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Acronyms and Abbreviations

SLR	SLR Consulting Limited
EIAR	Environmental Impact Assessment Report
EIA	Environmental Impact Assessment
EU	European Union
IGI	The Institute of Geologists of Ireland
EPA	Environmental Protection Agency
ISIS	Irish Soil Information System
GSI	Geological Survey of Ireland
IFS	Irish Forestry Soils
IGH	Irish Geological Heritage
NHA	Natural Heritage Area
OSI	Ordnance Survey Ireland
ERT	Electrical Resistivity Tomography
TDR	Turbine Delivery Route
Site	The subject Site where the Proposed Development is located
Proposed Development	As defined in of Chapter 2 of this EIAR

INTRODUCTION

6.1 This section of the EIAR provides a description of the existing land, soils and geological setting at the regional and local scale, an assessment of the impact of the Proposed Development on the land, soils and geological features of the area and also other geological aspects of the Proposed Development during the construction, operation and decommissioning phases.

6.2 All elements of the Proposed Development are described in **Chapter 2** of this EIAR.

Statement of Authority

6.3 This chapter of the EIAR was prepared by Paul Gordon (EurGeol, PGeol) and Hannah McGillycuddy (MIT) of SLR Consulting.

- Paul has a BSc in Geology and an MSc in Environmental Management and has over 20 years' professional experience, primarily in the Irish minerals industry, including the writing of land, soils and geology chapters for EIARs in Ireland.
- Hannah has a BSc in Geology and an MSc in Exploration Field Geology and has 6 years' professional experience in writing land, soils and geology chapters for EIARs in Ireland.

6.4 A Site walkover has been carried out by SLR Consulting in February 2022. Peat probing and sampling was undertaken in October 2022, August 2023 and March 2024. The October 2022 probing and sampling was undertaken by Sam Irwin and Saul Sanchez, two of SLR's field geologists. The August 2023 survey was undertaken by Saul Sanchez and Hannah McGillycuddy. Both surveys were designed by Paul Gordon, with input from Colin Duncan. Colin has conducted PLHRAs in Scotland and Ireland for >20 years.

SCOPE OF WORK/EIA SCOPING

6.5 This EIAR is based on a desk study of the Proposed Development Site and surrounding lands using published geological data, information from online data sources (refer to Reference Section below), a walkover Site visit (February 2022) and peat probing previously carried out by SLR in October 2022, August 2023 and March 2024.

REGULATORY BACKGROUND

EU Directives

6.6 The following EU Directive relate to Land, Soils and Geology at the Site in this EIAR:

- Directive 2014/52/EU of the European Parliament and of the Council of 16 April 2014 amending Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment ('the EIA Directive')
- Directive 2006/21/EC of the European Parliament and of the Council of 15 March 2006 on the management of waste from extractive industries ('Management of Waste Directive'); and Directive 2004/35/CE of the European Parliament and of the Council of 21 April 2004 on environmental liability with regard to the prevention and remedying of environmental damage ('Environmental Liability Directive').

6.7 The EIA Directive sets out the information required in an EIAR. The Management of Waste Directive and the Environmental Liability Directive regulate the activities at the Site.

Irish Legislation

6.8 The following legislation relates to Land, Soils and Geology at the Site in this EIAR:

- S.I. No. 296 of 2018, European Communities (Planning and Development) (Environmental Impact Assessment) Regulations 2018;
- S.I. No. 473 of 2011, European Union (Environmental Impact Assessment and Habitats) Regulations 2011;
- S.I. No. 584 of 2011, European Union (Environmental Impact Assessment and Habitats) (No.2) Regulations 2011;
- S.I. No. 272/2009 – European Communities Environmental Objectives (Surface Waters) Regulations 2009, and subsequent amendments;
- S.I. No. 9/2010 – European Communities Environmental Objectives (Groundwater) Regulations) 2010, and subsequent amendments; and
- The Planning and Development Act 2000 as amended.

Guidelines

6.9 The Land, Soils and Geology Chapter of this EIAR has been prepared in accordance with the following guidelines:

- Best Practice Guidelines for the Irish Wind Energy; Irish Wind Energy Association (2012);
- Environmental Impact Assessment of National Road Schemes - A Practical Guide; National Roads Authority (2008);
- Geological Survey of Ireland, Irish Concrete Federation Geological Heritage Guidelines for the Extractive Industry (2008);
- Good Practice Guide for Handling Soils. Sheets 1 & 2. Ministry of Agriculture, Fisheries and Food (UK) (2000);
- Guidelines on the Information to be Contained in Environmental Impact Assessment Reports. Environmental Protection Agency, Johnstown Castle Estate, Co. Wexford; (2022);
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment; Department of Housing, Planning and Local Government (2018);
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements; Institute of Geologists of Ireland (2013);
- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes; National Roads Authority (2008);
- Specification for Road Works Series 600 –Earthworks. Transport Infrastructure Ireland (March, 2013);
- Wind Energy Development Guidelines, Department of Housing, Local Government and Heritage (2006); and

- Draft Revised Wind Energy Development Guidelines December 2019. Department of Housing, Planning and Local Government.

BASELINE STUDY METHODOLOGY

6.10 This assessment involved a review of published literature and information, the findings from a walkover survey of the Site and the surrounding geological context and peat probing carried on at two turbine locations.

6.11 This baseline study describes the receiving environment at and in the immediate vicinity of the Site using the available baseline information gathered, specifically:

- **Context of the receiving environment** - location/ magnitude/ spatial extent and trends of the environmental factors;
- **Character of the receiving environment** - distinguishing aspects of the environment being considered here;
- **Significance of the receiving environment** - the quality, value or designation is assigned to the existing environment; and
- **Sensitivity of the receiving environment** - how sensitive is the aspect of the environment to change.

6.12 The baseline study is a qualitative assessment of the available information based on professional experience and interpretation of the available data.

Geographical and Temporal Study Area

6.13 For the purposes of this assessment, the geographical study area includes the Proposed Development and a 2 km offset from these when considering land, soils and geology aspects. This is in line with the recommended study area in the IGI's 'Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapter of Environmental Impact Statements' (2013).

6.14 The TDR will follow an existing road network with no likely direct interaction with land, soils or geology and in the context of the assessment in this chapter, the study area for the TDR follows the TDR route only. The TDR route will be considered within the following sections, where relevant.

6.15 The temporal scope of the assessment covers the construction, operation and decommissioning phases for the Proposed Development.

Sources of Information

6.16 The following sources of information were consulted in the preparation of the receiving environment baseline study for Land, Soils and Geology:

- Geological Survey of Ireland (www.gsi.ie);
- Teagasc subsoil mapping for Irish Forestry Soils Project (www.epa.ie);
- Irish Soils Information System (www.teagasc.ie/soils);
- Environmental Protection Agency (https://gis.epa.ie/EPAMaps/);
- Irish Geological Heritage Programme (www.gsi.ie);

- Ordnance Survey Ireland, Cassini 6" map (1830s - 1930s), 6" historical map (1837 – 1842), 25" historical map (1888 - 1913) and aerial imagery (1995 – 2018) (https://webapps.geohive.ie/mapviewer/index.html); and
- Google Earth Historical Imagery (various dates between October 2010 – April 2022 using Google Earth Pro https://www.google.com/earth/versions/).

BASELINE ENVIRONMENT

Land

6.17 Within the EIA Directive land is recognised as a 'natural resource'. The EIA Directive also refers to the importance of the sustainable use of soil and the need to address the unsustainable increase in settlement areas over time ('land take'). Therefore, the consideration of land as a natural resource and impacts with regard to land take must be considered in the EIAR.

6.18 The introduction section to the EU Directive (as amended by 2014/52/EU) notes that the:

'Final document of the United Nations Conference on Sustainable Development held in Rio de Janeiro on 20-22 June 2012, which recognises the economic and social significance of good land management, including soil, and the need for urgent action to reverse land degradation. Public and private projects should therefore consider and limit their impact on land, particularly as regards land take, and on soil, including as regards organic matter, erosion, compaction and sealing; appropriate land use plans and policies at national, regional and local level are also relevant in this regard.'

6.19 Land can be considered to be a resource with a beneficial use to society, for example agricultural land use, extractive industry land use or urban residential land use. Excess or unnecessary land take may therefore result in the loss or sterilisation of key land resources. This in turn has the potential to have adverse social and economic consequences for society.

6.20 A review of the 6" historical maps and the 25" historical map shows the study area contained a mixture of scattered fields, woodland, sparse residential housing and farmsteads during these periods (1839s-1942 and 1888 – 1913) (OSI, 2023). Ballinlough Castle lies within the east of the Study Area.

