9 SOILS AND GEOLOGY

9.1 INTRODUCTION

This chapter assesses the potential likely effects on the land, soils and geology environment of the Project. This includes all elements within the Redline Boundary, **Figure 1.2**, the wind turbines, electrical substation, site access tracks, turbine hardstands, temporary and permanent spoil storage and all site infrastructure. This Chapter also provides a description of the work required along the proposed Grid Connection (GC) route and the Turbine Delivery Route (TDR). Where adverse effects are predicted, the chapter identifies appropriate mitigation strategies therein. The assessment will consider the potential effects during the following phases of the Project:

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

The Project refers to all elements of the application for the construction, operation and decommissioning of the proposed Garrane Green Energy Project (**Chapter 2: Project Description**).

This chapter of the EIAR is supported by the following Appendix documents provided in **Volume IV** of this EIAR:

- **Appendix 9.1 - Determination of Ground Conditions**
- **Appendix 9.2 – Site Investigation Report**
- **Appendix 9.3 – Supplementary Site Investigation Report**

This assessment should be read in conjunction with:

- **Chapter 6: Biodiversity**
- **Chapter 10: Hydrology and Hydrogeology**
- **Chapter 16: Material Assets and Other Issues**

A Construction Environmental Management Plan (**CEMP)** is also appended to the EIAR in **Appendix 2.1**. This document will be further developed and agreed with the local authority at the pre-construction phase, once a contractor has been appointed. The **CEMP** will cover the construction of the Project. It will include all of the mitigation recommended within the EIAR. For the purpose of this application, a summary of the mitigation measures is included in **Appendix 18.1**.

9.1.1 Assessment Structure

In line with the EIA Directive (Directive 2014/52/EU)[1], current EPA Guidelines on the information to be contained in Environmental Impact Assessment Reports (2022), S.I. No. 296/2018 - European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018S.I. and Institute of Geologists of Ireland (IGI) (2013) Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements; the structure of this soils and geology chapter is as follows:

- Details of the assessment methodology utilised for desk and field studies, in the context of legal and planning frameworks.
- Description of baseline conditions at the Site.
- Identification and assessment of effects to soils and geology associated with the Project, during the construction, operational and Decommissioning phases of the Project.
- Mitigation measures to avoid or reduce the effects identified.
- Identification and assessment of residual impact of the Development considering mitigation measures.
- Identification and assessment of cumulative effects, if and where applicable.

9.1.2 Project Description

9.1.2.1 Wind Farm Site

Permission is being sought by the Developer for the construction of 9 No. wind turbines, a permanent Met Mast, an on-site 110kV Substation with loop-in connection to the existing 110kV OHL between Charleville and Kilonan, all ancillary works. Temporary accommodation requirements at locations along the TDR are not included in the planning application but are assessed as part of the EIAR.

The proposed works within the Redline Boundary will include the following main components:

- Erection of 9 No. wind turbines with a tip height of 170m. The wind turbines will have a rotor diameter of 150m and a hub height of 95m.
- Upgrade of existing Access Tracks and construction of new permanent Access Tracks, permanent turbine hardstand areas and turbine foundations.
- Construction of two new bridge crossings on-site, one over the River Maigue and one over the Charleville Stream.
- Upgrade of existing site drainage network and installation of new site drainage.
- Wind Farm Internal Cabling connecting the wind turbines to the electrical substation.

[1] Refers to Directive 2011/92/EU of the European Parliament and of the Council of 13 December 2011 on the assessment of the effects of certain public and private projects on the environment as amended by Directive 2014/52/EU.

- Construction of a permanent on-site AIS 110kV Substation, with a 'loop in' Grid Connection to the existing 110kV overhead line between Charleville and Killonan, including two single-storey control buildings with welfare facilities, all associated electrical plant and equipment, security fencing, gates, signage, all associated underground cabling, private well for water supply, wastewater holding tank, and all ancillary structures and works.
- Construction of a permanent double circuit 110kV underground cable and two steel cable interface masts to connect to the existing overhead line.
- Erection of a permanent 60m Meteorological Mast for monitoring wind speeds.
- Construction of a Temporary Construction Compound for use during construction.
- Upgrade of the existing entrance on the N20 (Site Entrance 1) (to be used for abnormal loads and turbine component delivery) and upgrade of an existing site entrance on the L1537 (Site Entrance 2) (to be used for all construction traffic except for abnormal loads and turbine component delivery).
- 6 No. temporary spoil storage areas and 1 No. permanent spoil storage area.
- Biodiversity enhancement and improvements associated with the Project.
- Landscaping, fencing and all associated ancillary works.

A 10-year planning permission and 35-year operational life from the date of commissioning of the entire wind farm is being sought.

The EIAR assesses the Project which includes the works within the Redline Boundary as outlined above as well as the temporary accommodation requirements at 6 No. locations along the proposed TDR from Foynes Port. A TDR option from the Port of Galway was also assessed for the delivery of turbine blades only which includes temporary accommodation works at 11 No. locations.

9.1.2.2 Haul Route

It is proposed abnormal loads will use Site Entrance 1 for access into the Site only and will then exit the Site via Site Entrance 2 Construction traffic will use Site Entrance 2 for the main site, the Substation and Grid Connection infrastructure. Further information can be found in Chapter 17: Traffic and Transport.

9.1.2.3 Turbine Delivery Route

It is proposed that the turbine nacelles, tower hubs and rotor blades will be landed in Foynes Port, Co. Limerick. From there, they will be transported to the Site via the N69, N18, M20 and N20 public roads to the upgraded Site Entrance 1.

Temporary upgrade and widening works to facilitate abnormal deliveries are required only at the N20 Site entrance. In addition to this verge strengthening to withstand wheel loadings from abnormal loads will also be required at the following locations: -

1 - N69 / L6188 Junction at Foynes Port

2 - N69 Roundabout at Clarina

3 - N69 / N18 /R510 Dock Road West Roundabout

Section 2.5.4 in Chapter 2: Project Description details the route of the TDR along with the upgrade works required.

9.1.2.4 Grid Connection (GC)

The circa 380m Grid Connection (GC) from the Substation, **Figure 2.10 in Appendix 2.2**, will connect to the existing 110kV overhead cable network. The GC will consist of a series of electrical circuits laid in ducts and will be laid in fields using the "open dig" method installation. Refer to **Section 2.5.9 in Chapter 2: Project Description** for further details.

9.1.3 Statement of Authority

This Chapter of the EIAR has been prepared by John Whiteford, Whiteford Geoservices Limited (WGL).

John Whiteford BSc (Hons) Geophys AMIOSH MEAGE FGS has more than 25 years of experience in the field of earth sciences, geotechnical engineering and management. His academic qualifications are a BSc with Honours in Geophysics from Edinburgh University, with memberships of The European Association of Geoscientists and Engineers and The Institute of Safety and Health.

John Whiteford has been engaged in full-time consultancy for the past 25 years and since 2000 trading as Whiteford Geoservices Limited. The company and its staff of professional and technical personnel has completed in excess 2200 contracts for clients within the Soils and Geology Assessment discipline, where they have built up a recognised level of specialist experience, particularly in the field of Wind Energy.

Working in Ireland, UK, in Europe and worldwide the company has been involved in more than 130 wind power projects of which the following are typical examples.

- 29 Turbine 101MW Yellow River Wind Farm, Killnure, Co. Offaly.
- 8 Turbine 16.8MW Sheskin Wind Farm, Bellacorrick, Co. Mayo.
- 2 Turbine 4.6MW Templederry Wind Farm, Nenagh, Co. Tipperary.
- 1 Turbine 0.9MW Clooncon East Single Turbine, Taum, Co. Galway.

- 6 Turbine 14MW Tullynamoyle 2 Wind Farm, Co. Leitrim.
- 5 Turbine 17MW Killala (Phase 1) Wind Farm, Killala, Co. Mayo.
- 5 Turbine 10MW Hornberget Wind Farm, Mala, Sweden; and
- 23 Turbine 21MW Wigton Wind Farm Phase I, Mandeville, Jamaica.

The field work and interpretative reporting was designed and executed by members of the following project team:

1. Mr Ryan Calvert BSc (Hons) Forensic Science – Technical Director. (17 years' experience).
2. Mr James Ardern BSc (Hons) Geology, Senior Project Geologist. (18 years' experience)
3. Mr Jamie Stothers – Technician. (9 years' experience).

9.2 ASSESSMENT METHODOLOGY AND SIGNIFICANCE CRITERIA

9.2.1 Assessment Methodology

The following assessments were undertaken in order to evaluate the potential effects of the Project on the soils, geology and ground stability aspects of the environment at the Site, the Grid Connection (GC) and the Turbine Delivery Route (TDR):

- Characterise the topographical, geological and geomorphological regime of the Site, the GC and the TDR from the data acquired through desk study and onsite surveys.
- Consider ground stability issues as a result of the Project, its design and methodology of construction.
- Assess the combined data acquired and evaluate any likely effects on the soils, geology and ground stability aspects of the environment.
- If effects are identified, consider measures that would prevent, mitigate or reduce the identified effects.
- Present and report these findings in a clear and logical format that complies with EIAR reporting requirements.

9.2.2 Study Area

The study area is defined as the region within which changes to the soils and geology environment associated with the Project could reasonably impact sensitive receptors. All potential effects of the Project have a limited zone of influence and for these the study area has been limited to 2km from the Site boundary, in line with the methodology outlined in the 2013 IGI Guidelines for Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements. However, there is also the potential for the zone of influence to be greatly extended, for instance soil contamination by watercourses. In such

a case effects can potentially impact receptors downstream, in excess of 2km from the Site boundary. For this reason, sensitive receptors up to 10km away have been included in the assessment. Analysis of historic soil contamination events associated with wind farms indicates that 10km is the upper threshold for significant impact in this respect.

9.2.3 Assessment Principles

Direct impacts or effects on geological attributes or the properties of soils and rock formations are mainly localised in the context of soils and geology (e.g., excavated soils from excavations, stored and used as back fill). However, during all phases of the works, soils and geology impacts give rise to potential sources of contamination being spread by water run-off (i.e., indirect or secondary impacts) affecting ecological and hydrological receptors. For example: Contamination of the soils and geology by chemicals, cementitious construction material, or silt, is considered a localised impact, but should this contamination be intercepted by surface water or groundwater bodies the impact is potentially regional, depending on the environmental circumstances. Therefore, throughout this report references will be made to **Chapter 10: Hydrology and Hydrogeology,** for further detail and clarification on potential effects and mitigation measures proposed for the Project.

9.2.4 Relevant Legislation and Guidance

This assessment complies with the European Directive 2011/92/EU as amended by Directive 2014/52/EU which requires Environmental Impact Assessment for certain types of major development before project consent is granted. This assessment was undertaken in accordance with the following Irish legislation (transposition of the aforementioned directive):

- SI No. 600 of 2001 as amended: Planning and Development Regulations 2001 to 2023.
- Planning and Development Act 2000 to 2025

In addition to this the following planning legislation, environmental legislation relevant to geological, geotechnical, hydrological and hydrogeological aspects of the environment have been referred to:

- The Heritage Act 1995 (as amended),
- The Wildlife Acts, 2000-2022.European Union (Invasive Alien Species) Regulations 2024;Waste Management Acts 1996-2024.
- European Communities Act, 1972
- S.I. No. 547/2008 - European Communities (Environmental Liability) Regulations 2008

- S.I. No. 323/2020 European Union (Waste Directive) Regulations 2020.
- Directive 2000/60/EC, 2000 "Establishing a framework for community action in the field of water policy".

Geographically, the site is located within County Limerick and consequently, the Limerick Development Plan (2022-2028) has also been consulted as part of the EIA process.

Other guidance documents employed to assist with the production of this assessment report are as follows: -

- BSI (2015 + A1 2020) Code of Practice for Site Investigations - BS 5930
- CIRIA (2006) Control of Water Pollution from Linear Construction Projects – Technical Guidance
- Creighton, R. et al. (2006) Landslides of Ireland Department of Environment, Community and Local Government (DECLG) (August 2018),
- Guidelines for Planning Authorities and An Bord Pleanála on Carrying Out Environmental Impact Assessment (DHPLG, 2018).
- DHPLG (2017) Interim Guidelines for Planning Authorities on Statutory Plans, Renewable Energy and Climate Change and Wind Energy Development Guidelines 2006
- Department of Housing, Planning and Local Government (2019) Draft Revised Wind Energy Development Guidelines
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Commission 2017).
- European Commission (EC) (2021) EU Soil Strategy for 2030
- Environmental Protection Agency (EPA) (2015) Advice Notes for Preparing Environmental Impact Statements – DRAFT September 2015 (Supersedes 2003 version)
- EPA (2022) Guidelines on the Information to be Contained in Environmental Impact Assessment Reports
- EPA (2022) EPA Map Viewer
- Feehan, J. and O'Donovan, G. (1996) The bogs of Ireland
- Geological Survey Ireland (GSI) Geological Survey Ireland Spatial Resources
- Gharedaghloo, B. (2018) Characterizing the transport of hydrocarbon contaminants in peat soils and peatlands
- 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 National Seismic Network (INSI) (2022) Recent Earthquakes
- Irish Wind Energy Association (IWEA) (2012) Best Practice Guidelines for the Irish Wind Energy Industry
- Johnston, W. (2022) Physical Landforms of Ireland
- National Roads Authority (NRA) (2008) Guidelines on Procedures for the Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes
- NPWS (2015) National Peatlands Strategy
- NPWS (2017) Best practice in raised bog restoration in Ireland
- NRA (2008) Environmental Impact Assessment of National Road Schemes – A Practical Guide – Rev 1
- NRA (2014) Guidelines for the Management of Waste from National Road Construction Projects
- Scottish Forestry Commission (2006) "Guidelines for the Risk Management of Peat Slips on the Construction of Low Volume / Low-Cost Roads Over Peat"
- Scottish Government (2017) Peat Landslide Hazard and Risk Assessment: Best Practice Guide for Proposed Electricity Generation Developments
- Scottish National Heritage (SNH) (2013) A Handbook on Environmental Impact Assessment
- Teagasc (2022) Soil Map Viewer

9.2.5 Desk Study

Desk study information has been interpreted to establish the preliminary baseline conditions within the study area ahead of the site investigations and has been employed for both preliminary layout design as well as for design of the site investigation works.

The desk study, consisting of a review of datasets, information, and literature resources relevant to the Site, has been completed and includes the following sources and preliminary assessment elements:

- Analysis of Geological Survey of Ireland (GSI) Geological, Geotechnical and Geological Heritage site mapping (www.gsi.ie) – accessed 18/06/2025
- Analysis of Geological Survey of Ireland (GSI) Groundwater, Landslides and Aggregate Potential mapping (www.gsi.ie) – accessed 18/06/2025
- Analysis of Environmental Protection Agency (EPA) online mapping database (www.epa.ie) –– accessed 18/06/2025

This desk study analysis involved the following components:

- Review of Project specific maps and drawings detailing the proposed Project infrastructure, Turbine Delivery Route and Haul Route.
- Study and assessment of the proposed locations of Turbines, Access Tracks, 110kV Substation, Met Mast, other ancillary infrastructure, Turbine Delivery Route / Haul Route and Grid Connection relative to available data on topography and slope gradients.
- Study and assessment of the proposed locations of Turbines, Access Tracks, 110kV Substation, Met Mast, other ancillary infrastructure, Turbine Delivery Route / Haul Route and Grid Connection relative to available data on soils, subsoil and bedrock geology.
- Screen for the presence of peat organic soils and identify if Peat Landslide Hazard Assessment (PLHA) is applicable.
- Overlay Ordnance Survey of Ireland (OSI) 1:250,000, 1:50,000 and 1:10,560 (6") mapping with proposed layout arrangements, to identify potential geohazards ahead of walkover survey.
- Overlay Geological Survey of Ireland (GSI) Geology maps (1:100,000) to determine site bedrock and superficial soils geology together with the presence of any major faults, features or other anomalies.
- Overlay Geological Survey of Ireland (GSI) Groundwater Karst and Groundwater Wells and Springs maps (1:100,000) to determine the location of potential karst features and private / public water supplies.
- Overlay Environmental Protection Agency (EPA) and Teagasc (Agricultural Agriculture & Food Authority) Soils and Subsoil maps (1:50,000) to determine categories of soils and subsoil at the Site.
- Overlay Geological Survey of Ireland (GSI) Landslide Susceptibility maps to determine site landslide susceptibility risk classification.
- Search of the GSI landslide database for records of landslide mass movement events at and near the Study Area.
- Overlay Geological Survey of Ireland (GSI) Aggregate Potential maps (1:100,000) to determine the economic value of "site won" aggregate.

9.2.6 Field Work

9.2.6.1 Preliminary Geotechnical Investigations, Site Walk Over and Observations

Following completion of the desk study, an initial site walkover survey was undertaken by John Whiteford and Jaime Stothers in August 2022 and then following revisions to the layout

the first ground investigation campaign was undertaken, by Jaime Stothers, in September 2022.

Following completion of the layout design process, a second round of ground investigations was undertaken to confirm ground conditions at the specified turbine infrastructure, Met Mast, Substation, as well as average conditions for the Access Track network, ancillary infrastructure and Grid Connection.

