMC Directive 2014/30/EU will mean that the electromagnetic emissions from devices used will not cause interference to other equipment.

In the event the Project is granted planning permission a protocol will be signed between 2RN and the Developer, in which the Developer will accept total financial responsibility for remedial measures which could be required as a result of potential negative impact of the wind farm on 2RN's network specifically RTÉ DTT viewers.

13.6.6 Cumulative Effects

All existing, approved and proposed projects in **Appendix 2.4** have been considered for potential cumulative effects. There are a number of proposed, permitted or operational wind farms within 20 km of the Development (**Appendix 2.2**). Each developer is responsible for engaging with all relevant telecommunications operators to ensure their proposals will not interfere with television or radio signals by acting as a physical barrier. Therefore, as each project is designed and built to avoid impacts arising, a cumulative impact cannot arise. There will be no cumulative impacts relating to the Project and surrounding projects in relation to telecommunications.

13.6.7 Statement of Significance

The implementation of mitigation measures will ensure no interference with communication links. Therefore, no significant effects are predicted on telecommunications or radio reception as a result of the Project.

13.7 ELECTRICITY NETWORKS

13.7.1 Introduction

This section describes the transmission network and the anticipated connection option. It is not proposed to utilise any elements of the distribution network.

The nationwide electricity transmission system allows for the transport of large volumes of electricity from generation stations, including wind farms, to bulk supply points near the main population centres where it interconnects with the distribution system.

The Grid Connection will be 19.9 km in length and will be along public roads, private roads and forestry roads.

Connection will be sought from the grid system operator by application to EirGrid. The substation will connect via underground 38kV cables. At the existing Ballyvouskill 220kV substation, the cable will connect into existing infrastructure within the confines of the substation and its compound. The Grid Connection will be constructed to the requirements and specifications (CDS-GFS-00-001-R1) of EirGrid.

13.7.2 Assessment Methodology

Punch Consulting Engineers prepared a Civil and Structural Due Diligence Report which assesses utilities along the Grid Connection Route and can be found in **Appendix 13.2**. The report assesses the impacts based on desktop study, consultation and site visit.

EirGrid was consulted about the Development and the connection to Ballyvouskill 220 kV substation via an online webinar. EirGrid confirmed that it cannot determine any proposed connection methods until the formal connection application process is completed. ESB responded to consultation with relevant information of their network installations, which are adjacent to and cross the cable route (**Appendix 13.2**).

13.7.3 Assessment of Potential Effects

Due to the fact that all on-site internal cabling will be underground as will the grid connection from the onsite substation to Ballyvouskill, there will be no impact on the overhead electricity network.

The Development will contribute directly and in the long term to the electricity network by strengthening it through additional renewable energy generation.

At the existing Ballyvouskill 220kV substation, the cable will connect into existing infrastructure within the confines of the substation and its compound and thus will have a slight, short term effect.

13.7.4 The 'Do-nothing' Impact

If the Project does not proceed, there will be no offset to fossil fuel usage, and no provision of additional electricity generation in the local area.

13.7.5 Mitigation Measures

Mitigation by design and avoidance will minimise impacts on existing electricity networks.

- Prior to construction confirmatory drawings for all existing services will be sought from ESB Networks.
- Immediately prior to construction taking place, the area where excavation is planned will be surveyed by CAT scan (sub-surface survey technique to locate any below-ground utilities) and all existing services will be verified. Temporary warning signs will be erected.
- The as-built location of the installed ducts will be surveyed and recorded using a total station/GPS before the trench is backfilled to record the exact location of the ducts. The co-ordinates will be plotted on as-built record drawings for the grid connection cable operational phase.
- Clear and visible temporary safety signage will be erected all around the perimeter of the live work area to visibly warn members of the public of the hazards of ongoing construction works.

13.7.6 Cumulative Effects

All existing, approved and proposed projects in **Appendix 2.4** have been considered. There are a number of proposed, permitted or operational wind farms within 20 km of the Development. There will be no cumulative impacts relating to the Project and surrounding projects in relation to electricity networks during the construction phase.

Potential negative cumulative effects on electricity networks are unlikely during the operational and decommissioning phases.

13.7.7 Statement of Significance

No significant negative impacts on the grid connection or grid network are anticipated. There will be a long-term slight positive residual impact on transmission infrastructure in the area (due to the installation of new infrastructure) and no impact on distribution. It is not proposed to utilise any elements of the distribution network.

13.8 AIR NAVIGATION

13.8.1 Introduction

Operating wind farms have the potential to cause a variety of adverse effects on aviation. Rotating wind turbine blades may have an impact on certain aviation operations, particularly those involving radar. The physical height of turbines can cause obstruction to aviation and the overall performance of communications, navigation and surveillance equipment. All structures over 150 m in height are required by the Irish Aviation Authority to have lighting to warn aviation traffic. The Development's ground to blade tip height of the wind turbines will range from 177 m to 185 m during operation. The tallest tip height (185 m) represents the largest obstacle of any turbine within the Turbine Range to air traffic (irrespective of the turbine selected and constructed within the Turbine Range, a turbine with an equal or lesser tip height will still be within that space).

Enniskeane Airstrip is 35 km to the south-east. Bantry Aerodrome is 33 km to the south-west of the Development. The closest regional airport is Kerry Airport, 31 km to the north-west. The closest international airport is Cork, 51 km to the south-east.

13.8.2 Consultation

Consultation with the relevant aviation organisations was initiated during the scoping process, to identify any potential aviation issues that could be affected by the Development. The findings are summarised in **Table 13.3**.

Table 13.3: Summary of Consultation Response

Consultee	Scoping Date	Response Date	Response
Irish Aviation Authority The Times Building 11-12 D'Olier Street Dublin 2	16/11/2020	17/12/2020	*"Turbine No. 1 is approximately 30 kms South East of Kerry Airport. The aerodrome operator should be contacted and requested to assess whether a preliminary screening assessment is required in relation to the potential impact on instrument flight procedures or any communication, navigation and surveillance equipment at Kerry Airport.* *Subject to that being completed and no likely significant impact being noted, the Aerodromes division would likely issue the following general observation during the formal planning process….* *1. Agree an aeronautical obstacle warning light scheme for the wind farm development.* *2. Provide as-constructed coordinates in WGS84 format together with ground and tip height elevations at each wind turbine location.* *3. Notify the Authority of intention to commence crane operations with at least 30 days prior notification of their erection.*
Kerry Airport Farranfore Killarney Co. Kerry V93 KHF7	21/12/2020 22/11/2022 13/02/2023 31/03/2023	08/03/2023	*"From an initial review the development would appear to be outside Kerry Airports 15 km OLS area. However as you have highlighted in your scoping document section 4.2, the development has potential to impact on aviation coverage, and as such I would recommend that this be investigated further to confirm the development will not impact on the safe operation of aircraft and maintain current aviation associated coverage such as radio, radar, navigational aids etc. The requirements for lighting and inclusion of the structures on associated maps etc will I am sure be addressed by the IAA."*

Consultee	Scoping Date	Response Date	Response
		18/04/2023	For the assessment report (Appendix 13.3) 1. Section 2.2 as the proposed development penetrates the Annex 15 Aerodrome surfaces, the developer must ensure the development does not impact or increase current published operating minima associated with Kerry Airport. 2. Section 2.3 MSA's- any development must ensure that there is no impact on the current published MSA's associated with Kerry Airport. 3. Section 2.8- Obstacle warning lights- the developer should liaise with the Aviation Authority to ensure that the development is included on maps and lighted in the interest of aviation safeguarding. 4. The assessment and planning should include the assessment of the construction phase as part of planning to ensure cranes or other equipment involved in the development do not impact on Aviation safety during the construction phase.
Cork Airport Kinsale Road Cork T12P5NF	16/11/2020	No Response	None

13.8.3 Assessment Methodology

Following scoping with Irish Aviation Authority (IAA), Kerry Airport and Cork Airport, Ai Bridges a communication specialist was commissioned to undertake an aviation impact assessment of the operational phase of the Development, which is attached as **Appendix 13.3**.

The aviation assessment which included a desk-top study and modelling reviewed the possible impacts of the proposed wind farm on aviation systems in the vicinity of the Development. As part of the review, the following subjects were considered:

- Annex 14 - Obstacle Limitation Surfaces (OLS)
- Annex 15 – Aerodrome Surfaces
- Minimum Sector Altitudes (MSA)
- Instrument Flight Procedures
- Permitted Wind Farms in vicinity of Proposed Wind Farm
- Communications, Navigation and Radar Surveillance Systems Safeguarding
- Flight Inspection and Calibration
- Aeronautical Obstacle Warning Light Scheme

- Irish Air Corps / Department of Defence (DoD) Safeguarding

13.8.4 Assessment of Potential Effects

The aviation impact assessment found the proposed turbines would penetrate the ICAO Annex 15 Aerodrome Surface for Kerry Airport. As a result, all obstacles, if more than 100 meters above terrain for a distance of 45 km from centre point of Kerry Airport, need to be registered in the IAA Air Navigation Obstacle Data Set.

The impact assessment concluded that no significant effects are predicted on air navigation as a result of the Development.

13.8.5 The 'Do-Nothing Impact'

If the Development were not to proceed, there would be no impact on aviation operations in the area.

13.8.6 Mitigation Measures

Although no potential effects were identified, the following mitigation measures proposed by the Irish Aviation Authority (IAA) and Kerry Airport will be implemented:

- An aeronautical lighting scheme for the Development will be agreed with the IAA and will be installed.
- As-constructed coordinates in WGS84 format together with ground and tip height elevations at each wind turbine location will be provided to the IAA.
- The IAA will be notified of intention to commence crane operations with at least 30 days prior notification of their erection.

13.8.7 Cumulative Effects

All existing, approved and proposed projects in **Appendix 2.4** have been considered. There are a number of proposed, permitted or operational wind farms within 20 km of the Development. Each Developer is responsible for engaging with the aviation authority to ensure the proposals will not interfere with aviation radio signals by acting as a physical barrier. Therefore, as each project is designed and built to avoid impacts arising, a cumulative impact cannot arise. There will be no cumulative impacts relating to the Development and surrounding projects in relation to aviation during the construction phase.

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

13.8.8 Statement of Significance

No significant impacts are predicted in terms of air navigation. In adherence to IAA Safety Regulations and ICAO Annex 15, aeronautical obstacle warning light schemes will be installed as requested by IAA. Co-ordinates of ground and tip height elevations at each wind turbine location as constructed will be provided to the IAA. IAA will be notified of the provision of the intention to commence crane operations within a minimum of 30 days prior to erection.

13.9 QUARRIES

13.9.1 Introduction

While sub-base and base course materials for the Access Track and Turbine Hardstand construction will be sourced on site from the borrow pit, crushed stone will be imported for the final running layer. The crushed stone (5,470 m^3) for construction of the Development will come from licenced quarries in the locality such as:

- McGroup Keim Quarry;
- Coppeen Concrete, Enniskeane;
- Mid-Cork Quarries, Gortnadiha;
- McSweeney Bros, Kilmichael;
- Keohane Readymix, Ballygurteen, and
- Murray Bros Tarmacadam Ltd, Ardcahan.

These quarries will also be the source of crushed stone and concrete for turbine foundations and grid connection works. The locations of these quarries in relation to the Development can be seen in **Figure 15.3**.

13.9.2 Assessment of Potential Effects

The construction of the Development will impact on natural resources such as aggregates which will be sourced from the quarries in proximity to the Site (section 13.9.1).

It is likely that a small amount of granular material may be required to maintain access tracks during operation which could impact the source quarry. However, the decommissioning phase will have no impact on the source quarry.

The use of imported materiel will have a slight, permanent negative impact on non-renewable resources of the area. This impact is considered to be imperceptible in the long-term.

13.9.3 The 'Do-Nothing Impact'

If the Project were not to proceed, there would be no impact on quarry operations in the area and quarrying activities would continue.

13.9.4 Mitigation Measures

- Existing tracks have been used where possible and the layout was designed to minimise the length of new track required in order to reduce the requirement for such stone material.
- The on-site borrow pit will provide a total volume of 50,276 m^3. The quarry will only be used where the material won onsite is not suitable.
- Local quarries have been identified to reduce impact on transportation (Please see **Chapter 15: Traffic and Transportation).**
- The source quarry will be chosen based on stone which is chemically similar to that occurring at the Development. This will reduce hydrogeochemical impacts. (Please see **Chapter 8: Soils and Geology**)

13.9.5 Cumulative Effects

All existing, approved and proposed projects in **Appendix 2.4** have been considered.

The very nature of a quarry is that it will be subjected to cumulative effects as it is the source of stone for almost all developments in the area.

Therefore, there will be cumulative impacts relating to the Project and surrounding projects in relation to quarries during the construction phase.

Potential negative cumulative effects on quarries are imperceptible/unlikely during the operational and decommissioning phases.

13.9.6 Statement of Significance

No significant negative impacts on local quarries are anticipated. There will be a slight, permanent negative residual impact on natural resources in the area.

This impact is considered to be imperceptible in the long-term.

13.10 UTILITIES

13.10.1 Introduction

In order to assess the potential for significant effects on built services gas, water and waste in the vicinity of the Development, scoping requests were made to Irish Water and Cork County Council including Water Services and the Environment departments. Refer to **Chapter 1: Introduction** of this EIAR for details in relation to the EIA scoping exercise. In addition to this, Punch Consulting Engineers prepared a Civil and Structural Due Diligence Report (**Appendix 13.2**) which assesses utilities along the Grid Connection Route.

13.10.2 Assessment Methodology

In order to assess the potential for impacts to electricity and water infrastructure and waste services, a scoping exercise was carried out with a number of key consultees, including ESB, Irish Water and Local Authorities. Full details of the scoping exercise that was carried out is provided in **Chapter 1: Introduction**.

A desk study of available information from the EPA did not identify any waste facilities, illegal waste activities, chemical monitoring points or industrial EPA licensed facilities within a 2 km radius of the wind farm site. The nearest waste facility to the Development is Macroom Civic Amenity Site (W0142-01).

13.10.3 Assessment of Potential Effects - Gas, Water Utilities

There are no gas mains located within the Site Boundary. There is therefore no potential for impact. Gas Networks Ireland responded to a consultation request confirming no existing services along the Grid Connection Route or Turbine Delivery Route and there does not appear to be any visible gas infrastructure along the route (**Appendix 13.2**).

Given that no detailed information has been provided by Irish Water or Cork County Council in relation to water services within the Site Boundary, it has been assumed that there is the potential to encounter local water services within the Development.

During Punch Consulting Engineers survey of the Grid Connection Route, the locations of watermains, fire hydrants, metres and sluice valves were recorded and can be found in **Appendix 13.2**.

Potential impacts arising from the Development relating to existing water services have been assessed and are detailed in **Chapter 9: Hydrology and Hydrogeology** and referred to in **Chapter 4: Population and Human Health** with accompanying mitigation measures.

13.10.4 Assessment of Potential Effects - Waste

Staff Facilities

During the construction, operational and decommissioning phases of the Development, there will be the typical waste generated in an office such as left-over food and sandwich wrappers. This is a non-hazardous waste. All such waste will be stored appropriately and safely from wind, rain and wild animals that often tear apart rubbish bags. The effects of this waste will be not significant.

Waste generated on site is estimated to range between 0.005 kg and 0.189kg per person per day.[5]

Sewage

The self-contained port-a-loo units at the construction/decommissioning phase will be managed and serviced regularly (by removal of the contents by tanker to a designated sewage treatment plant such as Ballyvourney/Ballymakeera Wastewater Treatment Plant) and removed off site on completion of construction. Toilet waste is a non-hazardous waste and effects will be slightly significant.

The maximum wastewater production during construction is estimated to be the same as the maximum water consumption (1,000 litres per day)[6].

All wastewater will be tankered off-site by a licensed waste collector to the nearest wastewater treatment plant, (Ballyvourney/Ballymakeera). There will be no on-site treatment of wastewater and effects will be not significant.

Concrete

The use of concrete (construction of Turbine Foundations, Substations etc.) onsite will have slight and permanent effects. It is expected that 20 L – 30 L of concrete washout will be produced during the construction phase which will be collected in designated skip(s) in a bunded area located in the designated concrete washout facility at the contractor's compound located to the north-east of T3.

[5] Based on 1 hour a day within communal facilities. Worldwide, waste generated per person per day averages 0.74 kilogram but ranges widely, from 0.11 to 4.54 kilograms. (World Bank) Available Online: https://datatopics.worldbank.org/what-a-waste/trends_in_solid_waste_management.html [Accessed 24/08/2022]

[6] Table 3 of the EPA WW treatment Manual (Treatment systems for Small Communities, Business, Leisure Centres and Hotels), Environmental Protection Agency, 1999. Quarry (Excluding Canteen) best reflects a construction site. [Available online: https://www.epa.ie/publications/compliance--enforcement/wastewater/EPA_water_treatment_manual_-small-comm_business.pdf]

Concrete structures will be left in place during decommissioning and allowed to naturally revegetate over time. This is the least impactful process of decommissioning. As the Site will have already been altered, the impacts are imperceptible and permanent.

Chemicals, Fuels and Oils

Oil waste and diesel are classified as hazardous waste/dangerous substance. There is no expected chemical/fuel/oil waste other than from rags and residual amounts in containers. Without mitigation, the effects would be slight and medium-term in duration. However, through the implementation of the mitigation measures set out in section 13.10.7 of this chapter, the residual effects will be not significant in the construction/decommissioning phase. The storage/use of such liquids is not seen necessary on site during the operational phase; thus, the effects are imperceptible.

Refuelling

As this has been mitigated by design, the residual effects are not significant.

There will be no need for refuelling onsite during the operational phase and effects are imperceptible.

The quantity of waste produced from refuelling is imperceptible.

Packaging

Packaging will be brought on site during the construction, operational and decommissioning phases and can include cardboard, wood and plastics used to package turbine components. Packaging waste will be dealt with in accordance with the European Union (Packaging) Regulations 2014 (S.I. No. 282 of 2014).

'A producer who supplies to another producer packaging material, packaging or packaged products shall comply with any reasonable request from the latter producer for data on the weight of the material or packaging concerned sufficient to enable the latter producer to comply with these Regulations.'

The occurrence of 10 kg of plastic per turbine blade, between 40 and 50 pallets and 50 to 60 cable drums are expected. This will be removed from site for re-use by an authorised person(s).

This waste is non-hazardous, and the effects of this waste are not significant.

Metals

During decommissioning, it is expected that 3,575 tonnes of steel from decommissioned turbines will be removed. This waste is non-hazardous, and effects will be not significant.

Excavated Materials

Excavated materials will be required for habitat and ecological restoration, reprofiling and backfilling in accordance with the **Appendix 2.1**. As such, excavated materials will not be classified as waste except along the Grid Connection Route.

An estimated 6,557 m^3 of material will be excavated along the Grid Connection Route and will be transported by an authorised waste permit holder to a licensed facility.

The effect of this will be not significant.

13.10.5 The 'Do-Nothing Impact'

If the Project were not to proceed, there would be no impact on the utilities or waste in the area.

13.10.6 Mitigation Measures - Utilities

Mitigation measures relating to existing water services have been assessed and are detailed in **Chapter 9: Hydrology and Hydrogeology** and referred to in **Chapter 4: Population and Human Health.**

13.10.7 Mitigation Measures - Waste

Staff Facilities

Provision for separation of waste streams will be provided so that e.g., paper, and cardboard waste and bottles may be recycled.

Sewage

It is proposed to install a rainwater harvesting system as the source of water for toilet facilities for the operational phase. Wastewater from the staff welfare facilities in the control building will be collected in a sealed storage tank, fitted with a high-level alarm. This is a device installed in a fuel storage tank that is capable of sounding an alarm, during a filling operation, when the liquid level nears the top of the tank.

Concrete

During the construction phase:

- Precast concrete will be used wherever possible i.e., formed offsite. Elements of the Development where precast concrete will be used have been identified and are indicated in the CEMP. Elements of the Development where the use of precast concrete will be used include structural elements of watercourse crossings (single span / closed culverts) as well as Cable Joint Bays. Elements of the Development where the use of precast concrete is not possible include turbine foundations and joint bay pit excavations. Where the use of precast concrete is not possible the following mitigation measures will apply.
- The acquisition, transport and use of any cement or concrete on site will be planned fully in advance and supervised at all times.
- Vehicles transporting such material will be relatively clean upon arrival on site, that is; vehicles will be washed/rinsed removing cementitious material leaving the source location of the material. There will be no excess cementitious material on vehicles which could be deposited on trackways or anywhere else on site. To this end, vehicles will undergo a visual inspection prior to being permitted to drive onto the proposed site or progress beyond the contractor's yard. Vehicles will also be in good working order.
- Any shuttering installed to contain the concrete during pouring will be installed to a high standard with minimal potential for leaks. Additional measures will be taken to ensure this, for example the use of plastic sheeting or other sealing products at joints.
- Concrete will be poured during metrological dry periods/seasons. This will reduce the potential for surface water run off being significantly affected by freshly poured concrete. This will require limiting these works to dry meteorological conditions i.e. avoid foreseen sustained rainfall (any foreseen rainfall event longer than 4 hour duration) and/or any foreseen intense rainfall event (>3 mm/hour, yellow on Met Eireann rain forecast maps), and do not proceed during any yellow (or worse) rainfall warning issued by Met Eireann. This also will avoid such conditions while concrete is curing, in so far as practical.
- Ground crew will have a spill kit readily available, and any spillages or deposits will be cleaned/removed as soon as possible and disposed of appropriately.
- Pouring of concrete into standing water within excavations will be avoided. Excavations will be prepared before pouring of concrete by pumping standing water out of excavations to the buffered surface water discharge systems in place.
- Temporary storage of cement bound sand (if required) will be on hardstand areas only where there is no direct drainage to surface waters and where the area has been bunded e.g., using sand-bags and geotextile sheeting or silt fencing to contain any solids in run-off.
- No surplus concrete will be stored or deposited anywhere on site. Such material will be returned to the source location or disposed of off-site appropriately. A concrete washings area can be seen on Drawing No. 6226-PL-803.

Upon implementation of the above mitigation measures, the effects of the construction of the Development are considered to be not significant.

Chemicals, Fuels and Oils

All storage containers of over 200 litres will have a secondary containment of 110% capacity to ensure that any leaking oil is contained and does not enter the aquatic environment.

A Chemical and Waste Inventory will be kept. This inventory will include:

- List of all substances stored on-site (volume and description)
- Procedures and location details for storage of all materials listed
- Waste disposal records, including copies of all Waste Transfer Notes detailing disposal routes and waste carriers used
- Any tap or valve permanently fixed to the mobile unit through which oil can be discharged to the open or when delivered through a flexible pipe which is fitted permanently to the mobile unit, will be fitted with a lock and locked shut when not in use
- Sight gauges will be fitted with a valve or tap, which will be shut when not in use Sight gauge tubes, if used will be well supported and fitted with a valve
- Mobile units must have secondary containment when in use/out on site

All dangerous substances will be conveyed in a container that compiles with the ADR. As such the manufacturer of each bowser will provide certification to contractors of the following:

- A leak-proof test certificate
- A copy of the IBC approval certificate
- An identification plate attached to the container

Where mobile bowsers are used on site, guidelines will be followed so that:

- Any flexible pipe, tap or valve will be fitted with a lock where it leaves the container and be locked shut when not in use;
- Flexible delivery pipes will be fitted with manually operated pumps or a valve at the delivery end that closes automatically when not in use. Where possible, a nozzle designed to dispense oil will be used;
- The pump or valve will have a lock and be locked shut when not in use.

For loads in excess of 1000 litres (220 gallons), the bowser vehicle driver will have undergone training and hold a special license.

Refuelling

During construction/decommissioning, where possible all refuelling on site will be within the temporary compound within the re-fuelling area (see Drawing No. 6226-PL-803). Only essential refuelling (e.g., cranes) will be carried out, outside of this area, but not within 65 m of any watercourse. In such cases a non-permeable High-density Polyethylene (HDPE) membrane will be provided beneath connection points to catch any residual oil during filling and disconnection. This membrane will be inspected and if there is any sign of oil contamination, it will be removed from site by a specialist licensed waste contractor. All vehicles will be well maintained and free from oil or hydraulic fuel leaks.

Packaging

In accordance with the waste hierarchy, packaging will be returned to the originator ahead of re-use or recycling. Where this is not possible, waste will be separated as appropriate and safely stored on site appropriately in anticipation of recycling.

Metals

Waste metals from concrete reinforcing during construction and removal of metals during decommissioning etc. will have commercial value and will be re-used or recycled with the appropriate licensed waste contractor.

13.10.8 Statement of Significance

There are no gas mains located within the Site Boundary. There is therefore no potential for impact.

It has been assumed that there is the potential to encounter local water services within the Development. Potential impacts arising from the Development relating to existing water services have been assessed and are considered not significant.

There are no EPA-licensed or local authority-authorised waste facilities or activities located within the Site. The closest, authorised municipal waste facility is located approximately 18.3 km south-east of the Development in the townland of Codrum, Macroom, Co. Cork. A list of waste facilities within the vicinity of the Development has been included in **Appendix 2.1: CEMP; Management Plan 5: Waste Management Plan**. Please see **Figure 15.5** for mapped facilities.

The residual effects of waste produced as a result of the construction, operational and decommissioning phases of the Development are considered to be not significant.

14 CULTURAL HERITAGE

14.1 INTRODUCTION

This chapter assesses the impacts of the Project (**Figure 2.2**) on Cultural Heritage. The term 'Project' is used within the chapter to refer to all elements of the application for the construction of Inchamore Wind Farm (**Chapter 2: Project Description**), including the Grid Connection Route and Turbine Delivery Route. The term 'Site' is used to refer to all land that falls within the Inchamore Wind Farm Site Boundary. The term 'Development' is used to describe the wind turbines, all site infrastructure and all works required along the Turbine Delivery Route within the Redline Boundary.

The assessment considers the potential effects during the following phases:

- Construction phase;
- Operation phase, and
- Decommissioning phase.

Where negative effects are predicted, the chapter identifies appropriate mitigation strategies therein.

The term 'Cultural Heritage' encompasses heritage assets relevant to both the tangible resource (archaeology, architecture heritage); and non-tangible resources (history, folklore, tradition, place names etc.). The recorded and potential cultural heritage resource within lands encompassing the proposed wind farm site (the Site) and the surrounding landscape was reviewed in order to compile a comprehensive cultural heritage baseline for the assessment. The proposed Grid Connection Route and the route for the delivery of turbines to the Site were also assessed. The extent of the study area assessed is defined in **Section 14.2.1**.

Common acronyms used throughout this EIAR can be found in **Appendix 1.2.** This chapter of the EIAR is supported by Figures provided in Volume III and by the following Appendix document provided in Volume IV of this EIAR:

- **Appendix 14.1 Plates**

A Construction and Environmental Management Plan (CEMP) is appended to the EIAR in **Appendix 2.1**. In the event planning consent is granted for the Development, the CEMP will be updated prior to commencement of development to address the requirements of any relevant planning conditions, including any additional mitigation measures, which are conditioned and will be submitted to the planning authority for written approval. For the purpose of this application, a summary of the mitigation measures is included in **Appendix 17.1**.

14.1.1 Statement of Authority

The chapter was prepared by Tony Cummins, a Senior Archaeologist with John Cronin and Associates. Mr Cummins holds B.A. and M.A. degrees in archaeology (University College Cork, 1992/1994) and has accumulated twenty-eight years' continuous industry experience. He was confirmed as a licence eligible archaeologist by the National Monuments Service in 1998 and has extensive experience in the preparation of cultural heritage assessments.

14.1.2 Assessment Structure

The results of the desktop study and field surveys, which are provided in **Section 14.3** of this chapter, together with the other assessments are considered to allow the Board to carry out an assessment of the Project from a Cultural Heritage perspective. In line with the revised EIA Directive and current EPA guidelines (as detailed in **Section 14.2.2** below) the chapter provides considerations of effects based on the following:

- Assessment of cultural heritage value and sensitivity;
- Assessment of the magnitude of cultural heritage effects within the Study Area;
- Assessment of the significance of cultural heritage impacts; and
- Assessment of cumulative cultural heritage impacts.

14.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

14.2.1 Definition of Study Area

The study area reviewed for the assessment comprised the area within the Development and the surrounding lands extending for 1 km in all directions beyond its Redline Boundary as well as a 100 m wide area centred on the Grid Connection Route and works required to facilitate the Turbine Delivery Route. The extent of the Development study area was chosen in order to compile a baseline context for the known cultural heritage resource within the Site and its environs as well as to assess potential direct and indirect impacts on the locations and settings of known cultural heritage assets within this area. The extent of the 100 m study area centred on the Grid Connection Route and Turbine Delivery Route work areas was chosen in order to appraise if there are any known elements of the cultural resource within their localised footprints or close environs, including potential sub-surface elements which may be susceptible to direct or indirect impacts.

In addition, the wider landscape extending for 10 km in all directions from the Site was reviewed to determine the presence of any nationally significant cultural heritage assets with heightened visual sensitivities, i.e., National Monuments in State Care and World Heritage sites (including tentative sites). This also included a review of other cultural heritage assets with visual attributes that extend beyond their immediate settings within this area, such as archaeological monuments with ritual visual alignments across the wider landscape that may be potentially subject to intrusions by turbines (e.g., stone circles, stone rows and megalithic tombs). The extent of the 10 km area was chosen in order to appraise if the wider landscape contains individual or groupings of such visually sensitive assets that may be susceptible to potential medium-to-high magnitudes of indirect impacts on their wider settings or alignments.

A review of the assessment of the significance of visual impacts on publicly accessible cultural heritage receptors within 20 km of the Development presented in the Landscape and Amenity Assessment chapter was also carried out (see **Chapter 12**). An archaeological review of this 20 km area did not identify other monuments or cultural heritage locations within publicly accessible lands that likely required visual impact assessment.

14.2.2 Assessment Methodology

The methodology used for this assessment follows guidelines presented in the *Guidelines for Information to be Contained in EIAR* (2022). The chapter complies with the requirements of Directive 2011/92/EU as amended by Directive 2014/52/EU, and the Planning and Development Act, 2000 (as amended) and Planning and Development Regulations, 2001 (as amended).

14.2.3 Relevant Legislation and Guidance

The tangible elements of the cultural heritage resource can be broadly divided into the archaeological resource comprising sites and monuments dating from the prehistoric period to the post-medieval period and the architectural heritage resource, encompassing standing structures and sites of cultural importance often dating to the post-medieval and modern periods. In addition, assets such as local placenames, folklore and traditions are considered part of the intangible cultural heritage resource. The management and protection of the cultural heritage resource in Ireland is achieved through a framework of international conventions and national laws and policies. This framework was established in accordance with the provisions of the 'European Convention on the Protection of the Archaeological Heritage' (the Valletta Convention) and the 'European Convention on the Protection of Architectural Heritage' (Grenada Convention). Both of these conventions were ratified by Ireland in 1997. While there is no current national legislation providing legal protection for the Irish intangible heritage resource it is noted that the UNESCO *Convention for the Safeguarding of the Intangible Cultural Heritage*, 2003, which seeks to safeguard and promote awareness of this element of cultural heritage, was ratified by Ireland in 2015.

The legislation and guidelines that are relevant to this assessment comprise the following:

- National Monuments Act 1930 (and amendments);
- Heritage Act (1995);
- National Cultural Institutions Act (1997);
- Architectural Heritage (National Inventory) and Historic Monuments (Misc) Provisions Act (1999);
- Planning and Development Act (2000) as amended;
- Department of Arts, Heritage and Gaeltacht (2011) *Architectural Heritage Protection: Guidelines for Planning Authorities*[1] , and
- Department of Arts, Heritage, Gaeltacht and the Islands (1999) *Framework and Principles for the Protection of Archaeological Heritage*[2]

14.2.4 Archaeological Heritage

The National Monuments Service is currently based in the Department of Housing, Local Government and Heritage and is responsible for the preservation, protection and promotion of Ireland's archaeological heritage. The National Monuments Acts 1930 (and amendments), the Heritage Act 1995 and relevant provisions of the National Cultural Institutions Act 1997 are the primary means of ensuring the satisfactory protection of archaeological remains. There are a number of mechanisms under the National Monuments Acts that are applied to secure the protection of archaeological monuments. These include the designation of National Monument status, the Register of Historic Monuments, the Record of Monuments and Places and the Sites and Monuments Record as well as the placing of Preservation Orders and Temporary Preservation Orders on endangered sites.

A National Monument is described as 'a monument or the remains of a monument, the preservation of which is a matter of national importance by reason of the historical, architectural, traditional, artistic or archaeological interest attaching thereto' (Section 2, National Monument Act, 1930). The Record of Monuments and Places was established under Section 12(1) of the National Monuments (Amendment) Act, 1994 and was based on the Sites and Monuments Record and Register of Historic Monuments. These records comprise lists and maps of all known archaeological monuments and places for each county in the State. The National Monuments Service maintains an online Historic Environment Viewer[3] which comprises an interactive map/search facility that provide access to records stored on its national database of sites and monuments. The Viewer includes designated areas around recorded monuments known as 'zones of notification' which do not comprise

[1] [1] https://www.gov.ie/en/publication/0937a-architectural-heritage-protection-guidelines-for-planning-authorities/
[2] https://www.archaeology.ie/sites/default/files/media/publications/framework-and-principles-for-protection-of-archaeological-heritage.pdf
[3] https://maps.archaeology.ie/HistoricEnvironment/

buffer zones but are intended to indicate areas of archaeological potential within their environs[4]. All archaeological sites listed in the Record of Monuments and Places receive statutory protection under the National Monuments Act 1994 and no works can be undertaken at their locations, including their surrounding zones of notification, without providing two months advance notice to the National Monuments Service.

The Sites and Monuments Record and the Record of Monuments and Places list two archaeological sites within the Redline Boundary as well as a further 15 examples within the surrounding 1 km area and these are detailed in **Section 14.3**. The potential for the presence of hitherto unrecorded, sub-surface archaeological features within Project areas is also considered.

14.2.4.1 Architectural Heritage

The protection of the architectural heritage resource is provided for through a range of legal instruments that include the Heritage Act 1995, the Architectural Heritage (National Inventory) and National Monuments (Misc. Provisions) Act 1999, and the Planning and Development Act 2000 Section (2.1) of the Heritage Act 1995, describes architectural heritage as follows:

All structures, buildings, traditional and designed, and groups of buildings including streetscapes 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, and, without prejudice to the generality of the foregoing, includes railways and related buildings and structures and any place comprising the remains or traces of any such railway, building or structure.

The Planning and Development Act 2000 requires Planning Authorities to maintain a 'Record of Protected Structures' of buildings and other structures that are of special architectural, historical, archaeological, artistic, cultural, scientific, social or technical interest. All structures listed for protection in current development plans, are designated protected structures and planning permission is required for any works to such structures that would affect their character. A protected structure also includes the lands and other structures within its curtilage. While the notion of curtilage is not defined by legislation, the *Architectural Heritage Protection Guidelines for Local Authorities*[5] (Department of Arts, Heritage and the Gaeltacht 2011), describes it as the parcel of land immediately associated with a structure and which is (or was) in use for the purposes of the structure. The Project, and surrounding study area, extends into Counties Cork and Kerry and the current Record of Protected Structures for these administrative areas are published in the County Cork

[4] https://www.archaeology.ie/sites/default/files/media/publications/archaeology-planning-process-pl13.pdf
[5] https://www.gov.ie/en/publication/0937a-architectural-heritage-protection-guidelines-for-planning-authorities/

Development Plan 2022-2028 and the County Kerry Development Plan 2022-2028. The Planning and Development Act 2000 also provides for the inclusion of objectives for preserving the character of places, areas, groups of structures or townscapes of special interest designated as Architectural Conservation Areas.

The Architectural Heritage Act 1999 established the National Inventory of Architectural Heritage and the National Inventory of Architectural Heritage Historic Gardens and Designed Landscapes to create a record of built heritage structures and associated lands within the State. While inclusion in the National Inventory of Architectural Heritage does not provide statutory protection to a structure, it does provide an indication of architectural heritage value and the inventory is intended to advise local authorities on compilation of their Records of Protected Structures.

14.2.4.2 Cork County Development Plan 2022-2028

The County Cork Development Plan 2022-2028[6] includes a number of policies and objectives in relation to the protection of the cultural heritage resource within the county and these include objectives in relation to the protection of the archaeological resource (HE 16-9b: Management of Monuments within development sites, HE 16-10c: Undiscovered Archaeological Sites, HE 16-7 Battlefield, Ambush and Siege Sites and Defensive Archaeology, HE 16-9: Archaeology and Infrastructure Schemes, HE 16-6 Industrial and Post Medieval Archaeology and HE 16-9c Archaeological Landscapes). The Development Plan also includes a number of policies and objectives in relation to the protection of the architectural heritage resource within the county including the protection of designated structures and Architectural Conservation Areas (HE 16-14: Record of Protected Structures, HE 16-15: Protection of Structures on the NIAH and E 16-18: Architectural Conservation Areas) as well as non-designated features such as vernacular buildings, historic gardens and landscapes, masonry walls, railings, follies, gates, bridges and street furniture that are of built heritage significance (HE 16-16: Protection of Non-Structural Elements of Built Heritage, HE 16-19:Vernacular Heritage and HE 16-20: Historic Landscapes). The Development Plan also includes a number of policies and objectives in relation to the protection of the cultural heritage resource within the county, including aspects such as the cultural heritage of the county (HE 16-23: Cultural Heritage), linguistic heritage (HE 16-22: Gaeltacht Areas), placenames (HE 16-24: Naming of New Developments) and the arts (HE 16-26: The Arts). The *Múscraí Heritage Plan: conservation, management and interpretation plan 2018-2032*[7] was also reviewed as part of the assessment.

[6] https://www.corkcoco.ie/en/resident/planning-and-development/cork-county-development-plan-2022-2028
[7] https://www.corkcoco.ie/sites/default/files/2019-01/M%C3%BAscra%C3%AD%20Gaeltacht%20CMIP%20Final%20Draft%20Jan%202019.pdf

14.2.4.3 Kerry County Development Plan 2022-2028

While the Site is contained within County Cork, the surrounding 1 km study area around its Redline Boundary, as well as sections of the Site Access Road and Grid Connection Route, extend into County Kerry. The County Kerry Development Plan 2022-2028[8] was therefore also reviewed as part of the assessment. Section 8.3 of the Development Plan includes the Council's objectives for the protection of the archaeological resource which includes sections in relation to recorded archaeological monuments as well as the underwater archaeological resource (Development Plan Sections 8.3.1 and 8.3.3). The Development Plan also identifies 19 archaeological landscapes within the County and contains objectives that protect the monuments and their landscape settings within these areas as well as their visual aspect and monument inter-visibility (Development Plan Section 8.3.2). The Project does not extend into the boundaries of any of these designated archaeological landscapes. The Site is located c.2 km outside the boundary of The Paps Archaeological Landscape (Development Plan Archaeological Landscape ref. 13[9]) while a section of the Grid Connection Route follows an existing forestry road that extends outside the southern end of the boundary of this designated landscape. The closest section of this existing forestry road is located c.30 m outside the landscape boundary (**Figure 14.11**). The Development Plan also presents objectives for the protection of the architectural heritage resource, including Protected Structures, Architectural Conservation Areas, vernacular architecture, historic landscapes and arts/culture (Development Plan Sections 8.4.2, 8.4.3, 8.4.4, 8.4.5 and 8.2.1).

14.2.5 Desktop Study

The assessment presents the results of a desktop study of relevant published sources and datasets undertaken in order to identify all recorded and potential archaeological, architectural and other cultural heritage sites/features/areas within the study areas of the Site, Grid Connection Route and Turbine Delivery Route. The principal sources reviewed for the assessment of the recorded archaeological resource were the Sites and Monuments Record and the Record of Monuments and Places. The current Record of Protected Structures for Counties Cork and Kerry as well as the National Inventory of Architectural Heritage were consulted for assessing the designated architectural heritage resource. Other sources consulted as part of the assessment included the following:

[8] http://docstore.kerrycoco.ie/KCCWebsite/planning/devplan/vol1updated.pdf

[9] https://consult.kerrycoco.ie/sites/default/files/4%20Archaeological%20Landscapes.pdf

Archaeological Inventory of County Cork Vols. 3 and 5:

These publications present summary descriptions of the recorded archaeological sites within this area of the county and relevant entries are included within the chapter. In addition, the current national online database resources pertaining to same were reviewed on the National Monuments Service's Historic Environment Viewer (www.archaeology.ie) in March 2023. A section of the 1 km study area around the Site as well as sections of the Site Access Road, Turbine Delivery Route and Grid Connection Route extend into an area of County Kerry that does not have a published archaeological inventory. The review of the Historic Environment Viewer included an appraisal of the known archaeological monuments within the relevant lands in County Kerry.

Heritage Council of Ireland Map Viewer:

This online mapping source (www.heritagemaps.ie) collates various cultural heritage datasets provided by, among others, the National Monuments Service, the National Museum of Ireland, local authorities, the Royal Academy of Ireland and the Office of Public Works and was reviewed in March 2023.

Topographical Files of the National Museum of Ireland:

These files, which are archived in the museum premises in Kildare Street, Dublin, were reviewed as part of the assessment and contain no entries for any of the townlands within the study area.

Database of Irish Excavation Reports:

This database contains summary accounts of all archaeological excavations carried out in Ireland (North and South) from 1970 to present. Current data was accessed via www.excavations.ie in March 2023.

Literary Sources:

Various published sources were consulted in order to assess the archaeological, historical, architectural heritage and folklore record of the study area.

