



Chapter 08 Land and Soils

Ballinlee Wind Farm

Ballinlee Green Energy Ltd.

September 2025

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8 Land and Soils

8.1 Introduction

This chapter assesses any likely significant effects to the land and soils environment arising from the proposed development. A full description of the proposed development, development lands and all associated project elements is provided in **Volume II, Chapter 02** Description of the Proposed Development of this EIAR. The assessment comprises:

- A review of the existing receiving environment;
- Prediction and characterisation of likely effects;
- Evaluation of effects significance; and
- Consideration of mitigation measures, where appropriate.

8.1.1 Competency of Assessor

This chapter of this EIAR has been prepared by Claire Boylan of Malachy Walsh and Partners (MWP). Claire Boylan holds a BSc (EnvMgt), an Adv Dip Planning and Environmental Law, a BBS and DipSci. Claire is an experienced Environmental Scientist at MWP, having worked for 6 years in the environmental sector. Claire has worked on a variety of infrastructure projects, environmental licensing applications, conducted environmental assessments and supported the delivery of a number of environmental deliverables including Environmental Impact Assessment (EIA) Screening Reports, Appropriate Assessment (AA), Natura Impact Statements (NIS) and Environmental Impact Assessment Reports (EIAR). Claire has been involved in the preparation of EIARs for the following projects:

- Dernacart Wind Farm
- Leeseide Quays Large Scale Residential Development
- Architectural & Metal Systems Anodising Facility

This assessment has been reviewed by Maura Talbot. Maura is a Chartered Environmentalist (IES/SocEnv) with 25+ years of experience working as a Senior and Principal Environmental and Socio-Economic Specialist Consultant and joined MWP in April 2022. Maura has managed and contributed to environmental impact assessments for a wide variety of development and infrastructure projects including wind farms in Southern Africa and Ireland.

8.1.2 Legislation & Guidance

The Land and Soils chapter details the land, soils, subsoils and geology of the proposed development, in accordance with the requirements of the following European and Irish legislation:

- EU Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the Environment as amended by Directive 2014/92/EU of the European Parliament and of the Council;
- Heritage Act 2018;

- Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy with amendments 2455/2001/EC, 2008/32/EC and 2008/105/EC (Water Framework Directive (WFD));
- Planning and Development Act 2000; as amended and
- Planning and Development Regulations, 2001 as amended.

8.2 Methodology

The assessment methodology included a desk-based study, a site visit, and a qualitative assessment of the potential effects. The assessment criteria for geology, land and was completed in accordance with the following guidelines:

- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Environmental Protection Agency (2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- European Union (2017): Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU);
- Institute of Geologists Ireland (2013): Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- National Roads Authority (2005): Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018);
- National Roads Authority (2009): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;
- Scottish Executive (2017): Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, 2nd Edition; and
- European Commission (2021): EU Soil Strategy for 2030.

8.2.1 Desktop Study

The methodology used for this study included desk-based research of published information and site visits to assemble information on the local receiving environment. The desk study included the following activities:

- Review of Ordnance Survey Mapping and aerial photography to establish existing land use and settlement patterns within the study area;
- Review of LiDAR data provided by client, OSI contour data and identification of water features on site;
- Examination of the Geological Survey of Ireland (GSI) datasets pertaining to geological (bedrock, heritage, subsoil, etc.) and extractive industry data;
- Examination of EPA / Geohive / Teagasc online soil and subsoil maps;
- Review of local and regional development plans and planning policy in order to identify future development and identify any planning applications within the study area;

- Review of Limerick City and County Council's Planning Register to identify relevant development proposals currently under consideration by the Council; and
- Review of Mague River Catchment Characterisation by Catherine Dalton and Niall Walsh.

In accordance with the methodology outlined in the Institute of Geologists Ireland (2013): Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements, maps should be sourced to allow for the review of the geological and hydrogeological conditions that exist within a minimum of 2km of the site boundary. A set of geological and soils maps were generated in GIS using data acquired from the Geological Survey Ireland (GSI), the Environmental Protection Agency (EPA) and Geohive Online maps, and are included as figures in this chapter.

8.2.2 Field Survey

A number of site visits were undertaken to determine the geology and aggregate resource at various locations throughout the proposed development site.

Northwest Geotech undertook a site survey on the 6th and 9th August 2024 which comprised:

- Twenty-four machine dug trial pits.

The trial pits were excavated using a 3t tracked excavator fitted with a 400m wide bucket, to depths of up to 2.70m. Any water strikes encountered during excavation were recorded along with any changes in their levels as the excavation proceeded. Groundwater was encountered as seepage in some trial pits and is further discussed in **Section 8.3.13** in this Land and Soil Chapter and also in Northwest Geotech Ltd, 2024 Ground Investigation Report (EIAR **Volume III, Appendix 8A**).

A site survey was also undertaken on the 29th November 2024 and the 7th February 2025 by MWP to verify gathered information. There were 9 additional trial pits excavated to refine the location of the borrow pit. The findings are summarised in **Table 8-4**. The data collected is still valid for the purposes of this assessment as there has been no significant land use change since the site visits.

The SI works conducted by MWP were conducted in accordance with:

- Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland.
- IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. National Standards Authority of Ireland.
- BS 5930: 2015+A1:2020: Code of practice for ground investigations. British Standards Institution.

8.2.3 Study Area

The site of the proposed wind farm development is located in a rural area of east Limerick approximately 18km south of Limerick City and 3km southwest of Bruff, Co. Limerick. The area of the wind farm site within the planning application boundary is approximately 255.12ha.

Also included within the proposed development is a new temporary access track via R-516 located in the townland of Tullovin and a grid route connection approximately 27.6km in length.

The lands within the wind farm site in the planning application boundary are privately owned lands which are predominantly in agricultural use. These lands are situated within the townlands of Ballincurra, Ballinlee South, Ballingayroure, Ballinlea, Knockuregare, Ballinlee North, Carrigeen and Camas South. The L1414 transects the site

east to west and ribbon development is dispersed along the route. Some areas of land are in use for agriculture and forestry.

The N20 (Limerick to Cork road) is c. 6km to the west and the N24 (Limerick to Waterford road) is c. 25km to the east of the proposed development.

The Turbine Delivery Route (TDR) will begin at the port of Foynes in Limerick. The components will be delivered from the port to the proposed wind farm site along the Motorway, National, Regional and Local Road network. The first section of the route is along the N69 as far as the N18 (east) bypass. The TDR route turns south onto the M20 and at the N200 junction, turns left at Ballybronogue. From Croom town, the TDR turns on to the R-516 to the site.

8.2.4 Scope of Assessment

‘Land and Soil’ are considered geological terms and in current, historical and planned land use. The subject matter of hydrogeology and hydrology are further addressed in **Volume II, Chapter 09** Water of this EIAR however they are referenced also in this chapter given that the scope of the chapters overlap between soils, geology, hydrology and hydrogeology.

This assessment considers the effects of the construction, operation and decommissioning of the proposed development in terms of how the proposal could affect the local land and soil environment and how soils on site have a bearing on the site layout, site selection and locations of turbines. The scope will include potential impacts on the receiving land and soils that may have significant effects and the implementation of appropriate mitigation measures if required.

8.2.4.1 Assessment Criteria

Using information from the desk study and data from the site investigations, the soil and geological environment within the Proposed Development site is assessed using the criteria set out in **Table 8-1** (NRA, 2008).

The importance/sensitivity of the existing environment combined with the description of the effect (Character, Magnitude, Duration, Probability and Consequence) is used to determine the significance of the effect. The methodology for the description of the effect is in accordance with the EPA (2022) Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIAR) and is described in detail in **Volume II, Chapter 01** Introduction of this EIAR.

Table 8-1: Estimation of Importance of Soil and Geology Criteria (NRA, 2008)

Importance	Criteria	Typical Example
Very High	Attribute has a high quality, significance or value on a regional or national scale.	
	Degree or extent of soil contamination is significant on a national or regional scale.	Geological feature rare on a regional or national scale (NHA).
	Volume of peat and/or soft organic soil underlying route is significant on a national or regional scale.	Large existing quarry or pit. Proven economically extractable mineral resource.

Importance	Criteria	Typical Example
High	Attribute has a high quality, significance or value on a local scale. Degree or extent of soil contamination is significant on a local scale. Volume of peat and/or soft organic soil underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes. Geological feature of high value on a local scale (County Geological Site). Well drained and/or highly fertility soils. Moderately sized existing quarry or pit Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying site is moderate on a local scale.	Contaminated soil on site with previous light industrial usage. Small recent landfill site for mixed Wastes. Moderately drained and/or moderate fertility soils. Small existing quarry or pit. Sub-economic extractable mineral Resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

8.2.5 Statement on Limitations and Difficulties Encountered

Limitations and difficulties have not been encountered during this assessment.

8.3 Baseline Environment

8.3.1 Site Location and Description

The area within the proposed development is located in the townlands of Ballincurra, Ballinlee South, Ballingayrou, Ballinrea, Knockuregare, Ballinlee North, Carrigeen and Camas South approximately 18km south of Limerick City and 3km southwest of Bruff, Co. Limerick.

The L1414 transects the wind farm site east to west and ribbon residential development is dispersed along the route. Lands are in use for agriculture and forestry. A gas transmission pipeline is mapped crossing the proposed wind farm site and along part of the grid route as shown in **Figure 8-15**.

The N20 (Limerick to Cork road) is c. 6km to the west and the N24 (Limerick to Waterford road) is c. 25km to the east of the proposed development.

An element of the Turbine Delivery Route, the temporary access track adjacent to Tullovin Bidge, which is located in the townland of Tullovin is included within the development red line boundary. The track is c. 250m long by 5.5m wide.

The grid connection route is approximately 27.6km in length and runs from the existing Killonan 220/110kV Substation to the proposed on site 110 kV substation .

According to the EPA online mapping (<https://gis.epa.ie/EPAMaps/default>), there are no licenced waste facilities or historic landfills on or within the immediate environs of the Wind Farm Site. There are no existing IPCC licenses granted within or near the Wind Farm Site.

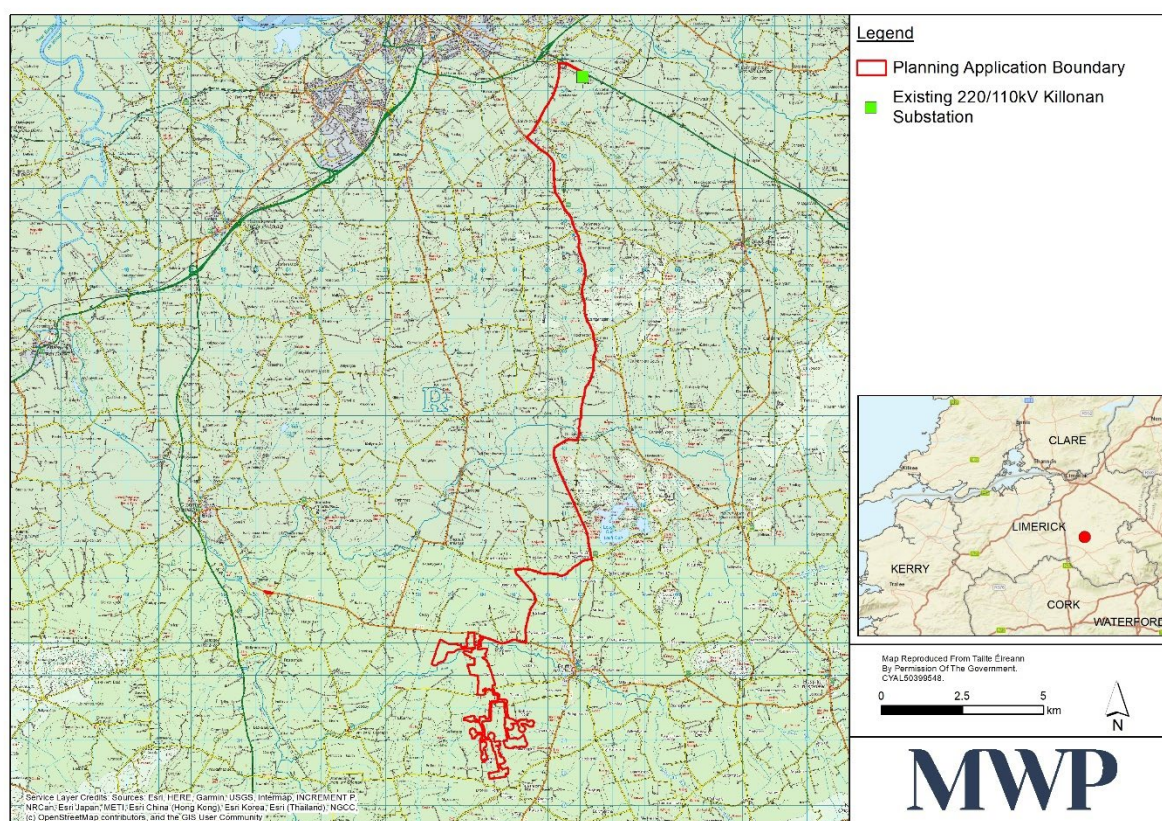


Figure 8-1: Site Location

8.3.2 Existing Land Use

8.3.2.1 Wind Farm Site

The published Corine Land Cover Maps (www.epa.ie) show that much of the wind farm site is located on agricultural pastures (Agricultural Area 231) with some Coniferous Forest (321). Agricultural pastures dominate

the surrounding lands (see **Figure 8-2**) with a scattered pattern of rural dwellings and farmhouses. The land use at the site has been mapped as shown in **Figure 8-3**.



Figure 8-2: Agricultural Pasture within Proposed Development

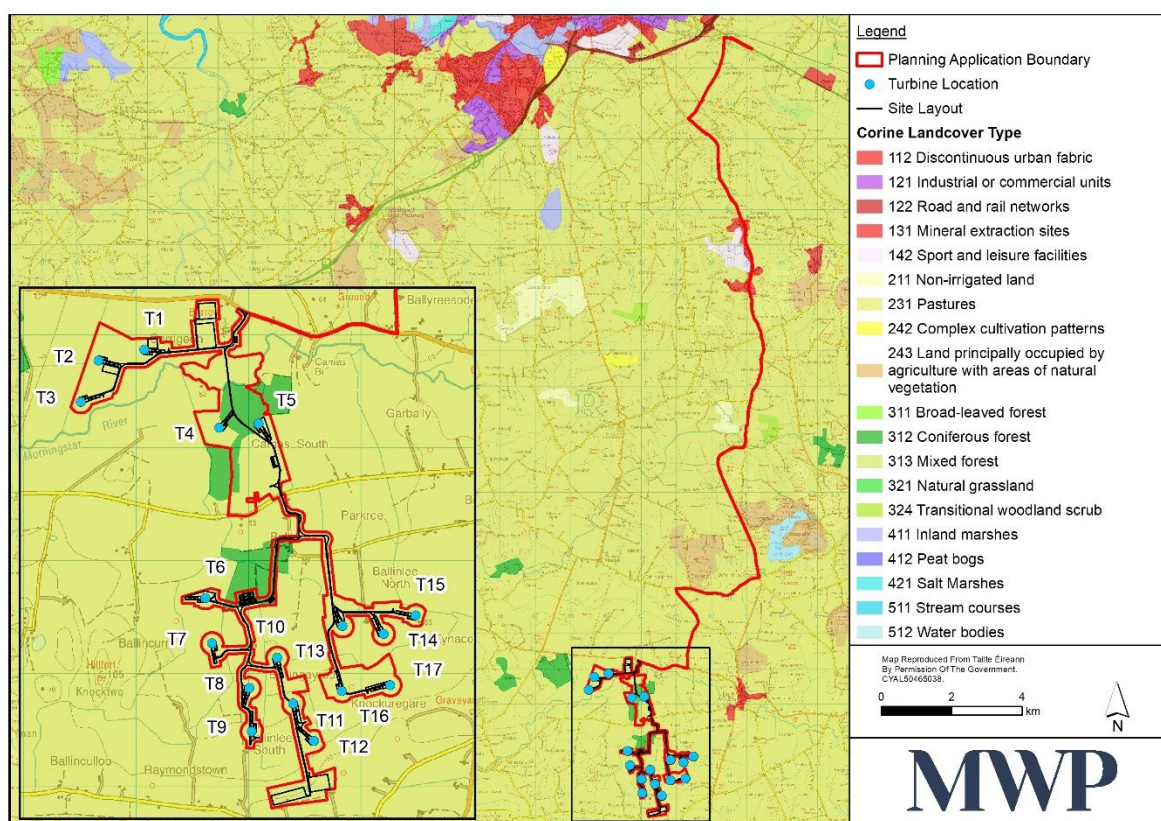


Figure 8-3: Corine 2018 Land Cover Mapping

8.3.2.2 Grid Connection

Land use along the underground electrical cabling route is almost entirely an existing road carriageway. Where the underground electrical cabling route enters the Wind Farm Site, from the existing public road carriageway, and connects to the onsite 110kV substation, the land use is primarily agricultural.

8.3.2.3 Turbine Delivery Route

The temporary access track required for the Turbine Delivery Route (TDR) will be installed on land which are currently in agricultural use (grassland). The remainder of the route is part of the public road network. The delivery of turbine components to the proposed development will require temporary works on sections of the public road network along the delivery route including hedge or tree cutting, relocation of powerlines/poles, lampposts, signage and verge strengthening.

