MWP

Chapter 09 Land and Soil

Ballycar Wind Farm

9. Land and Soils

9.1 Introduction

This chapter describes any potential effects on land and soils due to the construction, operation and decommissioning of the proposed development. A full description of the proposed development, development lands and all associated project elements is provided in **Chapter 2**. The nature and probability of any effects on the existing land and soils environment arising from the overall development has been assessed. The assessment comprises of:

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

9.1.1 Competency of Assessor

The assessment was undertaken by Jasmin Spoerri (BSc, MSc), an Engineering Geologist with over two years' experience in engineering geology, environmental geology, and geotechnical engineering. She holds an MSc in Applied Environmental Geoscience from University College Cork. Jasmin has been involved in geological investigation/interpretation, geotechnical investigation/interpretation, hydrogeological assessment and investigation, and environmental assessment. Jasmin has written Land and Soils chapters for various projects such as pharmaceutical developments: LEO Pharma, Little Island, Co. Cork and Abbott Kilkenny Facility, Abbott (Ireland), Co. Kilkenny, and housing developments: Castlelake SHD, Carrigtwohill, Co. Cork. This included assessment of environmental impacts on Land, Soils, Geology, Hydrogeology as well as cumulative impacts with various other aspects of the environment. She has also worked on Geotechnical Interpretive Reports (GIRs) for several renewable energy projects including Moanvane Wind Farm, Co. Offaly and Coole Wind Farm, Co. Westmeath, substations and grid connections including the 110kV substation and grid connection in the townlands of Ballykilleen, Cloncreen and Ballinowlart North, Co. Offaly.

Paddy Curran (BE, MSc, DipPM, CEng, MICE) also contributed to this assessment. Paddy is a Senior Engineer and has over 11 years' experience in civil engineering, particularly in the area of Geotechnical Engineering. Project experience includes delivering the geotechnical investigation/interpretation, design and construction support for Tullabrack Wind Farm, Derryadd Windfarm EIS and Carrownagowan Wind Farm.

This assessment has been reviewed by Olivia Holmes. Olivia is a Chartered Engineer and Chartered Environmental Practitioner with over 20 years' experience in Environmental Engineering focussing primarily on Environmental Impact Assessment (EIA), Appropriate Assessment (AA) and planning. She has prepared and reviewed a number of Land & Soil chapters of EIARs over her career to date for a broad range of projects.

9.1.2 Legislation

This document is in compliance with 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.
- Planning and Development Act 2000.
- Planning and Development Regulations, 2001 - 2023.
- Clare County Council (2022): Clare County Development Plan 2023-2029.

9.2 Methodology

The assessment methodology included a desk-based study, site visits, and a qualitative assessment of the potential effects. The assessment criteria for geology, land and soils are based on the guidelines from the following reports:

- Coillte (2009): Forest Operations & Water Protection Guidelines;
- Environmental Protection Agency (2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- EU Environmental Impact Assessment of Projects: Guidance on Scoping. European Union;
- Environmental Protection Agency (2022): Glossary of Effects included in Guidelines on Information to be contained in Environmental Impact Assessment Reports; (EPA, 2022);
- 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; and
- Scottish Executive (2017): Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, 2nd Edition.

9.2.1 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, refer to **Section 9.2.3**.
- Examination of the Geological Survey of Ireland (GSI) datasets pertaining to geological (bedrock, heritage, subsoil, etc.) and extractive industry data.
- Examination of Environmental Protection Agency (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 allocations within the study area.
- Review of Clare County Council's Planning Register to identify relevant development proposals currently under consideration by the Council.

Following the desk top study and field surveys, a set of geological and soils maps were generated in GIS using data acquired from GSI, the EPA and GeoHive Online maps, and are included as figures in this chapter.

9.2.2 Site Walkover and Field Survey

Site reconnaissance surveys were carried out to verify the features identified during the desk study and to enable an interpretation of the site in the context of the surrounding environment. Dates of the site visits are provided in **Table 9-1**.

- Small areas of peaty soil were identified south of the proposed T1 foundation base and hardstand location. Maximum peaty soil depths of 1.0m were measured during peat probing. Infrastructure will not be built in this area and plant will not be used within the area.
- An engineering and geotechnical site walkover was used to review characteristics of the site that needed consideration in the design. This included the public access road towards the site, the location of the site entrance, the existing drainage within the site, a review of the ground conditions including limited peat or rock outcrops, and a review of the topography of this site.
- No evidence of historical landslides or incipient instability were noted during the site visits.

Table 9-1: Summary of Site Visits

Date	Personnel	Purpose of Site Visit
15/11/2021	Peter Barry (Senior Environmental Consultant)	Peat probing survey
15/11/2021	Maire Keane (Ecologist)	Peat probing survey
21/04/2022	Paddy Curran (Senior Engineer)	Engineering and geotechnical site walkover

9.2.3 Study Area

The EIAR Study Area for Land and Soils primarily focused on the footprint of the proposed development infrastructure, as well as the lands adjacent to the site. The proposed development area and study area for the land and soils assessment is shown in **Figure 9-1**.