These preliminary geotechnical works consisted of the following: -

- A site visit and visual walkover assessment of the main wind farm infrastructure and grid connection route. (September 2022)
- Review of bedrock outcrops, along with sub-soils and soil characterisation at proposed turbine locations. (September 2022)
- Excavation of 6 Nr trial holes to assess ground conditions and their variation across the Site, to a maximum depth of 3.60m below existing ground level. These excavations also served to provide ground truthing in respect of the GSI mapping data previously consulted. (September 2022)
- 20 Nr. Electrical Resistivity Tomography (ERT) profiles undertake, at the specific location of wind turbine infrastructure for T1, T2, T3, T4, T5, T6, T7, T8, T9 & Met Mast to a maximum depth of 20m below existing ground level. (August 2024)
- 4 Nr. machine excavated trial holes to assess ground conditions at the Substation, to a maximum depth of 3.80m below existing ground level. (September 2024)
- Screening for the presence of peat soils at the main infrastructure, together with determination of soil and peat (if present) characteristics at each turbine. These works consisted of peat thickness probing (using "depthing" rods) and gouge auguring to confirm soil / peat thickness, in-situ shear vane testing to determine undrained soil shear strength and an assessment of peat decomposition, according to Von Post. (August 2024)
- Walkover Survey reconnaissance to identify, sensitive receptors with respect to effects relating to soils and geology, as well as potential areas for spoil deposition. (Initially in September 2022 and then again in August 2024). At this time, the site was also assessed for general stability, with a search undertaken for potential pre-failure indicators, failure preconditions and potential triggering mechanisms in relation to soil movement/failure evident at the Site. (September 2022 and August 2024).

Peat Landslide Hazard, as per the guidance contained in "Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments":

Prepared for Energy Consents Unit, Scottish Government, Second Edition 2017, (the Scottish Guidance), has been screened out as a potential effect of the Project, following the walkover survey.

The screening assessment of soils, undertaken initially during the walkover survey, and later confirmed during the extensive site investigation campaign, did not identify the presence of either Peat soils or Peat bog habitat at the Site.

Soil samples recovered on-site did not record the presence of sufficient humic material for soils to be classified as Peat. Neither could any of the lands within the Site be classified as Bogland Habitat, according to the EU Habitats Directive 1992 (Council Directive 92/43/EEC).

Consequently, Peat Landslide Hazard has been screened out as a particular risk with respect to the Proposed Project. No further, more detailed, peat assessment are required.

9.2.7 Evaluation of Potential Effects

9.2.7.1 Sensitivity

Table 9.1: Criteria for Rating Site Attributes – Soils and Geology 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.

Table 9.2: Criteria for Rating Site Sensitivity – Soils and Geology Specific

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

9.2.7.2 Magnitude

Table 9.3: Describing the Magnitude of Effects

Magnitude of Impact	Description
Imperceptible	An impact capable of measurement but without noticeable consequences.
Slight	An impact that alters the character of the environment without affecting its sensitivities.
Moderate	An impact that alters the character of the environment in a manner that is consistent with the existing or emerging trends.
Significant	An impact, which by its character, magnitude, duration or intensity alters a sensitive aspect of the environment.
Profound	An impact which obliterates all previous sensitive characteristics.

Table 9.4: Qualifying the Magnitude of Impact on Soil and Geological Attributes

Magnitude of Impact	Description	Example
Large Adverse	Results in a loss of attribute.	Removal of the majority (>50%) of geological heritage feature.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute.	Removal of part (15-50%) of geological heritage feature.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute.	Removal of small part (<15%) of geological heritage feature.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity.	No measurable changes in attributes.
Minor Beneficial	Results in minor improvement of attribute quality.	Minor enhancement of geological heritage feature.
Moderate Beneficial	Results in moderate improvement of attribute quality.	Moderate enhancement of geological heritage feature.
Major Beneficial	Results in major improvement of attribute quality.	Major enhancement of geological heritage feature.

9.2.7.3 *Significance Criteria*

Table 9.5: Weighted Rating of Significant Environmental Effects

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

9.2.8 Scoping Responses and Consultation

Table 9.6: Scoping Responses and Consultation

Consultee	Type and Date	Summary of Consultee Response with Relevance to This Chapter	Addressed
Geological Survey of Ireland	Scoping response received 11th Jun 2024.	***Geoheritage*** *A national inventory of geoheritage sites known as County Geological Sites (CGSs) is managed by the Geoheritage Programme of Geological Survey Ireland. CGSs, as adopted under the National Heritage Plan, include sites that are of national importance which have been selected as the very best examples for NHA (Natural Heritage Areas) designation. NHA designation will be completed in partnership with the National Parks and Wildlife Service (NPWS). CGSs are now routinely included in County Development Plans and in the GIS of planning departments, to ensure the recognition and appropriate protection of geological heritage within the planning system. CGSs can be viewed online under the Geological Heritage tab on the online Map Viewer* *The audit for Co. Limerick was carried out in 2022. The full report details can be found at here. Our records show that there is one CGS, Knocksouna LK022, within 1km of the Proposed Development.* ***Geological Mapping*** *Geological Survey Ireland maintains online datasets of bedrock and subsoils geological mapping that are reliable and accessible. We would encourage you to use these data which can be found here, in your future assessments.* ***Geotechnical Database Resources*** *Geological Survey Ireland continues to develop their national geotechnical database and viewer with site*	Refer to Sections **9.3.5, 9.3.6, 9.3.7, 9.3.8, 9.3.9 and 9.3.10** for the findings of the baseline assessment in these respects. Refer to Section **9.4** for details of the assessment of potential effects.

Consultee	Type and Date	Summary of Consultee Response with Relevance to This Chapter	Addressed
		investigation data submitted voluntarily by the industry. They encourage the accessing and use of this resource as it can provide an invaluable resource for baseline geological assessment. ***Geohazards*** *Geohazards can cause widespread damage to landscapes, wildlife, human property and human life. In Ireland, landslides, flooding and coastal erosion are the most prevalent of these hazards. We recommend that geohazards be taken into consideration, especially when developing areas where these risks are prevalent, and we encourage the use of our data when doing so.* *GSI has information on landslides in Ireland via the National Landslide Database and Landslide Susceptibility Map both of which are available for viewing on our dedicated Map Viewer. Associated guidance documentation relating to the National Landslide Susceptibility Map is also available.* *GSI also hold resources in respect to Flood Risk Assessment and recommends that both these resources be consulted when undertaking baseline geological assessments.* ***Natural Resources (Minerals/Aggregates)*** *Geological Survey Ireland provides data, maps, interpretations and advice on matters related to minerals, their use and their development in our Minerals section of the website. The Active Quarries, Mineral Localities and the Aggregate Potential maps are available on our Map Viewer. Similarly, they recommend consultation of these records to inform the baseline assessment.*	
Environmental Health Service, Ashbourne Hall, Limerick (EHS)	7th Jun 2024	*As part of HSE EIA Scoping, EHS have produced an Environmental Health Service Submission Report with the following requests specific to Soils and Geology:* ***General Introduction*** *The applicant should consider the findings of the High Court judgement issued in the judicial review of the Derryadd Wind Farm. (2021 IEHC 390 [20202 No. 557 JR] P. Sweetman v An Bord Pleanála)* *Generally, the Environmental Impact Assessment should examine all likely significant impacts and provide the following information for each:* *a) Description of the receiving environment.* *b) The nature and scale of the impact.* *c) An assessment of the significance of the impact.* *d) Proposed mitigation measures.* *e) Residual impacts.* *The Environmental Health Service (EHS) recommends that the following matters are included and assessed in the EIAR* *• Public Consultation*	These relevant responses are partly addressed in the Soils and Geology Chapter, and partly within the Water and Hydrology Chapter. a) Refer to Sections 9.3 for details of the baseline assessment carried out in this respect b) Refer to Section, 9.4 for assessment of these potential effects.

Consultee	Type and Date	Summary of Consultee Response with Relevance to This Chapter	Addressed
		• Decommissioning phase of the proposed wind farm *• Siting and location of turbines* *• Geological Impacts* *• Cumulative impacts* ***Decommissioning*** *The EIAR should detail the eventual fate of the wind turbines and associated material i.e. will the material be recycled or how will it be disposed of.* ***Siting, Location and details of Turbines*** *Details of the foundations for the wind turbine including depth, quantity and material to be used should be included in the EIAR.* ***Geotechnical and Peat Stability Assessment*** *A detailed assessment of the current ground stability of the site for the proposed windfarm development and all proposed mitigation measures should be detailed in the EIAR. The assessment should include the impact construction work may have on the future stability of ground conditions, taking into consideration extreme weather events, site drainage and the potential for soil erosion. Information should be provided on the make and model of the turbines and on construction details for the turbine foundations, including the depth and volume of concrete required. An accurate assessment of the potential impacts of the foundations on water quality and peat stability cannot be undertaken without this information.* *Reference is made to a peat slide which occurred near Ballybofey in Co. Donegal on 13th November 2020 which may have been linked to construction activity at Meenbog Wind Farm. Potential impacts on water supply associated with contamination following a peat slide include sedimentation and alteration of pH levels.* *The Environmental Health Service recommends that a detailed Peat Stability/Geotechnical Assessment should be undertaken to assess the suitability of the soil for the proposed development. The EIAR should include provision for a peat stability monitoring programme to identify early signs of potential bog slides ('pre-failure indicators' see the Scottish Government's 'Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Developments 2017)* ***Cumulative Impacts*** *All existing or proposed wind farm developments in the vicinity should be clearly identified in the EIAR. The impact on sensitive receptors of the proposed development combined with any other wind farm/renewable energy developments in the vicinity should be considered. The EIAR should include a detailed assessment of any likely significant cumulative impacts of the proposed windfarm development.*	Peat Landslide Hazard has been screened out for The Project. Peat soils were found to be absent. Refer to **Sections 9.3.7.1 and 9.3.11** Further assessment is not required. Refer to **Tables 2.1 and 2.2** in **Chapter 2: Project Description.**

9.3 BASELINE DESCRIPTION

9.3.1 Introduction

An initial investigation of the existing land, soils and geology 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 soils and geology conditions within the study area and the significance of any potential adverse effects have been assessed. The assessment of potential soils and geology effects is detailed in Section **9.4.**

9.3.2 Site Description

Permission is being sought by the Developer for the construction of 9 No. wind turbines, a permanent Met Mast, an on-site 110kV Substation with loop-in connection to the existing 110kV OHL between Charleville and Kilonan. Temporary accommodation requirements at locations along the TDR are not included in the planning application but are assessed as part of the EIAR.

Figure 9.1: Site Layout and EIA Core Study Area (*GSI – TE Imagery DG 2011 – 2013 ITM)*

This wind farm is to be constructed on lands east of N20, at Garrane, Ballynagoul, Creggane, Charleville & Kilmallock, Co. Limerick, approximately 2.5km north of Charleville, Co. Cork.

The Project also includes a series of temporary alterations to existing public and private roads, construction of bridges and culverts and additional land take required for the Turbine Delivery Route (TDR). A full description of the project details is available in **Chapter 2 Project Description.**

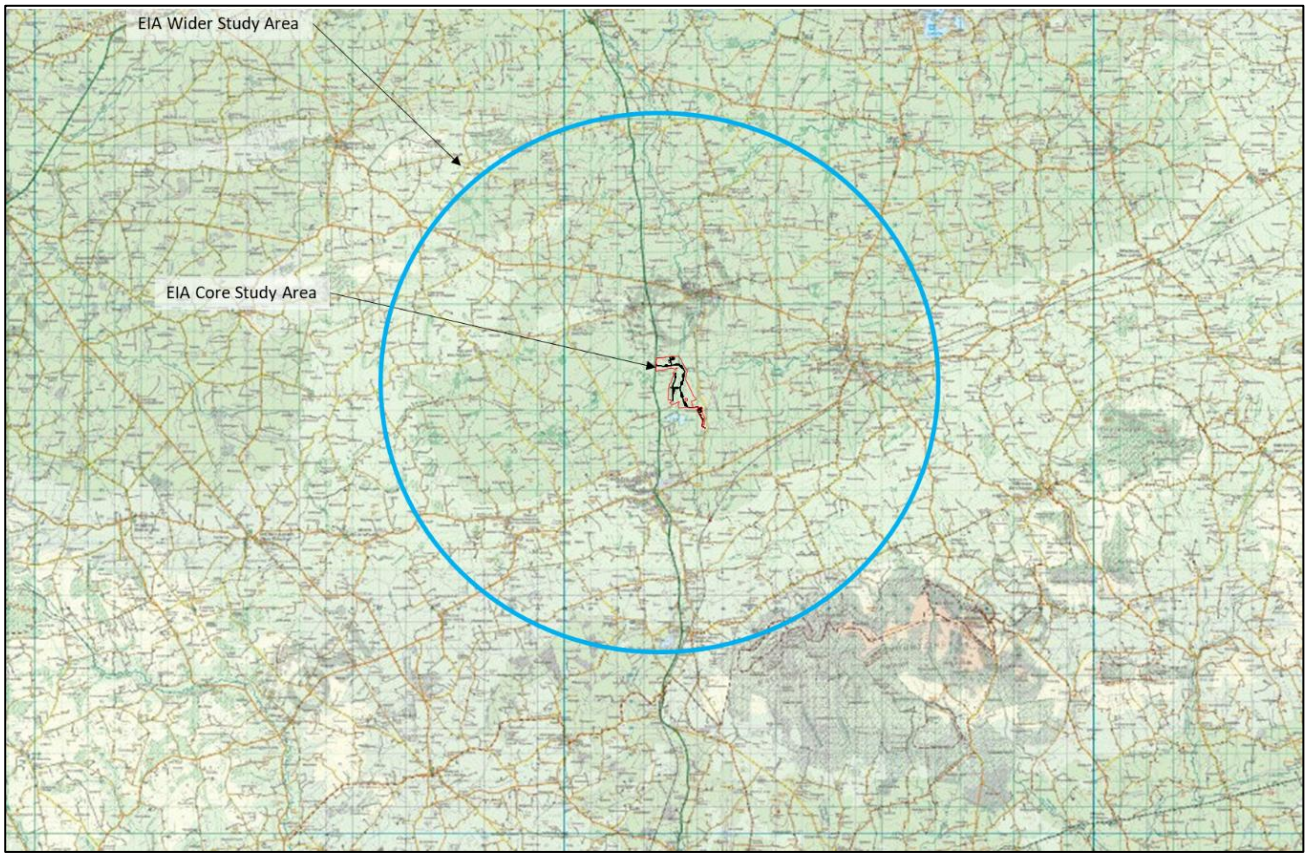

Figure 9.1A: EIA Wider Study Area (*GSI – TE Imagery DG 2011 – 2013 ITM)*

9.3.3 Land Use

9.3.3.1 Wind Farm

Land use within the wind farm site consists of agricultural pastureland for cattle, some of which are potentially viable for arable use. A portion of the Site is also traversed by an underground industrial outflow pipeline which conveys treated waste water from a waste water treatment plant, the pipeline was constructed and is operated by The Kerry Group as detailed in **Chapter 16: Material Assets** and shown on **Drawing No. 6839-JOD-GGE-XX-DR-C-0404**.

9.3.3.2 Turbine Delivery Route / Haul Route

The turbine delivery route and haul route consist entirely of public roads. Three small areas of land take will be required to construct road widening at 2 no. Site entrances, one off the N20, and one off the L1537 Site Entrance. These works will be undertaken within private agricultural lands in both cases.

9.3.3.3 Grid Connection Route

A circa 380m underground grid connection will connect the on-site 110kV Substation to the existing 110kV overhead line, where it will connect to the National Grid. This entire route is within private agricultural lands. Installation works will consist of "open dig" methods to place the new 110kV circuits within a series of underground ducts.

9.3.4 Topography

Analysis of coarse topographic information indicates that the proposed Project located near Charleville, Co. Cork, occupies a predominantly flat portion of low-lying lands, portions of which are within the floodplains of the Maigue and Loobagh Rivers.

Ground elevations for within the red line boundary vary from 58m to 73m at the highest point in the south of the Site. Slope gradients within the majority of the Site are between 0 and 2 degrees to the horizontal, although small areas of slopes up to 4.5 degrees are present to the south.

9.3.5 Bedrock Geology

According to the GSI online database, the Project footprint for Garrane Green Energy Project is immediately underlain by the following rock formations: -

- Waulsortian Limestones – Massive unbeded limestones
- Visean Limestones – Undifferentiated limestones
- Ballysteen Formation – Dark muddy limestone, shale

All the above-mentioned rock formations are soluble, although neither the Ballysteen Formation nor the Visean Limestones typically exhibit the characteristics of a "karst" landscape. However, the Waulsortian Limestones, which underlies a significant proportion of the Site, is known to exhibit typical karst landscape (dissolution) features. Karst landscapes can be problematic for construction, as the underlying rock formation tends to be both deeply weathered and has the ability to dissolve, under the action of groundwater, causing features such as sinkholes, subterranean drainage systems and other potential sources of instability.

Such conditions have significance for foundation design and the stability of wind farm infrastructure.

That being said, no dissolution /karst features such as sinkholes, subterranean watercourses or significant springs are either recorded by GSI within the Site, nor have any such features been observed during site walkover surveys. None of the shallow exploratory holes (3.80m maximum depth), undertaken during the Site Investigation campaign, recorded the presence of a solid rock formation. Analysis of historic ground investigation records published by GSI, indicates that very thick superficial soil thicknesses of up to 21.90m overly the bedrock in the northern portion of the Site.