Cartographic Sources:

A review of available historic cartographic sources was undertaken, and these included the 17th-century Down Survey and various map editions published by the Ordnance Survey from the mid-19th century onward. These sources can indicate the presence of past settlement patterns, including features of archaeological and architectural heritage significance that no longer have any surface expression. Relevant extracts from the reviewed cartographic sources are presented in **EIAR Volume III (Figures 14.4 and 14.5)**.

Aerial, Satellite and LiDAR imagery:

A review of available imagery of the study area was undertaken in order to review the extent of modern interventions and to ascertain if any traces of unrecorded archaeological sites were visible within the Site.

Irish National Folklore Collection:

A review was undertaken of transcribed material from the National Folklore Collection archive which has been digitised and published online at www.duchas.ie.

UNESCO designated World Heritage Sites and Tentative List:

There are two designated World Heritage sites in Ireland and a number of other significant examples have been included in a Tentative List (2022) that has been put forward by Ireland for inclusion. None of these designated or tentative sites are located within 20 km of the Project.

14.2.6 Field Survey

Proposed development areas were surveyed on 22nd June 2020, 19th May 2021, 26th July 2021 and 3rd November 2021 and this included inspections of the Site, which includes the Site Access Road extending to the Site from the N22 road to the north and the Grid Connection Route. A windshield survey of the Turbine Delivery Route was also carried out. The surveyed lands were assessed in terms of historic landscape, existing land use, tree cover and the potential for the presence and survival of unrecorded archaeological and undesignated architectural heritage sites/features. The results of the field surveys are described within **Section 14.3.14** while annotated extracts from the photographic record are provided in **Appendix 14.1**.

14.2.7 Consultation

During the scoping stage the Development Applications Unit provided a response on 19th April 2021 to the request for comment on the scoping report provided to it. This response did not include any content in relation to the Cultural Heritage resource.'

14.2.8 Predicted Impacts on Archaeological, Architectural and Cultural Heritage

The following provides a summary of the criteria used to assess impacts in order to concisely outline the methodology specifically applied to the cultural heritage resource which has been informed by relevant EPA and ICOMOS guidelines (see **Section 14.2**).

Duration of Effect

The duration of effects is assessed based on the following criteria:

- Momentary (seconds to minutes)
- Brief < 1 day
- Temporary <1 year
- Short-term 1-7 years
- Medium Term 7-15 years
- Long Term 15-60 years
- Permanent > 60 years
- Reversible: Effects that can be undone, for example through remediation or restoration

Quality of Effect

The quality of an effect on the cultural heritage resource can be positive, neutral or negative:

- Positive Effect – a change which improves the quality of the cultural heritage environment, (e.g., increasing amenity value of a site in terms of managed access, signage, presentation or high-quality conservation/restoration and re-use of an otherwise vulnerable derelict structure)
- Neutral Effect – no change or effects that are imperceptible, within the normal bounds of variation for the cultural heritage environment
- Negative Effect – a change which reduces the quality of the cultural heritage resource, (e.g., visual intrusion on the setting of an asset, physical intrusion on features/setting of a site)

Type of Effect

The type of effect on the cultural heritage resource can be direct, indirect or no predicted impact.

- Direct Impact – where a cultural heritage site is physically located within the footprint of the EIA Development, which will result in its complete or partial removal.
- Indirect Impact – where a cultural heritage site or its setting in the landscape is located within the environs of the EIA Development.
- No predicted impact – where the EIA Development will not adversely or positively affect a cultural heritage site.

Magnitude of Effect

This is based on the degree of change, incorporating any mitigation measures, on a cultural heritage asset and can be negative or positive. The magnitude is ranked without regard to the value of the asset according to the following scale: High; Medium; Low and Negligible and has been informed by criteria published in the International Council on Monuments and Sites *Guidance on Heritage Impact Assessments for Cultural World Heritage Properties* (ICOMOS 2011) (**Table 14.1**).

Value assessment criteria

The evaluation of the values of cultural heritage assets used for the purposes of assessment is not intended as definitive, but rather an indicator which contributes to a wider judgment based the individual circumstances of each asset. The value of all known or potential assets that may be affected by development are ranked according to the following scale: Very High; High; Medium; Low; Negligible and Unknown. The factors for assessing the value of cultural heritage assets provided in **Table 14.2** have regard to the ICOMOS *Guidance on Heritage Impact Assessments for Cultural World Heritage Properties*[10] (ICOMOS 2011, 14.17). This guidance is intended as indicative and is used in combination with a consideration of the condition/preservation; documentary/historical significance, group value, rarity, visibility in the landscape, fragility/vulnerability and amenity value of the cultural heritage assets on a case-by-case basis. The values assigned to identified assets within the study areas were determined following the completion of the desktop research combined with subsequent site inspections and are presented in **Section 14.4** of this chapter.

Significance of Effects

The significance of effect can be described as Profound, Very Significant, Significant, Moderate, Slight, Not Significant or Imperceptible (**Table 14.3**) and is assigned based on the combined evaluation of effect magnitude and asset significance (**Table 14.4**).

Table 14.1: Magnitude of Impact Assessment Indicators for Cultural Heritage Assets

Indicative factors for assessing the Magnitude of Impact on the Cultural Heritage Asset *(after ICOMOS Guidelines 2011)*	
High	Most or all key archaeological or architectural materials affected such that the resource is totally altered Comprehensive changes to setting Changes to most or all key historic landscape elements, parcels or components; extreme visual effects; fundamental changes to use or access; resulting in total change to historic landscape character Major changes to area that affect Intangible Cultural Heritage activities or associations or visual links and cultural appreciation
Medium	Changes to many key archaeological or historic building materials/elements such that the resource is clearly/significantly modified Considerable changes to setting that affect the character of a cultural heritage asset. Changes to the setting of a historic building, such that it is significantly modified

[10] https://www.iccrom.org/sites/default/files/2018-07/icomos_guidance_on_heritage_impact_assessments_for_cultural_world_heritage_properties.pdf

Indicative factors for assessing the Magnitude of Impact on the Cultural Heritage Asset *(after ICOMOS Guidelines 2011)*	
	Change to many key historic landscape elements, parcels or components, visual change to many key aspects of the historic landscape, considerable changes to use or access, resulting in moderate changes to historic landscape character Considerable changes to area that affect the Intangible Cultural Heritage activities or associations or visual links and cultural appreciation.
Low	Changes to key archaeological materials/historic building elements, such that the resource is slightly altered/slightly different Slight changes to setting of an archaeological monument Change to setting of a historic building, such that it is noticeably changed Change to few key historic landscape elements, parcels or components; slight visual changes to few key aspects of historic landscape; slight changes to use or access; resulting in limited change to historic landscape character Changes to area that affect the Intangible Cultural Heritage activities or associations or visual links and cultural appreciation
Negligible	Very minor changes to key archaeological materials or setting Slight changes to historic building elements or setting that hardly affect it Very minor changes to key historic landscape elements, parcels or components; virtually unchanged visual effects; very slight changes to use or access; resulting in very small change to historic landscape character Very minor changes to area that affect the Intangible Cultural Heritage activities or associations or visual links and cultural appreciation

Table 14.2: Value Indicators for Cultural Heritage Assets

Indicative factors for assessing Value of Cultural Heritage Assets *(after ICOMOS Guidelines 2011)*	
Very High	*Potential for International Significance which may include* World Heritage Sites (including Tentative List properties) Assets of acknowledged international importance Assets that can contribute significantly to international research objectives Intangible associations with individuals or innovations of international significance
High	*Potential for National Significance which may include* Nationally designated sites, buildings and landscapes of significant quality, rarity, preservation and importance Undesignated assets of the quality and importance to be designated Assets that can contribute significantly to acknowledged national research objectives Archaeological Landscapes with significant group value Intangible associations with individuals or innovations of national significance
Medium	*Potential for Regional Significance which may include* Designated or undesignated assets that can contribute significantly to regional research objectives, including buildings that can be shown to have exceptional qualities in their fabric or historical associations Conservation Areas and historic townscapes containing buildings that contribute significantly to its historic character Intangible associations with individuals or innovations of regional significance
Low	*Potential for Local Significance which may include* Assets compromised by poor preservation and/or poor survival of contextual associations Assets of limited value, but with potential to contribute to local research objectives Historic Townscape or built-up areas of limited historic integrity in their buildings and settings Intangible associations with individuals or innovations of local significance
Negligible	Assets with very little or no surviving archaeological interest Landscapes with little or no significant historical interest

Indicative factors for assessing Value of Cultural Heritage Assets *(after ICOMOS Guidelines 2011)*	
	Buildings or urban areas of no architectural or historical note; buildings of an intrusive character
Unknown	Assets whose importance has not been ascertained Buildings with some hidden (i.e., inaccessible) potential for historic significance

Table 14.3: Significance of Effects (per EPA EIAR Guidelines 2022)

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

Table 14.4: Significance of Effects (per EPA EIAR Guidelines 2022)

Magnitude of Impact	**High**	Not Significant/ Slight	Moderate/ Significant	Significant/ Very Significant	Very Significant/ Profound
	Medium	Not Significant	Slight	Moderate/ Significant	Significant/ Very significant
	Low	Not Significant/ Imperceptible	Slight/ Not Significant	Slight	Moderate
	Negligible	Imperceptible	Not Significant/ Imperceptible	Not Significant/ Slight	Slight
		Negligible	**Low**	**Medium**	**High**
		Value/Sensitivity of the Asset			

14.3 BASELINE DESCRIPTION

14.3.1 Introduction

The following sections presents summary details of the main periods within the Irish archaeological record with references to identified cultural heritage assets located within the study area around the wind farm site, turbine delivery and the Grid Connection Route Datasets have been interrogated and retrieved from current state and local authority sources and are considered accurate at the time of writing in March 2023. **Section 14.3.2** provides a chronological overview of the Site study area since prehistoric times and includes references to known archaeological monuments within the area. The published Archaeological Survey of Ireland inventory descriptions of these monuments are then presented in **Section 14.3.3**. Other baseline information relating to the Site are presented in Sections **14.3.4** to **14.3.11** (inclusive) and baseline information on the Grid Connection Route and Turbine Delivery Routes have been collated in **Sections 14.3.12** and **14.3.13**.

14.3.2 The Wind Farm Site: Archaeological and Historical Background

Prehistoric Periods

Until the recent identification of Palaeolithic human butchery marks on a bear bone recovered from a cave site in County Clare, the earliest recorded evidence for human activity in Ireland dated to the Mesolithic period (7000–4000 BC) when groups of hunter-gatherers lived on the heavily wooded island. The archaeological record indicates that these mobile groups tended to favour coastal, lake and river shores locations which provided a transport resource and also provided elements of their varied diet. They did not construct any settlements or monuments that have left any above ground traces although their presence in an area can often be identified by scatters of worked flints in ploughed fields or sub-surface traces of their settlements revealed during earth-moving undertaken as part of development works. The Neolithic period (4000-2400 BC) began with the arrival of agriculture and its establishment as the principal form of economic subsistence, which resulted in more permanent settlement patterns. As a consequence of the more settled nature of agrarian life, new site-types, such as substantial rectangular timber houses, field systems and various types of megalithic tombs, begin to appear in the archaeological record. There are no known archaeological sites dating to the Mesolithic or Neolithic periods located within 1 km of the Site.

Metalworking arrived in Ireland with the advent of the Bronze Age period (c. 2400–500 BC). This new technology introduced a new artefactual assemblage into the Irish archaeological record and this period was also associated with the construction of new monument types such as standing stones, stone rows, stone circles and fulachta fiadh. The development of new burial practices meant that the construction of funerary monuments such as cairns, barrows, boulder burials and tumuli or cists was a common practice during this period. The arrival of iron-working technology in Ireland saw the advent of the Iron Age (600 BC – 400 AD). Relatively little has been known about settlement patterns during this period until recent decades when the corpus of evidence has been greatly increased by the discovery of Iron Age sites during archaeological investigations undertaken as part of various development projects.

The Site contains one field boundary feature (CO057-006----) and an enclosure site (CO057-007----) both of which are located within Inchamore townland in the area between

Turbines 1 and 2 **(Figures 14.1 and 14.2)**. These site types may potentially date to any period from prehistory onward and typically require archaeological excavation to determine their origin. The classification of 'field boundary' as an archaeological monument refers to field enclosures of potential antiquity and is often applied to remnant traces of walling sealed by bog growth. Isolated sections of such walling can be revealed by turf cutting works and may be an indication of the presence of wider field systems which may remain undetected below existing ground surfaces. They are often found associated with the remains of stone hut sites particularly within unimproved upland areas in western counties. The term 'enclosure' is applied to monuments with observable enclosing elements but have little or no other surviving diagnostic features that allow further classification. The field surveys carried out as part of this assessment included inspections of the locations of these two monuments within the Site and further details are provided in **Section 14.3.14**.

The surrounding 1 km study area also contains two sites of potential or likely Bronze Age date, and these comprise an unclassified megalithic structure (KE086-007----), located within a section of a forestry plantation *c.*460 m outside the north end of the Site and a *fulacht fia* (CO057-008007-) located *c.*550 m outside the south end of the Site **(Figure 14.1)** The megalithic structure and standing stone monuments are associated with funerary or other ritual activities while fulacht fia comprise burnt mounds or spreads that are typically interpreted as the remains of cooking sites. The presence of these monuments within the environs of the Site indicates the potential presence of an established Bronze Age population in the general area who were undertaking both ritual and domestic activities. The settlement sites during this period comprised one or more timber structures and the remains of their foundations and habitation deposits can survive beneath modern ground surfaces. There is also a cluster of recorded archaeological sites located within an area of Inchamore townland at distances of *c.*350 m-480 m outside the southern end of the Site and these comprise a field boundary (CO057-008001-), two enclosures (CO057-008004- and CO057-008005-) and four hut sites (CO057-008002-, CO057-008003-, CO057-008006- and CO057-008008-) **(Figure 14.1)**. These sites may conceivably date to any period from prehistory onward and it is not possible to determine their origin without recourse to archaeological excavation.

A review of the landscape extending for 10 km from the Wind farm Site revealed the presence of various extant prehistoric monuments of probable Bronze Age origin which have likely ritual alignments across the wider landscape, and these comprise five stone circles, thirteen wedge tombs, two unclassified megalithic structures and one stone row **(Table 14.5 and Figure 14.7)**. The methodology used to assess whether any examples have direct alignments towards turbines within the Site, which may intrude on these alignments, entailed reviews of their archaeological inventory descriptions to determine their recorded alignments, and these were then analysed by cross-referencing each of the monuments' locations in relation to the Site. This review revealed that only one example, a wedge tomb (CO058-060----) located 2.25 m to the northeast of the nearest turbine (T4), has a recorded alignment facing towards the Site (**Figure 14.7**). The Archaeological Survey of Ireland record that this monument is in a ruinous condition within an area of cut away bog and appears to have been exposed by turf cutting. A review of aerial and satellite imagery of its general location revealed that it is located within private lands on the northwest side of a modern forestry plantation and that turf-cutting has continued within its close environs during recent decades. Wedge tombs consist of a long burial gallery formed by large stone slabs, sometimes with an antechamber or small closed end-chamber. They are generally broader and higher at the front, which tends to face towards the west and southwest directions. O' Brien[11] has noted that monuments such as wedge tombs were aligned towards the general direction of the setting sun in the general southwest quadrant during the darker months of the year.

Table 14.5: Review of monuments with potential visual alignments within 10 km of Site

Monument no.	Class	Condition (ASI)	Approx. distance from nearest turbine	Recorded Alignment (ASI)	Aligned towards Site?
CO058-060----	Megalithic tomb - wedge tomb	In ruins	2.25 km to NE	NE-SW	Yes
CO058-075----	Megalithic tomb - wedge tomb	Collapsed	1.8 km to NW	n/a	n/a
CO058-076----	Megalithic tomb - wedge tomb	Partially exposed in cutaway bog face	2.9 km to NE	E-W	No
CO068-005----	Megalithic tomb - wedge tomb	Extant but capstone displaced	7.9 km to S	NE-SW	No
CO069-003----	Megalithic tomb - wedge tomb	In ruins	5.1 km to S	ENE-WSW	No
CO069-014----	Megalithic tomb - wedge tomb	Extant but capstone displaced	6.9 km to SE	E-W	No
CO069-029----	Megalithic tomb - wedge tomb	Extant	8.7 km to SE	ENE-WSW	No
CO069-069----	Megalithic tomb - wedge tomb	Partial remains	3.8 km to SE	N-S	No
CO069-093----	Megalithic tomb - wedge tomb	Extant but capstone displaced	7.2 km to S	E-W	No
KE076-038----	Megalithic tomb - wedge tomb	Extant but partially sealed with field clearance material	3.7 km to NW	ENE-WSW	No

[11] O'Brien, W. (2012) *Iverni: A prehistory of Cork*. The Collins Press. pg 192-3

Monument no.	Class	Condition (ASI)	Approx. distance from nearest turbine	Recorded Alignment (ASI)	Aligned towards Site?
KE076-056----	Megalithic tomb - wedge tomb	Extant but capstone displaced	3.4 km to NW	E-W.	No
KE085-001----	Megalithic tomb - wedge tomb	Extant but partially buried in bog and in forestry	8 km to WNW	E-W	No
KE085-053001-	Megalithic tomb - unclassified	Possible megalith in ruinous condition	5.8 km to SW	n/a	n/a
KE086-007----	Megalithic structure	Irregular-shaped stone structure in forestry, possible megalith	0.67 km to N	E-W	No
KE094-095----	Megalithic tomb - wedge tomb	Extant but capstone displaced	10 km to SW	E-W	No
CO058-029----	Stone circle - five-stone	Extant but one stone missing	5.5 km to SE	E-W	No
CO069-013----	Stone circle - multiple-stone	Extant	7.7 km to SE	NNE-SSW	No
CO069-015----	Stone circle - multiple-stone	Partially collapsed	6.7 km to SE	NNE-SSW	No
CO069-026----	Stone circle - five-stone	Extant	8 km to SE	NE-SW	No
CO069-076----	Stone circle - five-stone	Extant	2.9 km to S	ENE-WSW	No
CO069-027----	Stone row	Extant	8.1 km to SE	NE-SW	No
KE086-009----	Stone pair	Extant	2.5 km to SW	NW-SE	No
CO058-007----	Stone pair	Extant	3.8 km to NW	ENE-WSW	No

Early Medieval to Post-Medieval Periods

The early medieval period began with the introduction of Christianity to Ireland and continued until the arrival of the Anglo-Normans in the late 12th century (c. 400–1169 AD). While this period saw the emergence of the first phases of urbanisation around the larger monasteries and the Hiberno-Norse ports, the dominant settlement pattern continued to be rural-based and founded on an agricultural economy centred on enclosed farmsteads known as ringforts, with stone-built equivalents known as cashels. The early medieval church sites were often morphologically similar to ringforts but are often differentiated by the presence of features such as church buildings, graves, stone crosses and shrines. While there are notable early medieval ecclesiastic sites located within the Baile Bhúire and Gougane Barra areas in the wider landscape, there are no recorded examples within the study area.

There is one potential early medieval site located within the study area and this comprises a holy well (CO057-009----) in Inchamore townland at a distance of 670 m to the south of the Redline Boundary. Holy wells are common features within the Irish landscape and are typically sited at natural springs with some examples simply formed by natural depressions that fill with water while others have stone-built surrounds which often date to recent centuries. The traditions and veneration associated with these sites may date to the earliest phase of Irish Christianity with the potential that they likely form a continuation of pre-Christian ritual activity. Many wells have associations with a saint's name and were the site of annual visitations, known as patrons or patterns, which were held on the named saint's day, a practice which still continues at some examples. The holy well waters are also typically associated with traditions ascribing them various curative properties.

The arrival of the Anglo-Normans in the late 12th century broadly marks the advent of the Irish high medieval period which continued to c.1400 and was followed by the late medieval period which extended to c.1550. These periods saw the continuing expansion of Irish urbanisation as many of the port cities developed into international trading centres and numerous villages and towns began to develop throughout the country, often within the environs of Anglo-Norman manorial centres which were defended by masonry castles. By the 15th century, the native Irish chieftains and lords began to construct tower-house castles within their own landholdings as centres of territorial control. In 1207, King John granted Richard de Cogan rights to an area taking in all or part of Muskerry much of which was still under Gaelic control at that time. The initial land grant for what was to become the barony of Múscraí dates to 1352 when lands on the Cork-Kerry border were the subject of grant from the English crown to Cormac McCarthy. It has been noted that much of the subsequently conquered lands within the region were concentrated along the Lee Valley and that many remote mountainous areas remained in Gaelic control[12]. There are no recorded late or high medieval monuments located within the study area.

The centuries following 1550 comprise the post-medieval period which continued into the middle of the 19th century and the period thereafter is often described as early modern. The early phase of the post-medieval period was a turbulent time in Ireland and included the mid-17th century Cromwellian Wars which resulted in extensive dispossession of forfeited Gaelic lands. The 17th century Down Survey records compiled following the latter period of conflict provide very little information on the two townlands that extend into the Redline Boundary (Inchamore and Milleeny). The annotated maps indicate that land use within the general area was dominated by rough mountain lands, pasture and woodlands. These maps typically only depict larger settlements as well as other significant features such as castles, churches, roads and bridges, none of which are shown within the general area around Inchamore and Milleeny. The Survey records that the lands within the Redline

[12] Butler, W. A. (1910) 'The Barony of Muskerry'. *Journal of the Cork Historical and Archaeological Society*, Vol. 16, No. 86, p. 81-8.

Boundary were controlled by Catholic landowners in 1641, with David McTeigue Herlihy possessing Inchamore and William Oge Herlihy possessing Milleeny. The lands around Baile Mhic Íre, Baile Bhúirne and Cúil Aodha were subsequently granted to Sir John Colthurst who is named as the owner of Inchamore and Milleeny in the 1670 Survey records.

An agricultural boom in the late 18th and early 19th centuries saw a rise in prices for both Irish tillage and dairy produce which resulted in landlords investing in extensive land improvement works within their holdings to increase productivity. This included widespread land drainage works and enclosure of open lands into field systems that survive to the present-day. The post-medieval period saw the development of high and low status stone houses throughout the Irish countryside and rural settlement clusters at this time typically consisted of single-storey thatched cottages with associated farm buildings while two-storey farmhouses became more common during the 19th century. The settlement pattern throughout much of the rural landscape was greatly affected by the Famine period and its aftermath in the middle of the 19th century which saw the depopulation of many areas. The population records in the wider area region note a 32.7% drop in population in Baile Bhúirne and 35.1% drop in Cill na Martra between 1841 and 1851[13].

The Topographical Dictionary of Ireland[14] provides descriptions of Irish parishes during the early decades of the 19th century and often provides information on contemporary land use patterns, historical events and the presence of archaeological sites and features of architectural heritage interest such as large country houses. The Site is located within the civil parish of Ballyvourney and Lewis's description of this area concentrates on the settlement of the same name but, while it contains no references to the townlands of Inchamore and Milleeny, it does note that other areas of the parish contained about 16,000 acres of rough pasture and moorland, which might be drained and brought into a state of profitable cultivation. Further details on the character of the Site and its environs during the 19th century are presented in the review of historical Ordnance Survey (OS) maps (**Section 14.4.10**).

The recorded archaeological monuments within 1 km of the Site include seven lime kilns which are a common feature in the Irish rural landscape with many dating to recent centuries although the potential exists that some examples may pre-date the post-medieval period. The recorded location of a trackway (KE086-002----) of potential antiquity is c.760 m outside the north end of the Site (**Figure 14.1**). The Archaeological Survey of Ireland inventory

[13] https://www.corkcoco.ie/sites/default/files/2019-01/M%C3%BAscra%C3%AD%20Gaeltacht%20CMIP%20Final%20Draft%20Jan%202019.pdf
[14] Lewis, S. (1837) *Topographical Dictionary of Ireland*. 2 Volumes. Lewis & Company, London

description for this monument notes that its recorded location is covered in forestry and is not visible at ground level, but the Record of Monuments and Places map[15] (Sheet KE086) indicates that it was aligned in a broadly east to west direction and this projected route does not extend within the Site.

14.3.3 Record of Monuments and Places

There are two recorded archaeological monuments located within the Site, which comprise an enclosure (CO057-007----) and a field boundary (CO057-006----), while there are a further 15 examples within the surrounding 1 km area, one of which has been classified as 'redundant record' by the Archaeological Survey of Ireland (KE076-071----) (**Figure 14.1**). None of these monuments are designated as National Monuments in State Ownership or Guardianship or have been assigned Preservation Orders but are afforded legal protection by their inclusion in the Record of Monuments and Places. The published Archaeological Survey of Ireland inventory descriptions of these monuments are presented in **Table 14.6**, which also provides their distances from the nearest proposed Development areas.

[15] https://archaeology.ie/sites/default/files/media/pdf/Archaeology-RMP-Kerry-Map-(1998)-0019.pdf

Table 14.6: Recorded Archaeological Monuments within 1 km of Site

Monument no.	Class	Townland	Archaeological Survey of Ireland inventory description	ITM E	ITM N	Approx. distance from nearest development area
CO057-006----	Field boundary	Inchamore	In rough hill grazing on bog, on a gentle S-facing slope, with a view across the valley to Carrignaspirroge. Traces of mainly curvilinear, relict, stone field boundaries (T 0.6 m; H 0.3 m) protrude above the surface of the bog in a roughly rectangular area (c. 150 m E-W; c. 70 m N-S). The relict walls disappear in level areas, where the bog is deeper.	512568	578626	190 m to northwest of T2 hardstand
CO057-007----	Enclosure	Inchamore	In rough hill grazing on bog, on a S-facing slope with views across a valley to Carrignaspirroge. A D-shaped area (6 m N-S) with the straight side at N (L 10.5 m), is defined by a mixture of large slabs and stones set beside the linear face of outcropping rock at N and elsewhere by the curving remains of a stone wall (T 0.65; H 0.5 m) protruding above the surface of the bog. The interior is partially covered with rushes.	512761	578718	150 m to north of T2 hardstand
KE086-007----	Megalithic structure	Derryreag	In a coniferous wood, on the NE-facing slopes of Inchamore Mountain. An irregular-shaped structure (1.75 m NE-SW; 1.4 m NW-SE) of boulder-type stones, roofed with stone lintels, on top of which is a mound of smaller stones. There is a small, partially collapsed chamber (H 1 m) within this structure with an entrance on the E side. Another similar structure (2 m N-S; 1.3 m E-W) lies c. 2 m to the S.	512529	579681	670 m north of T3 hardstand
KE086-002----	Road	Derryreag	In a mixture of rough hill pasture and forestry, on a SE-facing slope. In the 1930s Capt. D. B. O'Connell noted an ancient trackway here (SMR file). The area is obscured by dense forest and overgrowth and the trackway is not visible at ground level.	512805	580064	865 m north of T3 hardstand
CO057-008001-	Field boundary	Inchamore	In rough hill grazing on bog, on a S-facing slope, with views across the valley to Carrignaspirroge. A network of mainly curvilinear, relict, stone field boundaries (T 0.6 m; H 0.3 m), that protrude above the surface of the bog, occurs intermittently throughout a roughly rectangular area (c. 180 m E-W; c. 90 m N-S). Stone slabs set at right angles to the line of the wall are occasionally visible along stretches of the relict boundaries. The walls run on into the deeper bog in hollow or level areas. Four hut sites (CO057-008002-, CO057-008003, CO057-008006, CO057-008008-), two enclosures (CO057-008004-, CO057-008005-) and a fulacht fia (CO057-008007-) are within the field boundary network.	512440	577841	480 m south of Met Mast

Monument no.	Class	Townland	Archaeological Survey of Ireland inventory description	ITM E	ITM N	Approx. distance from nearest development area
CO057-008002-	Hut site	Inchamore	In rough hill grazing, on bog, on a S-facing slope and within a network of relict field boundaries (CO057-008001-). The remains of a D-shaped hut site (4.5 m N-S) defined by a curving stone wall (T 0.5 m; H 0.3 m) with a straight N side (L 4 m). The stone wall protrudes intermittently above the surface of the bog. The interior is raised (H 0.2 m) at the S to compensate for the hillslope. The linear wall at the N is incorporated into an E-W field wall.	512418	577828	510 m south of Met Mast
CO057-008003-	Hut site	Inchamore	In rough hill grazing, on bog, on a S-facing slope and within a network of relict field boundaries (CO057-008001-). The remains of a circular hut site (diam. 2.4 m) defined by a stone wall (T 0.6 m; H 0.4 m) which protrudes above the surface of the bog. The level interior is in pasture. Field walls abut the hut site at the NW and the SE. An enclosure (CO057-008004-) is c. 15 m to the S.	512439	577847	480 m south of Met Mast
CO057-008004-	Enclosure	Inchamore	Within an area of field walls (CO057-008001-) in rough hill grazing on bog, on a S-facing slope with views across the valley to Carrignaspirroge. A right-angled, SW-facing corner is defined by the remains of a N-S (L 5 m) and an E-W (L 6 m) field wall and is enclosed at SW by a curving wall, all of which (T 0.55; H 0.4 m) protrude intermittently above the surface of the bog. There is a hut site (CO057-008003-) c. 15 m to the N.	512443	577835	495 m south of Met Mast
CO057-008005-	Enclosure	Inchamore	In rough hill grazing, on a terrace on a S-facing slope and within a network of field boundaries (CO057-008001-). A D-shaped area (12 m E-W) defined at the straight E side by a drystone wall (L 12 m; T 1 m at the base) narrowing as it rises to a height of 1.2 m. Elsewhere it is defined by the remains of a stone wall (T 1 m; H 0.3 m), protruding above the surface of the bog. The almost level interior is raised (H 0.4 m) at SW. There is a hut site (CO057-008006-) c. 6 m to the SW.	512500	577782	720 m south of Met Mast
CO057-008006-	Hut site	Inchamore	In rough hill grazing, on bog, on a S-facing slope and within a network of relict field boundaries (CO057-008001-). The remains of an oval hut site (2.8 m E-W; 2 m N-S) defined by a stone wall (T 0.5 m; H 0.2 m) which protrudes intermittently above the surface of the bog. An enclosure (CO057-008005-) is c. 6 m to the NE.	512495	577784	520 m south of Met Mast
CO057-008007-	Fulacht fia	Inchamore	In rough hill grazing and within a network of field walls (CO057-008001-). A horseshoe-shaped mound (7 m E-W; 6.1 m N-S; H 1 m) of heat-shattered	512595	577659	620 m south of Met Mast

Monument no.	Class	Townland	Archaeological Survey of Ireland inventory description	ITM E	ITM N	Approx. distance from nearest development area
			stones and charcoal-enriched soil. The opening (Wth 1.7 m) faces W. The S edge of the mound has been damaged due to recent drainage works.			
CO057-008008-	Hut site	Inchamore	In rough hill grazing, on bog, on a S-facing slope and within a network of relict field boundaries (CO057-008001-). The remains of an oval hut site (3.5 m E-W; 2.3 m N-S) defined by the lower courses of a drystone wall (T 0.55; H 0.75 m) which protrude above the surface of the bog. The wall is best preserved along the E arc. Rubble is scattered in the W half of the interior.	512444	577741	580 m south of Met Mast
CO057-005----	Lime kiln	Inchamore	No published description	512455	577587	715 m south of Met Mast
CO057-009----	Holy well	Inchamore	On the N side of a road, on a S-facing slope. Spring water emerges from the base of an earthen bank which is covered with ferns, briars and bushes. According to local information, this is a holy well and its water was used to cure animal ailments.	512272	577561	715 m southwest of Met Mast
CO057-010----	Lime kiln	Inchamore	No published description	512204	577539	860 m southwest of Met Mast
CO057-012----	Structure	Mileeny	No published description	513684	577663	950 m south of T5 hardstand
CO058-001----	Lime kiln	Derreenalig	On N side of laneway, built into slight break in slope. Roughly rectangular kiln (c. 6 m N-S; c. 8 m E-W; front H 3.8 m; rear H 0.6 m), partially collapsed. Front elevation (S) has lintelled recess (H 1.75 m; Wth 1.5 m; D 2.1 m), with sloping slabs to rear. Circular funnel (diam. c. 1.5 m) almost completely infilled.	514293	579793	950 m northeast of T4 hardstand

14.3.4 Topographical Files of the National Museum of Ireland

The National Museum of Ireland's Topographical File archive, which is stored in the museum premises at Kildare Street, Dublin was inspected during the assessment and contains no files for any of the townlands within the study area.

14.3.5 Aerial, Satellite and LiDAR Imagery

A review of online aerial/satellite images of the Site, including those published by the Ordnance Survey of Ireland, Google and Bing, revealed that the proposed turbine locations have been occupied by areas of heathland, improved fields and commercial forestry plantations since at least the 1990s. A study by the Heritage Council of Ireland[16] on the impacts of forestry plantation works on archaeological sites, including their surface and buried elements, has noted that the initial planting process involves a number of ground disturbance activities, such as ploughing, drainage, access roads and planting, that have the potential to destroy or severely impact any sites within the plantation. Further impacts are also likely to occur during the operational phase of the plantation through continued disturbance by extensive root systems, which will entwine with any sub-surface archaeological deposits or features with little or no potential of removal without causing their destruction. Additional impacts during subsequent harvesting and replanting processes were also noted. The study also concluded that given the impossibility of aerial reconnaissance and access constraints during field surveys, the potential for detecting unrecorded sites within forestry plantations is unlikely to be possible. However, the development and widespread use of LiDAR technology in recent years has allowed for the potential for reconnoitring forestry plantations through the use of aerial imagery that can screen out the forestry canopy and allows for the assessment of the presence of surface traces of potential archaeological sites, which can be visible as surface anomalies indicated the presence of features such as enclosing ditches, low mounds and partially levelled structures.

The LiDAR imagery of the Site commissioned by the Developer was made available for archaeological review as part of this assessment (**Figure 14.6**). The imagery encompasses the locations of all turbines as well as other infrastructure within the majority of the Site but it does not extend to the N22 road to the north. The imagery clearly outlines the extent of ground disturbance within the forestry plantations which is visible as close set, linear surface anomalies resulting from cultivation and drainage ground works. The imagery also shows the presence of linear land drains extending through areas of open heath as well as surface traces of ground works undertaken to create areas of improved grassland during modern land reclamation works. The detail on the imagery also depicts the uneven nature of the

[16] Johnson, G. (1998) *Archaeology and Forestry in Ireland.* The Heritage Council of Ireland

ground terrain within areas of rocky heathland. No surface traces of potential unrecorded archaeological sites or architectural heritage structures were noted within the Site during the LiDAR review.

14.3.6 Cork and Kerry County Development Plans

The current Records of Protected Structures for Counties Cork and Kerry, as published in the County Cork Development Plan 2022-2028 and the County Kerry Development Plan 2022-2028, do not list any structures or Architectural Conservation Areas located within the Site or within 1 km of its Redline Boundary.

14.3.7 National Monuments in State Ownership/Care Cork

There are no designated National Monuments in State Guardianship or Ownership located within 10 km of the Site.

14.3.8 National Inventory of Architectural Heritage

The National Inventory of Architectural Heritage does not list any structures, historic landscapes or gardens within the Site or within lands extending for 1 km from its boundary.

14.3.9 Previous Archaeological Work in the Wider Area: Excavations Database

The Database of Irish Excavation Reports contains no entries for any archaeological investigations within the Site. It does contain an entry for archaeological monitoring of the construction of a 15-turbine wind farm in Inchee townland, Co. Kerry in lands located c.2.7 km to the west of the Site which notes that nothing of archaeological significance was encountered (Excavation Licence 05E0112[17]). However, the Archaeological Survey of Ireland description of two standing stones in that area indicates that they were discovered during that project, potentially after the compilation of the Database entry. Archaeological monitoring of ground works during the construction of another two wind farms in Inchincoosh and Lettercannon townlands, located 3 km to the west of the Site, revealed the presence of a previously unrecorded possible hut site and a possible collapsed megalithic tomb which were excluded from the development area (Excavation Licence 08E0437[18]). Archaeological test trenching of the location of a potential fulacht fia site in an area of Coomacullen townland located 1.9 km to the north of the Site revealed nothing of archaeological significance (Excavation Licence 97E0184[19]). A review of the results of archaeological assessments and site investigations undertaken during the development of wind farms located within 10 km of the Project was also carried out as part of the Cumulative impact assessment and the results are presented in **Section 14.6**.

[17] https://excavations.ie/report/2005/Kerry/0013693/
[18] https://excavations.ie/report/2008/Kerry/0019629/
[19] https://excavations.ie/report/1997/Kerry/0002784/

14.3.10 Ordnance Survey Maps

The first edition 6-inch Ordnance Survey (OS) map published in 1846 shows the majority of the lands within the Site occupied by open, vacant, marginal heathland (**Figure 14.4**). A now demolished small farm building and an associated cluster of surrounding irregular fields are shown within the western end of the Site. The former location of the farm building is outside the footprint of the Development within the Site and the nearest Development area to its location is the Turbine 2 hardstand located in forestry c.90 m to the west. The locations of all of the turbines and associated infrastructure are shown as vacant, open heathland on the map, apart from the substation location which is shown as a small vacant field c.140 m to the east of the farm building. The coverage of the 25-inch OS map (1888-1913 series) does not extend into the Site. The detail on the second edition 6-inch OS map, which was published in 1900, demonstrates that the only notable alteration to the layout of the Site during the second half of the 19th century was the expansion of the reclaimed fields within the lower ground in the central area and the construction of second farm building within the east end of the Site (**Figure 14.5**). This building is also outside the footprint of the Development within the Site and the nearest proposed construction area is an access road to the substation located c.130 m to the north (**Figure 14.3**). The layout of the former location of the farm building in the west end of the Site appears unchanged and no additional structures are indicated within its environs. No potential unrecorded archaeological sites were noted within the Site during the review of the historic OS maps.

14.3.11 Undesignated Cultural Heritage Assets

While encompassing the protected archaeological and architectural heritage resources, cultural heritage also includes various undesignated assets such as demesne landscapes and vernacular structures as well as intangible assets such as folklore, placenames and historical events and associations. As noted in **Section 14.3.10**, the review of historic OS maps revealed the presence of two farm buildings within the Site and neither of these are located within the Development footprint. No other buildings or structures of potential vernacular heritage significance were noted within the Site.

The Site extends into two townlands (Inchamore and Milleeny) which are the smallest unit of land division in the Irish landscape, and many may preserve early Gaelic territorial boundaries that pre-date the Anglo-Norman conquest. Townland boundaries were recorded and standardised by the Ordnance Survey (OS) during the 19th century and their names typically comprise anglicisations of their original Irish names which often refer to natural topographical features, past landowners and farming practices, but some may also indicate the presence of archaeological sites within the townland, e.g. lios or rath typically indicate the presence of a ringfort while temple, saggart, termon or kill may record associations with a church site. The translations of the names of the two townlands that extend into the Site were sourced from the Placenames Database (www.logainm.ie) and neither refer to potential archaeological sites (**Table 14.7**). The boundary between these two townlands is formed by a narrow stream which extends in a north to south direction through the centre of the Site.

Table 14.7: Translation of Townland Names

Townland	Irish Origin	Translation	Placename Database notes	Archaeological Indicator?
Inchamore	An Inse Mhór	'large river meadow'	Mentioned in an 18th century registry of deeds	No
Milleeny	Na Millíní	'little hillocks'	Mentioned in an 18th century registry of deeds	No

The online database of the Irish National Folklore Collection (www.duchas.ie) was reviewed and it contains two entries relating to past activities in Inchamore and Milleeny townlands which are summarised below (**Table 14.8**).

Table 14.8: Summary of recorded folklore accounts

Source	Summary of Transcript	Observations
Síle Bean Uí Loingsigh	Provides an alternate origin for Milleeny placename which refers to the former presence of a grinding mill at the foot (south end?) of the townland.	This may be due to a mistranslation of the name or may alternatively refer to a milling activity within the south end of the townland, which is in the environs of Coolea
Diarmuid Ó hÉalaighthe	Records that Inchamore townland contained a number of small farm holdings with 2-room thatched cottages and refers to a clochan (hut site) in the west end of the townland where a herdsman formerly lived	The reference to a clochan may record the presence of a hut site of archaeological interest at an unknown location in the west end of Inchamore, perhaps associated with booleying farming activity in recent centuries. There are no construction works proposed in that area of the townland.

The proposed Development is located within the Múscraí Gaeltacht area with a number of settlement centres located within the wider landscape, e.g., Réidh na Doírí (Reenaree), Cúil Áodha (Coolea), Béal Átha an Ghaorthaidh (Ballingeary), Baile Bhúirne (Ballyvourney) and Baile Mhic Íre (Ballymakeera). The location has seen a general decline in population within the modern period and there are no settlement centres located within the Site or within 1 km of the Redline Boundary. The region also has notable associations with other intangible elements of the cultural heritage resource such as music, including Sean-nós singing, poetry and dance traditions. There are no institutions, such as local museums or other heritage centres, associated with the intangible cultural heritage of the area located within the Site or surrounding study area. The Cork County Council *Múscraí Heritage Plan:*

conservation, management and interpretation plan 2018-2032[20] identifies a range of assets and attributes considered to be of cultural heritage significance within the region, including specific assets considered to be of archaeological, architectural, historic, artistic and scientific interest. While the Plan does not purport to be an exhaustive list of such assets, it is noted that none of the identified examples are located in townlands within or adjacent to the Project.