The proposed development is located in a rural area of southeast Clare to the east of Woodcock Hill and approximately 3km northwest of Ardnacrusha, over 3km northwest of Limerick City and suburbs and 6.7km east of Sixmilebridge.

The proposed wind farm and associated infrastructure lie within the townlands of Glennagross, Cappateemore East, Ballycannan West, Ballycannan East, Ballycar South and Ballycar North.

Existing land cover at the site is a mix of pastures and coniferous forests. The majority of the site consists of pastures while the more elevated, areas of the site surrounding turbines T5 and T6 and the substation are composed of coniferous forest, which are owned and managed commercially. The surrounding land includes some pastures and lands principally occupied by agriculture, with significant areas of natural vegetation.

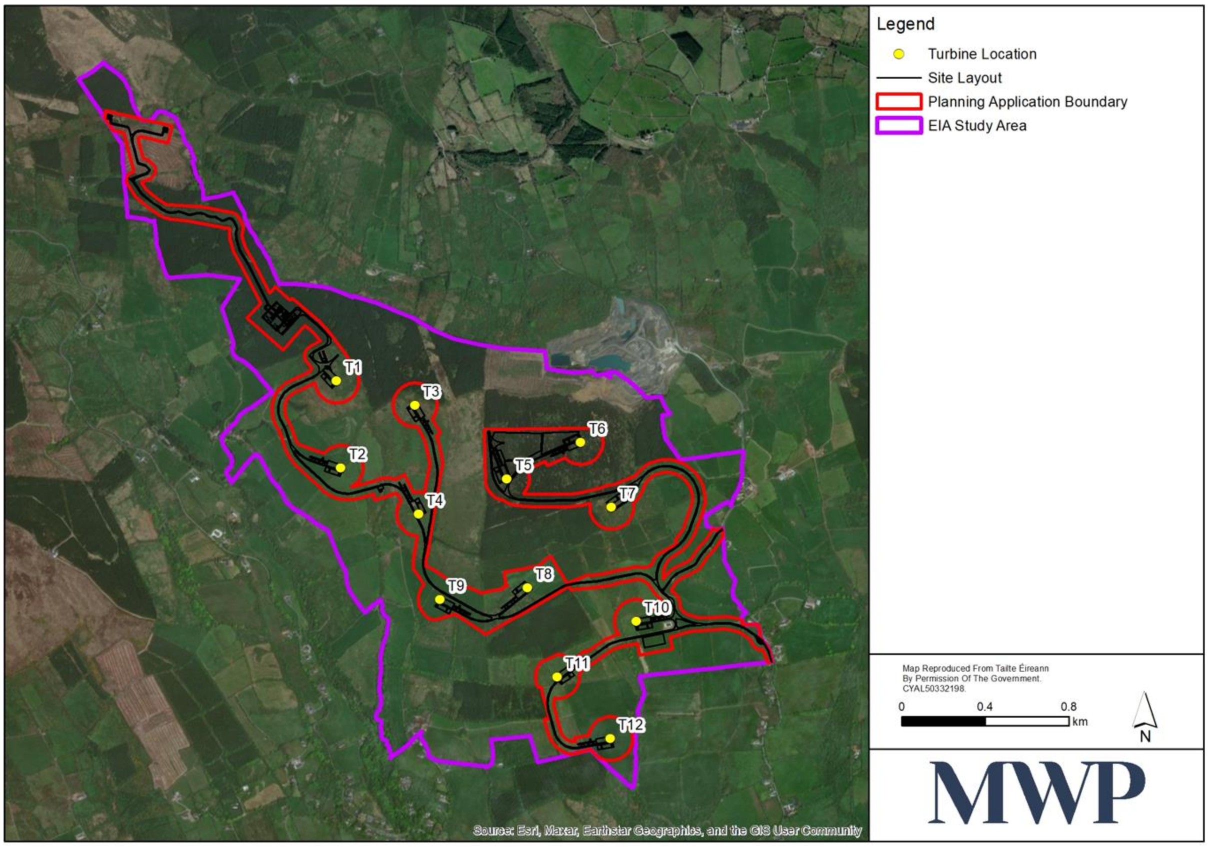

Figure 9-1: Study Area

9.2.4 Scope of Assessment

'Land and Soils' is considered a geological term in current, historical, and planned land use. The subject matter of hydrogeology is addressed in **Chapter 8 Water** of this **EIAR**.

Accordingly, the scope of this assessment is made with respect to these topic areas and considers the effects of the construction, operation, and decommissioning of the proposed development in terms of how the proposal could potentially affect the local land and soil environment, without appropriate mitigation measures being implemented if required. As part of consultation, Geological Survey Ireland were consulted, however at the time of writing no response has been received.

9.2.4.1 Assessment Criteria

The method of impact assessment and prediction follows the EPA (2022) *Guidelines on the information to be contained in Environmental Impact Assessment Reports (EIARs).* The methodology and approach outlined in the

EPA Guidelines was used to determine whether the proposed development had the potential to cause significant effects, without appropriate mitigation if required, on the land and soils environment and is as set out in **Table 9-2**.