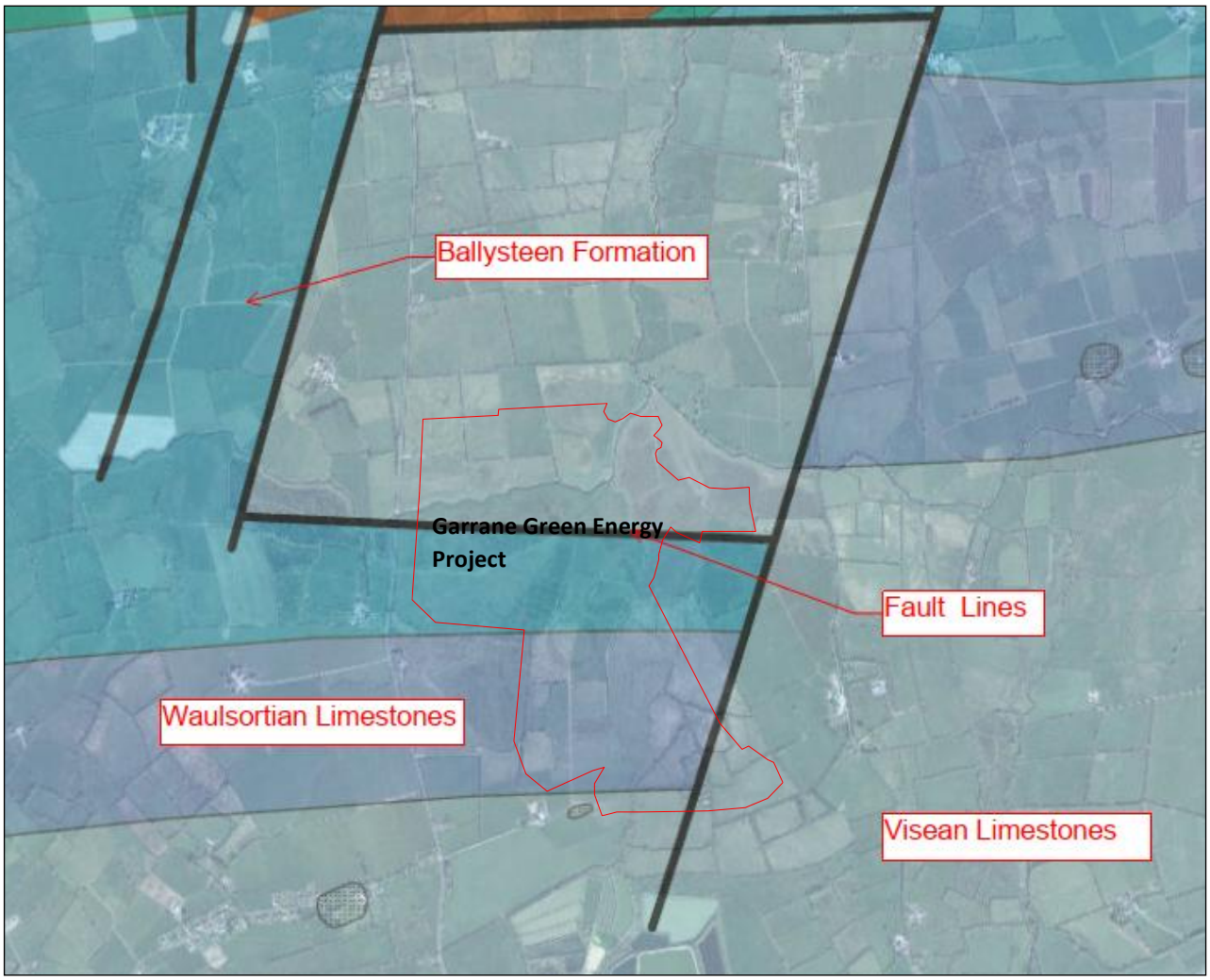

Figure 9.2: Bedrock Solid Geology (*Reproduced courtesy of GSI Datasets Public Viewer)*

9.3.6 Seismic Activity

Two geological faults traverse the Application Site. One of these crosses the northern portion of the Site in an approximately East – West direction. The other bisects the Site within the south eastern corner in an approximately south-west to north-east direction.

Faults and other discontinuities can be associated with groundwater pathways as well as seismic movement and will be considered for the purpose of detailed design. However, the Irish landmass is one of the least seismically active regions in the World, where no significant earthquakes (ML ≥ 5.4) have been recorded since records began.

The most significant seismic event recorded in Ireland by the British Geological Survey was a low energy, 3.70 magnitude seismic event, that occurred on 11th January 1951 within the Irish Sea, more than 100km from the wind farm site. In light of the above an assessment has been made with regard to the likely effects from such seismic activity. This has determined that any ground movement recorded can be expected to be negligible with respect to the Project proposed; where Peak Ground Accelerations can be expected to be in the order of 0.02g[2]. Such ground accelerations are considered to be **Not Significant**.

9.3.7 Soils and Subsoils

Superficial soils present within the Red-line Boundary largely consists of lake (lacustrine) deposits and river deposits (alluvium). The northern and southern extents of the site are underlain by cohesive glacial till (silt and clay), with small pockets of gravels present elsewhere.

For further information pertaining to site geology refer to the **Appendices 9.1, 9.2 and 9.3**:

- Appendix 9.1 Garrane Green Energy Project, Charleville, Co. Limerick - Desktop Study and Walkover Survey for Preliminary Determination of Ground Conditions" (2177-22A) 14 October 2022.
- Appendix 9.2 Garrane Green Energy Project, Charleville, Co. Limerick - Preliminary Site Investigation Works for Construction of New Wind Turbines, Access Tracks and Associated Infrastructure" (2177-22B) 17 October 2022.
- Appendix 9.3 Garrane Green Energy Project, Charleville, Co. Limerick – Supplementary Site Investigation Works for Construction of New Wind Turbines, Access Tracks and Associated Infrastructure" (2177-22C) 7 September 2024.

[2] Source: British Geological Survey – Search of Earthquake Database (accessed 12-12-2024); time period 1st Jan 1000 to 23/12/2022.

Reference to the Teagasc Soils Data maps (www.gsi.ie) indicate that the Project is predominantly covered by lake sediments and alluvium including poorly drained podzols, gleys and brown earths at the periphery of the Site. GSI mapping (**Refer to Figure 9.3**) classifies these soil types as follows:-

Lac – Lake sediments; L**acaustrine sediments**

AlluvMIN – Mineral alluvium ; **Alluvium**

AminPD – Poorly drained, mainly acidic gleys; **Till derived from Devonian sandstones.**

AdminDW – Acid brown earths / brown podzols; T**ill derived from Devonian sandstones.**

BminPD – Poorly drained, mainly basic gleys; **Till derived from limestones.**

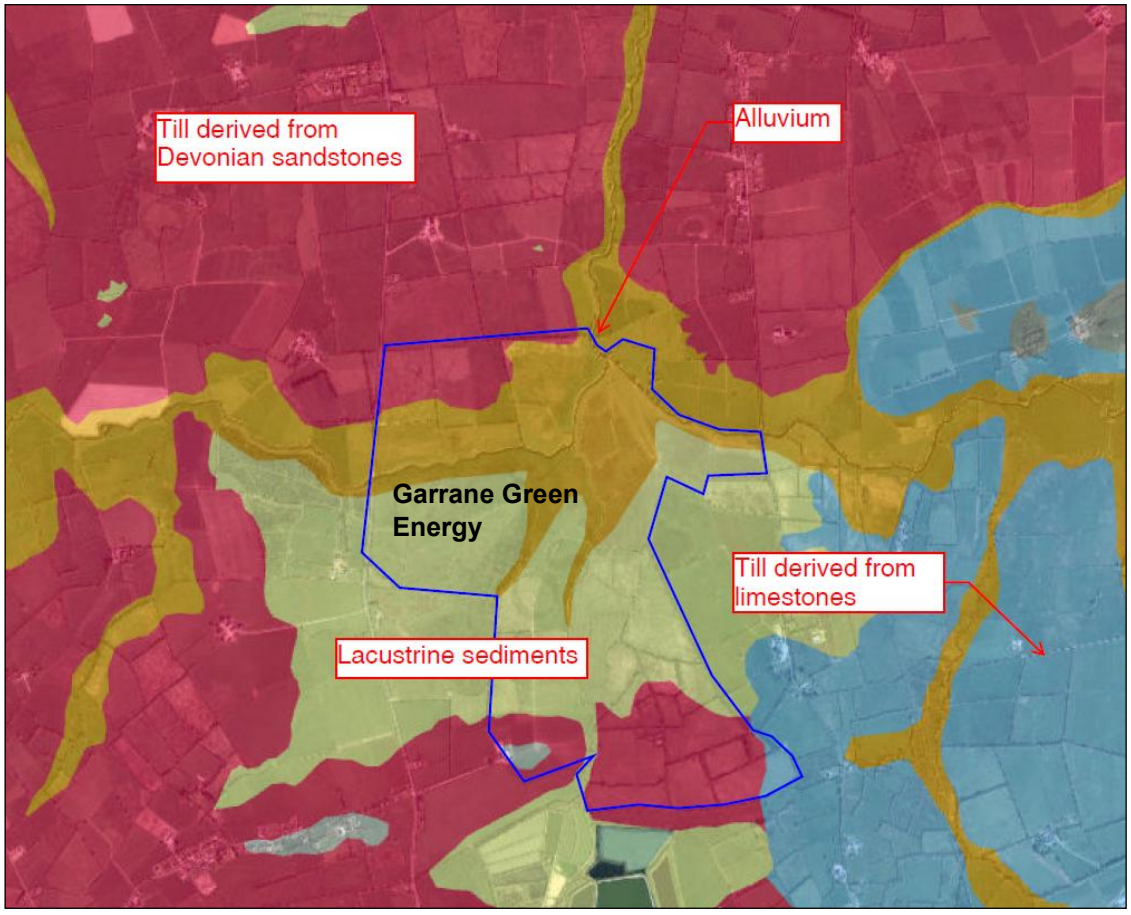

Figure 9.3: Superficial Geology (Reproduced courtesy of GSI Datasets Public Viewer)

9.3.7.1 Peat Depths

Peat Landslide Hazard screening was undertaken at the main structures, within the outlined boundary (shown in blue above). A total of 12 no. peat probes were undertaken during the initial phase of fieldwork in 2022.

Following changes to the layout, in 2024 as Detailed in **Chapter 3: Alternatives Considered**, a further 9 no. probes were completed at the revised turbines and a further 4nr at the Substation.

The results of these peat thickness measurements are given in **Table 9.7** overleaf.

Table 9.7: Peat Depth Distribution by Category

Peat Depth Category	Number of Survey Points
A – Absent or Negligible (0-0.5m)	25
B – Shallow (0.5-2.0m)	0
C – Moderately Deep (2.0-3.5m)	0
D – Deep (3.5-5.0m)	0
E– Very Deep (>5.0m)	0

o peat was recorded during these assessments and all organic soils encountered were classified as Topsoil.

9.3.7.2 Mineral Soils

A total of 10 no. hole excavations and 20 no. geophysical survey profiles were undertaken during the site investigation campaigns. The results of the investigations undertaken for the main wind farm infrastructures are summarised in **Table 9.8** and detailed further in **Appendix 9.3.**

Table 9.8: Summary of Sub-surface Lithology at the Main Structures

Infrastructure Location	Land Use	Topsoil Thickness (m)	Total Topsoil and Mineral Soil Thickness (m)	Competent Soil Depth (m)	Summary Soil Description
Turbine T1	Agriculture	0.30	3.80	4.40 (Rock Not Encountered)	Firm, brown, sandy, gravelly SILT/CLAY and dense, brownish grey, sandy, clayey GRAVEL and boulders.
Turbine T2	Agriculture	0.20 – 0.30	>3.20	5.00 (Rock Not Encountered)	Firm, brown, sandy, gravelly SILT/CLAY and dense, brownish grey, sandy, clayey GRAVEL and boulders.
Turbine T3	Agriculture	0.30	>3.20	4.00 (Rock Not Encountered)	Firm to stiff, brown sandy SILT/CLAY and boulders
Turbine T4	Agriculture	0.35	>3.20	2.30 (Rock Not Encountered)	Stiff, brown, sandy, gravelly CLAY and dense, brownish grey,

Infrastructure Location	Land Use	Topsoil Thickness (m)	Total Topsoil and Mineral Soil Thickness (m)	Competent Soil Depth (m)	Summary Soil Description
					sandy, clayey GRAVEL and boulders
Turbine T5	Agriculture	0.30	>3.20	4.40 (Rock Not Encountered)	Firm, brown, sandy, gravelly SILT/CLAY and dense, brownish grey, sandy, clayey GRAVEL and boulders.
Turbine T6	Agriculture	0.20 – 0.30	> 3.00	5.00 (Rock Not Encountered)	Firm, brown, sandy, gravelly SILT/CLAY and dense, brownish grey, sandy, clayey GRAVEL and boulders.
Turbine T7	Agriculture	0.30	>3.20	4.00 (Rock Not Encountered)	Firm to stiff, brown sandy SILT/CLAY and boulders
Turbine T8	Agriculture	0.35	>3.20	2.30 (Rock Not Encountered)	Stiff, brown, sandy, gravelly CLAY and dense, brownish grey, sandy, clayey GRAVEL and boulders
Turbine T9	Agriculture	0.35	>3.20	2.30 (Rock Not Encountered)	Stiff, brown, sandy, gravelly CLAY and dense, brownish grey, sandy, clayey GRAVEL and boulders
Substation	Agriculture	0.25	>3.80	1.60 – 2.20 (Rock Not Encountered)	Stiff, brown slightly sandy very gravelly SILT/CLAY. Medium cobble content. Occasional boulders
Substation / Compound	Agriculture	0.25	>3.80	1.60 – 2.20 (Rock Not Encountered)	Stiff, brown slightly sandy very gravelly SILT/CLAY. Medium cobble content. Occasional boulders
Met Mast	Agriculture	0.25	>1.60	1.60 – 2.20 (Rock Not Encountered)	Stiff, brown slightly sandy very gravelly SILT/CLAY. Medium cobble content. Occasional boulders

9.3.8 Geological Resource Importance

Review of the GSI Online Database and Google Earth Imagery data indicates that there are no quarries within 2km of the Site. The closest crushed aggregate quarries / pits are as follows:

1. Shane Foley Plant Hire Ltd (Quarry products, sand and gravel, contract crushing) 7km to the south.

2. Ballyhea Ready mix (Concrete, gravel) 7.1kn to the south.
3. Costello Quarry (Basalt aggregate) 9km to the north west.
4. Ballyorgan Quarry (Limestone aggregate) 14km to the east.
5. Kilmeedy Sandstone Building Stone Quarry (Building stones, crushed stones and decorative stones) 16.5km to the north west.
6. Liam Lynch (Quarries) Ltd (Crushed stone, ready-mix concrete, aggregates for concrete) 17km to the north west.
7. Rockmills Limestone Quarry (Crushed stone, ready-mix concrete, aggregates for concrete) 26km to the south east.
8. Croom Concrete Limited (Precast concrete) 12.3km to the north east.
9. Granagh Concrete Products (Concrete, sand & gravel chippings) 8.1km to the north west.
10. Ballyhea Readymix (Ready-mix concrete and stone products) 7.2km to the south.
11. Ducon Concrete Limited (Crushed stone, ready-mix concrete, aggregates for concrete) 31.2km to the south west.
12. White Rock Quarries (Crushed limestone aggregate) 23km to the south west.
13. Roadstone Mallow (Ready-mix concrete, aggregates, asphalt and macadam, mortar and plaster, concrete blocks and masonry, paving products) 25km to the south.

No records of shafts or adits associated with mineral exploration were observed within 10km of the site. No records of shafts or adits associated with mineral exploration have been recorded within the immediate vicinity.

According to Geological Survey Ireland (GSI), the Aggregate Potential for the rock formation underlying the wind farm site is generally categorised as LOW to MODERATE.

Analysis of the ground investigation results confirms soils to be thick and predominantly clay with the bedrock correspondingly deep. The potential to win good quality rock, from an on-site Borrow Pit is considered to be LOW, as suggested by GSI. Any loss of mineral resources caused by the Project will, consequently, be **Not Significant**.

9.3.9 Features of Geological Heritage

The Geological Survey of Ireland (GSI) maintains a database for known Geological Heritage Sites in Ireland. This database was accessed on 10th December 2024 and review of its published contents has determined that the following audited Geological Heritage Sites are present in the vicinity of the Application Site.

- LK022 Knocksouna (1.5km to the east of T7)

- LK001 Ballyhoura Mountains (9.7km SE)
- LK002: Ballylanders – Kilfinnane Morraine (11.6km SE)
- LK030: Tory Hill (14.7km N)
- LK024: Lough Gur (13.5km NW)

All of these Geological Sites, with the exception of Knocksouna, are outside the study area and not considered to be hydrologically linked to or influenced by the Application Site.
The Knocksouna site includes a series of warm water springs and a high bedrock crag to the north. The springs occur along a roughly east-west line at the foot of Knocksouna Hill, where twelve individual springs emerge through the alluvial floodplain of the River Loobagh, over a distance of 700m.

The bedrock is dolomitised Waulsortian "Reef" limestone, which has been planned, streamlined and sculpted by ice during the Ice Age. Southwards, in the same field, the land is underlain by oolitic limestones with similar bedding orientation. The contact between the two bedrock units is obscured by deep glacial till and alluvium in the area of the springs.
The Knocksouna site is considered to be unusual, relatively unique and to deserve recognition as a County Geological Site.

The Project and the Knocksouna site, although connected by the Loobagh River, are not hydrologically linked. The Knocksouna site lies upstream of the Project and therefore, any potential effect will be **Indirect, Long-term, Adverse and Imperceptible,** as a result of contamination by hydrocarbons, chemicals or siltation contamination entering the watercourse. In EIA terms the effect is considered as **Not Significant.**

9.3.10 Landslide Susceptibility

According to Geological Survey of Ireland (GSI) mapping, Landslide Susceptibility within the Application Site and along the grid connection is LOW or LOW (INFERRED) risk.

GSI also holds records of historic landslides and records one landslide event within 10km of the site. This landslide event (ref: GSI_LS03-0009) occurred in 1697 at Kapanihane Bog within the Estate of Brook Bridges, approximately 7km to the northwest, which resulted in a landslide occurring within the raised peat bog. There is no record of any impact as a result of this event and no other events have been recorded either within the site boundary or within 10km.

Within the Site ground slopes are either flat or of a very low angle and, consequently, potential for natural soil movement is also considered to be low.