14.3.12 Grid Connection Route

The Grid Connection Route will extend for c.80 m through a green field area to the west of the onsite substation and will thereafter follow sections of existing forest tracks extending from the Site to the existing Ballyvouskill substation. The section of the study area centred on the Grid Connection Route comprises a 100 m wide corridor centred on the route and this contains one recorded archaeological site which is listed as a redundant record in the Sites and Monuments Record (KE076-071----) and is not included in the Record of Monuments and Places (**Figure 14.8**). The below Archaeological Survey of Ireland inventory description of this redundant record has been published on the National Monuments Service's Historic Environment Viewer and confirms that the Archaeological Survey of Ireland have concluded that a potential enclosure reported to them at this location does not warrant acceptance as an archaeological monument. The entry also states that this redundant record is not scheduled for inclusion on the next edition of the Record of Monuments and Places and the Historic Environment Viewer mapping contains no Zone of Notification around its location:

KE076-071----
Class: Redundant record
Townland: DERRYREAG
Scheduled for inclusion in the next revision of the RMP: No
Description: Reported to the Archaeological Survey of Ireland as the location of a possible enclosure. This feature is located in forestry on sloping mountainside part of the Derrynasaggart Mountain range. Views are restricted because of the forestry, but the general aspect is towards the N towards the Paps Mountains. This is marked as a large D-shaped field on the Ordnance Survey 1st Edition map, and measures approximately 200m NE-SW, and 200m NW-SE. This has now been planted with forestry. It appears that the enclosing element is now a ditch, and has been widened and deepened by forestry works. At the SE side this is 3m wide and .1.5m deep. The drain on the north side of the site is of similar dimensions. The NE side (straight edge) is also a townland boundary between Derryreagh and Cummeenavrick. This is a 3m wide, 1.5m deep ditch along which a stream runs. It appears to have been widened as part of the forestry works. No trace of an

[20] https://www.corkcoco.ie/sites/default/files/2019-01/M%C3%BAscra%C3%AD%20Gaeltacht%20CMIP%20Final%20Draft%20Jan%202019.pdf

enclosing bank was noted. The evidence is not sufficient to warrant accepting this as the remains of an archaeological monument.

A section of the Grid Connection Route within County Kerry follows an existing forestry road that extends outside the southern boundary of The Paps Archaeological Landscape as designated in the Kerry Development Plan 2022-2028[21] (**Figure 14.11**). The nearest section of this existing forestry road to this archaeological landscape is located c.30 m outside its boundary. This landscape is described as follows in the County Kerry Development Plan 2022-2028:

According to legend The Paps are the earthly manifestation of the breasts (Paps) of the Mother Goddess Anu and would have been venerated as such throughout prehistory. The cairns on the summits of the mountains are likely to contain small passage tombs, while other features on the summit are also likely of similar date. The slopes of the mountains and surrounding area are littered with hut sites, enclosures, megalithic structures, triple banked barrow etc. While the locally important Christian focus at 'The City' in Gortnagane is likely to be of prehistoric origin also given the name Caher Crov Dearg and the likely association with the triadic mother goddess in the form Badb Catha or Raven of Battle. These sacred mountains and their surrounding archaeological, mythological and historic landscape are still venerated, albeit in Christian guise, to this day.

There are no archaeological sites associated with this landscape located within the 100 m wide study area centred on the existing forestry road that the Grid Connection Route will follow in the area outside the boundary of this archaeological landscape.

There are no Protected Structures or structures listed in the National Inventory of Architectural Heritage located within the study area centred on the Grid Connection Route and it does not extend through any historic settlements or Architectural Conservation Areas. The existing forestry roads that the Grid Connection Route follows are shown as areas of vacant uplands on historic Ordnance Survey mapping. No potential unrecorded archaeological sites or other cultural heritage assets were noted in the environs of the route.

14.3.13 Turbine Delivery Route

The Turbine Delivery Route will extend along the existing public road network from Ringaskiddy, Co. Cork to the Site entrance on the N22 road and will thereafter extend along an existing forestry road that forms the Site Access Road. The only recorded cultural heritage asset located within the environs of this section of the route along the Site Access Road is the redundant record (SMR KE076-071----) described in **Section 14.3.12** above. This is located within a forestry plantation in the lands to the west of the existing forest track

[21] https://consult.kerrycoco.ie/sites/default/files/4%20Archaeological%20Landscapes.pdf

that will form the delivery route. The other recorded archaeological sites within the 100 m wide study area corridor centred on the Turbine Delivery Route to Ringaskiddy comprise thirteen examples which are all located within adjoining private lands, and none contain any elements that extend into the public road network which will form the Turbine Delivery Route (**Table 14.9** and **Figure 14.10**). In addition, none of these archaeological sites are listed as National Monuments in State Care. The recorded sites within the study area are located within private properties adjacent to the public roads and no works to facilitate the delivery of turbines to the Site are proposed at their locations or environs. The reviewed study area also contains a number of archaeological sites which were uncovered during archaeological investigations carried out as part of the construction of the Ballincollig Bypass. These sites were completely excavated in advance of the construction of the bypass and no longer remain within the study area.

The 100 m wide study area corridor centred on the Turbine Delivery Route also contains thirteen designated architectural heritage structures, all within County Cork, which are listed in the Record of Protected Structures or are included in the National Inventory of Architectural Heritage (**Table 14.10** and **Figure 14.9**). The Turbine Delivery Route does not extend through any designated Architectural Conservation Areas. The study area includes two road bridges that are listed in the Record of Protected Structures, and these comprise Laney Bridge (RPS 0835) in the eastern outskirts of Macroom and Athsellis Bridge (RPS 0545) in Carrigderry townland (**Figure 14.9**). The Turbine Delivery Route does not extend across either of these bridges. The remainder of the other designated architectural structures within the study area are located within private properties adjacent to the public roads and no works to facilitate the delivery of turbines to the Site are proposed within any of these properties.

Table 14.9: Recorded Archaeological Sites within 100 m corridor centred on TDR

Monument no.	Class	Townland	ITM E	ITM N
CO058-002----	Kiln - lime	AN DOINAN ALAINN	515024	579449
CO058-045----	Ringfort - rath	BAILE MHIC IRE	522175	576675
CO058-051----	Fulacht fia	TONN LAIN	523052	575787
CO058-079----	Burnt mound	TONN LAIN	522582	576314
CO070-012----	Standing stone	CASIL AN BHUACAIGH	526192	574325
CO070-079----	Standing stone	INCHINLINANE	527840	573632
CO071-015----	Souterrain	BEALICK	535203	572930
CO071-016----	Mill - corn	BEALICK	535262	572862
CO083-069----	Fulacht fia	CLODAH	541404	566803
CO083-070----	Standing stone	CLODAH	541685	566670
CO083-140----	Bridge	CARRIGDARRERY	538949	568062
CO073-071----	Cave	CARRIGANE	555141	569905
CO073-137----	Burnt mound	CURRAHEEN	560815	569368

Table 14.10: Designated Architectural Heritage structures in 100 m corridor centred on TDR

Designation	Name	Townland	ITM E	ITM N
RPS 0835	Laney Bridge	Bealick	535274	572790
NIAH 20907102	Firville House	Bealick	535219	572890
NIAH 20907106	House	Coolcour	535810	570708
RPS 0545	Athsellis Bridge	Carrigderry	538948	568062
NIAH 20908319	Monument	Ballymichael	540705	566844
NIAH 20908326	Crookstown House gate	Inchirahilly	542637	566711
NIAH 20908403	Horan's Bar	Inchirahilly	544234	567381
RPS 0553	Rosemount House	Currahaly	548761	568947
NIAH 20907221	House	Currahaly	549560	569133
NIAH 20907226	House	Knockanemore	553105	570136
NIAH 20907308	Srelane House	Knockanemore	553610	570265
NIAH 20987029	Church of the Immaculate Heart of Mary	Shanbally	575595	564469
NIAH 20987044	The Oratory	Ringaskiddy	578224	564274

14.3.14 Field Work

The Project location, including the Site, Grid Connection Route and Turbine Delivery Route from the N22, was inspected in clear weather conditions by the author on 22nd June 2020, 19th May 2021, 26th July 2021 and 3rd November 2021. These inspections included field walking surveys of the locations and environs of all turbines and associated infrastructure, as well as the locations of known archaeological monuments within the Site. The purpose of the field surveys was to assess the potential for direct and indirect impacts on the locations and settings of known monuments, to establish if any unrecorded features of cultural heritage interest exist at proposed Development locations and to appraise the potential for the presence of sub-surface archaeological sites or features at these locations.

The results of the field survey are presented below in table formats which include descriptions of the results of the inspection of known archaeological monuments within the Site (**Tables 14.11** and **14.12**). Descriptions of two potential previously unrecorded archaeological features noted during inspections of the lands *c.*40 m to the north of Turbine 2 are provided in **Table 14.13** and their locations are shown on **Figure 14.2**. These features comprise an upright stone and a nearby small arc of surface stones which may form the remains of a potential hut site and both are located at distances of 30 m outside the Site. While the potential exists that both of these features are non-archaeological in origin, their locations were provided to the Project design team at an early stage in the design process to ensure that they will be avoided, and both will be retained *in situ*.

Two farm buildings are shown within the Site on the historic OS maps. The farm building in the west end of the Site has been levelled and a later concrete-surfaced farmyard, which also contains a number of semi-derelict outbuildings of 20th century appearance is now located in the area to the north and is shown on **Figure 14.1**. This farmyard is not indicated on the historic OS maps and does not contain any features deemed to be of any architectural or vernacular heritage merit. An overgrown, derelict farmhouse occupies the location of the farm building depicted in the east half of the Site on the second edition 6-inch map and it appears to have been abandoned in recent decades (**Figure 14.3**). While this late 19th century building does not comprise a well-preserved structure of architectural heritage merit it is considered to be of likely local (low) vernacular heritage interest.

Descriptions of the inspections of the turbine locations and associated infrastructure within the Site are presented in **Table 14.14**, which also collates information gathered during reviews of historic mapping as well as aerial/satellite (OSI and Google Earth) and LiDAR imagery for each location.

Table 14.11: Collated information on Field Boundary CO057-006----

Recorded Monument	Class	Townland	Recorded ITM (ASI)	Confirmed ITM
CO057-006----	Field Boundary	Inchamore	512568, 578626	512568, 578626
ASI Description	*In rough hill grazing on bog, on a gentle S-facing slope, with a view across the valley to Carrignaspirroge. Traces of mainly curvilinear, relict, stone field boundaries (T 0.6 m; H 0.3 m) protrude above the surface of the bog in a roughly rectangular area (c. 150 m E-W; c. 70 m N-S). The relict walls disappear in level areas, where the bog is deeper.*			
Survey Notes	The visible surface expression of the field boundary is orientated north-northwest to south-southeast (NNW-SSE) and comprises a c.50 m long section of a drystone wall footing (c. 40cm-60cm wide) which extends 10cm-30cm above existing ground surface. This likely forms the west end of the rectangular area described by the Archaeological Survey of Ireland and is located c.250 m to the northwest of T2. The visible northern section of this section extends to an area of natural bedrock outcrop and terminates at the margin of a level area of upland heath. There was no visible surface trace of any walling extending to the east or west of this area, which is dominated by bedrock outcropping, and the potential exists that the wall either terminates at this point or continues beneath the existing ground surface within the area of upland heath to the north. The southern end of the visible section of the wall has been truncated by an east-west land drain (c.1 m wide) and an inspection of the drain section in this area revealed that the wall stones extend c.40cm below existing ground surface and appear to rest on the surface of the underlying natural subsoil. A number of surface stones which may form part of the wall are visible for c. 2 m to the south of the drain and no visible traces were observed thereafter. The land drain continues to the east for a distance of c.145 m from the point where it intersects with the north-south section of wall along a slightly curvilinear course before it turns to the south and extends into forestry. It is noted that the length of the east-west section of this drain extending from its intersection with the visible section of the field boundary corresponds to the length of the east-west section of the field boundary described in the above archaeological inventory entry. The drain is flanked on the southern side by a low deposit of stones and soil which may form part of the east-section of the field wall noted in the inventory entry, although the potential that this deposit actually represents upcast material from the drain which was interpreted as a field wall is noted. No surface traces of the field boundary were noted extending towards the location of any proposed construction area within the Site.			

Table 14.12: Collated information on Enclosure CO057-007----

Recorded Monument	Class	Townland	Recorded ITM (ASI)	Confirmed ITM
CO057-007----	Enclosure	Inchamore	512761, 578718	512761, 578718
ASI Description	*In rough hill grazing on bog, on a S-facing slope with views across a valley to Carrignaspirroge. A D-shaped area (6 m N-S) with the straight side at N (L 10.5 m), is defined by a mixture of large slabs and stones set beside the linear face of outcropping rock at N and elsewhere by the curving remains of a stone wall (T 0.65; H 0.5 m) protruding above the surface of the bog. The interior is partially covered with rushes.*			
Survey Notes	This site survives as described by the Archaeological Survey of Ireland and comprises a small enclosure with a low surface expression that is not visible at ground beyond its immediate environs. The northern side of the enclosure has been constructed against a natural rock outcrop which supplements the enclosing element on this side and screens its location entirely from the east. The drystone wall contains stones of varying size and shape with a number of large, upright angular 'orthostat' type stones forming the north-western enclosing element, while elsewhere, a mix of large horizontal slabs and smaller sub-rounded stones are present. The extant walls measure between 0.6 m and 1.2 m in width and between 0.4 m and 1.1 m in height. While there are a number of narrow gaps in the east and west sides it is unclear whether any these comprise an entrance feature or are the result of localised overgrowth or collapse of the walling. The interior of the enclosure slopes gently downwards to the east and is grass covered with areas of rush growth. The size and layout of the enclosure is not suggestive of an early medieval cashel monument, and the potential exists that it may have functioned as a small animal pen associated with historical transhumance farming activity. The site is located c.130 m from the nearest element of the Development which comprises the Turbine 2 hardstand to the south.			

Table 14.13: Potential unrecorded archaeological sites identified during field survey

Feature Type	ITM	Description
Potential Hut	512856, 578650	Situated a gentle slope approximately 100 m downslope and to the southeast of enclosure (CO057-007----), the possible footing of a hut site was noted during field inspections. It comprised an arc of loose stones measuring c.2.5 m in length (NE-SW) containing one to two stones forming a feature measuring c.0.4 m to 0.5 m in width. The stones were only evident to a maximum height of c.0.3 m above ground level but grass growth and sod formation may obscure further traces. If these stones do form the basal remains of a potential hut site, a projection of the visible arc is suggestive of a feature measuring 2 m-2.5 m in diameter. The interpretation of this feature as being of potential archaeological origin is tentative as it is located within a large glacial scatter of surface stones and is abutted by prone stones in all directions. No clearance activity appears to have been carried out in its environs and the potential that it comprises a random arrangement of stones within this area is considered possible.
Upright Stone	512840, 578643	Another potential archaeological feature was noted c.18 m to the southwest of the potential hut site described above and this comprises an upright stone within the same glacial scatter of surface stones. The long axis of the stone is aligned in a northwest to southeast direction, it measures a maximum height of 1.68 m, a maximum width at base of 0.88 m and tapers to width of 0.2 m near the top. The thickness of the stone also tapers inwards towards its top with a thickness of 0.6 m at base and 0.2 m at top. While the slight potential exists for this to be a prehistoric standing stone, its alignment does not correspond to the northeast to southwest alignment of the majority of such monuments and its presence within a glacial stone scatter may be suggestive of a natural origin.

Table 14.14: Field survey results

Development Element	Townland	Distance to nearest archaeological site	1st edition 6-inch OS map	Aerial/Satellite and LiDAR images	Field Survey Notes
Turbine 1	Inchamore	Enclosure located c. 450 m to southeast (CO057-007----)	Map shows the location of turbine, hardstand and access road as vacant marginal land.	Shown within area of vacant rocky land on aerial images. No potential archaeological sites or built structures were noted at the location during a review of LiDAR imagery	Location comprises an area of open heathland on a large rocky ridge. The access road will extend to its location from T3 to the east across an area of rocky heath and an area of improved grassland at east
Turbine 2	Inchamore	Enclosure located c. 110 m to north of hardstand (CO057-007----)	Map shows the location of turbine, hardstand and access road as vacant marginal land. A farmyard is shown c.90 m to the east of the nearest section of the hardstand	Shown within a forested area with grassland at north end of hardstand. No potential archaeological sites or built structures were noted at the location during a review of LiDAR imagery	The turbine and southern end of hardstand are within a commercial forestry plantation while the north end of the hardstand and access route extend through semi-improved pasture. A visual appraisal of the plantation indicated that the underlying ground surface has been heavily disturbed by tree growth and cultivation works. The grassland area at the north end of the hardstand is marginal in quality with machine cut drains along the edges. There are frequent surface stones in the areas outside the improved grassland which appear geological in origin but may also include stones from early modern field clearance activity. The access route to the north end of the turbine will cross a narrow stream, which appears to have been recut by machine. The stream was nearly dry at the time of inspection and no potential fords, steeping stones or other features of cultural heritage potential were noted. The proposed crossing will entail a clear span structure and no in-channel works will be required.
Turbine 3	Inchamore	Enclosure located c. 370 m to southwest (CO057-007----)	Map shows the location of turbine, hardstand and access road as vacant, unenclosed marginal land.	Majority of hardstand is shown within forestry on aerial images while turbine and north end of hardstand are within an area of vacant heath land. Access route to northeast is within forestry while routes to west and southwest extend through marginal lands. No potential archaeological sites or built	Majority of hardstand shown within forestry on aerial images while turbine and north end of hardstand are within an area of disturbed marginal land. Access route to northeast is within forestry while routes to west and southwest extend through marginal lands.

Development Element	Townland	Distance to nearest archaeological site	1st edition 6-inch OS map	Aerial/Satellite and LiDAR images	Field Survey Notes
				structures were noted at the location during a review of LiDAR imagery	
Turbine 4	Milleeny	Enclosure located c. 895 m to southwest (CO057-007----)	Map shows the location of turbine, hardstand and access road as vacant, unenclosed marginal land.	Shown within forestry on aerial images. No potential archaeological sites or built structures were noted at the location during a review of LiDAR imagery	Located within an area of forestry on a west-facing slope. The ground surface has been heavily disturbed by tree roots and forest cultivation.
Turbine 5	Milleeny	Enclosure located c. 1,110 m to west (CO057-007----)	Map shows the location of turbine, hardstand and access road as vacant, unenclosed marginal land.	Shown within forestry on aerial images. No potential archaeological sites or built structures were noted at the location during a review of LiDAR imagery	Located within an area of forestry on a west-facing slope. The ground surface has been heavily disturbed by tree roots and forest cultivation.
Site Compound	Inchamore	Enclosure located c. 760 m to southwest (CO057-007----)	Map shows the location as vacant, marginal land.	Shown within forestry on aerial images. No potential archaeological sites or built structures were noted at the location during a review of LiDAR imagery	Located within a level area within forestry plantation. The ground surface has been extensively disturbed by tree planting
Substation	Inchamore	Enc losure located c. 440 m to west (CO057-007----)	Map shows small fields at location which are associated with a farm building located 140 m to west of substation	Shown within vacant field on aerial images. No potential archaeological sites or built structures were noted at the location during a review of LiDAR imagery	Recent forestry plantation ground preparation works were visible within the field containing the proposed substation location at the time of inspection and this included linear, machine excavated land drains. No potential archaeological or architectural heritage structures were noted at the location. The existing farmyard c.100 m to the west is not indicated on the historic OS maps and contains a number of small 20th century outbuildings. No remains of the farm building shown in the area to the south of the yard on the 1st edition 6-inch OS map were identified. No features of vernacular heritage significance were noted within the existing yard. It is accessed from a farm lane to the south which is outside the proposed development areas within the site. The second farm building shown in the east end of the Site on the second edition 6-inch OS map survives extant and comprises an overgrown

Development Element	Townland	Distance to nearest archaeological site	1st edition 6-inch OS map	Aerial/Satellite and LiDAR images	Field Survey Notes
					farmhouse that appears to have been abandoned in recent decades. The access route to the substation will cross a narrow stream, which forms the boundary between Inchamore and Milleeny townlands. The stream comprised a moderately flowing, shallow channel, averaging c.1 m in width by 0.5 m in depth, at the time of inspection and no potential fords, steeping stones or other features of cultural heritage potential were noted. The proposed crossing will entail a clear span structure and no in-channel works will be required.
Met Mast	Inchamore	Hut site located c.480 m to south (CO057-008003-)	Map shows the location as vacant, marginal land.	Shown within forestry on aerial images. No potential archaeological sites or built structures were noted at the location during a review of LiDAR imagery	The location of the met mast and proposed access road from the northeast remain occupied by a forestry plantation. An inspection of the area revealed that the ground surface has been disturbed by forestry plantation works and tree root activity.
Grid Connection	Various	Redundant record (KE076-071----) located within an area of route using horizontal directional drilling. The nearest section of the boundary of the Paps Archaeological Landscape as designated in the Kerry County Development 2022-2028 is located c.30 m the north of an existing forestry track which occupies the grid route in the	Map shows the route extending through as vacant uplands.	The forestry roads and adjacent plantations along the route are visible on aerial images from the 1990s onward. The imagery indicates that the southern section of the forest road extending to the Site on the south side of the N22 was constructed post-2005. The route extends outside the LiDAR coverage of the Site	No potential unrecorded features of archaeological, architectural or cultural heritage interest were noted during inspections of the localised green field areas along the section of the route to the west of the proposed substation within the Site. The construction of the existing forestry tracks has resulted in the reduction of ground surface along the route and adjoining lands on both sides have been disturbed by forestry plantations. The forest tracks extend across three small streams within the plantation to the north of the N22 and the use of horizontal direction drilling under these watercourses will not require any in-channel works. The location of redundant record (KE076-071----) is within an inaccessible forestry plantation. The use of horizontal direction drilling in this area will not require any trench excavations at its location.

Development Element	Townland	Distance to nearest archaeological site	1st edition 6-inch OS map	Aerial/Satellite and LiDAR images	Field Survey Notes
		area to the north of the N22			
Borrow Pit	Milleeny	Lime kiln located c.980 m to north (CO058-001----)	Map shows the location as vacant, marginal land.	Shown within forestry on aerial images. No potential archaeological sites or built structures visible on LiDAR imagery.	Localised mechanised ground works were ongoing within the southern end of area during the inspection and appeared to be associated with the extraction of bedrock material. The remainder of the proposed borrow pit location was occupied by forestry
Turbine Delivery Route	Derryreagh and Derreenaling	Redundant record (KE076-071----) located within adjoining forestry to west of Site access Road section. As detailed in Tables 14.9 and 14.10, there are various cultural heritage assets located within properties adjacent to the public roads that form the section of the route to Ringaskddy	Map shows the route extending through as vacant lands and roadways.	The imagery indicates that the southern half of the forest road extending to the Site on the south side of the N22 was constructed post-2005. The forest road in the north end of the route is present on imagery from the 1990s. Location of route extends outside the LiDAR coverage. The public roads along the route to Ringaskiddy are visible on the reviewed aerial and satellite images, including recent images of the Macroom bypass	The route from the N22 to the north of the Site extends along existing stone surfaced forest roads which are flanked by drains and adjacent sections of the forestry plantations. No potential features of cultural heritage interest were noted within the environs of the route. A windshield survey of the public roads extending to Ringaskiddy revealed no elements of the cultural heritage resource extending into the road carriages that will be used to transport turbines to the Site.

14.3.15 Summary

There are two recorded archaeological sites within the Site, and these comprise a field boundary (CO057-006----) and a small, stone-built enclosure (CO057-007----). The identified remains of these sites are located at respective distances of 190 m and 150 m from the Turbine 2 hardstand location. There are an additional 15 recorded archaeological sites within lands extending for 1 km from the Site and none of these are located within 480 m of any proposed construction areas (**Table 14.6** and **Figure 14.1**). All of these external archaeological sites are located within private lands not accessible to the public and none have been designated as National Monuments in State Care. Two features of archaeological potential, an upright stone and a potential hut site, were identified during the field surveys carried out as part of this assessment (**Table 14.13**). While these are only tentatively interpreted as being of potential archaeological origin, both are located c.30 m outside the Redline Boundary and will be retained *in situ* (**Figure 14.2**)

There are no designated architectural heritage structures located in the Site or within the lands extending for 1 km outside its Redline Boundary. No potential undesignated features of architectural heritage interest, such as country houses with associated designed gardens/demesne lands, are located within the Site or within 1 km of the Redline Boundary. The derelict remains of a farmhouse shown within the east end of the Site on the second edition 6-inch OS map (1900) survives extant and is a structure of vernacular heritage interest. No proposed construction areas are within 110 m of its location, and it will be retained *in situ* within the Site (**Figure 14.3**).

The Grid Connection Route extends through the location of a redundant record listed in the Sites and Monuments (KE076-071----). The Archaeological Survey of Ireland have concluded that this record does not warrant acceptance as an archaeological monument and it is not scheduled for inclusion in the next edition of the Record of Monuments and Places (see **Section 14.3.12**). It is located within a forestry plantation to the south of the N22 road and the proposed methodology for the section of the Grid Connection Route will entail horizontal directional drilling under its location and will not require any trench excavations (**Figure 14.8**). There are no other recorded archaeological sites or any architectural heritage structures located within the 100 m wide corridor centred on the Grid Connection Route. A section of the route in the area to the north of the N22 follows an existing forestry road that extends outside the southern boundary of The Paps Archaeological Landscape as designated in the County Kerry Development Plan 2022-2028[22] (**Figure 14.11**).

[22] https://consult.kerrycoco.ie/sites/default/files/4%20Archaeological%20Landscapes.pdf

The Turbine Delivery Route to the Site entrance on the N22 road will extend along the public road network from Ringaskiddy, Co. Cork. The route will thereafter extend to the Site along an existing forestry road from the N22 road. The only recorded cultural heritage asset located within the environs of this section of the route is the redundant record (SMR KE076-071----) described in **Section 14.3.12**. This is located within a forestry plantation in the lands to the west of the existing forest track that will form the delivery route. The remainder of the route from Ringaskiddy to the Site will extend along public roads. There are various recorded archaeological sites and designated architectural heritage structures located within the reviewed 100 m study area corridor centred on these roads and none contain any elements that extend into the road carriageways (**Tables 14.9** and **14.10** and **Figures 14.9** and **14.10**).

a. The known archaeological sites within the study area are commonly found within the Irish landscape, are located within inaccessible private lands and retain no discernible amenity or tourist attributes. Their current condition as well as potential sensitivities to indirect impacts of a visual nature, have been assessed based on their classifications, designations, inventory descriptions, reviews of historical maps and modern aerial/satellite images and the ICOMOS guidelines summarised in **Table 14.2** of this chapter. The values assigned to these archaeological sites are identified in **Tables 14.15** and **14.16**. It should be noted that many archaeological sites, including levelled examples, have the potential to possess subsurface features, artefacts and other archaeological remains, that may be of High or Very High values, but this cannot be ascertained without recourse to archaeological excavation, and these are attributes unlikely to be subject to effects in the absence of direct impacts.

14.4 ASSESSMENT OF POTENTIAL EFFECTS

14.4.1 Construction Phase – Direct Impacts

The construction phase will result in no predicted direct impacts on the two recorded archaeological monuments located within the Site (Field Boundary CO057-006----and Enclosure CO057-007----) neither of which are located within 150 m of any proposed construction areas. An upright stone and a small arc of ground stones noted *c.*40 m to the north of the T2 hardstand during the field surveys are deemed to be potential archaeological features, but this interpretation is intended as tentative (see **Table 14.13** and **Figure 14.2**). Both of these potential archaeological features are located c.30 m outside the Redline Boundary and will remain *in situ* outside the Site. There are no designated architectural structures located within the Site and no undesignated features of cultural heritage interest were identified at any proposed construction areas. The remains of a farm building within the east end of the Site, which is indicated on the second edition OS map (published 1900), will be avoided and retained *in situ*. The boundary between Inchamore and Milleeny townlands comprises a small stream that extends north to south through the central area of the Site. There will be one crossing over this stream to facilitate access to the onsite substation and this will entail a clean span bridge which will require no in-channel works. It is, therefore, concluded that the construction phase will not result in any direct impacts on any identified elements of the cultural heritage resource.

The locations of T2, T4 and T5, and their associated hardstands and sections of access routes, as well as the site compound and met mast locations are within forestry plantations. The cultivation and drainage ground works combined with the subsequent development of root networks within such plantations result in extensive ground disturbance which has a high potential to have removed or severely degraded any unrecorded archaeological features at these locations. While there is a low potential for the presence of unrecorded, archaeological sites within the forested locations, the potential for the survival of elements of unrecorded archaeological remains cannot be completely discounted. The potential for the presence of sub-surface archaeological sites and artefacts exists within the areas of improved pasture and heathlands within the Site and these comprise T1, an area of the T2 hardstand, T3 and the substation as well as sections of the access roads to their locations. While the existence as well as the location, extent and nature of such unrecorded, sub-surface archaeological remains are indeterminable the potential exists for direct, negative impacts on any such remains that may exist within Development areas and this will require mitigation. The Development will not require in-channel works within any watercourses and will have no predicted impacts on any potential underwater archaeological remains.

The majority of the Grid Connection Route from the existing Ballyvouskill substation extends along existing forestry tracks with a localised section utilising horizontal directional drilling under streams and the environs of the N22 road as well as a section extending through a green field area to the west of the proposed onsite substation. The Grid Connection Route extends through the location of a redundant record listed in the Sites and Monuments Record (KE076-071----). The Archaeological Survey of Ireland have concluded that this record does not warrant acceptance as an archaeological monument and it is not scheduled for inclusion in the next edition of the Record of Monuments and Places. It is located within a forestry plantation to the south of the N22 road and the proposed methodology for the section of the Grid Connection Route entail horizontal directional drilling under its location and will not require any trench excavations (**Figure 14.8**). There are no other recorded archaeological sites within a 100 m corridor centred on the Grid Connection Route. A section of the route in the area to the north of the N22 follows an existing forestry road that extends outside the southern boundary of The Paps Archaeological Landscape as designated in the County Kerry Development Plan 2022-2028[23] (**Figure 14.11**). The Grid Connection Route does not extend into this landscape and the cable trench will be excavated within areas previously disturbed by the construction of the existing forestry roads.

There are also no designated or undesignated architectural heritage structures, such as historic masonry bridges, located within 100 m of the Grid Connection Route. The existing forestry track along the section of the route to the north of the N22 crosses three small streams and the proposed use of horizontal directional drilling under these watercourses will result in no direct in-channel impacts. The Grid Connection Route will, therefore, result in no predicted direct impacts on the archaeological, architectural and cultural heritage resources.

The Turbine Delivery Route from Ringaskiddy, County Cork to the Site entrance on the N22 road will entail the use of the existing public road network. While there are various cultural heritage assets located within the 100 m study area corridor centred on this route (**Tables 14.9** and **14.10** and **Figures 14.9** and **14.10**), none contain elements that extend into the road carriageways and the transport of turbines from Ringaskiddy to the Site will not result in any predicted direct impacts on the cultural heritage resource. The section of the Site Access Road route from the N22 follows an existing forestry road in this area and the only recorded archaeological site within a 100 m wide corridor centred on this section of the route is the redundant record (KE076-071----) located within the forestry plantation to the west (**Figure 14.8**). Any required upgrading works to this track to facilitate the delivery of turbines to the Site will result in no direct impacts on the cultural heritage resource.

14.4.2 Construction Phase – Indirect Impacts

There are two recorded archaeological sites within the Site, and these comprise a field boundary (CO057-006----), with visible remains located *c.*190 m to the west of T2, and an enclosure (CO057-007----) located *c.*150 m to the north of T2 (**Figure 14.2**). The wider settings of both of these archaeological sites will be subject to short term, slight, negative, indirect impacts during the construction phase. There are 15 other archaeological sites located within private lands within 1 km of the Site and none are located within 480 m of

[23] https://consult.kerrycoco.ie/sites/default/files/4%20Archaeological%20Landscapes.pdf

any proposed Development areas (**Table 14.6** and **Figure 14.1**). In addition, none of these sites are accessible to the public or have been designated as National Monuments in State Care. A review of the landscape extending for 10 km from the Site revealed that there are also no National Monuments in State Care or World Heritage sites (including tentative list) located within this area. The construction phase is, therefore, predicted to result in no predicted indirect impacts on the recorded archaeological monuments located within the lands within 1 km the Site.

There are no designated architectural heritage structures within 1 km of the Site and no indirect negative impacts on this element of the cultural heritage resource are predicted during the construction phase. There is one extant undesignated derelict farm building of low cultural heritage value located within the east end of the Site. No construction phase works are proposed within 110 m of its location and no indirect impacts on this structure are predicted during the construction phase (**Figure 14.3**).

The proposed Project is located within the Múscraí Gaeltacht area. While the construction phase will see the arrival of construction workers to the area, this will be a short term occurrence and will not result in permanent settlement of the area by non-Irish speakers. The Project is, therefore, predicted to result in a negligible, indirect, not significant impact on the Irish language or cultural heritage of the Gaeltacht area during the construction phase.

The Sites and Monuments Record lists a redundant record (KE076-071----) within the environs of the section of the Grid Connection Route and Turbine Delivery Route extending from the N22 road to the Site. As previously noted, the Archaeological Survey of Ireland have concluded that the redundant record does not warrant acceptance as an archaeological monument (see **Section 14.3.12**). The use of horizontal directional drilling to install the Grid Connection Route in this area and the use of the existing forestry road to the east of the site listed as a redundant record (KE076-071----) to facilitate the delivery of turbines will result in no predicted indirect impacts on this redundant record site. The location of the Grid Connection Route that extends along the southern side of The Paps Archaeological Landscape is occupied by an existing forestry road and is screened by forestry on both sides. There are no other recorded archaeological sites or any architectural heritage structures located within 100 m of the Grid Connection Route. The Grid Connection Route will not result in any predicted indirect impacts on the cultural heritage resource during the construction phase.

While there are various cultural heritage assets located within the 100 m study area corridor centred on the Turbine Delivery Route (**Tables 14.9** and **14.10** and **Figures 14.9** and **14.10**), none contain elements that extend into the road carriageways and the transport of turbines from Ringaskiddy to the Site will not result in any predicted indirect impacts on the cultural heritage resource during the construction phase.

Table 14.15: Summary of construction phase impacts on cultural heritage assets in study area

Monument No.	Classification (Condition)	Indicative Value range	Impact Type	Impact Quality	Impact Magnitude	Impact Duration	Impact Significance
CO057-006----	Field boundary (partially extant)	Medium-High	Indirect	Negative	Slight	Short term	Slight
CO057-007----	Enclosure (Extant)	High	Indirect	Negative	Slight	Short term	Slight
KE086-007----	Megalithic structure (Collapsed and in forestry)	Medium-High	No predicted impact	Neutral	n/a	n/a	None
KE086-002----	Road (no surface trace)	Medium	No predicted impact	Neutral	n/a	n/a	None
CO057-008001-	Field boundary (part of group)	High	No predicted impact	Neutral	n/a	n/a	None
CO057-008002-	Hut site (part of group)	High	No predicted impact	Neutral	n/a	n/a	None
CO057-008003-	Hut site (part of group)	High	No predicted impact	Neutral	n/a	n/a	None
CO057-008004-	Enclosure (part of group)	High	Indirect	Neutral	n/a	n/a	None
CO057-008005-	Enclosure (part of group)	High	No predicted impact	Neutral	n/a	n/a	None
CO057-008006-	Hut site (part of group)	High	No predicted impact	Neutral	n/a	n/a	None
CO057-008007-	Fulacht fia (part of group)	High	No predicted impact	Neutral	n/a	n/a	None
CO057-008008-	Hut site (part of group)	High	No predicted impact	Neutral	n/a	n/a	None

Monument No.	Classification (Condition)	Indicative Value range	Impact Type	Impact Quality	Impact Magnitude	Impact Duration	Impact Significance
CO057-001----	Lime kiln (partially collapsed)	Medium	No predicted impact	Neutral	n/a	n/a	None
KE076-071----	Redundant Record	Negligible	No predicted impact	Neutral	n/a	n/a	None
CO057-005----	Lime kiln (no inventory description)	Medium	No predicted impact	Neutral	n/a	n/a	None
CO057-009----	Holy well (overgrown spring)	Medium-High	No predicted impact	Neutral	n/a	n/a	None
CO057-010----	Lime kiln (no inventory description)	Medium	Indirect	Neutral	n/a	n/a	Slight
CO057-012----	Structure (no inventory description)	Medium	No predicted impact	Neutral	n/a	n/a	None
CO058-001----	Lime kiln (partially collapsed)	Medium	No predicted impact	Neutral	n/a	n/a	None
None	Upright stone and potential hut	Low-Medium	No predicted impact	Neutral	n/a	n/a	None
None	Farm building (derelict)	Low	No predicted impact	Neutral	n/a	n/a	None
None	Inchamore Milleeny townland boundary (stream)	Low	Direct	Negative	Negligible	Short term	Not significant
Kerry County Council Archaeological Landscape No.13	The Paps Archaeological Landscape	High	No predicted impact	Neutral	n/a	n/a	None

14.4.3 Operational Phase – Direct Impacts

The operational phase of the Project will result in no predicted direct physical impacts on the known archaeological, architectural and cultural heritage resources. In addition, the successful implementation of the mitigation measures presented in **Section 14.6** will result in the preservation *in situ* (by avoidance) or the preservation in record (by archaeological excavation) of any unrecorded, sub-surface archaeological sites or features that may exist within proposed Development areas. There will, therefore, be no predicted direct impacts on any such potential unrecorded archaeological sites during the operational phase.

14.4.4 Operational Phase – Indirect Impacts

The Site

As detailed in **Table 14.16**, the operational phase will result in a range of indirect negative impacts of a visual nature on the wider setting of a number of recorded archaeological sites within the study area and the surrounding landscape which will range from not significant to moderate in significance. The one predicted indirect negative impact of moderate significance will arise from the presence of three turbines (T1, T2 and T3) and associated access routes within a 500 m area extending to the south, northwest and northeast of an extant archaeological site (Enclosure CO057-007----) (**Figure 14.1**). This is predicted to result in a medium magnitude of impact on the historic landscape setting of this recorded archaeological monument, which is of potential medium-high value and, based on the EPA impact assessment criteria presented in **Table 14.4** (**Section 14.2.8**), this will result in a predicted reversible, negative, indirect, moderate significance of impact.

The recorded archaeological resource within an area extending for 10 km from the Site was assessed to determine the presence of other monuments within the wider landscape that may have potential visual sensitivities, i.e. ritual alignments. This revealed that only one example has a potential direct alignment towards the Site, and this comprises a wedge tomb (CO058-060----) located within a disturbed area of cut-away bog 2.25 km to the northeast (**Figure 14.7**) While this monument has legal protection by its inclusion on the Recorded of Monuments and Places, it is not designated as a National Monument in State Care considered to be of national significance. The monument is located within private lands not accessible to the public and is recorded as being in ruinous condition by the Archaeological Survey of Ireland. Given its distance from the Site in combination with its recorded designation, inaccessibility and partial surviving extent, the potential indirect, negative impact on its wider setting is appraised as being low in magnitude and slight in significance. Given the distances of the other monuments with visual alignment attributes from the Site in combination with the absence of recorded direct visual alignments towards its location, no predicted moderate or significant indirect negative impacts on their settings are predicted and likely slight indirect impacts on their wider settings will be reversed following decommissioning.

A review of the landscape extending for 10 km from the Site revealed that there are no National Monuments in State Care or World Heritage sites (including tentative list) located within this area. The operational phase will therefore not result in any predicted indirect impacts on archaeological sites assigned these designations.

The Landscape and Amenity impact assessment (**Chapter 12**) provides an assessment of potential cumulative visual impacts on the Western Summit of 'the Paps of Anu', which forms a prominent location within The Paps Archaeological Landscape as designated in the County Kerry Development Plan 2022-2028. This assessment concludes that the visual impact, including cumulative, from this location will be low in magnitude and moderate in significance (see **Chapter 12; Section 12.4.3.5** and **Table 12.7**). The Landscape and Amenity assessment also concludes that the heritage area within the Gougane Barra valley, including Saint Finbarr's Oratory which is c.12 km to the southwest, is not contained within the Zone of Theoretical Visibility pattern and the Development has no potential for visibility from within this valley (see **Chapter 12; Section 12.3.3.1**).

In conclusion, while the turbines within the Site will be visible from various cultural heritage assets within the surrounding landscape, no likely significant, indirect impacts on examples with notable visual or amenity sensitivities are predicted during the operational phase.

a. The Project is located within the Múscraí Gaeltacht area. The requirement for low numbers of onsite staff during the operation phase will be intermittent and this will not result in any predicted impacts on the Irish language or cultural heritage of this Gaeltacht area.

Grid Connection Route

As the Grid Connection Route will comprise a buried cable it will, therefore, result in no predicted direct impacts on the cultural heritage resource during the operational phase.

Turbine Delivery Route

In the event that any turbines are required to be replaced using the same delivery route from Ringaskiddy during the operational phase, no likely impacts on the cultural resource are predicted.