Table 9-2: Description of Effects

	Term	Description
Quality of Effects	Positive	A change which improves the quality of the environment
	Neutral	No effects or effects that are imperceptible, within normal bounds of variation or within the margin of forecasting error
	Negative /adverse	A change which reduces the quality of the environment
Significance of Effects	Imperceptible	An effect capable of measurement but without significant consequence
	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences
	Slight	An effect which causes noticeable changes in the character of the environment without affecting its sensitivities
	Moderate	An effect that alters the character of the environment in a manner that is consistent with existing and emerging baseline trends
	Significant	An effect which, by its character, magnitude duration or intensity alters a sensitive aspect of the environment
	Very Significant	An effect which, by its character, magnitude duration or intensity alters most of a sensitive aspect of the environment
	Profound	An effect which obliterates sensitive characteristics
Extent and Context of Effects	Extent	Describe the size of the area, the number of sites and the proportion of a population affected by an effect.
	Context	Describe whether the extent, duration or frequency will conform or contrast with established (baseline) conditions (is it the biggest, longest effect ever?)
Probability of Effects	Likely	The effects that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented
	Unlikely	The effects that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented
Duration of Effect	Momentary	Effects lasting from seconds to minutes
	Brief	Effects lasting less than a day
	Temporary	Effects lasting less than a year

	Term	Description
	Short-term	Effects lasting one to seven years
	Medium-term	Effects lasting seven to fifteen years
	Long-term	Effects lasting fifteen to sixty years
	Permanent	Effects lasting over sixty years
	Reversible	Effects than can be undone e.g. through remediation or restoration
	Frequency	How often the effect will occur (once, rarely, occasionally, frequently, constantly – or hourly, daily, weekly, monthly, annually)
Types of Effects	Indirect	Effects on the environment, which are not a direct result of the project, often produced away from the project site or because of a complex pathway.
	Cumulative	The addition of many minor or significant effects, including effects of other projects, to create a larger, more significant effect.
	'Do Nothing'	The environment as it would be in the future should the subject project not be carried out.
	'Worst case'	The effects arising from a project in the case where mitigation measures substantially fail.
	Indeterminable	When the full consequences of a change in the environment cannot be described.
	Irreversible	When the character, distinctiveness, diversity, or reproductive capacity of an environment is permanently lost.
	Residual	The degree of environmental change that will occur after the proposed mitigation measures have taken effect.
	Synergistic	Where the resultant effect is of greater significance than the sum of its constituents, (e.g., combination of SO_x and NO_x to produce smog).

Source: Guidelines on Information to be contained in Environmental Effect Assessment Reports (EPA, 2022)

9.2.5 Statement on Limitations and Difficulties Encountered

Limitations and difficulties have not been encountered during this assessment.

9.3 Baseline Environment

9.3.1 Site Location and Description

The proposed development is located in the Electoral Divisions of Cloontra and Ballycannon in rural south Co. Clare to the east of Woodcock Hill and is approx. 3 km northwest of Limerick City and suburbs, approx. 6.7km southeast of Sixmilebridge, and approx. 3 km northwest of Ardnacrusha. The elevated ground to the west (2.2km approximately) of the proposed development site is Woodcock Hill (363m AOD). Bordering the site to the north is O'Connell's quarry which is currently active.

The topography of the area is hilly with elevations ranging between 60 – 260m AOD. The terrain gently slopes southeast towards the canal of Ardnacrusha.

The relevant study area for the proposed development is primarily in agricultural use, with areas of conifer forests, transitional woodland scrub throughout and located within the townlands of Glennagross, Ballycar North, Ballycar South, Ballycannan West, Ballycannan East, and Cappateemore East. The site can be accessed by the R471, R464 and N18, and the local roads.

In addition to the proposed development as described, there is a proposed underground connection between T1 and the proposed 110kV substation which will be located northwest of T1. The underground connection from T1 is routed along existing forestry tracks and through conifer forestry to the north west of the wind farm site and connects to the proposed 110kV substation. From the proposed 110kV substation, an underground cable is routed in a north west direction where it connects to the existing 110 kV overhead line. The proposed 110kV grid route is approximately 1.5km in length. 1.0km of the 110kV grid route is proposed within existing forestry tracks, with the remaining 0.5km routed through conifer forestry. It also crosses a 3m wide local public road. A new unbound stone access track will be constructed over the 110kV grid route on private lands to allow access for future maintenance.

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 temporary local road widening. Such works are temporary for the delivery of turbine components and are not included in the planning application boundary.

9.3.2 Existing Land Use

The land use at the study area has been mapped as shown in **Figure 9-2**. The land cover mapping was created using information from CORINE Land Cover 2018 available on the EPA online mapping system.

The following land uses have been identified within and around the study area:

- 231 – Pastures;
- 243 – Land principally occupied by agriculture with areas of natural vegetation;
- 311 – Broad-leaved Forest;
- 312 – Coniferous Forest;
- 313 – Mixed Forest; and
- 324 – Transitional woodland scrub.