9.3.11 Peat Slide Risk Assessment

Peat Landslide Hazard has been screened out for the application Site.

All wind farm infrastructure is considered to be sufficiently distant from existing peat bog (external to the Site), so as to render any adverse impact to the construction works negligible.

This preliminary screening has determined that peat landslide hazard is negligible. The walkover survey and subsequent site investigations confirm the absence of peat soils within the Application Site.

9.3.12 Designated Sites

The following protected sites and contaminated lands in the vicinity of the Applicant Site are designated according to the Government of Ireland's EPA Map Viewer, (https://gis.epa.ie/EPAMaps/) (accessed on 18th June 2025):

- Mountrussell Wood Proposed NHA (Ref 002088 – 8.2km)
- Blackwater River SAC (Ref 002170 – 8.9km)
- Ballyhoura Mountains SAC (Ref 002036 – 9.8km)
- Ballyhoura Mountains Proposed NHA (Ref 002036 – 9.9km)
- Ballyroe Hill and Mortlestown Hill Proposed NHA (Ref: 002089 – 13km)
- Heathfield Wood (Ref: 001434 – 13.5km)
- Tory Hill SAC and Proposed NHA (Ref 002087 – 14.5km)
- Glen Bog SAC (Ref 001430 – 15.3km)
- Ballynacourtney Wood Proposed NHA (Ref 002162 – 16.7km)
- Adare Woodlands / NHA (Ref 00429 – 17.8km)
- Hawkswood Bog NHA (Ref 002355 – 16km)

None of these designated sites are within the study area and do not have the potential to be affected by the Project. No other protected sites are considered to be within the zone of influence of the Application Site. Any adverse effect caused by the Project will be **Not Significant.**

9.3.13 Soil Contamination

There are no known areas of existing soil contamination within the Site and no evidence of measurable soil contamination was observed during walkover surveys or the site investigation. As agricultural equipment is used across much of the Site, it is possible that minor fuel spills and leaks have occurred locally in the past. There will also be imported soils of unknown provenance surrounding the underground pipeline owned and maintained by the Kerry Group, which traverses the Site in a roughly north – south direction, passing just east of the met mast and close to the western edges of turbines T3 and T5.

Since the works required for the Project will not involve the excavation or disturbance of the existing pipeline and historic agricultural contamination has not been observed, the potential impact from pre-existing soil contamination is considered to be low.

9.3.14 Other Sensitive Receptors

A portion of the Application Site overlaps with the buffer apportioned to a Private Water Supply (of unknown origin; assumed agricultural) recorded by GSI as IE_GSI_GW_Well_19496 (GSI Name: 1411NWW033), located at Grid Reference ITM: E=554850, N=626360.

The potential for adverse effect on this Private Water Supply is considered to be **Not Significant**. Refer to **Chapter 10: Hydrology and Hydrogeology, Section 10.3.18.2** for further details.

The are no Group Water Supply or other Public Water Supply Schemes within the Study Area.

A system of Surface Water Reservoirs, owned and operated by the Kerry Group, are located within the Study Area, immediately south of the Site. Refer to **Figure 9.11 – Groundwater Wells and Source Protection Zones** These reservoirs are used by the Kerry Group, as part of their manufacturing process, but are not considered to be hydrologically linked to the Project Site. The potential for adverse effect by the Project is considered to be **Not Significant.**

9.3.15 Site Investigations – Summary of Findings

Table 9.9 presents a summary of the findings of the Soils and Geology Baseline together with preliminary design recommendations.

Table 9.9: Summary of Site Investigation Findings and Recommendations

Element Ref:	Element Assessed at Site Investigation Stage	Summary Soil Description
1A	Typical Soil Overburden (Wind Farm)	Refer to **Table 7.8**.
1B	Typical Soil Overburden and Bedrock (Grid Connection)	TOPSOIL, overlying granular and cohesive mineral soils. All circuits will be laid within the superficial soils. Bedrock excavation is not anticipated.
2	Typical Turbine Foundation Overburden Thickness (m) (Material to be removed during the construction phase)	T1 = 2.75m T2 = 3.60m T3 = 2.20m T4 = 2.30m T5 = 2.20m T6 = 2.30m T7 = 2.30m T8 = 2.20m T9 = 2.30m Pylons = 0.60m Substation Compound = 0.25m Met Mast = 1.2m
2	Rock Type (Wind Farm)	Soluble dark LIMESTONE rock pertaining to the Waulsortian Limestones formation. Shallow rock was not encountered during the SI Trial Hole campaign; however, the geophysical surveys did identify the presence of intact limestone at 4m to 5m at the Met Mast and T5, and 6m to 8m at turbine T1. Formations typical of highly decomposed limestone were also recorded at turbines T2 and T3 (6m to 8m below ground level) and at turbines T3, T4, T6, T7, T8 and T9 (4m to 6m below ground level)
4	Rock Competence (Wind Farm)	According to geophysical survey findings the upper surface of the limestone rock formation is variably weathered. At the Met Mast and turbine T1 intact competent rock has been identified, but at T2, T3, T4, T5, T6, T7, T8 and T9 the limestone formation is deeply weathered and highly decomposed.
5	Typical Depth to Non Rippable Rock	Analysis of geophysical survey data indicates depth to intact limestone varies from 4m to >18m at the main infrastructure. Historic borehole records indicate weathered LIMESTONE at depths of up to 21m below existing ground level.
6	Anticipated Wind Turbine Foundation Type	T1 = Gravity Base Foundation T2 = Gravity Base Foundation T3 = Gravity Base Foundation T4 = Piled Foundation T5 = Piled Foundation T6 = Piled Foundation T7 = Piled Foundation T8 = Piled Foundation T9 = Gravity Base Foundation Substation = Raft, strip or pad foundations within the firm mineral soils Substation Compound = Raft, strip or pad foundations within the firm mineral soils for structures MET MAST = Raft, strip or pad foundations within the firm mineral soils

Element Ref:	Element Assessed at Site Investigation Stage	Summary Soil Description
7	Slope Stability	T1 : FoS > 1.1 (Acceptable) T2 : FoS > 1.1 (Acceptable) T3 : FoS > 1.1 (Acceptable) T4 : FoS > 1.1 (Acceptable) T5 : FoS > 1.1 (Acceptable) T6 : FoS > 1.1 (Acceptable) T7 : FoS > 1.1 (Acceptable) T8 : FoS > 1.1 (Acceptable) T9 : FoS > 1.1 (Acceptable) Substation : FoS > 1.1 (Acceptable) Substation Compound FoS > 1.1 (Acceptable) Met Mast FoS > 1.1 (Acceptable)
8	Karst Features	No "karst" features such as sinkholes, caves, cavities, voids or subterranean watercourses are recorded within the Site, on GSI Mapping. The Waulsortian Limestones, known to be associated with "karst" Landforms elsewhere, underlies turbines T2, T3 and T4. Elsewhere, T1, T5, T6, T7, T8, T9 and the Met Mast are underlain by the Ballysteen Formation and Visean Limestones. These rock formations are less associated with "karst" but nevertheless similarly soluble. Although no "karst" features such as sinkholes, caves, cavities, voids or subterranean watercourses were located during the walkover survey or intrusive SI, a number of anomalies were recorded by the geophysical survey. In particular, the geophysical investigation identified deep rock weathering at T2, T3, T4, & T7 of the type typically associated with "karst" features.
9	Groundwater Observations	Weak flow at 5.91m (WTG01) - Mobile Weak flow at 2.34m (WTG03) – Mobile Weak flow at 4.30 (WTG04) - |Mobile) No groundwater observed at WTG02 and SUBSTATION
10	GSI – Crushed Rock Aggregate Potential	According to Geological Survey Ireland, the Aggregate Potential for the Borrow Pit site is categorised as follows: - <u>Low to Moderate</u> Following the site investigation, the author suggests that the potential to win rock on-site Borrow Pit is worse than suggested by GSI. Consequently, the potential for aggregate extraction at the site is considered to be LOW.
11	Predicted Performance of rock formations as construction aggregate	Only Medium Strong LIMESTONE rock strata (or better) have potential. This material was not encountered during the SI campaign and believed to be at some a depth that it would be considered uneconomic to recover.

9.4 ASSESSMENT OF POTENTIAL EFFECTS

Where not specifically stated otherwise, all potential effects detailed in this section are pre-mitigation potential effects.

The significance of an effect has been determined by considering the magnitude of the impact and the sensitivity of the receptor, with the classifications assigned in accordance

with the EPA Guidelines, (EPA, 2022), including **Imperceptible, Not Significant, Slight, Moderate, Significant, Very Significant** and **Profound**. (**Table 9.5**).

In considering the effects, criteria such as quality, duration, probability and type have also been considered, per the criteria detailed in Table 3.4 of the EPA Guidelines (EPA, 2022). For the purpose of this assessment, effects rates as '**Significant**' or above are considered to be **Significant** in EIA terms. Effects identified as '**Moderate**' significance or below are not considered to be **Not Significant** in EIA terms.

Proposed mitigation measures for each potential effect are listed in Section 10.6 and summaries of both the residual effect following mitigation and its significance are detailed in this section.

9.4.1 Do Nothing Impact

The "Do Nothing Effect" is the effect on the Site should the proposed wind farm not be constructed. In this case, it is envisaged that the current land use would remain as it is now, with continued medium intensity grazing for cattle. Given the nature of the land, being generally pastureland, it is unlikely that any substantial changes in this use will occur in the near future. There will still be potential for moderate adverse effects on the groundwater aquifer from contamination of soils by agricultural activities.

Assessment of existing conditions with respect to their potential effect on soils and geology are detailed in **Table 9.10**, below.

Table 9.10: Do Nothing Effect

Item	Assessed Element	Assessed Baseline Condition	Anticipated Do Nothing Effect
1	Water Regime – Response to Storm events	Combination of surface water and groundwater at site of wind farm infrastructure, where some of the infrastructure resides within the flood plain of the River Maigue. Storm events will result in localised soli degradation, siltation of watercourses and localised erosion.	Do Nothing Potential Effect – Siltation of Watercourse, Soil Erosion and Degradation. Adverse, direct, moderate, site-wide / potentially regional, conforms to baseline, likely, short term.
2	Water Regime - Erosion of slopes	Current slopes within the Site are of low susceptible to soil erosion during high rainfall events.	Do Nothing Potential Effect – Soil Degradation and Failure. Adverse, direct, slight, site-wide / potentially regional, conforms to baseline, likely, short term.

Item	Assessed Element	Assessed Baseline Condition	Anticipated Do Nothing Effect
3	General Soil Stability	Current slopes are low. Soils are considered to be in a state of stable equilibrium.	Do Nothing Potential Effect – Soil Failure. Adverse, direct, slight, site-wide, conforms to baseline, unlikely, short term.
4	Land Contamination	No contamination of natural soils and groundwater were encountered at The Site. Potential for activities to cause contamination remains.	Do Nothing Potential Effect: Adverse, direct, moderate, site-wide, contrasts to baseline, unlikely, long term.

9.4.2 Construction Phase Potential Effects

The Project is characterised by the construction of infrastructure necessary to complete the wind farm as described in the **Chapter 2: Project Description.**

The direct and indirect effects of the construction activities, and their expected duration are assessed further in the following sections, where the particular activities that will give rise to effects on soils and geology are listed below:

- Turbine Construction
- Substation and Compound Construction
- Crane hard stand and temporary blade lay down hard stand construction.
- Temporary construction compound
- Met Mast construction.
- Installation of internal cabling
- Installation of grid connection cabling
- Construction of Site Tracks
- Spoil deposition
- Upgrade Turbine Delivery / Haul Route; construction of 2 No. bridges.

The effects on land, land use, natural resources and protected sites, as a consequence of conducting the works are also assessed in the following sections.

9.4.2.1 Compaction, Erosion and Degradation

The movement of construction traffic throughout the site has the potential to effect soils by causing soil compaction, which in turn may impact upon hydrology. Compaction occurs when soil particles are pressed together, reducing pore space.

This, therefore, has the following potential effects:

- Loss of soil structure,

- Reduction of soil fertility
- Reduction in permeability and rainfall infiltration,
- increasing the risk of surface water runoff and erosion. This reduction in permeability is known as "soil sealing"

Erosion is caused by the action of wind, climate and other weathering forces on the soil mass and can result in the following potential effects:-

- Loss of soil structure,
- Reduction of soil fertility
- Vegetation loss
- Indirect siltation of water courses

The superficial soils underlying the Site are generally clays of low permeability and coupled with the fact that the site has flat or gently sloping topography, the effects of compaction will not result in a significant increase in runoff. The potential for compaction and erosion of the soil is considered to be **Short Term** with a **Small Adverse** magnitude of impact.

The potential effect is considered to be of **Moderate** significance. Mitigation measures will be adopted throughout the construction phase to reduce the occurrence of compaction, although it should be noted that the majority of the construction work and vehicles will take place on the new tracks and crane hardstanding's and thus of a smaller footprint.

Table 9.11: Effect Summary – Compaction and Erosion

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Compaction, Erosion and Degradation	Direct	Adverse	Moderate	Site	Contrast to baseline	Likely	Short Term

9.4.2.2 Land and Land Use

25,635m^3 of topsoil and 20,770m^3 of subsoil removal will occur during construction excavations and is an unavoidable consequence of the Project. This will result in an adverse effect to land capability for agriculture, causing a loss of moderately productive agricultural lands. Removal of the soil (both organic topsoil and mineral soils) and bedrock is considered to be a permanent effect as it would not normally be reversed, although some reinstatement of the agricultural capability is possible after decommissioning.

9.4.2.2.1 Land Take – Wind Farm

Construction of the wind farm will be a long-term alteration to the current agricultural land use. Although, the wind farm will have a finite lifespan and the land use returned to agriculture following decommissioning, there will initially be a significant loss of farmable area (c. 158.75 ha) during construction, which will have a commercial impact on farmed land holdings. However, this loss will be reduced to 11.256ha following construction, when lands demarcated for the construction phase, but peripheral to the infrastructure, will be returned to agricultural usage following reinstatement.

Considering the above, the effect caused to soils and geology, by land take for the wind farm, is considered to be a **Long-term, Adverse** and **Moderate**. In EIA terms the effect is considered as **Not Significant.**

9.4.2.2.2 Land Take - Turbine Delivery Route (TDR)

No land take will occur within public roads, but short sections of land takes will occur within private third-party lands, where widening is required at the 2 no. Site entrance. The effect of this land take is considered to be **Long-term, Adverse** and **Slight**. In EIA terms the effect is considered as **Not Significant**.

9.4.2.2.3 Land Take - Grid Connection Route (GC)

Removal of the topsoil and mineral soils to install cables within a field is considered to be a temporary effect as the ground will be reinstated in a "like-for-like" fashion immediately following installation of the circuits. The effect this will have in relation to the Grid Connection is considered to be **Temporary, Adverse and Slight.** In EIA terms the effect is considered as **Not Significant**.

Table 9.12: Effect Summary – Land Use

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Land Take – Wind Farm	Direct	Adverse	Moderate	Site	Contrast to baseline	Likely	Long Term
Land Take – TDR	Direct	Adverse	Slight	Site	Contrast to baseline	Likely	Long Term
Land Take - GCR	Direct	Adverse	Slight	Site	Conforms to baseline	Likely	Temporary

9.4.2.3 Subsoil and Bedrock Removal

20,770m3 of subsoil (consisting of acid and basic gleys, brown podzols, alluvium and lacustrine sediments) and bedrock (to a much lesser degree) removal will occur during construction excavations and is an unavoidable consequence of the proposed Project. The potential effects associated with soil and bedrock removal are as follows:-

- Alteration of natural geological landforms,
- Reduction in capacity for the soils to support vegetation
- Changes in permeability and rainfall infiltration
- Alteration of topography so as to reduce slope stability

Invasive species can also be spread during the removal of soils. This is addressed in **Chapter 6: Biodiversity**. Although no invasive species were identified during the surveys the EcOW will continue to monitor for their presence at pre-construction stage.

Spoil generated during these operations will be selectively reused during the construction phase with any remainder stored locally within a series of spoil repositories, for reuse during the decommissioning phase. Refer to **Chapter 2: Project Description: Drawing No. 6839-JOD-GGE-XX-DR-C-0200 – 0209** for details.

No further subsoil or bedrock removal will be required during the operational phase. During the decommissioning phase, the soil and rock spoil will be remobilised for the purpose of land restoration.

9.4.2.3.1 Excavations

The operation of removing soils and bedrock increases the potential for contaminating soil movements to occur. Processes such as soil instability, poor spoil handling, compaction and subsidence brought about by earthworks activities, can cause a release of silt into the environment, which can adversely affect local (and potentially regional) sensitive receptors, such as watercourses and their associated flora and fauna.

Excavations will be required for most aspects of the Project including for turbine foundations, turbine hardstand areas, Access Tracks, areas of widening on the TDR / Haul Route, Site Compound, cable trenches, Substation, Substation Compound, Met Mast, Grid Connection, other ancillary infrastructure and drainage. Estimates of these excavation volumes are presented in **Table 9.1.3** below.

Table 9.13: Estimates of Excavation Volumes

Description	Topsoil Quantity (m3)	Subsoil and Rock Quantity (m3)
Spoil generated during construction activities	25,635	20,770
Selected subsoil re-used as construction fill (Type 6F2) during the construction phase	-	4,155
Selected subsoil will be utilised as Type 4 material for during the construction phase	-	16,615
Selected topsoil used for reinstatement following completion of the construction phase	25,635	-
Surplus soil to be re-used off site	0	0

The effects associated with general excavation works are considered to be **Long-term, Adverse** and **Significant.**

This is because of the scale of the earthworks (both in terms of depth and volume), the volume of material removed, and the size of the plant used to facilitate it. Refer to the **CEMP** in **Appendix 2.1** which details the excavation works required.