Table 14.16: Summary of operational phase impacts on cultural heritage assets in 1 km study area

Monument No.	Classification (Condition)	Indicative Value range	Impact Type	Impact Quality	Impact Magnitude	Impact Duration	Impact Significance
CO057-006----	Field boundary (partially extant)	Medium-High	Indirect	Negative	Low	Long term	Slight
CO057-007----	Enclosure (Extant)	Medium-High	Indirect	Negative	Medium	Long term	Moderate
KE086-007----	Megalithic structure (Collapsed and in forestry)	Medium-High	No predicted impact	Neutral	n/a	n/a	None
KE086-002----	Road (no surface trace in forestry)	Medium	No predicted impact	Neutral	n/a	n/a	None
CO057-008001-	Field boundary (part of group)	High	Indirect	Negative	Low	Long term	Slight
CO057-008002-	Hut site (part of group)	High	Indirect	Negative	Low	Long term	Slight
CO057-008003-	Hut site (part of group)	High	Indirect	Negative	Low	Long term	Slight
CO057-008004-	Enclosure (part of group)	High	Indirect	Negative	Low	Long term	Slight
CO057-008005-	Enclosure (part of group)	High	Indirect	Negative	Low	Long term	Slight
CO057-008006-	Hut site (part of group)	High	Indirect	Negative	Low	Long term	Slight
CO057-008007-	Fulacht fia (part of group)	High	Indirect	Negative	Low	Long term	Slight
CO057-008008-	Hut site (part of group)	High	Indirect	Negative	Low	Long term	Slight

Monument No.	Classification (Condition)	Indicative Value range	Impact Type	Impact Quality	Impact Magnitude	Impact Duration	Impact Significance
KE076-071----	Redundant Record	Negligible	No predicted impact	Neutral	n/a	n/a	None
CO057-005----	Lime kiln (no inventory description)	Medium	Indirect	Negative	Negligible	Long term	Not significant
CO057-009----	Holy well (overgrown spring)	Medium-High	Indirect	Negative	Low	Long term	Slight
CO057-010----	Lime kiln (no inventory description)	Medium	Indirect	Negative	Negligible	Long term	Not significant
CO057-012----	Structure (no inventory description)	Medium	Indirect	Negative	Negligible	Long term	Not significant
CO058-001----	Lime kiln (partially collapsed)	Medium	Indirect	Negative	Negligible	Long term	Not significant
None	Upright stone and potential hut	Low-Medium	Indirect	Negative	Low	Long term	Slight
None	Farm building (derelict)	Low	Indirect	Negative	Negligible	Long term	Not significant
None	Inchamore Milleeny townland boundary (stream)	Low	Direct	Negative	Negligible	Long term	Not significant
Kerry County Council Archaeological Landscape No.13	The Paps Archaeological Landscape	High	Indirect	Negative	Low	Long term	Moderate

14.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

14.5.1 Construction Phase

The wind farm layout was informed by the archaeological desktop studies and fieldwork undertaken during the design and assessment phases and was designed to avoid the known locations of known and potential archaeological monuments as well as an undesignated late 19th century farm building within the east end of the Site.

The mitigation measures presented in this section comprise construction phase archaeological monitoring of ground works as well as protection measures for known and potential cultural heritage assets within the Site. These mitigation measures are in accordance with guidelines for planning conditions for wind energy developments within close proximity to recorded archaeological monuments as published in Section 7.4 of the *2006 Wind Energy Development Guidelines*[24] and Section 7.6 of the *2019 Draft Revised Wind Energy Development Guidelines*[25].

Ground works during the construction phase will be subject to archaeological monitoring by a suitably qualified archaeologist under licence by the National Monuments Service. A systematic advance programme of archaeological field-walking surveys will also be carried out within Development areas in forestry plantations following tree felling to confirm the conditions predicted in this assessment, i.e., that they contain no visible surface traces of potential unrecorded archaeological or architectural heritage sites.

In the event that any sub-surface archaeological features are identified during archaeological monitoring they will be securely cordoned off, cleaned and recorded *in situ*. The National Monuments Service will then be notified and consulted to determine further appropriate mitigation measures, which may include preservation *in situ* (by avoidance) or preservation by record (archaeological excavation).

The archaeologist appointed to monitor the construction phase will also supervise the establishment of minimum 30 m radius concentric buffer zones around the external-most elements of Field Boundary (CO057-006----) and Enclosure (CO057-007----). These buffer zones will be securely fenced off and their locations will be clearly signed as 'No Entry' for the duration of the construction phase. No ground works of any kind (including but not limited to advance geotechnical site investigation) and no machinery, storage of materials

[24] https://www.gov.ie/en/publication/f449e-wind-energy-development-guidelines-2006/
[25] https://www.gov.ie/en/publication/9d0f66-draft-revised-wind-energy-development-guidelines-december-2019/

or any other activity related to construction will occur within these buffer zones. The location of a derelict farm building, which shown on the second edition 6-inch OS map (published 1900), is c.110 m outside the nearest construction area within the Site. This will be clearly signed as "No Entry" during the construction phase. The locations of these onsite archaeological monuments and farm building will also be identified as 'no-entry' areas during the construction phase site inductions. The location of two features located c.40 m to the north of T2, which are tentatively identified as being of archaeological potential (hut site and upright stone), are located in private lands outside the Redline Boundary. The erection of fencing around their locations will therefore not be feasible but, "No Entry" signs will be erected at the north, south and east edges of the Redline Boundary within their environs.

The Project is located within the Múscraí Gaeltacht area and any signage erected within the public realm during the construction phase will include Irish and English text.

14.5.2 Construction Phase Residual Impacts – Direct

The mitigation measures presented in **Section 14.5.1** will provide for either the avoidance of the potential unrecorded, sub-surface archaeological resource within the footprint of proposed construction locations or the proper and adequate recording of this resource by full archaeological excavation. Preservation *in situ* shall allow for a negligible magnitude of impact resulting in a potential not significant/imperceptible significance of effect in the context of residual impact on the unrecorded archaeological resource. Preservation by record shall allow for a high magnitude of impact, albeit ameliorated by the creation of a full and detailed archaeological record, the results of which shall be publicly disseminated. This shall result in a potential slight/moderate range of significance of effect in the context of residual impacts on the unrecorded archaeological resource.

14.5.3 Construction Phase Residual Impacts – Indirect

The buffer zone mitigation measures presented in **Section 14.5.1** will provide for the protection of known archaeological monuments and undesignated historical buildings within the Site. No residual construction phase indirect impacts are predicted following the implementation of these mitigation measures.

14.5.4 Operational Phase

Following the successful implementation of the mitigation measures presented in **Section 14.5.1**, the operational phase of the Project will result in no predicted direct impacts on the known archaeological, architectural and cultural heritage resources and, therefore, no mitigation measures for direct operational phase impacts will be required.

As detailed in **Section 14.4.4**, the wind farm turbines will result in a range of long term, indirect, negative impacts of a visual nature on the wider setting of archaeological sites within the environs of the Site during the operational phase which will range from not significant to moderate in significance (**Table 14.16**). Given the nature of the wind farm turbines there are no mitigation measures that can address these visual impacts, but it is noted that they will be reversed following the decommissioning phase. The Grid Connection Route and Turbine Delivery Route will result in no predicted residual impacts.

14.5.5 Operation Phase Residual Impacts - Direct

No operation phase direct residual impacts on the cultural heritage resource are predicted following the implementation of mitigation measures presented in **Section 14.5.1**.

14.5.6 Operation Phase Residual Impacts - Indirect

The operation phase will result in a range of not significant to moderate, long term, negative residual indirect impacts on archaeological sites within the environs of the Project (**Table 14.16**). It is noted that these will all be reversed following decommissioning of the Project.

14.6 CUMULATIVE IMPACTS

A review of wind farm developments within 10 km of the Project was carried out in order to assess potential cumulative impacts on the cultural heritage resource (**Table 14.17**). This included a review of available archaeological and cultural heritage impact assessments of these developments included in the online planning files published on the Cork County Council (CCC) and Kerry County Council (KCC) planning enquiry systems as well as the Database of Irish Excavation Reports. A review of other developments within 3 km of the Project was also carried out and the results are presented below (**Table 14.18**).

Table 14.17: Review of wind farm developments within 10 km of the Project

Wind Farm	Status	No. of Turbines	Approximate Distance to the Site Boundary	Direction from the Development	Cultural Heritage Review
Cleanrath	Operational	9	9.93 km	South East	Archaeological testing and monitoring carried out as part of this development revealed nothing of archaeological significance[26]
Clydaghroe, Clonkeen	Operational	4	6.05 km	North East	The Excavations Database does not contain any entries for this development. A review of its location revealed that the site does

[26] https://excavations.ie/report/2019/Cork/0029095/

Wind Farm	Status	No. of Turbines	Approximate Distance to the Site Boundary	Direction from the Development	Cultural Heritage Review
					not contain any designated cultural heritage sites
Coumaclovane, Coolea	Permitted	1	3.17 km	South-West	The Excavations Database does not contain any entries for this development. A review of its location revealed that the site does not contain any designated cultural heritage sites
Coolknoohil, Inchee	Operational	2	3.94 km	South-West	Archaeological monitoring of this development revealed nothing of archaeological significance[27]
Coolknoohil, Kilgarvan	Operational	11	4.40 km	South-West	Archaeological monitoring of this development revealed nothing of archaeological significance[28]
Coomagearlahy Kilgarvan	Operational	15	2.70 km	South-West	Archaeological monitoring of this development revealed nothing of archaeological significance[29]
Cummeennabuddoge, Clydaghroe, Cloonkeen	Operational	2	7.23 km	North-East	The Excavations Database does not contain any entries for this development. A review of the EIS for the development revealed that its location does not contain any designated cultural heritage sites[30]
Coomacheo	Operational	15	9.02 km	North-East	Advance archaeological site investigations of the development location revealed nothing of archaeological significance[31]
Derragh	Operational	6	7.52 km	South	A review of the Cultural Heritage Chapter in the EIS prepared for the for this development was carried out and revealed that it was assessed to have no predicted direct or significant impacts on the cultural heritage resource[32]. The assessment also concluded that the visual impacts on archaeological sites within the surrounding landscape would be slight in significance.
Gortnakilla, Clonkeen Killarney	Permitted	4	1.87 km	West	A review of the cultural heritage assessment prepared for this location was carried out and revealed that it contained no known cultural heritage assets[33]
Grousemount, Barnastooka	Operational	24	7.38 km	South-West	Archaeological investigations at this development revealed various features including the remains of upland hut sites (Licence 16E0127[34]). All of these were preserved *in situ* by avoidance apart from one example which was preserved by record by an

[27] https://excavations.ie/report/2013/Kerry/0024269/
[28] https://excavations.ie/report/2004/Kerry/0011861/
[29] https://excavations.ie/report/2005/Kerry/0013693/
[30] http://docstore.kerrycoco.ie/planningfiles/061680.pdf
[31] https://excavations.ie/report/2006/Cork/0015047/
[32] http://planning.corkcoco.ie/ePlan/AppFileRefDetails/156966/0
[33] http://docstore.kerrycoco.ie/planningfiles/061396.pdf
[34] https://excavations.ie/report/2016/Kerry/0025172/

Wind Farm	Status	No. of Turbines	Approximate Distance to the Site Boundary	Direction from the Development	Cultural Heritage Review
					archaeological excavation which revealed it to be a cairn containing a Bronze Age 'short cist' (Licence 18E0324[35]).
Gortyrahilly	Proposed	14	4.7 km	South	The cultural heritage assessment of this proposed development concluded that it would result in no predicted direct or significant impacts on the resource[36]
Inchee, Poulbatha & Foilgreana	Operational	6	3.30 km	South-West	Archaeological monitoring of the construction of this development revealed nothing of archaeological significance [37]
Inchincoosh Kilgarvan	Operational	6	4.51 km	West	Archaeological monitoring of the construction of this development revealed nothing of archaeological significance[38]
Rosseightragh, Lettercannon, Kilgarvan	Operational	7	5.23 km	South West	Archaeological monitoring of the construction of this development revealed nothing of archaeological significance[39]
Knocknamork	Permitted	7	4.42 km	North East	The cultural heritage assessment of this proposed development concluded that it would result in no predicted direct or significant impacts on the resource[40]
Sillahertane Kilgarvan	Operational	10	7.03 km	South-West	Archaeological monitoring of the construction of this development revealed nothing of archaeological significance[41]
Cummeennabuddoge	Pre-planning	17	4.72 km	North East	A review of the location of this proposed development revealed that there are no recorded archaeological sites or designated architectural heritage structures within its boundary

[35] https://excavations.ie/report/2018/Kerry/0027273/
[36] https://gortyrahillyplanning.ie/environmental/
[37] http://docstore.kerrycoco.ie/planningfiles/031188.pdf
[38] https://excavations.ie/report/2008/Kerry/0019629/
[39] https://excavations.ie/report/2008/Kerry/0019629/
[40] http://planningdocs.corkcoco.ie/PlanningDocumentDisplay/documents/18a-194972
[41] https://excavations.ie/report/2008/Kerry/0019648/

Table 14.18: Review of other developments within 3 km of the Project

Planning ref.	Development type	Status	Approx. Distance from Project	Cultural Heritage Review
CCC ref. 174167	Solar Farm	Granted	3 km to southwest	A pre-development archaeological assessment concluded there were no recorded archaeological sites located within or in close proximity to the subject site. No likely significant impacts were predicted, and archaeological monitoring of construction phase was recommended[42], This recommendation was included as a condition in the grant of planning.
CCC. ref. 215127	Temporary meteorological mast	Granted	Adjacent	A pre-development archaeological assessment noted the presence of two archaeological sites (enclosure CO057-007---- and field boundary CO057-006----) within the environs of the subject site. The proposed development was designed to avoid their locations and no likely direct or significant impacts were predicted[43]. Archaeological monitoring of construction phase was recommended and this was included as a condition in the grant of planning.
CCC. ref. 217318	Telecommunications structure	Granted	0.6 km to east	The online planning file for this development does not contain an archaeological assessment. A review of its location revealed that it does not contain any recorded archaeological sites
CCC. ref. 224455	House	Granted	2.1 km to south	The online planning file for this development does not contain an archaeological assessment. A review of its location revealed that it does not contain any recorded archaeological sites
CCC. ref. 196555	Land reclamation	Granted	2.8 km to south	The online planning file for this development does not contain an archaeological assessment. A review of its location revealed that it does not contain any recorded archaeological sites
CCC. ref. 204959	Farm buildings	Granted	1.8 km to south	The online planning file for this development does not contain an archaeological assessment. A review of its location revealed that it does not contain any recorded archaeological sites
CCC. ref. 214587	House	Granted	1.8 km to south	The online planning file for this development does not contain an archaeological assessment. A review of its location revealed that it does not contain any recorded archaeological sites
CCC. ref. 186505	House	Granted	1.8 km to southeast	The online planning file for this development does not contain an archaeological assessment. A review of its location revealed that it does not contain any recorded archaeological sites
CCC. ref. 184273	House	Granted	1.8 km to southeast	The online planning file for this development does not contain an archaeological assessment. A review of its location revealed that it does not contain any recorded archaeological sites
CCC ref. 196056	House	Granted	2.8 km to southeast	The online planning file for this development does not contain an archaeological

[42] http://planningdocs.corkcoco.ie/PlanningDocumentDisplay/documents/18a-174167
[43] http://planningdocs.corkcoco.ie/PlanningDocumentDisplay/documents/18a-215127

Planning ref.	Development type	Status	Approx. Distance from Project	Cultural Heritage Review
				assessment. A review of its location revealed that it does not contain any recorded archaeological sites

Given the absence of any direct or significant impacts on the recorded cultural heritage resource arising from the Project, in combination with the results of the above review of wind farms, it is concluded that the proposed Project is not predicted to contribute to any significant direct cumulative impacts on the cultural heritage resource of the wider area.

The Development will result in a range of not significant to moderate, negative, indirect impacts on the settings of archaeological monuments within surrounding lands (**Table 14.16**). Given the distances and locations of the other reviewed wind farm developments from the Development, it is concluded that they will not act in combination to result in any likely significant, negative, indirect cumulative impacts on the settings of these monuments. In addition, as described in **Section 14.3.2**, a review of archaeological monument types with visual alignment attributes within the 10 km of the Site revealed that the Development will not result in any predicted likely moderate or significant indirect negative impacts on any of their settings or alignments. The review of available cultural heritage impact assessments of the wind farm developments listed in **Table 14.17** revealed that none of these assessments predicted any likely significant, indirect impacts on any monuments within the wider environs of the assessed wind farm locations.

The Landscape and Amenity impact assessment (**Chapter 12**) provides an assessment of potential cumulative visual impacts on the Western Summit of 'the Paps of Anu', which forms a prominent location within The Paps Archaeological Landscape. This assessment concludes that the cumulative visual impact from this location is Moderate in significance (see **Chapter 12; Section 12.4.3.5**). The Landscape and Amenity assessment also concludes that the heritage site of Gougane Barra, including Saint Finbarr's Oratory which is c.12 km to the southwest, is not contained within the Zone of Theoretical Visibility pattern and indicated no potential for visibility from within this valley location (see **Chapter 12; Section 12.3.3.1**).

It is, therefore, concluded that the Development will not act in combination with the reviewed wind farm developments to result in likely significant indirect negative cumulative impacts on the settings or alignments of such ritual archaeological monuments within the wider landscape. There are no National Monuments in State Care or World Heritage sites (including tentative list) located within 10 km of the Site and the Development is not predicted to contribute to any cumulative impacts on such monuments.

The locations of other developments, including residential and agricultural developments, within 3 km of the Development were also reviewed on the County Cork and Kerry planning enquiry systems. The majority of these reviewed developments are small-scale in extent, including dwelling houses and farm buildings, and no examples that will result in direct or indirect significant cumulative impacts, on any recorded archaeological sites or designated architectural heritage structures were noted. Two of the reviewed developments are located within 1 km of the Site and these comprise a temporary meteorological mast and a telecommunication structure (**Table 14.18**; CCC refs 215127 and 217318). These two permitted developments are not predicted to result in any likely significant indirect impacts on the known cultural heritage resource and are not considered likely to contribute to any significant indirect impacts in combination with the Development. This is due to their distance from the Development in combination with the absence of cultural heritage constraints with notable visual sensitivities, such as megalithic tombs, stone rows/circles, within their environs. The review did not identify any other examples that will combine with the Development to result in any likely significant cumulative impacts on the cultural heritage resource.

14.7 DECOMMISIONING IMPACTS

No direct impacts on known elements of the cultural heritage resource are predicted during the decommissioning phase as there are no recorded cultural heritage assets located within or adjacent to the footprint of the various elements of the wind farm that will be subject to decommissioning. Any unrecorded, sub-surface archaeological remains identified during archaeological monitoring of the construction phase will either be preserved *in situ* by avoidance within the Site or preserved by record (excavation) and no decommissioning impacts on such potential features are predicted. The decommissioning of the Development will result in the reversal of the long term, indirect, negative visual impacts on the archaeological monuments located within the environs of the Site and the wider landscape (**Table 14.16**).

14.8 CONCLUSIONS

The Project will not result in any predicted direct negative impacts on any known archaeological monuments or architectural heritage structures. The locations of two recorded archaeological sites within the Site will be cordoned off within fenced buffer zones for the duration of the construction phase. No in-channel works within any watercourses will be carried out and no impacts on any potential underwater archaeological remains are predicted. The potential exists for the presence of unrecorded, sub-surface archaeological features within the Site and archaeological monitoring of the construction phase will be carried out under licence from the National Monuments Service by a suitably qualified archaeologist. In the event that any sub-surface archaeological remains are identified during monitoring, they will be cleaned, recorded and left to remain *in situ* within cordoned off areas while the National Monuments Service are notified and as described above in respect of measures which may entail preservation *in situ* by avoidance or preservation by record by archaeological excavation.

The Project will result in a range of not significant to moderate, indirect negative visual impacts on the settings of archaeological monuments located within surrounding lands during the operational phase (**Table 14.16**). These indirect impacts will be long term in duration and will be reversed following the decommissioning phase.

14.9 SUMMARY OF SIGNIFICANT EFFECTS

No predicted significant direct, indirect or cumulative effects on the Cultural Heritage resource arising from the proposed Project have been identified.

14.10 STATEMENT OF SIGNIFICANCE

An assessment has been made of the potential for significant effects of the Project on the cultural heritage resource. Following the application of effective mitigation measures based on best practice guidelines, including archaeological inputs during the Project design process combined with onsite archaeological monitoring of the construction phase, the Project is not predicted to result in likely significant effects on the cultural heritage resource.

15 TRAFFIC AND TRANSPORT

15.1 INTRODUCTION

15.1.1 Background and Objectives

This chapter assesses the potential traffic and transport effects of the Project, describes the existing transport network, identifies whether there is any potential for significant effects to arise (both in isolation and in combination with other developments) and outlines any mitigation measures as required. The assessment will consider the potential effects during the following phases of the Development:

- Construction of the Project,
- Operation of the Project, and
- Decommissioning of the Project.

For developments of this nature, the construction phase is the critical impact period with impacts experienced on the surrounding road network. These impacts are both the short-term additional traffic volumes and the geometric requirements of the oversized loads associated with the turbine components. The locations on the public road network requiring remedial measures to accommodate turbine delivery will be temporary in nature as shown in **Table 15.12** , apart from the enhancement of the existing junction with the N22, and are outlined in this Chapter.

Construction materials and tree felling for the wind farm and the delivery of turbine components will use the existing public road network as far as the proposed entrance off the N22, which is an existing forestry entrance at Derryreag. Construction materials for much of the grid connection will use an existing access from the N22 to the forest track at Cummeenavrick (see **Figure 15.4**).

While the wind farm site is located in Co. Cork, the site entrance off the N22 at Derryreag is located in Co. Kerry. The site access point for much of the grid connection at Cummeenavrick is located in Co. Kerry (see **Figure 15.4**).

A Swept Path Analysis has been carried out on the Haul Route for the abnormal loads associated with turbine components. The Swept Path Analysis includes an assessment of blade oversail (ie. where the blade protrudes outside the road corridor). The assessment was done using a Siemen SG155 Blade component super wing carrier which is designed to transport the size of blades required for the turbine.

The haul routes proposed for all other construction materials is referred to as the Civil Construction Haul Route.

The grid connection haulage route will overlap with the civil construction route mainly with the entrance to the grid connection works being slightly further North on the N22 in Co. Kerry. The excavation of the grid connection trenches will coincide with the work that will be required on the forest track entrance which will be used as the civil construction haul route.

This chapter outlines potential effects of the Project on traffic and transport based on the Swept Path Analysis which has been undertaken for the abnormal loads Haul Route. It also estimates the number of HGV and other traffic movements on the Civil Construction Haul Route used for materials deliveries and assesses the associated impacts.

Figures are contained in **Volume III**.

Common acronyms used throughout this EIAR can be found in **Appendix 1.2**. This chapter of the EIAR is supported by Figures provided in Volume III and by the following Appendix documents provided in Volume IV of this EIAR:

- **Appendix 15.1: Collett Route Survey Reports of October 2022 and November 2022**
- **Appendix 15.2: Swept Path Analysis Drawings**
- **Appendix 15.3: Road Safety Audit**

15.1.2 Statement of Authority

This chapter of the EIAR has been prepared by David Kiely, Director, Jennings O'Donovan & Partners Limited who holds a BE in Civil Engineering from University College Dublin and MSc in Environmental Protection from IT Sligo. He is a Fellow of Engineers Ireland, a Chartered Member of the Institution of Civil Engineers (UK) and has over 39 years' experience. He has extensive experience in the preparation of EIARs and EISs for environmental projects including Wind Farms, Solar Farms, Waste Water Projects and various Commercial Developments. David has also been involved in the construction of over 60 wind farms since 1997.

The Collett Route Survey Reports for wind turbines were prepared by Spencer Budgen and reviewed by Steven Mangham of Collett & Son, Halifax, West Yorkshire, UK. Collett & Son owns a fleet of over 60 vehicles and 100 trailers and is one of the main transport contractors who deliver wind turbine components to locations in Ireland. They also provide consultancy services in relation to the assessment of turbine haul routes. Mr. Mangham also oversaw the preparation of the Swept Path Analysis drawings for the turbine haul route between Ringaskiddy and Derryreag, west of Ballyvourney. He completed the survey dated 12th October 2022 with the help of Spencer Budgen (renewables surveyor) and Jacob Halstead (transportation specialist)

Mr. Mangham has a BTech in Civil Engineering from Leeds College of Building and a BSc in Civil Engineering from Leeds Beckett University. He has been employed by Collett & Son for over 12 years and is their Consultancy Manager. He has been involved in transport assessments for over 250 wind farms in the UK and for over 40 wind farms in Ireland.

G. Mohammadi from Collett & Son also prepared Swept Path Analysis drawings between Ringaskiddy Port, Co. Cork and the site access junction off the N22 at Derryreag Td., Co. Kerry.

The Swept Path Analysis and design of the site access junction with the N22 and the upgrading works to the existing forest track were prepared and designed by John Doogan, Senior Designer at Jennings O'Donovan & Partners Limited. John has a National Diploma in Civil Engineering from Bolton Street College of Technology, Dublin and has over 32 years of road design experience. He has worked on over 30 wind farms in Ireland and Sweden.

Topographic surveys of the lands for the proposed site access junction (existing forest access) with the N22 were carried out by Mr. Garry Henebry, Managing Director, GHE Surveying, Mitchelstown, Co. Cork. Garry Henebry is the Managing Director of GHE Surveying and has 20 years' experience of surveying. Garry qualified from St. Johns Central College Cork City in 2001 with a Diploma in Architectural Design and since then has established an extensive background in planning, civil engineering and surveying. GHE operates out of Mitchelstown, Co. Cork and are nationwide throughout Ireland with their services. They provide precise and detailed measurement information at all stages of a project and specialise in the provision of innovative solutions to all aspects of engineering surveying in the civil sector and all aspects of land and measured building surveying. Garry has provided surveying services to contractors engaged in the construction of wind farm and grid connections.

15.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

15.2.1 Assessment Methodology

This assessment has involved the following elements, further details of which are provided in the following sections:

- Policy and guidance review;
- Desk study, including review of available maps and published information;
- Site visit (driving the route) including review of road network to be used;
- Topographical Survey of potential 'constraints';
- Swept Path Analysis of the Haul Route;
- Establishment of Baseline Scenario;
- Evaluation of potential effects;
- Evaluation of the significance of these effects;
- Identification of measures to avoid and mitigate potential effects;

Existing, permitted and known proposed developments and projects are cumulatively assessed in the EIAR. This includes projects and developments that are pending a decision from the planning authority and other known projects which are in the advanced stages of being prepared to be submitted for planning and have the potential for in combination effects, namely the Cummeennabuddoge Wind Farm. Cummeennabuddoge Wind Farm is at the pre-planning/concept stage and is being prepared by the same client as Inchamore Wind Farm, and including the evaluation of residual effects following implementation of mitigation measures.

15.2.2 Planning Policy and Guidelines/Guidance

In addition to the EIAR standards outlined in **Chapter 1: Introduction**, the following guidance, guidelines and standards have been used in the preparation of this chapter:

Table 15.1: Policy and Guidance

Policy / Author	Title	Policy
Cork County Council	Cork County Development Plan 2022-2028	The CDP states: *"Objective TM12-2-2: Promote and facilitate an active travel culture in the County where active travel is a viable choice.* *f) Where appropriate, identify alternative routes, signposted for cycling and walking, to improve the experience and uptake of active travel.* *h) Seek to improve connectivity within the County and region for walking routes and commuter cycling routes and recreational amenity functions."*

Policy / Author	Title	Policy
		"Objective TM 12.8: Traffic/Mobility Management and Road Safety *a) Where traffic movements associated with a development proposal have the potential to have a material impact on the safety and free flow of traffic on a National, Regional or other Local Routes, the submission of a Traffic and Transport Assessment (TTA) and Road Safety Audit will be required as part of the proposal.* *d) Ensure that all new vehicular accesses are designed to appropriate standards of visibility to ensure the safety of other road users.* *e) Improve the standards and safety of public roads and to protect the investment of public resources in the provision, improvement and maintenance of the public road network."* *"Objective TM 12.13: National, Regional and Local Road Network* *Key Project 2040 projects:* • *N22 Ballyvourney to Macroom road* *i) Promote the improvement of strategic Regional and Local Roads throughout the County in accordance with the strategies identified for the main settlements in this plan.* *j) Restrict individual access onto national roads in order to protect the substantial investment in the national road network, to improve carrying capacity, efficiency and safety and to prevent the premature obsolescence of the network.* *k) Limit access to regional roads where appropriate so as to protect the carrying capacity of the network and have regard to safety considerations, particularly where access to a lower category road is available.* *l) Ensure that all route upgrades are planned, designed and constructed to be compliant with EU environmental directives and to minimise impacts on biodiversity, built heritage and landscape.* *m) Avoid the creation of additional access points from new developments or the generation of increased traffic from existing accesses onto national roads to which speed limits of greater than 50kph apply.*
Kerry County Council	Kerry County Development Plan 2022 – 2028	The CDP has the following objectives relevant to traffic and transport aspects of the proposed development: **KCDP 14-20** Enhance and improve regional connectivity through upgraded transport infrastructure and effective public transport services. **KCDP 14-21** Improve access for all vulnerable road users and people with disabilities to all modes of transport with provision for universal design thereby increasing and improving transport facilities for all users. **KCDP 14-22** Protect and sustainably develop the county's principal transportation assets including ports, Kerry Airport, and strategic road and rail corridors. **KCDP 14-23** Promote the sustainable development of all transportation links both within and out of the County in co-

Policy / Author	Title	Policy
		operation with adjacent Local Authorities to integrate different modes of transport. Extract fromSection 14.4 "In accordance with Section 2.7 of the DoELG Spatial Planning and National Roads Guidelines for Planning Authorities, particular care must be exercised in the assessment and management of development proposals in the Development Plan relating to development objectives or the zoning of locations at or close to junctions on the national road network in accordance with the provisions of official policy." Extract from Table 14.3: National Primary/Secondary Roads projects N21/N22 Tralee to County Boundary. **KCDP 14-25** Seek to protect and safeguard the significant investment made in strategic economic infrastructure, in particular the network of roads, the existing rail line to Tralee and major water and wastewater projects, through the promotion of appropriate development and settlement patterns and the integration of land use and transportation activities. **KCDP 14-26** Strengthen Steady State Investment in our existing road networks to ensure that existing networks are maintained to a high level to ensure quality levels of safety, service, accessibility and connectivity to transport users of all transport modes. **KCDP 14-27** Provide, or facilitate the sustainable provision of all road infrastructure projects set out in Table 14.3 with priority given to infrastructure serving the key Towns. **KCDP 14-28** Support the development of the Adare, Newcastlewest and Abbeyfeale By-passes and N21 realignment as a strategic link corridor between Co. Kerry and Co. Limerick and support the completion of the Macroom By-pass and further improvements and realignments of the N22 corridor. **KCDP 14-29** Protect the capacity and safety of the National Road and Strategically Important Regional Road network in the County and ensure compliance and adherence to the provisions of official Government policy outlined in the Section 28 Ministerial Guidelines 'Spatial Planning and National Roads Guidelines for Planning Authorities' (DoECLG, 2012) in order to safeguard carrying capacity and safety of National Primary and Secondary Routes and associated national road junctions. **KCDP 14-30** Avoid the creation of any additional access point from new development or the generation of increased traffic from existing accesses to National Roads to which speed limits greater than 60 km/h apply. This provision applies to all categories of development, including individual

Policy / Author	Title	Policy
		houses in rural areas, regardless of the housing circumstances of the applicant. **KCDP 14-31** Consider proposals for access onto National Roads on the approaches to or exit from urban centres that are subject to a speed limit of 60 km/h before a lower 50 km/h limit (otherwise known as transitional zones) subject to a road safety audit and in accordance with the TII publication; The Treatment of Transition Zones to Towns and Villages on National Roads DN-GEO-03084 (2018). **KCDP 14-34** a) Facilitate and support planning applications for economic job creation entitles which require access onto National Primary/Secondary Roads subject to compliance with section 2.5 & 2.6 of the guidelines, with early engagement with the TII. b) Favourably consider new planning applications which require access onto National Primary/Secondary Roads for family members where there are existing entrances which is supported by a detailed Road Safety Audit.
Department of Transport, Tourism and Sport and Department of Environment, Community and Local Government	The Design Manual for Urban Roads and Streets (DMURS)	This document outlines guidelines on the design of urban roads and streets in terms of street networks, street signage, pedestrians and cyclists, carriageways (widths, surfaces, junctions etc.), policies and plans, design process and audits (safety and quality).
Transport Infrastructure Ireland (TII)	Traffic and Transport Assessment Guidelines (PE-PDV-02045, May 2014)	The guidelines provide guidance for developers, planning authorities and the National Roads Authority (NRA) for: • Scoping for traffic and transport assessment for future development and development areas, particularly areas in proximity to national roads, • Defining thresholds where studies are recommended to minimise the impact of future proposals on the national road network, • Contributing to the provision of sustainable forms of development and better-informed planning decisions.
Transport Infrastructure Ireland (TII)	Geometric Design of Junctions (priority junctions, direct accesses, roundabouts, grade separated, and compact grade separated junctions) DN-GEO-03060, June 2017)	Design Standards for Junction Design, excl. major interchanges.
Transport Infrastructure Ireland (TII)	Rural Road Link Design (DN-GEO-03031 June 2017)	This Standard applies to Single and Dual Carriageway roads (including Motorways) in rural areas. It also applies to single carriageway Urban Relief Roads and Urban Dual Carriageways and Motorways. The Standard shall be used to derive the Design Speed, and the appropriate values of geometric parameters for use in the design of the road alignment. It sets out the basic principles to be used in co-ordinating the various elements of the road layout, which together form the three-dimensional design of the road.

Policy / Author	Title	Policy
Transport Infrastructure Ireland (TII)	Design Phase Procedure for Road Safety Improvement Schemes (DN-GEO-03030, April 2021)	This Standard sets out the procedures to be followed for the technical aspects of the Design Phase of the following scheme types: • Road Safety Improvement Schemes • Urban Road Schemes • Road Safety Improvements aspects • Local authority general improvement schemes which have not been identified as Road Safety Improvement Schemes, schemes led, funded or partly funded by other agencies, development led schemes and/or community schemes.
Transport Infrastructure Ireland (TII)	Project Appraisal Guidelines for National Roads Unit 5.3 – Travel Demand Projections (PE-PAG-02017, May 2019)	This document provides guidance on the development of transport models for use in the appraisal of transport infrastructure. The guidance addresses the scoping and construction of transport models which reflect transport demand and supply in a 'Base Year'. It provides guidance on the preparation of future travel demand projections for use in modelling and appraisal.
Transport Infrastructure Ireland (TII)	Expansion Factor for Short Period Traffic Counts (PE-PAG-02039, October 2016)	This document aims to support the conversion of short period traffic counts to annual average daily traffic (AADT).
Transport Infrastructure Ireland (TII)	Road Safety Audit (GE-STY-01024, December 2017)	This Standard outlines the requirements for Road Safety Audits in the management of the national road infrastructure. It sets out the procedures required to implement Road Safety Audits and defines the relevant schemes and stages in the design and construction at which audits shall be undertaken.
Department of the Environment and Local Government and Department of Transport	Traffic Management Guidelines 2012	This document outlines guidelines for traffic management and sustainability, consultation and monitoring, speed management, junctions, vulnerable road users, public transport and parking. The guidelines recommend that consultation is carried out for schemes that involve a long construction period or area. The guidelines outline the relevant legislation governing different types of road works. The guidelines outline safety measures to be taken in the design of roads and junctions. The guidelines outline the arrangements for temporary traffic management where construction and improvement of roads is taking place and who should be consulted in planning for roadworks and the factors to consider.
Department of Transport, Tourism and Sport	Guidelines for Managing Openings in Public Roads (Second Edition, April 2017)	The document prescribes standards in respect of the work of forming openings, backfilling and the reinstatement of road surfaces and the associated materials to be used on all roads other than National Roads. It also prescribes procedures and requirements in relation to the use of MapRoad Roadworks Licensing (MRL) and its use for all road openings in public roads other than those openings carried out by a road authority.
Transport Infrastructure Ireland (TII)	Spatial Planning and National Roads Guidelines	It is in the public interest, in so far as is reasonably practicable, that the national road network continues to serve its intended strategic purpose. The EIAR should identify the methods/techniques proposed for any works traversing/in proximity to the national road network, in order to demonstrate that the development can proceed

Policy / Author	Title	Policy
		complementary to safeguarding the capacity, safety and operational efficiency of that network.

15.2.3 Scoping Responses and Consultation

Consultation responses are shown in **Table 15.2**.

Table 15.2: Consultation Responses

Consultee	Type & Date	Summary of Response	Response to Consultee
Transport Infrastructure Ireland (TII)	Email dated 7th December 2020	With respect to EIAR Scoping issues, the recommendations indicated below provide only general guidance for the preparation of EIAR, which may affect the National Roads Network. The developer should have regard, inter alia, to the following: 1. As set down in the "Spatial Planning and National Roads" Guidelines, it is in the public interest, in so far as is reasonably practicable, that the national road network continues to serve its intended strategic purpose. The EIAR should identify the methods/techniques proposed for any works traversing/in proximity to the national road network, in order to demonstrate that the development can proceed complementary to safeguarding the capacity, safety and operational efficiency of that network. 2. Consultations should be had with the relevant Local Authority/National Roads Design Office, with regard to locations of existing and future national road schemes.	Addressed by this EIAR / Chapter.
		3. In relation to cabling and potential connection routing, the scheme promoter should note locations of existing and future national road schemes and develop proposals to safeguard proposed road schemes. As outlined above, consult with the Local Authority/National Roads Design Office in relation to any schemes in planning in the area, especially on the N22. Proposals should be developed to safeguard proposed road schemes, as TII will not be responsible for costs associated with future relocation of cable routing, where proposals are catered for in an area of a proposed national road scheme. In that regard, consideration should be given to routing options, use of existing crossings, depth of cable laying etc.	Addressed in sections 15.5.16 and 15.6.1 of this Chapter and in Road Safety Audit in Appendix 15.3.
		In the context of existing national roads, alternatives to the provision of cabling along the national road network, such as alternative routing or the laying of cabling in private lands adjoining the national road, should be considered in the interests of safeguarding the investment in and the potential for future upgrade works to the national road network. The cable routing should avoid all impacts to existing TII infrastructure such as traffic counters, weather stations, etc. and works required	Noted, however this is not applicable as the majority (99%) of the grid connection is to be located outside public roads Furthermore there have been

Consultee	Type & Date	Summary of Response	Response to Consultee
		to such infrastructure shall only be undertaken in consultation with and subject to the agreement of TII. Any costs attributable shall be borne by the applicant/developer. The developer should also be aware that separate approvals may be required for works traversing the national road network.	recent upgrades in the form of the new N22 from Macroom to Ballyvourney.
		4. Clearly identify haul routes proposed and fully assess the network to be traversed. Separate structure approvals/permits and other licences may be required in connection with the proposed haul route and all structures on the haul route should be checked by the applicant/developer to confirm their capacity to accommodate any abnormal load proposed.	
		5. Where appropriate, subject to meeting the appropriate thresholds and criteria and having regard to best practice, a Traffic and Transport Assessment (TTA) be carried out in accordance with relevant guidelines, noting traffic volumes attending the site and traffic routes to/from the site, with reference to impacts on the national road network and junctions of lower category roads with national roads. TII's 'Traffic and Transport Assessment Guidelines' (2014) should be referred to in relation to proposed development with potential impacts on the national road network. The scheme promoter is also advised to have regard to Section 2.2 of the TII TTA Guidelines, which addresses requirements for sub-threshold TTA.	Addressed in this Chapter
		6. TII Standards should be consulted to determine the requirement for Road Safety Audit and Road Safety Impact Assessment.	Addressed in Sections 15.3.5 and 15.3.6
		7. Assessments and design and construction and maintenance standards and guidance are available at TII Publications, which replaced the National Road Authority (NRA) Design Manual for Roads and Bridges and the NRA Manual of Contract Documents for Road Works.	
		8. The developer, in conducting Environmental Impact Assessment, should have regard to TII Environment Guidelines that deal with assessment and mitigation measures for varied environmental factors and occurrences. In particular: a. TII's Environmental Assessment and Construction Guidelines, Including the 'Guidelines for the Treatment of Air Quality During the Planning and Construction of National Road Schemes' (NRA, 2006).	Addressed in this Chapter.
		b. The EIAR should consider the 'Environmental Noise Regulations 2006' (SI 140 of 2006) and, in particular, how the development will affect future action plans by the relevant competent authority. The developer may need to consider the incorporation of noise barriers to reduce noise impacts (see 'Guidelines for the Treatment of Noise and Vibration in National Road Schemes (1st Rev, NRA, 2004).	Noted and referred to in this Chapter where relevant
		Notwithstanding, any of the above, the developer should be aware that this list is non-exhaustive, thus site and development specific issues should be addressed in accordance with best practice.	

Consultee	Type & Date	Summary of Response	Response to Consultee
			Addressed in Chapter 13. Addressed in Chapter 11.
Cork County Council	Pre-Planning Consultation meeting Notes 23/11/2022	No specific comments in relation to traffic and transportation.	No response required in this Chapter.
Kerry County Council	Notes from Pre Planning Call with Kerry County Council dated 03.11.2022	1. KCC noted that the Senior Engineer for TII is Paul Curry but they would advise on who the TII point of contact would be to consult with. 2. KCC noted that the location of the site entrance from a sightline's' perspective should be appropriate. 3. KCC queried how many landowners were involved with the proposed works on the turbine delivery route and if they had been signed up. 4. KCC queried if the proposed development would need to utilise the turning area at the island junction similar to what was being proposed for Gortyrahilly Wind Farm.	Noted Proposed in this Chapter..

15.2.4 Study Area

The study area for Traffic and Transport assessment is defined as the wind farm Site, the Haul Route for Turbine Components, the Civil Construction Haul Route for the importation of rock, concrete and other construction materials to the Site primarily from local quarries ,the Grid Connection Route and the Tree felling Haul Routes to the Sawmills..

The Turbine Components Abnormal Haul Route is shown on **Figure 15.1** and **Figure 15.2**, the Civil Construction Haul Route is shown on **Figure 15.3**, the Grid Connection Route is shown on **Figure 15.4** and locations for disposal of spoil from construction of the grid connection are shown on **Figure 15.5**.

It is proposed that the turbine and electrical components will be delivered via Ringaskiddy Port, Co. Cork. The following route is proposed and is discussed in further detail in **Appendix 15.1**:

- Exit Ringaskiddy Port onto N28.
- At the roundabout, continue on N28.
- At the roundabout, continue on N28.
- At the roundabout, take the 2nd exit onto N28.
- Continue on N28, then take the slip road onto N40.