The development boundary containing turbine footprints T5, T6, borrow pit, some access tracks, deposition areas, grid route and the proposed substation comprises of *coniferous forest*. The development boundary containing turbine footprints T1, T2, T3, T4, T7, T8, T9, T10, T11, T12, access tracks, met mast and temporary construction compound are located in areas labelled *pastures*.

The substation and grid connection are within areas categorised as *coniferous forest.* The temporary local road widening at the junction of the R464 and L3056 comprises of pastures.

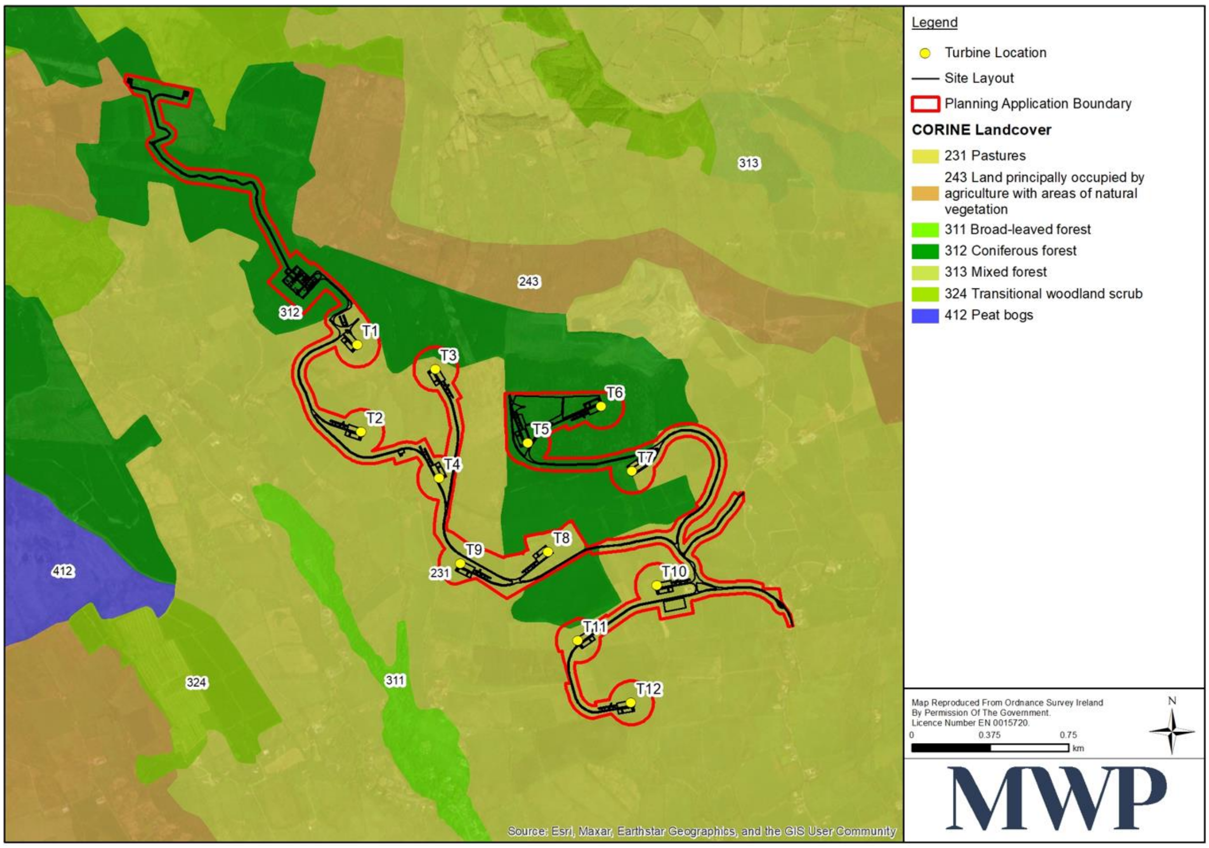

Figure 9-2: CORINE Landcover (source: EPA)

9.3.3 Topography

The site is described as being located at the southern slope of a hill within a hill-and-trough landscape. The maximum elevation of the site is approximately 260m AOD. Elevations of the site range between circa 60m AOD in the southeastern portion of the site to 260m AOD in the northeastern portions of the site, and reach approximately 245m AOD in the north western portion of the site (**Figure 9-3**).