8.3.3 Topography

The topography of the site is relatively flat (**Figure 8-4**). Turbine locations have been selected to allow for a balance of cut and fill of the underlying strata at each location. The Wind Turbine Generator (WTG) locations were chosen considering adjacent stakeholders, land available, ecological constraints, hydrological characteristics and spacing. Elevations of the site range between approx. 49 - 79m Above the Ordnance Datum (AOD) in areas where infrastructure is to be developed.



Figure 8-4: Topography (1m contours)

8.3.4 Regional Geology

The following is an excerpt of a summary of the Geology of County Limerick from ‘The Geological Heritage of County Limerick’: “County Limerick has five main episodes in its geological story. The first of these is represented by rocks of the Ballyhoura, Slieve Felim and Galtee Mountains. Here, Silurian marine rocks, around 440 million years old, are found where erosion of the uplands has stripped off the younger Devonian sandstones and conglomerates. The Devonian rocks, of sediments deposited by rivers, form the second stage. They surround the Silurian rocks in these mountain ranges, as well as forming most of the upland area of Corronoher and Knockfeerina Ridges. The Carboniferous Period began around 360 million years ago and forms the third episode. Its limestone forms the bedrock to the lowland plains. These are limestones from open marine environments. Midway through this phase a period of volcanic activity saw basalt lava and other volcanic rocks deposited on the limestones. In the fourth episode, the Upper Carboniferous, deep-water marine shales and deltaic sandstones were deposited and these now form the Mullaghareirk Mountains and the adjacent Abbeyfeale Plateau. However, the most significant force to shape the county as we see it today was the fifth major episode, the Ice Age, which ended about 11,500 years ago. Large ice sheets covered the entire region and county, and eroded the surface rocks. As the ice eventually melted away, the meltwaters reorganised the sediments into iconic landforms like eskers, also with outwash terraces of sand and gravel” (GSI, 2021). See **Figure 8-5** for bedrock of County Limerick.



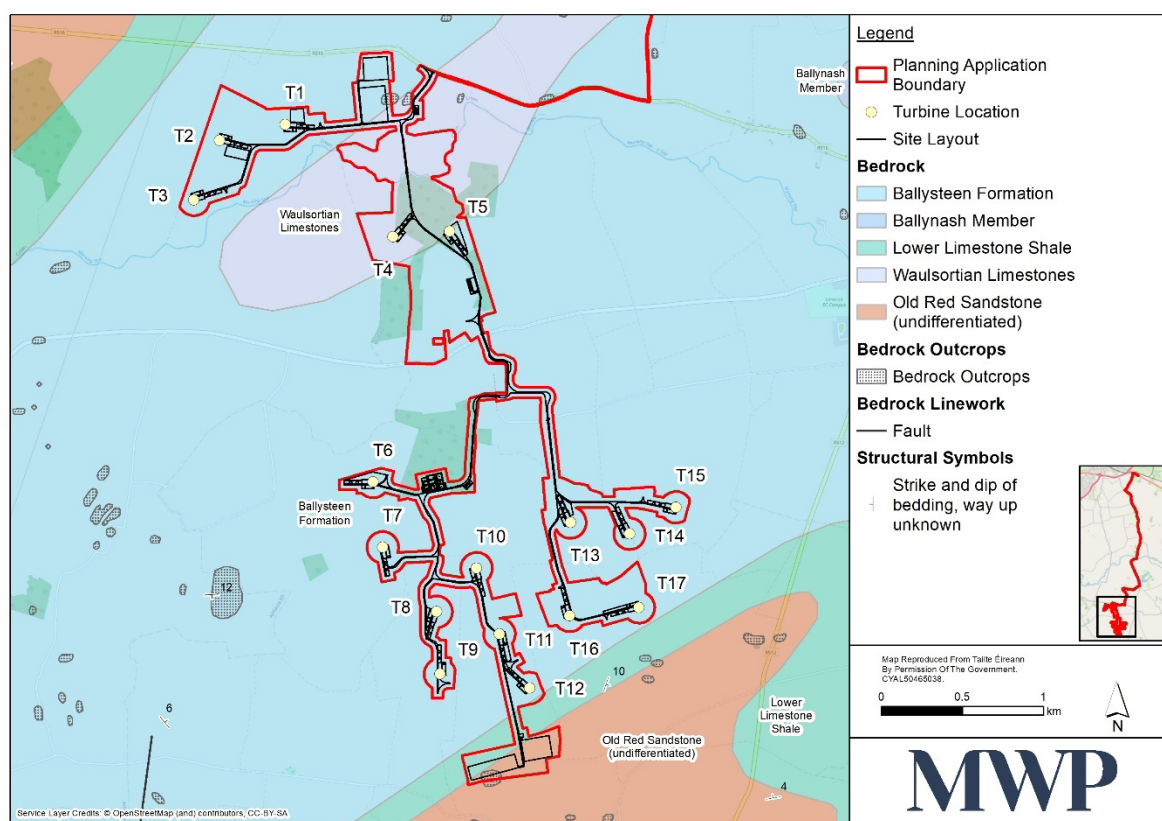


Figure 8-6: Bedrock Geology of subject site (Source: GSI)

Published geological mapping indicate the superficial deposits underlying the site comprise Glacial Till with localised pockets of alluvium. These deposits are underlain by limestone and shale of the Ballysteen Formation.

8.3.5.2 Grid Connection Route and Substation

The bedrock geology along the underground electrical cabling route consists mostly of Waulsortian Limestone, with areas of Ballysteen Formation, Knockroe Vitric-Lithic Tuff Member, Herbertstown Limestone Formation, Knockroe Basalt Lava Flow Member, Lough Gur Formation, Volcaniclastic Rocks and Visean Limestones (undifferentiated) through the route.

Local bedrock geology for the grid route shown in **Figure 8-7**.

8.3.5.3 Turbine Delivery Route (TDR)

The location of the temporary works along the TDR, at Tullovin Bridge, is underlain by Old Red Sandstone which is described as consisting of red conglomerate, sandstone and mudstone.

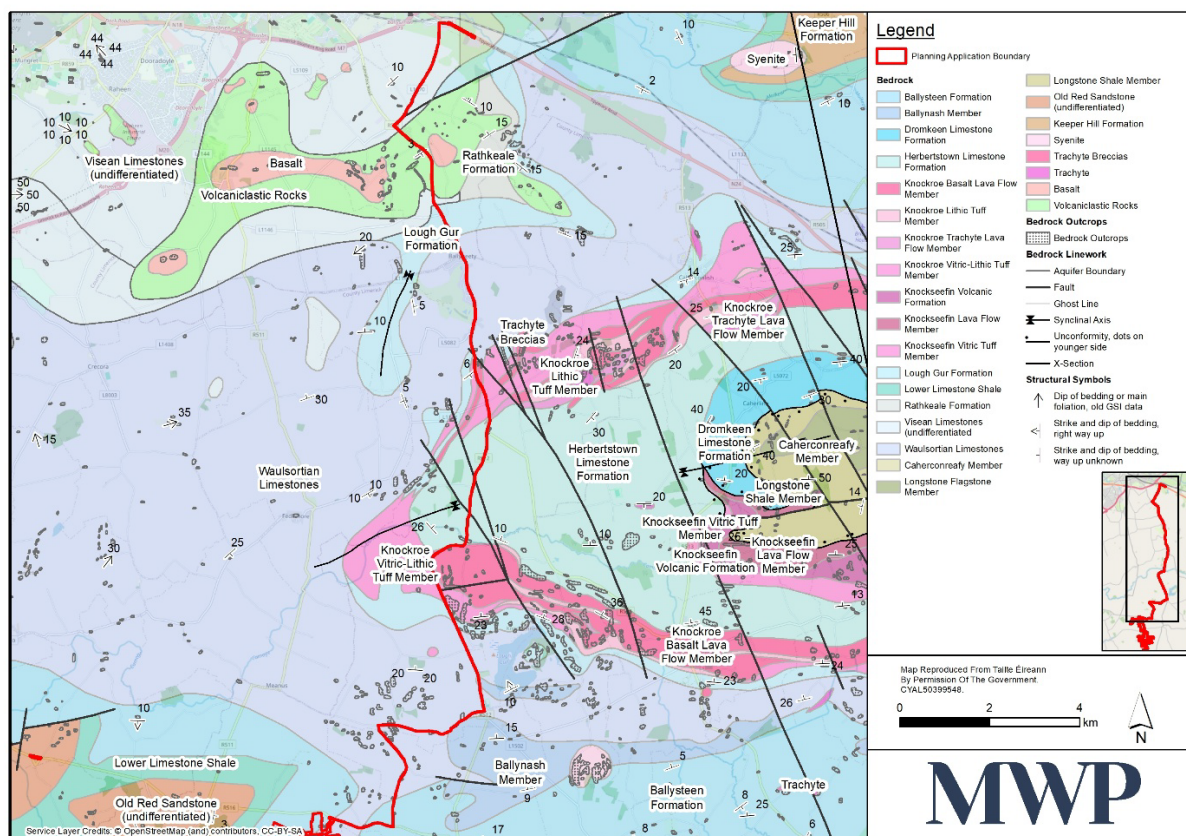


Figure 8-7: Geology Grid Route

8.3.6 Soil and Subsoil

Soil includes the topsoil (soil) and subsoil, which together provide for the following important functions:

- Facilitate the hydrological cycle in the filtration/recharge, storage and discharge of rainwater;
- Support all terrestrial ecology, including all flora and fauna (and all food crops);
- Protect and enhance biodiversity;
- Holding or preserving archaeological remains; and
- Provision of raw materials and a base on which to build.

Soil (topsoil) and subsoil may generally derive from parent geological material and organic matter under the influence of processes including weathering and erosion.

The published soils map (GSI) for the wind farm site indicates three types of soil within the site (see **Figure 8-8**). **Table 8-2** outlines the predominant soil type at the majority of the wind farm.

Table 8-2: Soil Types - Proposed Development Site

Material Name	Material Description	Soil Code	Category
Till derived chiefly from limestone	Limestone till (Carboniferous)	BminDW	Deep well drained mineral (Mainly basic)
Till derived chiefly from limestone	Limestone till (Carboniferous)	BminPD	Mineral poorly drained (Mainly basic)
Alluvium	Alluvium undifferentiated	AlluvMIN	Alluvial (mineral)
Bedrock at Surface Calcareous	Surface Shallow Gleys	BminSP	Shallow poorly drained mineral (Mainly basic)
Bedrock at surface Calcareous	Shallow well drained mineral	RckCa	Shallow well drained mineral (Mainly basic)
Bedrock at surface Non-Calcareous	Bedrock at surface	RckNca	Shallow well drained mineral (Mainly acidic)

During the Northwest Geotech Survey 6th – 9th August 2024, 24 trial pit holes were excavated to depths of up to 2.70m. A detailed log is provided in the Northwest Geotech report in this EIAR, **Volume III, Appendix 8A**.

A summary of the ground types encountered were:

- Topsoil: encountered typically in 200-400mm thickness across the site.
- Recent deposits (peat): encountered at depth in TP01, TP02, TP04 as spongy dark brown amorphous peat, thickness of 0.25m – 0.80m.
- Glacial Till: sandy gravelly clay, frequently with low to medium cobble and boulder content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth.

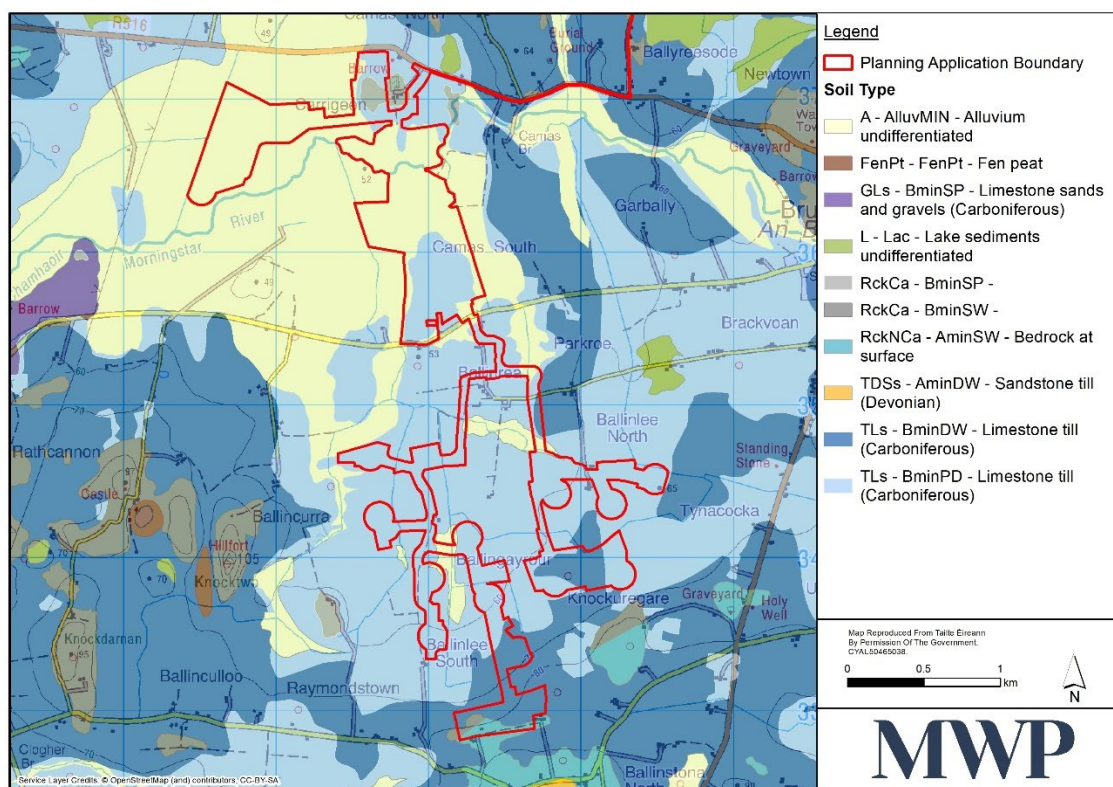


Figure 8-8: Teagasc Soils Wind Farm (Source: GSI)



8.3.6.1 Grid Connection Route and Substation

8.3.6.2 Turbine Delivery Route (TDR)

September 2025

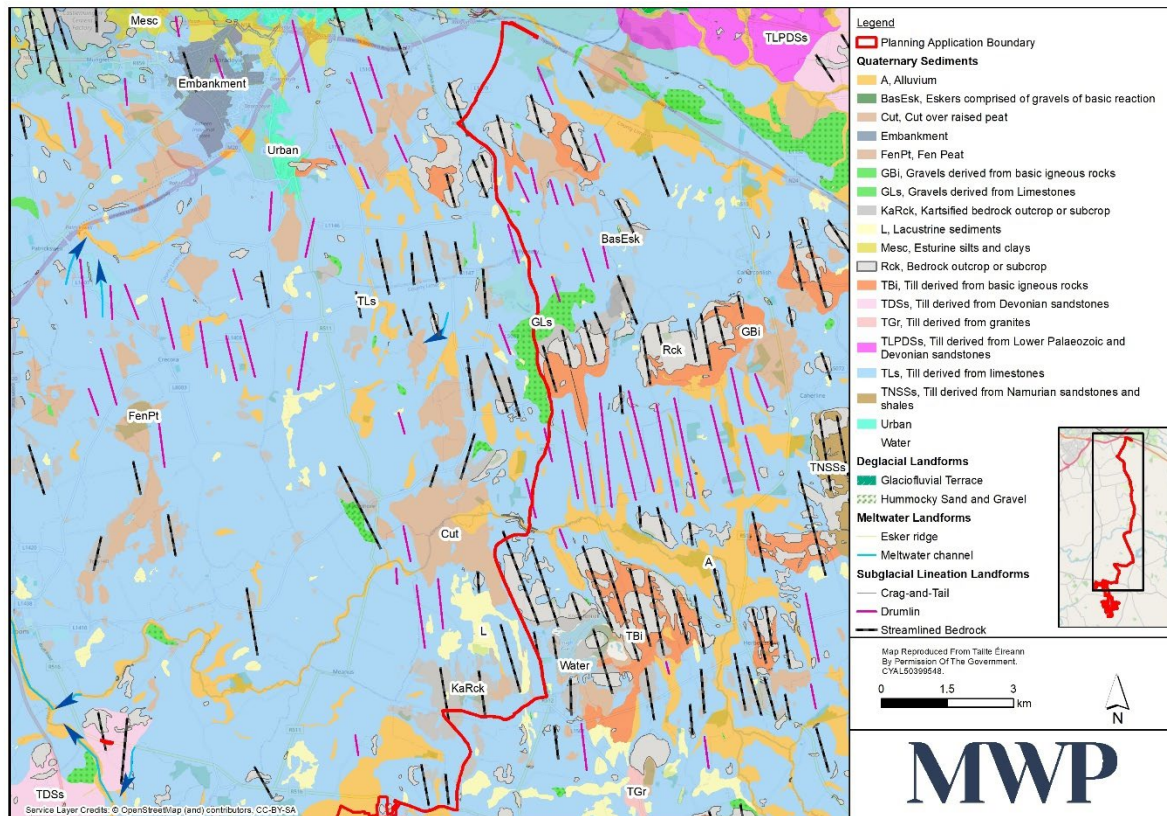


Figure 8-10: Quaternary Sediments Grid Connection Route

8.3.7 Geological Heritage

A review of the GSI Geological Heritage Database available on the GSI online mapping system indicates that there are no audited or unaudited geological heritage sites within or adjacent to the proposed development. The nearest mapped geological site is c. 4.5km north-east of the proposed development (see **Figure 8-11**). The nearest mapped geological heritage sites are also detailed in **Table 8-3**. Given the distances to the proposed development, no effects to geological heritage are predicted because of the proposed development.