- Continue on N40 to N22, use new Macroom By-Pass which ends north-west of Ballyvourney (to be known as Ballyvourney junction).
- Rejoin the existing N22, Continue on N22, then turn left at site access point at Derryreag. At the site access, Continue on c.2.5 km of forest track to the wind farm site.
- Upon exit from the site (c.2.5 km forest track),turn left onto N22, then turn right at the island junction at the South side of Cummeenavrick (Co. Kerry) and complete a 180 degree turning manoeuvre and continue on the N22.

While sub-base and base course materials for the internal wind farm site Access Tracks and Turbine Hardstand construction will be sourced from on-site excavations and an on-site borrow pit, crushed stone will be imported for the final running layer. Specific grades of rock fill will be required as fill under Turbine Foundations. The crushed stone as well as rock fill and concrete for Turbine Foundations, concrete blocks for the construction of the substation building and precast chambers for site cabling will be sourced from one of the local quarries in the area such as the following which are show on Figure 15.3:

- McGroup Keim Quarry;
- Coppeen Concrete, Enniskeane;
- Mid-Cork Quarries, Gortnadiha;
- McSweeney Bros, Kilmichael;
- Keohane Readymix, Ballygurteen,and
- Murray Bros Tarmacadam Ltd, Ardcahan.

These quarries will also be the source of crushed stone and concrete for grid connection works.

The N22 Macroom By-Pass is a dual carriageway Type 2 road with four junctions:

- Baile Bhuirne (Ballyvourney) grade-separated junction: the tie in with the existing N22 at the western end of the road development west of Baile Bhuirne.
- Tonn Láin (Toolane) grade-separated junction and off-line roundabout: This provides access to and from the existing N22, to the east of Baile Mhic Íre.
- Gurteenroe grade-separated junction and off-line roundabout: The location where the proposed route crosses the regional road, R582.
- Coolcour roundabout: This is the tie-in with the existing N22 at the eastern end of the road development in the townland of Coolcour.

Two of these junctions are at each end of the by-pass with only two in between.

The materials delivery routes proposed are such as to maximise use of the new N22 Macroom By-Pass and to avoid centres of population such as Macroom, Ballyvourney and Ballymakeery.

For the quarries to the south, trucks will use the R599, R586, R587, then the R584, then the existing N22 south-eastwards to join the new N22 Macroom By-Pass, will follow the new N22 Macroom By-Pass to the Ballyvourney Junction, then exit onto existing N22 and travel westwards to Derryreag and then enter the wind farm Site (see **Figure 15.3**).

From Keim, trucks will follow the R582 in a south-easterly direction and join the New Macroom By-Pass (N22) at Gurteenroe Junction. They will then follow the new N22 By-Pass to Ballyvourney Junction and then the existing N22 to Derryreag to access the forest track in the wind farm site (see **Figure 15.3**).

Wood from forestry felling required to accommodate part of the Project will be removed from the site once the civil works are complete. Three suitable locations have been identified in Enniskeane and Lissarda (Enniskeane Timber Products LTD., Graingers Sawmills Ltd. and GP Wood Donniskey). The proposed tree feeling route for transporting wood is shown on **Figure 15.6.** This route is effectively the reverse of the civil construction haul route and trucks will leave the wind farm site via the forest track and turn left on the N22, drive Northwards on the existing N22 to the turning area in Cummeenavrick and then travel to the Ballyvourney junction of the new N22 Macroom By-Pass, follow the By-Pass to the ? N22 junction and then either head south-westwards to the R584, or to the Coolcour junction with the existing N22 and then proceed south-eastwards to the L-7489 shown on **Figure 15.6**.

The proposed grid route is largely independent of the haul routes (see **Figure 15.4**). Leaving the wind farm site, the grid route will follow the forest tracks for c.1.5 km as far as the N22 which will be crossed by directional drilling (70 m). It will then follow the old route of the N22 (also by directional drilling) for a short distance (c.0.58 km) before following forestry tracks to the existing Ballyvouskill Substation. Of the total length of 19.9 km, only 0.07 km will be within public roads with a further 0.58 km under former roads.

For the grid connection, general material excavated from trenches will be graded on top of or adjacent to the existing tracks. As the N22 will be crossed by directional drilling, very little waste (c.30 m^3) will arise from drilling. This soil waste will be transported to one or more of the following licensed facilities (see **Figure 15.5**):

- Tomas Mullins, Scrahanagown, Coolea, Co. Cork;
- Richard & Dennis Carroll Plant Ltd., Clonfadda, Macroom, Co. Cork;
- Ciaran Ryan Plant Hire Ltd., Ballymacorcoran, Clondrohid, Co. Cork, and
- Séan Ó Luasa, Na Foithrí (Fuhirees), Cúil Aodha, Maighchromth, Co. Chorcaí.

Soil and stone spoil from road widening at the site access from the N22 at Derryreagh will be disposed of to the same facilities.

Grid construction traffic for the section of grid south-west of the N22 will be from the N22 at the site access at Derryreag Townland For the section of the grid connection north-east of the N22, access will be gained from the N22 at Cummeenavrick Townland. (see Figure 15.6).

15.2.5 Desk Study

Primary Route Assessments for the turbine component haul route were undertaken by Collett & Sons Ltd., Halifax, U.K. who are specialists in the transportation of wind turbine components. This is included in **Appendix 15.1**.

Desk Studies of the Study Area were largely completed in advance of undertaking the route survey. This involved using Google Maps and Streetview to assess the proposed haul route road network from Ringaskiddy Port and from Foynes Port. The civil construction haul route was assessed in a similar manner as was potential traffic associated with the grid route.

Cork County Council and Kerry County Council were consulted as part of the Scoping process. Cork County Council did not have any specific comments in relation to traffic and transport while Kerry County Council had the comments listed in **Table 15.2**.

Traffic count data from TII was used to assess the current Baseline Scenario on the N22 in the area.

15.2.6 Field Work

A Preliminary Route Assessment was carried out in October 2022 for the turbine component haul route between Ringaskiddy Port and the Site , this included the use of the Macroom By-Pass and to reflect the use of a 76.82 m blade component.

The second route survey (Report of November 2022) examined the route between Foynes Port and the Site and was based on the use of a 77.5 m blade.This is further discussed in **Chapter 3: Alternatives Considered.**

In each case, the route was assessed by a two-person team and the various junctions and constraints were photographed. A copy of each report is included in **Appendix 15.1.**

For the range of wind turbines under consideration, the rotor diameters will vary from 149 m to 155 m. For a typical central hub diameter of 3 m, the blade lengths will range from 73 m to 76.82 m. In terms of turbine transportation, the effects of transporting a 76.82 m blade (maximum blade length under consideration) will be similar to those of 73 m. No additional works are required to facilitate their transportation nor any further impacts predicted.

The distance between Ringaskiddy Port and the Site is c.91.6 km while the distance between Foynes Port and the Site is c.216 km. The route from Ringaskiddy using the Macroom By-pass to Site will be generally wider than the route from Foynes. At the proposed site entrance to the wind farm, vehicles from Foynes would have to turn right onto the forest track while being parked in an overtaking lane. This is considered as a dangerous manoeuvre. Accordingly, due to the much shorter length, better quality road and safer entry to the site, the route from Ringaskiddy was selected.

A Topographical Survey of the area for potential works at the proposed site entrance off the N22 at Derryreag was undertaken during October 2022 by GHE Surveying.

This fieldwork enabled the junction design drawing to be prepared by JOD (see Planning Drawing No. 6225-JOD-XX-DR-C-200/LT1).

15.2.7 Evaluation of Potential Effects

The baseline environment is described in **Section 15.3**. The available data will then be utilised to identify and categorise potential effects likely to affect the national and local road network used for the Turbine Component Haul Route, the Civil Construction/Sawmill Haul Routes and the Grid Connection as a result of the Development.

The statutory criteria (EPA, 2002; EPA, 2003) for the assessment of 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 transboundary nature (if applicable). The descriptors used in this Environmental Impact Assessment Report (EIAR) are those set out in EPA (2002) 'Glossary of Impacts'.

Effects may be categorised as follows:

- Direct: where the existing traffic and transport environment in proximity to the Development is altered, in whole or in part.
- Indirect: where the traffic and transport environment beyond the Project is altered by activities related to the construction or operation of the Project.
- No Effect: where the Development has neither negative nor positive effect upon the traffic and transport environment.

15.2.8 Sensitivity

The sensitivity of the local transport infrastructure has been identified utilising the criteria outlined within the Traffic and Transport Assessment Guidelines (PE-PDV-02045, May 2014) (TII Guidance).). These criteria are outlined within **Table 15.3** below.

Table 15.3: Receptor Sensitivity

Importance	Description
High	Receptors of greatest sensitivity to changes in traffic flow including: People whose livelihood depends upon unrestricted movement within their environment including commercial drivers and companies who employ them, local residents, schools and colleges.
Medium	Traffic flow sensitive receptors including: People who habitually pass through the area, but whose livelihoods are not dependent on free access. Would also generally include: congested junctions, community services, parks, businesses with roadside frontage and recreation facilities.
Low	Receptors with some sensitivity to changes in traffic flow: People who occasionally use the road network. Would also include: public open spaces, nature conservation areas, listed buildings, tourist attractions, residential roads with adequate footway provision and churches.
Negligible	Receptors with very low sensitivity to traffic flows: People not sensitive to transport effects. Would also refer to receptors that are sufficiently distant from the affected roads and junctions.

Table 15.4 below provides the general approach to determining the importance and sensitivity of a resource or receptor based on The Institute for Environmental Management and Assessment (IEMA) Guidelines[1]. The assessment of environmental impacts arising from road traffic is not an exact science and a degree of professional judgement is required. The definitions set out in **Table 15.4** below are generally applied. This will partially define the magnitude and significance criteria set out in the sections below, while applying thresholds quoted in the IEMA Guidance. Sensitive receptors are generally areas with key facilities associated with high footfall.

[1]The Institute of Environmental Management and Assessment (1993), Guidelines for the Environmental Assessment of Road Traffic

Table 15.4: Determining the Importance / Sensitivity of Receptor

Importance/Sensitivity of Receptor	Resource	Receptor
High	Traffic flows on highway network near schools, colleges, hospitals playgrounds, accident blackspots, retirement homes and roads without footways that are used by pedestrians.	Residents/workers travelling to and from work on foot and by vehicle, school children, leisure walkers.
Medium	Traffic flows at congested junctions and on highway network near shopping areas with roadside frontage, roads with narrow footways, unsegregated cycleways, community centres, parks, recreation facilities.	Residents/workers travelling to and from work on foot and by vehicle, school children, leisure walkers, people visiting shops etc.
Low	Traffic flows adjacent to places of worship, public open space, nature conservation areas, listed buildings, tourist attractions and residential areas with adequate footway provision.	Residents/workers travelling to these places.
Very Low	Receptors with low sensitivity to traffic flows and those sufficiently distant from affected roads and junctions.	Residents/workers travelling by foot or by vehicle.

15.2.9 Magnitude

The magnitude of potential impacts has been defined in accordance with the criteria provided in the 2022 EPA publication 'Guidelines on the information to be contained in Environmental Impact Statements' as outlined within **Table 15.5**.

The Institute for Environmental Management and Assessment (IEMA) Guidelines contains two broad principles to determine the scale and extent of an assessment, which are:

- Principle 1 – include road links where traffic flows are predicted to increase by more than 30% (or where the number of heavy goods vehicles is predicted to increase by more than 30%).
- Principle 2 – include any other specifically sensitive areas where traffic flows are predicted to increase by 10% or more.

If the predicted increase is lower than these thresholds, then the effects can be considered to be low or not significant. If the increases are above the thresholds, then the increase can potentially be significant and assessment is required.

The Traffic and Transport Assessment Guidelines (PE-PDV-02045, TII, May 2014) were developed to assess the potential effects of major developments on the national road network during their operation. These guidelines are applicable to the national roads relevant to the Project and have been used to assess the construction, operation and decommissioning phases non the N22, N28 and N40.

The IEMA Guidelines acknowledge that there are no commonly agreed thresholds for judging the magnitude of change for the effects assessed, with the exception of severance, for which IEMA suggests thresholds of 30%, 60% and 90% for slight, moderate and substantial impacts respectively.

For the most robust approach, the built-up area thresholds in line with the IEMA guidance have been used to guide assessments of magnitude of change. However, a level of professional judgement has been applied to arrive at a set of common thresholds for ascertaining the magnitude of impact. In respect of the environmental effects of traffic, magnitude, based on increase in total vehicular traffic and/or HGV traffic has been determined on the following basis:

- High – considerable deterioration / improvement in local circumstances (total traffic flows of +/-90%).
- Medium – readily apparent change in conditions (total traffic flows of +/- 60 – 90%).
- Low – perceptible change in conditions of circumstances (total traffic flows of +/- 30 – 60%).
- Very Low — no discernible change in conditions (total traffic flows of less than +/- 30%).

Table 15.5: Magnitude of Change

Magnitude of Effect	Description
Significant	The Development could result in a change of length or duration to the current traffic routes or schedules which could result in hardship.
Moderate	The Development could result in delays or the need to reschedule which may cause inconvenience.
Slight	The Development could occasionally cause minor modifications to routes, or slight delays in current schedules, or on activities in the short-term.
Imperceptible	The Development does not cause an effect on movement of road traffic above normal levels.

15.2.10 Significance of Effects

A combination of the magnitude of the impact under consideration and the sensitivity or value of the receiving environment / receptor, as set out in **Table 15.4** can be used in considering the overall significance of an effect. The general approach adopted for classifying effects is outlined in **Table 15.6**. A Major Moderate effect is seen as '**significant**'. A Minor or Negligible effect is seen as '**not significant**'.

Table 15.6: Significance of Effects

Sensitivity/Value of Receptor	Magnitude of Impact			
	High	Medium	Low	Very Low
High	Major	Major	Moderate	Minor
Medium	Major	Moderate	Minor	Negligible
Low	Moderate	Minor	Negligible	Negligible
Very Low	Minor	Negligible	Negligible	Negligible

15.3 BASELINE DESCRIPTION

15.3.1 Site Location, Context and the Development

Separate haul routes are proposed for turbine abnormal components and civil construction materials, tree felling haul route to sawmills and for the various elements of the grid connection. Each are described below.

The proposed Turbine Components Haul Route is shown in **Figures 15.1** and **15.2** and the proposed Civil Construction Haul Route (crushed stone, concrete, concrete blocks and precast units) will come from the quarries as shown on **Figure 15.3**. Incidental building materials will be sourced from either Macroom or Killarney. The grid connection route is shown on **Figure 15.4** as well as traffic access points. Disposal routes for soil and stone arising from the directional drilling of 0.65 km of the grid connection and spoil from widening at the site access at Derryreag are shown in **Figure 15.5**. Disposal routes for forestry logs felled at the wind farm Site are shown on **Figure 15.6**.

It is proposed that the turbine nacelles, tower hubs and rotor blades will be landed at Ringaskiddy Port, County Cork. From there they will be transported to the N22 some 5 km north-west of Ballyvourney and then turn left (south-westwards) onto an existing forest track to gain access to the site.

Whilst a final choice of turbine type for the Development has yet to be made, the vehicle used for the Swept Path Analysis is the largest associated with the turbine range proposed (see **Chapter 2: Project Description**, **Section 2.5.2** for further details). The Swept Path Analysis has been completed for a turbine with 155 m rotor diameter, which has a blade length of 76.82 m. This is the longest blade length of all the turbines currently under consideration[2] and would have the greatest potential impact on road passage requirements. As the shortest blade under consideration would be 73.0 m, the swept paths would be only marginally different and the effects will be similar to the 76.82 m blade. No additional works are required to facilitate their transportation nor are any further impacts predicted.

[2] The GE5.3-158 has a larger blade overall but has a two-part construction and so will not be as long for transportation purposes.

While a detailed assessment of the route is presented in this chapter and associated appendices, it should be noted that road signage and street furniture can change between planning and construction stages. So as to confirm the suitability of any changes to the roadway or to street furniture along the route between EIAR and pre-construction, a further survey of the route will be undertaken using a transport vehicle prior to the delivery of turbine components to Site.

For the civils works during construction, crushed stone materials for the running surfaces of the Site Access Tracks and Turbine Hardstands will be sourced from one of the local authorised quarries in the area. Ready-mix concrete for Turbine Foundation construction and substation foundations will also be sourced from one of the local authorised quarries. The local quarries are located either to the north-east at Keim or to the south-east at Kilmichael, Coppeen, Gortnadiya, Ardcahan or Ballygurteen as described in **Section 15.2.4** above. HGV's from any of these quarries will use the same routes between the N22 and the Development Site. The proposed Civil Construction Haul Route is outlined in **Figure 15.3**. Other incidential material deliveries will use standard HGVs and use the local, national and regional road network.

Wood from the Tree Felling activity will be hauled to sawmills shown in **Figure 15.6.** After turning left onto the N22, then turning right at the northern end of the existing island junction at Cumeenavrick and complete a 180 degree turning manoeuvre and continue on the N22 , at the end of the Macroom Bypass, Trucks will use either the R584, R587, R585, then the R586, or alternatively the L7489 to the proposed sawmills. There are 3 proposed sawmills for the felled wood obtained on Site.

For the section of grid connection north of the N22, traffic for the delivery of crushed stone, ducting, cables and precast components will access the grid route from the N22 eastwards along forest tracks to Ballyvouskill. Access to the grid route between the N22 and the wind farm Site will be via the forest tracks/site access at Derryreag. **Figure 15.5** shows the grid connection access routes and spoil disposal locations and routes for the relatively small volume of material arising from directional drilling.

Workers employed on the Site will generally use the N22 and the construction traffic routes to reach the Site.

15.3.2 Sensitive Receptors

The Site is generally served by the N22 which runs between Cork City and Tralee. The N22 is approximately 0.9 kilometres (km) to the north-east of the Site and has a speed limit of 100 km / hour (hr). The N22 by-pass opened on the 9th December 2023, and will avoid traffic through Macroom, Ballymakeery and Ballyvourney.

Receptors considered as having 'high' sensitivity are primarily premises which are directly on the N28, N40 and N22 which have significant potential to generate traffic.

Between Ringaskiddy Port and the Wind Farm Site, the sensitive receptors are assessed in **Table 15.7**.

There are no sensitive receptors along the grid connection route. Therefore, a table is not required.

Table 15.7: Sensitivity of Receptors – Turbine Component Haul Route

Receptor	Sensitivity	Reasons/Comments
Various Businesses and Factories on N28 including Pfizer Ireland Pharmaceuticals	Very Low	Located north of N28 but with multiple junctions onto N28.
Shanbally Shop & Deli	Medium	Shop has direct access onto Shanbally Roundabout/N28 with pedestrians crossing.
Shanbally National School	High	Located on Maroon Terrace south of roundabout/N28.
Residences at Shanbally	Low	Roadside residences as well as multiple junctions onto N28 giving access to residential developments.
Church of the Immaculate Heart of Mary, Shanbally, Co. Cork	Medium	The church is located along the N28 and fronts onto the Haul Route. Some mass attendees are highly likely to use the N28 to get to the church and increased traffic on the road may affect access and egress from the church car park.
Shamrock GAA Club	Medium	Located to south of N28, junction onto N28.
Various Businesses/ Factories incl. Enva and Zenith	Very Low	Located north of N28 but with multiple junctions onto N28.
Raffeen Bridge, Accommodation, Monkstown, Co. Cork	Very Low	Located to south of N28, access via Raffeen Road onto N28.
Various Private Dwelling in Raffeen area	Very Low	Located to north and south of N28. Access onto N28 via R610, L2470 and Raffeen Road.
Storage Yard, Raffeen	Low / Very Low	Located to south of N28 with direct access.
Various Businesses and Private Residences in Hilltown Area	Very Low	Access to N28 via L6469, L6477 and other Local Roads.
Maxol Service Station	Medium	Adjacent to N28.

Receptor	Sensitivity	Reasons/Comments
Agricultural Landholdings, Farmsteads and Private Dwelling	Low	Occasional direct access onto N28.
Douglas, Rochestown, Deanrock, Bishopstown, Maryborough, Togher, Urban Areas of Cork City – Residences, Businesses	Very Low	Major junctions only onto N28 and N40/South Ring Road. Mast Receptors sufficiently distant from affected roads and junctions.
Marymount University Hospital & Hospice	High	The Hospital is located off the Curraheen Road Junction of the N40. Slow movement of traffic components could delay access to the slip road.
Cork City Football Club; Curaheen Park Greyhound Stadium. Cork Show Grounds, Agricultural landholdings, Farmsteads and Private Dwellings.	Medium / Low	Major junctions only onto N40 & N22 from (Curraheen Road) and Maglin Road.
Urban Area of Ballincollig, Coolroe, Classis Lake,	Very Low	Major junctions only onto N22. Most Receptors sufficiently distant from affected roads and junctions.
Roadstone Quarry, Classis, Co. Cork.	Very Low	Major junctions only onto N22 via R608.
The Ovens Bar, Ovens, Co. Cork	High	Roadside Access onto N22.
Agricultural Landholdings, Farmsteads, Businesses and Private Dwellings between Ovens and Farranavarra.	Very Low	Occasional direct access onto N22.
Roadstone Quarry, Garryhesta	Very Low	Not in commercial use. Direct access onto N22.
White Lodge Bed & Breakfast, and Farran House self-catering accommodation, Farranavarra, Co. Cork; Farranavarra Village.	Medium/Low	Some properties and businesses have direct access onto N22.
Agricultural Landholdings, Farmsteads, Businesses and Private Dwellings between Farranavarra and Crookstown, Co. Cork	Medium/Low	Occasional direct access onto N22.
Crookstown Village	Very Low	To the North of N21 and largely contained within two junctions with N22. Properties to south join N22 via Ryecroft Manor Road.
Roadstone Quarry, Castlemore	Medium / Low	Located to south of N22. Access to N22 is via R585.
Agricultural Landholdings, Farmsteads, Businesses, and Private Dwellings between Crookstown and Lissarda, Co. Cork	Medium / Low	Occasional direct access onto N22.
Lissarda Village & Kilmurray Cross incl. O'Leary's Garage, Circle K	High	Direct access onto N22. Route is through centre of village.

Receptor	Sensitivity	Reasons/Comments
Filling Station, Ma Fitz's Bar & Restaurant, Garden Centre, Chinese Restaurant, Other Business Units, Roadside Residences		
Agricultural Landholdings, Farmsteads, Businesses and Private Residences between Kilmurray Cross and Coolcour	Medium / Low	Occasional Direct Access onto N22.
Fountain House Bed & Breakfast, Mashanageass, Co. Cork	Medium	Close to N22.
The Lee Valley Park	Medium	Amenity Area on R584 west of N22.
Urban area of Macroom between Gurteenroe Coolcour Junction and Junction on Re-aligned N22	Very Low	New By-Pass Road with entry/exit from major junctions only.
Rural Area between Gurteenroe Junction and Toolane Junction on re-aligned N22	Very Low	New By-Pass Road with entry/exit from major junctions.
Villages of Ballymakeery and Ballyvourney between Toolane Junction and Bhaile Bhuirne Junction on re-aligned N22	Very Low	N22 is being realigned so as to avoid villages. However, they will have access junctions onto N22.
Hillview House Bed & Breakfast 1, Coolcower Macroom, Co. Cork	Low/Medium	Close to junction of old and new realignment of N22.
Rural Area between N22 By-Pass (Ballyvourney) junction and Commeenavarick	Very Low	Occasional entry via N22.

For the civil works construction haul route, the sensitive receptors are assessed in **Table 15.8**.

Table 15.8: Sensitivity of Receptors – Civil Construction Haul Route

Receptor	Sensitivity	Reasons/Comments
Agricultural Landholdings, Farmsteads, Businesses and Private Residences on R584, R587, R585, R586 and R599	Medium/Low	Occasional direct access onto Regional Roads.
Agricultural Landholdings, Farmsteads, Businesses and Private Residences on R582	Medium/Low	Occasional direct access onto R582.

Receptor	Sensitivity	Reasons/Comments
N22 Macroom By-Pass between Coolcour Junction and Ballyvourney Junction	Very Low	New By-Pass road with no direct access by sensitive users.
Existing N22 between Ballyvourney Junction and forest entrance/access to windfarm. Agricultural Landholdings, Farmsteads, Business and Private Residents	Medium/Low	Direct access onto N22.
Agricultural Landholdings, Farmsteads, Businesses and Private Residences on existing N22 between Ballyvourney Junction and Cummeenavrick for grid connection.	Medium/Low	Direct access onto N22.

15.3.3 Road Access to the Site

15.3.3.1 Turbine Haul Route

For the turbine haul route, much of journey from Ringaskiddy Port to the Wind Farm Site will be on National Primary Roads shown on **Figure 15.1** and **Figure 15.2**. These include the N28, N40 and N22. These roads vary in terms of width, number of lanes and types of junctions.

Leaving Ringaskiddy Port, the N28 initially has two lanes westwards from the R613 junction. This narrows to one lane prior to the Pfizer Roundabout and continues towards Shanbally in a similar manner with traffic islands at either side of junctions. The speed limit is 50 km/h. Shanbally is the transition from an industrial area to a largely residential area.

After Shanbally, the road has a central reservation (painted) to allow for right turning at junctions while the speed limit is 60 km/h (see **Appendix 15.1**).

From Raffeen, the road widens such that there is a hard shoulder in each direction and the speed limit increases to 100 km/hr.

A central reservation with splitter islands (splitter islands accommodate street furniture which will need to be relocated temporarily to allow passage of turbine blades) is present at the approach to the R611 Roundabout. A contraflow manoeuvre is required at this location, street furniture to be removed and a tree to be pruned at the approach to the R611 Roundabout (see **Appendix 15.2**).

It is also present following the roundabout on the N28/R617 junction. Westwards from that junction, there is a climbing lane prior to the road narrowing to two single lanes without hard shoulders for a short distance before widening again with one lane and hard shoulder westwards and two lanes and hard shoulder eastwards. Approaching N40 junction, the N28 widens to three lanes in each direction.

The N40 (South Ring Road) has two lanes and hard shoulder in each direction, it widens further towards the junction with the N27. All junctions are merge type junctions. At Ballincollig, the N40 becomes the N22. The N22 continues generally as one lane plus hard shoulder in each direction to Lissarda where it narrows to one lane in each direction with no hard shoulders for a short distance. It also narrows approaching the first River Lee crossing and continues as a single lane in each direction (no hard shoulder) to Coolcour.

At Coolcour, a new section of the N22 has opened to general traffic on the 9th December 2022 (N22 Baile Bhuirne to Macroom Road Development). . This route will be used for the proposed Inchamore Wind Farm which is likely to start construction in 2025 (should permission be granted).

Turbine delivery vehicles will re-join the existing N22 at Baile Bhuirne Junction which is c.2 km north-west of the village of Ballyvourney. They will then proceed westwards towards the existing forest entrance at Derryreag near the Kerry county boundary. The existing N22 between the proposed Ballyvourney Junction (N22 By Pass) and Derryreag has a hard shoulder in each direction. An overtaking lane in the eastwards direction ends close to the forest entrance. The overall existing surfaced road width at the forest entrance location (proposed access to wind farm) is 15.5 m as follows:

- Westbound hard shoulder 3.0 m
- Westbound lane 4.0 m
- Eastbound overtaking lane 4.0 m
- Eastbound lane 3.5 m
- Eastbound hard shoulder 1.0 m

See Photos 15.1 and 15.2 of the N22 and forest entrance. Delivery vehicles will then follow the forest track to the wind farm, a distance of c.2.5 km, see Photos 15.3, 15.4 and 15.5.

Photo 15.1 – N22 at Derryreag

Photo No. 15.2 – Forest Entrance

Photo 15.3 – Existing Forest Road at Chainage 1000 m

Photo No. 15.4 – Existing Forest Road at Chainage 1800 m

Photo 15.5 – Existing Forest Road near Chainage 2250 m

Photo Locations are shown on **Figure 15.7**.

Vehicles will exit the site and turn left onto the N22, then turn right at the northern end of the existing island junction at Cumeenavrick and complete a 180 degree turning manoeuvre and continue on the N22.

15.3.3.2 Civil Construction Haul Route

From Keim, trucks will follow the R582 in a south-easterly direction to the N22 Macroom Bypass (Gurteenroe Junction), follow the bypass westwards to the Ballyvourney Junction with existing N22, follow the existing N22 westwards to the forestry entrance at Derryreag and then turn left and follow the forest track to the wind farm site or to the grid connection on the southern side of the N22.

For the grid to the northern side of the N22, trucks will follow the same route but go past the forestry entrance to Cummeenavrick, turn right and then follow the forest route of the N22 for c.400 m before following forestry tracks along the route.

For the quarries to the south, trucks would use the R587, then the R584 to the existing N22, proceed south-westwards to the Coolcour Junction of the Macroom By-pass, proceed north-westwards along the bypass to the Ballyvourney Junction with existing N22, follow existing N22 westwards to the forestry entrance at Derryreag and then turn left and follow the forest track to the wind farm site or to the grid connection on the southern side of the N22. For the grid to the northern side of the N22, trucks will follow the same route but go past the forestry entrance to Cummeenavrick, turn right and then follow the forest route of the N22 for c.400 m before following forestry tracks along the route.

The grid connection will be laid within existing/proposed trails for a distance of 1.3 km within the wind farm site. From there, it will follow forest tracks as far as the N22 which will be crossed by directional drilling. It will then follow the old route of the N22 for a short distance (also by directional drilling) (c.0.58 km) before following forestry tracks to the existing Ballyvouskill Substation. Of the total length of 19.9 km, some 19.2 km will be laid within lands and forest tracks.

15.3.4 Delivery Vehicle Specification

Delivery of wind turbine components will be carried out using oversized vehicles. Two different types of loads will arise via very long loads for turbine blades and wide/high loads for tower bottom sections. The longest vehicle used during deliveries will be for the rotor blades and will be an approximately 7 m long articulated vehicle with a trailer length of 55.5 m trailer and a 17 m overhang for the blade. An indicative delivery vehicle schematic is shown in **Figure 15.8** below. The Swept Path Analysis (see **Appendix 15.2**) assesses the extent of obstacles to be removed (e.g. tree pruning) or relocated (street furniture or poles) or the extent of any potential oversail into private lands associated with blade transportation. It was based on the use of a 76.8 m blade which is the longest blade for the range of turbines under consideration. The outcome would be similar for a 73 m blade which is the shortest blade for the range of turbines under consideration. No additional works are required to facilitate their transportation and no further impacts are predicted.

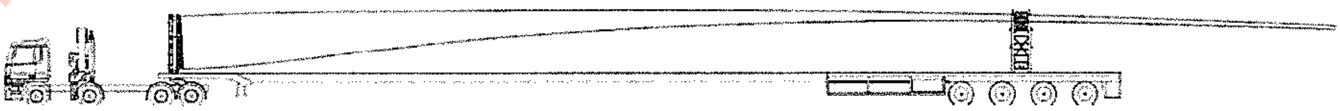


Figure 15.8: Turbine Delivery Vehicle for Turbine Rotor Blades (SG155)

The widest and tallest turbine delivery vehicle from the ground will be for the turbine tower sections. The bottom tower section will be 4.69 m wide which is 0.14 m wider than the blade delivery vehicle. These dimensions will be similar for the range of turbines under consideration. They are 4.435 m tall which is 1.035 m taller than the blade delivery vehicle and 0.335 m taller than the hub delivery vehicle. This vehicle is shown in **Figure 15.9**.

For the tower sections associated with the range of turbines under consideration, no additional works outside of those required for the blades are required to facilitate their transportation and no further impacts are predicted.

A survey of the Haul Route has been undertaken by Collett & Sons (see **Appendix 15.1**) to identify the extent of works required. The blade delivery vehicle has a total height of 3.936 m. The proposed delivery vehicle length, width and height parameters used to complete the SPA are based on the worst-case scenario using the SG 155 Blade component super wing carrier.

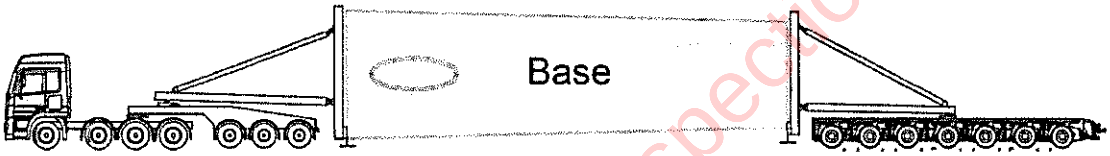


Figure 15.9: Turbine Tower Section Delivery Vehicle (SG155)

Delivery of other materials to Site for the construction of the wind farm will be undertaken using standard HGVs, the largest of which is expected to be a 16.5 m standard 6 axle articulated vehicle.

15.3.5 Existing Traffic Volumes

15.3.5.1 TII DATA

There is one TII traffic counter located(TII count traffic continuously)[3] on the N22 at Slieveragh Cross, north-west of Ballyvourney (Station Id: TMU N22 060.0E) and c.5.5 km east of the forest access at Derryreag, see **Figure 15.10**. This is c.0.48 km from the Ballyvourney Junction of the new N22 Macroom By-Pass. The Average Annual Daily Traffic (AADT) volume on the road was recorded as being 7,258 vehicles in 2019 (2020 and 2021 values are less due to Covid Restrictions) as outlined in **Table 15.09**. From this figure, the number of HGVs was 385 with light vehicles making up the remaining 6,873 of the total of 7,258. The 2022 figure reflects traffic counted between 1st January and 28th November 2022 and, when extrapolated forward, is likely to be similar to the 2019 value.

[3] https://trafficdata.tii.ie/public multinodemap.asp

Table 15.9: TII Traffic Data

Station Id. TMU N22 060.0E Description: N22 Between Killarney and Macroom, Ballyvourney, Co. Cork			
	AADT	% HGV	Coverage
2022*	7,032	5.4%	90.1%
2021	5,784	6.4%	100.0%
2020	4,941	6.9%	99.7%
2019	7,258	5.3%	96.8%
2018	7,159	5.4%	99.7%
2017	6,933	5.1%	99.7%

*Up to 28th November 2022

The TII traffic counter is located on all haul routes to the site and as there are no junctions of significance between the counter and the site entrance at Derryreag and the grid entrance at Cummeenavrick, it is considered as being representative of traffic volumes in the vicinity of the proposed development.

15.3.6 Predicted Future Traffic Volumes

TII publication "Project Appraisal Guidelines for National Roads Unit 5.3 – Travel Demand projections, PE-PAG-02017, May 2019 can be used to predict future growth in traffic volumes across Ireland. Traffic volumes are predicted to increase in the coming years (predictions are for the period 2016 to 2030) when construction of the Development is likely to take place. **Table 15.10** shows the multiplier for County Cork under different growth rate scenarios.

Table 15.10: Traffic Annual Growth Predictions Formulae (Multipliers) for County Cork 2016 to 2030

Low Sensitivity Growth Rate		Central Growth Rate		High Sensitivity Growth Rate	
LV	HV	LV	HV	LV	HV
1.0173	1.0361	1.0189	1.0377	1.0223	1.0411

LV = Light Vehicles, HV = Heavy Vehicles

Assuming that construction will take place in 2026, under the high sensitivity scenario, the amount of light vehicles on the N22 will increase to 8,020 in 2026 from the 2019 AADT of 6,873 and heavy vehicles will increase to 510 in 2026 from 385 in 2019.

The estimated capacity of the N22 national primary road in the vicinity of Ballyvourney is based on Table 6.1 of the TII publication DN-GEO-03031 – Rural link design which provides a table of recommended rural road layouts and capacities for each cross section.

The N22 at Derryreag and Cummeenavrick is similar in section to a 7.3 m Type 1 single carriageway. A Type 1 carriageway has a guidance capacity of 11,600 AADT for level of service D (approaching unstable flow). The new N22 Macroom By-Pass will be a Type 2 Dual Carriageway. Such a road has a guidance capacity of 20,000 for Level of Service D.

When the growth predictions are applied to the recorded traffic figures, the N22 is predicted to be running at approximately 73.5% capacity at the Derryreag and Cummeenavrick locations (existing N22 west of the by-pass) in 2027 and therefore has capacity to accommodate additional traffic in the future. The N22 Macroom By-Pass is predicted to be running at approximately 11,100 to 11,200 AADT in 2027[4] or at 56% capacity.

15.3.7 Accident Statistics

The Road Safety Authority publish tables on "Road Casualties and Collisions in Ireland" each year. The last published table for National Routes is for 2017.

Statistics are divided into those occurring "Inside Built-up Areas" and those occurring "Outside Built-up Areas". **Table 15.11** below presents a summary of accidents for the N22 for the years 2013 to 2017.

Table 15.11: Summary of Accidents for the N22 for the years 2013 to 2017

Year	Inside Build Up Areas			Total	Outside Built Up Areas			Total	Overall Total	Collision Rate per km
	F	SI	MI		F	SI	MI			
2017	1	1	14	16	1	7	21	29	45	0.39
2016	0	4	19	23	2	5	21	28	51	0.44
2015	0	2	23	25	1	7	22	30	55	0.47
2014	0	0	12	12	4	8	21	33	45	0.38
2013	0	1	8	9	4	3	13	20	29	0.25

F = Fatal
SI = Significant Injuries
MI – Minor Injuries

For the N22, historical accidents were more prevalent outside built-up areas than inside them.

4 N22 Baile Bhuirne – Macroom (Baile Bhuirne to Coolcour) Environmental Impact Statement, Volume 3 – Figures, McCarthy Hyder Consultants, October 2009

15.4 PROPOSED WORKS

15.4.1 Construction Phase

The construction period of the Project is anticipated to take approximately 21 months. The majority of HGV deliveries to Site will take place during turbine foundation (reinforcing steel and ready-mix concrete), turbine hardstands and Site access track upgrade works. During this period, there will be trips associated with the arrival and departure of construction staff. While much of the stone for site tracks and hardstands will be sourced from on-site borrow pits and from the excavation works, a finishing layer of imported stone will be required prior to turbine delivery.

Staff trips will mainly be made using cars and vans, while deliveries of steel, concrete, and rock and construction materials will be made by HGVs. The majority of deliveries will be during the first half of the construction period. It is important to note that it is anticipated that ready-mix concrete and hardcore materials will be sourced from local quarries in the area either to the north or south of the N22, will use the new N22 Macroom By-Pass to Ballyvourney Junction with N22, then the existing N22 to the forest access to the wind farm Site at Derryreag or will continue to Cummeenavrick for access to the grid connections such that Ballymakeery and Ballyvourney villages will be avoided and the urban area of Macroom will also largely be avoided.

It is expected that construction hours will be between 07:00 and 19:00 Monday to Friday and 07:00 – 13:00 on Saturdays with no working on Sundays or on Bank or Public Holidays unless agreed otherwise with Cork County Council (e.g. for concrete works for foundations which may start before 07:00). Some special deliveries such as turbine components and concrete for Turbine Foundations are likely to be required to be delivered outside of these times in consultation with Cork County Council (see Section 15.4.2).

15.4.2 Turbine Component Haul Route

For abnormal loads between Ringaskiddy Port and the wind farm Site, some minor works will be required to facilitate the delivery of turbine components. Some of these will be relatively minor in nature for example temporary removal (and reinstatement on completion of delivery) of street furniture and signage. The extent of works has been determined by reference to the Collett Report of October 2022 (see **Appendix 15.1** for Swept Path Analysis Drawings prepared by Collett for that part of the haul route between Ringaskiddy Port and Derryreag) and to the results of a swept path analysis prepared by JOD (see **Appendix 15.2**) for the forest entrance off the N22 at Derryreag.

The JOD Swept Path Analysis drawings were created using AutoTrack Software and was informed by the results of topographic surveys carried out by GHE Surveying during October 2022.

The use of special transporter vehicles with rear wheel steering in the delivery of wind turbine components will ensure safe transportation and manoeuvrability on the roads. Extendable transporter vehicles will be retracted on return journeys which allays the need for a SPA of the Cummeenavrick N22 junction at Co. Kerry.

Table 15.12 presents a summary of the works required on the turbine component haul route. Photographs of each location are included in the Collett Report of October 2022.