6.21 A review of Google Earth imagery (October 2010 - April 2022) and OSI aerial imagery (1995 – 2018) identifies that mixed conifer and broadleaf forestry has occupied much of the Site to the south while the wider study area remains a mixture of scattered fields, sparse housing and farmsteads. Some of the forestry is on land that was previously used for peat extraction. A quarry appears on aerial imagery after 1995 outside the Proposed Development Site to the south east of the Northern Cluster.

6.22 The Proposed Cable Corridor between the Proposed Development Site and the Proposed Substation near Clonmellon to the north, predominantly comprises an existing road network (L5542 and N52) with grass margins and/or hedgerows and treelines adjacent to the road margins. The proposed substation site near Clonmellon is currently an agricultural field.

6.23 Other land uses in the study area consist of the village of Clonmellon within the north of the study area.

6.24 Corine Landcover 2018 classifies that there are two broad land uses on the Site and within the study area. These are agricultural lands and forested lands.

6.25 The TDR is in current use as part of the existing regional, national and road network between the Site and Dublin Port.

Soils Baseline

6.26 Soil is defined as the top layer of the earth's crust and is formed by mineral particles, organic matter, water, air and living organisms. Soil is an extremely complex, variable and living medium and its characteristics are a function of parent subsoil or bedrock materials, climate, relief and the actions of living organisms over time.

6.27 Soil formation is an extremely slow process and can take thousands of years to evolve; soil can be considered essentially as a non-renewable resource.

6.28 As the interface between the earth, the air and the water, soil performs many vital functions; it supports food and other biomass production (forestry, biofuels etc.) by providing anchorage for vegetation and storing water and nutrients long enough for plants to absorb them. Soil also stores, filters and transforms other substances, including carbon and nitrogen, and has a role supporting habitats serving as a platform for human activity.

National Soils

6.29 The ISIS project was undertaken by the EPA and Teagasc, and has gathered together existing information and data from soil survey work in Ireland, which has been augmented with new field data, leading to the production of a new national soil map at a scale of 1:250,000 (www.teagasc.ie/soils).

6.30 The ISIS project has identified a number of Soil Associations across Ireland, which are each comprised of a range of soil types (or 'Series'), each of them different in properties, with different environmental and agronomic responses. For each soil type, the properties have been recorded in a database maintained by Teagasc.

6.31 The soil association classified beneath the majority of the Proposed Development Site is the Elton series (1000a) (see **Figure 6-1**). Elton soils are described as a fine, loamy drift with limestones. The soils in this association are considered to have good agricultural potential being friable deep soils with plentiful, well-developed roots and a high base saturation with good nutrient retention.

6.32 Two other soils found onsite are River Alluvium and Peat. The River Alluvium is confined to the northwest of the Site, in the area beneath turbine location T2. Peat is mapped in the north, underlying turbine location T1 and T3 (GSI, 2023). It is also mapped in the west-central part of the site, at turbine location T7 (GSI, 2023).

6.33 The wider study area is made up of a mixture of River Alluvium, Elton soils and Peat.

6.34 Soils immediately beneath the TDR area and proposed grid connection route underlie the road network and comprise engineered fill/Made Ground. Soils beneath the proposed substation comprise Elton soils.

Subsoils

6.35 The Quaternary (Subsoil) deposits were deposited during the last 2 million years, and essentially comprise the unconsolidated materials overlying bedrock. The two predominant types of quaternary subsoils in Ireland are glacial till, deposited at the base of ice sheets, and sand & gravel deposits, associated with the melting of the ice sheets and are generally termed 'glaciofluvial outwash sands and gravels.' Other extensive Quaternary subsoils in Ireland include peat, river alluvium and coastal process deposits. Most Quaternary subsoils

in Ireland were deposited after the maximum of the last glaciation, the Midlandian, which occurred approximately 17,000 years ago.

6.36 The subsoils across Ireland have been mapped on a national basis by Teagasc as part of the EPA Soil and Subsoil Mapping Project for the Irish Forestry Soils (IFS) project. The subsoil mapping was undertaken at a national basis using existing Quaternary Geology maps, publications, remote sensing and field mapping and sampling.

6.37 The subsoils previously covering and adjacent to the Site have been mapped under the IFS project. The Proposed Development Site and wider study area is underlain predominately by a mixture of limestone sands and gravels (GLs) and limestone tills (TLs), see **Figure 6-2**. There are also lesser occurrences of peat, basic esker sands and gravels (BasEsk), undifferentiated lacustrine sediments and undifferentiated alluvium.

6.38 Subsoil mapping indicates that there are two types of peat mapped within the Site area. To the north, underlying turbine locations T1 and T3, previous mapping by Teagasc has identified fen peat in this area. Most fen peats in Ireland have been drained for agriculture and it appears that this occurrence has been at least partially drained. Fen peats typically have poor drainage and are suitable for grazing only.

6.39 To the south of the Site in the area underlying turbine location T7, Teagasc has mapped an area of cut peat. Historic aerial photography indicates that peat extraction was carried out in the area. No peat was observed here during the SLR Site walkover and peat probing (See Section "*Site Investigations and Field Assessments*", below).

6.40 Subsoils immediately beneath the TDR and proposed grid connection route underlie the road network and comprise engineered fill/Made Ground. Subsoils beneath the Proposed Substation comprise Carboniferous limestone tills.

Bedrock Geology

6.41 The Proposed Development Site is entirely underlain by the Lucan Formation, a Lower Carboniferous mixed package of limestones and shales with chert bands (**Figure 6-3**). The Lucan Formation occurs extensively throughout the Dublin basin, an area extending westwards from County Dublin, through the central and northern midlands. The Lucan Formation in this area is described by the GSI as a locally important aquifer which is moderately productive only in local zones.

6.42 There is no bedrock outcrop recorded by GSI at the Site. There is an active quarry near the Proposed Development Site but outside the Planning Application Boundary.

6.43 No major geological structures are recorded at the Site on the GSI mapping. One northwest trending fault is interpreted to terminate close to the western boundary of the Site. However, given the lack of variation in the bedrock geology and the relative lack of outcrop, it is not likely that the location of such faults can be known with any certainty.

6.44 A review of public borehole data files kept by the Department of Environment, Climate and Communications, shows there is a borehole log (ID RN-1245-1) drilled by Rio Tinto in 1998 within the Site area. This borehole is located c. 125 m west of turbine location T6. A review of the borehole log shows 6.44 m of overburden was encountered before collaring in 13.56 m of dark shaly limestone (described as "Calp" limestone in the logs which is synonymous with the Lucan Formation). Underlying the Lucan Formation is Waulsortian limestone (255.4 m) and reef equivalent which can be dolomitised, Argillaceous Bioclastic Limestone (ABL) (290.6 m), Shaley Pales (84.4 m) and sandstones, shales, micrites and calcarenites units (187.7 m). The borehole terminated at 838.1 m in sandstone.

6.45 The wider study area is also entirely underlain by the Lucan Formation, this includes the proposed grid connection route and substation.

6.46 Bedrock geology beneath the TDR area comprise various sequences of Carboniferous limestones and a shale and sandstone (Namurian undifferentiated).

Geological Heritage

6.47 There are no audited geological heritage sites within the Proposed Development Site itself or within the wider study area (including the Proposed Cable Corridor and Proposed Substation **Figure 6-4** (GSI, 2023). No unaudited heritage Sites are found within the study area or the Site either (GSI, 2023).

Economic Geology

6.48 A review of the GSI's mineral localities (GSI, 2023) shows that there are no identified mineral localities within the Site or within the study area.

6.49 One existing sand and gravel quarry is located near the Northern Cluster but outside the Proposed Development Site.

6.50 A review of the GSI's historical quarry database (2023) identifies that there have been 9 pits within the study area (but none within the Site), however dates of operation are not provided. Notes associated with the pits by the GSI state they are either "*OSIextragravelpitspoints*" ('OSI extra gravel pits points) or "*GM-GRAVPI-S*". It is considered here that these denote gravel pits.

6.51 There are no historical pits noted on the OSI's 25 inch and 6 inch maps which correlate with these 9 pits.

6.52 Two of the historical pits are located adjacent to the existing quarry which is located within the study area but not the Site.

Site Investigations and Field Assessments

6.53 A Peat Landslide Hazard & Risk Assessment (PLHRA) was undertaken by SLR as part of the baseline assessment of the Site (**Appendix 6-1**).