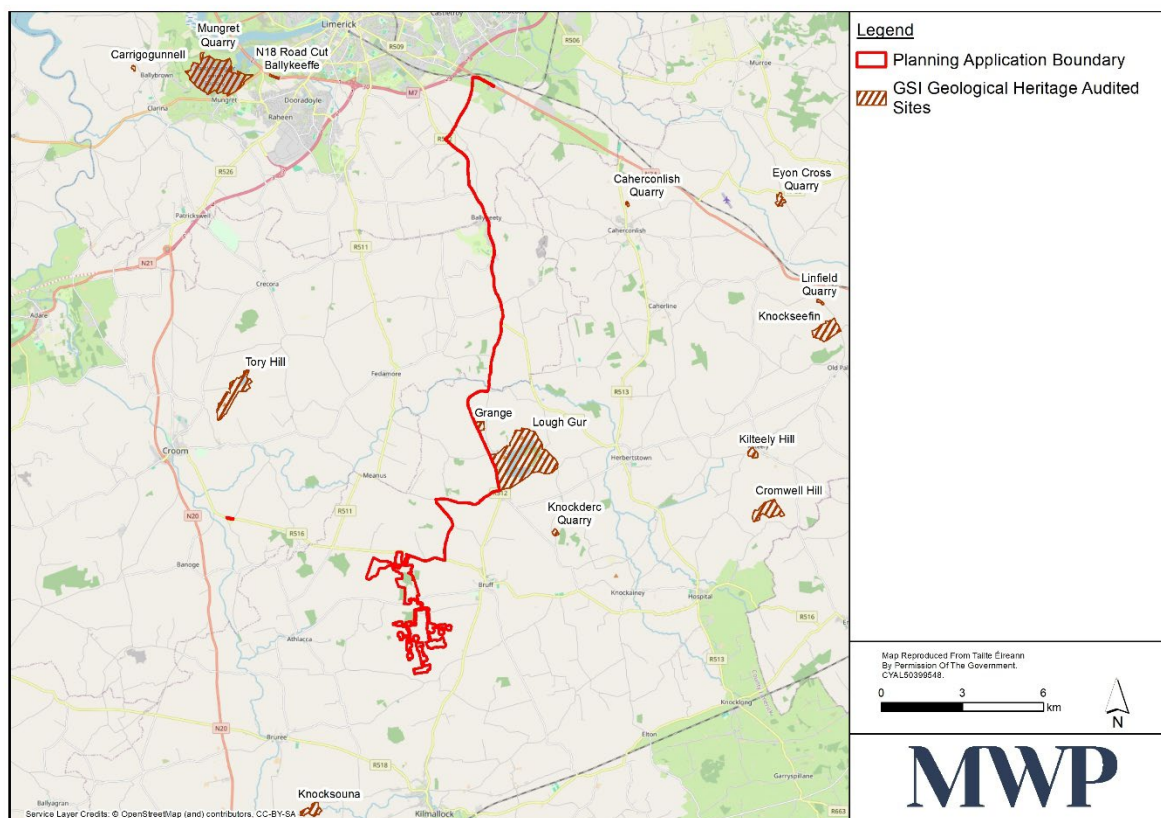


Figure 8-11: Geological Heritage (source: GSI)

Table 8-3: Geological Heritage Sites in Proximity to Proposed Development

Site Code	Site Name	Site Description	Distance
LK030	Tory Hill	The Tory Hill site includes a high, elongate, northeast to southeast oriented ridge, which is 2 km northeast of Croom. The site also contains a low basin to the northeast, hosting a lake.	14.6km north west
LK017	Grange	A former small quarry and adjacent hillside; quarry now in use as cattle pen.	6.5km north east
LK025	Lough Gur	Lough Gur is a unique shallow lake (typically ≤ 4 m) that is fed by groundwater and surface run-off.	4.5km north east
LK020	Knockderc Quarry	A large, abandoned quarry in Mississippian (Lower Carboniferous) syenite.	5.2km east
LK022	Knocksouna	The Knocksouna site includes a series of warm water springs and a high, bedrock crag to their north.	7.15km south west
LK002	Ballylanders-Kilfinnane Moraine	The Ballylanders – Kilfinnane Moraine comprises a number of ridges of glacial sediments encircling the Ballyroe and Slieveveagh ridges, at the northeastern edge of the Ballyhoura Mountains	12km south east

Source: GSI online database

8.3.7.1 Grid Route and Substation

Two of the geological heritage sites as indicated (LK017 & LK025 in **Table 8-3**) are located along the underground electrical cabling route, which has previously been cut through by a road carriageway. Site LK017, Grange was the location of a former quarry and is now in use as a cattle pen. There will be no interaction between the proposed grid connection within the public road and Grange Heritage site. LK025 Lough Gur is a lake fed by groundwater

and surface run-off. The lake is located approximately 360m from the R512 public road. There are residential properties and farmland located along the R512 between the road and Lough Gur. There will not be any interaction between Lough Gur heritage site and the installation of the cable within the public road.

8.3.7.2 Turbine Delivery Route (TDR)

There are no geological heritage sites associated with or in proximity to the temporary access track located adjacent to Tullovin Bridge.

8.3.8 Economic Geology

The closest recorded quarry is c. 3km west however this quarry is recorded as being filled/restored. The nearest active quarry to the site is c. 9.5km at Ballinleeny, Co. Limerick.

Recorded mineral locations have the potential to be used for future mineral extraction. According to the GSI, there are a number of recorded metallic and non-metallic mineral locations in the area, mainly composed of iron and zinc (see **Figure 8-12**). There are no records of any metallic or non-metallic mineral locations within the proposed development site.

The GSI online Aggregate Potential Mapping Database shows that two locations within the wind farm site have very high crushed rock aggregate potential. These are the two locations for the proposed borrow pits. In contrast the GSI record for granular aggregate across the site is very low to moderate.

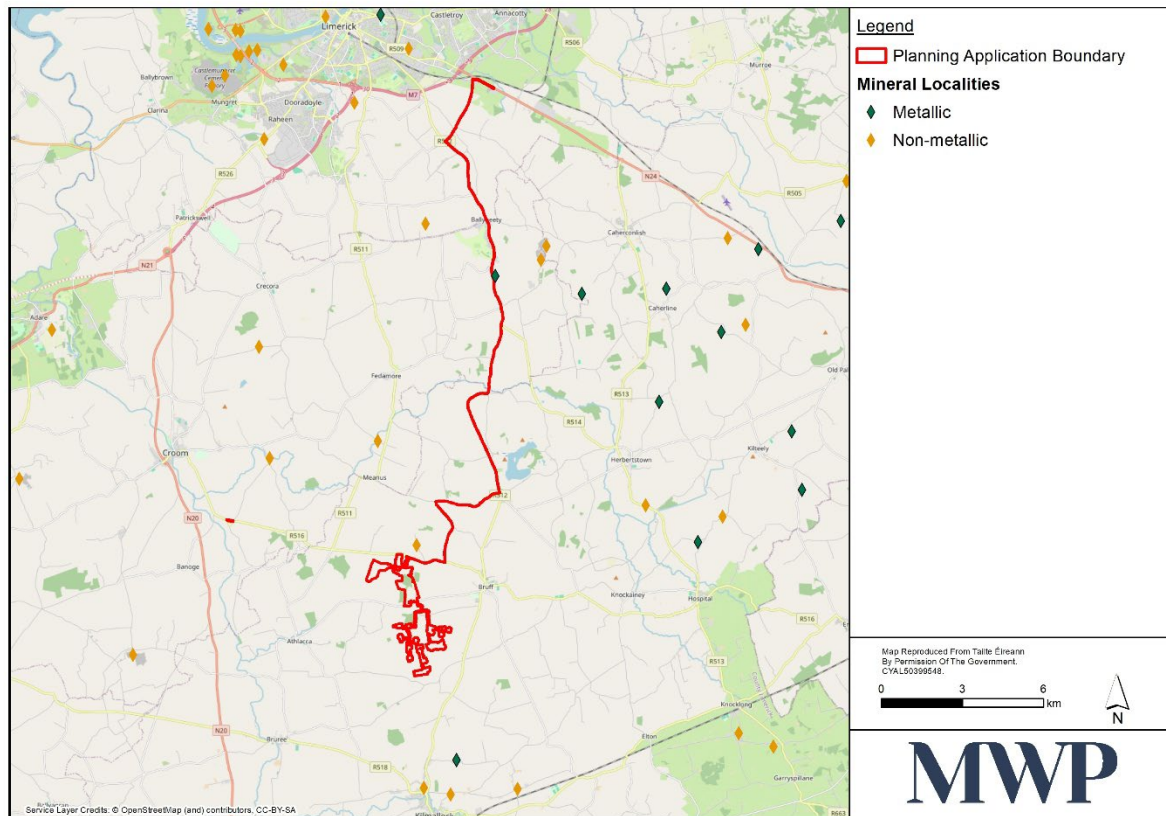


Figure 8-12: Mineral Localities (source: GSI)

8.3.8.1 Grid Connection Route and Substation

Granular aggregate potential is mapped as very high at the mid point along the grid route (Stonepark). There are no other aggregate potential resources indicated along the route. The majority of the grid route is mapped as high potential to very high potential for crushed rock aggregate.

8.3.9 Existing Slope Stability

From a desk-top review, the GSI's Landslide Events database have no record of any landslides recorded within or in proximity to the proposed development. The nearest recorded landslide is located approximately 12km north west of the proposed development (Kapanihane 1697). According to the GSI Landslide Susceptibility map (Figure 8-13), the proposed development is located in areas classified as being "Low" and "Low (inferred)".

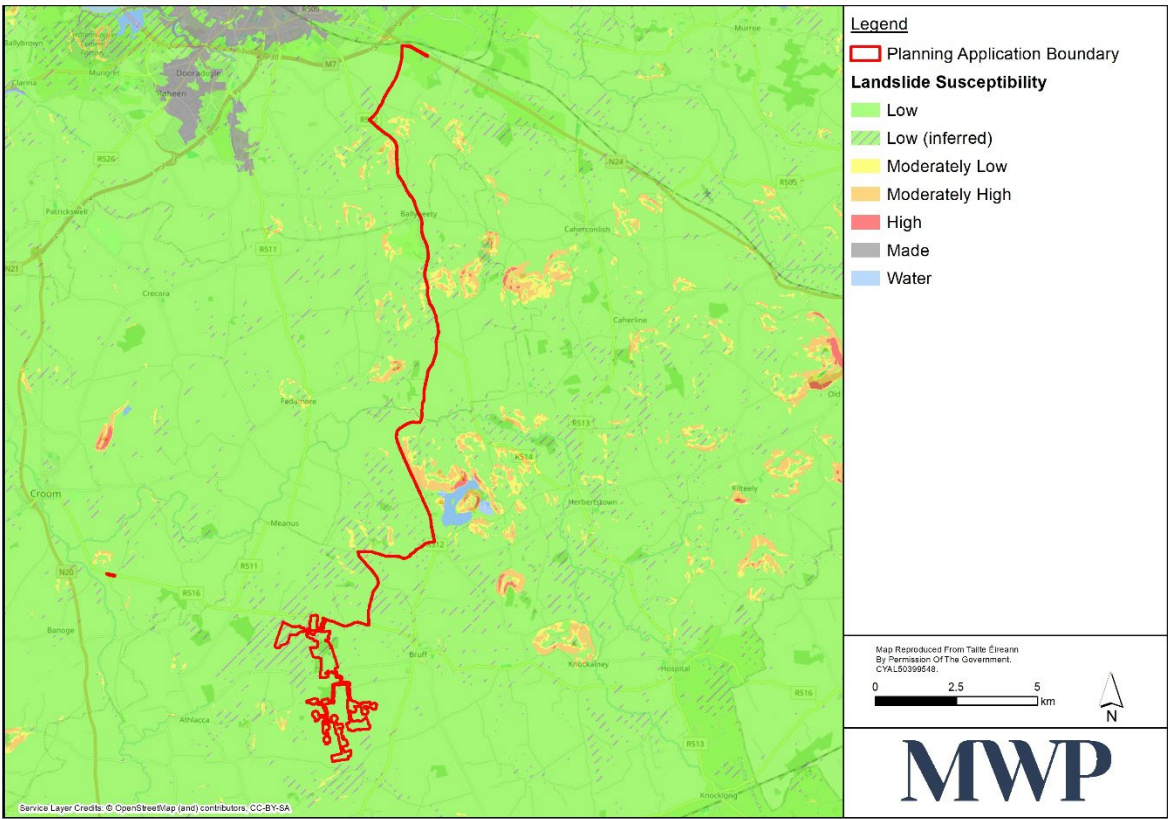


Figure 8-13: Landslide Susceptibility (Source: GSI)

A scoping exercise was carried out to determine whether a detailed Peat Landslide Hazard and Risk Assessment is required for this site. This scoping exercise reviewed whether peat was present onsite. No peat is mapped on the GSI maps for the site, however during site investigations a small area of peaty type soil was noted in the north-eastern corner of the site. Site investigations found small patches of peat at the locations of Turbines 1, 2 & 4 with an average depth of less than 0.5m. The depth of peat and existing ground slope at the locations of Turbines 1, 2 & 4 are plotted on the graph shown below in **Figure 8-14**. The peat risk ranking at all three locations is zero therefore a Peat Stability Risk Assessment is not warranted for this site. Overall, there is no risk of instability of the site, access tracks, turbine bases, or grid connection from peat.

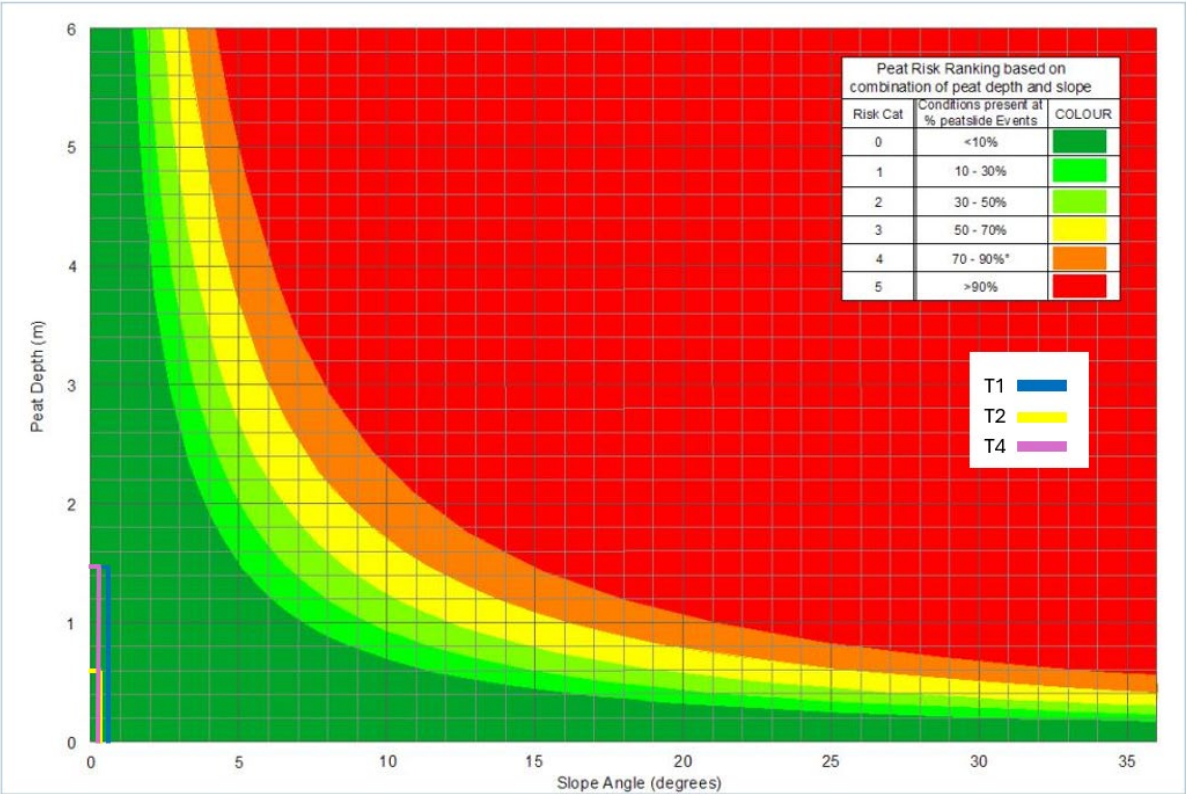


Figure 8-14: Peat Risk Category

The effects of peat depth and slope on the probability of a peat slide, presented in **Figure 8-14**, are calculated from the GSI dataset of recorded peat slides in Ireland. The shapes of the curves adopted for the probability analysis are influenced by the relationship between ground slope and peat depth as calculated using Infinite Slope Stability Analysis.

8.3.10 Borrow Pits

There are no existing borrow pits on site. There are two (2) No. proposed on-site borrow pit locations which have been identified to provide fill material for the various infrastructure requirements such as internal tracks, passing bays, hardstands, foundations, and temporary compounds. Site investigations were conducted to determine the depth below ground level to the rock strata layer. This was found to vary from 0.5 to 1.5m below ground level, refer to Trial Pit Logs (EIAR **Volume III, Appendix 8B**) for further information on the borrow pit site investigations.