Table 15.12: Temporary Works Required on Turbine Component Haul Route

Reference Point in Collett Report	Potential Constraint	Works Description No works required Temporary works required Permanent works required
1	Exit from Ringaskiddy Port	Flower pots and fencing to be removed. Bollards to be removed. Localised area of road widening required at bollard location. See Collett Drawing 343154-10A1.1.
2	N28 Roundabout at Pfizer	Signage and Street furniture to be temporarily removed for central area of roundabout and from Splitter Island beyond roundabout. Road widening required into roundabout and at Splitter Island. See Collett Drawing 343154-20A1.1.
3	Splitter Island on N28	No works required
4	Splitter Island on N28 at Shanbally	No works required
5	N28 Roundabout at Shanbally	Signage and bollards to be temporarily removed. Road widening required at Splitter Island. See Collett Drawing 343154-30A1.1.
6	Splitter Island on N28	No works required
7	Splitter Island on N28	No works required
8	Splitter Island on N28	No works required
9	Splitter Island on N28	No works required
10	Splitter Island on N28	No works required
11	Splitter Island on N28	No works required
12	Splitter Island on N28	No works required
13	N28 / R611 Roundabout	Signage and Street Furniture to be Temporarily Removed from Entry Splitter Island. Tree to be pruned. See Collett Drawing 343154-10A0.1.
14	Splitter Island on N28	No works required
15	N28 / N40 Junction	No works required
16	Splitter Island on N22	No works required
17	Splitter Island on N22 at Srelane	Flexi Bollards to be Temporarily Flattened

Reference Point in Collett Report	Potential Constraint	Works Description
18	Splitter Island on N22 near Ovens	Flexi Bollards to be Temporarily Flattened
19	Splitter Island on N22 at Ovens	No works required
20	Splitter Island on N22 at Ovens	No works required
21	Splitter Island on N22 at Ovens	No works required
22	Splitter Island on N22	No works required
23	Splitter Island on N22	No works required
24	Splitter Island on N22	No works required
25	Splitter Island on N22	No works required
26	Splitter Island on N22	No works required
27	Splitter Island on N22	No works required
28	Splitter Island on N22	Flexi Bollards to be Temporarily Flattened
29	Splitter Island on N22	No works required
30	Splitter Island on N22	No works required
31	Splitter Island on N22	No works required
32	Splitter Island on N22	No works required
33	Splitter Island on N22	No works required
34	Left Bend on N22	No works required
35	Right Bend on N22	No works required
36	Macroom By-Pass Interchange	Localised triangular area of Road Widening Required on approach to Roundabout. Signage may need to be temporarily removed =. See Collett Drawing 343154-50A1.1.
37	N22 By-Pass Interchange at Ballyvourney	Street Furniture/Signage to be temporarily removed. Road bearing surface to be provided across part of Roundabout. See Collett Drawing 343154-60A1.1.
38	Forest Entrance / Site Access off N22 at Derryreag	Remove vertical hump through junction so as to reduce gradient towards N22.
38	Forest Junction	Remove earth berm at eastern side of junction so as to increase junction width.
38	Forest Junction	Remove vegetation at western side of junction so as to increase junction width.
38	Forest Junction	Provide additional stone for junction tracked area.
38	Forest Junction	Provide double layer of bitumen macadam surfacing between edge of N22 and some 30 m into junction.
38	Forest Junction	Provide road drainage incl. heavy duty "ACO" type interceptor drain at interface between widened junction and edge of N22.
38	Junction	Provide new fencing, road signs and markings

Key (shading of Works Description cells):
- No works required
- Temporary works required
- Permanent works required

Reference Point in Collett Report	Potential Constraint	Works Description	No works required / Temporary works required / Permanent works required
38	Junction	Provide new road signage.	
n/a	Junction	Widen Forest Track at bend at Chainage 200 (Drawing: JOD-01.1 Survey Inchamore AT Rev0 3D)	
n/a	Forest Track	Grade and stone and fill potholes at Chainage 1000 (Drawing: JOD-01.3 Survey Inchamore AT Rev0 3D)	
n/a	Forest Track	Widen bend at Chainage 1800 (Drawing: JOD-01.5 Survey Inchamore AT Rev0 3D).	
n/a	Forest Track	Widen bend at Chainage 2250. (Drawing: JOD-01.6 Survey Inchamore AT Rev0 3D)	

From **Table 15.12** above, it is evident that very minor temporary works are required between Ringaskiddy Port and the forest entrance at Derryreag. These are shaded in "Orange" in **Table 15.12**. However, works are required at the forest junction and to the existing forest track between Derryreag and the Wind Farm Site – these are shaded in red in **Table 15.12** and shown on Drawings 6226-PL-101 and 6226- PL-102, **Appendix 15.2**.

At the forest entrance at Derryreag, an earth berm is to be removed on the eastern side, vegetation is to be removed on the western side, the track is to be widened and realigned vertically so as to remove a hump and reduce the gradient towards the N22. The junction will be surfaced with a double layer (60 mm base course + 40 mm wearing course) of bitumen macadam), drainage will be provided including a heavy duty 'Aco' type drain across the junction near the edge of the N22. New fencing will be provided shown on Drawing 200-LT1. For slow moving HGV's leaving the site on the forest track construction haul route, a right turn would have to cross the eastbound overtaking lane, which is considered to be a potentially dangerous manoeuvre . To address this, the empty turbine delivery HGV's will turn left onto N22, then turn right at the northern end of the existing island junction at Cummeenavrick and complete a 180 degree turning manoeuvre and continue on the N22 (See **Figure 15.1**). In addition, it is proposed that a 'Stop' sign, a 'No Right Turn' sign and road markings will be placed at the exit from the forest road and the N22 such that HGV's only turn left (westwards) and will turn around at the former N22 area at Cummeenavrick which is c. 2.5 km from the wind farm (see **Appendix 15.1**).

The upgrade to the forest track works are shown on Drawing 6226-PL-210. For the c.2.5 km distance between the Cummeenavrick N22 junction and the wind farm road, the forest track is generally in a good condition. However, bends need to be realigned at three locations. These works are shown on Drawings 6226-PL-101 and 6226- PL-102.

15.4.3 Civil Construction Haul Route

No upgrade works are necessary to the N22 to facilitate the delivery of materials. However, preparatory works such as signage and directions to the wind farm Site will be installed pre-construction on the approach to the site entrance on the N22 in accordance with Chapter 8 of the Traffic Management Guidelines. August 2019 (see **Section 15.6 Mitigation Measures**).

A condition survey of the existing N22 between Ballyvourney Junction and Cummeenavrick will be carried out prior to commencement of construction and another post-construction. The Developer will lodge a bond with Kerry County Council (and Cork County Council if required) prior to commencement of construction in the amount to be agreed with the Council(s) for the possible repair/upkeep of the road. During the construction period, the road will be inspected weekly by the Developer's Resident Engineer. The Contractor will be instructed to repair any defects within the following week. At the end of the construction period, any further defects will be remedied to the satisfaction of Kerry County Council, Cork County Council and TII.

Similar to returning turbine delivery vehicles discussed above, for slow moving HGV's leaving the site on the forest track construction haul route, a right turn would have to cross the eastbound overtaking lane which is considered to be a potentially dangerous manoeuvre. To address this, empty turbine delivery HGV's will turn left onto the N22, then turn right at the northern end of the existing island junction at Cummeenavrick and complete a 180 degree turning manoeuvre and continue on the N22 (see **Figure 15.1**). In addition, it is proposed that a 'Stop' sign, a 'No Right Turn' sign and road markings will be placed at the exit from the forest road and the N22 such that HGV's only turn left (westwards) and will turn around at the former N22 area at Cummeenavrick.

15.4.4 Grid Connection

No road upgrade works are proposed to facilitate the delivery of materials.

No trenches or joint bays will be installed within public roads.

15.4.5 Wind Farm Internal Access Tracks

Within c.50 m of entering the wind farm site, the road splits into two branches, each giving access to three turbines.

The eastern branch will give access to turbines T4 and T5 as well as to the 38 kV sub-station and to the borrow pit.

The western branch will give access to the temporary site compound, turbines T1, T2 and T3 as well as the anemometer mast.

One borrow pit (located north of Turbine T5) will service the Site.

15.5 ASSESSMENT OF POTENTIAL EFFECTS

15.5.1 HGV Deliveries

15.5.1.1 The estimated timescale for the completion of the construction phase is 21 months, inclusive of all works to Site Access Tracks, access routes, substation building and erection and commissioning of turbines and grid connection works.

Tables 15.13 to **Table 15.16** present a summary of the estimated HGV and abnormal load deliveries of materials required to construct the wind farm, the turbine component haul route improvement works and the grid connection.

15.5.1.2 It is estimated that 840 m^3 of structural concrete and 60 m^3 of blinding concrete will be required for each turbine foundation and that an additional 360 m^3 will be required for the substation buildings and plinths, met mast foundation and other miscellaneous works. This gives a total volume of concrete of 4,860 m^3. . Based on 6 m^3 per concrete truck, some 810 loads will be required.

15.5.1.3 It is estimated that 90t of reinforcing steel will be required for each turbine foundation and that an additional 50t will be required for the substation, met mast foundation and miscellaneous works. These total 500t. At 20t/load, some 25 deliveries of reinforcing steel will be required. Obtaining the reinforced steel from Cork is an option.

15.5.1.4 For the proposed area of new Site tracks of 15,998 m^2 (see **Chapter 2: Project Description**, Section 2.5.5, - 3,555 m long x 4.5 m wide), some 1,599 m^3 of imported crushed stone will be required for a 100 mm finishing layer. Allowing for additional stone at bends and junctions, the total volume is estimated at 1,700 m^3.

For the upgrading works to 3,102 m of existing track, some 1396 m^3 will be required. Allowing for widening at bends, the total volume is estimated at 1400 m^3.

For the total hardstand area of 5 x 4,740 m^2 (see **Chapter 2: Project Description**, Section 2.5.3), some 2,844 m^3 of imported stone will be required for the finishing layer.

These volumes of imported stone total 5,470 m^3. At 12 m^3/load, some 456 deliveries will be required.

15.3.1.5 For the substation area of 50.24 m x 23.251, (see TLI Drawing 05836-DR-226 in the planning drawings), a volume of 233 m^3 or 12 loads are required.

15.3.1.6 Depending on the soil/rock profile, imported crushed stone (engineering fill) may be required under turbine foundations as upfill. Allowing 0.3 m depth per foundation, then 766 m^3 is required. At 12 m^3/load, some 64 loads are required.

15.3.1.7 For the 38 kV on-site substation, most of the deliveries will be crushed stone, building materials, electrical switchgear and equipment. However, there will be a transformer (38 kV/20 kV) which will be an abnormal load but can be accommodated on the Civil Construction Haul Route.

For the 38 kV substation, it is estimated that 20 loads will be required for concrete blocks, precast concrete elements, timber, steel doors, rendering materials, fencing, electrical cabling, panels, transformer and other equipment. The majority of these (18 No.) are expected to come from Cork.

15.3.1.8 Two electrical circuits are proposed within the wind farm site, one to serve Turbines T1, T2 and T3 and the other to serve T4 and T5. Each circuit will connect to the on-site substation at 20 kV. The total length of 20 kV single circuit is estimated at 3,900 m while there will be 900 m of double circuit to the substation. Imported bedding/backfill material will be required within the trenches. This will give a requirement of 76 loads. Each single circuit trench will have 4 No. 110 mm diameter ducts and the double circuit will have 8 No. Thus, the total length of ducts is estimated at 22.8 km. This is typically delivered in 6 m lengths at 3 km per load which would give rise to 8 loads. Ducting will be imported via Ringaskiddy.

For 20 kV cables, the total length will be 17.1 km. For a typical mass/metre of 5.8 kg, the total mass is 99.18 t which will require 5 loads. These will be imported via Ringaskiddy.

For fibre optic cable, one load will be required. This will be imported via Ringaskiddy.

For precast concrete joint bays, one load will be required.

The total of the above related to the internal electrical circuits is 91 loads (76+8+5+1+1).

15.3.1.9 Four loads are estimated for met/anemometer mast materials while 30 loads are estimated for general civil engineering materials such as geofabrics, drainage pipes, water crossings, fencing etc. These will be delivered via Cork.

15.3.1.10 Forest felling will be required in advance of construction works. It is anticipated that brash will be left on site and that logs will be removed off site following felling and will not be left stacked on site.. During the delivery period, if turbines are delivered at night, then logs will be removed by day using the Site access tracks.

The total felling area is estimated at 32.36 ha and the total volume of wood is estimated at 11,140 m^3. This is equivalent to 5,013 tonnes. This is equivalent to 251 loads. Allowing for part loads, voids etc., the total allowance is for 300 loads over a 12-week period equivalent to 5 loads per day. Good quality logs will be used for timber manufacture and transported to:

- Grainger's Sawmills, GP, Enniskeane, Ballymoney, Co. Cork;
- Enniskeane Timber Products Ltd., Ballineen, Co. Cork, and
- GP Wood, Lissarda, Co. Cork.

These locations are shown on **Figure 15.6**.

Should the quality be poor, the timber will be transported to either Clonmel or Waterford for sheeting board manufacture via the N22.

15.5.1.11 Very little waste is envisaged from the construction phase and likely to result from offcuts of timber, electrical cables, cable drums and packaging. These materials will be segregated on site and removed to a licensed recycling facility listed in Section 15.2.4above, once a load accumulates. On average, 1 load/month is envisaged. Cable drums will be transported to the cable manufacturer for re-use.

15.5.1.12 Based on the quantities of materials described above, it is estimated that during civil construction, approximately 1, 781 HGV loads will be delivered to the wind farm Site. Much of these deliveries will be over the 11-month period between months 2 to 12. This equates to approximately 162 loads per month or an average of 7 to 9 loads per day. The peak number of deliveries per day will occur during the concrete pour for turbine foundation construction. An estimated 140 concrete deliveries will be required per turbine foundation as the entire concrete pour has to be placed within 8-10 hours. Some other materials will also be delivered on such days, so a realistic estimation of peak deliveries is approximately 150 deliveries per day (for at least 6 separate days in the construction programme when the turbine foundations will be poured). On these concrete pour days, some 14-18 deliveries per hour will be required.

A summary of estimated loads for the Civil/Electrical Construction Works is presented in **Table 15.13**.

Table 15.13: HGV and Abnormal Load Deliveries – Associated with Civil/Electrical Construction Works

Materials	Quantity	No. of Deliveries
Site Establishment and Removal	10 no.	10
Concrete	4,860 m³	810
Reinforcing Steel	500t	25
Substation Building and electrical equipment	-	20
Other – Geotextile Mats, Tools, Fencing etc.	-	30
Internal Cabling Materials incl. bedding	-	91
Met Mast Materials	-	4
Imported Crushed Stone (engineering fill) as Upfill to Foundations	766 m³	389
Imported Crushed Stone for Substation, 200 mm thick	233 m³	12
Imported Crushed Stone for Site Access Track and Turbine Hardstands (assumes 100 mm thick wearing course)	5,470 m³	456
Forestry Removal	11,140 m³	300
Site Reinstatement	-	5
Waste – 1 container/month	-	21
Total	-	1, 848

15.5.1.13 Turbine components will be delivered to Site over a period of approximately 8-10 weeks after civil works are completed. It is estimated that approximately 48 loads of turbine components and 50 loads of crane parts will be delivered/removed during this period. The majority of these loads will be classified as abnormal loads and the relevant approvals and permits[5] will be obtained by the turbine supplier or by its appointed haulage contractor before deliveries take place.

[5] Abnormal Loads Permit

The expected number of HGV deliveries for turbine components are based on specifications from the potential turbine manufacturers, on best estimates of trips generated by similar sized windfarms and previous experience in windfarm planning and civil construction. These figures are likely to vary to some degree depending on the individual lengths of tower sections offered by different manufacturers, but not to the extent that impacts are likely to be significantly changed. A summary of the estimated HGV loads to Site associated with wind turbine components is presented in **Table 15.14**.

Following completion of the construction works, it is estimated that approximately 10 loads will be needed to remove all temporary equipment and materials used onsite e.g. temporary compound, fencing, cabins, storage containers, etc.

The total number of HGV loads associated with turbine components and the N22/Forestry Junction upgrade works is estimated at 175.

Table 15.14: HGV and Abnormal Load Deliveries – Associated with Wind Turbine Components And Associated Works

Materials	Quantity	No. of Deliveries
Site Establishment and Removal	10	10
Anchor Cages & Foundation Templates	5	5
Tower Sections	-	20
Nacelles	5	5
Rotor Blades	15	15
Transformers, Panels and Cabling	-	3
Tools etc.	-	1
Crane Deliveries to Site, including ballast, booms, etc. and removal of same	2 Cranes	50
Road Widening on Turbine Haul Route N22 Forest Access – Soil Disposal	500 m^3	25
Crushed Stone for Widening and Strengthening of Turbine Haul Route at N22 Forest Access	400 m^3	20
Road Surfacing for Turbine Haul Route at N22 Forest Access	200 t	10
Fencing and Miscellaneous Deliveries to N22 Forest Access	2	2
Total		**166**

15.5.1.14 For the grid works, it is assumed that 0.92 m^3 of concrete blinding is required per joint bay and 0.16 m^3 per communication/link chamber. These will require 20 m^3 lean mix concrete or 4 loads at up to 6 m^3 per load. The locations of joint bays are shown on **TLI Drawing No. 05934-DR-201 to 05934-DR-210** included in **Volume III: Figures**.

Some 20 loads of precast components are required for joint bay walls and roof slabs as well as complete communication and link chambers.

For joint bay floor slabs, some 51 m^3 concrete is required which is equivalent to 9 loads.

For 38 kV cables, 800 mm^2 aluminium, the weight per km of cable is 6.251 t. For a total length of 61.0 km (19.85 km x 3 phases plus 2.5% for wastage), the weight will be 381 t and will require 20 loads. Allowing another load for fibre optic cables brings the total to 21 loads. These will be delivered via Ringaskiddy.

Some 80 km of ducting is required which is typically delivered in 6 m lengths, typically 3 km per load. Thus, some 27 loads are required. These will be delivered via Ringaskiddy.Some 30 m^3 of material will arise from directional drilling under the N22 for disposal off site at a licenced facility.

Some 0.290 m^3 of lean mix concrete is required per linear metre of trench. This will give a requirement for 5,597 m^3 of lean mix concrete which is equivalent to some 932 deliveries to Site for the complete grid connection route.

Table 15.15 provides a break down of the various deliveries relevant to the grid connection.

Table 15.15: 38 kV Grid Connection between On-Site Substation and Ballyvouskill Substation

Length of Grid Connection in Roads by Directional Drill	**650**		
Length of Grid Connection in Tracks, Lands	19,200		
Number of Joint Bays	18		
Materials	**Quantity**	**Unit**	**No. of Deliveries**
Site Establishment and Removal	8	No.	8
Concrete Blinding for Joint Bays, Comms Chambers and Link Boxes	20	m^3	4
Concrete for Floors of Joint Bays	51	m^3	9
Pre-Cast Concrete Joint Bays and Communication Chambers	20	No.	20
Other – Steel mesh, Geotextiles, Silt Fencing, Fencing, Danger Tape, etc.	4	No.	4
Grid Connection Cables	381	t	20
Grid Connection Ducting	80	km	27
Disposal of Excavated materials from Directional Drill Trenches in Public Roads	30	m^3	2
Lean Mix Concrete for Trenches	5,597	m^3	932
Total No. of Deliveries	-	-	1,026

15.5.1.15 **Table 15.16** shows an indicative potential breakdown of loads delivered to Site over a 21 month period. The total number of loads is estimated at 3,040.

Table 15.16: Indicative No. of HGV and Abnormal Load Deliveries Over 21 Month Construction Period

Activity	Month																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Wind Farm Site Establishment/ Fencing of Environmental Areas, Buffer Zones,etc.	5	15	10	5																5	
Internal Access Road Upgrade & Construction (imported stone)			90	90																12	
Substation & Compound Construction Civil Works			2	2	2	2	2	12													
Substation Electrical Works									2	2	2	2	2								
Substation Commissioning																					
Excavation and Construction of Turbine +Met Mast Foundations			26	41	175	145	145	145	145	145											
Excavation and Construction of Hardstands										97	98										
Forestry Removal													100	100	100						
Internal Cabling Installation										21	21	21	21	2	5						
Road Widening, Turbine Haul Route – Forest Entrance			25	20		10	2														
Turbine Delivery and Erection			5								4	37	11	23	2					24	4
Grid Connection						97	93	93	93	93	93	93	93	93	93	88	4				
Energisation																					
Turbine Commissioning																					

Activity	Month																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
Met Mast Delivery and Erection																		4			
Site Reinstatement and Finishing Works																					5
Waste Management	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Totals	6	16	159	159	178	255	243	251	241	359	219	154	228	219	201	89	5	5	1	42	10

Based on the indicative timetable outlined above the peak times for HGV deliveries will be in months 5 to 10 when the turbine foundations will be constructed, hardstands and Site tracks will be finished in imported stone and the grid connection works will be ongoing. This is estimated to result in a maximum of 359 trips during month 10 with an average of 16 HGV trips per day in this period. Peak deliveries are expected to be during the period of concrete pours for turbine foundations when there will be approximately 140 loads per Turbine Foundation. If one foundation is poured per month, then the balance of the loads in the busiest month would be 219 loads or 10 loads per day over the remaining days of the month.

15.5.2 Staff/Worker Light Goods Vehicle Traffic

For the wind farm construction, a peak workforce of 40 persons are anticipated on the main Site (see **Chapter 4: Table 4.7**). There will be peaks and troughs in the numbers, with the peak workforce during the general Site works.

In addition to the onsite construction workforce, additional construction staff will be required for the grid connection cable laying works. Two gangs will be required for the grid connection. A maximum of 20 construction staff are anticipated. Thus, up to 60 workers could be employed at peak times between the wind farm and grid connection.

The 60 workers will generally travel to the Site via light vehicle (LV) (i.e. car or small van) assuming 1 person per vehicle, or 60 trips to and 60 trips from the site per day. This is made up of:

- 40 trips each way to/from wind farm Site.
- 20 trips each way to/from grid construction works.

15.5.3 Predicted Additional Traffic on Roads During Construction Phase, Magnitude and Significance of Impacts

Based on the analysis in **Section 15.5.1** above, **Table 15.17** below has been prepared which summarises the peak additional HGV deliveries per road element while **Table 15.18** provides a summary of the peak additional traffic movements (ie. HGV and LGV and one delivery equating to two traffic movements). **Figure 15.11** Shows the various road nodes referred to in these tables.

For each road element, the maximum potential for load deliveries is assumed e.g. from B to A, it is assumed that all deliveries will come from suppliers to the south while for Keim to C, it is assumed that all deliveries will come from suppliers to the north.

It is assumed that 92% of grid connection deliveries will be via Cummeenavrick in direct proportion to the length of grid connection to the north of the N22.

It is assumed that all HGV's leaving the wind farm site will turn westwards and then proceed to turn at Cummeenavrick so as to turn eastwards.

Table 15.17: Summary of Peak Additional HGV / Abnormal Load Deliveries to Site Per Road Element

Node	Road	Civil & Electrical	Turbine	Grid	Total
Ringaskiddy to A	Ringaskiddy Port to Coolcour Junction of New N22 Macroom By-Pass	66	98	48	212
B to A	Existing N22 between R584 Junction and Coolcour Junction with New N22 By-Pass	1,923	48	978	2,949
Keim to C	Keim to Gurteenroe Junction on New N22 By-Pass	1,923	48	978	2,949
A to C	New N22 By-Pass between Coolcour Junction and Gurteenroe junction	1,989	146	1,026	3,161
C to D	New N22 By-Pass between Gurteenroe Junction and Ballyvourney Junction	1,989	146	1,026	3,161
D to E	Existing N22 between Ballyvourney Junction of New N22 By-Pass and Forest Access at Derryreag	1,989	146	1,026	3,161
E to F	Existing N22 between Forest Access at Derryreag and Grid Entrance at Cummeenavrick	1,989	146	1,026	3,161
F to G	Forest Track	0	0	944	944

Table 15.18: Summary of Peak Additional HGV / Abnormal Traffic Movements on Roads

Node	Road	Total No. Of Deliveries	Peak Deliveries/ Month	Peak Deliveries/ Day	Staff	Peak Traffic Movements/ Day[6]
Ringaskiddy to A	Ringaskiddy Port to Coolcour Junction of New N22 Macroom By-Pass	212	45	5	0	10
B to A	Existing N22 between R584 Junction and Coolcour Junction with New N22 By-Pass	2, 949	480	150	40	380
Keim to C	Keim to Gurteenroe Junction on New N22 By-Pass	2, 949	480	150	40	380
A to C	New N22 By-Pass between Coolcour Junction and Gurteenroe junction	3, 161	485	150	60	420
C to D	New N22 By-Pass between Gurteenroe Junction and Ballyvourney Junction	3, 161	485	150	60	420
D to E	Existing N22 between Ballyvourney Junction of New N22 By-Pass and L Forest Access at Derryreag	3, 161	485	150	60	420
E to F	Existing N22 between Forest Access at Derryreag and Grid Entrance at Cummeenavrick	3, 161	485	150	60	420
F to G	Forest Track	944			20	60

The numbers of HGVs generated by the Development (420 movements per day at peak) could be considered a significant increase on the numbers of HGVs which are predicted to use the existing N22 in 2026 (510) (see Section 15.3.6). However, the construction stage traffic movements between Ringaskiddy Port and Macroom (node Ringaskiddy Port to A)

[6] On the basis of each delivery equating to two traffic movements.

(N28, N40 and N22 to Macroom) will be low at 10 movements (5 deliveries) per day. Assuming that the majority of the route between Ringaskiddy and Macroom has a capacity of 11,600 AADT, the change would be 0.1%. The magnitude of change is considered as being "Very Low" (see **Section 15.2.9**).

The magnitude of change is summarised within **Table 15.19** below.

For the existing N22 near Macroom between the R584 and the Coolcour Junction of the new N22 Macroom By-Pass (Nodes B to A), an additional 380 traffic movements per day will arise during concreting of turbine foundations. The predicted flows (see **Section 15.3.6**) for the N22 for 2027 would be 8,900 – 9,500 AADT around Macroom. Assuming a guidance capacity of 11,600 AADT, adding a further 380 traffic movements would increase flows to 9,280 – 9,880 which would still be within the guidance capacity of 11,600 AADT. The flows would increase by 4.1% which, in terms of magnitude, are considered as being "Very Low" (see **Section 15.2.9**).

For the new N22 Macroom By-Pass, the peak additional 420 traffic movements per day will arise during concreting of turbine foundations. The peak only occurs on 5 days when the concrete foundations are being poured. The predicted flows for the N22 Macroom By-Pass for 2027 are 11,100 to 11,200 AADT (see **Section 15.3.6**). This is 56% of the guidance capacity of 20,000 AADT. Adding a further 420 movements would increase the 2027 flows to 11,490 to 11,590 which is still well within the guidance capacity of 20,000. The flows would increase by 3.8% which, in terms of magnitude, are considered as being "Very Low" (See **Section 15.2.9**) x.

For the existing N22 between the new Ballyvourney Junction and Derryreag/ Cummeenavrick (node A to F), an additional 420 traffic movements will arise. As discussed in **Section 15.3.6**, flows on the existing N22 would be 8,356 AADT in 2026. As discussed in **Section 15.3.6**, the guidance capacity of this section of the N22 is 11,600 AADT. The predicted additional flows would increase flows by 5.0% to 8,776 which is still well inside the AADT of 11,600. In terms of magnitude, the change is considered as "Very Low" (see **Section 15.2.9**).

From the wind farm Site to the Forest track/N22 junction (node F to G), an additional 60 traffic movements will arise. As discussed in **Section 15.3.6**, flows on the existing N22 would be 8,356 AADT in 2026. As discussed in **Section 15.3.6**, the guidance capacity of this section of the N22 is 11,600 AADT. The predicted additional flows would increase flows by 1.0% to 8,416 which is still well inside the AADT of 11,600. In terms of magnitude, the change is considered as "Very Low" (see **Section 15.2.9**).

From the analysis above, the significance of the impacts are assessed (with reference to **Table 15.6**) and are presented in **Table 15.19**. The significance of the impacts are "Negligible" to "Minor" on the N22 (existing and new Macroom By-Pass).

Table 15.19: Magnitude and Significance of Impacts

Node	Road	Sensitivity[7]	Magnitude	Significance of Effects	Duration
Ringaskiddy to A	Ringaskiddy Port to Coolcour Junction of New N22 Macroom By-Pass	Very Low to High	Very Low	Negligible to Minor	Short Term
B to A	Existing N22 between R584 Junction and Coolcour Junction with New N22 By-Pass	Medium to Low	Very Low	Negligible	Short Term
Keim to C	Keim to Gurteenroe Junction on New N22 By-Pass	Medium to Low	Low	Negligible to Minor	Short Term
A to C	New N22 By-Pass between Coolcour Junction and Gurteenroe junction	Very Low	Very Low	Negligible	Short Term
C to D	New N22 By-Pass between Gurteenroe Junction and Ballyvourney Junction	Very Low	Very Low	Negligible	Short Term
D to E	Existing N22 between Ballyvourney Junction of New N22 By-Pass and Forest Access at Derryreag	Low	Very Low	Negligible	Short Term
E to F	Existing N22 between Forest Access at Derryreag and Grid Entrance at Cummeenavrick	Low	Very Low	Negligible	Short Term
F to G	Forest Track	Low	Very Low	Negligible	Short Term

[7] Sensitivity referenced to Table 15.3 and Table 15.4.

Therefore, the effects on the local road network (including abnormal turbine delivery route, civil construction haul route, grid connection route and tree felling haul route) can be predicted to be direct, negative, negligible to minor (depending on the section of road as detailed in **Section 15.5.3**) but short-term in nature as it will arise for less than two years.

15.5.4 Works on the Haul Route

As outlined in **Table 15.12**, works will be required at a number of locations along the Turbine Components Haul Route from Ringaskiddy Port to the Site. These works may cause some short-term disruption to local road users. However, these effects will be confined to a relatively short period during the construction phase, prior to the delivery of turbine components and hence are not predicted to have a significant effect. Street furniture will be adjusted (where necessary) such that it is socketed into the ground. Street furniture will be removed daily in advance of turbine delivery (which will occur at night) and be replaced immediately following the passage of the abnormal vehicles such that daytime traffic can continue as normal. The proposed works on the forest junction off the N22 at Derryreag and at the grid entrance at Cummeenavrick can be carried out without the need for traffic disruption. Signage will be provided warning of the new site entrances and that there are construction sites ahead.

Tie-in surfacing works to the edge of the N22 at Derryreag will be carried out during periods of low traffic flows.

15.5.5 Works on the Grid Connection

For the grid connection, all of the works will be constructed off the public roads.

15.5.6 Light Vehicles/Vans and Construction Personnel

The number of staff on the Site will vary according to the phase of works, peaking at up to approximately 40 during turbine foundation construction. It is expected that the majority of workers will arrive onsite in mini-buses and crew vehicles which are used to transport teams of workers from the various contractors. Subject to public health conditions, vehicle sharing will be actively encouraged to reduce vehicular movements.

It is expected that a maximum of 40 vehicles will visit the Wind Farm Site on a daily basis during the peak construction period (Turbine Foundation construction). This is estimated to be an increase of 0.8 % on predicted levels for 2026 on the N22. Parking for staff will be provided at the Temporary Construction Compound. Given the distance between the Site and the public roadway, no parking is expected or will be allowed on the N22. A number of additional unscheduled visits may be required throughout the construction period for site inspections, site meetings, and unforeseen circumstances. The predicted effect is negligible to low due to the relatively low increase in traffic over the baseline situation.

15.5.7 Air Quality

Good local air quality is essential for the health and quality of life of residents along the Haul Route. Transport accounts for a significant proportion of pollutants in the atmosphere namely, CO_2 emissions, nitrogen dioxide (NO_2) and particulate matter (PM_{10}). NO_2 emissions can also be harmful to vegetation and ecosystems in the vicinity of the Haul Route. The increase in traffic movements on the local road network of an average of approximately 76 (average 16 HGV's + 60 cars and vans) trips per day over a short-term period is low relative to the baseline and therefore the effect of the Development on air quality will be imperceptible.

15.5.8 Noise and Vibration

There is likely to be some noise and vibration from HGV movements along the Haul Route on the regional roads, particularly on the R587, R584 and R582 which can cause disturbance to residents living along these roads. Due to the relatively low number of trips generated per day, (apart from the six days when concrete pours are taking place) the restrictions on working hours and the short-term nature of the construction phase, the effects of noise and vibration are not predicted to be significant. Mitigation measures are discussed in **Section 15.6** and in **Chapter 11: Noise**.

15.5.9 Pedestrians and Vulnerable Road Users

Pedestrian intimidation can occur where there are large changes to traffic flow and composition. No local roads will be used and there is no significant pedestrian traffic in the area.

15.5.10 Driver Delay

The existing N22 is estimated to be at 73.9 % of its capacity in 2026 with HGV and LGV traffic for the Development taking it to 77.2% considering peak movements. No delay is envisaged due to capacity. Apart from the presence of the additional volumes of slower moving HGVs on the road, no specific driver delay is envisaged.

There is potential for some driver delay on the turbine component haul route during the delivery of abnormal load components. Abnormal load deliveries will be timed to take place outside of peak times, possibly at night, and therefore the potential effects are not considered to be significant.

15.5.11 Severance

As all haul routes are either Regional or National Roads which are well established and as no road closures are proposed, severance (i.e. the separation of residents from local amenities or social networks is unlikely to arise.

15.5.12 Mud and Debris on the Local Road Network

HGVs leaving the Site have the potential to transport mud, stones or other debris from the Site to the surrounding road network on wheels of the vehicles. This could cause nuisance to local road users or damage to vehicles from loose debris. This effect can be predicted to be direct, negative, minor and short-term in nature confined to the initial decommissioning and construction phases only and will be subject to mitigation measures. Mitigation measures are also prescribed in **Section 15.6** and in **Chapter 10: Air Quality and Climate.**

15.5.13 Effects on Road Network during Construction Phase

Traffic numbers during construction are outlined in **Section 15.5.1**. As the roads are estimated to have sufficient spare capacity, the overall potential effect on the roads is assessed to be minor to negligible, negative effect of short-term duration and high probability during construction of the Development.

15.5.14 Operational Phase – Traffic

During the operational phase of the Project, the wind farm will normally be unmanned. Operational and remote monitoring activities will be carried out on an ongoing basis via telephone and computer links. However, regular visits to the Site will be necessary for maintenance and routine inspections. A car or van will normally be required for these routine inspections. Under normal circumstances the operation of the windfarm would require 1-2 visits to the Site per week by trained personnel and/or accompanied visitors. Parking will be provided outside the electrical compound at the onsite substation. In the case of a major fault e.g. breakdown of a turbine component, larger machinery, including possibly mobile cranes, will require access to the Site. Should a major turbine component need to be replaced e.g. wind turbine blade, the blade can be transported to site using the same route as for the construction of the turbines. Typically, once every 5 years, paintwork may need to be touched up on turbines and the blades cleaned. A Mobile Elevating Work Platform (MEWP) will be used for such activities.

The remaining forestry on Site i.e. surrounding the footprint of construction works will not be felled until 2035.

There will be a low volume of traffic generated during the operational phase of the Project. The effect of traffic associated with the operation of the Development on the existing public road network will be imperceptible due to the type of traffic and the low volume of traffic generated during operation. However, there will be slight temporary short-term effects should major turbine components need to be replaced.

The grid connection will, following commissioning, be taken in charge by ESB Networks and no regular ongoing maintenance is predicted. Due to the strict requirements of ESB Networks Functional Specification, the level of supervision normally provided by the Developer and by ESB Networks, and the extent of testing prior to commissioning, the probability of the occurrence of faults on 38 kV cable connections is very low. However, should a fault occur it would most likely be within a joint bay which could be exposed and the joint repaired over 3-4 days.

Warning signage for drivers exiting the development together with advance stop signage will be installed at the N22 junction. A suitable surface friction will be provided and maintained on the forest track/N22 junction approach, though a bound surface to the access road will need to be provided. The turning area will not appear as a continuation of the National Road under any lighting conditions.

15.5.15 Traffic Impact During Decommissioning Phase

During decommissioning, it is envisaged that the total volume of HGV traffic will be relatively small compared to the construction period (5 – 10 HGV per day) on the basis that the Site Access Tracks will remain in place to serve ongoing forestry and agriculture activity and the turbine hardstands will be allowed to revegetate into the surrounding habitat with only the turbines being removed from Site for recycling/reconditioning. This phase could be expected to last approximately 12-24 weeks. With the site access tracks and turbine hardstands left in place and revegetated, the effect is predicted to be an imperceptible effect on traffic. As the turbine blades can be cut into manageable lengths on decommissioning, there is are requirements to adjust street furniture on the turbine supply haul route for decommissioning.

15.5.16 Need for a Road Safety Audit

A Road Safety Audit is required for all National Road Schemes. TII Publication GE-STY-01024, Dec. 2017 sets out two categories of scheme:

- Road Scheme – A scheme which results in new road construction or permanent change to the existing road or roadside layout.

- Development Scheme – A Scheme which results in a change to the road or roadside layout that is indicated and/or executed for commercial or private development.

The Development will use and cross the N22 National Road but does not propose any modifications to the National Road. None of the modifications in TII Publication GE-STY-01024, (Dec. 2017) Appendix A – Scheme Type and Audit Stage of GE-STY-01024 are proposed.

Objective TM 12.8 of the Cork County Development Plan 2022-2028 requires that:
"Where traffic movements associated with a development have the potential to have a material impact on the safety and free flow of traffic on a National, Regional or other Local Routes, the submission of a Traffic and Transport Assessment (TTA) and Road Safety Audit will be required as part of the proposal".

Sight distance at the forest entrance at Derryreag is excellent in both directions (i.e. several hundred metres). However, the existing forest entrance/junction will be expanded and traffic will be intensified during the construction and decommissioning phases. The existing road layout is such that vehicles exiting the site entrances would have to cross an overtaking lane. Vehicles entering the site from the west could potentially have to park in the overtaking lane while awaiting a gap in traffic. Both of these scenarios are considered as potential to have a material impact on safety. Accordingly, a Road Safety Audit has been completed (please see **Appendix 15.3**).

A stage 1 Road Safety Audit was done in April 2023 and highlights the following as results form the audit:

Collision Data

Road Collision Data is not currently available on the Road Safety Authority Database, therefore no collision trends in the immediate vicinity of the proposed site can be analysed.

National Road Climbing Lane

Problem: The proposals indicate barriers to be provided to close down the national road southbound offside lane, where the climbing lane exists. This area of the national road is up a steep gradient.

Hazard: Faster moving traffic may attempt to overtake slower moving vehicles that are particularly slow due to the road gradient, and cut back in just prior to the temporary barriers. Collisions with the barriers or side swipe collisions with the slow moving vehicle may result.

Recommendation:

- Retain the dual lane set up for the full extent of the climbing lane.
- Adjust the refuge island within the mouth of the development junction such that right turning into the junction is near impossible for long vehicles.
- Ensure all drivers destined for the development are instructed to approach from the south only.

National Road Signage

Problem: Users may attempt to turn right into the development from the national road. These users are likely to wait in the N22 offside lane for gaps in opposing traffic.

Hazard: The stationary vehicle may be subject to rear end shunts from though traffic.

Recommendation: Provide suitable signage prohibiting right turning into the development junction. Additionally, provide signage guiding development traffic to a suitable turning location further to the east.

Development Junction – Gradient

Problem: The development junction is to a steep downhill gradient. Users exiting the development may proceed towards the National Road at excessive speed and fail to stop for the junction.

Hazard: Overshoot incidents may result.

Recommendation: Provide suitable warning signage for drivers exiting the development together with advanced stop signage and also ensure suitable surface friction is provided and maintained on approach to the junction.

Vehicle Swept Paths

Problem: It is not clear from the drawings if delivery vehicles have sufficient space to enter the development left from the National Road.

Hazard: Users may slow/stop with the tail of the vehicle protruding into the National Road. Rear-end shunts may result.

Recommendation: Undertake swept path analysis and adjust the paved area accordingly.

Turning Area

Problem: The audit team have been advised that vehicles departing the development will turn left from the development junction and undertake a turn at a location further to the north. The formation of the inbound junction for turning may appear as a continuation of the National Road during hours of darkness.

Hazard: Northbound National Road drivers may errantly divert from the mainline to enter this new junction. Impact with southbound National Road traffic may result.

Recommendation: Ensure this junction does not appear as a continuation of the National Road under any lighting conditions.

15.6 MITIGATION MEASURES

15.6.1 Construction Phase

The potential effects of the construction of the Project have been identified as being negligible to minor (see **Table 15.19**), but temporary in nature. The following mitigation measures are proposed:

- A Traffic Management Plan (TMP) has been developed (see Management Plan 7 attached to the CEMP). Prior to construction and once the Contractor's have confirmed their suppliers, the TMP will be updated in consultation with Cork County Council, Kerry County Council and An Garda Síochána as necessary to take account of any conditions attached to a grant of p55ermission. All drivers will be made aware of the location and presence of sensitive receptors at an induction session prior to construction activities taking place and will be made aware of the speed limits of the various roads on the route which are contained in the TMP and on the traffic arrangements for entering and exiting the site. This is to ensure compliance with speed limits, and traffic management arrangements.
- At the forest junction at the N22 (wind farm access) bitumen macadam surface will be provided some 30 m into the junction with room to park HGV's clear of the N22.
- The forest access track will be regraded so as to reduce the gradient towards the N22. An "Aco" type drain shall be provided to intercept rainfall run-off.

- All the traffic to the wind farm site will approach from the east such that they turn left at the forest access. All traffic leaving the wind farm site will turn left only and, if required, can turn around at Cummeenavrick turning area. Signage and road markings will be provided to facilitate/promote these manoeuvres.
- The new N22 Macroom By-Pass will be used to transport turbine components, materials for upgrading the turbine haul route, materials for construction of the civil and electrical works to and from the wind farm site, as well as materials for the grid connection so as to minimise traffic through built-up areas such as Macroom, Ballymakeery and Ballyvourney.
- All significant traffic likely to be generated by Inchamore Wind Farm will be during the construction of the Project and will be temporary in nature. It is envisaged that the construction period for the wind farm will span a 21-month period with the underground cable being installed over a concurrent 12-month period. The construction-phase Traffic Management Plan will mitigate these impacts. A number of mitigation measures are embedded within the design:
    - The design is such as to minimise the extent of the new build requirement by using existing forestry tracks where possible, thereby minimising materials requirements.
    - The design is such as to maximise the use of onsite resources (particularly stone material for track construction) to minimise the requirement for material import. Some 49,842 of stone is proposed to be won from the borrow pit which equates to a 4,154 HGV trips to the site avoided (see **Chapter 2: Table 2.4a**).
    - Retaining surplus excavated material on the Site so as to reinstate the borrow pits, thereby eliminating traffic associated with the disposal of same. Some50,276 m^3 of spoil are proposed to be stored in the on-site borrow pit or in roadside berms, resulting in a saving of 4,190 HGV trips off the site (see **Chapter 2: Table 2.4b**).
    - Designing the cable for installation in pre-laid ducts, rather than directly installing the cable in the ground. The latter would require the entire trench from joint bay to joint bay to be fully open for cable laying.
- There will be special transporter vehicles with rear wheel steering used in delivery of wind turbine components to ensure safe transportation and manoeuvrability on the roads. Extendable transporter vehicles will be retracted on return journeys.
- Prior to the delivery of abnormal loads i.e. turbine components, the Applicant or their representatives, will consult with An Garda Síochána and Cork and Kerry County Council Roads Departments to discuss the requirement for a Garda escort.
- The Developer will confirm the intended timescale for abnormal deliveries and every effort will be made to avoid peak times such as school drop off times, church services,

sporting events, peak traffic times where it is considered this may lead to unnecessary disruption.