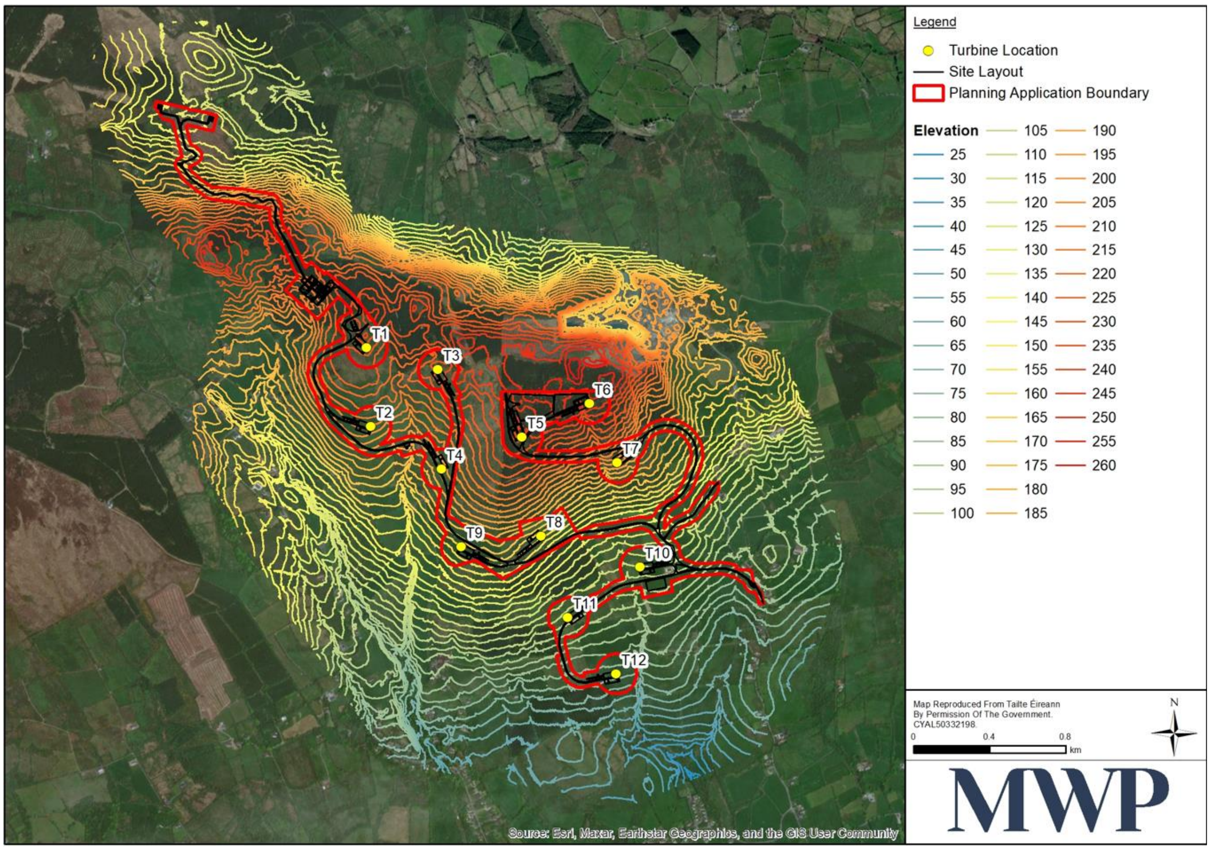

Figure 9-3: Topography (5m contour)

9.3.4 Regional Geology

The lithology of county Clare is mainly composed of carboniferous sedimentary rock. Visean limestones and calcareous shales can be found to the north and east, and namurian shale, sandstone, siltstone & coal can be found to the west and south. These rocks have only been mildly affected by folding and metamorphism and as such, retain many of their original sedimentary and depositional structures.

According to the Geological Heritage of Clare, (GSI, 2005) East Clare is composed of fluvio-deltaic & basial marine (Turbiditic); interbedded Shale, sandstone, siltstone & coal. This took place during the Upper Carboniferous (320 mya) period. These represent successive deltaic sediments filling a marine basin, changing sea levels represented by cyclothems in which sea level changed several times and deposited thin layers of coal during this process, and muddy rivers carrying sand and silt into the Shannon trough basin. These rocks were folded towards the end of the Carboniferous period during the Variscan Orogeny (**Figure 9-4**).

The most significant force to shape the form of the county as we see it today was the Ice Age which ended about 10,000 years ago. Large ice sheets several hundred metres in thickness covered the county for thousands of years and eroded the rocks beneath. As the ice eventually melted away, the meltwaters reorganised the sediments into iconic landforms like eskers, adjacent to large fans and deltas of sand and gravel. Eskers were formed by sub-glacial rivers, that is, they flowed in tunnels at the base of the ice sheets. Drumlins are raised features that appear as elongated hills. Formed as glacial ice carved across a landscape and clustered near the end point of glaciers, they are composed of weathered rock, glacial till, and rock flour. They are used as an important interpretive tool for the direction and speed at which a glacier moved during the last glacial maxima. Streamlined bedrock is another common post-glacial feature that can be seen in the area. Fast-moving ice carved out grooves into the bedrock creating large ridges across the landscape.