6.54 The purpose of the PLHRA is to consider the potential risk of peat slides occurring at the Site such that suitable controls and appropriate methodologies can be employed during construction and commissioning of the wind farm to mitigate against these risks. The PLHRA incorporates data gathered during Site walkover and a Phase 1 peat survey carried out at turbine locations T1 and T7 (as these are mapped by the GSI as underlain by peat) by SLR in October 2022, August 2023 and March 2024.

6.55 The PLHRA identifies that the Site is located in a low-lying area, with an undulating topography and no significant hill slope gradients.

6.56 The thickness of the peat was assessed using a graduated peat probe. A peat auger was used to recover disturbed samples from a range of depths for an estimate of moisture content.

6.57 Where the peat probing met refusal on a hard substrate, the 'feel' of the refusal can provide an insight into the nature of the substrate. The following criteria were used to assess likely material:

- Solid and abrupt refusal – rock;
- Solid but less abrupt refusal with grinding or crunching sound – sand or gravel;

- Rapid and firm refusal – clay; and
- Gradual refusal – dense peat or soft clay.

6.58 The peat survey at the south area (beneath turbine location T7), mapped as cut bog, found no peat (**Appendix 6-1**).

6.59 The fen peat, to the north of the Site beneath turbine locations T1 and T3, was found to vary in terms of thickness and coverage.

6.60 A total of 153 probe holes were undertaken between locations T1, T3 and the access tracks.

6.61 The PLHRA found that the slopes onsite, when viewed in conjunction with the Peat Depth Plans (**Appendix 6-1**, **Figure 6**), indicate that the peat is generally limited to patchy, flat areas that areas are consistent with the surrounding topography.

6.62 The peat surveys shows that in the northern peat area:

- Peat across the area varies in terms of thickness, from 0.1m to 4.0m. 70% of the area surveyed either has no peat developed, or has a peat thickness of <1.5m;
- Peat development in the immediate vicinity of proposed location T1 is limited;
- Peat development in the immediate vicinity of proposed location T3 is variable in thickness;
- The thickest peat is associated with particularly flat topography (<1° of slope);
- As expected for fen peat, it is developed in a relatively low-lying area.

6.63 Accumulations of peat up to 0.5m thick are considered to be too thin to be classified as true peat deposits and are often classified as organic soils or peaty soils.

6.64 The underlying soil/peat thickness at each location was recorded and the data used to draw the interpreted peat thickness map, presented as **Figure 6** in **Appendix 6-1**.

6.65 In most cases, the peat is underlain by clay or peaty clay.

6.66 The PLHRA found that the risk of slope instability due to peat in the northern fen peat area, in the vicinity of T1 and T3, is low to negligible.

Geohazards

Landslides/Slope Stability

6.67 Landslides/mass movements/slope stability issues typically occur due to erosion of features such as cliffs, or due to factors such as slope, saturation/drainage, vegetation, soil structure and loading/disturbance on Sites with unconsolidated deposits such as peat.

6.68 The study area and Site is predominantly within an area of low landslide susceptibility (GSI, 2023). More than 90% of the Site, including all proposed access tracks and turbine locations, are classified as low or low (inferred) for landslide susceptibility. There are some small zones classified as low c. 80-100m from proposed turbine location T1. No temporary or permanent infrastructure is planned for either of these locations and it is therefore considered that the risk of instability in relation to these areas is negligible.

Radon

6.69 Radon is a naturally occurring radioactive gas which forms from the radioactive decay of uranium in predominantly igneous rocks and associated soils. Radon gas can cause lung cancer when a person is exposed to high levels of the gas over a prolonged period of time.

The acceptable level (reference level) for workplace radon in Ireland is 300 Bq/m3. However, outdoor work settings offer little threat from radon exposure as the gas can only become confined and concentrated indoors within a building.

6.70 The majority of the study area and Site indicates that 1 in 10 homes are likely to have high radon levels with an area between Clonmellon village and the Site noted as likely to have 1 in 20 homes to with high radon levels (EPA, 2023).

Karst

6.71 No karst features are mapped by the GSI present within the Site or study area (including proposed grid connection route and substation).

IMPACT ASSESSMENT

Evaluation Methodology

6.72 This evaluation of impacts in this chapter is based on a methodology which adheres to the "*Guidelines for the Assessment of Geology, Hydrology and Hydrogeology for National Road Schemes*" (National Roads Authority, 2009), the "*Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements*" published (IGI, 2013) and *"Guidelines on the Information to be contained in Environmental Impact Assessment Reports"* (EPA, 2022).

6.73 **Table 6-1** below shows the matrix for significance of effect used in this assessment.

Table 6-1 Significance Matrix

	Magnitude of Impact (Degree of Change)				
Environmental Importance (Sensitivity)		**Negligible**	**Low**	**Medium**	**High**
	High	Slight	Slight or moderate	Moderate or large	Profound
	Medium	Imperceptible or slight	Slight or moderate	Moderate	Large or profound
	Low	Imperceptible	Slight	Slight	Slight or moderate
	Negligible	Imperceptible	Imperceptible or slight	Imperceptible or slight	Slight

Selection of Sensitive Receptors

Land

6.74 Land use in the Site area will change due to the Proposed Development. Removal of forestry will be required at 4 turbine locations, in addition to some linear loss due to the creation of additional internal access tracks. It is proposed to fell between 19.62ha and 20.09ha of forestry for the Proposed Development. Replant lands are required.

6.75 Consideration within this chapter (Land, Soils and Geology) is given only to the subject of land take/land use loss.

6.76 Lands in current use for conifer forestry will be lost due to the Proposed Development within the Site. This will be considered further in the assessment.

Soils and Subsoils

6.77 There will be a disturbance to soils and subsoils within the Site, including removal of soils for the turbine bases, excavation of the borrow pits for use of material as fill for access tracks within the Site and the excavation of soils for the cable laying. The quaternary deposits at the Site are ubiquitous in a regional context. However, consideration will be given further in the assessment on the potential impacts to quaternary sediments due to the Proposed Development.

Bedrock Geology

6.78 The bedrock within the Proposed Development Site is part of the Lucan Formation and will involve the extraction of rock in the borrow pits to facilitate the Proposed Development. Consideration will be given further in the assessment to the potential impact to bedrock (e.g. leaks and spills seeping into the bedrock and for use of the bedrock resource, see economic geology, below).

Geological Heritage

6.79 There are no geological heritage sites within the study area or Proposed Development Site. Geological heritage sites are not considered further in this assessment.

Economic Geology

6.80 There is no current extensive quarrying usage within the Proposed Development Site which would be impacted by the Proposed Development. Within the study area, only one quarry has been identified. The soils and bedrock within the Site are considered to represent a geological resource which can be used by the Proposed Development to facilitate its construction. The use of this as a resource onsite will be considered further.

Geohazards

6.81 No historical evidence of landslides is recorded within the area. The area mapped by the GSI as underlain by cut peat to the south (beneath turbine location T7) has been assessed during a Site walkover and peat probing and is not underlain by peat (due to historical peat extraction). Slopes are low in the area. Fen peat has been identified in the area of turbine locations T1 and T3 to the north, through both GSI mapping and peat probing carried out by SLR. Further consideration will be given in the assessment to the stability in the area of turbine locations T1 and T3.

6.82 While the majority of Proposed Development Site is located within a higher radon risk area, site works both during construction, operations and potential decommissioning will be outdoors in nature. Radon risk is associated with indoor exposure over a prolonged period, as this will not occur in the context of the Proposed Development, radon risk will not be considered further in this assessment.

6.83 Karst is scoped out for further assessment due to the lack of identified karst features and the shaly nature of the Lucan Formation which underlies the Site.

Summary

6.84 In terms of land, soils and geology baseline considered here, the principal sensitive receptors are shown in **Table 6-2**, below. Importance and reasoning is taken after the National Roads Authority Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (2008) in relation to aspects to be considered and assessment approach.

Table 6-2 Status and Importance Land, Soil and Geology Receptors

Receptor	Importance and Reasoning
Land	Low (forest predominantly and agricultural land within Site area, no particular value to locality but will be partially removed from the Site as a result of the Proposed Development)
Soils and subsoils	Low (no designation, no rarity, Site importance for sediments to be extracted, moved and/or reused within the Site as part of the Proposed Development works)
Bedrock Geology	Low (while it is proposed to be used within the Proposed Development as a resource, it is ubiquitous and only of Site importance as a resource)
Human health/built structure	High (human beings such as workers onsite)

POTENTIAL EFFECTS

6.85 The main potential impacts and associated effects that will be considered in the assessment relate to the following:

- Activities or events that might impact quaternary sediment quality during construction and operation phase (e.g. soil contamination by a fuel or oil spill or leakage);
- Geotechnical instability arising due to the presence of peat in the area of turbine locations T1 and T3 to the north; and
- Extraction of sediments and bedrock and their relocation and reuse within the Site area as part of development works.