The combined areas of the borrow pits is 60,700m². The topsoil and mineral soil above the rock layer will need to be excavated to facilitate the extraction of rock from the borrow pits. This soil will be stored in the adjacent temporary deposition areas. The extraction of rock may be undertaken by a combination of rock breaking and ripping. It is estimated that these will provide 99,852m³ (c. 61%) of aggregate material required for the proposed development. Additional information on the borrow pit dimensions can be found on **Planning Drawing No. 22635-MWP-00-00-DR-C-5073** and **22635-MWP-00-00-DR-C-5074**. Further information on the construction methodology of the borrow pits is located in Construction Environmental Management Plan (EIAR **Volume III, Appendix 2A**).

Post-construction, the borrow pits will be filled with excess soil and stone material generated on the site during construction and thereafter topped with the mineral soil and topsoil stored in the adjacent temporary deposition area . The capacity of the borrow pits is c. 99,852m³ (volume of aggregate removed from borrow pit). The soil and

stones will be deposited, in layers of 0.5m and will not exceed a total thickness of 1.5m. Material will only be deposited on slopes of less than 5 degrees to the horizontal and greater than 10m from the top of a cutting. The exact location of such areas will be confirmed on consultation with the geotechnical engineer. The borrow pit sites will then be revegetated and restored to their current use as pasture.

8.3.11 Deposition Areas

All excavated material will be transported to a deposition area within the wind farm site. Should any material be found to be contaminated, it will be transported offsite to an appropriately licensed facility. Ballinlee Wind Farm has nine (9) no. permanent deposition areas and two (2) no. temporary deposition areas which will act as material storage areas for the management of excess material generated on site during construction. After all suitable material has been reused within the site, the remaining material will be landscaped within the designated deposition areas. These deposition areas are dispersed throughout the proposed development, reducing the need to transport material across the site. The proposed locations for the permanent and temporary deposition areas are shown on **Planning Drawing No. 22635-MWP-00-00DR-C-5006 to 22635-MWP-00-00DR-C-5020** and details are shown on **Planning Drawing No. 22635-MWP-00-00-DR-C-5418**. Details of the deposition areas are described in further detail in this EIAR **Volume II, Chapter 04** Civil Engineering and in this EIAR **Volume III, Appendix 2A**, Construction Environmental Management Plan (CEMP).

8.3.12 Turbine Foundation

It is proposed to construct 17 turbine foundation pads. Each turbine base will bear onto rock or other such suitable bearing stratum and the foundation will be 27m in diameter and generally to a depth of 3.5m below ground level. The excavation works will be carried out using hydraulic excavators. If rock is encountered then it will be removed by a combination of rock breaking and ripping and if necessary, blasting.

If poor ground conditions are encountered during excavation piled foundation may be considered. A piled foundation requires the use of a piling machine equipped with an auger drill to rotary bore a number of holes around the area of the turbine base to the sub-formation depth determined at construction stage. Piling if required, will be limited and localised. Refer to this EIAR **Volume II, Chapter 04** Civil Engineering for further details.

8.3.13 Existing Geotechnical Conditions

Site investigation (SI) works were carried out by Northwest Geotech on the 6th and 9th August 2024. These works were to provide geotechnical and environmental information for input as to the design and construction of the proposed wind farm.

The site operations comprised:

- Twenty-four machine dug trial pits.

Ground types encountered during the SI include:

- Topsoil: encountered typically 200-400mm thickness across the site;
- Recent deposits (peat): encountered in TP01, TP02, TP04 at depth as spongy dark brown amorphous peat in 0.25m-0.80m;
- Glacial Till: sandy gravelly clay, frequently with low to medium cobble and boulder content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth.

The location of the Northwest Geotech trial pits are shown in **Figure 8-15**.

Groundwater was encountered as seepage at depths of 1.40m for TP04 and at a depth of 2.20m for TP16. No groundwater was encountered for BP01, BP04, BP101, BP102, BR01, BR02, SS, TP01, TP02, TP03, TP05, TP06, TP07, TP08, TP09, TP10, TP11, TP12, TP13, TP14, TP15 and TP17. It should be noted that groundwater levels vary due to seasonal and/or other effects and may at times differ to those recorded during the investigation.

Further site investigation works were carried out by MWP during November 2024 and February 2025. A plan for location of trial pits was adjusted during the site visit to target productivity and 9 areas were tested. The predominant materials encountered were sand, silt and clay. Trial pit logs are included in this EIAR **Volume III, Appendix 8B** Trial Pit Logs and detailed in **Table 8-4**.

Table 8-4: Trial Pit Logs Nov 24 & Feb 25

Trial Pit Number	ITM(X)	ITM(Y)	Depth (m)	Description
TPBP10	560552	632992	0.0-0.25 0.25-0.5 0.5-1.4 1.4-2.1 2.1	Topsoil Silt Sand Gravel Boulders
TPBP11	560478	632913	0.0-0.20 0.20-0.6 0.6-1.8 1.8	Topsoil Sand Clay Boulders
TPBP13	560609	632968	0.0-0.30 0.30-0.75 0.75-1.8 1.8-2.5 2.5-2.7 2.7	Topsoil Gravel Sand Sand Sand Boulders
TPBP15	560443	632884	0.0-0.30 0.30-1.0 1.0-2.1 2.1	Topsoil Silt Sand Boulders
TPBP16	560391	632795	0.0-0.30 0.30-0.70 0.70-1.40 1.40-2.40 2.40	Topsoil Clay Clay Sand Boulders
TPBP17	560407	632956	0.0-0.25 0.25-0.70 0.70-2.20 2.20-2.70 2.70	Topsoil Silt Silt Silt Boulders/Termination at depth
TPBP18	560356	633001	0.0-0.20 0.20-1.00 1.00-3.00 3.00	Topsoil Silt Silt Excavator at max reach

Trial Pit Number	ITM(X)	ITM(Y)	Depth (m)	Description
TPBP19	560228	632914	0.0-0.20	Topsoil
			0.20-0.65	Silt
			0.65-1.00	Silt
			1.00	Excavator unable to progress
TPBP20	560216	632969	0.0-0.20	Topsoil
			0.20-0.70	Silt
			0.70-1.90	Clay
			1.90-2.80	Clay
			2.80	Excavator unable to progress

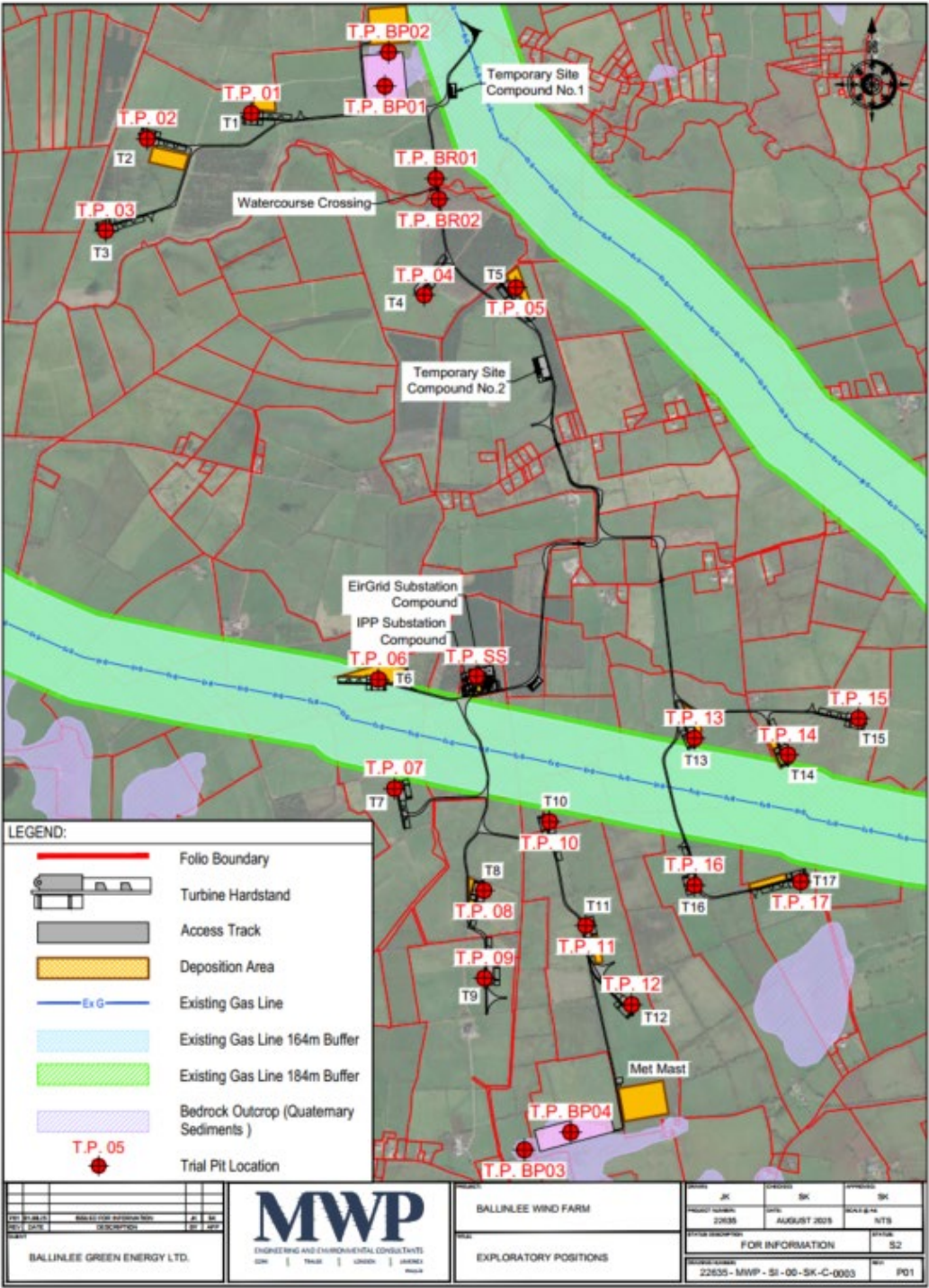


Figure 8-15: Trial Pit Positions

There are 11 mineral boreholes located within 4km of the proposed development (Figure 8-16), description provided in Table 8-5.

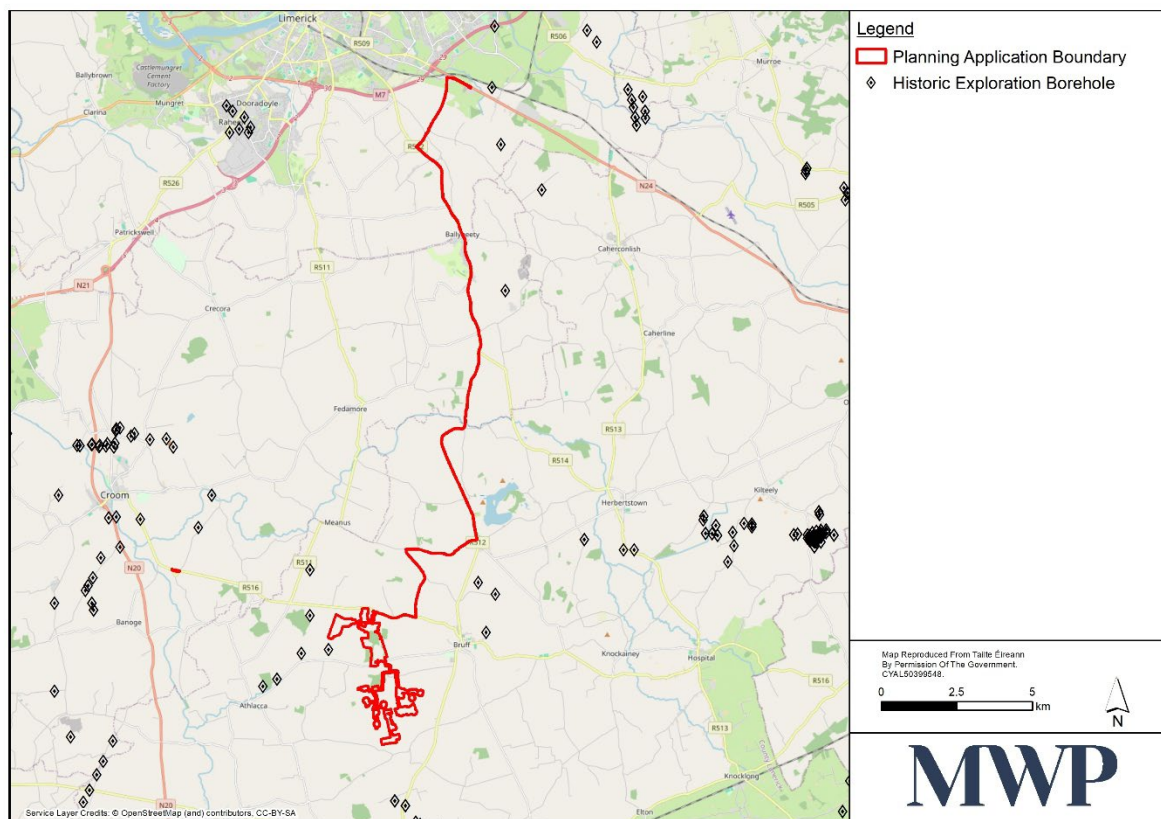


Figure 8-16: Historic Exploration Boreholes drilled between 1957 – 2002 (Source: GSI)

Table 8-5: Description of Historic Exploration Boreholes drilled between 1957 – 2002

Borehole ID	Number of Boreholes	Distance from Site	Overall Description
80-BC/22	3	c. 2.0km	Summary: 0-11' Overburden; 11-52' Bioclastic Limestone; 52'-190.25' Shaly Bioclastic Limestone; 190.25-199' Ballyvergin Shale; 199'-281' Ringmoylan Shales; 281'-406' Hellon House Beds; 406'-426' Old Red Sandstone
80-BC/21	3	c.2.5km	Summary: 0-12.5' Overburden; 12.5-286' Bioclastic Limestone; 286'-386' Shaly Bioclastic Limestone
89-3267/2	1	c.0.5km	Summary: 0-18 Overburden; 18-28 Grey broken up reef transition; 28-64.4 Black gougry limestone/mudstone; 64.4-69.2 Pale Gougry Igneous?; 69.2-71.3 Black Gougry Limestone/Mudstone
79-1488/3	1	c. 1.0km	Summary: 0-47' Overburden; 47-88 Basal Carboniferous; 47-88'
89-3267/1	1	c. 1.6km	Summary: 0-17m overburden; 17-24.5 Reef transition; 24.5-40.3 ABL
76-1488/1	2	c. 2.72km	Summary: 0-15' Overburden; 15-23.5 Laminated Shale; 23.5-60' Calcarenite; 60-69.5' Dark Muddy Calcarenite; 69.5-96' Calcareous Sandstone; 96-135' Green and Maroon Mudstone; 135-257' Sandstone.

8.3.14 Existing Access Tracks and Land Drains

There are existing tracks to access the forestry and agricultural lands. Many of the fields are also bounded by land drains which hold overland flow during rainfall and are dry during much of the year. The relevant 0.5km of existing access tracks will be upgraded as part of the development. This is detailed in **Volume II, Chapter 04** Civil Engineering of this EIAR.

8.3.15 Sensitivity of the Soils and Geology of the site

The sensitivity of the receiving land, soils and geology environment was identified for the proposed development. The sensitivity of an environmental receptor is based on its ability to absorb an impact without perceptible change.

Using the NRA guidelines shown in **Table 8-1**, the land and soils present within the wind farm site, grid connection route and TDR temporary access track have a mixture of both a medium sensitivity and a low sensitivity.

There are no designated Geological National Heritage Areas within the main wind farm site. There are two designated sites along the grid route however these are already impacted by the existing road carriageway. The small amount of peat present on the wind farm site would indicate that the sensitivity rating is low. The site infrastructure is predominantly underlain by poorly drained soils.

The geology along the grid connection route would be classified as having a medium sensitivity as the bedrock may be karstified in some areas which would mean the attribute has a medium quality, significance or value on a local scale.

8.3.16 Geohazards

Geological hazards at a wind farm site can include features like faults, karst areas and presence of specific soil types such as peat. A review of the GSI database indicates no karstic features or faults at the wind farm site. During Northwest Geotech's site investigation a small amount of peat was discovered but indicated no risk as discussed in **Section 8.3.9**.

The grid connection will be installed within the existing road network therefore it is not anticipated that geological hazards will be encountered.

8.4 Assessment of Effects

The development has three main spatial components which are considered in assessment of effects, the main wind farm site, the grid connection from the wind farm to the existing Killonan 220/110kV substation and the Turbine Delivery Route (TDR). These components are described in detail in **Volume II, Chapter 02** Description of the Proposed Development and **Volume II, Chapter 04** Civil Engineering of this EIAR.

The main wind farm development comprises a number of elements including excavation for construction of the 17 turbine foundations and hardstands, construction of three temporary construction compounds, establishment and management of nine permanent deposition areas, two temporary deposition areas, construction of a met mast and construction of a substation. Forestry removal (between conifer plantation, immature woodland and mixed broadleaved/conifer woodland) of approximately 14.4 hectares, 922m of treeline and 1,900m of hedgerow is to be removed. 0.5km of existing tracks will be upgraded, 2.0km of new floating tracks and 8.3km of new excavated tracks will be constructed to access the turbines, substation compound and meteorological mast.

Internal site access tracks are required to interconnect elements of the site and allow access to all wind turbines and wind farm infrastructure.

These access tracks will be constructed using excavated and floating track techniques depending on the ground conditions. See **Planning Drawing No. 22635-MWP-00-00-DR-C-5406** for details. The methods of construction are outlined in **Volume II, Chapter 04** Civil Engineering of this EIAR.