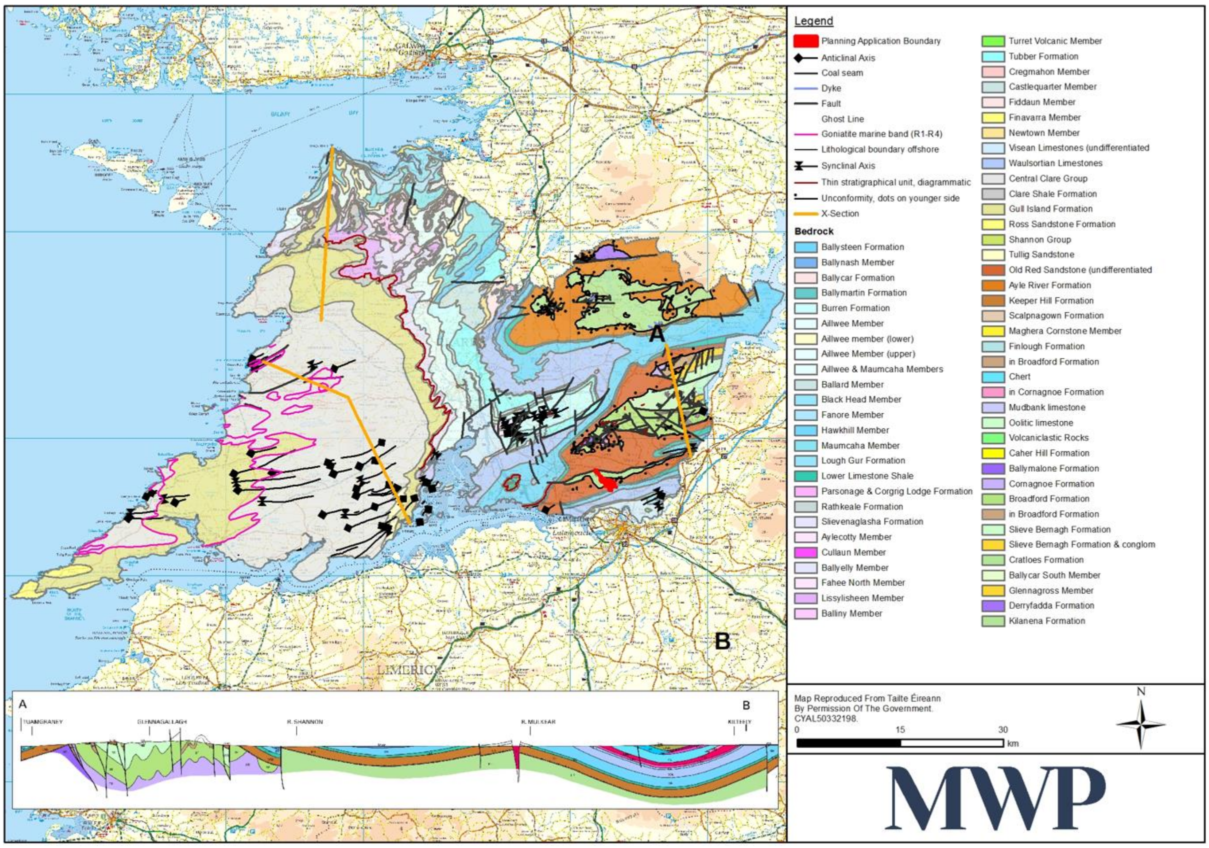

Figure 9-4: Bedrock Geology of County Clare (source: GSI)

9.3.5 Local Geology

The proposed development site is underlain by the Carboniferous rocks, with a dominant presence of *Old Red Sandstone* formation in central parts of the proposed development site. These rocks consists of conglomerates and breccias indicative of the new phase of deposition after the closure of Iapetus ocean. Parts of the western and eastern areas of the development site are underlain by *Cratloe* and *Ballycar South* formations, where rocks of Sandstone and Siltstone are laminated with calcium carbonate grading up to fine sand. The southern parts of the development site are dominated by the limestone rocks belonging to *Lower Limestone Shale, Ballysteen* formation and *Waulsortian Limestone* (**Figure 9-5**).

Evidence of faulting can be seen in the area. The fault strikes east to west and makes up a portion of the northern boundary of the study area. The presence of discontinuities trending east-west is mapped running across the northern part of the study boundary, which acts as a contact for the Cratloe and Ballycar south member formation. Geological processes that lead to the formation of fault lines and earthquakes are less pronounced in Ireland and aren't considered a risk due to lack of seismic activity. The bedrock at the temporary local road widening at the junction of the R464 and L3056 comprises of Visean Limestones (undifferentiated) (CDVIS).

The rocks found within and immediately adjacent to the study boundary are described from literature below with the symbol for each formation given in brackets for cross-reference purposes with the GSI 1:100,000 scale bedrock geology map.

- Old Red Sandstone (DDORS): These Devonian-Carboniferous rocks are described as Sandstones Siltstones and Mudstones, comprising poorly sorted clastics of polymictic pebble conglomerates and breccias.
- Ballysteen Formation (CDBALL): These Carboniferous rocks are described as fossiliferous dark grey – muddy Limestones, which are irregularly interbedded with Bioclastic limestones (Wackstones and Packstones) with fossiliferous Calcareous Shales. It is characterised with thickness of 100 - 200m.
- Waulsortian Limestones (CDWAUL): Described as Carboniferous massive, unbedded lime - mudstones. Sometimes informally called "reef" limestones, although inaccurate. Dominantly pale grey, crudely bedded or massive limestone. Known to be moderately to intensely karstified. Typically 300 - 500 m thick.
- Cratloes Formation (SUCLRO): These Silurian rocks are described as thin, medium bedded laminated Sandstones and Siltstones, comprised of calcium carbonate (calcareous) which grades up to fine sand. The presence of iron nodules in the formation is associated with the process of decalcification. The observed thickness is identified to be 300 m approximately.
- Ballycar South Member (SUCLROb): These Silurian rocks are described as a fossiliferous conglomeratic Sandstone, with the characteristic presence of fossil depositions. This formation is considered a part of the Cratloe Formation.
- Lower Limestone Shale (CDLLS): These carboniferous rocks are described as Sandstone, Mudstone, Shale