In EIA terms, the effect is considered as **Significant**.

9.4.2.3.2 Site Access Tracks

Site Access Tracks will be needed to accommodate the construction works and to provide access to the turbine locations for the whole life cycle of the wind farm. The tracks will be constructed within the firm mineral soils using unbound crushed aggregates and incorporate drainage to maintain the performance of the pavement during wet weather.

The effect associated with excavations for soil and bedrock removal for the Site Access Tracks (*loss of agricultural resource, degradation of soil structure, changes to drainage, as well as increased potential for erosion*) is **Long-term**, **Adverse** and **Significant**. This is because of the scale of the earthworks (both in terms of depth and volume), the volume of material removed, and the size of the plant used to facilitate it.

In EIA terms, the effect is considered as **Significant**.

9.4.2.3.3 Turbine Foundations and Hardstand Areas

The soil encountered at each turbine and infrastructure location, during construction, is considered to be a combination of topsoil, and both granular and cohesive mineral soils. The underlying Limestone rock formation is the preferred formation for the transference of foundation loads but is unlikely to be exposed in excavations due to the significant soil thickness present. Turbines T4, T5, T6, T7 and T8 lie within the floodplain, and will be constructed using piled foundations, in order to transfer foundations loads directly onto the underlying rock formation. For all other turbines (T1, T2, T3 and T9) and associated infrastructure, the overlying topsoils will be removed until mineral till soils of sufficient competence are encountered and the construction of standard strip, pad or base foundations commenced. Refer to **Table 9.14,** for proposed foundation arrangements.

9.4.2.3.4 Bedrock Excavations at Turbine foundations

Significant bedrock excavations will not be required for the construction of turbine foundations, which is generally at a depth considered to be beyond shallow excavations. Locally, some excavations may encounter rock, but this will be exceptional and highly localised.

Any rock excavated during construction will be selectively reused as construction fill where possible.

Table 9.14: Indicative Depth to Bedrock at Proposed Turbine Locations

Turbine No. / Unit	Foundation Type and Depth of excavation	Depth to Competent Rock (mBGL)
T1	Gravity Base 3.75m	>5.00
T2	Gravity Base 4.95m	>7.00
T3	Gravity Base 3.70m	>6.00
T4	Piled 2.30m	>5.50
T5	Gravity Base 2.20m	>6.00
T6	Piled 2.30m	>5.00
T7	Piled 2.30m	>5.00
T8	Piled 2.20m	>5.50
T9	Gravity Base 3.40m	>5.00
Substation	Strip, Pad or Raft 0.60m	>3.80
Substation Compound	Strip, Pad or Raft 0.25m	>3.80
Met Mast	Gravity Base 1.20m	>3.00

Confirmatory construction stage ground investigations will confirm the quality and strength of the bedrock, where present. Where deep or large excavations are required in moderately strong to strong rock, heavy breakers will be deployed for this purpose. No rock blasting will be employed to remove rock at the application Site.

The effects associated with excavations for soil and bedrock removal at Turbine and Turbine Hardstand areas *(Alteration of natural geological landforms, reduction in capacity for the soils to support vegetation, changes in permeability and rainfall infiltration as well as alteration of topography so as to reduce slope stability*) are **Permanent**, **Adverse** and **Significant**.

In EIA terms, the effect is considered as **Significant**.

9.4.2.3.5 Wind Farm Site Cable Trenches

Cable trenches throughout the Site will be excavated to a depth of 1.0m prior to installation of cable ducts. During construction, the topsoil and mineral soils will be stored separately and any excess remaining after reinstatement will either be stored permanently on site or removed for disposal off-site.

Imported granular fill will be used to surround the cables, albeit with suitable excavated soils being reused for backfill. The effect associated with excavations for wind farm internal cabling *(Degradation of soil structure, changes to drainage regime and reduction in soil fertility)* are **Long-term**, **Adverse** and **Not Significant**.

In EIA terms, the effect is considered as **Not Significant**.

9.4.2.3.6 Borrow Pit

No borrow pits are proposed for the Site.

9.4.2.3.7 Turbine Delivery Route / Haul Routes

The Turbine Delivery Route will generally use the existing public roads. However, widening will be needed at the 2 no. Site entrances. Details are presented in **Chapter 17: Traffic and Transport**.

Generally, the impacts associated with this will be as per the Site Access Track construction but on a very minor scale and reversible. The effects *(loss of soil ability to support vegetation, degradation of soil structure, changes to drainage and increased potential for erosion)* are **Long-term, Adverse** and **Not Significant** effects.

In EIA terms, the effect is considered as **Not Significant**.

9.4.2.3.8 Grid Connection (GC)

Grid connection trenches will be excavated along the grid connection route, between the Substation and the Loop-in" connection to the existing110kV OHL between Kilonan and Charleville. The trenches will be within agricultural fields, to a proposed depth of 1.30m, depending on confirmatory investigations. Excavation of topsoil and mineral soils will be required.

These trenches will be backfilled using imported granular material with the excavated material stored on-site at one of the soil repositories or recycled for use elsewhere. The effects associated with excavations for cable trenches (Degradation of soil structure, changes to drainage regime, reduction in soil fertility and reduced stability) are **Permanent, Adverse** and **Not Significant**.

In EIA terms, the effect is considered as **Not Significant**.

9.4.2.3.9 Site Compound

One site compound and one blade laydown area will be employed. The compound will be temporary, for the duration of the construction phase. Refer to **Chapter 2: Project Description Section 2.6.7, Figure 1.2,** and **Table 2.8** for details.

The potential effects for the temporary construction compound are considered to be **Temporary, Adverse** and **Slight.** In EIA terms, the effect is considered as **Not Significant**.

9.4.2.3.10 Total Volumes of Material to be Excavated

Refer to **Table 9.13.** 25,635m^3 of Topsoil and 20,770m^3 of Subsoil will be excavated to construct the Project.

It is envisaged that spoil generated can be used as structural fill in Access Tracks, turbine hardstands, turbine foundation construction, reinstatement, roadside berms, hedgerow and tree planting and landscaping.

Where excess topsoil or subsoil material is generated which cannot be utilised for reinstatement or landscaping purposes, it is proposed to develop a permanent spoil storage area (berm) where excess soil and subsoil will be stored permanently. The permanent spoil area (berm) is 4,050m^2 and will be 2m in height with a storage capacity of 8,100m^3.

A general summary of all the pre-mitigation effects associated with subsoil and bedrock removal is presented in **Table 9.15.**

Table 9.15: Effect Summary – Soil and Bedrock Removal

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Soil and Bedrock Removal –Excavations	Direct	Adverse	Significant	Site	Contrast to baseline	Likely	Long Term
Soil and Bedrock Removal - Site Access Tracks	Direct	Adverse	Significant	Site	Conforms to baseline	Likely	Long Term
Soil and Bedrock Removal – Turbine and Hardstand Areas	Direct	Adverse	Significant	Site	Contrast to baseline	Likely	Permanent
Soil and Bedrock Removal – Wind Farm Site Cable Trenches	Direct	Adverse	Not significant	Site	Contrast to baseline	Likely	Long Term
Soil and Bedrock Removal – Turbine Delivery Route / Haul Route	Direct	Adverse	Not significant	Regional	Contrast to baseline	Likely	Long Term
Earthworks Activities – Grid Connection Cable	Direct	Adverse	Not significant	Site	Contrast to baseline	Likely	Permanent
Earthworks Activities – Temporary Construction Compound	Direct	Adverse	Slight	Site	Contrast to baseline	Likely	Temporary

9.4.2.4 Storage and Stockpiles

9.4.2.4.1 Overview

Spoil generated on Site will be either topsoil, small amounts of organic soils, mineral soils or rock. This spoil will be re-used, where possible, as fill around infrastructure and to construct stockpiles / bunds along the edge of site tracks, at the substation and around the edges of the construction compound.

Removal of soil and rock during construction produces spoil that lacks the competence and stability it had before removal. Such spoil is a hazard to the wider environment where it can have the following effects on soils and geology:

- Contamination by way of siltation of watercourses.
- Loss of soil structure and fertility during stockpiling; and
- Landslide hazard, where spoil is not managed appropriately.

The handling, management and re-use of excavated spoil material is of importance during the construction phase of the project.

Excavated spoil material will arise from all infrastructure elements of the wind farm (foundations, tracks, hardstands, cabling, grid connection etc.).

Estimated total volumes of material to be excavated are presented in **Table 9.13.**

9.4.2.4.2 Spoil Management

Within the spoil management process there is potential for a moderate adverse effect on soil due to erosion of inappropriately managed excavated materials. However, any effects from the handling of excavated materials will be managed through good site practice, as per NRA Guidelines. A robust sediment and erosion plan, greatly reduces the risk of erosion or sediment release to surface waters.

Organic matter loss can occur when wet peat or organic soils are excavated and allowed to dry in the open air. Such material is a major source of carbon, and the loss of organic matter leads to an emission source of carbon dioxide (CO_2) and nitrogen dioxide (NO_2). A Carbon Calculator can be found in **Chapter 13: Air Quality and Climate**, which addresses the effect of loss of carbon to the atmosphere through the drying out of organic soils excavated as part of the Project.

Excavated soil and bedrock will be re-used for the construction of site Access Tracks and as construction fill wherever suitable. No excavated soils will be taken offsite.

Any residual soils that cannot be re-used will be stored at a designated spoil repository on lands, next to the Substation Compound. For further details of this and for spoil kept in stockpiles, re-used and permanently stored refer to the Spoil Management Plan, **Appendix 2.1 CEMP – Management Plan 4**.

This process of storage, stockpiling and spoil management will have a **Long-term, Adverse** and **Moderate** effect on the geology and soils associated with the proposed project. In EIA terms, the effect is considered as **Not Significant**.

A general summary of all the pre-mitigation effects associated with subsoil and bedrock removal is presented in **Table 9.16.**

Table 9.16: Effect Summary – Storage and Stockpiles / Spoil Management

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Earthworks Activities – Storage and Stockpiles / Spoil Management	Direct	Adverse	Moderate	Site	Contrast to baseline	Likely	Long Term

9.4.2.5 Vehicular Movement

9.4.2.5.1 Overview

Vehicle movement will occur primarily during the construction phase of the wind farm. Construction vehicles will include cranes, excavators, dumper trucks, concrete trucks, private cars (construction personnel). Please refer to **Chapter 17: Traffic and Transport**.

Vehicular movement causes compaction and sealing of the subsoils and has the following effects on soils and geology:

- Loss of soil structure.
- Reduction of soil fertility; and
- Reduction in permeability and rainfall infiltration.

9.4.2.5.2 Turbine Delivery Route/ Haul Route and Site Tracks

There will be no material changes to the existing public roads sections of these routes. There will, however, be limited change to two small areas of private lands, resulting from the widening of existing site Access Tracks at the Site entrances, within existing agricultural lands. This will result in compaction and sealing of the underlying soils. This effect is considered to be **Temporary, Adverse and Slight**. In EIA terms the effect is considered as **Not Significant**.

The effects of compaction associated with additional heavy vehicle movements along the turbine delivery route and haul route is considered to be **Temporary, Adverse** and **Moderate**. In EIA terms the effect is considered as **Not Significant**.

Vehicle movement along the site Access Tracks will also result in a compaction of the underlying soils. The effects associated with vehicle movements on the geology and soils along the Site Access Tracks is considered to be **Permanent, Adverse** and **Moderate.** In EIA terms the effect is considered as **Not Significant.**

A summary of the pre-mitigation effects associated with vehicle movement is given in **Table 9.17.**

Table 9.17: Effect Summary – Vehicular Movement

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Vehicle Movement - Compaction, erosion and degradation of soils arising from vehicular movement along existing public and private roads	Direct	Adverse	Moderate	Localised	Conforms to baseline	Likely	Temporary
Vehicle Movement – Compaction, subsidence and settlement of newly established and upgraded Site tracks	Direct	Adverse	Moderate	Localised	Contrast to baseline.	Likely	Permanent

9.4.2.6 Peat Landslide Hazard, Ground Stability and Failure

Peat landslide, ground instability and ground failure result in the following effects on soils and geology:

- Alteration to existing geology, by removal of soils by transportation down slope and exposure of bedrock.
- Loss of soil structure.
- Reduction of soil fertility.
- Reduction in permeability and rainfall infiltration.
- Loss of or damage to existing vegetation, crops or pastureland; and
- Loss of or damage to existing structures, infrastructure and buildings and / or adverse effects in relation to their stability

Ground instability or failure refers to a significant mass movement of a body of soil or rock that would have an adverse effect on the Project and the surrounding environment.

Peat Landslide Hazard has been screened out as a potential impact on soils and geology as this was not recorded within the footprint of the wind farm infrastructure.

A significant amount of Site Investigation data has been acquired across the Wind Farm site and this data provides confidence on the depth of topsoil, subsoil and subsoil type. Subsoils are logged as mineral soil glacial till deposits comprising Silty / Clayey SANDS and GRAVELS or Sandy / Gravelly SILTS and CLAYS.

These mainly cohesive subsoils are generally not associated with ground instability or a risk of landslides, where, in this particular case, they reside on slopes of less than 3 degrees to the horizontal. Consequently, the overall landslide susceptibility has been assessed or inferred to be low within the footprint of the Project.

The walkover survey and intrusive site investigation did not record the presence of typical karst features, within the rock below the subsoils, which could affect ground stability. However, the geophysical surveys did identify deep rock weathering at turbines T2, T3, T4, & T7 typical of "karst" features, with potential to impact stability.

An iterative design process, involving multiple stages of ground investigations, followed by turbine and infrastructure re-design has already been completed in order to avoid poor ground conditions including karst features. Confirmatory pre-construction site investigations, may be undertaken to supplement the current site investigation data, prior to detailed foundation design.

The subsurface conditions underlying the proposed Grid Connection have also been assessed and found to consist of topsoil overlying glacial till deposits of varying consistency. No significant areas of weak organic soils are expected. No rock excavation is expected to be needed to install the circuits at the scheduled depth, where rock is known to be at much greater depth.

In light of the above, potential effects associated with ground stability and localised failure are considered to be **Long-term, Adverse** and **Significant**. In EIA terms, the effect is considered as **Significant**.

The potential effects associated with soil landslide are considered to be **Permanent**, **Adverse** and **Moderate**, In EIA terms, the effect is considered as **Not Significant**.

The potential effects associated with ground stability are contained in **Table 9.18,** below.

Table 9.18: Effect Summary – Peat Landslide Hazard, Ground Stability and Failure

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Ground Stability and Failure - Stability issues and slope failure arising	Direct or Indirect / Secondary	Adverse	Significant	Localised / Potentially Regional	Contrast to baseline	Likely	Long term / Permanent

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
from construction activities. (Localised displacement and settlement)							
Ground Stability and Failure - Stability issues and slope failure arising from construction activities (Landslide)	Indirect / Secondary	Adverse	Moderate	Localised / Potentially Regional	Contrast to baseline	Unlikely	Permanent

9.4.2.7 Soil Contamination

9.4.2.7.1 Overview

No extant contaminated soils were recorded during the Site Investigation campaign. Accidental spillage of fuels, release of chemicals or importation of contaminated materials during construction works poses a significant pollution risk, where the potential sensitive receptors such as the native soils, underlying groundwater aquifers, existing pipeline and local watercourses have the potential to be adversely affected.

The most sensitive indirect receptors in this respect are the River Maigue, its tributaries and the existing Kerry Group pipeline. The Knocksouna Site of Geological Significance, 1.5km to the east has also been considered for potential indirect impact, but determined to be of only Low sensitivity, due to the lack of hydrological and hydrogeological connectivity. Refer to **Chapter 10: Hydrology and Hydrogeology, Sections 10.3.17.7 and 10.3.20.3**. The Knocksouna Site lies upstream of the Project and at sufficient distance (1.5km) from the Project, that the weak permeability of the low vulnerability cohesive soils will effectively contain any potential spread of contaminants. At a distance of 1.5km any potential effect will be Imperceptible.

The overlying natural soils are considered only weakly permeable, generally thick and offer a high degree of protection to the limestone aquifer below. However, excavation of this material will result in the generation of spoil that will lack the cohesion or competence of the in-situ soils. For the purpose of this assessment these spoil arisings are treated both as construction materials and as a potential contaminant. As a construction material spoil has the potential to become mobilised by surface water flows and to ultimately become entrained within watercourses causing siltation. As a potential contaminant spoil is a "foreign" material with the potential to alter the chemistry of, and fertility of the existing soil environment. Given the high-water table and proximity of construction works to the River Maigue and existing Kerry Group pipeline, sensitivity in respect to Contamination is

considered to be High, the magnitude of potential impact Significant and the nature of the impact to be Moderate Adverse.

Consequently, the weighted significance of the environmental effect on the soils and geology environment is considered to be **Indirect, Long-term, Adverse and Significant**. In EIA terms, the effect is considered as **Significant.**

The following sections present a breakdown of all other possible effects associated with the use of construction plant during the construction process.

9.4.2.7.2 Hydrocarbons

Wherever there are vehicles and plant in use, there is the potential for a direct hydrocarbon release which may contaminate the soil and subsoil. A spill also has the potential to indirectly pollute water, if the soil and subsoil act as a pathway from any source of pollution.

The accumulation of small amounts of fuels and lubricants during routine plant use can also be a significant pollution risk. Hydrocarbons have a high toxicity to humans, flora and fauna including fish and if released is persistent in the environment. Large spills or leaks have the potential to result in significant or profound effects (i.e. contamination of soil, subsoils and pollution of underlying aquifers) on the geological and water environment.