- Abnormal loads are likely to travel at night and outside the normal construction times as may be required by An Garda Síochána. Due to the relatively modest distance between Ringaskiddy Port and the Site of c.92.8 km, the journey is achievable within a 2-3 hour timeframe. Accordingly, locations for resting will not be required. Local residents along the affected route will be notified of the timescale for abnormal load deliveries.
- A condition survey of the existing N22 between Cummeenavrick and the Ballyvourney Junction of the Macroom Bypass will be carried out prior to commencement of construction and another will be undertaken post-construction. The Developer will lodge a bond with Kerry County Council and or Cork County Council prior to commencement of construction in the amount to be agreed with the respective Council for the possible repair/upkeep of the road. During the construction period, the road will be inspected weekly by the Developer's Resident Engineer and the Contractor will be instructed to repair any defects within the following week. At the end of the construction period, any further defects will be remedied to the satisfaction of Kerry Council Council, Cork County Council and Transport Infrastructure Ireland.
- Wheel cleaning equipment will be used at the exit from the wind farm Site at Derryreagh and also at the exit from the Grid Connection Works at Cummeenavrick to prevent any mud and/or stones being transferred from Site to the public road network. All drivers will be required to see that their vehicle is free from dirt and stones prior to departure from the construction Site.
- The Site entry point will also be appropriately signed. Access to the wind farm construction Site will be controlled by on Site personnel and all visitors will be asked to sign in and out of the Site by security / Site personnel on entering and exiting the Site. All Site visitors will undergo a Site induction covering Health and Safety issues at the Contractor's temporary compound and will be required to wear appropriate Personal Protective Equipment (PPE) while onsite.
- Any dust generating activities will be minimised where practical during windy conditions, and drivers will adopt driving practices to minimise the creation of dust. Where conditions exist for dust to become friable, techniques such as damping down of the potentially affected areas will be employed.
- To reduce dust emissions, vehicle containers/loads of crushed stone will be covered during both entrance and egress to the Site.
- A survey of the turbine component haul route will be undertaken prior to commencement to identify if any new overhead lines or broadband lines will need to be

raised along the route to allow abnormal loads such as tower sections and nacelles to be delivered.

- During the construction phase, clear construction warning signs will be placed on the N22 as necessary, which will advise road users of the presence of a construction Site and of the likelihood of vehicles entering and exiting the Site or road construction areas. This will help improve road safety.
- Works on public roads on the turbine delivery haul road and grid connection will be strictly in accordance with "Guidance for the Control and Management of Traffic at Road Works – 2nd Edition 2010" as well as "Traffic Signs Manual 2010-Chapter 8- Temporary Traffic Measures and Signs at Roadworks".
- Where required, . Road Opening Licence will be obtained for the directional drill of the grid connection under the N22.
- All vehicles using or while in operation at the wind farm site shall either have roof mounted flashing beacons or will use their hazard lights.
- A speed limit of 25 km/h shall apply to all vehicles within the wind farm site.

15.6.2 Operational Phase

Effects during operation have been assessed as being imperceptible. However, it is still important that any effect is minimised as for as is possible. Therefore, the following measures are recommended:

- All vehicles using the wind farm site shall either have roof mounted flashing beacons or will use their hazard lights.
- A speed limit of 25 km/h shall apply to all vehicles within the wind farm site.
- Locational signage shall be maintained throughout the operational period.
- Road surfaces shall be inspected on a quarterly basis and will be repaired within one month of the inspection.
- Safety arrangements at the forest road entrance/exit at Derryreag shall be reviewed every two years to confirm that traffic management arrangements are adequate.

15.6.3 Decommissioning Phase

As the turbine blades can be cut into manageable lengths on decommissioning, there are no requirements to adjust street furniture on the turbine supply haul route for decommissioning.

The wind turbines proposed as part of the proposed Development are expected to have a lifespan of up to 35 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 decommissioning (4 - 6 months) of the proposed wind farm, the wind turbines will be disassembled in reverse order to how they were erected. All above ground turbine components will be separated, cut and removed off-site for recycling. Turbine foundations will remain in place underground and allowed to revegetate or 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 potentially significant environment nuisances such as noise, dust and/or vibration. The site roadways will be in use for additional purposes to the operation of the wind farm (e.g. for forestry and recreational use) by the time the decommissioning of the project arises and therefore the site roads will remain in situ for future use. .

The grid connection, when completed, will be handed over to ESB Networks as the Distribution System Operator and thus it will not be removed.

The traffic management of the decommissioning phase will be informed by the road conditions at the time of decommissioning. It is not possible to predict the changes to the public road infrastructure and policies in the next 30-40 years. It is envisaged that a Traffic Management Plan will be developed for the decommissioning phase.

Nevertheless, the following traffic management measures are likely to be required:

- Signage will be erected at the site entrance and on the N22 approaching the site.
- Construction traffic associated with decommissioning will be scheduled so as to avoid school drop off and collection times.
- All vehicles using or while in operation at the wind farm site shall either have roof mounted flashing beacons or will use their hazard lights.
- A speed limit of 25 km/h shall apply to all vehicles within the wind farm site.

15.7 CUMULATIVE EFFECTS

15.7.1 Construction Phase

Table 2.1 of **Chapter 2: Project Description** as well as **Figure 2.2** sets out the existing and proposed wind farms within 20 km of the Site.

The Cork County Council Planning portal and the Kerry County Council Planning Portal were accessed to check planning permissions granted within a 20 km radius of the wind farm.

Various wind farms have been granted permission and amendments/additions (e.g. Battery Energy Storage) to consented wind farms have also been granted.

Much of the non-wind planning permissions relate to (see **Appendix 2.4**):

- Dwelling houses;
- Extensions to dwelling houses;
- Agriculture buildings;
- Sports/Recreation facilities, and
- School Extensions.

In terms of their scale, it is considered that the construction of the dwelling houses or extensions to dwelling houses or the agricultural buildings or the sports/recreation facilities or the school extensions would only have a negligible to minor localised impact on traffic should their construction be concurrent with the Project because the roadways have capacity to handle the increase in traffic volumes.

Should any projects to the north of the N22 be developed concurrently with the Project then the most likely effects will be on the N22 and on the N28/N40/N22 from Ringaskiddy. In such an event, deliveries from the port and and concrete deliveries will be co-ordinated such that there will not be any intensification of deliveries.

The Sites identified as being within 20 km of the proposed Development (see Figure 2.3) which are permitted but not yet constructed or which are proposed or which are at pre-planning are:

- **Coolea – Single turbine, 3.17 km to south-west – Status: Permitted**
  Likely to use N22 as haul route. Potential for cumulative effects.

- **Coolknoohil Inchee – Two turbines, 3.93 km to south-west – Status: Permitted**
  Likely to use N22 as haul route. Potential for cumulative effects.

- **Curraglass – Seven turbines 14.97 km to south-west – Status: Permitted**
  The roads to be used for Inchamore are remote from this Site and no cumulative impact on roads or traffic is envisaged.

- **Cummeenabuddoge – Seventeen turbines, 4.72 km to north-east – Status: Pre-Planning/Concept Stage**
  Likely to use N22 as haul route and likely to use same grid connection route to Ballyvouskill. Potential for cumulative effects.

- **Gneeves Milstreet – Four turbines, 10.20 km to north-east – Status: Operational**
  The haul route to be used for Inchamore are remote from this Site and no cumulative impact on roads or traffic is envisaged.

- **Gortnakilla – Four turbines, 1.87 km to west – Status: Permitted**
  Likely to use N22 as haul route. Potential for cumulative effects.

- **Gortyrahilly – Fourteen turbines, 4.95 m to south – Status: Proposed/SID project pending decision from An Bord Pleanála**
  Likely to use same grid connection route to Ballyvouskill and turbine delivery route as the Project . Potential for cumulative effects.

- **Knocknamork – Seven turbines 4.42 km north-east – Status: Permitted**
  Likely to use N22 for haul route and likely to use same grid connection route to Ballyvouskill. Potential for cumulative effects.

The proposed Gortyrahilly, Cummeenabuddoge and Knocknamork wind farms are also likely to connect to Ballyvouskill substation. The proposed grid routes are shown in **Figure 15. 12**. All three will share the forest track with the Inchamore grid connection. The above information is summarised in **Table 15.20** below.

Table 15.20: Potential for Cumulative Effects from the Construction of Neighbouring Wind Farms

Proposed Wind Farm	Use of N22 Between Coolcour and Cummeenavrick	Use of Forest Track for Grid Connection
Coolae	Yes	No
Coolknoohil Inchee	Yes	No
Curraglass	No	No
Cummeenabuddoge	Yes	Yes
Gneeves Hillstreet	No	No
Gortnakilla	Yes	No
Gortyrahilly	Yes	Yes
Knocknamark	Yes	Yes

Any of the six wind farms shown in **Table 15.20** which will use the N22 will have the potential for similar impact during days when concrete pours for turbine foundations are scheduled.

Should four wind farms have a concrete pour on the same day, then the existing N22 would be close to its guidance capacity for those particular days. However, it is unlikely that it would be possible for any more than two to proceed in any one day with one project being serviced from Keim and the other from a quarry to the south of the N22 as these have limited capacity to supply more than that.

Construction activity between the various developers will need to be scheduled such that, ideally, concrete pours will only take place on one site on any particular day.

Construction activities along the forest track to be used for the four grid connections (Inchamore, Gortyrahilly, Cummeenabuddoge and Knocknamork) , will be scheduled through cross project communication such that there is free access for traffic along the forest track and such that no queues will arise on the N22 should the wind farms be constructed in the same timeframe.

There could also be cumulative effects should blades need to be replaced in an operational wind farm during the construction phase. However, in the unlikely event of such a scenario the replacement blades would have a 3-4 month lead time and deliveries can be co-ordinated. It would not lead to significant effects. Wind farms do not generate a significant amount of traffic during operation as outlined in **Section 15.5.13**.

If the construction phases of the consented but not yet constructed windfarms were to overlap, then there is potential for cumulative effects on the road network from construction traffic and turbine delivery. However, the Coolae and Coolknoohil projects are already consented and so are likely to be constructed prior to the construction of the Development. Should there be overlap, the projects are relatively small with localised works and the effect is predicted to be low, negative, direct but short-term on the N22 with the potential increase in HGV movements. Accordingly, any cumulative impact will be limited and is considered as being slight to moderate and of short duration.

It is possible that a blade (or set of blades) could require replacement if damaged for example by lightning on the nearby wind farms such as Grousemount or Derragh Wind Farms. Should this coincide with the construction period for Inchamore, then there is the potential for cumulative transport affects. However, these are considered as being of low probability, slight impact and of short duration.

15.7.2 Operational Phase

The level of maintenance traffic is normally 1-2 visits per week per wind farm with 5-6 visits per week for a month per year during servicing.

Traffic during the operation periods of Inchamore Wind Farm as well as neighbouring sites will be low and in the range of 0 – 10 trips per day. The effect is rated as being insignificant.

15.7.3 Decommissioning

All of the wind farms listed in **Table 15.20**, have operational periods (generally 25-35 years following commissioning) prescribed by their planning permissions and application documents. No two wind farms will be connected at the same time by ESB/EirGrid due to issues of electrical safety. Therefore, the operational life of the various wind farms will expire on different dates. The decommissioning periods are relatively short (4-6 months). . Accordingly, only slight impacts over those assessed in **Section 15.5.14** are predicted. It is unlikely that any significant cumulative impacts will arise.

15.8 RESIDUAL EFFECTS OF THE DEVELOPMENT

15.8.1 HGV Deliveries and Construction Phase Residual Effects

On the turbine component haul route, there is likely to be a slight, negative, short-term residual effect on the national road network with an increase in traffic volumes on the roads and works at a number of locations as outlined in **Table 15.12**.

The potential effects of the construction of the Project have been identified as being negligible to minor (see **Table 15.19**), but temporary in nature. The mitigation measures are highlighted in **Section 15.6.1**.

The Project is likely to have a minor/negligible effect on the N22 road given increased traffic volumes are unavoidable. However, with the mitigation outlined, these will be minimised.

15.8.2 Operational Phase Residual Effects

There will be no residual effects during the operational phase as only occasional light vehicles and mobile elevation work platforms (MEWP's) are envisaged to visit the wind farm Site during operation for routine checking and maintenance should a significant component of the wind farm require replacing.

15.8.3 Final Decommissioning Phase Residual effects

On the Turbine Component Haul Route, there is likely to be a slight, negative, short-term residual effect on the road network with an increase in traffic volumes on the roads and works at a number of locations as outlined in **Table 15.12** assuming the turbine components are transported back to Ringaskiddy Port. However, the extent of such works will be less than for the construction stage as blades can be cut prior to transportation.

Effects during the decommissioning phase have been assessed to be low compared to the construction phase if hardstand areas are left in place and revegetated . In this case, the effect can be assessed as being imperceptible.

15.9 MONITORING

The condition of the road surface of the N22 near the Site (between Cummeenavrick and the Ballyvourney Junction of the Macroom By-Pass) used to transport construction materials will be monitored during construction so that any damage caused by construction traffic associated with the Project can be identified and maintenance works carried out as soon as practicable to avoid issues for other road users and the local population of the area.

The appointed Contractor will be responsible for seeing that HGV drivers travelling to and from the Site obey the designated speed limits, rules of the road and that they only use the designated civils construction haul route. This will be undertaken through regular tool box talks for drivers during the construction of the Project

15.10 SUMMARY OF SIGNIFICANT EFFECTS

This section has assessed the significance of potential effects of the Project on traffic and transport. The construction stage of the Project has generally been assessed as having the potential to result in effects of a negative to minor, direct, short-term, high probability effect or lower (depending on the road element) during the construction phase only. After mitigation, the residual effects have been assessed as minor to negligible, negative and short-term in nature.

The operational stage impacts are considered as being imperceptible.

The decommissioning stage impacts are considered as being slight, negative, direct, negative to minor probability and short-term in nature.

Potential cumulative effects as detailed in **Section 15.7** were assessed as being slight to moderate, negative, short-term and low probability in nature.

Given that only effects of significant effect or greater are considered "significant" in terms of national legislation, the potential effects of the Project on traffic and transport are considered to be **not significant**.

15.11 STATEMENT OF SIGNIFICANCE

This assessment has identified that the potential effects of the Project on traffic and transport are considered to be **not significant**, given the mitigation measures embedded in the design and proposed for the implementation of the Project.

16 MAJOR ACCIDENTS AND NATURAL DISASTERS

16.1 INTRODUCTION

This section of the Environmental Impact Assessment Report (EIAR) describes the likely significant effects on the environment arising from the vulnerability of the Project, as detailed in **Chapter 2: Project Description**, to risks of major accidents and/or natural disasters. It has been completed in accordance with the guidance set out by the Environmental Protection Agency (EPA) in 'Guidelines on Information to be contained in Environmental Impact Statements' (EPA, 2022) and the European Commission in relation to Environmental Impact Assessment of Projects (Directive 2011/92/EU, as amended by 2014/52/EU), namely 'Guidance on the preparation of the Environmental Impact Assessment Report'.

The assessment of the vulnerability of the Project to major accidents and natural disasters is carried out in compliance with the EIA Directive as amended which states the need to assess:

"the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or natural disasters which are relevant to the project concerned."

The objective of this assessment is to ensure that appropriate precautionary actions are taken for those projects.

"because of their vulnerability to major accidents and/or natural disasters, are likely to have significant adverse effects on the environment".

Based on the requirements of the EIA Directive, this chapter seeks to determine:

- The relevant major accidents and/or natural disasters, if any, that the Project could be vulnerable to;
- The potential for these major accidents and/or natural disasters to result in likely significant adverse environmental effect(s), and
- The measures that are in place, or need to be in place, to prevent or mitigate the likely significant adverse effects of such events on the environment.

16.1.1 Statement of Authority

This chapter has been prepared by Ms. Sarah Moore with the assistance of Ms. Shirley Bradley of Jennings O'Donovan & Partners Limited.

Ms. Sarah Moore is a Senior Environmental Consultant and holds a Bachelor (Hons.) Degree in Environmental Science from University of Limerick and a MSc (Dist) in Environmental Engineering from Queen's University, Belfast. She has worked in environmental consultancy for over fourteen years and has prepared AA Screenings, Environmental Reports and EIARs.

Ms. Shirley Bradley is a Graduate Environmental Scientist with a First-Class Honours Degree (BSc Hons) in Environmental Science from the Institute of Technology, Sligo. She was also awarded with the Governing Body award for a BSc in Environmental Protection. Shirley's key capabilities are in report writing, assisting Senior Consultants and GIS.

16.2 ASSESSMENT METHODOLOGY

The following sources of information and literature pertinent to the area were used in the preparation of this section:

- Census of Ireland;
- Regional Spatial and Economic Strategy (RSES) 2020-2032, published by the Southern Regional Assembly on 31 January 2020;
- Cork County Development Plan 2022 – 2028;
- Cork County Council Website, and
- Fáilte Ireland.

Major accidents or natural disasters are hazards which have the potential to affect the Project and consequently have potential impacts on the environment. These include accidents during construction and operation caused by operational failure and/or natural hazards. The assessment of the risk of major accidents and/or disaster considers all factors defined in the EIA Directive that have been considered in this EIAR, i.e., population and human health, biodiversity, land, soil (peat stability), water, air and climate and material assets, cultural heritage and the landscape.

16.2.1 Legislative Context

16.2.1.1 Legislation

An assessment of the following key elements was undertaken in accordance with the EIA Directive as amended:

- The vulnerability of the Project to potential accidents and disasters
- The Project's potential to cause major accidents or disasters which pose a risk to the environment

The information relevant to major accidents and/or disasters to be included in the EIAR is set out in paragraph 8 of Annex IV of the EIA Directive as follows:

"(8) A description of the expected significant adverse effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned. Relevant information available and obtained through risk assessments pursuant to Union legislation such as Directive 2012/18/EU of the European Parliament and of the Council or Council Directive 2009/71/Euratom or relevant assessments carried out pursuant to national legislation may be used for this purpose provided that the requirements of this Directive are met. Where appropriate, this description should include measures envisaged to prevent or mitigate the significant adverse effects of such events on the environment and details of the preparedness for and proposed response to such emergencies".

16.2.1.2 Guidance Documents

The following guidance documents have been consulted in the preparation of this section:

- European Commission (2017) Environmental Impact Assessment of Projects – Guidance on the preparation of Environmental Impact Assessment Reports;
- Environmental Protection Agency (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports;
- Department of Environment, Heritage and Local Government (2010) A Guide to Risk Assessment in Major Emergency Management;
- Environmental Protect Agency (2014) Guidance on Assessing and Costing Environmental Liabilities;
- Department of Defence (2020) A National Risk Assessment for Ireland, and
- Cork County Council (2021) Major Emergency Plan.

16.2.2 Categorisation of the Baseline Environment

A desk-study has been completed to establish the baseline environment for which the proposed risk assessment is being carried out. This will influence both the likelihood and the impact of a major accident or natural disaster. Local and regional context has been established prior to undertaking the risk assessment to develop an understanding of the vulnerability and resilience of the area to emergency situations.

Further detail on the baseline environment is provided in **Section 16.3**.

16.2.3 Impact Assessment Methodology

16.2.3.1 Introduction

This assessment is focused on an understanding that the Project will be designed, built and operated in line with the methodologies and measures prescribed in this EIAR. Therefore, the overall vulnerability of the Project to risks of major accidents and natural disasters is considered low.

An assessment of potential accidents and disaster scenarios such as pollution incidents to ground and watercourses as well as assessment of flooding events and peat instability are described in detail in the relevant EIAR assessment chapters (Refer to **Chapters 8: Soils and Geology** and **Chapter 9: Hydrology and Hydrogeology** for further details).

16.2.3.2 Site-Specific Risk Assessment Methodology

A site-specific risk assessment identifies and quantifies risks focusing on unplanned, but possible and plausible events occurring during the construction, operation and decommissioning of the Project. The approach to identifying and quantifying risks associated with the Project by means of a site-specific risk assessment is derived from the EPA 'Guidance on Assessing and Costing Environmental Liabilities' document[1]. The following steps were taken as part of the site-specific risk assessment:

- Risk identification;
- Risk classification;
- Likelihood and consequence; and
- Risk evaluation.

16.2.3.2.1 Risk Identification

Risks have been reviewed through the identification of reasonably foreseeable risks in consultation with relevant contributors to this EIAR (Please see **Chapter 1: Introduction** for *Curriculum Vitae* of contributors). The identification of risks has focused on non-standard but plausible incidents that could occur at or as a result of the Project during construction, operation and decommissioning phases.

In accordance with the European Commission EIAR Guidance, risks are identified in respect of the projects:

1. Potential to cause accidents and/or disasters, and
2. Vulnerability to potential disaster/accident.

[1] EPA (2014) Guidance on assessing and costing environmental liabilities. [Accessed online 05/09/2022] Available at https://www.epa.ie/publications/compliance--enforcement/licensees/reporting/financial-provisions/EPA_OEE-Guidance-and-Assessing-WEB.pdf

16.2.3.2.2 *Risk Classification*

Classification of Likelihood

After identifying the potential risks, the likelihood of occurrence of each risk has been assessed. An analysis of safety procedures and proposed environmental controls was considered when estimating likelihood of identified potential risks occurring. **Table 16.1** defines the likelihood ratings that have been applied.

The approach adopted has assumed a 'risk likelihood' where one or more aspects of the likelihood description are met.

Table 16.1: Classification of Likelihood (Source: DoEHLG, 2010)

Ranking	Likelihood	Description
1	Extremely Unlikely	May occur only in exceptional circumstances; once every 500 or more years.
2	Very Unlikely	Is not expected to occur; and/or no recorded incidents or anecdotal evidence; and/or very few incidents in associated organisations, facilities or communities; and / or little opportunity, reason or means to occur; may occur once every 100-500 years.
3	Unlikely	May occur at some time; and /or few, infrequent, random recorded incidents or little anecdotal evidence; some incidents in associated or comparable organisation's worldwide; some opportunity, reason or means to occur; may occur once per 10-100 years.
4	Likely	Likely to or may occur; regular recorded incidents and strong anecdotal evidence and will probably occur once per 1-10 years.
5	Very Likely	Very likely to occur; high level of recorded incidents and/or strong anecdotal evidence. Will probably occur more than once a year.

Classification of Consequence

The consequence rating assigned to each risk has assumed that all proposed mitigation measures and/or safety procedures have failed to prevent the major accident and/or disaster. Furthermore, the Cork County Council Major Emergency Plan (2021), if implemented as intended, would work to reduce the consequence of any major accident or disaster. The consequence of the impact if the event occurs has been assigned as described in **Table 16.2**.

The consequence of a risk to/from the Project has been determined where one or more aspects of the consequence description are met, i.e., risks that have no consequence have been excluded from the assessment.

Table 16.2: Classification of Impact (Source: DoEHLG, 2010)

Ranking	Likelihood	Impact	Description
1	Minor	Life, Health, Welfare	Small number of people affected; no fatalities and small number of minor injuries with first aid treatment.
		Environment	No contamination, localised effects
		Infrastructure	<€0.5M
		Social	Minor localised disruption to community services or infrastructure (<6 hours).
2	Limited	Life, Health, Welfare	Single fatality; limited number of people affected; a few serious injuries with hospitalisation and medical treatment required. Localised displacement of a small number of people for 6-24 hours. Personal support satisfied through local arrangements.
		Environment	Simple contamination, localised effects of short duration
		Infrastructure	€0.5-3M
		Social	Normal community functioning with some inconvenience
3	Serious	Life, Health, Welfare	Significant number of people in affected area impacted with multiple fatalities (<5), multiple serious or extensive injuries (20), significant hospitalisation. Large number of people displaced for 6-24 hours or possibly beyond; up to 500 evacuated.

Ranking	Likelihood	Impact	Description
			External resources required for personal support.
		Environment	Simple contamination, widespread effects or extended duration
		Infrastructure	€3-10M
		Social	Community only partially functioning, some services available.
4	Very Serious	Life, Health, Welfare	5 to 50 fatalities, up to 100 serious injuries, up to 2000 evacuated
		Environment	Heavy contamination, localised effects or extended duration
		Infrastructure	€10-25M
		Social	Community functioning poorly, minimal services available
5	Catastrophic	Life, Health, Welfare	Large numbers of people impacted with significant numbers of fatalities (>50), injuries in the hundreds, more than 2000 evacuated.
		Environment	Very heavy contamination, widespread effects of extended duration.
		Infrastructure	>€25M
		Social	Serious damage to infrastructure causing significant disruption to, or loss of, key services for prolonged period. Community unable to function without significant support.

Risk Evaluation

Once classified, the likelihood and consequence ratings have been multiplied to establish a 'risk score' to support the evaluation of risks by means of a risk matrix.

The risk matrix sourced from the DoEHLG Guide to Risk Assessment in Major Emergency Management (and as outlined in **Table 16.3**) indicates the critical nature of each risk. This risk matrix has therefore been applied to evaluate each of the risks associated with the Project. The risk matrix is colour coded to provide a broad indication of the critical nature of each risk:

- The red zone represents 'high risk scenarios';
- The amber zone represents 'medium risk scenarios', and
- The green zone represents 'low risk scenarios.

Table 16.3: Classification of Impact (Source: DoEHLG, 2010)

		Consequence Rating				
		1.Minor	2.Limited	3. Serious	4.Very Serious	5.Catastrophic
Likelihood Rating	5.Very Likely					
	4. Likely					
	3. Unlikely					
	2. Very Unlikely					
	1. Extremely Unlikely					

16.3 PROJECT HAZARD ANALYSIS

The HSE Emergency Management: Emergency Plans outline several hazard categories which may have the potential to lead to a major emergency. The hazard categories include Natural, Transportation, Technological and Civil. The hazard categories, types and subtypes, and their relevance to the Project, are listed below in **Table 16.4**.

As of November 2022, there is no Emergency Plan publicly available for Area 4 (Cork, Kerry). **Table 16.4** below was modelled on available Emergency Plans namely Area 1 (Donegal, Sligo, Leitrim, Cavan, and Monaghan) and Area 2 (Galway, Mayo, and Roscommon).

Table 16.4: HSE Emergency Plan hazard types (HSE, 2022)

Category	Type	Subtype	Relevance to the Project
Natural Hazards			
Meteorological	Storm / Gale Both coastal and inland areas can be affected by high winds	Both coastal and inland areas can be affected by high winds	Poor driving conditions Loss of infrastructure Flooding Falling Trees
	Heavy Snow	Blizzards- 'Poor visibility	Poor Driving conditions
	Severe Cold / Frost extremes of Temperature	Icy Roads/Impassable Roads Hypothermia Freezing of Supply Network	Poor Driving Conditions Public Health Risk Lack of Road Grit
	Thunder & Lightening Dense/ Persistent Fog Heat Wave /Drought	Road Traffic collisions	Loss of Infrastructure Poor driving conditions Public Health Risk Water Shortage
Hydrological	Flooding	Coastal / Inland	Potential for flooding via on-site rivers
	Heavy Rain		May lead to flooding in Low Lying areas or areas with poor drainage
Geological	Landslide		Peat Instability
	Forest / Wilderness fire - Air Pollution		Majority of the Site and some of surrounding area is forested.
Transportation Hazards			
Aviation	Aircraft Collision /Loss	Mid Air and Land	Not Applicable
Road	Multiple Road Traffic Collision		Public Roads via which construction staff and materials access the site.
	Hazmat		Fuel Transport to/from site
	Bridge		Not Applicable
Water	Inland Water ways	Pleasure Craft/Cruises Pollution from above	Not Applicable
	Coastal	Car Ferry/ passenger Ferries	Not Applicable

Category	Type	Subtype	Relevance to the Project
Technological Hazards			
Industrial Accidents	Explosions		Damage to Infrastructure Personal Injuries/ fatalities
	Petrochemical Fires		Personal Injuries, severe burns/ fatalities Air Pollution
	Industrial Fires	LPG Tank Fire	Not Applicable
	Gas Emission		Not Applicable
	Fluid/ Fuel Emission		Refuelling on site
Explosions	Domestic	Natural Gas explosion	Not Applicable
	Bomb		Not Applicable
	LPG		Not Applicable
	Pipeline		Not Applicable
Fires			Air Pollution
Building Collapse			Not Applicable
Hazardous substance		Accident at site	Not Applicable
		Transportation accident	Hazmat on roads
		Weapons	Not Applicable
	Biological	Leak/Weapons	Not Applicable
	Radiological	"Dirty Bomb"	Not Applicable
		Industrial Accident	Damage to Infrastructure Personal Injuries/ fatalities
		Health facilities	Not Applicable
Pollution/ Contamination	Air/Water Pollution		Fire Sediment-laden Water Run Off Fuel/hydrocarbon spill/leak
Civil Hazards			
Major Crowd Safety	(Movement, crushing etc.)	Pop Concerts Sports Events Fireworks displays Air shows	Not Applicable
Loss of Critical Infrastructure	Energy and Power Supply	Electricity	Connection to national grid
		Natural Gas	Not Applicable
		Fuel Oil	Not Applicable
		Communications	Telecom operators, mobile phone networks
Food Situation Crisis		Food Contamination Drought	Not Applicable
Water Supply		Shortage/ Contamination Freezing /Flooding	Not Applicable
Epidemics and pandemic		Communicable diseases	Not Applicable
Animal Disease		Foot & Mouth Avian Influenza	Not Applicable

Category	Type	Subtype	Relevance to the Project
Terrorism	Bombs	Car-bombs	Not Applicable
		Bombs in buildings	Not Applicable
		Fire-bombing	Not Applicable
	CBRNE		Not Applicable
	Disruption	Bomb scares	Not Applicable

The risks which are most relevant to this assessment are described in the sections that follow.

16.3.1 Meteorological

Ireland has a temperate, oceanic climate, resulting in mild winters and cool summers. The dominant influence on Ireland's climate is the Atlantic Ocean. Consequently, Ireland does not suffer from the extremes of temperature experienced by many other countries at similar latitude. The hills and mountains, many of which are near the coasts, provide shelter from strong winds and from the direct oceanic influence.

The Met Éireann weather station at Cork Airport is the nearest weather and climate monitoring station to the Project that has meteorological data recorded for the 30- year period from 1991 to 2021. The monitoring station is located approximately 48 kilometres south-east of the Project. Meteorological data recorded at Cork Airport over the 30-year period from 1991 - 2021 is shown in **Chapter 10: Air and Climate**. The wettest months are October and December, June is usually the driest. July is the warmest month with a mean daily temperature of 15.2° Celsius(C) and January is the coldest with a mean daily temperature of 5.8°C. The average annual temperature is 10.0°C.

The works programme for the construction stage of the Project will take account of weather forecasts and work will be suspended in the case of extreme weather events.

The following forecasting and weather warning 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.
- Weather Warning or Advisories: Met Éireann's main suite of warnings are issued by the duty forecaster between 10am and midday and are updated as necessary as new information becomes available. In general, warnings will not be issued more than 60-

hours ahead of the expected adverse weather but advisories on potential hazards are issued up to a week in advance. The three warning categories are:

- o Yellow: Not unusual weather. Localised danger.
- o Orange: Infrequent. Dangerous/disruptive.
- o Red: Rare. Extremely dangerous/destructive.

- 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 Éireann 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.
- Consultancy Service: Met Éireann 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.

16.3.2 Hydrological

As detailed in **Chapter 9: Hydrology and Hydrogeology, Appendix 9.1** Inchamore Wind Farm Site Specific Flood Risk Assessment, no recurring or historic flood incidents are recorded within the Site or along the Grid Connection Route and Turbine Delivery Route.

Inspection of Base Maps from Ordinance Survey of Ireland records, i.e. First Edition 6-inch map (1839-1842) indicate that Wind Farm Site itself, the TDR and the GCR are not susceptible to flooding. The National Flood Hazard Mapping database operated by the OPW also confirms there are no areas represented as being low, medium or high probability risk to flood areas within the Project. Furthermore, there have been no recorded flood events on the OPW Database in the immediate vicinity of the Project.

No recurring flood incidents within the Site or immediately downstream were identified from OPW's Flood Hazard Mapping. The closest mapped recurring flood event is the Sullane (030) river approximately 10 km to the southeast of the site near Ballymakeery town. This flood risk area identified extends along the Sullane (030) and continues after the Sullane (030) river and the Lee (Cork)(030) river merge in Carrigdrohid Reservoir.

Where complete, the CFRAM[2] Study OPW Flood Risk Assessment Maps are now the primary reference for flood risk planning in Ireland and supersede the PFRAM maps. No areas of the Project are within a zone mapped as being either low (0.1% AEP[3]), medium (1% AEP) or high (10% AEP) probability of fluvial flooding. There are no areas of pluvial flood extents mapped near the Site.

Based on the information gained through the flood identification process, no parts of the site are mapped within any fluvial flood zones (Flood Zones A - B).

All proposed works (except for watercourse crossings) are located at least 65 m from a watercourse.

As the associated drainage - some of which is permeant for the lifetime of the Project, will be attenuated for greenfield run-off, the Project will not increase the risk of flooding elsewhere in the catchment. Based on this information, the Project complies with the appropriate policy guidelines for the area and is at no risk of flooding.

A 1 in 100-year storm event scenario results in a net increase of surface water runoff associated with the Development, calculated to be c. 0.172 m^3/second, or 1.436% relative to the Site area (Redline Boundary). This net increase relative to the scale of the Site or the scale of the associated catchment is considered an adverse but imperceptible or negligible impact of the Development.

The Project will use the latest best practice guidance to ensure that flood risk within or downstream of the Site is not increased as a function of the Project, i.e., a neutral impact at a minimum.

The risk of the wind farm contributing to downstream flooding is also very low, as the long-term plan for the site is to retain and slow down drainage water prior to release. Robust drainage measures on the site will include swales, silt traps, check dams, settlement ponds and buffered outfalls. Please refer to the **Chapter 9** of this EIAR for further details.

[2] CFRAM is Catchment Flood Risk Assessment and Management. The national CFRAM programme commenced in Ireland in 2011, and is managed by the OPW. The CFRAM Programme is central to the medium to long-term strategy for the reduction and management of flood risk in Ireland.
[3] AEP is the annual exceedance probability.

16.3.3 Peat Stability

A comprehensive and robust Peat Stability Assessment was undertaken for the Site and used to inform the design process including the siting of all proposed main infrastructure locations and drainage control measures. A desk-stop study was undertaken for the Turbine Delivery Route and Grid Connection Route. This was considered sufficient due to the nature and scale of the works associated with these elements. The Peat Stability Assessment was informed by the Scottish Government's 2017 guidance document, Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments. Intrusive ground investigation works were carried out as part of the Peat Stability Assessment which included peat depth probing, shear strength testing, ground augering/coring and trial pitting. The extensive suite of ground investigations and the robust peat stability assessment completed ensured that the risk of such an event occurring during the construction, operation or decommissioning at the Project is minimised.

Peat depth across the site is generally very shallow to shallow with the exception of isolated pockets of moderately deep peat delineated by shallow subsoils and/or bedrock at or near the surface, particularly in the north west of the site. No infrastructure is proposed in the areas of moderately deep peat. There was no deep or very deep peat observed at the Site. The risk of landslides occurring on the proposed site under worst case scenario conditions has been determined to be generally very low to low.

Please see **Chapter 8: Soils and Geology** and **Appendix 8.1** for more details.

16.3.4 Traffic

The Project will utilise the existing road network during the construction phase. Construction related traffic will originate from the delivery of materials to site, removal of surplus excavated material from site and transport of employees to, from and throughout the site. The localised traffic disruptions will be mitigated through the use of industry standard traffic management measures. Please see **Chapter 15: Traffic and Transport** and **Appendix 2.1** for details.

A Traffic Management Plan (**Appendix 2.1**) is provided specifying details relating to traffic management. Prior to the commencement of the construction phase of the Project, a detailed Traffic Management Plan will be prepared by the Contractor for agreement with the relevant local authorities and An Garda Síochána. The Traffic Management Plan includes recommendations for the following:

- Traffic Management Co-ordinator;

- Delivery Programme;
- Provision of information to locals;
- A Pre and Post Construction Condition Survey;
- Liaison with the relevant local authority;
- Implementation of temporary alterations to the road network at critical locations;
- Identification of delivery routes;
- Delivery times of large turbine components;
- Travel plan for construction workers;
- Additional measures, and
- Re-instatement works.

Please see **Chapter 15: Traffic and Transportation** and Traffic Management Plan (**Appendix 2.1**) for further details.

16.3.5 Industrial Accident

The Project is not connected to or in the vicinity of any site regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations (SEVESO sites), therefore no significant effects associated with major industrial accidents involving dangerous substances are anticipated. Gas explosions, petrochemical fires and fires from fuel emissions, leakages and spillages could occur causing personal injury, structural damage and forest fires.

16.3.6 Loss of Critical Infrastructure

EirGrid operates and develops Ireland's electricity grid. This includes interconnecting to neighbouring grids and running the wholesale electricity market. The grid safely brings power from generators such as wind farms to the ESB network that supplies homes and business in Ireland. It also brings power directly to large energy users. There are two types of electricity generation: synchronous generation and non-synchronous generation. Synchronous generation produces the same amount of electricity all the time e.g., fossil fuels. Non-synchronous generation produces varying amounts of electricity depending on the energy available. EirGrid operate the grid from National Control Centres in Dublin and Belfast, matching electricity production to customer demand, switching from synchronous to non- synchronous where required to ensure no power outages. Therefore, any technical fault at the Project would not impact the local or national energy supply.

The Project is anticipated to connect to the existing Ballyvouskill 220kV Substation.

16.3.7 Contamination

The Project has the potential to cause contamination and pollution of groundwater and surface water from potential release of hydrocarbons, earthworks and excavations on site. A Construction Environment Management Plan (CEMP) (**Appendix 2.1**) has been prepared in conjunction with the Environmental Impact Assessment Report and the Natura Impact Statement which accompanies the planning application for the Project.

Section 3 of the CEMP sets out details of the environmental controls to be implemented on site. The CEMP provides details on site drainage measures, peat stability monitoring measures, waste management and pollution prevention measures for refuelling and managing hazardous materials and cement-based products. The CEMP also sets out the Emergency Response Procedure (**Management Plan 1**) to be adopted in the event of an emergency including contamination, health and safety and environmental protection.

The CEMP provides details on all mitigation and monitoring measures to be actioned prior to construction, during the construction, operation and decommissioning phase. The CEMP will be subject to ongoing review through regular environmental auditing and site inspections during the construction phase. This will confirm the efficacy and implementation of all mitigation measures and commitments identified in the application documentation. Please see **Chapter 2: Project Description** and **Appendix 2.1 Construction Environmental Management Plan** for further details.

16.3.8 Health andSafety

During construction of the Project, all staff will be made aware of 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 2013'. This will encompass the use of all necessary Personal Protective Equipment and adherence to the site Health and Safety Plan. An Emergency Response Plan (ERP) (**Appendix 2.1**) will be implemented and adhered to on site. The ERP provides details of procedures to be adopted in the event of an emergency in terms of site health and safety and environmental protection.

16.3.9 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 Department of Housing, Planning and Local Government's "Draft Revised Wind Energy Guidelines, December 2019" state health and safety issues are generally covered by separate legislation and not by planning legislation however developers of wind energy developments should be aware of their requirements.

The DoEHLG Guidelines 2006 and the draft revised guidelines 2019 state that there is a very remote possibility of injury to people from flying fragments of ice or from a damaged blade. However, most blades are composite structures with no bolts or separate components and the danger is therefore minimised. The build-up of ice on turbines is unlikely to present problems. The wind turbines will be fitted with anti-vibration sensors, which will detect any imbalance caused by icing of the blades. The sensors will cause the turbine to wait until the blades have been de-iced prior to beginning operation.

Turbine blades are manufactured of glass reinforced plastic which will prevent any likelihood of an increase in lightning strikes within the Site 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.

16.3.10 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), construction staff, operational & maintenance staff or recreational users of the site as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables.

The ESB document 'EMF & You' (ESB, 2017)[4] provides further practical information on EMF. Further details on the potential impacts of electromagnetic interference to telecommunications and aviation are presented in the **Chapter 13: Material Assets and Other Issues.**

16.4 RISK ASSESSMENT

This section outlines the possible risks associated with the Project for the construction, operational and decommissioning phases.

These risks have been assessed in accordance with the relevant classification as outlined in **Table 16.1** and **Table 16.2.**

The consequence rating assigned to each potential risk assumes that all proposed mitigation measures and safety procedures have failed to prevent the major accident and/or disaster.

16.4.1 Likely Significant Effects

16.4.1.1 *Do-Nothing Scenario*

If the Project was not to proceed it would not be able to supply the electricity generated to the national grid. The opportunity to generate renewable energy and electrical supply to the national grid would be lost. Commercial forestry operations, existing land-use practices and recreational amenities would continue at the Site.