A site drainage system will be implemented along all works areas including internal site access tracks, storage areas, crane hardstands and temporary site construction compound.

The grid connection comprises installation of an underground cabling system within the public road and wind farm access tracks of approximately 27.6km.

The Turbine Delivery Route and associated works comprise the transport of the turbine components along the public road from the Port of Foynes to the main wind farm site.

The relevant works are further discussed in the following sections. This section considers the phases of construction, operation and decommissioning of the proposed developments elements relevant to soil and geology.

8.4.1 Construction Phase

The predicted effects on soils and land from the proposed development are discussed in the following sections. The activities that have the potential to cause damage to the existing geological environment and surrounding receptors, as a result of effects to the geological environment, may also indirectly effect the aquatic environment if appropriate mitigation measures discussed in **Volume II, Chapter 09** Water of this EIAR are not implemented.

The proposed development will involve the removal of soil, subsoil and bedrock for facilitating the construction of elements of the proposed development such as access tracks, hardstand emplacements, turbine foundations, biodiversity enhancement areas, temporary construction compounds and the clear span pre-cast concrete bridge. The aggregates (rock, stone, gravel and sand) used during construction of the access tracks, hardstands and substation will be extracted from the proposed onsite borrow pits (99,852m³) and from imported materials (67,740m³). Large amounts of aggregates (167,592m³), concrete (35,586m³) and steel (2,882 tonnes) will be used during construction. Concrete and additional aggregate materials will be sourced from authorised facilities. The following quarries operate in close proximity to the site:

- Costello Quarry Products;
- Liam Lynch Quarries;
- Bobby O' Connell & Sons Ltd Quarry.

Table 8-6: Summary of Approximate Aggregate and Reinforced Steel Quantities

Item	Unit	Quantity
Total volume of aggregate required (including site won and imported)	m3	167592
Site won aggregate from onsite borrow pit	m3	99852
Total volume of site won aggregate required	m3	99852
Imported stone for turbine bases	m3	16905

Item	Unit	Quantity
Imported stone for turbine hardstand	m3	7548
Imported stone for access tracks	m3	9801
Imported stone for temporary compound	m3	1320
Imported stone for substation area	m3	10362
Imported stone for independent power provider	m3	5313
Imported stone for met mast area	m3	532
Imported stone for internal cable route	m3	1203
Imported stone for external cable route	m3	14755
Total volume of imported aggregate required	m3	67740
Concrete for turbine bases	m3	19097
Concrete for substation	m3	63
Concrete for independent power provider	m3	66
Concrete for met mast	m3	12
Concrete for internal cable route	m3	4922
Concrete for external cable route	m3	11426
Total volume concrete required	m3	35586
Reinforced steel for turbine bases	tonnes	2865
Reinforced steel for substation	tonnes	8
Reinforced steel for independent power provider	tonnes	8
Reinforced steel for met mast	tonnes	1
Total volume of imported steel reinforcement required	tonnes	2882

Estimated volumes of material are presented in **Volume II, Chapter 02** Description of the Proposed Development and **Volume II, Chapter 04, Section 4.12** Civil Engineering of this EIAR.

A total of c. 296,918m³ of soil, subsoil and bedrock will be excavated from the windfarm site to facilitate the construction of elements of the proposed development. This material will be stored in the deposition areas, some will be used for later reinstatement (borrow pits 197,275m³) and landscaping works around the site.

The proposed deposition areas will be subdivided into a series of cells. Silt fencing will be installed around the perimeter of the deposition areas. Each cell will be bunded by an embankment of engineered fill material capable of allowing a tracked excavator to move between cells during deposition activities. The deposited material will be c. 1.5m high and the overall deposition area is c. 43,750m². The material will be deposited in layers of 0.5m. Post construction any remaining material will be finished with topsoil and revegetated.

A total of c. 24,840m³ will be excavated during the external grid route works and this material will be sent to a suitably licensed facility.

Any materials containing invasive species will be appropriately managed and sent to authorised facilities.

The evaluation of the most likely significant effects are described below. The lands within the development boundary, where the permanent works, wind farm and associated infrastructure will be built, will see the majority of the earthworks and excavations, therefore these are the main areas of the assessment's attention.

8.4.1.1 Change of Land Use

Wind Farm

Land use is the term to describe the human activities which take place within a given area of space. All new development proposals have the potential to affect the character of a local area and human environment by introducing a new incompatible land use activity which could result in physical disruption, severance or exclusion of the user's ability to continue existing activities, or the sterilisation of lands that adversely affect future land use potential.

The majority of the site consists of agricultural pastures. During the construction phase of the works, material will be excavated, moved, altered, or compacted and will influence the existing land use requirements. These construction works will be carried out in a phased basis outlined in **Volume II, Chapter 02**, Description of the Proposed Development, **Table 2-6** of this EIAR. In this respect, land use associated with the required development footprint will change over the course of the construction phase from existing pastoral activities to a functioning wind farm. The surrounding lands not required as part of the development footprint will remain in agricultural use.

The permanent land use within the planning application boundary is provided in **Table 8-7**. Permanent land use change will affect 4.5% of the total lands within the planning application boundary area.

Table 8-7: Permanent Land Use Requirements Development Site

Item	Description	Unit	Quantity
Wind Turbine Construction	Wind turbine hardstand area for vehicle during construction and operational phase 1,797m ²	m ²	30549
Access Tracks	Existing, new and upgraded access tracks both founded and floated required for construction and operational phases. 10.8km x 5.5m	m ²	59400
Substation	Substation compound including fences, grid connection access tracks & attenuation for operational phase	m ²	9350
IPP	Independent Power Provider compound + maintenance compound including attenuation for operational phase	m ²	3500
Met Mast	Permanent met mast + vehicle hardstand for operational phase	m ²	806
Material Deposition Areas	9 No. permanent deposition areas throughout site	m ²	43627
Sediment Settlement Ponds	Permanent sediment settlement ponds used for the operational phase throughout the site	m ²	2400

Item	Description	Unit	Quantity
	each pond is 24m ² and is sized to treat an area of 2400m ²		

The proposed works require the construction of turbine bases, hardstands, permanent met mast, substation, internal tracks, cable trenches, and grid connection. With the removal of soil and subsoil from the construction areas, there will be slight alteration to the site topography, but on a wider scale these changes to the land and landscape will be imperceptible. All the excavations will be reinstated to ground level/existing level.

Grid Route

Land along the grid route is existing public road and there are only very small, proposed changes to land, and imperceptible changes to topography. Along the grid connection route all excavations will be short term, usually reinstated on the same day to existing ground/road level. The land use adjacent to the grid connection route comprises mainly of agricultural land and facilities, and residential dwellings. In terms of effects to neighbouring lands and land uses, it is considered that the grid connection will not pose a risk to either existing or future land uses.

Turbine Delivery Route

Along the turbine delivery route, some locations will require verges to be filled with granular material to harden the surface for transport vehicles. Also, at reference point 15, a route is required through a private field which will require construction of a temporary track which is 250m in length. At reference point 18 (the site entrance), the existing access track will need to be widened for delivery of turbine components. Refer to **Planning Drawing No. 22635-MWP-00-00DR-C-5071, 22635-MWP-00-00DR-C-5072 and 22635-MWP-00-00DR-C-5008.**

Due to the scale and nature of the works and low sensitivity of the receiving environment, it is considered that the turbine delivery route will not pose a risk to either existing or future land uses. Further information can be found in Turbine Delivery Route Report (EIAR **Volume III, Appendix 2C**).

Summary

It is considered that without the implementation of mitigation measures, the alteration of land use has the potential to alter the character of the land and soils (including geological) environment. Without mitigation, the alteration of land use within the wind farm site, will have an ***adverse, short-term, direct, localised, moderate, likely effect*** on land use and the grid connection and TDR will have an ***adverse, localised, brief, direct, minor and likely and not significant effect***. With consideration of the low to medium sensitivity of the receiving environment, the overall impact is deemed ***not significant to slight***. Similarly, during decommissioning, temporary disruptions to land uses and access are likely. Mitigation measures are outlined in **Section 8.5**.

8.4.1.2 Effects on Soil and Geology

8.4.1.2.1 Soil Erosion

Soil erosion is the process whereby agents, such as wind and water, gradually detach, remove, and transport soil particles, causing a breakdown in the soil resource. Soil erosion from wind, water and ice can occur when:

- Topsoil is removed, exposing the soil and subsoil;
- Soil levels from cut and fill practices are altered due to excavation and compaction;

- Soil deposition areas are exposed, prior to revegetation;
- Open excavations are left exposed for a period of time;
- Stockpiled and exposed soil is not maintained or stored incorrectly;
- Activities from earthworks leave soils exposed;
- Mismanagement of material transport, material alterations and storage occurs;
- Other construction activities such as vehicular movement and heavy machinery with large tyre threads remove topsoil and soils from excavations; and
- Heavy rainfall and strong winds in dry conditions can cause soil to mobilise.

Main Wind Farm Site

During the construction phase, volumes of soil, subsoil and bedrock will be excavated, moved, altered and/or removed from certain areas of the site in order to facilitate the construction of the proposed development. Topsoil and subsoil will be reused for landscaping. Excavated soil, subsoil and bedrock will be required for site levelling, construction of the wind farm site infrastructure, i.e., gravity foundations for turbine bases, crane hardstands, met masts, substation, internal cable network, tracks and drainage accommodation works. This will result in the permanent removal of material at excavation locations. Stone required for the construction of new access tracks, construction compound and drainage will be imported from local quarries, where feasible.

The total volume of excavated material for the proposed development is approximately 321,758m³.

Table 8-8: Excavated Material

Item	Unit	Quantity
Excavation for turbine bases	m ³	62435
Excavation for turbine hardstand	m ³	26277
Excavation for access tracks	m ³	27390
Excavation for temporary compound	m ³	6000
Excavation for substation	m ³	5610
Excavation for Independent Power Provider	m ³	2100
Excavation for met mast	m ³	484
Excavation for internal cable route	m ³	12141
Excavation for external cable route	m ³	24840
Excavation of rock to be re-used or stored on-site (Borrow Pit)	m ³	99851
Excavation of soil/subsoil to be re-used or stored on-site (Borrow Pit)	m ³	54630

All material volume estimates can be found in **Table 4-1** in **Volume II, Chapter 04** Civil Engineering of this EIAR.

Grid Connection

Excavation of soils, subsoils and bedrock will also be required along the grid route. These works will result in temporary and brief disturbance to sections of the public road surface, subsoil, and bedrock. The majority of subsoil excavated along the grid cable connection will be reinstated following these works. The active construction area for the grid connection will be small, ranging from 100 to 200 meters in length at any one time, and it will be transient in nature as it moves along the route.

Excavation, material management, and vehicular movement activities will be managed during construction as detailed in the CEMP (EIAR **Volume III, Appendix 2A**).

Turbine Delivery Route

The majority of the turbine delivery route will not require excavation. Addition of granular material to soft verges is not likely to contribute to soil erosion. Limited soil removal may be required for the construction of the short temporary private track. The track will be constructed as a floated or founded design and reinstated after the turbine delivery.

8.4.1.2.2 *Compaction/Loading*

Wind Farm

Soil compaction describes the reduction of pore space within the soil structure. This also causes the soil to have less total pore volume, an increase in bulk density, reduced rate of water infiltration and drainage, expulsion of air within the soil, and change in soil strength.

Soil compaction may occur due to movement of overland traffic, such as construction and maintenance vehicles. Regular movement of heavy vehicles and plant on off-alignment sections, and greenfield areas would result in an increased risk to soil and subsoil integrity during the construction phase of the proposed development, without implementation of mitigation measures discussed in further sections. Without mitigation, other effects such as a temporary increase in surface water runoff, and subsequently an increase in erosion may result.

The project CEMP (EIAR **Volume III, Appendix 2A**) includes site management controls to mitigate for compaction.

A Traffic Management Plan (TMP) has been developed for the construction phase (refer **Volume III, Appendix 16A** of this EIAR). This is to manage and control vehicular movement onsite. Measures will include the scheduling of HGVs during the construction phase to reduce the number of vehicles moving in, through and off site. This in turn will reduce the impact of soil compaction and erosion. Unscheduled vehicles will not have access to the site. Machinery will not operate directly on excavated/stockpiled soils. Heavy vehicles will only follow designated and newly constructed access tracks and avoid loading areas which are not contained within the footprint of the main works to minimise disturbance of the original soil and subsoil formations and to retain soil structure. This implies that machinery will be kept on tracks and aside from advancing excavations, will not move onto areas that are not permitted for the development. Buffers will also be created between tracks and monuments to prevent threat of disturbance.

The compound, vehicles, stockpiled materials and heavy machinery will be in place for the duration of the construction phase and will be removed once commissioning is complete.

Within excavations and around excavations, pore water pressure will be kept low by avoiding loading the soil/subsoil and giving careful attention to the existing drainage, as compaction would alter the surface drainage regime (see **Volume II, Chapter 09** Water of this EIAR).

Grid Route

The majority of subsoil excavated along the grid cable connection route along the public roads will be reinstated to existing ground/road level following these works. The active construction area for the grid connection will be small, ranging from 100 to 200 meters in length at any one time, and it will be transient in nature as it moves along the route.

Turbine Delivery Route

Some compaction of soils may occur along the TDR where hardening of soft verges is required and the temporary access track adjacent to Tullovin Bridge is to be installed. The surface area where this will occur is very localised.

8.4.1.2.3 Slope Stability

Wind Farm

A slope failure involves a mass movement of earth material under shear stress along one or several surfaces. The movement may be rotational or planar. A slip is defined as a small movement of soil, debris, earth, or rock down a slope. It can take the form as a minor landslide, a land slip, a soil slip, or soil creep. These can affect the land and soils environment during the construction phase of the proposed development, particularly in excavations, material movement, earthworks, and storage of material on site. This can cause several direct effects including erosion, contamination, sedimentation, instability of the land, and waste generation, as well as indirectly effecting other environments including water, biodiversity, material assets and landscape & visual.

Slippage can occur as a result of an increase in overburden load on slopes, earthworks that affect slope angles and embankments, unstable embankments, unstable excavations, cut-and-fill techniques from excavations, uncovered stockpiled materials, or unforeseen ground conditions not identified during geotechnical investigations. These can be exacerbated by adverse weather conditions from heavy rain, wind, and ice. Slips are more likely to occur on slopes >25° but have been known to occur on much gentler slopes.

Slips on the proposed development are considered low risk due to the gently sloping topography. However, excavation and earthworks will affect this. Deposition areas and borrow pits have potential for slippage if mitigation measures are not put in place. Similarly, stockpiled material is at risk of slipping if no mitigation measures are put in place. Where larger deposition areas are proposed, the construction stage of the wind farm will utilise a mix of open (swales/clear span culverts) and closed conduits (culverts/pipes) as part of the surface water network. Wind farm open surface water features are designed in accordance with *CIRIA - C753 The SuDS Manual 2015* and *Limerick City and County Council - Surface Water/SuDS Specification 2022*. The closed surface water network varies from plastic (uPVC, HDPE) and concrete (RCRRJ) pipes to box/arch culverts. The open surface water network consists of clean conveyance/attenuation and cut-off swales. Disruption to the existing natural surface water network (drains, minor watercourses) will be mitigated by the construction of swales. Swales carrying construction site runoff will be diverted into sediment settlement ponds that reduce flow velocities, allowing sedimentation which reduces the sediment loading. The swales are conveyance/attenuation swales and therefore serve a dual purpose, not only directing dirty water to the sediment settlement ponds but also provide attenuation storage for the surface water runoff. Refer to **Planning Drawing No. 22635-MWP-00-00-DR-C-5052** to **22635-MWP-00-00-DR-C-5066** for further information on the layout of the wind farm surface water network.

A desktop study of the site was undertaken, which included a review of LiDAR and OSi contour data and identification of water features on the site, all of which can have an impact on slope stability. During site visits, no areas were identified as prone to stability risk.

Grid Route and Turbine Delivery Route

Excavation along the grid route will occur in lengths 100-200m in made ground. Works along the grid route and TDR will not result impacts from slope stability.

Summary

The receptors at the main wind farm development site (soil, subsoils and bedrock) would be classed as low sensitivity due to the low amount of peat on-site and limited economic mineral resource. Soil erosion, compaction and slope stability represent **adverse, moderate, localised, minor, direct, likely and short-term effects** on the land and soils environment, without the implementation of appropriate mitigation measures, which are included in **Section 8.5.1**. With consideration of the sensitivity of the receiving environment and the degree of the effect, the overall significance of the impact in the absence of mitigation is deemed *slight*.

The soil, subsoil and bedrock along the grid route and TDR would be classed as medium sensitivity receptors. The degree of the effect (*adverse, localised, brief, direct, likely, minor to temporary and localised*) combined with the sensitivity of the receiving environment indicate the overall significance of the impact to be *not significant*.

8.4.1.3 Accidental Spills & Contamination/Pollution

Soil sedimentation and silt sedimentation can occur due to the land disturbance that occurs during the construction phase. Sedimentation may lead to the erosion of the soil, transportation of contaminants throughout the land and soil and compaction of the soil, reducing porosity and affecting water infiltration in the soil. Wastewater from construction processes or leakage from poor welfare facilities can alter the nutrient and microbial balance of the land and soils environment. Contaminated runoff arising from soil erosion on construction sites can pose a significant risk to the geological and hydrogeological environments, if allowed to percolate into the soil matrix. Sedimentation can also affect safety on the site from build-up, flooding from drain blockages, and maintenance issues from soil erosion. Soil loss due to erosion can result if areas are left exposed.