6.86 These are considered and assessed in the following sections.

Potential Effects – Construction

6.87 **Table 6-5** later in this chapter, summarises the potential effects discussed in the following subsections. All elements of the Proposed Development are described in **Chapter 2** of this EIAR, while the most relevant of the proposals to this assessment are set out below.

Turbines (and Associated Infrastructure), TDR, CC, Borrow Pits and Substation

6.88 The Proposed Development predominantly consists of a mixture of agricultural land, primarily grazing, and forestry. The works associated with the Proposed Development will all involve land take whereby existing forestry land and agricultural land is used for the turbine (and associated infrastructure, borrow pits and electricity substation) land use. Between 19.62ha and 20.09ha of forestry will be felled to enable the Proposed Development. The potential impact due to land take is considered to be low (adverse) and the significance of effect is considered to be Slight for the turbine locations.

6.89 Land use will not change along the TDR due to its use as the TDR. The TDR will follow existing roads and thereby align with the existing land use. The grid connection cable will be underground and there will be a temporary disturbance to land use during construction as cables are laid, but there will be no permanent change in land use. Land take/land use change is not considered further in this assessment for the TDR and Proposed Cable Corridor.

6.90 Material (soils, subsoils and bedrock (in the borrow pits only)) will be required to be excavated at the turbine locations and associated infrastructure, substation and within the borrow pits. In the case of the turbines (and associated infrastructure), this excavation is so that infrastructure components can be installed along with fill material. In the case of the borrow pits, removal of material from this area is for the purpose of reusing the material as fill material in the wider site.

6.91 Laying of the grid connection cable will involve the laying of 6 km of cables underground. A bedding layer of sand will be added to the trench and PVC ducts and couplers will be installed on top of this. Trenches will then be backfilled.

6.92 An estimation of the aggregate material quantities for all elements of the Proposed Development has been made; the on-site borrow pits and the excess from the cut and fill requirements are likely to result in all aggregate material being won within the Site. However, to ensure a robust assessment, it has been assumed that the type of aggregate required for construction will be imported. **Table 6-3** provides a summary of the material quantities (aggregates only) required on Site.

Table 6-3 Estimated Aggregate Quantities

Proposed Infrastructure	Volume of Aggregate	Approximate Tonnages of Aggregate
Access tracks (new & upgraded)	22,160m^3	39,888t
Turbine bases (area & base formation)	7,260m^3	13,068t
Hardstanding and laydown areas	18,920m^3	34,056t
cv Substation	16,280m^3	29,304t
Construction compound	3,615m^3	6,507t
Misc	8,500	15,300
TOTAL	**76,735m^3**	**138,123t**

6.93 A total of 35,414 tonnes (t) of aggregate material will be required for the construction of the Proposed Development. There is no direct loss of in-situ bedrock at the Proposed Development Site except within the borrow pits. Soils will be removed at the Site at turbine locations and associated infrastructure, electricity substation and also within the borrow pits. However, the excavated soils and bedrock will remain onsite and will be reused to build infrastructure items such as access tracks, hardstanding areas and foundations (i.e. cut-and-fill). It is proposed that construction of the wind turbine foundations will require excavation of peat (at T1 and T3) and subsoil to create a suitable area for the foundation of the base. The loss of onsite geological resources (bedrock, soils and subsoils) is considered to be of low impact and the effect significance is considered to be *Slight*.

6.94 The TDR will not require the excavation of soil, subsoil or bedrock as it is an existing road network. Further consideration of the TDR is scoped out for consideration of excavation of soils, subsoils and bedrock.

6.95 Disturbance will occur to local soils along the cable route as they are excavated to 1.2m. Excavated material will be reused during backfilling of the trenches. Excess material will also be used to backfill the borrow pits within the Site. No excavated soils will be sent offsite, all soils will be reused within the Site. The potential impact to soils and subsoils through excavation is considered to be low (adverse) and the significance of the effect is considered to be *Slight.*

6.96 Fuel and oil leaks and spills are a potential indirect impact associated with construction machinery and construction work areas/compounds within the Site (i.e. turbines, borrow pits and substation). During soil and rock extraction, there is an increased risk to soil and bedrock should a leak or spill occur. However, construction works associated with the turbine locations and site compounds will involve shallow earthworks and infilling of excavations as part of foundation works which will occur within a short time period, reducing the potential exposure risk. The borrow pits will be partially backfilled with any remaining soils once it is no longer in use. The potential magnitude of impact to bedrock, soils and subsoils is considered to be low and the potential significance of effect is considered to be *Slight.*

6.97 During construction, excavation will be carried out by excavators and heavy machinery which have the potential to leak/spill fuels and oils. However, given the confined natured of the work along the GDR (i.e. small working trench area), small numbers of heavy vehicles will be in use at any one time while excavating or backfilling the trench route. It is considered unlikely in this scenario that a large scale fuel or oil leakage could occur and any incidents would be small and easily contained before substances could leak into the underlying sediments and bedrock. The potential impact to soils/subsoils and bedrock from a fuel/oil leak or spill is considered to be negligible (adverse) and the significance of the effect is considered to be *Imperceptible*.

6.98 The TDR is an existing road network which does not allow the direct infiltration of spills and leaks to soils, subsoils or bedrock. Further consideration of the TDR is scoped out for soils, subsoils and bedrock due to leaks and spills in this assessment.

6.99 Fen peat has been identified beneath proposed turbine location T1 and T3 to the north of the Site. The PLHRA (**Appendix 6-1**) identifies that the initial site walkover carried out by SLR considered the following:

- There is no evidence of historical or current peat slide activity at the Site (having reviewed historical imagery dating back to 1985);
- There is little elevation change across the Site, with the topography best described as gently undulating; and
- Conclusions of a detailed walkover and results from probing.

6.100 The initial site walkover assessed that the potential for peat sliding was negligible. Further analysis then considered the terrain at the Site using GIS to analyse slopes and gradients in the mapped fen peat area for turbine locations T1 and T3 (**Appendix 6-1**, **Figure 5**). The site-specific slope data has been combined with site specific peat depth data and using Irish Government guidance for the assessment of the risk of instability in peat, and an assessment of peat slide risk (**Appendix 6-1**).

6.101 The PLHRA's method of risk and hazard assessment has been developed with reference to the Irish Guidance[1]. Key factors which may have an effect on the stability of the peat deposits have been identified leading to an assessment of the risk of peat instability.

6.102 Risk scores were determined, which, when combined with an assessment of vulnerability of potential targets, were developed into an assessment of the hazard. In order to differentiate between risk and hazard, the following nomenclature has been adopted (see **Table 6-4**).

[1] Dept of Housing, Planning & Local Government (2019). Draft Revised Wind Energy Development Guidelines.

Table 6-4 Risk and Hazard

Risk	Hazard
Negligible	Insignificant
Low	Significant
Medium	Substantial
High	Serious

6.103 The characteristics of peat failure phenomena have been incorporated in the PLHRA to evaluate the risk of instability occurring within the peat areas. Of the 135 locations that were probed in areas of peat development, 43 have been classified as low risk and 92 as negligible risk (see **Appendix A of Appendix 6-1**). No medium or high-risk locations were identified. These quantitative results are consistent with observations made during the site walkover and the subsequent peat probing survey.

6.104 It is considered that the potential magnitude of impact to turbine locations T1 and T3 due to a presence of peat is considered to be negligible-low and the potential significance of effect is considered to be *Slight* to *Moderate*.

6.105 No peat has been identified in the area of the other turbine locations, it is considered that potential magnitude of impact to other turbine locations is considered to be negligible and the potential significance of effect is considered to be *Slight*.