16.4.1.2 Assessment of Effects During Construction

A risk register has been developed which contains all potentially relevant risks identified during the construction phase of the Project. Six risks specific to the construction of the Project have been identified and are presented in **Table 16.5.**

Table 16.5: Risk Register - Construction Phase

Risk ID	Potential Risk	Possible Cause
Potential vulnerability to disaster risks		
A	**Severe Weather** Risk to construction activity on site	Extreme weather- periods of heavy rainfall, taking into account climate change and strong winds
B	**Flooding**	

[4] EMF & You: Information about Electric & Magnetic Fields and the electricity network in Ireland Available at: https://esb.ie/docs/default-source/default-document-library/emf-public-information_booklet_v9.pdf?sfvrsn=0.

Risk ID	Potential Risk	Possible Cause
	High levels of surface water on site	Extreme weather- periods of heavy rainfall, taking into account climate change and strong winds
C	**Peat Stability** Movement of peat within the site during construction	Mismanagement of excavated material on site Severe weather conditions- storm, flooding
Potential to cause accidents and / or disasters		
D	**Traffic Incident** Collisions onsite and offsite with vehicles involved in construction of the Project	Driver negligence or failure of vehicular operations on site roads. Traffic Management Plan not implemented
E	**Contamination** Discharge or spillage of fuel, chemical solvents into watercourse or percolated to groundwater	Fuel spillage during delivery to site. Failure of fuel storage tank or tanks in plant and machinery and vehicles. Drainage and seepage water resulting from infrastructure excavation; Stockpiled excavated material providing a point source of exposed sediment; Construction of the Project cable trench resulting in entrainment of sediment from the excavations during construction; and, Erosion of sediment from emplaced site drainage channels.
F	Industrial Accident- Fire, gas explosion	Equipment or infrastructure failure; Electrical problems; and Employee negligence.

16.4.1.3 Assessment of Effect During Operation

Six risks specific to the operation of the Project have been identified and are presented in **Table 16.6**.

Table 16.6: Risk Register – Operational Phase

Risk ID	Potential Risk	Possible Cause
Potential vulnerability to disaster risks		
G	**Contamination**	

Risk ID	Potential Risk	Possible Cause
	Discharge or spillage of fuel, chemical solvents, sewage or wastewater into watercourse or percolated to groundwater	A vehicular incident on the public road involving fuel, wastewater or sewage transportation in the operational phase.
Potential to cause accidents and / or disasters		
H	**Industrial Accident – Fire / Gas Explosion**	Equipment or infrastructure failure; Electrical problems; and Employee negligence.
I	**Collapse/ damage to structures**	Earthquakes; and Vehicular collisions due to driver negligence on public roads.
J	**Traffic Incident** Collisions onsite and offsite with vehicles involved in operation of the Project.	Driver negligence or failure of vehicular operations on site roads. Traffic Management not implemented
K	**Industrial Accident Fire/ Gas explosion**	Petrochemical Fires causing personal injury, structural damage and forest fires.
L	**Loss of Critical Infrastructure**	Electrical fault at substation bay

16.4.1.4 Assessment of Effect During Decommissioning

Six risks specific to the decommissioning of the Project have been identified and are presented in **Table 16.7**.

Table 16.7: Risk Register – Decommissioning Phase

Risk ID	Potential Risk	Possible Cause
Potential vulnerability to disaster risks		
M	**Severe Weather** Risk to decommissioning activity on site	Extreme weather- periods of heavy rainfall, taking into account climate change and strong winds
N	**Flooding of site** High levels of surface water on site	Extreme weather- periods of heavy rainfall, taking into account climate change and strong winds
Potential to cause accidents and / or disasters		
O	**Traffic Incident**	

Risk ID	Potential Risk	Possible Cause
	Collisions onsite and offsite with vehicles involved in construction of the Project	Driver negligence or failure of vehicular operations on site roads. Traffic Management not implemented
P	**Contamination** Discharge or spillage of fuel, chemical solvents into watercourse or percolated to groundwater	Fuel spillage during delivery to site. Failure of fuel storage tank or tanks in plant and machinery and vehicles. Drainage and seepage water resulting from infrastructure excavation. Erosion of sediment from emplaced site drainage channels.
Q	**Industrial Accident - Fire/Gas explosion**	Petrochemical Fires causing personal injury, structural damage and forest fires.
R	**Loss of Critical Infrastructure**	Electrical fault at substation bay

These risks have been assessed in accordance with the relevant classification (Refer to **Table 16.1** and **Table 16.2**) and the resulting risk analysis is given in **Table 16.6**.

The risk register is based upon possible risks associated with the Project. As outlined in **Section 16.3**, the consequence rating assigned to each potential risk assumes that all proposed mitigation measures and safety procedures have failed to prevent the major accident and/or disaster.

16.4.1.5 Assessment of Effect – Summary

Table 16.8: Risk Assessment

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
Construction Phase								
A	Severe Weather	Extreme weather-periods of heavy rainfall, taking into account climate change and strong winds	Illness or loss of life; Sedimentation of nearby watercourse Damage to, or depletion of aquatic habitats and species;	3	The risk of severe weather is unlikely when considering the assessment in **Chapter 10: Air and Climate** and weather conditions recorded over the last 30 years within the area.	1	The risk of severe weather conditions during the construction phase will result in a minor consequence in that a small number of people would be affected' should a severe weather occur, with 'no fatalities and a small number of minor injuries with first aid treatment'. No contamination, localised effects.	3
B	Flooding	Extreme weather-periods of heavy rainfall, taking into account climate	Illness or loss of life; Sedimentation of nearby watercourse;	2	The risk of flooding is considered very unlikely when taking into account the	1	The risk of flooding during the construction phase will result in a minor consequence in	2

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
		change and strong winds	Damage to, or depletion of aquatic habitats and species;		baseline assessment in **Chapter 9: Hydrology and Hydrogeology** and due to no recurring or historic flood incidents being recorded within the Wind Farm site or along the Grid Connection route.		that a small number of people would be affected' should a severe weather occur, with no fatalities and a small number of minor injuries with first aid treatment'. No contamination of environment (e.g., watercourses), localised effects.	
C	Peat Stability	Mismanagement of excavated material on site Extreme weather conditions	Movement of peat within the Project; Sedimentation of nearby watercourse; Damage to, or depletion of aquatic habitats and species;	2	The Project has been designed to minimise the potential for peat instability and failure. Refer to **Appendix 8.1: Geotechnical and Peat Stability Assessment Report**	2	The risk of peat instability during the construction phase will result in a limited consequence in that there would be a limited number of people affected' with 'localised effects of short duration.	4

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
							Contamination of environment (e.g., watercourses), localised effects of short duration.	
D	Traffic Incident	Driver negligence or failure of vehicular operations on Site Access Roads. Traffic Management not implemented or not adhered	Injury or loss of life.	3	A limited number of vehicles will be permitted on the Site as part of the construction phase. As such, it can be determined that there is some 'opportunity, reason or means' for a vehicle collision to occur on site, 'at some time.' An unlikely risk is therefore predicted.	1	A minor consequence is predicted. Having regard to on-site speed limits and vehicular movements, a small number of people would be affected' should a vehicular collision occur, with no fatalities and small number of minor injuries with first aid treatment.'	3
E	Contamination	Fuel spillage during delivery to site.	Damage to, or depletion of aquatic habitats and species	2	As outlined in **Chapter 2: Project Description** and the **Appendix 2.1 Construction**	2	The risk of a fuel spillage or impact on surround drainage during the construction phase will	4

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
		Failure of fuel storage tank or tanks in plant and machinery and vehicles. Drainage and seepage water resulting from infrastructure excavation; Stockpiled excavated material providing a point source of exposed sediment; Construction of the Project resulting in entrainment of sediment from the	Release of suspended solids to surface watercourses and could result in an increase in the suspended sediment load, resulting in increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies		**Environmental Management Plan,** fuel will be stored on-site but in a bunded area to ensure containment and prevent spillages of fuel. No fuels, chemicals or solvents will be stored outside of the confines of the site. Setback distances from sensitive hydrological features means that adequate room is maintained for the proposed drainage mitigation measures as detailed in **Chapter 9: Hydrology and Hydrogeology.**		result in a limited consequence in that there would be a limited number of people affected' with 'localised effects of short duration through the use of bunded containment areas and proposed drainage mitigation measures during construction. Contamination of environment (e.g., watercourses), localised effects of short duration.	

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
		excavations during construction; and, Erosion of sediment from emplaced site drainage channels						
F	Industrial Accident - Fire/Gas explosion	Equipment or infrastructure failure; Fuel spillage/storage Electrical problems; and Employee negligence	Illness or loss of life; Damage to, or depletion of habitats and species; and Impacts on ambient air quality.	2	As outlined in **Chapter 2 Project Description** and **Appendix 2.1: Construction Environmental Management Plan,** fuel will not be stored on-site post construction, therefore fuel is not considered to be a significant fire risk. There are no Gas Networks within the vicinity of the Project.	2	Should a fire/explosion occur at the site, it will be of a limited consequence in that there would be a limited number of people affected' with localised effects of short duration due to the nature of the project and the lack of infrastructure or fuel storage during operation that would result in any such incident. There will be normal community functioning in the area	4

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
					Therefore, there is low risk of explosion. In accordance with Chapter 19 of the Safety, Health and Welfare at Work Act 2005 (the 2005 Act), the Project will be subject to a fire safety risk assessment which would assist in the confirmation of any major risks of fire on site e.g., wind turbines, substation, vandalism.		with some inconvenience. Simple contamination of environment (e.g., watercourses), localised effects of short duration.	
Operational Phase								
G	Contamination	A vehicular incident, refuelling incident, wastewater or sewage transportation in	Damage to, or depletion of aquatic habitats and species.	2	As outlined in **Chapter 2: Project Description** and **Appendix 2.1 Construction Environmental**	2	The risk of a fuel spillage or impact on surrounding drainage during the operational stage will result in a limited	4

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
		the operational phase.	Release of suspended solids to surface watercourses could result in an increase in the suspended sediment load. Increased turbidity which in turn could affect the water quality and fish stocks of downstream water bodies		**Management Plan**, fuel will be stored on-site but in a bunded area to ensure containment and prevent spillages of fuel. No fuels, chemicals or solvents will be stored outside of the confines of the site. Setback distances from sensitive hydrological features means that adequate room is maintained for the proposed drainage measures as detailed in **Chapter 9: Hydrology and Hydrogeology**.		consequence in that there would be a limited number of people affected with localised effects of short duration through the use of bunded containment areas during operation. Simple contamination of environment (e.g., watercourses), localised effects of short duration.	

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
H	Industrial Accident - Fire/Gas explosion	Equipment or infrastructure failure; Fuel spillage/storage Electrical problems; and Employee negligence	Illness or loss of life; Damage to, or depletion of habitats and species; and Impacts on ambient air quality.	2	As outlined in **Chapter 2: Project Description**, fuel will not be stored on-site post construction therefore fuel is not considered to be a significant fire risk. Gas will not be used onsite; therefore it is not considered a fire/explosion risk. In accordance with Chapter 19 of the Safety, Health and Welfare at Work Act 2005 (the 2005 Act), the Project will be subject to a fire safety risk assessment which would assist in the	2	Should a fire/explosion occur at the site, it will be of limited consequence in that there would be a limited number of people affected with localised effects of short duration due to the nature of the project and the lack of infrastructure or fuel storage during operation that would result in any such incident. There will be normal community functioning in the area with some inconvenience. Simple contamination of environment (e.g., watercourses), localised effects of short duration.	4

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
					identification of any major risks of fire on site e.g. wind turbines, substation, vandalism			
I	Collapse/ damage to structures	Landslide/ Earthquake; and Extreme weather conditions such as flooding and storms. Vehicular collisions due to driver negligence Mismanagement of excavated material on site	Injury or loss of life. Movement of peat within the site; Sedimentation of nearby watercourse; Damage to, or depletion of aquatic habitats and species;	2	According to the Irish National Seismic Network, earthquakes measuring ~2 on the Richter Scale are "normal" in terms of seismicity in Ireland. These are known as microearthquakes; they are not commonly felt by people and are generally recorded only on local seismographs. As such, buildings in Ireland are extremely unlikely to be damaged or collapse due to seismic activity.	1	The risk of infrastructure collapse or damage to structures during the construction phase will result in a minor consequence in that a small number of people would be affected, with no fatalities and a small number of minor injuries with first aid treatment. No contamination of environment (e.g., watercourses), localised effects.	2

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
					Having regard to public speed limits within the site, it is not predicted that any collision of vehicles and any infrastructure would result in significant damage/collapse. The Project has been designed to take into account any issues on peat or spoil stability			
J	Traffic Incident	Driver negligence or failure of vehicular operations on Site Access Roads. Traffic Management not implemented	Injury or loss of life.	3	A limited number of vehicles will be permitted on the Site as part of the operation phase. As such, it can be determined that there is some 'opportunity, reason or means for a	1	A minor consequence is predicted. Having regard to on-site speed limits and vehicular movements, a small number of people would be affected should a vehicular collision occur, with no fatalities and small number of minor	3

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
					vehicle collision to occur on site, 'at some time.'		injuries with first aid treatment.	
K	Loss of Critical Infrastructure	Equipment or infrastructure failure; Electrical problems; Employee negligence Landslide/ Earthquake; Extreme weather conditions such as flooding and storms.	Injury or loss of life	1	EirGrid operate the grid from National Control Centres matching electricity production to customer demand, switching from synchronous to non-synchronous where required to ensure no power outages. The Project will be connected to a single bay at Ballyvouskill 220kV substation and any shortages or failures will not impact other connections to the same substation	2	Should a power failure occur at the Ballyvouskill 220kV substation, it will result in a limited number of people affected-localised effects of short duration	2

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
Decommissioning Phase								
L	Severe Weather	Extreme weather- periods of heavy rainfall, taking into account climate change and strong winds	Illness or loss of life; Sedimentation of nearby watercourse Damage to, or depletion of aquatic habitats and species.	2	The risk of severe weather is unlikely when considering the assessment in **Chapter 10: Air and Climate** and weather conditions recorded over the last 30 years within the area.	1	The risk of severe weather conditions during the decommissioning phase will result in a minor consequence in that small number of people would be affected should a severe weather occur, with no fatalities and a small number of minor injuries with first aid treatment. No contamination of environment (e.g., watercourses), localised effects.	2
M	Flooding	Extreme weather- periods of heavy rainfall, taking into account climate	Illness or loss of life; Sedimentation of nearby watercourse	1	The risk of flooding is considered very unlikely when taking into account the	1	The risk of flooding during the decommissioning phase will result in a minor	1

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
		change and strong winds	Damage to, or depletion of aquatic habitats and species;		baseline assessment in **Chapter 9: Hydrology and Hydrogeology** and due to no recurring or historic flood incidents recorded within the Site or along the Grid Connection route.		consequence in that 'small number of people would be affected should a severe weather event occur, with no fatalities and a small number of minor injuries with first aid treatment. No contamination of environment (e.g., watercourses), localised effects.	
N	Traffic Incident	Driver negligence or failure of vehicular operations on Site Access Roads. Traffic Management not implemented	Injury or loss of life.	3	A limited number of vehicles will be permitted on the Site as part of the decommissioning phase. As such, it can be determined that there is some 'opportunity,	1	A minor consequence is predicted. Having regard to on-site speed limits and vehicular movements, a small number of people would be affected should a vehicular collision occur, with no fatalities and small number of minor	3

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
					reason or means for a vehicle collision to occur on site, 'at some time.' An unlikely risk is therefore predicted.		injuries with first aid treatment.	
O	Contamination	Fuel spillage during delivery to site. Failure of fuel storage tank or tanks in plant and machinery and vehicles. Drainage and seepage water resulting from infrastructure removal. Erosion of sediment from site drainage channels.	Damage to, or depletion of aquatic habitats and species 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	2	As outlined in **Chapter 2: Project Description** and **Appendix 2.1 Construction Environmental Management Plan**, fuel will be stored on-site but in a bunded area to ensure containment and prevent spillages of fuel. No fuels, chemicals or solvents will be stored outside of the confines of the Site. Setback distances from sensitive hydrological	2	The risk of a fuel spillage or impact on surrounding drainage during the decommissioning phase will result in a limited consequence in that there would be a limited number of people affected with localised effects of short duration through the use of bunded containment areas during operation. Simple contamination of environment (e.g., watercourses), localised effects of short duration.	4

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
			stocks of downstream water bodies.		features means that adequate room is maintained for the proposed drainage measures as detailed in **Chapter 9: Hydrology and Hydrogeology**.			
P	Industrial Accident- Fire/gas explosion	Equipment or infrastructure failure; Fuel spillage/storage Electrical problems; and Employee negligence	Injury or loss of life Structural damage Forest fires Air Pollution Damage to, or depletion of habitats and species Contamination	2	As outlined in **Chapter 2: Project Description** and **Appendix 2.1 Construction Environmental Management Plan**, fuel will not be stored on-site post construction therefore fuel is not considered to be a significant fire risk. In accordance with Chapter 19 of the	2	Should a fire/explosion occur at the site, a limited consequence in that there would be a limited number of people affected with localised effects of short duration due to the nature of the project and the lack of infrastructure or fuel storage during decommissioning that would result in any such incident. There will be normal community	4

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
					Safety, Health and Welfare at Work Act 2005 (the 2005 Act), the Project will be subject to a fire safety risk assessment which would assist in the identification of any major risks of fire on site.		functioning in the area with some inconvenience. Simple contamination of environment (e.g., watercourses), localised effects of short duration.	
Q	Loss of Critical Infrastructure	Equipment or infrastructure failure; Electrical problems; and Employee negligence Landslide/ Earthquake; and	Injury or loss of life	1	EirGrid operate the grid from National Control Centres matching electricity production to customer demand, switching from synchronous to non-synchronous where required to ensure no power outages. The Project will be connected to	2	Should a power failure occur at the Ballyvouskill 220kV substation, it will result in a limited number of people affected-localised effects of short duration	2

Risk ID	Potential Risk	Possible Cause	Environmental Effect	Likelihood Rating	Basis of Likelihood	Consequence Rating	Basis of Consequence	Risk Score (Consequence x Likelihood)
		Extreme weather conditions such as flooding and storms.			Ballyvouskill 220kV substation and any shortages or failures will not impact other connections to the same substation			

The risk assessment for each of the potential risks identified are consolidated in **Table 16.9** which provides their 'risk score.' A corresponding risk matrix is provided in **Table 16.10**, which is colour coded to provide an indication of the critical nature of each risk. As outlined in **Table 16.3**, the red zone represents 'high risk' scenarios', the amber zone represents 'medium risk scenarios and the green zone represents 'low risk scenarios.

Table 16.9: Risk Scores

Risk ID	Potential Risk	Likelihood Rating	Consequence Rating	Risk Score
Construction Phase				
A	Severe Weather	3	1	3
B	Flooding	1	1	1
C	Peat Stability	2	2	4
D	Traffic Incident	3	1	3
E	Contamination	2	2	4
F	Industrial Accident - Fire/Gas explosion	2	2	4
Operational Phase				
G	Contamination	2	2	4
H	Industrial Accident - Fire/Gas explosion	2	2	4
I	Collapse/ damage to structures	2	1	2
J	Traffic Incident	3	1	3
K	Loss of Critical Infrastructure	1	2	2
Decommissioning Phase				
L	Severe Weather	2	1	2
M	Flooding	1	1	1
N	Traffic Incident	3	1	3
O	Contamination	2	2	4
P	Industrial Accident- Fire/gas explosion	2	2	4
Q	Loss of Critical Infrastructure	1	2	2

Table 16.10: Risk Matrix

Likelihood Rating		Consequence Rating: 1.Minor	2.Limited	3. Serious	4.Very Serious	5.Catastrophic
	5.Very Likely					
	4. Likely					
	3. Unlikely	D,N				
	2. Very Unlikely	A,C,I,L,J,M	B,E,F,G,H,O ,P			
	1. Extremely Unlikely		K,Q			

Table 16.10, presents the potential risks identified during the construction, operation and decommissioning of the Project all or which can be classified as 'low risk scenarios.'

The scenario with the highest risk score in terms of a major accident and/or natural disaster during the construction, operation and decommissioning phase of the Project is identified below:

Peat Stability During Construction

The likelihood of peat instability during the construction of the Project is considered very unlikely as the soil stability risk assessment classified the site as low risk. The risk of peat instability has been minimised through the careful design of the Project and will be further limited through the implementation of the best practice construction control measures outlined in **Appendix 8.1**.

The risk of peat instability is 'very unlikely' to occur and will have 'limited' consequences should it do so, representing a 'low-risk scenario' during the construction phase.

Contamination During Construction, Operation and Decommissioning

There is a potential risk of contamination from site activities during the construction, operational and decommissioning phases from potential release of hydrocarbons. The risk of contamination was given a risk score of 4. However, as outlined in **Chapter 2: Project Description**, **Appendix 2.1**: Construction Environmental Management Plan (CEMP) and **Chapter 9: Hydrology and Hydrogeology**, measures are proposed and will be put in place to reduce the risk of accidental spillage and contamination of pollution risk to groundwater, surface water and associated ecosystems, and to terrestrial ecology.

The risk of contamination is 'very unlikely' to occur as adherence to the CEMP mitigation measures will be required and will have 'limited' consequences should it do so, representing a 'low-risk scenario' during the construction, operation and decommissioning phases.

Industrial Accident-Fire/Gas Explosion During Construction, Operation and Decommissioning

There is a potential risk of fire/explosion at the Project. However, as outlined in **Section 16.2.1**, the scope of this assessment has been based on the understanding that the Project will be designed, built and operated in line with current best practice. Further, in accordance with Chapter 19 of the Safety, Health and Welfare at Work Acts 2005 to 2014, the Project will be subject to a fire safety risk assessment which will assist in the identification of any major risks of fire on site e.g., wind turbines, substation, vandalism.

Therefore, the risk of fire/explosion occurring at the Project resulting in a major accident and/or disaster was given a risk score of 4. This indicates a scenario that is 'very unlikely' to occur and having 'limited' consequences should it do so, representing a 'low-risk scenario' during the operational phase.

16.4.2 Mitigation Measures

As outlined in **Section 16.4.1**, the scenarios with the highest risk score in terms of the occurrence of major accident and/or disaster were identified as 'Contamination' of the Project and risk of 'Industrial Accident- Fire/Gas Explosion' during the construction, operation and decommissioning phases.

The Project has been designed in accordance with the best practice measures described in detail in this EIAR and, as such, mitigation against the risk of major accidents and/or disasters is embedded through the design.

As discussed, the application for the Project is accompanied by a CEMP (**Appendix 2.1**) which sets out details of the environmental controls to be implemented on site. The CEMP sets out the Emergency Response Procedure to be adopted in the event of an emergency including contamination, health and safety and environmental protection. The CEMP provides details on all mitigation and monitoring measures to be actioned prior to construction, during the construction, operation and decommissioning phase. The CEMP will be subject to ongoing review through regular environmental auditing and site inspections. This will confirm the efficacy and implementation of all mitigation measures and commitments identified in the application documentation.

The CEMP includes an Emergency Response Plan (**Management Plan 1**). It provides details of procedures to be adopted in the event of an emergency relating to health & safety or environmental protection. The Emergency Response Plan includes details on the response required and the responsibilities of all personnel in the event of an emergency. Please see **Appendix 2.1** for details.

16.4.3 Residual Effects

The risk of a major accident and/or disaster during the construction of the Project is considered 'low' in accordance with the 'Guide to Risk Assessment in Major Emergency Management' (DoEHLG, 2010).

It is considered that when the mitigation and monitoring measures outlined in the CEMP are implemented and adhered to, there will not be significant residual effect(s) associated with the construction, operation and decommissioning of the Project.

16.4.4 Assessment of Cumulative Effects

16.4.4.1 Cumulative Impact Assessment

A search in relation to developments that may have the potential to result in a cumulative impact with the Project on the environment was carried out as part of the EIAR (Please see **Appendix 2.4**). The Project has been considered, cumulatively with these developments. The closest developments to the Site that are not yet constructed are a solar farm (Cork CoCo Planning Ref. No. 174167) located 3.1 km south-east of the Site and Gortnakilla, Clonkeen, Killarney Wind Farm located 1.87 km west of the Site. The closest operational project is Coomagearlahy Kilgarvan Wind Farm located 2.70 km south-west of the Site. Due to the separation distance of the projects, the Project being located at a higher elevation than the other developments, lack of connectivity of forestry parcels and the implementation of proposed mitigation measures, there is no potential for significant cumulative increase in the vulnerability of the Project to risks such as peat stability, flooding, contamination, fire or traffic or loss of critical infrastructure.

17 INTERACTIONS OF THE FOREGOING AND A SUMMARY OF MITIGATION MEASURES

17.1 INTERACTIONS OF THE FOREGOING

17.1.1 Introduction

The foregoing topics in earlier chapters do not exist in isolation from each other and consequently, any impact on one element of the environment may also impact on another. The Irish Environmental Protection Agency have developed a simple matrix to show the key interactions and interrelationships between the environmental aspects of a Development (**Table 17.1**). The interactions between impacts on different factors have been addressed as relevant throughout the EIAR (**Table 17.2**). The cumulative slight impact on a number of topics may result in a significant impact on another topic.

17.1.2 Impact Interactions

Where any potential negative impacts have been identified during the assessment process, these impacts have been avoided by embedded design mitigation or at a minimum, reduced by the proposed mitigation measures.

17.2 SUMMARY OF MITIGATION MEASURES

This Chapter summarises mitigation measures proposed elsewhere in the EIAR. Chapters 4 to 16 of the EIAR outline the findings of the assessment of the predicted effects of the Project on a topic by topic basis. The significance of these effects have been assessed using criteria defined in the topic chapters. In the context of The EPA Guidelines (2022), the significance of effects is categorised from imperceptible through to not significant, significant and profound with varying sub-categories.

17.2.1 Embedded Mitigation

Embedded mitigation includes design changes that were made to reduce or eliminate adverse effects, as well as normal good practice measures; these have avoided the majority of potentially significant effects. **Appendix 17.1** summarises mitigation measures for all technical assessment chapters.

The process of applying the embedded mitigation is set out in **Chapter 2: Project Description**. The key design aspects comprising embedded mitigation include:

- Avoiding inconsistent turbine spacing, outliers and excessive turbine overlapping to minimise visual confusion and ensure a balanced/compact array of key views;
- Achieving an appropriate scale of turbine, taking account of the landscape context;

- Upgrading existing forestry tracks to be used as Site Access Roads at the Site;
- Respecting and understanding the ground conditions and topography of the Site; including avoiding effects on active peat where possible;
- Maximising the separation from residential dwellings, and
- Respecting other environmental constraints and associated buffer separations.

17.2.2 Specific Mitigation Measures

In addition to mitigation proposed to address significant adverse effects (**Appendix 17.1**), certain chapters have also proposed further measures to reduce effects that were assessed as 'Not Significant' before mitigation.

Table 17.2 outlines interactions between environmental aspects. Technical assessments have assessed pathways, both direct and indirect that can magnify effects through the interaction or accumulation of effects. Effects have been cross-referenced between chapter topics. An outline of potential interactions between chapters/topics is presented in **Table 17.1**.

Table 17.1: Summary matrix of Interactions of Impacts during Construction, Operational and Decommissioning Phases (Source: Adapted from EIAR Guidelines, 2022)

	Population & Human Health		Biodiversity		Ornithology		Soils & Geology		Hydrology and Hydrogeolog y		Noise		Landscape & Visual		Material Assets		Cultural Heritage		Traffic & Transportatio n		Major Accidents and Natural Disasters	
	Const & Deco m	Ope r	Const & Deco m	Ope r	Const & Deco m	Ope r	Const & Deco m	Ope r	Const & Deco m	Ope r	Const & Deco m	Ope r	Const & Deco m	Ope r	Const & Deco m	Ope r	Const & Deco m	Ope r	Const & Deco m	Oper	Const & Deco m	Ope r
Population & Human Health																						
Biodiversity																						
Ornithology																						
Soils & Geology																						
Hydrology and Hydrogeolog y																						
Noise																						
Landscape & Visual																						
Material Assets																						
Archaeology and Cultural Heritage																						
Traffic & Transportatio n																						
Major Accidents & Natural Disasters																						

Note: Const. = Construction phase; Oper = Operational phase Decom. = Decommissioning

Interaction or inter-relationship

No interaction or inter-relationship

Table 17.2: Interactions & Inter-relationships between Environmental Aspects of the Development

Interaction	Description
Population and Human Health & Hydrology and Hydrogeology	Impacts could be observed through flood risk polluting waters supply and also recreational fisheries; **Chapter 9: Hydrology and Hydrogeology** considers these aspects and concludes that there are there are no impacts.
Population and Human Health & Noise	The noise assessment inherently covers any interaction as the methodology used and limits applied are designed to protect health and amenity.
Population and Human Health & Landscape and Visual	The construction phase of the Project will see a temporary introduction of machinery and the erection of five turbines into a natural but already modified landscape. **Chapter 12: Landscape and Visual Amenity** assessed the landscape effects, the visual effects and the cumulative effects of the Project, including assessment from recreational scenic viewpoints, and was also informed by the findings of the Assessment. The interactions between the environmental aspects were carefully considered in the EIAR, particularly in the design of the turbine layout. Detailed zone of theoretical visibility maps (ZTVs), route screening analysis and photomontages were prepared to assess the level of impact. Based on the findings of the collective assessments it is considered that the Project will not give rise to any significant effects, either singly or in combination. Tourists to Ireland have become accustomed to the vision of turbines on the landscape and given the scenario where more windfarms will be built in Ireland in the future, the most widely held view is that this will not impact their likelihood to visit the area again.
Population and Human Health & Material Assets: 1. Shadow Flicker 2. Air Navigation 3. Telecommunications 4. Socio-economic	1. The shadow flicker assessment identified the potential for shadow flicker to affect between 20 No. out of 39 No. receptors within the shadow flicker study area. The assessment identified no significant effects, given that shadow flicker is unlikely to cause a nuisance to nearby inhabited dwellings. It also notes that the function to stop the turbine if required to do so, is available. The potential effects of the Project from shadow flicker are considered to be **Not Significant.** 1. Operating windfarms have the potential to cause a variety of adverse effects on aviation. Rotating wind turbine blades may have an impact on certain aviation operations, particularly those involving radar. The physical height of turbines can cause obstruction to aviation and the overall performance of communications, navigation and surveillance equipment. All structures over 150 m in height are required to have lighting to warn aviation traffic. No significant impacts are predicted in terms of human beings and air navigation. In adherence to IAA Safety Regulations and ICAO Annex 15, aeronautical obstacle warning light schemes will be installed as requested by IAA, co-ordinates of ground and tip height elevations at each wind turbine location. 2. During operation, wind turbines have the potential to interfere with electromagnetic signals passing above the ground due to the nature and size of the windfarm. During the construction and decommissioning phase activity, signals may be passed below ground via existing infrastructure. Impacts may include overground or underground communication cables, microwave links, telecommunication links, business radio and television reception. Mitigation measures were implemented in the design phase through mitigation by avoidance i.e., the known routes of the telecommunication links were plotted and a buffer was applied to them, outside of which the proposed turbines were located. In the operational phase, all electrical components, equipment, apparatus and systems will be required by Irish and European law to comply with the EMC

Interaction	Description
	Directive 2014/30/EU. Compliance with this Directive will mean that the electromagnetic emissions from these devices will not cause interference to other equipment. Turbine and substation control electronics will be typical of any circuits used by industry or a conventional generating station. There is no potential for interference with the links from other windfarms in combination with the Project. Based on the remote location of the Project and a distance of 753 metres to the nearest residential dwelling, no significant impacts are predicted on telecommunications or radio reception as a result of the Project. 3. The Project will provide opportunities for local suppliers to be engaged in the construction phase. This will be a minor beneficial impact. The developer will seek to secure positive benefits for the local/regional economy by encouraging the use of local labour, manufacture and suppliers where possible. They will hold 'Meet the Developer' days prior to construction to allow local contractors to engage with the process and maximise opportunities.
Population and Human Health & Air and Climate	Impacts on air quality during the construction and decommissioning phase may occur due to dust emissions from construction activities onsite and through increased traffic and associated exhaust emissions from construction traffic. These interactions have been considered as part of the EIAR, without significant effects being predicted and suitable mitigation measures provided to further reduce potential impacts. During the operational phase, the energy generated by the Project will offset energy and the associated emission of greenhouse gases from electricity-generating stations dependent on fossil fuels, thereby having a net positive effect on climate. In doing so, there will likely be reduced effects from climate change on human beings. The cumulative effect of the Project with other Irish renewable generation is considered to be a fundamental change in the climate effects of Ireland's energy supply, which is a **major, positive effect,** that is **Significant** (beneficial) under the EIA Regulations and will contribute to Ireland's binding emission reduction targets.
Population and Human Health & Cultural Heritage	Damaging a cultural asset could affect tourism; this has been considered in **Chapter 14: Cultural Heritage** and will not to be an issue.
Population and Human Health & Traffic and Transport	The construction and decommissioning phase will give rise to traffic movements of abnormal loads and is likely to create some short-term inconvenience for road users. A **Traffic Management Plan** (TMP) will be in place and minimise disruption insofar as possible. Suitable mitigation measures to reduce dust emissions have been outlined **in Chapter 15: Traffic and Transportation.**
Population and Human Health & Major Accidents and Natural Disasters	A wind farm is not a recognised source of chemical pollution. Should a major accident or natural disaster occur, the potential sources of pollution onsite during both the construction and operational phases are limited. There is limited potential for significant natural disasters to occur at the Site. Ireland is a geologically stable country with a mild temperate climate. The potential natural disasters that may occur are therefore limited to peat-slide, flooding and fire. In the highly unlikely event that the stability of peat is compromised, an Emergency Response Plan has been prepared and can be found in **Appendix 2.1: Construction Environmental Management Plan, Management Plan 1.**
Biodiversity & Ornithology	All interactions for any habitat or species including those associated with Special Protection Areas (SPA) or Special Areas of Conservation (SAC) are considered in the Natura Impact Statement and not considered further here.
Biodiversity & Hydrology and Hydrogeology	Contamination of surface water and groundwater could occur from many elements including wastewater sanitation contamination, hydrocarbon contamination, watercourse crossings construction, entrainment of suspended solids during earth works, increased entrainment of contaminants and other impacts arising due to

Interaction	Description
	localised stability issues, amongst other potential sources. Contamination of water quality could impact both flora and fauna including fisheries, otter, lizards and amphibians (loss of breeding ponds) amongst others. Lagoon-type sediment traps and plant filtration beds will be installed in watercourses to maintain water quality and prevent potential impacts on protected species located downstream such as the freshwater pearl mussel. These interactions have been considered as part of the EIAR, with suitable mitigation measures provided to minimise potential impacts.
Biodiversity & Soils and Geology	Potential impacts on biodiversity during the construction and decommissioning phase could include disturbance to birds and mammals from loss / changes in habitat. The Project has been designed to avoid impacts on Annex I peatland, wet heath, dry heath, and siliceous rock habitat as much as practicably possible. . Restoration will be undertaken in line with the **Habitat Enhancement Plan** (**Appendix 5.5**).
Biodiversity & Major Accidents & Natural Disasters	Potential impacts on biodiversity during the construction and decommissioning phase could include disturbance to birds and mammals from loss / changes in habitat. The Project has been designed in accordance with the best practice measures described in detail in this EIAR and, as such, mitigation against the risk of major accidents and/or disasters is embedded through the design.
Ornithology & Noise	The ornithology assessment considers general disturbance to sensitive bird species, including that caused by the sources likely to occur during the construction and decommissioning of the Project. The potential effects on birds from noise will not be significant and temporary in nature.
Ornithology & Major Accidents and Natural Disasters	Potential impacts on biodiversity during the construction and decommissioning phase could include disturbance to birds from loss/ changes in habitat. The Project has been designed in accordance with the best practice measures described in detail in this EIAR and, as such, mitigation against the risk of major accidents and/or disasters is embedded through the design to ensure no such impacts will occur.
Soils and Geology & Hydrology and Hydrogeology and Landscape and Visual	The hydrogeological balance of the Site could be impacted by the amount of earth materials excavated. Adopting good practices, planning ahead and real time monitoring in more sensitive (>1 m peat depth) areas will ensure that any excavations associated with the Project will have minimal impact. These interactions have been considered as part of the EIAR, with suitable mitigation measures provided to minimise potential impacts. Application of the mitigation measures will reduce the risk of stability issues and impacts on hydrology and hydrogeology arising at a localised scale.
Soils and Geology & Landscape and Visual & Major Accidents and Natural Disasters	The unavoidable residual impacts on the soils and geology environment as a function of the Project is that there will be a change in ground conditions at the Site with the replacement of natural materials such as peat, subsoil and bedrock by concrete, subgrade and surfacing materials. Stability issues and slope failure arising from vehicular movement could cause significant local or at worst-case scenario landslide issues. Where suitable mitigation measures are applied and proper precautions and planning are executed effectively, the risk of such potential impacts will be significantly reduced and considered avoidable.
Soils and Geology, Landscape and Visual & Archaeology and Cultural Heritage	The construction and decommissioning phase pertaining to the Project will involve significant ground reduction and topsoil removal throughout the design layout footprint. While there are two recorded archaeological sites within the Redline Boundary, none are located on the footprint of any proposed construction areas. There is a possibility of encountering unrecorded archaeological finds/features throughout these areas, during the construction and decommissioning phase and increasing the area of disturbed soil. If any sub-surface archaeological features are identified during

Interaction	Description
	archaeological monitoring they will be securely cordoned off, cleaned and recorded *in situ*. The National Monuments Service will then be notified and consulted to determine further appropriate mitigation measures, which may include preservation *in situ* (by avoidance) or preservation by record (archaeological excavation). These interactions were considered in the EIAR, both in the design of turbine layout and in the design of mitigation measures. Monitoring, including a watching brief in undisturbed portions of the footprint will be carried out. All records will be preserved where found. The operational phase will result in a range of indirect negative impacts of a visual nature on the wider setting of a number of recorded archaeological sites within the study area and the surrounding landscape which will range from not significant to moderate in significance. The one predicted indirect negative impact of moderate significance will arise from the presence of three turbines (T1, T2 and T3) and associated access routes within a 500 m area extending to the south, northwest and northeast of an extant archaeological site (Enclosure CO057-007----) (Figure 14.1). This is predicted to result in a medium magnitude of impact on the historic landscape setting of this recorded archaeological monument, which is of potential medium-high value and, based on the EPA impact assessment criteria presented in Table 14.4 (Section 14.2.8), this will result in a predicted reversible, negative, indirect, moderate significance of impact.
Soil and Geology & Major Accidents and Natural Disasters	The Project has been designed in accordance with the best practice measures described in detail in this EIAR and, as such, mitigation against the risk of major accidents and/or disasters is embedded through the design. The Project has been designed in accordance with the best practice measures described in detail in this EIAR and, as such, mitigation against the risk of major accidents and/or disasters is embedded through the design.
Hydrology & Biodiversity	There is a potential for Fisheries to be impacted by a disturbance or contamination of watercourses during the construction period if the stated mitigation measures are not adhered to. However, the mitigation measures to protect watercourses outlined in Aquatic Ecology, Soils and Geology and Hydrology and Hydrogeology chapters will be strictly adhered to which includes monitoring of Site water run-off during all phases of the Project.
Hydrology and Major Accidents & Natural Disasters	The Project will use the latest best practice guidance to ensure that flood risk within or downstream of the Site is not increased as a function of the Project, i.e., a neutral impact at a minimum. The risk of the wind farm contributing to downstream flooding is very low, as the long-term plan for the site is to retain and slow down drainage water prior to release. Robust drainage measures on the site will include swales, silt traps, check dams, settlement ponds and buffered outfalls. This has been addressed **in Chapter 9: Hydrology and Hydrogeology.**
Noise & Traffic and Transportation	Traffic and Transportation will create noise onsite and along the Site Access Roads. Site contractors will be required to employ the best practicable means of reducing noise emissions from plant, machinery and activities, as advocated in BS 5228. Such potential effects are considered to be not significant.

Interaction	Description
Noise & Major Accidents and Natural Disasters	Alarms (e.g., for security, fire) will be sounded in cases of emergency. The maintenance of these alarms is essential and any faulty alarm causing nuisance alerts will be replaced accordingly. Incidents such as explosions in the substation buildings will have a noise impact. However, proper maintenance and operation will make this risk unlikely.
Landscape and Visual & Material Assets	The Irish Aviation Authority (IAA) has outlined criteria regarding tall structures and the installation of an aeronautical obstacle warning light scheme for the Project. This has been addressed in **Chapter 13: Material Assets and Other Issues**.
Material Assets & Major Accidents and Natural Disasters	TheProject is not connected to or in the vicinity of any site regulated under the Control of Major Accident Hazards Involving Dangerous Substances Regulations (SEVESO sites), therefore no significant effects associated with major industrial accidents involving dangerous substances are anticipated. Any technical fault at the Project would not impact the local or national energy supply. 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), construction staff, operational & maintenance staff or recreational users of the site as the ICNIRP guidelines will not be exceeded at any distances even directly above the cables.
Traffic and Transport & Biodiversity: Fisheries	During the construction phase, increased traffic could lead to increased sedimentation/pollution of watercourses as moving vehicles disrupt soil and emit pollutants. The interactions between these aspects were considered in the EIAR and mitigation has been embedded in the design of the Project. This assessment has identified no potentially significant residual effects on Fisheries from Traffic & Transportation from the Project.
Traffic and Transport & Major Accidents & Natural Disasters	The Project will utilise the existing road network during the construction phase.. Construction related traffic will originate from the delivery of materials to site, removal of surplus excavated material from site and transport of employees to, from and throughout the Site. The localised traffic disruptions will be mitigated through the use of industry standard traffic management measures. Please see **Chapter 15: Traffic and Transport** and **Appendix 2.1** for details.