Any spill of fuel and chemicals, release of silt and leaching from contaminated materials will present a **Long-term, Adverse** and **Significant** effect on the soils and geological environment associated with the proposed Project. In EIA terms, the effect is considered as **Significant.**

9.4.2.7.3 Wastewater and Sanitation

Wastewater / sewerage effluent will arise from the Substation toilet and welfare facilities and has the potential cause contamination of the soils where it is not suitably constrained.

The effects associated with wastewater and sewerage without mitigation are considered to be **Short-term, Adverse** and **Moderate**. In EIA terms the effect is considered as **Not Significant.**

9.4.2.7.4 Construction or Cementitious Materials

A number of materials will be stored and used onsite throughout the construction phase of the Project, including imported aggregates, concrete and bentonite. Should these

contaminants (in the case of cement and bentonite) be spilt they have potential to indirectly adversely impact affect water quality.

Spillages of concrete may occur during the laying of foundations required for the substation and inverter/transformer units. Contamination of surface water may also occur as a result of spillages from routine plant maintenance, improper storage or simply from accidental spillages. Should a contamination event occur, there is potential for indirect impact where surface water runoff with pollutant loads, enters drainage ditches identified within the vicinity of the Application Site.

Imported aggregates will be employed as part of the construction process. Importation of materials from sources outside the Site have the potential to introduce contamination unless appropriate controls, such as material certification and on-site sampling and testing are undertaken. Where these are not inert, they have the potential to leach contaminants directly into the soils and indirectly, via flowing or percolating surface water, into watercourses and the groundwater aquifer.

The effects associated with construction or cementitious materials is considered to be Temporary, Adverse and Moderate. In EIA terms, the effect is considered as Not Significant.

9.4.2.7.5 General Waste

9.4.2.7.5.1 Construction Spoil

There are 6no. temporary spoil storage areas and 1 no. permanent spoil storage area. Al spoil will be managed on site. Refer to **Chapter 2: Project Description: Drawing No. 6839-JOD-GGE-XX-DR-C-0200 – 0209**. Spoil identified as potentially hazardous will be promptly stored on an impermeable surface within properly bunded areas in accordance with good site practice as described in the IWEA and Scottish Best Practice Guidelines and in accordance with **Appendix 2.1**, **CEMP**. The effects associated with the use of construction materials are considered to be **Long-term, Adverse** and **Moderate.** In EIA terms the effect is considered as **Not Significant**.

9.4.2.7.5.2 General Waste

A policy of Reduce, Reuse and Recycle will apply. All construction and operation waste materials will be correctly sorted, recycled or disposed of and follows best practice as described in the IWEA and Scottish Best Practice Guidelines and in accordance with the CEMP. Refer to **Chapter 2, Section 2.6.4** for further details. The effects associated with

waste materials is considered to be **Temporary, Adverse** and **Slight.** In EIA terms the effect is considered as **Not Significant**.

In summary, the Project has the potential to give rise to the following pre-mitigation soil contamination effects, shown in **Table 9.19** below:

Table 9.19: Effect Summary – Soil Contamination

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Soil and Groundwater – Pollution of Surface Water Run-off and Groundwater Bodies	Indirect / Secondary	Adverse	Significant	Localised / Potentially Regional	Contrast to baseline	Unlikely	Long term
Soil and Groundwater Contamination - Hydrocarbons	Direct or Indirect / Secondary	Adverse	Significant	Localised / Potentially Regional	Contrast to baseline	Unlikely	Long term
Soil and Groundwater Contamination – Wastewater and Sanitation	Direct or Indirect / Secondary	Adverse	Moderate	Localised / Potentially Regional	Conforms to baseline	Likely	Long-term
Soil and Groundwater Contamination – Construction and Cementitious materials	Direct or Indirect / Secondary	Adverse	Moderate	Localised / Potentially Regional	Contrast to baseline	Likely	Temporary
Waste Materials – Construction Spoil	Direct	Adverse	Moderate	Localised*	Contrast to baseline	Unlikely	Long term / Permanent
Waste Materials – General Waste	Direct	Adverse	Slight	Localised*	Contrast to baseline	Unlikely	Temporary

9.4.2.7.6 Features of Geological Heritage

The LK022 Knocksouna site of geological heritage is located 1.5km to the east of the Site and has been assessed for potential effects from the Project.

The Knocksouna site is a local source of upwelling thermal springs that rise along the base of a rocky outcrop along the edge of the Loobagh River, upstream from the Site. The Knocksouna site is considered to be unusual and relatively unique and, for this reason, has been classified as a County Geological Site. For further details refer to **Chapter 10: Hydrology and Hydrogeology, Sections 10.3.17.7 and 10.3.20.3**.

Since the Project and the Knocksouna site are neither hydrologically nor hydro geologically linked to the Project, there is only potential for an **Indirect, Long-term**, **Adverse,** and **Imperceptible** effect as a result of contamination by hydrocarbons, chemicals or siltation.

Table 9.20: Effect Summary – Features of Geological Heritage

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Degradation of Quality of Sites of Geological Significance Importance caused by emissions / pollution from the Project	Indirect/ Secondary	Adverse	Imperceptible	Regional	Contrast to baseline	Unlikely	Long term

9.4.3 Operational Phase Potential Effects

The direct and indirect effects of the operational phase of The Project is assessed in the following sections.

9.4.3.1 Soil Compaction, Erosion and Degradation

No significant new excavations will be undertaken during the operational phase of The Project., so no new compaction of soils will occur. Ongoing settlement of structures, site tracks, spoil deposition area and other infrastructure will continue to occur during the operational phase, but this is low in significance and monitored regularly.

The effects are considered to be **Long-term, Adverse** and **Slight**. In EIA terms, the effect is considered as **Not Significant**.

9.4.3.2 Land Take Windfarm

No adverse effect on land use is envisaged during the operational phase of the Project, when the land take will reduce from 11.256ha (construction phase) to 5.095ha.

9.4.3.3 Soil Contamination

9.4.3.3.1 Hydrocarbons and Chemicals

Wherever there are vehicles and plant in use, there is the potential for a direct hydrocarbon release which may contaminate the soil and subsoil. Use of chemicals, such as lubricants, cleaning agents, pesticides etc. during this phase carries the same degree of risk.

Any potential spill of hydrocarbons or other chemicals will continue to present a **Long-term, Adverse, Significant** effect on the soil and geological environment. In EIA terms this is considered as **Significant.**

9.4.3.3.2 General Waste

The effects associated with waste materials is considered to be **Long-term, Adverse** and **Slight.** In EIA terms the effect is considered as **Not Significant.**

In summary, the Project has the potential to give rise to the following pre-mitigation operational effects, shown in **Table 9.21** below:

Table 9.21: Effect Summary – Operational Phase

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Soil Compaction and Subsidence	Direct	Adverse	Slight	Localised*	Contrast to baseline	Unlikely	Long-term
Land and Land Use	Direct	Adverse	Imperceptible	Localised	Contrast to baseline	Likely	Long term / Permanent
Soil Contamination – Hydrocarbons and Chemicals	Direct	Adverse	Significant	Localised	Contrast to baseline	Likely	Long term
Soil contamination - Operational Wastes	Direct	Adverse	Slight	Localised*	Contrast to baseline	Likely	Long term

9.4.4 Decommissioning of the Wind Farm

This EIAR assumes full decommissioning of the proposed wind farm will take place after 35-years. All structures above ground level shall be demolished and removed from the site for reuse/recycling; however, access tracks are likely to be retained for continued use by the landowners for agricultural purposes.

Hardstand areas will be remediated to match the existing landscape as closely as possible. **The Decommissioning Plan (Appendix 2.1 CEMP**) specifies that the turbine hardstands will be allowed to naturally revegetate. The habitat that would be expected to develop is likely to fall into a mosaic of semi-natural grassland (GS).

The Grid Connection and the Substation will become an asset of the national grid under the management of ESB and& EirGrid and will likely remain in place upon decommissioning of the wind farm as required by ESB/EirGrid.

Certain aspects of activities occurring during the construction phase are anticipated to occur at reduced levels during decommissioning, such as excavation of turbine foundations that will be left in situ and covered with soil for reinstatement. Access tracks will also remain for

ongoing usage as farm tracks. In addition, the use of building materials, including concrete and aggregates will not be required.

In general,, the potential effects associated with decommissioning will be similar to those associated with construction, but of reduced magnitude because extensive excavation and wet concrete handling will not be required.

The potential environmental effect from ground disturbance, soil storage and stockpiling and contamination by fuel leaks will remain during the decommissioning period.
A summary of these potential effects is provided in **Table 9.22**.

Table 9.22: Effect Summary – Decommissioning Phase

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Land and Land Uses	Direct	Adverse	Slight	Localised*	Contrast to baseline	Likely	Long-term
Vehicle Movement - Compaction, erosion and degradation of soils arising from vehicular movement along existing public and private roads	Direct	Adverse	Slight	Localised	Contrast to baseline	Unlikely	Long term / Permanent
Ground Stability and Failure - Stability issues and slope failure arising from construction activities. (Localised displacement and settlement)	Direct	Adverse	Slight			Likely	Long term
Ground Stability and Failure - Stability issues and slope failure arising from construction activities (Landslide)	Direct	Adverse	Slight			Unlikely	Long term
Soil and Groundwater Contamination	Direct	Adverse	Moderate	Localised	Contrast to baseline	Unlikely	Long term
Decommissioning Spoil	Direct	Adverse	Slight	Localised*	Contrast to baseline	Likely	Short term
Waste Materials – General Waste	Direct	Adverse	Slight	Localised*	Contrast to baseline	Unlikely	Short term

9.4.5 Cumulative Effects

Cumulative effects of the Project with other developments in the region, as discussed in **Chapter 2: Project Description – Sections 2.3.2 and 2.3.3** relate to the indirect effects that may arise due to the use of public roads as haul routes to bring construction materials to Site and the cumulative effect on the use of natural resources.

The use of local quarries, aggregate and concrete suppliers, of which there are 6 no. within 20km of the site (**EIAR Chapter 2; Table 2.5**), have been assessed to be a potential cumulative effect to the Project and these potential effects; Vehicle Movement, Turbine Delivery Route / Haul Route are discussed in this chapter.

During the construction of the Project there will be a requirement for the importation of engineered fill from source quarries. There is a total of 10 no. "larger" construction projects (9 no. permitted) that have been granted planning permission within 10km. One of these projects is a solar energy development of significant in scale (planning ref: An Bord Pleanála ref 306915).
Should construction work of the Project coincide with the construction of these solar developments, the demand for imported aggregate for both projects has the potential to have a cumulative impact on local quarries.

However, given that there is a total of 6 no. quarry and concrete suppliers within 20km, the impact on local quarries is expected to be not significant, as supply should exceed demand. That notwithstanding the construction phase will coincide with increased heavy vehicle traffic on the local public road network.

As such, it is considered there will be a **Temporary, Adverse** and **Moderate** cumulative effect, caused mainly by increased vehicle traffic, during the construction and decommissioning phases of the project. In EIA terms this is considered as **Not Significant.** During the operational phase this effect will reduce to a **Long-term, Adverse** and **Not Significant** cumulative effect. In EIA terms this is considered as **Not Significant.**

9.5 MITIGATION MEASURES AND RESIDUAL EFFECTS

9.5.1 Design Phase

With regard to the proposed project design, the principles or risk management and best practice has been followed and will continue to be implemented as follows:

The primary mitigation measure employed has been the design of the wind farm in terms of locating the turbines, access roads, material storage areas and other site infrastructure on agricultural lands, where the soils are extensively worked and drained, so as to be remote from residential and sensitive commercial properties.

In order to reduce the impacts on geology, hydrogeology and slope stability, infrastructure has also been positioned within areas of thinner organic soils / soft ground and lower slope

gradients away from designated watercourses and other sensitive features. Extensive work has already been undertaken at the preliminary design stage to apply risk avoidance by design which has included the following:

- Peat probing to screen for the presence of peat or other organic soil deposits across the site and layout.
- Excavation of trial pits and undertaking of geophysical surveys to establish overburden and bedrock characteristics.
- Relocation and micro-siting of turbines, hardstandings, access roads and other infrastructure based on the site assessments and geotechnical assessments in order to reduce ground risk associated with the proposed project.
- The works have been designed and checked by geotechnical engineers, who are suitably qualified and experienced in excavation and earthworks design and construction methodologies.
- Where the construction footprint for the Project coincides with the Floodplain of the River Maigue, no permanent storage of spoil will be undertaken. Temporary storage will be limited to the period of construction only and scheduled to coincide with optimal annual weather conditions. The 6-no. temporary spoil storage areas and 1 no. permanent spoil storage are shown on Figure 9.1.
- Prior to commencement of construction works at structures in the proximity of sensitive waterbodies and Access Track crossing watercourses, appropriate pollution prevention arrangements will be put in place to prevent contaminated surface water run-off from construction activities entering these watercourses, other water bodies or the existing underground pipeline. Refer to **Chapter 10: Hydrology and Hydrogeology** for details.

The following will also be implemented:

- Any excavation and construction related works will be subject to a design risk assessment at detailed design stage to determine risk levels for the construction, operation and maintenance and decommissioning of the works. Identified impacts will be minimised by the application of principles of avoidance, prevention and protection. Information on residual impacts will be recorded and relayed to appropriate parties.
- A detailed method statement for each element of the works will be prepared by the Contractor prior to any element of the work being conducted.
- Given that the works comprise a sizeable proportion of excavation and earthworks, suitably qualified and experienced geotechnical personnel will be engaged on site to supervise the works.
- The Contract will require programming of the works such that earthworks are not scheduled during severe weather conditions or at times of prolonged high rainfall.

9.5.2 Construction Phase

The following sections outline appropriate mitigation measures to avoid or reduce the potential effect of the Project during the construction phase.

9.5.2.1 Construction Environmental Management Plan

A Construction Environmental Management Plan (CEMP) has been prepared for the proposed Project and is included in **Volume IV, Appendix 2.1**. The CEMP defines the work practices, environmental management procedures and management responsibilities relating to the construction phase of the proposed project.

The CEMP sets out the key environmental management measures associated with the construction, operation and decommissioning of the proposed wind farm, to ensure that during these phases of the Project, the environment is protected, and any potential impacts are minimised.

The CEMP will be developed further at the construction stage, on the appointment of the main contractor to the project to address the requirements of any relevant planning conditions, including any additional mitigation measures that are conditioned and shall be submitted to the planning authority prior to the commencement of the construction phase. The CEMP will incorporate the mitigation of potential effects to land, soils and geology from the proposed project outlined in the following sections.

9.5.2.2 Erosion, Degradation and Soil Sealing

The Project will be constructed in a phased manner in order to reduce the potential effects of The Project on the Soils and Geology. Phased construction reduces the amount of open, exposed excavations at any one time, lowering the risk of compaction and reducing soil exposure to degradation.

To further mitigate against the compaction of soil at the site, prior to the commencement of any earthworks, the work corridor will be demarcated, and machinery will stay within this corridor so that soils outside the work area are not damaged or suffer degradation.

Excavations will then be conducted from access tracks as they are constructed in order to reduce the compaction of soft or otherwise sensitive ground.

The amount of exposed ground and soil stockpiles will also be kept to a minimum and any stockpiles in place for an extended period of time will be allowed to re-vegetate naturally.

9.5.2.3 Subsoil and Bedrock Removal

Construction of the Project will result in the removal of soils in parts of the site to facilitate excavation for the construction of Access Tracks and hardstands for the wind turbines within a competent stratum suitable for the emplacement of foundations.

Ground conditions vary across the site with mineral soils of varying depths and competence present. At the proposed turbine bases the excavation depth required is anticipated to be a maximum of 6.00m to a suitable bearing stratum. For Access Tracks and turbine hardstands this is expected to be average 0.50m and consequently less significant.

Excavation volumes will also be minimised by the use of piled foundations for wind turbines T4, T5, T6, T7 and T8.

One of the primary mitigation measures employed at the preliminary design stage was the minimisation of volumes of excavated overburden deposits to be exported off site. In the case of the construction of the Project, all excavated overburden will either be re-used or retained on-site in the permanent spoil storage area (berm).

This will include:

- Use of suitable site-won material (mineral soils consisting predominantly of sands and gravels) as general fill in the construction of access tracks, hardstands and in reinstatement around turbine foundations.
- Surplus overburden will be re-used on site in the form of landscaping and for reinstatement purposes.
- Residual surplus overburden will also be stored at a permanent spoil repository, located adjacent to the Substation. Refer to the **CEMP, Spoil Management Plan** for details.

Surplus overburden deposits excavated during the course of the works will be stored, for the duration of the Project, in a designated spoil deposition area until they can be employed for Site reinstatement.

Temporary stockpiles (not exceeding 2m in height) of separated soil material types will be placed adjacent to the excavation areas prior to reinstatement, but outside the Floodplain of the River Maigue. These stockpiles will be shaped and sealed to prevent the ingress of water from rainfall.

9.5.2.3.1 Mitigation by Avoidance

Preliminary site investigation has allowed for selection of the most appropriate type of foundation for structures, Access Tracks, Substation, Substation Compound, Met Mast and other infrastructure. This in turn has allowed the extent of excavations required to be minimised and consequently, generation of excessive spoil material will be avoided.

9.5.2.3.2 Mitigation by Good Practices

Good practices, such as limiting the construction zone by demarcation and the sealing of temporary stockpiles against degradation from rainfall will be employed impacts on the soil resource.

9.5.2.3.3 Mitigation by Reduction

Apart from the measures taken in the design phase of the Project (avoiding the need for and reducing volumes of subsoils to be removed) there are no other reductive mitigation measures in terms of subsoil and bedrock removal, that is the layout of the Project minimises the impact of subsoil and bedrock removal in so far as practical, without compromising or reducing the Project itself.

9.5.2.3.4 Mitigation by Reuse

All topsoil will either be reused for landscaping purposes during the construction phase or stored on-site for reuse during the Decommissioning phase of the works.