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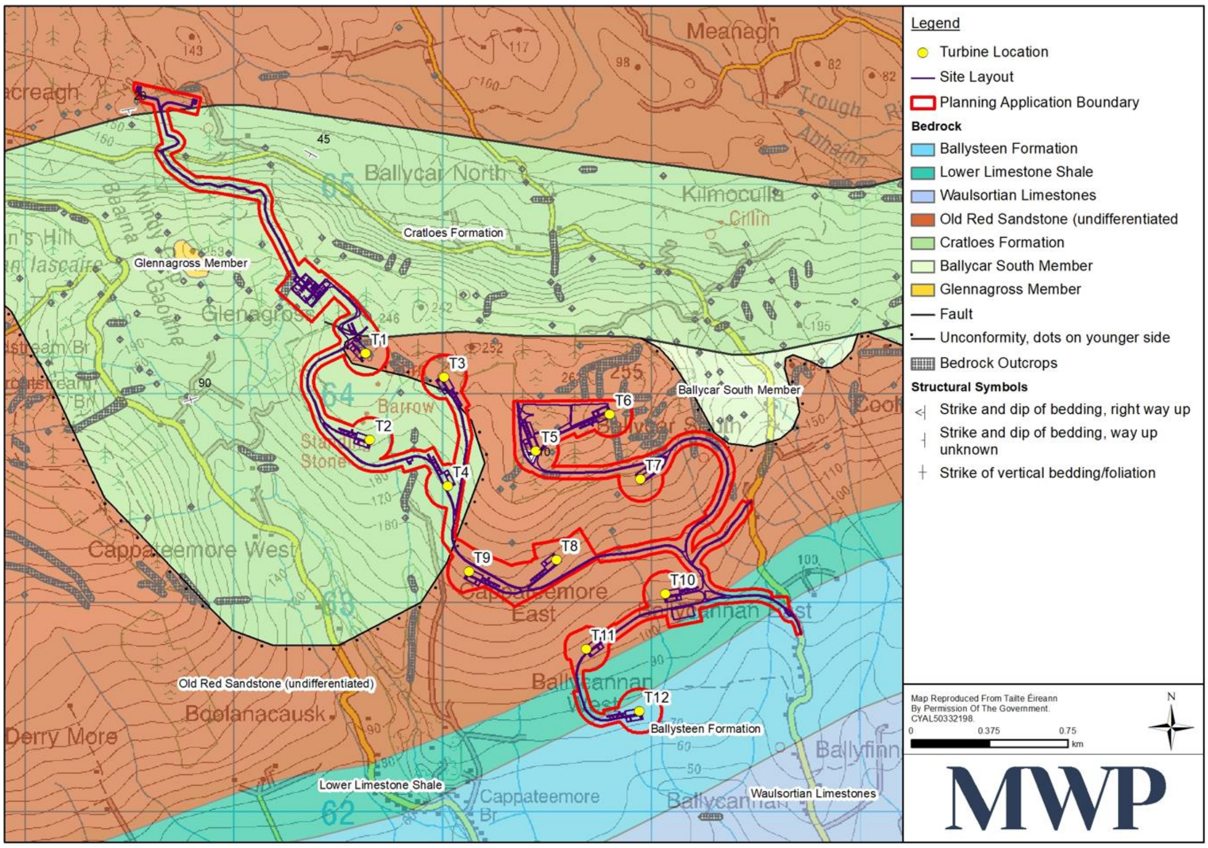

Figure 9-5: Bedrock Geology (source: GSI)

9.3.5.1 Grid Connection Route and Substation

The main lithology underlaying the grid connection route consists of carboniferous rocks, namely the Cratloes Formation as described in **Section 9.3.5**, with a section at the end of the grid connection comprising of Old Red Sandstone. The units within the Cratloes formation are often fractured and easily weatherable due to its carbonate chemical composition. The sediments are fine-as thin, medium bedded laminated Sandstones and Siltstones, comprised of calcium carbonate (calcareous) which grades up to fine sand.

The rocks found within and immediately adjacent to the substation and grid connection areas are described from literature below with the symbol for each formation given in brackets for cross-reference purposes with the GSI 1:100,000 scale bedrock geology map.

- Cratloes Formation (SUCLRO): These Silurian rocks are described as thin, medium bedded laminated Sandstones and Siltstones, comprised of calcium carbonate (calcareous) which grades up to fine sand. The presence of iron nodules in the formation is associated with the process of decalcification. The observed thickness is identified to be 300 m approximately.
- Old Red Sandstone (DDORS): These Devonian-Carboniferous rocks are described as Sandstones Siltstones and Mudstones, comprising poorly sorted clastics of polymictic pebble conglomerates and breccias.