Table 6-5 Evaluation of Initial Construction Impacts and their Effect Significance (without mitigation)

Project Phase	Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect *
Construction	Land	Low	Forestry and agricultural land loss within Site.	Low (Adverse) (turbines (and associated infrastructure), electricity substation, and borrow pits)	Slight (Adverse) (turbines (and associated infrastructure) electricity substation, borrow pits)
			Temporary disruption to land use as cable route is lain.	Negligible (Cable Route)	Slight (Cable Route)
Construction	Soil and subsoil	Low	Material (soils, subsoils) will be required to be excavated at the turbine locations, access tracks and within the borrow pits. Permanent loss but excavated material will remain onsite and will be reused to build infrastructure items such as access tracks, turbine, hardstanding and substation foundations. In the case of the cable route, soils and subsoils will be removed but will be reused during backfilling of the trenches.	Low (Adverse) (turbines (and associated infrastructure), electricity substation, borrow pits and Cable Route)	Slight (Adverse) (turbines (and associated infrastructure), electricity substation, borrow pits and Cable Route)
			Fuel and oil spills and leaks to soils and subsoils during construction within the Site and along the cable route	Low (Adverse) (turbines (and associated infrastructure), electricity substation, borrow pits and Cable Route)	Slight (Adverse) (turbines (and associated infrastructure), electricity substation, borrow pits and Cable Route)

Project Phase	Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect *
Construction	Bedrock geology (as an insitu feature)	Low	Fuel and oil spills and leaks during construction and along the cable route	Low (Adverse) (turbines (and associated infrastructure), electricity substation, borrow pit, TDR and Cable Route)	Slight (Adverse) (turbines (and associated infrastructure), electricity substation, borrow pits, TDR and Cable Route)
Construction	Human health/built structure	High	Peat instability around turbine locations T1 and T3 due to the presence of fen peat	Negligible to low (Adverse)	Slight to Moderate (Adverse)

Potential Effects – Operational

6.106 **Table 6-6**, below, summarises the potential effects discussed in the following subsections.

Turbines (and Associated Infrastructure), TDR, CC and Substation

6.107 During the operational phase of the Proposed Development, there will be no new direct effects to land, soils, subsoils and bedrock due to the Proposed Development. Routine site maintenance of the turbines (and associated infrastructure) will be undertaken which has the potential to indirectly effect soils, subsoils and bedrock at the Site. The borrow pits will have been restored and no longer in use during this phase and the electricity substation will have no further potential effect on soils, subsoils or bedrock. Given that there will be no exposed excavations and a small number of vehicles/equipment required for maintenance, the magnitude of impact from fuel and oil leaks and spills is considered to be negligible and the potential significance of effect is considered to be *Imperceptible.*

6.108 Given the construction phase will be designed to reduce the risk of peat instability (through mitigation measures detailed below), inherent design measures will be in place to reduce the risk of peat instability (such as the design and implementation of drainage management systems onsite, refer to Sections 6.1 and 6.2 of **Appendix 6-1**), it is considered that the potential effect is negligible and the potential significance of effect is considered to be *Slight.*

6.109 Similar to the operational phase associated with the turbines (and associated infrastructure) and TDR, the operational phase for the cable route will have no new direct effects on land, soils, subsoils or bedrock. Routine site maintenance will also be required for the cable route and the magnitude of impact from fuel and oil leaks and spills is considered to be negligible and the potential significance of effect is considered to be *Imperceptible* to soils, subsoils and geology.

Table 6-6 Evaluation of Initial Operational Impacts and their Effect Significance

Project Phase	Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect *
Operations	Soils, subsoils	Low	Fuel and other substance leaks and spills from machinery and plant onsite	Negligible (Adverse)	Imperceptible
Operations	Bedrock geology	Low (as an insitu feature)	Fuel and other substance leaks and spills from machinery and plant onsite	Negligible (Adverse)	Imperceptible
Operations	Human health	High (human beings/workers)	Peat instability around turbine location T1 and T3 due to the presence of fen peat	Negligible (Adverse)	Slight

Potential Effects – Decommissioning

6.110 **Table 6-7** below, summarises the potential effects discussed in the following subsections.

6.111 The Proposed Development seeks a 35-year operational period. Wind turbines may, subject to planning permission, be replaced with a new set of turbines or the Proposed Development may be decommissioned. Consideration will be given here in the following subsections to the potential effects arising from decommissioning of the Site.

Turbines (and Associated Infrastructure) TDR, CC and Substation

6.112 During the decommissioning phase of the Proposed Development, the turbines will be fully disconnected from the power supply.

6.113 Given the construction phase will be designed to reduce the risk of peat instability (through mitigation measures detailed below), and these will continue into the operational phase, inherent design measures will be in place during the decommissioning phase to reduce the risk of peat instability (such as the design and implementation of drainage management systems onsite, refer to Sections 6.1 and 6.2 of **Appendix 6-1**), it is considered that the potential effect is negligible and the potential significance of effect is considered to be *Slight.*

6.114 The foundations will be covered over and allowed to re-vegetate naturally. Leaving turbine foundations in situ is considered a more environmentally sensible option as to remove the reinforced concrete associated with each turbine would result in environmental nuisances such as noise and vibration and dust. It is proposed that the internal Site access tracks will be left in situ, subject to agreement with Westmeath County Council and the relevant landowners. It is envisaged that the remaining wider forestry and agricultural uses would still be in-situ during the decommissioning phase and the most likely land use would be a return to forestry and agriculture. Similar to the construction and operation phases, machinery and plant operating in the Site areas represents a potential fuel and oil spill risk.

6.115 The proposed substation will be taken in charge by ESBN /EirGrid upon completion and should be left in place forming part of the national electricity network. It is anticipated that the substation would be in situ on a permanent basis and not time limited as will be the case for the main wind farm site.

6.116 The potential impact of this decommissioning and return to agriculture and forestry land use is considered to be negligible and the potential significance of effect is considered to be *Slight.*

6.117 Underground cabling will be cut back and left in situ along the Proposed Cable Corridor. Checks will be carried out to ensure that no environmental risks remain when the cabling is left behind.

6.118 The potential impact of this decommissioning on soils, subsoils and bedrock geology use is considered to be negligible and the potential significance of effect is considered to be *Slight.*

Table 6-7 Evaluation of Initial Decommissioning Phase Impacts and their Effect Significance

Project Phase	Receptor	Sensitivity	Source of Impact/Description of Change*	Impact Magnitude*	Level of Effect *
Decommissioning	Land	Low	Return to agriculture and forestry	Negligible (Beneficial)	Slight
Decommissioning	Soils, subsoils	Low	Fuel and other substance leaks and spills from machinery and plant onsite	Negligible (Adverse)	Slight
Decommissioning	Bedrock geology	Low (as an insitu feature)	Fuel and other substance leaks and spills from machinery and plant onsite	Negligible (Adverse)	Slight
Operations	Human health	High (human beings/workers)	Peat instability around turbine location T1 and T3 due to the presence of fen peat (during removal of the turbines)	Negligible (Adverse)	Slight

Cumulative Effects

6.119 In terms of all proposed and permitted developments within vicinity of the Site, the details of projects considered in the cumulative assessment are presented in **Appendix 1-1** 'Developments Considered in the Cumulative Assessment'. In the context of land, soils and geology, a search of the National Planning Map Viewer (myplan.ie) indicates that there are no other major planned developments in the vicinity of the Site or on surrounding lands that have recently been granted planning permission that have the potential to give rise to any significant adverse land, soils or geology cumulative impacts.

MITIGATION MEASURES

Mitigation Measures - Construction

Turbines (and Associated Infrastructure) TDR, CC, Borrow Pits and Substation

6.120 The following mitigation measures will be implemented in full during the construction phase:

- Site operations will be managed in accordance with relevant health and Safety legislation (Safety, Health & Welfare at Work Act (2005, as amended);
- Construction phase activities will take place in accordance with the Construction Environmental Management Plan (CEMP);
- Fencing will be maintained at the Site to ensure that the risk of injury to the public and livestock is minimised;
- Stockpiles will be evaluated and monitored and kept stable for safety and to minimise erosion;
- Permission will be sought from the Forestry Service to replant lands to compensate the loss of forestry land within the Site area by replanting forestry at an alternative site within the State;
- In order to reduce the risk of localised erosion (and potential dust emissions) during the excavation and infilling, the area of bare or exposed soils and rock will be kept to a minimum, insofar as practicable, by progressive restoration of final and backfilled surfaces. Where required, stockpiled soils (pending re-use) or exposed surfaces (pending further backfilling to final ground level) will be temporarily covered; and
- All aspects of the proposed backfilling / construction phase works will be undertaken in accordance with relevant best practice environmental guidance published by the Environmental Protection Agency and other regulatory agencies. All activities will be undertaken in accordance with the provisions in the Waste Management Act 1996 (as amended).