9.5.2.4 Storage and Stockpiles

Spoil types will be treated separately. Mineral soils and topsoils / organic soils will be separated during excavation and these two types of spoil will be disposed of generally as follows:

A *Till soils will be deposited directly on top of other mineral soils. This will require the removal of peat where present to facilitate the process.*

B *Topsoils / Organic Soils will be stored separately, protected from the environment to maintain their integrity and used to reinstate the minerals soil surfaces following completion of construction works. No topsoil will be disposed of as part of the Project.*

1. Mineral soil reuse will take place at various locations within the wind farmland holding where low surface gradients combine with minimal peat depth and sufficient distance from sensitive receptors. These proposed spoil deposition areas are detailed in **Chapter 2: Project Description: Drawing No. 6839-JOD-GGE-XX-DR-C-0200 – 0209** and the **Spoil Management Plan**, contained within the **Appendix 2.1 - CEMP**.

2. It is intended that spoil movements will be minimised by disposing of the material within or immediately adjacent to the construction footprint of the structure from whence it was excavated. No Spoil disposal will take place with the Floodplain of the River Maigue.
3. Preparation of the Spoil Disposal sites as shown on **Figure 9.1** will involve the removal of the topsoil which will be transferred to a specific location to be stockpiled and maintained for re-use during restoration operations.
4. Spoil will be deposited, in layers of 0.50m and will not exceed a total thickness of 2.00m, unless contained by suitably designed and constrained berms.
5. Spoil will only be deposited on slopes of < 5 degrees to the horizontal and greater than 10m from the top of a cutting. The exact location of these deposition areas has been determined in consultation with the construction phase geotechnical specialist.
6. Spoil Disposal sites will have a regular weekly assessment, made by the construction manager or other suitably qualified individual, to ensure that stability and good condition is maintained.
7. Once disposal is complete the deposition area will be re-vegetated with the existing upper vegetated layer removed at the commencement of disposal operations. Upon commencement of the decommissioning / restoration phase guidance from a suitably qualified ecologist will be sought to provide a suitable methodology and programme of maintenance for the restored areas.

9.5.2.5 Vehicular Movements

Vehicular movements will be restricted to the footprint of the Proposed Project, particularly with respect to the newly constructed Site Access Tracks. This ensures that machinery must be kept on tracks and will not move onto areas that are not permitted.

Vehicular traffic on Site will be minimised through the re-use of excavated material on Site which will reduce the need to source material from external quarries.

As discussed previously, excavation volumes have been reduced during the design phase by avoiding areas of sensitive or soft soils and by avoiding excessive cut and fill during construction. This will result in reduced excavation volumes and therefore reduced site traffic.

Best practice as described in the IWEA and Scottish Best Practice Guidelines[3] will be applied during construction which will minimise double handling, again reducing the site traffic.

All works will be managed and conducted in accordance with the Construction Environmental Management Plan (**Sections 3.3.3** of the CEMP in **Appendix 2.1** of **Volume IV**), which will be updated by the civil engineering contractor and agreed prior to any Site works commencing.

9.5.2.6 Ground Stability

The Contractor will programme the works such that earthworks are not scheduled during severe weather conditions.

Details of the proposed methodology and mitigation measures are summarised below and are also outlined in the CEMP.

9.5.2.6.1 Earthworks Activities & Ground Stability – General Constraints and Anecdotal Evidence

Analysis of the historic conditions following soil movement indicates that the following main factors generally trigger slope failures:

1. Excessive quantities of spoil loaded onto sensitive topsoil, organic soils or sensitive soils covered sloping ground. (In such cases the gradient of the slope should be no more than 5 degrees to the horizontal). Topsoils and organic soils should always be removed prior to depositing spoil and retained for re-use as landscaping a material.
2. The angle of repose of the cut face of excavations is all too often found to be too high, sometimes 70 – 80 degrees to the horizontal. Battering back the sides of an excavation to approx. 60 degrees in clay soils and 30 degrees in granular or organic soils helps to reduce the potential for slippage, which will significantly reduce the potential for soil movement.
3. The height of any temporary stockpile or deposition area will not exceed 2m, unless suitably constrained.
4. Surface water flows will compromise most granular or cohesive soils at any slope angle and care should be taken to stop the development of such flows during construction.

[3] Irish Wind Energy Association (IWEA) (2012) Best Practice Guidelines for the Irish Wind Energy Industry, Fehilly Timoney & Company, Cork

The consequences of soil movements can be identified as Damage to Machinery, Damage or Loss of Access Track, Damage to Site Drainage, Site Works Damaged, Death or Injury to Personnel or Degradation to the Environment.

An emergency plan is to be prepared and will be enacted should soil movement occur.

9.5.2.6.2 Earthworks & Ground Stability – Prevention of Landslide

Application of the following procedures will have the effect of reducing the Hazard with respect to Ground Stability:

1. Excavated spoil will not be deposited on the down slope or up slope edges of the adjacent topsoil. This spoil will instead be deposited on the two flanks either side of the excavation (where gradient is least) and spread in such a way as to limit the surcharge pressure on sensitive topsoils.
2. The hardstanding areas surrounding the turbine bases will be designed in a manner such that crane loadings can be transferred directly onto the competent strata underlying any sensitive mineral soils. In order to facilitate these works it will be necessary to undertake limited excavations. To ensure effective sidewall support during these operations the contractor will adopt an approved engineering solution (such as a suitable bracing system or other method) to maintain sidewall stability at all times.
3. Movement can often occur during or following severe rainstorm events, particularly when following a prolonged dry spell. Extra vigilance will be maintained at such times, during construction.
4. All slopes are to be regularly checked, during the construction and operational phases, for development of tension cracks, which are indicative of slope movement.
5. Method statements will be followed at all times. Where modification is required, this will be agreed by the supervising engineer.
6. Slopes will not be undercut or excavations left unsupported for periods in excess of 24 hours. Excavations are to be backfilled as soon as practicable. Excavation and filling operations shall be coordinated to minimise the time an excavation remains opened.
7. Pore water pressure within excavations should be kept low at all times by draining deliberate or intentional sumps at regular intervals. This is to prevent ponding of water within excavations which can in turn increase hydraulic heads locally and potentially lead to instability.

8. The potential for Soil Movement will be monitored regularly during the construction and operational phases by means of regular site visits and assessments, by a suitably qualified and experienced professional.
9. Only experienced and competent contractors will be appointed to conduct the construction works.
10. Low ground bearing pressure machinery shall be used for transport of construction materials in sensitive areas, where ground conditions dictate its requirement.
11. Construction at less sensitive areas will be completed first to allow suitable construction practices to be established before works commence in the more difficult areas.
12. Sufficient time should be allowed to conduct the works in a safe and timely manner.

9.5.2.7 Soil Contamination

Design for the Project has been cognisant of the high sensitivity of the local and regional environment. In particular there is recognition that localised soil contamination, either from siltation, cementitious materials, hydrocarbons, the leaching of unknown contaminants from imported materials and from wastewater effluent percolation, has the potential to enter watercourses via surface water run-off and become entrained with flood waters or a rising groundwater table.

The probability for the unlikely event of contamination resulting via these mechanisms will be minimised through the application of good practice and adherence to the CEMP, which contains specific guidance in respect to Refuelling Procedures and Spoil Management (**Appendix 2.1**).

Likewise, the importation of materials from off-site will be closely monitored to ensure that no contamination is brought onto the site from external sources. Importation of materials such as aggregates and other forms of construction materials, will be subject to "wheel washing", documented, certified, sampled and evaluated as per the requirements of the CEMP and Waste Management Plan (**Appendix 2.1**).

Similarly, but to a lesser degree, there is potential for adverse impact from wastewater percolation unless wastewater is constrained. The only source of wastewater production will be the welfare facilities at the substation. The normal method for dealing with effluent in this case is to design a percolation field and use this to disperse the low-level pollution throughout the groundwater body. However, to remove any potential effect on soils and geology from wastewater contamination, foul effluent will be retained within a "closed"

system with all effluent being held within a bunded storage tank with a high-level alarm, drained on a regular basis and disposed of off-site at a suitable licensed facility. This will effectively break any potential pollution linkage to the wider environment.

The CEMP (**Sections 3.3.5** and **3.4.4** of the CEMP in **Appendix 2.1** of **Volume IV**) will be developed to include the checking of assets (plant, vehicles, fuel bowsers) on a regular basis during the construction phase of the Project. The purpose of this management control is to ensure that the measures in place are operating effectively, prevent accidental leakages, and identify potential breaches in the protective retention and attenuation network during earthworks operations.

Careful design of the wind farm has reduced the amount of site traffic required on Site by reducing access tracks lengths, excavation volumes and double handling. Similarly, good Site practice and a robust CEMP will also result in less traffic and a lower potential for fuel spills and leakages.

In order to guard against the risk of soil contamination the following specific mitigation measures will be applied:-

9.5.2.7.1 Storage of Fuels and Chemicals

As per Best Practice Guidance (BPGCS005)[4], all fuels, oils and chemicals on site will have a secondary containment system of 110% capacity and will be located more than 20m from any watercourse (i.e. outside of the watercourse buffer).

A bunded diesel bowser will be located inside a fenced off area within the Temporary Construction Compound. Other chemicals will be stored within a storage container with an accompanying Control of Substances Hazardous to Health ("COSHH") Datasheet in accordance with health and safety regulations. If generators are used on site, these shall be bunded (the bund shall be capable of containing 110% of the fuel tank's capacity). The bund shall be kept empty of water.

Where chemicals are required on site, they must be placed in an appropriate bund to prevent ground contamination. All chemicals must be stored in a correctly marked container clearly identifying the contents. Where labels are worn off, they must have a new label placed on them or the contents transferred to a correctly marked container. All safety data

[4] Best Practice Guide BPGCS005 - Oil Storage Guidelines. Available at: http://www.envirocentre.ie/includes/documents/OilStorageBPG.pdf;

sheets for all chemicals will be filed on site as part of a requirement under the provisions of the Construction Environmental Management Plan (CEMP).

Spill kits will be available at all work areas within machinery and at the site office. Contingency plans will be in place for dealing with a spillage should a spillage occur.

9.5.2.7.2 Refuelling

During construction, fuel and oil deliveries will take place within the designated refuelling area within the Temporary Construction Compound only. The Contractor will supervise site deliveries to ensure that the correct amount of material is delivered to the correct tank and the level is checked prior to refilling to avoid spillage.

Where refuelling of vehicles on site is necessary, the following guidelines will be strictly adhered to:

- Mobile plant will be filled in a designated area, on an impermeable surface well away from any drains
- A spill kit will be stored (and clearly marked) near refuelling areas.
- A bunded tank / bowser will be used with capacity of the bund to be 110% of the fuel storage capacity.
- Vehicles will never be left unattended during refuelling and drip trays should be located under all static plant vehicles.
- Hoses and valves will be checked regularly for signs of wear, and will be turned off and securely locked when not in use.
- Vehicles will not be left running unnecessarily and low emission fuels will be used where possible.
- Diesel pumps and similar equipment will be checked regularly and any accumulated oil removed for appropriate disposal.

9.5.2.7.3 Existing Contamination and Imported Materials

The following practices will be followed in relation to the excavation and reinstatement of turbines, hardstands, site tracks, substation, cable trenches, borrow pit excavation, topsoil stripping and any other earthworks, whenever foreign or fill materials are encountered:

- Any suspected fill or material foreign to the Site will be stored separately and separated into individual component types, such as concrete, aggregate and bituminous materials.
- Prior to disposal each stockpile of material will be classified with the relevant EU Waste Code by a relevant competent individual.

- To determine the relevant contamination classification for each stockpile (**Inert**, **Contaminated Non-Hazardous** or **Hazardous**) Waste Acceptance Classification testing will be undertaken in line with EPA guidance. The frequency for these tests will be 1 suite of tests for each 100m^3 of material.
- The results of all testing and waste disposal certificates will be retained on Site, by the Site Supervisor.

9.5.2.7.4 Concrete

There will be no concrete batching on the Site. Rather, it will be transported to the Site as it is required. A dedicated, bunded area will be created to cater for concrete wash-out and this will be within the onsite Temporary Construction Compound. This will be for the wash-out of the chutes only after the pour. Concrete trucks will then exit the Site via Site Entrance 2 and return to the supply plant to wash out the mixer itself. Refer to **Chapter 2, Section 2.6.3.**

The main concrete pours at the turbine locations will be planned in advance and proposed mitigation measures will be as follows:

- Avoiding large concrete pours, for turbine foundations, on days when temperatures are not optimal as per (BS 8110) (EN1992-1-2) or when heavy or prolonged rainfall is forecast i.e., during a period in which a Met Éireann Status Red weather event will/has occurred.
- Providing that all concrete pour areas are dewatered prior to pouring concrete and while the concrete is curing.
- Making covers available so that areas can be covered if heavy rain arrives during the curing process which will prevent runoff of concrete which has a high pH.

The chutes wash out on-site will require a small volume of water. This water will be directed to the concrete washout area which will be a temporary lined impermeable containment area or a siltbuster type washout unit or similar. The unit catches solid concrete and filters and contains the washout liquid for pH adjustment and solid separation. The residual liquids and sediments will be disposed of at an appropriately licenced facility.

Temporary lined impermeable containment areas are usually constructed using straw bales and lined with an impermeable geotextile membrane. Refer to CEMP for details. An alternative construction method would be to dig a hole in the ground and place an impermeable geotextile membrane in the hole so that no wastewater can penetrate the cover and seep into the soil and groundwater.

9.5.2.7.5 Wastewater and Sanitation

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.

All wastewaters will be tankered off-site by a licensed waste collector to a suitable plant in the vicinity of the Project. There will be no onsite treatment or disposal of wastewater.

9.5.2.7.6 General Waste

All materials used on Site and wastes generated on Site will be reduced by good Site practice and attention to the CEMP (**Sections 3.3.7** and **3.4.4** of the **CEMP** in **Appendix 2.1** of **Volume IV**). A policy of reduce, re-use and recycle will apply.

All waste will be segregated and re-used where possible or removed from Site for recycling. Any waste which is not recyclable or compostable will be properly disposed to landfill. Whenever possible, excavated spoil materials will be re-used close to the area of excavation. The careful design which has been achieved will result in minimal excess soil and rock.

Excess spoil material will be separated in terms of soil type (topsoil or mineral soils) and stored within a series of seven long-term spoil deposition areas, as identified on Figure 9.1. The locations for these spoil deposition areas have been carefully considered in terms of ground slope and soil characteristics as well as proximity to sensitive receptors and the flood zone. In this way any potential negative effects have been minimised. Mitigation to be applied is presented in **Sections 9.5.2.4 Storage and Stockpiles** and **9.5.2.6 Ground Stability**.

9.5.2.7.7 Pollution Prevention

Suitable protection for watercourses potentially affected by the works will be installed prior to relevant works proceeding. These measures will be in-line with EPA Pollution Prevention Guidelines. Protection measures will include:

- Plant and equipment will be stored on dedicated hard standing within the construction compound. This will minimise the risk of pollution caused by leakages occurring out of hours. Drip trays will be used where appropriate.
- All plant and equipment will use biodegradable hydraulic oil.

- Spill kits will be readily available to all personnel. The spill kits will be of an appropriate size and type for the materials held on site.
- Diesel fuel will be stored in a bunded diesel bowser which will be located within a fenced off area in the construction compound.
- Refuelling and maintenance of vehicles and plant will take place in designated areas of hardstanding.
- All other chemicals will be stored at the site compound within an appropriate storage facility along with an accompanying MDS Datasheet.
- Wastewater from the temporary staff toilets and washing facilities will be discharged to sealed containment systems and disposed via licensed contractors.
- Early seeding of lands near watercourses will be undertaken to reduce the potential for sediment runoff.

All staff on site will be made aware of the pollution prevention measures being implemented throughout the construction, operational and decommissioning phases using appropriate toolbox talks and the site induction.

9.5.2.7.8 Emergency Response

The emergency response plan, as detailed in the CEMP, has been developed in order to deal with any emergency accidents or spills. In particular an emergency spill kit with oil boom and absorbers will be kept on Site in the event of an accidental spill. All Site operatives will be trained in its use. In addition, all vehicles will also contain emergency spill kits.