A robust Surface Water Management Plan (SWMP) is included in this EIAR, **Volume III, Appendix 2E** which reduces any risk of sediment release to surface waters.

Contamination, or pollution, is the presence of human-made chemicals entering and altering the natural environment. It can occur as a result of waste-related activities, historical activities, leakages and accidental spillages of chemicals. Contamination can lead to the degradation and the physio-chemical alteration of the land, ground and surface water and soils environment as well as cause indirect effects to the biodiversity, human health and material asset environments.

Construction materials, including any hazardous substances such as fuel and oil, have the potential to affect the soil and geological environment should a spill occur. The accumulation of spills from fuels and lubricants during routine plant use can also be a pollution risk. The construction plant and machinery will be run on hydrocarbon fuel and oil and activities relating to hydrocarbons (storage, bunding, refuelling) will be managed during the works. Any effect from a hydrocarbon spill to soil may also indirectly effect the hydrological/hydrogeological environment.

Cement / concrete will be transported to and used across the site. Without proper management, cement spills and other construction materials pose a threat to the land and soils environment (soil matrix) and may indirectly impact on the hydrological environment and groundwater environment, as pH would likely be altered.

The effect of hydrocarbon spills on lands within the windfarm site, grid connection route and turbine delivery route were assessed and rated. Without appropriate mitigation measures, contamination from accidental spills of hydrocarbons, cement or contaminated waters represents an **adverse, localised, temporary, direct, likely, moderate and potential cumulative effect** to the geological and hydrogeological environment. The degree of the

effect combined with the sensitivity of the receiving environment indicate the overall significance of the impact to be *moderate*.

Mitigation measures to limit this can be found in **Section 8.5.1**.

8.4.1.4 Effects from Rock Blasting

Mechanical excavation will be primarily employed at the turbine locations, hardstands and borrow pits. In the unlikely event that rock unsuitable for ripping is discovered, blasting may be necessary. Blasting will not be carried out at the borrow pits. If blasting is required at turbine locations, it will result in some level of ground vibration and air overpressure. The intensity of vibration will depend on a number of factors including rock type and structure, weight/timing of explosive and distance from blast site.

It should be noted that while blasting has a higher intermittent noise level than rock breaking, it decreases the amount of breaking/ripping required with a subsequent reduction in time to extract material and the associated overall noise levels. Blasting will be carried out by a suitably qualified specialist under licence with a suite of standard best practice mitigation measures in place. Blasting, and mitigation measures associated with the process, are discussed in further detail in **Section 8.5** as well as in **Volume II, Chapter 13** Noise and Vibration of this EIAR and in **Volume III, Appendix 2A** Construction Environmental Management Plan.

Blasting mitigation measures, included within the CEMP (EIAR **Volume III, Appendix 2A**), will ensure compliance with the Explosives Acts 1875 and 2006 and BS 7385 in relation to blasting. Limerick City and County Council, An Garda Síochána, and adjoining landowners will be notified in advance of any blasting activities on the site. Additionally, the NPWS and any other required stakeholders will be consulted as part of the general engagement process and blasting permitting process in order to keep them informed of any blasting proposals for the site.

The lands within the windfarm site, grid connection route and turbine delivery route were assessed and rated. Due to the small scale of the facilities to be developed, the duration and design mitigation measures incorporated into the design, the magnitude of these potential impacts, prior to mitigation, is considered to be low for the wind farm site on land, soils and geology. As the magnitude for the wind farm site is considered to be low and the sensitivity of the land and soils in the proposed development site is low to medium, the resulting significance rating of blasting is considered *slight* without the implementation of the proposed mitigation measures.

The impact on land and soils and geology from rock blasting at turbine foundations, during the construction phase is assessed as **adverse, localised, brief and occasional, direct, likely, minor, low, and slight effect**.

Mitigation measures to limit this can be found in **Section 8.5.1**.

8.4.1.5 Effects from Piling

If poor ground conditions are encountered during excavation at the turbine locations and a significant depth to sub-formation is required, a piled foundation may be considered. Piling, if required is only considered at the turbine foundations within the wind farm site. The magnitude of potential effects associated with using piled foundations for the turbines is minor. Piling, if required on this proposed project site, will be limited and will not produce significant volumes of material. Any material arising from piling will be removed for recovery to the on-site deposition areas.

The lands within the windfarm site were assessed and rated.

The impact on land and soils and geology from using piled foundations throughout the wind farm site, during the construction phase is assessed as **adverse, localised, temporary, direct, likely, moderate, low, slight effect**.

Mitigation measures to limit this can be found in **Section 8.5.1.5**.

8.4.1.6 Effects from Tree Felling

Felling of approximately 1,900m hedgerows, 922m of treelines and 14.4hectares of overall forestry removal is required within and around wind farm infrastructure to accommodate the construction of the turbine foundations and associated hardstands, access tracks, turbine assembly and deposition areas. Forestry and trees in a radius of between 73.9m to 97.1m around each turbine will be felled as part of the project. Sections of conifer forestry that are proposed to be felled for this purpose are highlighted in **Figure 8-17**. Additional tree line and hedge removal will be needed in some areas for the new access tracks and construction areas.

The following two areas of conifer plantation felling will be required:

1. For Turbines 4 and 5 and their associated hardstands and access tracks and deposition areas are indicated in **Volume II, Chapter 02**, Description of the Proposed Development, **Figure 2-20** of this EIAR.
2. For the proposed substation, construction compound 1 and the access track from the site entrance to the substation and beyond to T6 indicated in **Volume II, Chapter 02**, Description of the Proposed Development, **Figure 2-21** of this EIAR.

Forestry felling including conifer plantation, immature woodland and mixed broadleaved/conifer woodland of approximately 14.4ha will be undertaken in accordance with a tree felling licence, using good working practices as outlined by the Department of Agriculture, Food, and the Marine (DAFM) Standards for Felling and Reforestation (2019) and will follow the specifications set out in Forest Service's 'Forestry and Water Quality Guidelines' (2000) and 'Forest Harvesting and Environmental Guidelines' (2000).

Any felling to facilitate the turbine construction and operation will be undertaken by a suitably experienced and qualified felling company subject to a Felling Licence Application. Felling will be carried out within the safeguards set out in the Forestry Service Guidelines, which set out guidelines and regulations for forestry operations, including different aspects such as felling, reforestation and environmental protection, albeit forestry felled for wind energy projects is excluded from FSC certification if carried out during the construction phase.

The main effects to soils arising from tree felling are related to (see **8.4.1.2 Effects on Soil and Geology**) landscaping, soil excavation, and root and stump harvesting, which can cause extensive soil disturbance and expose underlying overburden. This in turn may influence soil stability and contribute to soil sedimentation, soil erosion and surface water runoff. A large volume of soil can remain attached to roots when stumps are extracted from the ground. The use of heavy machinery can also induce soil loading and compression of soft deposits which may influence surface water runoff and soil erosion rates.

The effects of tree felling on lands and soils within the windfarm site, grid connection route and turbine delivery route were assessed and rated. Due to the scale of the facilities to be developed, the duration and design mitigation measures incorporated into the design, the magnitude of these potential felling impacts on land, soils and geology, prior to mitigation, is considered to be *minor* for the wind farm site. The magnitude on land and soils from the scale of the tree felling is considered to be minor and the sensitivity of the land and soils in the proposed project site is low, this results in the significance of the effects of tree felling being considered *slight* without the implementation of the proposed mitigation measures.

The impact on land and soils and geology from tree felling throughout the wind farm site, during the construction phase is assessed as **adverse, localised, temporary, direct, likely, negligible, low, not significant effect**.

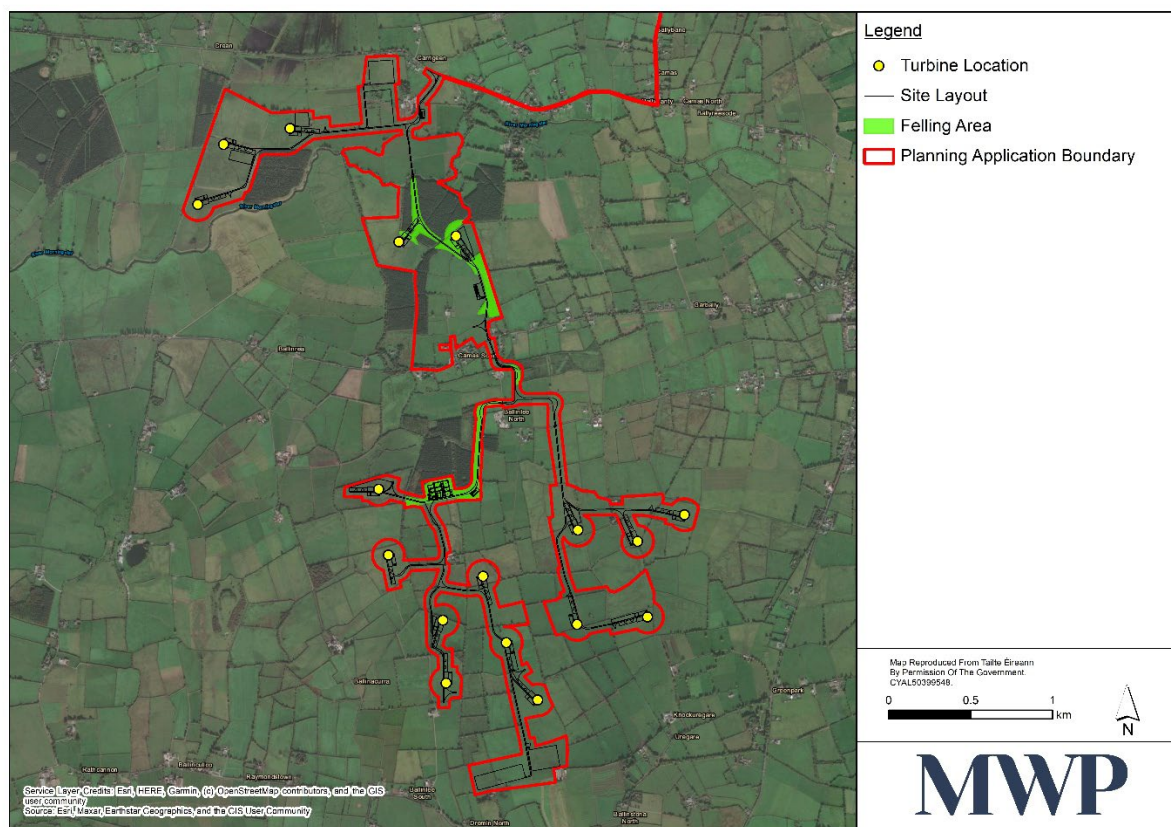


Figure 8-17: Area where tree felling to occur

8.4.2 Operational Phase

8.4.2.1 Change of Land Use

All potential effects to land and land use will occur during the construction phase of the proposed development. No additional effects to land and land use will occur during the operational phase, as no further works are proposed.

Once the wind farm is operational, existing agricultural activities will recommence following construction. Conventional felling and forestry activities will resume and continue to take place at the site independent of the wind farm development. Approximately 14.4ha of forestry will be permanently displaced in the footprint of the wind farm site during the construction phase.

The lands within the windfarm site, grid connection route and turbine delivery route were assessed and rated. Due to the scale of the facilities to be developed, the duration and design mitigation measures incorporated into the design, the magnitude of these potential impacts on land use change, prior to mitigation, is considered to be *negligible* for the wind farm site and turbine delivery route without the implementation of the proposed mitigation measures. As the magnitude is considered to be *negligible* and the sensitivity of the land and soils in the wind farm site and turbine delivery route is *low* this leads to the significance of change of land use during the operational phase to be determined as *not significant*.

The impact on land and soils and geology from change of land use throughout the wind farm site, during the operational phase is assessed as **adverse, localised, long term, direct, likely, negligible and a not significant effect**.

Mitigation measures have been applied to the design to minimise the land use footprint and land use change associated with the proposed development. Only observation and monitoring measures such as ongoing management of drainage swales, cross checking stability of borrow pits and deposition areas, management of in drain filtration are required during maintenance. As such, no mitigations are considered necessary for the effects on land use during the operational phase of the proposed development.

8.4.2.2 Effects on Soil and Geology

There will be no excavations during the operational phase, however some erosion of soil will continue early into the operation phase until the vegetation becomes established and erosion potential reduces to pre-construction levels. Post construction, landscaping and revegetation of excavated areas, the deposition areas, and areas over the hardstand footprint will recover soil structure and function. All vehicular movement during operation and maintenance will be restricted to the areas of hardstanding and existing/newly constructed access tracks. Wheel wash facilities will be available to prevent soil and water contamination. The effect on the hydrogeology will remain, although to a far lesser extent, due to the risks associated with sedimentation and contamination of the aquifers as a result of erosion and runoff (see **Volume II, Chapter 09** Water of this EIAR). However, as disturbed areas are revegetated and construction traffic is stopped, these effects will also be reduced to minimal levels.

Traffic levels will be very low during the operational phase in comparison to the construction phase. Maintenance works on turbines will be carried out from the existing access tracks and hardstands. All vehicular movement during operation and maintenance will be restricted to the areas of hardstanding and existing/newly constructed access tracks.

Due to the nature and scale of the project activities during the operational phase, the magnitude of the potential effects on soils and geology, prior to mitigation, is considered to be *minor* for the wind farm site, grid connection route and turbine delivery route, without the implementation of the proposed mitigation measures. As the sensitivity of the land and soils in the proposed wind farm site is low, the significance of effects on soils and geology during the operational phase are determined to be not significant.

The impact on land and soils and geology within the wind farm site, during the operational phase is assessed as **adverse, localised, temporary, direct, likely, minor, low, and not significant effect**.

Mitigation measures to limit this can be found in **Section 8.5.2**.

8.4.2.3 Accidental Spills and Contamination/Pollution

There is some potential for accidental spillages from plant and machinery operating at the proposed development site to occur, with the effect depending on the nature of the emission. Some construction vehicles or plant may be necessary for the maintenance of turbines which could result in minor accidental leaks or spills of fuel/oil.

The transformer in the substation and transformers in each turbine are oil cooled. There is potential for spills / leaks of oils from this equipment resulting in contamination of soils and groundwater.

The lands within the windfarm site, grid connection route and turbine delivery route were assessed and rated. Due to the scale/volume of the activities and potentially contaminating substances on site, and the design mitigation measures incorporated into the project, the magnitude of these potential effects, prior to mitigation, is considered to be *moderate* for the proposed project site, without the implementation of the proposed mitigation measures. As the magnitude is considered to be *moderate* and the sensitivity of the land and soils in the proposed project site is *high* this would lead to the significance of accidental spills and contamination/pollution during the operational phase to be determined as *moderate*.

The impact on land and soils and geology from accidental spills and contamination throughout the wind farm site, during the operational phase is assessed as **adverse, localised, short-term, direct, unlikely, high, and slight**.

Mitigation measures to limit this can be found in **Section 8.5.2**.

8.4.3 Decommissioning Phase

The potential effects (to soils, subsoils and bedrock excavation, potential contamination by leaks and spills, erosion of exposed subsoils) associated with the decommissioning of the proposed development will be significantly reduced in magnitude relative to the construction phase due to the absence of any excavation works.

Turbine components will be removed at the decommissioning stage, however it is envisaged that access tracks will remain in place. Hardstanding and foundation areas will be reinstated to match the surrounding landscape. The turbine bases will be rehabilitated by covering with local topsoil in order to regenerate vegetation which will reduce runoff and sedimentation effects.

Some of the effects will be avoided by leaving elements of the proposed development in place where appropriate. It is likely that turbine components where possible will be reused as they have a life well in excess of the wind farm proposal i.e., greater than 35 years. The current view is that the disturbance associated with the removal of the elements (hard core and sediment) would be more deleterious than leaving them in place. Underground cables will likely be cut back and left underground as removal may do more harm than leaving them in situ.

As such, the decommissioning phase of the project will require minimal earthworks and have minimal adverse effects of soils and geology. A return to the original land use practices will recommence. It is considered that without the implementation of mitigation measures, the effect of the development on land and soils at the decommissioning phase would have an effect which causes noticeable changes in the character of the environment without affecting its sensitivities. This represents a **positive, localised, long-term, direct, likely, long-term and not significant effect**.

The grid cable will remain a permanent part of the national grid and therefore decommissioning is not foreseen. In the event of decommissioning, it will involve removing the cable from the ducting but leaving the ducting and associated supporting structure in place. It is also likely the substation will remain in place and will previously have been taken in charge by the system operator, after the wind farm is connected to the national electricity grid.

Effects resulting from decommissioning activities (increased traffic onsite and removal of wind farm infrastructure) on the land and soils include:

- Minimal Earthworks to cover foundations and hardstands
- Revegetation Impacts

The magnitude of the effect of these minor earth works during the decommissioning phase is **negligible**. It is envisaged that access tracks will remain in place. Hardstanding and foundation areas will be reinstated to match the surrounding landscape which will require minor earthworks. The turbine bases will be rehabilitated by covering with local topsoil in order to regenerate vegetation which will reduce run off and sedimentation effects. Therefore, no significant effect will occur.

Hydrocarbon spills could arise from vehicles and machinery used to remove turbine components. This will however be temporary in nature and no significant effect will result.