6.121 The proposed mitigation measures to deal with potential fuel / oil spills include the following:

- Ensuring that any refuelling of mobile plant undertaken within the Site is only undertaken using double skinned bowsers;
- No oils, greases, hydraulic fluids or hazardous substances (or any associated wastes) will be stored across the Site. All such materials will be stored under cover, over fuel spill trays / bunded containers within designated storage areas within the construction compounds;

- Good site management practices will be implemented to reduce risks of spills, including regular monitoring and inspection of storage vessels and regular maintenance and servicing of construction plant and equipment;
- The Applicant will ensure that such plant and resources as are necessary to ensure that the Site will be managed and operated in accordance with best waste management practice and that activities comply fully with environmental management systems and planning consents; and
- Contingency plans / procedures will be developed to deal with potential leaks and spills. An emergency spill response kit will be held on Site.

6.122 The following is a list of mitigation measures that should be incorporated into the development of construction methodologies for the works in all areas of peat during the detailed design stage, these will support the operational phase of the Proposed Development:

- Appropriately experienced and qualified engineering geologist/geotechnical engineer should be appointed during the construction phase, to provide advice during the setting out and construction phases of the works;
- Geotechnical Risk Register is developed and maintained by the appointed geotechnical engineer;
- A minimisation of “undercutting” of peat slopes, but where this cannot be avoided, a more detailed assessment of the area of concern by the geotechnical engineer would be undertaken;
- Methodologies will be developed as a contingency to minimise the effects to watercourses in the unlikely event of peat instability; and
- Use of floating track across areas of deep peat.

6.123 Notwithstanding any of the above controls and mitigation measures, detailed design and construction practices would need to consider the particular ground conditions and the specific works at each location throughout the construction period.

6.124 To minimise the risk of potentially inducing peat landslides during construction of the development the following should be implemented:

- Raise Health and Safety awareness of the peat environment at the proposed development for construction staff by incorporating the issue into the site induction. Include peat slide risk assessment information (e.g. peat instability indicators, best practice and emergency procedures) in tool box talks with relevant operatives e.g. plant operatives;
- Introduce a ‘Peat Hazard Emergency Plan’ to provide instructions for site staff in the event of a peat slide or discovery of peat instability indicators;
- For sections of track that require track side cuttings into peat, suitable support measures would need to be designed to maintain the stability of the adjacent peat terrain;
- Refine/optimise the design through the pre-construction phase following completion of a detailed ground investigation; and
- Develop methodologies to ensure that accelerated degradation and erosion of exposed peat deposits does not occur as the break-up of the peat top mat has significant

implications for the morphology, and thus hydrology, of the peat (e.g. minimise off-track plant movements within areas of peat).

6.125 In order to maintain hydrological conditions (in consideration of peat stability around turbine locations T1 and T3), the following requirements of the drainage measures should be met:

- Development of drainage systems that would not create areas of concentrated flow or cause over-, or under-saturation of peat habitats;
- Development of robust drainage systems that would require minimal maintenance;
- Develop a robust design of drainage systems and associated measures (e.g. silt traps, etc.) to minimise sedimentation into natural watercourses. Method statements should be prepared in advance to mitigate against a slide occurring and should include, but not be limited to, the use of check dams and erosion protection to limit flows and prevent contamination of watercourses; and
- Measures shall be put in place to ensure drainage systems are well maintained, to include the identification and demarcation of zones of sensitive drainage or hydrology in areas of construction, e.g. inclusion of maintenance regimes for drainage systems into a construction management plan or similar.

Access Tracks Only

6.126 In order to maintain the current level or improve the stability of the peat mass on the slopes around the access track, it is necessary to ensure that the construction methods do not seriously disrupt the established drainage and that no areas are surcharged, either by water discharge or spoil.

6.127 The following principles will be adopted:

- Maintenance of existing drainage is critical, therefore all existing drainage tracks must be maintained and where necessary, channelled below the proposed track construction. Upslope side drainage ditches to the track would be required on side-long ground; the ditches should be constructed with small dams and cross drains where necessary so that:
- Water can pass below the track at regular intervals;
- Scour and erosion is avoided in the side ditches due to the limited volume and velocity;
- Concentrated discharges to the peat on the down slope side of the track are avoided;
- The camber of the track should encourage surface water to drain to the up-slope side drainage ditch;
- Track gradients to be maintained at the recommended gradients from the wind turbine supplier, typically shallower than 1 v: 8 h to facilitate access by the large specialist vehicles for both construction and transport of the wind turbine components. The maximum acceptable gradients are usually defined by the appointed wind turbine manufacturer.
- Identify and mark all existing drainage features within the access track corridors; these drainage features should be maintained (not enhanced) during the construction and operational phases of the Proposed Development;
- Install cross drains at regular intervals to maintain interstitial groundwater flow through the peat mass below the tracks where track settlement could reduce the natural permeability;

- Install additional drainage in areas up-slope to any track to prevent ponding and possible instability;
- Install small dams at regular intervals along the track side drains to prevent significant water velocities in the side drains causing deep erosion in the peat;
- Where track construction is required over peat areas in excess of 1m deep, this may be undertaken with a floating track construction, where the integrity of the peat allows;
- Cut and fill should be avoided in peat greater than 1m deep if possible; if not, the following requirements on side long ground (across contours) should be adopted;
    - Excavate to a sound stratum;
    - The majority of construction surfaces to be essentially horizontal with a slight fall to aid drainage;
    - Where the depth of cut is deemed unstable, employ a stepped or benched surface with the intention of minimising the exposed surface of the up-slope cut face;
    - Protect all exposed peat surfaces from erosion and desiccation, by ensuring the integrity and moisture content of the peat is maintained; and
    - The top of cut slopes should be provided with a small bund to retain the peat to prevent desiccation and maintain the local stability of the peat.

Mitigation Measures - Operational

Turbines (and Associated Infrastructure) and Substation

6.128 Site operations will be managed in accordance with relevant health and Safety legislation (Safety, Health & Welfare at Work Act (2005, as amended);

6.129 The proposed mitigation measures to deal with potential fuel / oil spills include the following:

- Ensuring that any refuelling of mobile plant undertaken within the Site is only undertaken using double skinned bowsers;
- No oils, greases, hydraulic fluids or hazardous substances (or any associated wastes) will be stored across the Site. All such materials will be stored under cover, over fuel spill trays / bunded containers within designated storage areas within the construction compounds;
- Good site management practices will be implemented to reduce risks of spills, including regular monitoring and inspection of storage vessels and regular maintenance and servicing of construction plant and equipment;
- The Applicant will ensure that such plant and resources as are necessary to ensure that the Site will be managed and operated in accordance with best waste management practice and that activities comply fully with environmental management systems and planning consents; and
- Contingency plans / procedures will be developed to deal with potential leaks and spills. An emergency spill response kit will be held on Site.

6.130 Measures shall be put in place to ensure drainage systems are well maintained, to include the identification and demarcation of zones of sensitive drainage or hydrology in areas e.g. inclusion of maintenance regimes for drainage systems into a management plan or similar.

6.131 Continue to use and update the 'Peat Hazard Emergency Plan' to provide instructions for site staff in the event of a peat slide or discovery of peat instability indicators. The Peat Hazard Emergency Plan should provide details on the frequency of proposed monitoring during operations.

Mitigation Measures - Decommissioning

Turbines (and Associated Infrastructure), TDR and GDR

6.132 Site operations will be managed in accordance with relevant health and safety legislation (Safety, Health & Welfare at Work Act (2005, as amended);

6.133 Stockpiles will be evaluated and monitored and kept stable for safety and to minimise erosion; and

6.134 Fencing will be maintained at the Site to ensure that the risk of injury to the public and livestock is minimised.

6.135 The proposed mitigation measures to deal with potential fuel / oil spills include the following:

- Ensuring that any refuelling of mobile plant undertaken within the Site is only undertaken using double skinned bowsers;
- No oils, greases, hydraulic fluids or hazardous substances (or any associated wastes) will be stored across the Site. All such materials will be stored under cover, over fuel spill trays / bunded containers within designated storage areas within the construction compounds;
- Good site management practices will be implemented to reduce risks of spills, including regular monitoring and inspection of storage vessels and regular maintenance and servicing of construction plant and equipment;
- The Applicant will ensure that such plant and resources as are necessary to ensure that the Site will be managed and operated in accordance with best waste management practice and that activities comply fully with environmental management systems and planning consents; and
- Contingency plans / procedures will be developed to deal with potential leaks and spills. An emergency spill response kit will be held on Site.