9.5.2.8 Construction Phase Residual Effects

The residual effects after implementation of all mitigation measures for the construction phase of the Project are presented in **Table 9.23.**

Table 9.23: Construction Phase Residual Effects Summary

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Compaction, Erosion and Degradation of Soils	Direct	Adverse	Slight (Not Significant in EIA terms)	Site	Contrast to baseline	Likely	Short Term
Land Take – Wind Farm	Direct	Adverse	Slight (Not Significant in EIA terms)	Site	Contrast to baseline	Likely	Long Term

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Land Take – TDR	Direct	Adverse	Not Significant	Site	Contrast to baseline	Likely	Long Term
Land Take - GCR	Direct	Adverse	Not Significant	Site	Conforms to baseline	Likely	Temporary
Soil and Bedrock Removal –Excavations	Direct	Adverse	Slight (Not Significant in EIA terms)	Site	Contrast to baseline	Likely	Long Term
Soil and Bedrock Removal - Access Tracks	Direct	Adverse	Slight (Not Significant in EIA terms)	Site	Conforms to baseline	Likely	Long Term
Soil and Bedrock Removal – Turbine and Hardstand Areas	Direct	Adverse	Slight (Not Significant in EIA terms)	Site	Contrast to baseline	Likely	Permanent
Soil and Bedrock Removal – Wind Farm Internal Cabling Trenches	Direct	Adverse	Not significant	Site	Contrast to baseline	Likely	Long Term
Soil and Bedrock Removal – Turbine Delivery Route / Haul Route	Direct	Adverse	Not significant	Regional	Contrast to baseline	Likely	Long Term
Earthworks Activities – Grid Connection Cable	Direct	Adverse	Not significant	Site	Contrast to baseline	Likely	Long Term
Earthworks Activities – Temporary Construction Compound	Direct	Adverse	Not significant	Site	Contrast to baseline	Likely	Temporary
Earthworks Activities – Storage and Stockpiles / Spoil Management	Direct	Adverse	Slight (Not Significant in EIA terms)	Site	Contrast to baseline	Likely	Long Term
Vehicle Movement - Compaction, erosion and degradation of soils arising from vehicular movement along existing public and private roads	Direct	Adverse	Slight (Not Significant in EIA terms)	Localised	Conforms to baseline	Likely	Temporary
Vehicle Movement – Compaction, subsidence and settlement of newly established and upgraded Access Tracks	Direct	Adverse	Slight (Not Significant in EIA terms)	Localised	Contrast to baseline.	Likely	Permanent
Ground Stability and Failure - Stability issues and slope failure arising from construction activities. (Localised displacement and settlement)	Direct or Indirect / Secondary	Adverse	Slight (Not Significant in EIA terms)	Localised / Potentially Regional	Contrast to baseline	Likely	Long term / Permanent

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Ground Stability and Failure - Stability issues and slope failure arising from construction activities (Landslide)	Indirect / Secondary	Adverse	Slight (Not Significant in EIA terms)	Localised / Potentially Regional	Contrast to baseline	Unlikely	Permanent
Soil and Groundwater – Pollution of Groundwater Aquifer	Indirect / Secondary	Adverse	Slight (Not Significant in EIA terms)	Localised / Potentially Regional	Contrast to baseline	Unlikely	Long term
Soil and Groundwater Contamination - Hydrocarbons	Direct or Indirect / Secondary	Adverse	Slight (Not Significant in EIA terms)	Localised / Potentially Regional	Contrast to baseline	Unlikely	Long term
Soil and Groundwater Contamination – Wastewater and Sanitation	Direct or Indirect / Secondary	Adverse	Slight (Not Significant in EIA terms)	Localised / Potentially Regional	Conforms to baseline	Likely	Temporary
Soil and Groundwater Contamination – Construction and Cementitious materials	Direct or Indirect / Secondary	Adverse	Slight (Not Significant in EIA terms)	Localised / Potentially Regional	Contrast to baseline	Likely	Temporary
Waste Materials – Construction Spoil	Direct	Adverse	Slight (Not Significant in EIA terms)	Localised*	Contrast to baseline	Unlikely	Long term / Permanent
Waste Materials – General Wastes	Direct	Adverse	Not Significant (Not Significant in EIA terms)	Localised*	Contrast to baseline	Unlikely	Temporary
Degradation of Quality of Sites of Designated Importance caused by emissions / pollution from the Project	Direct / Indirect	Adverse	Imperceptible (Not Significant in EIA terms)	Regional	Contrast to baseline	Unlikely	Long term

9.5.2.9 Operational Phase

It is not envisaged that the operation of The Project will result in significant impacts on the Soils and Geology regime within the Study Area, as there will be no further disturbance of overburden post construction.

The main potential residual impact during the operation phase would be the risk to groundwater from contamination from spills. Storage tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled. Refuelling of maintenance vehicles will be carried out from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

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

All wastes from the Substation, Substation Compound, turbines and ancillary facilities will be removed by the appropriate contractor. The operational team will carry out maintenance works (to Access Tracks, Substation, Substation Compound, turbines and other ancillary facilities) and will put in place control measures to mitigate the risk of hydrocarbon or oil spills during the operational phase of the windfarm. Any vehicles utilised during the operational phase will be maintained on a weekly basis and checked daily to ensure any damage or leakages are corrected.

Spoil waste stored in the spoil deposition areas will continue to be monitored for stability on a regular basis during the operational phase. This monitoring will check for early indications of movement such as the development of cracks, minor slippage and / or localised subsidence. Where identified, remediation actions will be taken to repair any failure and restore the integrity of the deposition area.

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

These potential effects are limited by the size of the fuel tank of vehicles used on the Site. Additional potential effects will occur in the event that a turbine needs replacement. The effects associated with this will be similar to those involved for vehicles movements during construction but much reduced.

There are no other effects relating to soils and geology during the operational phase of the Project.

9.5.2.9.1 Operational Phase Residual Effects

The potential effects on the soil and geological environment during the operational phase of the work will be mitigated through good Site practice as described in the IWEA and Scottish Best Practice Guidelines as detailed in the CEMP, relating to vehicular movements, hydrocarbon controls, sustainable use of natural resources, human health etc. as discussed previously.

Overall, the residual effects from these aspects will have a **Long-term / Permanent, Adverse** and **Not Significant** residual effect on the Site. In EIA terms the residual effect is considered as **Not Significant.**

The residual effects after implementation of all mitigation measures for the operational phase of the Project are presented in **Table 9.24**.

Table 9.24: Operational Phase Residual Effect Summary

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Soil Compaction and Subsidence	Direct	Adverse	Not Significant	Localised	Contrast to baseline	Likely	Long-term
Land and Land Use	Direct	Adverse	Imperceptible (Not Significant in EIA terms)	Localised	Contrast to baseline	Likely	Long term / Permanent
Soil Contamination – Hydrocarbons and Chemicals	Direct	Adverse	Slight (Not Significant in EIA terms)	Localised	Contrast to baseline	Unlikely	Long term
Soil contamination - Operational Wastes	Direct	Adverse	Not Significant	Localised	Contrast to baseline	Likely	Long term

9.5.3 Project Decommissioning and Restoration Phases

9.5.3.1 Decommissioning of Infrastructure

Following the permitted lifespan of the wind farm, decommissioning of the infrastructure will occur or the Site may be repowered with more modern turbines, subject to a separate planning application.

The Met Mast, internal cable network and other ancillary structures, will be removed and the areas reinstated using materials stored on site. The turbines, transformers and associated "above-ground" elements will be removed, but the foundations will be left in-situ and reinstated.

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

Grid connection infrastructure including the Substation, GC and ancillary electrical equipment shall form part of the national electricity grid network and will be left in situ.

9.5.3.2 Reinstatement of Redundant Access Track and Hardstand Areas

The temporary works areas needed for the construction period such as temporary widening and temporary track required for the TDR, site compound and blade laydown areas, will be reinstated using the excavated material removed and stockpiled on site, as soon as construction activities have been completed.

At the time of decommissioning of The Project, some of the effects associated with reinstatement of the site (excavation of access tracks) will be avoided by leaving these in place where possible. It is proposed to leave the access tracks in-situ at the decommissioning stage. IWEA state that "it may be best" to leave site tracks in-situ depending on the size and geography of the development. It is considered that leaving the access tracks in-situ will cause less environmental damage than removing and recycling them, so these elements of the construction will be retained.

Turbine hardstands and other ancillary infrastructure will be removed and covered with overburden and topsoil material to allow for re-vegetation of the Site.

Areas of excess soil and rock will be reused in order to match the surrounding land as near as possible. Drainage and slopes will be restored as close to the original ground as possible.

9.5.3.2.1 Reinstatement Phase Residual Effects

The residual effects associated with decommissioning includes waste generation, hydrocarbon leakage and erosion of soil and rock. In general, effects will be similar to those at construction, but of a greatly reduced magnitude.

On completion of reinstatement works, it is expected that the wind farm will be returned as close to its present condition as possible. In particular, areas where local drainage has been altered will be reinstated.

Refer to **Table 9.25** for Decommissioning Phase Residual Effects.

Table 9.25: Decommissioning Phase Residual Effects Summary

Effect Description	Type	Quality	Significance	Extent	Context	Probability	Duration / Frequency
Land and Land Use	Direct	Positive	Slight (Not Significant in EIA terms)	Localised	Contrast to baseline	Likely	Long term / Permanent
Vehicle Movement	Direct	Adverse	Not Significant	Localised	Contrast to baseline	Unlikely	Long term / Permanent
Peat Landslide Hazard, Ground Stability and Failure	Direct	Adverse	Not Significant	Localised	Contrast to baseline	Unlikely	Permanent
Ground Stability and Failure - Stability issues and slope failure arising from construction activities. (Localised displacement and settlement)	Direct or Indirect / Secondary	Adverse	Not Significant	Localised / Potentially Regional	Contrast to baseline	Likely	Long term / Permanent
Ground Stability and Failure - Stability issues and slope failure arising from construction activities (Landslide)	Indirect / Secondary	Adverse	Not Significant	Localised / Potentially Regional	Contrast to baseline	Unlikely	Permanent
Soil and Groundwater Contamination	Direct or Indirect / Secondary	Adverse	Slight (Not Significant in EIA terms)	Localised	Contrast to baseline	Unlikely	Long term
Decommissioning Spoil	Direct	Adverse	Not Significant	Localised	Contrast to baseline	Likely	Long term / Permanent
General Waste	Direct	Adverse	Not Significant	Localised	Contrast to baseline	Likely	Permanent

9.6 SUMMARY OF SIGNIFICANT EFFECTS

Providing the mitigation measures outlined in this chapter are fully implemented and best practice as described in the IWEA and Scottish Best Practice Guidelines is followed on Site, it is expected that effects associated with the Project will not be significant.

The CEMP also includes a suitable monitoring programme which will ensure that there is rigid adherence both to the CEMP and to the mitigation measures outlined here during construction, operation and decommissioning of the wind farm.

Table 9.26: Summary of Potential Effects 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**	**Mitigation Applied**	**Quality**	**Significance**
Compaction, Erosion and Degradation of Soils	Construction	Direct	Adverse	Small Adverse	Moderate	Site	Contrast to baseline	Likely	Short term	Yes	Yes	Adverse	Slight
Land Take – Wind Farm	Construction	Direct	Adverse	Moderate Adverse	Moderate	Site	Contrast to baseline	Likely	Long term	None	No	Adverse	Slight
Land Take – TDR	Construction	Direct	Adverse	Small Adverse	Slight	Site	Contrast to baseline	Likely	Long term	None	No	Adverse	Not Significant
Land Take - GCR	Construction	Direct	Adverse	Small Adverse	Slight	Site	Conforms to baseline	Likely	Temporary	None	No	Adverse	Not Significant
Soil and Bedrock Removal – Excavations	Construction	Direct	Adverse	Small Adverse	**Significant**	Site	Contrast to baseline	Likely	Long term	Yes	Yes	Adverse	Slight
Soil and Bedrock Removal - Access Tracks	Construction	Direct	Adverse	Small Adverse	**Significant**	Site	Conforms to baseline	Likely	Long term	Yes	Yes	Adverse	Slight
Soil and Bedrock Removal – Turbines and Hardstand Areas	Construction	Direct	Adverse	Small Adverse	**Significant**	Site	Conforms to baseline	Likely	Permanent	Yes	Yes	Adverse	Slight
Soil and Bedrock Removal – Wind Farm Internal Cabling Trenches	Construction	Direct	Adverse	Small Adverse	Not significant	Site	Contrast to baseline	Likely	Long term	Yes	Yes	Adverse	Not significant
Soil and Bedrock Removal – Turbine Delivery Route / Haul Route	Construction	Direct	Adverse	Small Adverse	Not significant	Regional	Contrast to baseline	Likely	Long term	None	No	Adverse	Not significant

		Qualifying Criteria Pre-Mitigation								Qualifying Criteria with Mitigation			
Effect / Impact Description	**Phase**	**Type**	**Quality**	**Scale**	**Significance**	**Extent**	**Context**	**Probability**	**Duration / Frequency**	**Mitigation**	**Mitigation Applied**	**Quality**	**Significance**
Earthworks Activities – Grid Connection Cable	Construction	Direct	Adverse	Small Adverse	Not Significant	Site	Contrast to baseline	Likely	Permanent	None	No	Adverse	Not Significant
Earthworks Activities – Temporary Construction Compound	Construction	Direct	Adverse	Small Adverse	Slight	Site	Contrast to baseline	Likely	Temporary	Yes	Yes	Adverse	Not Significant
Earthworks Activities – Storage and Stockpiles / Spoil Management	Construction	Direct	Adverse	Small Adverse	Moderate	Site	Contrast to baseline	Likely	Long term	Yes	Yes	Adverse	Slight
Vehicle Movement - Compaction, erosion and degradation of soils arising from vehicular movement along existing public and private roads	Construction	Direct	Adverse	Small Adverse	Moderate	Localised	Conforms to baseline	Likely	Temporary	Yes	Yes	Adverse	Slight
Vehicle Movement – Compaction, subsidence and settlement of newly established and upgraded Access Tracks	Construction	Direct	Adverse	Small Adverse	Moderate	Localised	Contrast to baseline.	Likely	Permanent	Yes	Yes	Adverse	Slight
Ground Stability and Failure - Stability issues and slope failure arising from construction activities. (Localised displacement and settlement)	Construction	Direct / or Indirect / Secondary	Adverse	Moderate Adverse	**Significant**	Localised / Potentially Regional	Contrast to baseline	Likely	Long term / Permanent	Yes	Yes	Adverse	Slight
Ground Stability and Failure - Stability issues and slope failure arising from construction activities (Landslide)	Construction	Indirect / Secondary	Adverse	Moderate Adverse	Moderate	Localised / Potentially Regional	Contrast to baseline	Unlikely	Permanent	Yes	Yes	Adverse	Slight
Soil and Groundwater – Pollution of Groundwater Aquifer	Construction	Indirect / Secondary	Adverse	Large Adverse	**Significant**	Localised / Potentially Regional	Contrast to baseline	Unlikely	Long term	Yes	Yes	Adverse	Slight
Soil and Groundwater Contamination - Hydrocarbons	Construction	Direct or Indirect / Secondary	Adverse	Large Adverse	**Significant**	Localised / Potentially Regional	Contrast to baseline	Unlikely	Long term	Yes	Yes	Adverse	Slight
Soil and Groundwater Contamination – Wastewater and Sanitation	Construction	Direct or Indirect / Secondary	Adverse	Large Adverse	Moderate	Localised / Potentially Regional	Conforms to baseline	Likely	Long term	Yes	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**	**Mitigation Applied**	**Quality**	**Significance**
Soil and Groundwater Contamination – Construction and Cementitious materials	Construction	Direct or Indirect / Secondary	Adverse	Large Adverse	Moderate	Localised / Potentially Regional	Contrast to baseline	Likely	Temporary	Yes	Yes	Adverse	Slight
Waste Materials – Construction Spoil	Construction	Direct	Adverse	Moderate Adverse	Moderate	Localised	Contrast to baseline	Unlikely	Long term / Permanent	Yes	Yes	Adverse	Slight
Waste Materials – General Waste	Construction	Direct	Adverse	Small Adverse	Slight	Localised	Contrast to baseline	Unlikely	Temporary	Yes	Yes	Adverse	Not Significant
Degradation of Quality of Sites of Geological Significance caused by emissions / pollution from the Project	Construction	Indirect / Secondary	Adverse	Large Adverse	Imperceptible	Regional	Contrast to baseline	Unlikely	Long term	No	No	Adverse	Imperceptible
Soil Compaction and Subsidence	Operation	Direct	Adverse	Small Adverse	Slight	Localised	Contrast to Baseline	Likely	Long term	Yes	Yes	Adverse	Not Significant
Land and Land Use	Operation	Direct	Adverse	Negligible	Imperceptible	Localised	Contrast to baseline	Likely	Long term / Permanent	None	No	Adverse	Imperceptible
Soil Contamination – Hydrocarbons and Chemicals	Operation	Indirect / Secondary	Adverse	Large Adverse	**Significant**	Local / Potentially Regional	Contrast to baseline	Unlikely	Long term	Yes	Yes	Adverse	Slight
Soil Contamination - Operational Wastes	Operation	Direct	Adverse	Small Adverse	Slight	Localised	Contrast to baseline	Likely	Long term	Yes	Yes	Adverse	Not Significant
Land and Land Uses	Decommissioning	Direct	Positive	Minor Beneficial	Slight	Localised	Contrast to baseline	Likely	Long term / Permanent	None	No	Positive	Slight
Vehicle Movement - Compaction, erosion and degradation of soils arising from vehicular movement along existing public and private roads	Decommissioning	Direct	Adverse	Small Adverse	Slight	Localised	Conforms to baseline	Unlikely	Long term / Permanent	Yes	Yes	Adverse	Not Significant
Ground Stability and Failure - Stability issues and slope failure arising from construction activities. (Localised displacement and settlement)	Decommissioning	Direct / or Indirect / Secondary	Adverse	Moderate Adverse	Slight	Localised	Contrast to baseline	Likely	Long term	Yes	Yes	Adverse	Not Significant

		Qualifying Criteria Pre-Mitigation								Qualifying Criteria with Mitigation			
Effect / Impact Description	**Phase**	**Type**	**Quality**	**Scale**	**Significance**	**Extent**	**Context**	**Probability**	**Duration / Frequency**	**Mitigation**	**Mitigation Applied**	**Quality**	**Significance**
Ground Stability and Failure - Stability issues and slope failure arising from construction activities (Landslide)	Decommissioning	Indirect / Secondary	Adverse	Moderate Adverse	Slight	Localised	Contrast to baseline	Unlikely	Long term	Yes	Yes	Adverse	Not significant
Soil and Groundwater Contamination	Decommissioning	Indirect / Secondary	Adverse	Large Adverse	Moderate	Localised	Contrast to baseline	Unlikely	Long term	Yes	Yes	Adverse	Slight
Decommissioning Spoil	Decommissioning	Direct or Indirect / Secondary	Adverse	Large Adverse	Slight	Localised	Contrast to baseline	Likely	Short term	Yes	Yes	Adverse	Not significant
Waste Materials – General Waste	Decommissioning	Direct	Adverse	Small Adverse	Slight	Localised	Contrast to baseline	Unlikely	Short term	Yes	Yes	Adverse	Not significant
	Note:												

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