A return to the original land use practices will recommence. The lands within the windfarm site, grid connection route and turbine delivery route were assessed and rated. A **slight** effect will occur on the proposed project site during the decommissioning phase without the implementation of the proposed mitigation measures. Due to the

scale of the facilities to be developed, the duration and design mitigation measures incorporated into the design the magnitude of these potential impacts, prior to mitigation, is considered to be *negligible* for the proposed project site. As the magnitude is considered to be *negligible* this would indicate the sensitivity of the land and soils in the proposed project site is low leading to the significance during the decommissioning phase to be determined as *slight*.

The impact on land and soils and geology from change of land use throughout the wind farm site, during the decommissioning phase is assessed as **positive, localised, long term, direct, likely, negligible, low and not significant effect**.

8.4.4 Do-Nothing

Under the do-nothing scenario, no development would take place on this site, the land and soils environment would remain unchanged, with the exception of future agricultural/forestry change. If the proposed development was not undertaken, there would be no direct or indirect significant effects on land, soils, or geology.

8.4.5 Cumulative Effects

Consideration has been given to the cumulative effects resulting from interactions with other surrounding developments and activities. Whilst soils, geology and land use have a largely static nature (with the exception of places where gravity has a role (on slopes) projects in the nearby area with similar large scale excavation or requirements for large quantities of imported materials such as stone, aggregates can contribute to cumulative effects. These effects may be increased by external causes, which could be organic or man-made (wind, water, ice, etc.).

Evaluation of the cumulative effects must also assess the potential linkage/pathways with nearby proposed/permitted/operational developments relative to their shared receptors.

Publicly available information on existing developments and land uses, and/or approved developments (collated from planning applications and relevant development plans) were considered for each of the environmental topics included in this EIAR, to identify whether there was any potential for cumulative/in combination effects with the proposed development. The key criteria for this scoping exercise included consideration of the types of potential impacts associated with the proposed development, common resources affected, receptors impacted, project timeframes (where available) and scale of development.

The list of projects considered in the cumulative assessment are identified in **Volume II, Chapter 01**, Introduction of this EIAR.

Projects of a nature and scale that were considered were permitted, applied for and reasonably foreseeable wind energy developments and grid infrastructure developments. Due to the site specific nature of the proposed construction works, there is no potential for significant cumulative effects in-combination with any other local developments on the land, soils and geology environment. As soil or sediment has the potential to enter watercourses within the site and aquifers beneath the site, the cumulative effect with the adjacent developments is also to be considered. The potential hydrological pathways are assessed in **Volume II, Chapter 09** Water of this EIAR.

The construction of the grid connection route will only require relatively localised excavation works within the existing roads, will be short duration, and will be linear and transient in nature and therefore, will not contribute to any significant cumulative effects on land, soils and geology.

Given the highly modified nature of the proposed development site and surrounding area, the potential for cumulative effects on the land and soils environment arising from the proposed development and developments on adjacent sites is considered to have an *adverse, not-significant, long-term effect*.

8.4.6 Risk of Major Accidents and Disasters

This section presents an assessment of the vulnerability of the proposed development in relation to major accidents and disasters. It assesses the likelihood of the proposed development to cause an increased risk of major accidents and disasters.

Major accidents can relate to any incident, technological or otherwise, which has the potential to have a significant impact on the turbines, substation, cable route or on the receiving environment. Examples of major accidents which have such potential are fire, explosion, traffic collisions, contamination and pollution.

A natural disaster is an all-encompassing term which describes any severe natural event which has the potential to cause disturbance to an individual, development or population. The severity depends on the receptor and the type of disaster. Examples of natural disasters are earthquakes, flooding, tsunamis, lightning strikes, hurricanes or any other extreme natural event.

A scoping exercise was carried out to determine whether a detailed Peat Landslide Hazard and Risk Assessment is required for this site. The exercise determined that no further assessment was required.

This section has also considered the potential increased risk of such events occurring as a result of climate change, such as sea-level rise and increased frequency in the occurrence of extreme weather events. The most relevant risk related to land, soils and geology is erosion, particularly of deposition areas, related to heavy rainfall and flooding events.

A detailed Flood Risk Assessment (FRA) (EIAR, **Volume III, Appendix 9D**) was carried out to identify the extent of the risk relating to fluvial flooding from the Morningstar River and its tributaries. A hydraulic model was created to predict flood extents and levels at the site. The turbines and infrastructure identified as having a high to medium probability of flooding were identified. Mitigation measures were recommended in order to offset the impact on flooding elsewhere and reduce the level of risk to the development. These include:

- The design flood level for the proposed substation is the 0.1% AEP MRFS flood level plus 500mm freeboard.
- The design flood level for the proposed 17 no. turbines is the 1% AEP MRFS flood level plus 300mm freeboard.
- Conveyance measures to be provided at various locations along the proposed access roads and the minimum conveyance capacity requirements are outlined in Section 4.4.7 of Flood Risk Assessment (FRA) (EIAR, **Volume III, Appendix 9D**).
- The proposed access tracks will only be raised to the maximum heights above existing ground levels, outlined in Section 4.4.7 of Flood Risk Assessment (FRA) (EIAR, **Volume III, Appendix 9D**), to allow floodplain flow to pass over the access track for more extreme exceedance flood events.

Based on the type, extent and level of risk presented to the development and the mitigation by design proposed, it is considered that there is low risk for the proposed development to cause a major accident or disaster. Furthermore, there is no increased risk to the development from a major accident or disaster.

8.5 Mitigation Measures

Appropriate mitigation measures to avoid or significantly reduce any potential effects of the proposed development are outlined in this section.

The primary mitigation measure employed has been the design of the proposed development in terms of locating the turbines, access tracks, and other proposed infrastructure in order to avoid and minimize the effects on land and soils. Mitigation measures for the land and soils environment during the construction, operational, and decommissioning phases of the proposed development are outlined in the following sections below.

8.5.1 Construction Phase

8.5.1.1 Mitigation Measures for Land Use

To reduce the potential effect of changing the land use associated with the footprint of the proposed development, the footprint of the works has been minimised to avoid unnecessary soil sealing, disruption, etc. A minimal volume of soil and subsoil will be removed to allow for infrastructural work to take place in comparison to the total volume present on the site due to optimisation of the layout by mitigation by design.

The proposed development will involve excavation of 321,758m³ of material. Large amounts of aggregates (167,592 m³), concrete (35,586m³), and steel (2,882t) will be used during construction. Refer to **Table 8-6**. Turbine locations, the alignment and rotation of the hardstands, and the routes of proposed new access tracks were designed to optimise the balance between access criteria and the required volumes of excavated and imported materials. The turbine foundation will be backfilled with a cohesive material, where possible using the material arising during the excavation, and landscaped using the vegetated soil set aside during the excavation.

The land associated with the footprint of the development will be reinstated at the end of the operational life of the proposed development such that it can be used again for pastoral purposes. The land outside the proposed development will not be affected by the development, and current land use practices will remain in place on these lands over the lifetime of the development. The area of land required to construct, operate, maintain and ultimately decommission the proposed development has been kept to the minimum reasonably practicable area as part of the design process. Existing access tracks have been utilised in the design as much as possible such that the existing land use does not change in these areas of the site during the operational life of the proposed development. This approach minimises the area temporarily altered from its current land use.

These measures are designed to reduce the effect of land use change by sequestering carbon, reducing waste (soil, subsoil, and rock materials), target limitations and controls on soil sealing, and not changing the use of the original lands where practicable.

The proposed grid route is located within the existing road network as much as possible, thereby minimising the impact on current land use.

8.5.1.2 Mitigation Measures for Soil and Geology

8.5.1.2.1 *Soil Erosion*

Materials used during the construction phase of the proposed development will be managed in line with the proposed CEMP which can be found in **EIAR Volume III, Appendix 2A**. The CEMP includes site management controls to mitigate for soil erosion. The measures are described below.

Excavations for the borrow pits and turbine hardstands will be the largest scale excavations onsite. These excavations will be completed to an approved temporary works design and carried out such that they are stable or adequately supported. This will involve creating safe side slope angles, installation of drainage around and within the excavation, and installation of sediment control measures within the drainage system to prevent soil erosion. Sediment control measures and further measures to limit soil erosion and discharges to the drainage system are outlined in **Volume II, Chapter 02** Description of the Proposed Development of this EIAR.

Drainage will be constructed in parallel with access track construction and turbine excavation, including drains and settling ponds, etc. A combination of new and upgraded drainage networks will be installed within the site. The existing drainage network will be utilised where possible and will be upgraded where necessary including the installation of settlement ponds and sediment traps at key locations. The drainage network has a twin system of water management separating out clean water from dirty water. This network and design approach is outlined in this EIAR, **Volume II, Chapter 02** Description of the Proposed Development. The proposed wind farm drainage design is illustrated on **Planning Drawing No. 22635-MWP-00-00-DR-C-5051 to 22635-MWP-08-00-DR-C-5066**. Temporary works will be such that they do not adversely interfere with existing drainage channels/regimes.

Temporary stockpiles of excavated material, stored in the footprint of the excavation areas, will be directed for use in backfilling and restoration or placed in the deposition areas on site. Reusable excavated sub-soils and aggregate will be stored in temporary stockpiles at suitably sheltered areas to prevent erosion or weathering and shall be shaped to ensure rainfall does not degrade the stored material. Stockpiles will be stored away from any open surface water drains, managing height and slope of all stockpiles and minimising soil movement. Estimated volumes of material can be found in **Table 2-10** of **Volume II, Chapter 02** Description of the Proposed Development of this EIAR. Excess material will be stored on site in the nine (9) designated permanent deposition areas and two (2) temporary deposition areas shown in **Figure 8-18**. The proposed deposition areas will be subdivided into a series of cells. Each cell will be bunded by an embankment of engineered fill material capable of allowing a tracked excavator to move between the cells during deposition activities. The size of each cell will be dictated by the maximum working length of the excavators working the deposition area. Each cell will be bunded on all downslope sides. The bund will be of adequate strength to retain the material stored within each cell. Upon completion of each cell the surface of the deposited material will be profiled to a gradient not exceeding 5%.

Design details such as maximum storage height and embankment slope are incorporated into the design of the temporary deposition area included in **Planning Drawing No. 22635-MWP-00-00-DR-C-5418**.

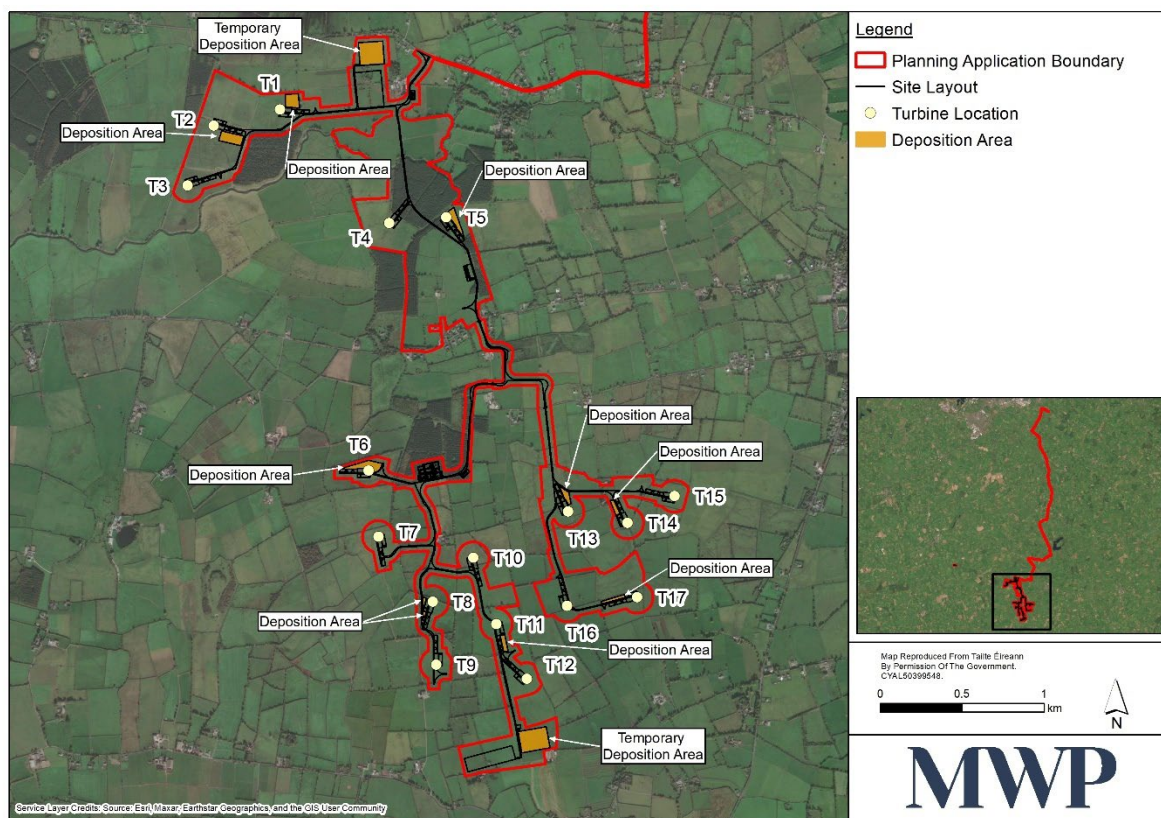


Figure 8-18: Location of Deposition Areas

Whenever possible, existing access tracks have been utilised to access turbine locations. This reduces the volume of excavated material and imported crushed rock for track construction. Excavations and material removal that will take place during the construction phase will be localised to the turbine locations and access tracks.

Excavated material from the grid route will be used to reinstate the area around the cable trench following backfilling of the trench with approved materials. In the event that there is a requirement for soil to be exported from site, this will be treated as an Article 27 by-product (a non-waste) where practicable or treated to comply with Article 28, and recycled if possible. A Resource Waste Management Plan (RWMP) will be implemented by the appointed contractor, and included as EIAR **Volume III, Appendix 2B**.

The implementation of erosion and sediment controls will be made prior to the commencement of site clearance works. Silt traps, such as geotextile membrane, will be placed in the existing drainage network prior to construction work. These will be inspected regularly and in the event of major rain events to ensure their performance adequacy, by a suitably qualified and experienced civil / structural engineer / ECoW and cleaned regularly as required.

The mitigation measures for the grid connection will be the same as those at the wind farm site. These include mitigation measures for soils and geology, drainage, siltation control, hydrocarbon release and general site management and will be fully in line with any requirements identified in the Environmental Management Plans found in the CEMP (EIAR **Volume III, Appendix 2A**). The land use at these locations will not change.

The subsoil and bedrock which will be excavated during the construction phase will be localised to the proposed grid connection route alignment. A minimal volume of subsoil and bedrock will be removed to allow for grid connection works, and suitable material will be reused in trench backfilling where possible. Excess excavated

material will be removed to the deposition areas. Once in place, the grid connection will not affect existing or further land uses.

8.5.1.2.2 *Soil Compaction*

Due to the significant loads that will be imposed by the outriggers of the main lifting crane during the erection process for the installation of the wind turbines on site; it is intended that the proposed crane hardstands will be constructed using excavation methods over the footprint of the hardstand area / turbine base.

The CEMP (EIAR **Volume III, Appendix 2A**) includes minimum site management controls to reduce and mitigate for compaction.

A TMP (EIAR **Volume III, Appendix 16A**) has been developed to manage and control vehicular movement onsite. Measures will include the scheduling of HGVs during the construction phase to reduce the number of vehicle movements in, through and off site. This in turn will reduce the impact of soil compaction and erosion. Unscheduled vehicles will not have access to the site. Machinery will not operate directly on excavated/stockpiled soils. Heavy vehicles will only follow designated and newly constructed access tracks and avoid loading areas which are not contained within the footprint of the main works to minimise disturbance of the original soil and subsoil formations and to retain soil structure.

The compound, vehicles, stockpiled materials and heavy machinery will be in place for the duration of the construction phase and will be removed once commissioning is complete.

Within and around excavations, pore water pressure will be kept low by avoiding loading the soil/subsoil and giving careful attention to the existing drainage, as compaction would alter the surface drainage regime (see **Volume II, Chapter 09** Water of this EIAR).

8.5.1.2.3 *Slope Stability*

The Contractor's method statements for each element of work will be reviewed and approved by the engineer prior to site operations. Prior to excavation, drains will be established to effectively intercept overland flow prior to earthworks. The existing network of drainage within the site will be utilised whenever possible. From examination of factual evidence to date, the majority of landslides occur after an intense period of rainfall. An emergency response system will be developed for the construction phase of the project, particularly during the early excavation phase. This, as a minimum, will involve 24 hour advance meteorological forecasting (Met Éireann download) linked to a trigger-response system. When a pre-determined rainfall trigger level is exceeded (e.g. 1 in 100 year storm event or very heavy rainfall at >25mm/hr), planned responses will be undertaken. These responses will include cessation of construction until the storm event including storm runoff has passed over.

From a desk-top review, the GSI's Landslide Events database have no records of any landslide events recorded within or in proximity to the site. The nearest recorded landslide is located approximately 12km north west of the proposed development (Kapanihane 1697). There are no other recorded landslides within a 20km radius.

A competent project geotechnical engineer or engineering geologist will be employed during the construction phase of the works. As part of the detailed design and assessment, identification of potential planes of weakness will be made in the overburden such as discrepancies in the material type and foliation direction in the bedrock. Earthworks will be constructed to safe stable angles in accordance with the detailed design and best practice. Plant and materials will be stored in approved locations only (proposed temporary site compound) and will not be positioned or trafficked in a manner that would surcharge existing or newly-formed slopes.