6.136 In order to reduce the risk of localised erosion (and potential dust emissions) during the excavation and infilling, the area of bare or exposed soils and rock will be kept to a minimum, insofar as practicable, by progressive restoration of final and backfilled surfaces. Where required, stockpiled soils (pending re-use) or exposed surfaces (pending further backfilling to final ground level) will be temporarily vegetated;

6.137 All aspects of the proposed backfilling works will be undertaken in accordance with relevant best practice environmental guidance published by the Environmental Protection Agency and other regulatory agencies. All activities will be undertaken in accordance with the provisions in the Waste Management Act (1996) as amended; and

6.138 Mitigation measures proposed in the construction phase for peat instability should be implemented during the decommissioning phase, where relevant.

‘DO-NOTHING SCENARIO’

6.139 The Do-Nothing scenario relevant to land, soils and geology is one where the Proposed Development does not go ahead and the Site will continue to be predominantly in forestry and agricultural use. No soils or geology would be extracted from the Site and no clearance of forestry (beyond normal felling and replanting) would occur.

RESIDUAL IMPACT ASSESSMENT

Residual Effects - Construction

6.140 With the implementation of the proposed mitigation measures, it is considered that the potential effects of fuel spill on soils and bedrock, will reduce to Imperceptible.

6.141 Residual effects for land from land use change, where relevant, will remain at *Slight* as land use will remain changed in the locality.

6.142 The residual effects for soils, subsoils and bedrock through the loss of material in excavation is considered to be unchanged at Slight, given the loss of in situ material cannot be offset.

6.143 The residual effect of the potential peat instability will reduce to *Slight* with the implementation of the mitigation measures.

Residual Effects - Operations

6.144 The residual effect to soils and bedrock through the indirect impact of leaks and spills is considered to be *Imperceptible*, or unchanged from the initial assessment.

6.145 The residual effects of potential peat instability will remain at *Slight.*

Residual Effects - Decommissioning

6.146 With the implementation of the proposed mitigation measures, it is considered that the potential effects of fuel spill on soils and bedrock, will reduce to *Imperceptible.*

6.147 The residual effects of potential peat instability will remain at *Slight.*

UNPLANNED EVENTS

6.148 Unplanned events within the Site have the potential to impact on the land, soils and geology at the Site. In the context of the Proposed Development, ground instability is considered to be the main disaster/accident that could be associated with the Proposed Development.

6.149 In the context of the Site and known history, it is considered that the fen peat could lead to instability in the area of turbine locations T1 and T3. However, during construction peat will be excavated in the area of the turbine location, which will reduce the depth of peat at this location. The principal surface indicator of peat slide potential is cracking of the peat land surface and it is the identification of crack patterns in the field and the attendant causes of the cracking that is fundamental to a peat stability assessment. Advance warning signs of the failure such as cracking, change in levels or slumping of the foundations and concrete bases associated with the wind turbines would be visible during Site inspections and standard maintenance works. Should there be indications of a potential instability concern, remedial measures could be implemented to prevent a failure event.

6.150 It is considered that the potential effects of such an event, which could only occur at the location of T1 or/and T3, would be Not Significant.

MONITORING

6.151 Periodic Site inspections should be undertaken of the Site area to inspect ground conditions during all phases, particularly after heavy rainfall events.

DIFFICULTIES ENCOUNTERED

6.152 No particular difficulties were encountered in undertaking the assessment of soils, land and geology.

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FIGURES

660000
663000
666000
669000
771000
768000
765000

N

T1
T2
T3
T4
T5
T6
T7
T8

Kells Hill
Kilskyre
Killua Castle Deer Park
Delvin
Athboy
N52
N51
R154
R395
L1546

0 1 2
Kilometres

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Development Site Boundary 2 km Buffer
- Proposed Internal Collector Cable
- Proposed Cable Route
- Proposed Access Track
- Proposed Temporary Construction Compound
- Proposed Operational Compound
- Proposed Substation Location
- Proposed Borrow Pit
- Proposed Crane Hardstanding
- Existing High Voltage Transmission Line

Irish Soil Information System - National Soils

- 05RIV - River
- 0650a - Mylerstown
- 0760c - Howardstown
- 1000a - Elton
- 1030b - Rathowen
- 1xx - Peat
- Urban
- Waterbody

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KNOCKANARRAGH WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT REPORT

LAND, SOILS & GEOLOGY

NATIONAL SOILS - OVERVIEW

FIGURE 6-1-a

Scale 1:35,000 @ A3

Date MARCH 2024

02036.00812.0093.0 National Soils

662000 663000 664000 665000

769000

768000

02036.00812.0093.0 National Soils

T1 T2 T3

N

0 250 500

Metres

LEGEND

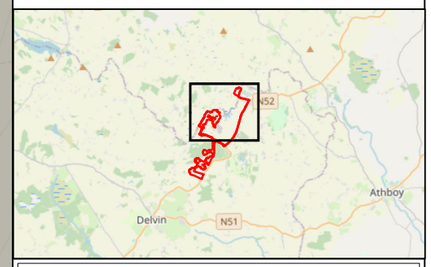
- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Access Point
- Proposed Cable Route
- Proposed Access Track
- Proposed Temporary Construction Compound
- Proposed Substation Location
- Proposed Borrow Pit

Proposed Crane Hardstanding

- Permanent Hardstanding
- Temporary Hardstanding
- Level and Clearance Area
- Existing High Voltage Transmission Line

Irish Soil Information System - National Soils

- 05RIV - River
- 1000a - Elton
- 1030b - Rathowen
- 1xx - Peat
- Urban
- Waterbody



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KNOCKANARRAGH WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT REPORT

LAND, SOILS & GEOLOGY

NATIONAL SOILS - NORTHERN CLUSTER

FIGURE 6-1-b

Scale 1:10,000 @ A3

Date MARCH 2024

662000
663000
664000
767000
766000
765000

T4
T5
T6
T7
T8

N

LEGEND

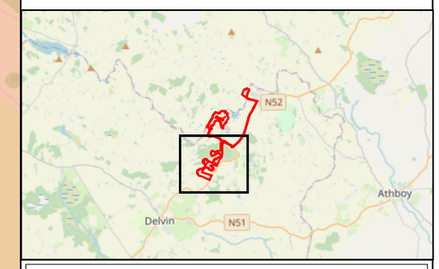
- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Access Point
- Proposed Internal Collector Cable
- Proposed Cable Route
- Proposed Access Track
- Proposed Operational Compound
- Proposed Borrow Pit

Proposed Crane Hardstanding

- Permanent Hardstanding
- Temporary Hardstanding
- Level and Clearance Area

Irish Soil Information System - National Soils

- 05RIV - River
- 1000a - Elton
- 1030b - Rathowen
- 1xx - Peat



0 250 500
Metres

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LAND, SOILS & GEOLOGY

NATIONAL SOILS - SOUTHERN CLUSTER

FIGURE 6-1-c

Scale 1:10,000 @ A3

Date MARCH 2024

02036.00812.0093.0 National Soils

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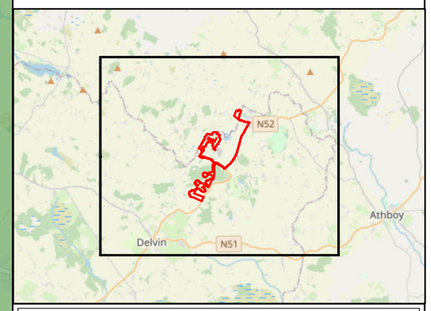
Kilometres

LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Development Site Boundary 2 km Buffer
- Proposed Internal Collector Cable
- Proposed Cable Route
- Proposed Access
- Proposed Temporary Construction Compound
- Proposed Operational Compound
- Proposed Substation Location
- Proposed Borrow Pit Search Area
- Proposed Crane Hardstanding
- Existing High Voltage Transmission Line

Environmental Protection Agency - Subsoils

- A - Alluvium Undifferentiated Gravelly
- AcEsk - Acidic Esker sands and gravels
- BasEsk - Basic Esker Sand and Gravel
- Cut - Cutover Peat
- FenPt - Fen Peat
- GLPSsS - Sandstone and shale sands and gravels Lower Palaeozoic
- GLs - Limestone Sand and Gravel Carboniferous
- L - Lake Sediments Undifferentiated
- Made Ground
- Rck - Bedrock at Surface
- TLPSsS - Sandstone and Shales Till Devonian/Carboniferous
- TLs - Limestone Till Carboniferous
- Water



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KNOCKANARRAGH WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT REPORT

LAND, SOILS & GEOLOGY

NATIONAL SUBSOILS - OVERVIEW

FIGURE 6-2-a

Scale 1:35,000 @ A3

Date MARCH 2024

02036.00812.0094.0 National Subsoils

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LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Access Point
- Proposed Cable Route
- Proposed Access
- Proposed Temporary Construction Compound
- Proposed Substation Location
- Proposed Borrow Pit Search Area
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Environmental Protection Agency - Subsoils

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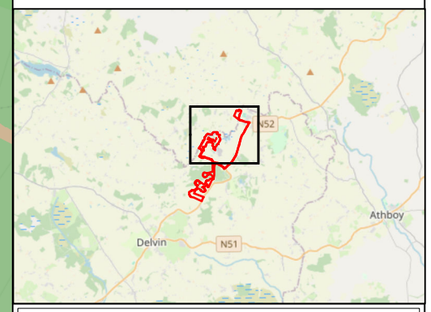
- Cut - Cutover Peat
- FenPt - Fen Peat
- GLs - Limestone Sand and Gravel Carboniferous
- L - Lake Sediments Undifferentiated
- Made Ground
- TLs - Limestone Till Carboniferous
- Water



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KNOCKANARRAGH WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT REPORT

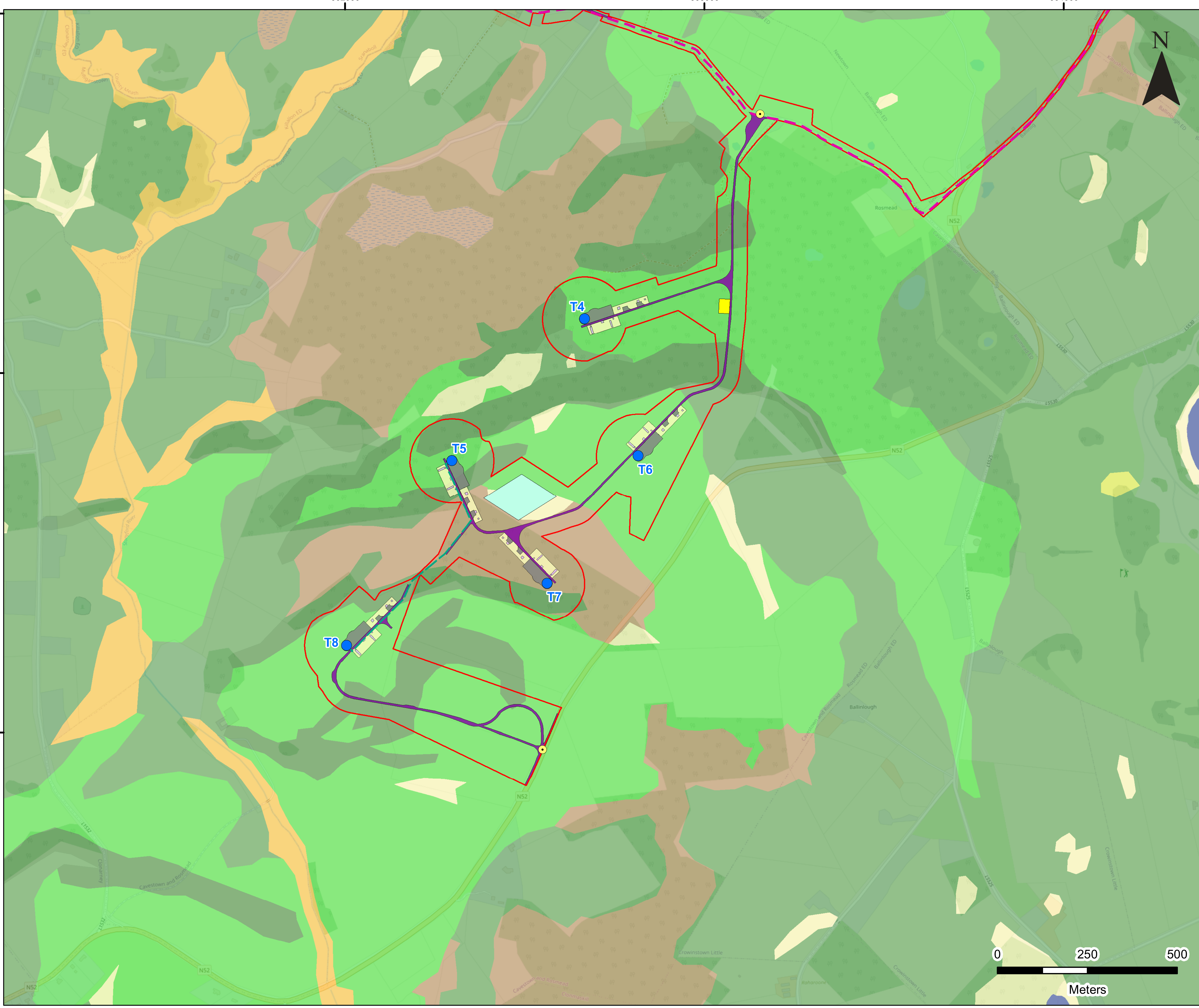
LAND, SOILS & GEOLOGY

NATIONAL SUBSOILS - NORTHERN CLUSTER

FIGURE 6-2-b

Scale	Date
1:10,000 @ A3	MARCH 2024

02036.00812.0094.0 National Subsoils

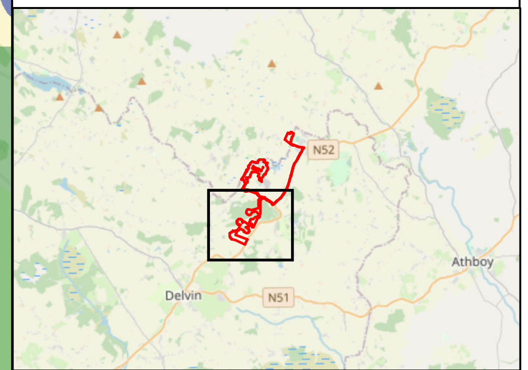


LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Access Point
- Proposed Internal Collector Cable
- Proposed Cable Route
- Proposed Access
- Proposed Operational Compound
- Proposed Borrow Pit Search Area

Environmental Protection Agency - Subsoils

- A - Alluvium Undifferentiated Gravelly
- BasEsk - Basic Esker Sand and Gravel
- Cut - Cutover Peat
- FenPt - Fen Peat
- GLs - Limestone Sand and Gravel Carboniferous
- L - Lake Sediments Undifferentiated
- Rck - Bedrock at Surface
- TLs - Limestone Till Carboniferous
- Water



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KNOCKANARRAGH WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT REPORT

LAND, SOILS & GEOLOGY

NATIONAL SUBSOILS - SOUTHERN CLUSTER

FIGURE 6-2-c

Scale	Date
1:10,000 @ A3	MARCH 2024

02036.00812.0094.0 National Subsoils

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Irish National Subsoils Map, 1:250k, V1b (2014) Teagasc, Cranfield University jointly funded by the EPA STRIVE Research Programme 2007-2013 and Teagasc

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LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Development Site Boundary 2 km Buffer
- Proposed Internal Collector Cable
- Proposed Cable Route
- Proposed Access Track
- Proposed Temporary Construction Compound
- Proposed Operational Compound
- Proposed Substation Location
- Proposed Borrow Pit
- Proposed Crane Hardstanding
- Existing High Voltage Transmission Line

Bedrock Feature

- Dip of Bedding or Main Foliation, Old GSI Data
- Horizontal Bedding

Bedrock Linear Feature

- Fault

Bedrock

CARBONIFEROUS

- Ballysteen Formation
- Lucan Formation
- Tober Colleen Formation
- Waulsortian Limestones

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KNOCKANARRAGH WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT REPORT

LAND, SOILS & GEOLOGY

BEDROCK GEOLOGY

FIGURE 6-3

Scale 1:35,000 @ A3

Date MARCH 2024

02036.00812.0095.0 Bedrock Geology

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LEGEND

- Proposed Development Site Boundary
- Proposed Turbine Location
- Proposed Development Site Boundary 2 km Buffer
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- Proposed Cable Route
- Proposed Access Track
- Proposed Temporary Construction Compound
- Proposed Operational Compound
- Proposed Substation Location
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- Proposed Crane Hardstanding
- Existing High Voltage Transmission Line

Note
No Geological Heritage Sites Present.

0 1 2
Kilometres

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KNOCKANARRAGH WIND FARM ENVIRONMENTAL IMPACT ASSESSMENT REPORT

LAND, SOILS & GEOLOGY

GEOLOGICAL HERITAGE

FIGURE 6-4

Scale 1:35,000 @ A3

Date MARCH 2024

02036.00812.0096.0 Geological Heritage

APPENDICES

Appendix 6-1: Peat Landslide Hazard Risk Assessment