8.5.1.3 Mitigation Measures for Accidental Spills and Contamination/Pollution

The CEMP (EIAR **Volume III, Appendix 2A**) includes site management controls to mitigate for contamination/pollution.

The permanent access track works will require a drainage network to be in place for the construction and operation phases of the wind farm. Fundamental to any construction phase is the need to keep clean water (i.e. runoff from adjacent ground upslope of the permitted development footprint) clean and manage all other runoff and water from construction in an appropriate manner. Wheel wash facilities will be available onsite for the duration of the construction phase. These, and other measures are outlined in the CEMP (EIAR **Volume III, Appendix 2A**). The proposed surface water drainage is summarised in **Volume II, Chapter 04 Civil Engineering, Chapter 09 Water and Chapter 17 Material Assets – Built Services** of this EIAR.

A bunded containment area will be provided within the compound for the storage of fuels, lubricants, oils etc.

Good site practice will be applied to ensure no fuels, oils or any other substance are stored in a manner on site in which they may spill and enter the ground, particularly when the initial top layer of made ground is excavated. Dedicated, bunded storage areas will be used for all fuels or hazardous substances. Spill kits will be maintained on site. The CEMP includes a management plan and can be seen in **Volume III, Appendix 2A** of this EIAR.

The potential for hydrocarbons getting into the existing drains, local watercourses, and the land and soils environment will be mitigated by only refuelling construction machinery and vehicles in designated refuelling areas using a prescribed re-fuelling procedure. A fuel management plan will be implemented incorporating the following elements:

- **Refuelling of Construction Plant On-Site** - Refuelling will be carried out using 110% capacity double bunded mobile bowsters. The refuelling bowster will be operated by trained personnel. The bowster will have spill containment equipment which the operators will be fully trained in using. Plant nappies or absorbent mats will be placed under refuelling points during all refuelling to absorb drips. Mobile bowsters, tanks and drums will be stored in secure, impermeable storage areas, over 50m away from drains and open water. To reduce the potential for oil leaks, only vehicles and machinery will be allowed onto the site that are mechanically sound. An up to date service record will be required from the main contractor. Should there be an oil leak or spill, the leak or spill will be contained immediately using oil spill kits. All oil and any contaminated material will be removed and properly disposed of in a licensed facility. Immediate action will be facilitated by easy access to oil spill kits. An oil spill kit that includes absorbing pads and socks will be kept at the site compound and also in site vehicles and machinery. Correct action in the event of a leak or spill will be facilitated by training all vehicle/machinery operators in the use of the spill kits, the correct containment and cleaning up of oil spills or leaks. This training will be provided by the Environmental Manager at site induction. In the event of a major oil spill, a company who provide a rapid response emergency service for major fuel spills will be immediately called for assistance, their contact details will be kept in the site office and in the spill kits kept in site vehicles and machinery.
- **Materials Handling, Fuels and Oil Storage** - Leakages of fuel/ oil from stores will be prevented by storing these materials in bunded tanks which have a capacity of 110% of the total volume of the stored oil. Ancillary equipment such as hoses and pipes will be contained within the bunded storage container. Taps, nozzles or valves will be fitted with a lock system.
- **Concrete** - On-site washing of concrete truck barrels will not be allowed. A designated chute wash down area, which will retain the washout water, will be located within the construction compound and there will be no other chute wash down activity on any other part of the site.

The drainage and treatment system will be managed and monitored, particularly after extreme rainfall events during the construction phase. Controls will be regularly inspected and maintained. A programme of inspection and maintenance will be designed and dedicated construction personnel such as an ECoW assigned to manage this programme. A checklist of the inspection and maintenance control measures will be developed and records kept of inspections and maintenance works. 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.

Stockpiles of stripped topsoil will be in locations with minimum trafficking to prevent damage and dusting. The access track surface can become contaminated with clay or other silty material during construction. Access track cleaning will, therefore, be undertaken regularly during wet weather to reduce the volume of sediment runoff to the treatment system. This is normally achieved by scraping the track surface with the front bucket of an excavator and disposing of the material at designated locations within the site.

8.5.1.4 Mitigation Measures for Rock Blasting (if required)

As part of the constraints led design process, the proposed turbine foundations have been located in areas away from steep slopes, a large change in the topography, and of thin soil cover as per **Volume II, Chapter 04** Civil Engineering of this EIAR. Turbines and infrastructure in these areas are deemed to have low susceptibility to landslides.

To mitigate against the risk of slope failure occurring, blasting will not be permitted at any locations unless robust mitigation measures are put in place. These include:

- Blasting will not occur after periods of heavy rainfall to mitigate against any ground stability. In particular, no blasting will take place for at least 24 hours following a period of rainfall which exceeds 25mm within the previous 24 hours.
- Rock blasting will only take place if extraction using rippers or hydraulic breakers is deemed impractical. Circumstances include where the rock strength is such that other means of extraction are not possible and production rates need to be increased to keep up with the construction programme.
- If rock blasting proves to be necessary, a detailed blasting design will be undertaken by a suitably qualified and experienced specialist for each location to ensure that a peak particle velocity (PPV) of 10 mm/s is not exceeded at a distance of greater than 20m from the blast holes as per BS 7385 Part 2: 1993. If this cannot be achieved, blasting will not be permitted at this location.
- A Blast Management Plan will ensure compliance with the Explosive Act 2006 (amended by Part 6 of the Criminal Justice Act 2006) and related legislation, and BS 7385 in relation to blasting.
- Limerick City and County Council, An Garda Síochána, and adjoining landowners will be notified in advance of any blasting activities on the site. The Blast Management Plan will be prepared by the appointed contractor prior to the construction phase.

8.5.1.5 Mitigation Measures for Piling

Piling if required, will be limited and localised.

- Piling will be carried out in accordance with best practice methodologies set out in TII Series 1600 documents for piling and guidelines from the Federation of Piling Specialist.
- Piles will be installed to the design depth and diameter, with casing or slurry support used where ground conditions require it. Only water-based, biodegradable, and non-hazardous compounds will be used, under controlled conditions.

- Pile integrity and/or load testing will be undertaken in accordance with the design requirements prior to proceeding with pile cap construction.
- Blinding concrete (approx. 100 mm thick) will be placed to provide a clean working surface. The concrete will be protected from rainfall during curing and all surface water runoff from the curing concrete will be directed to a swale and sediment settlement pond.

8.5.1.6 Mitigation Measures for Tree Felling

Topsoil removed from felled areas for the construction of the proposed development will be used in landscaping works or placed in the deposition areas. Where possible, the vegetative layer will be stored with the vegetation and soil facing the right way up to encourage regrowth. The felling areas will then be monitored and maintained following construction and into the operational phase of the development.

Any runoff from the clear-felled areas will be treated using the same design philosophy as that for the access tracks and hardstands. This includes the separation of clean and dirty water by the installation of berms, channelling dirty water to silt traps and settlement ponds and ensuring that the discharge rate of the drainage system is no higher than the existing condition by using engineered settlement ponds.

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

All works will be completed to standard forestry guidelines (Department of Agriculture, Food and the Marine [Teagasc], 2019, Standards for Felling and Reforestation), and in accordance with licence conditions issued by the Forest Service.

8.5.1.7 Mitigation Measures for the Grid Connection Route and Substation

The mitigation measures for the grid connection route and substation will be the same as those at the wind farm site as discussed in previous sections. These include mitigation measures for soils and geology, drainage, siltation control, hydrocarbon release and general site management and will be fully in line with any requirements identified in the Environmental Management Plans found in the CEMP (EIAR **Volume III, Appendix 2A**).

8.5.2 Operational Phase

8.5.2.1 Mitigation Measures for Land Use

The potential effect on the land and soils of the proposed development due to excavations will be significantly lower during operation and maintenance, as the majority of excavations will have been reinstated. Some erosion of soil may continue into the early operation phase, however as vegetation becomes established and equilibrium is achieved, erosion rates will reduce to normal levels. No additional mitigation measures are required in relation to land use for the soil and geological environment during the operation of the proposed development.

8.5.2.2 Mitigation Measures for Soil and Geology

All vehicular movement during operation and maintenance will be restricted to the areas of hardstanding and existing/newly constructed access tracks. The volume of traffic during the operational phase will be greatly reduced in comparison with the construction phase. The potential effect on slope stability will therefore be

minimal. The risks associated with sedimentation and contamination of the watercourses and aquifers due to erosion and runoff will be significantly reduced as areas are revegetated and construction/forestry traffic ceases. Drainage swales will continue to be monitored. Refer to Volume II **Chapter 09** Water of this EIAR for further details in relation to hydrology and hydrogeology.

8.5.2.3 Mitigation Measures for Accidental Spills and Contamination/Pollution

Mitigation measures for oils and fuels remain the same as the construction phase, however these risks will be significantly reduced during the operation stage as maintenance of the turbines, substation and maintenance vehicles is all that is required. Turbine transformers will be located within the turbines, so any leak of oil would be contained within or adjacent to the turbine. Minimal refuelling or maintenance of operational vehicles or plant will take place on site. Off-site refuelling will occur at a controlled fuelling station. Any on site re-fuelling will be undertaken using a double skinned bowser with spill kits at the ready for accidental leakages or spillages. A minimal amount of fuel will be stored on site. Storage areas where required will be bunded appropriately for the fuel storage volume during the operational phase and will be fitted with a storm drainage system and an appropriate oil interceptor. The plant used will be regularly inspected for leaks and fitness for purpose. These measures will be sufficient to reduce the risk of contamination to soil and subsoils, and groundwater and surface water quality. An emergency plan for the operational phase to deal with accidental spillages will be prepared and will be communicated to plant operatives. Spill kits will be available to deal with any accidental spillage in and outside the re-fuelling area. The substation transformer oil storage tanks will be in a concrete bund capable of holding 110% of the oil in the transformer and storage tanks. Any wastewater will be removed offsite by a licensed contractor.

8.5.2.4 Mitigation Measures for the Grid Connection and Substation

None required, unless repair works are undertaken, then mitigation will include:

- Use of temporary excavations over the shortest distances possible;
- All excavated material will be stored and reused during reinstatement.

8.5.3 Mitigation Measures for Cumulative Effects

Based on the finding that the potential for significant cumulative effects on land and soils arising from the proposed development is considered to be *negligible*, no specific measures to mitigate against cumulative effects are considered necessary.

8.5.4 Decommissioning Phase

Where appropriate, mitigation measures used during decommissioning activities shall be comparable to those used during construction. By keeping some development components in place, when necessary, some of the effects will be avoided. In order to recover vegetation and lessen the effects of runoff and sedimentation, the turbine bases will be rehabilitated by being covered with local topsoil. Access tracks that are not needed for farming or forestry will also be allowed to naturally revert to vegetation. The wind farm's materials and equipment will all be removed from the site and disposed of or repurposed in a way that is environmentally responsible. There will be mitigation measures put in place to prevent potential pollution from fuel leaks and soil compaction caused by nearby plants.

8.5.5 Mitigating the Risk of Major Accidents and Disasters

Incidents such as landslides or technological disasters can result in liabilities such as contaminated soil, loss of infrastructure and loss of life. Proactive risk management reduces the potential for an incident to occur, and therefore the CEMP (EIAR **Volume III, Appendix 2A**) for the proposed development sets out the Emergency Response Procedure to be adopted in the event of an emergency including contamination, health and safety and environmental protection. The proposed development has been designed and will be built in accordance with the best practice measures set out in this EIAR and, as such, mitigation against the risk of major accidents and/or disasters is embedded through the design.

8.6 Residual Effects

No significant residual effects on land, soil and geology are likely.

EFFECT (PRE-MITIGATION)	RECEPTOR	IMPACT/ACTIVITY	EFFECT (PRE-MITIGATION)	MITIGATION MEASURES	RESIDUAL EFFECT (POST-MITIGATION)							
					QUALITY OF EFFECT	SPATIAL EXTENT	DURATION	OTHER RELEVANT CRITERIA	LIKELIHOOD	MAGNITUDE	SENSITIVITY	SIGNIFICANCE
	CONSTRUCTION											
Change of Land Use	Land, Soils	Wind Farm site & facilities	Adverse, short-term, direct, localised, likely, moderate and slight effect	Section 8.5.1.	Adverse	Localised	Short-term	Direct	Likely	Minor	Low	Not Significant
		Grid Connecti on	Adverse, localised, brief, direct, likely, minor and not significant effect	Section 8.5.1.	Adverse	Localised	Short-term	Direct	Likely	Minor	Low	Not Significant
		TDR	Adverse, localised, brief, direct, likely, minor and not significant effect	Section 8.5.1.	Adverse	Localised	Short-term	Direct	Likely	Minor	Low	Not Significant
Soil erosion, compaction and slope stability	Soils and Geology	Wind Farm site & facilities	Adverse, moderate, localised, minor, short-term, direct, likely and slight effect	Section 8.5.1.	Adverse	Localised	Short-term	Direct	Likely	Minor	Low	Not Significant

EFFECT (PRE-MITIGATION)	RECEPTOR	IMPACT/ACTIVITY	EFFECT (PRE-MITIGATION)	MITIGATION MEASURES	RESIDUAL EFFECT (POST-MITIGATION)							
					QUALITY OF EFFECT	SPATIAL EXTENT	DURATION	OTHER RELEVANT CRITERIA	LIKELIHOOD	MAGNITUDE	SENSITIVITY	SIGNIFICANCE
		Grid Connection	Adverse, localised, temporary, direct, likely, minor, low and not significant effect		Adverse	Localised	Temporary	Direct	Likely	Minor	Low	Not Significant
		TDR	Adverse, localised, brief, direct, likely, negligible, low and not significant effect		Adverse	Localised	Temporary	Direct	Likely	Minor	Low	Not Significant
Accidental spills & contamination/pollution – hydrocarbons & cement	Land and Soils	Wind Farm Site	Adverse, localised, short-term, indirect, likely, moderate, cumulative and moderate effect	Section 8.5.1.	Adverse	Localised	Short-term	Direct	Unlikely	Minor	High	Slight
	Geology	Wind Farm Site	Adverse, localised, short-term, indirect, likely, moderate, cumulative and moderate effect		Adverse	Localised	Short-term	Indirect	Unlikely	Minor	High	Slight
Rock Blasting	Soils and Geology	Wind Farm Site	Adverse, localised, brief and occasional, direct, likely, major and slight effect	Section 8.5.1.	Adverse	Localised	Brief and Occasional	Direct	Likely	Minor	Low	Not Significant

EFFECT (PRE-MITIGATION)	RECEPTOR	IMPACT/ACTIVITY	EFFECT (PRE-MITIGATION)	MITIGATION MEASURES	RESIDUAL EFFECT (POST-MITIGATION)							
					QUALITY OF EFFECT	SPATIAL EXTENT	DURATION	OTHER RELEVANT CRITERIA	LIKELIHOOD	MAGNITUDE	SENSITIVITY	SIGNIFICANCE
Piling	Land and Soils, and Geology	Wind Farm Site	Adverse, localised, temporary, direct, likely, moderate, low and slight effect	Section 8.5.1.	Adverse	Localised	Temporary	Direct	Likely	Minor	Low	Slight
Tree and Hedge Felling	Land and Soils, and Geology	Wind Farm site	Adverse, localised, temporary, direct, likely, and minor effect	Section 8.5.1.	Adverse	Localised	Temporary	Direct	Likely	Negligible	Low	Not Significant
OPERATIONAL												
Change of Land Use	Land & soils & Geology	Wind Farm Site	Adverse localised, long-term, direct, likely, negligible, low and not significant effect	No mitigation required.	Adverse	Localised	Long-term	Direct	Likely	Negligible	Low	Not Significant
		Grid Route	Adverse localised, long-term, direct, likely, negligible, low and not significant effect	No mitigation required.	Adverse	Localised	Long-term	Direct	Likely	Negligible	Low	Not Significant
		TDR	Adverse, localised, temporary, direct, likely, negligible, low and not	No mitigation required.	Adverse	Localised	Temporary	Direct	Likely	Negligible	Low	Not Significant

EFFECT (PRE-MITIGATION)	RECEPTOR	IMPACT/ACTIVITY	EFFECT (PRE-MITIGATION)	MITIGATION MEASURES	RESIDUAL EFFECT (POST-MITIGATION)							
					QUALITY OF EFFECT	SPATIAL EXTENT	DURATION	OTHER RELEVANT CRITERIA	LIKELIHOOD	MAGNITUDE	SENSITIVITY	SIGNIFICANCE
			significant effect									
Effects on Soil and Geology	Soils and Geology	WF, GR & TDR	Adverse, localised, temporary, direct, likely, minor, low and not significant effect	Section 8.5.2	Adverse	Localised	Temporary	Direct	Likely	Negligible	Low	Not Significant
Accidental spills & contamination/ pollution	Land, Soils and Geology	WF, GR & TDR	Adverse, localised, temporary, direct, likely, moderate, high and moderate effect	Section 8.5.2	Adverse	Localised	Long-term	Direct	Unlikely	Minor	High	Slight
	DECOMMISSIONING											
Land use	Land and Soils	Wind farm	Positive, localised, long-term, direct, likely, negligible, low and not significant effect	Section 8.5.4	Positive	Localised	Long-term	Direct	Likely	Negligible	Low	Not Significant

8.7 Conclusions

In conclusion, no significant effects on the land, soil and geology of the site of the proposed development or along the grid connection route will occur during construction, operation, or during decommissioning due to correct procedures and outlined mitigations being implemented.

The assessment also confirms that there will be no significant cumulative effects on the land, soil and geology environment as a result of the proposed development and other proposed projects.

8.8 References

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