9.3.6 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;
- Provision of raw materials and a base on which to build.

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

The predominant soil type within the majority of the study area is "*AminSP – Shallow poorly drained mineral (Mainly acidic)"* according to the Teagasc/EPA Soil Maps available on the Geological Survey of Ireland online mapping system. The characteristics of the above soil type based on data from Teagasc are non-calcareous poorly drained mineral at shallow depth. *''AminSRPT'' – Shallow, rocky, peaty/non-peaty mineral complexes (Mainly Acidic)''* are mapped across a few parts of the study area mainly, the central and northern portions. AminSRPT is classified as predominantly shallow soils derived from non-calcareous rock or gravels with/without peaty surface horizon, with peaty topsoil with rocky mineral organic soil underneath. These soils are mainly montane-type soils occurring on mountain slopes. The soil varies widely and across short distance intervals in these settings from peat to outcropping rock and shallow soils, including Lithosols, to podzols and peaty podzols. In other words, though the description may appear broad it is the best fit for these areas (Teagasc, 2009). Site visits demonstrated only a small presence of peaty soil near T1 which has been delineated through site investigation and avoided within the design of the development. *''AminPD- Mineral poorly drained (Mainly Acidic)'' and ''AminDW -Deep well drained mineral (Mainly acidic)"* can be found in the eastern, western and southern portions of the study area (**Figure 9-6**). The soil type at the temporary local road widening at the junction of the R464 and L3056 comprises of "*MarSed – Marine/estuarine sediments*".

The Quaternary Sediments at the site shown on the Geological Survey of Ireland online mapping system include *Bedrock outcrop/Subcrop – ''RcK''*, covering the majority of the study area, and *''TLPScS – Till derived from lower Palaeozoic sandstones and shales "* to the south and south-east of the study area. The quaternary geomorphology of the area comprises features such as streamlined bedrock and meltwater channels (**Figure 9-7**). The quaternary sediments at the temporary local road widening at the junction of the R464 and L3056 comprises of "*Mesc – Esturine silts and clays*".

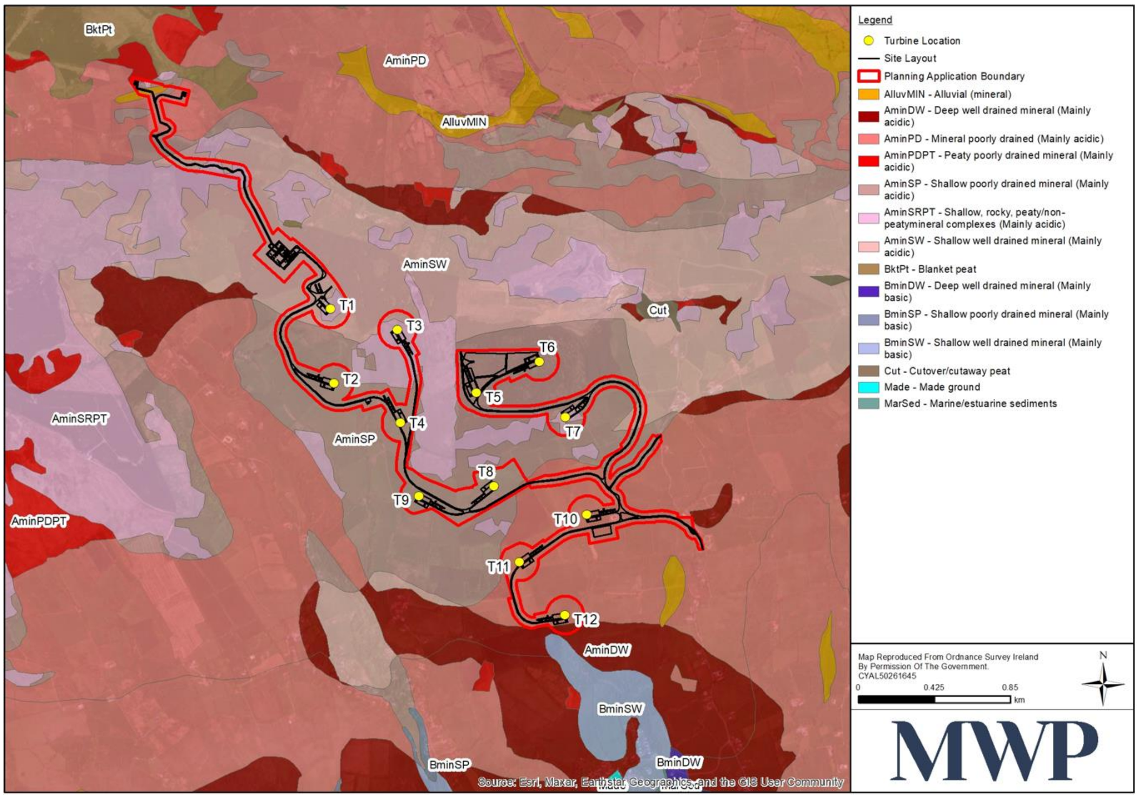

Figure 9-6: Teagasc Soils (source: GSI)

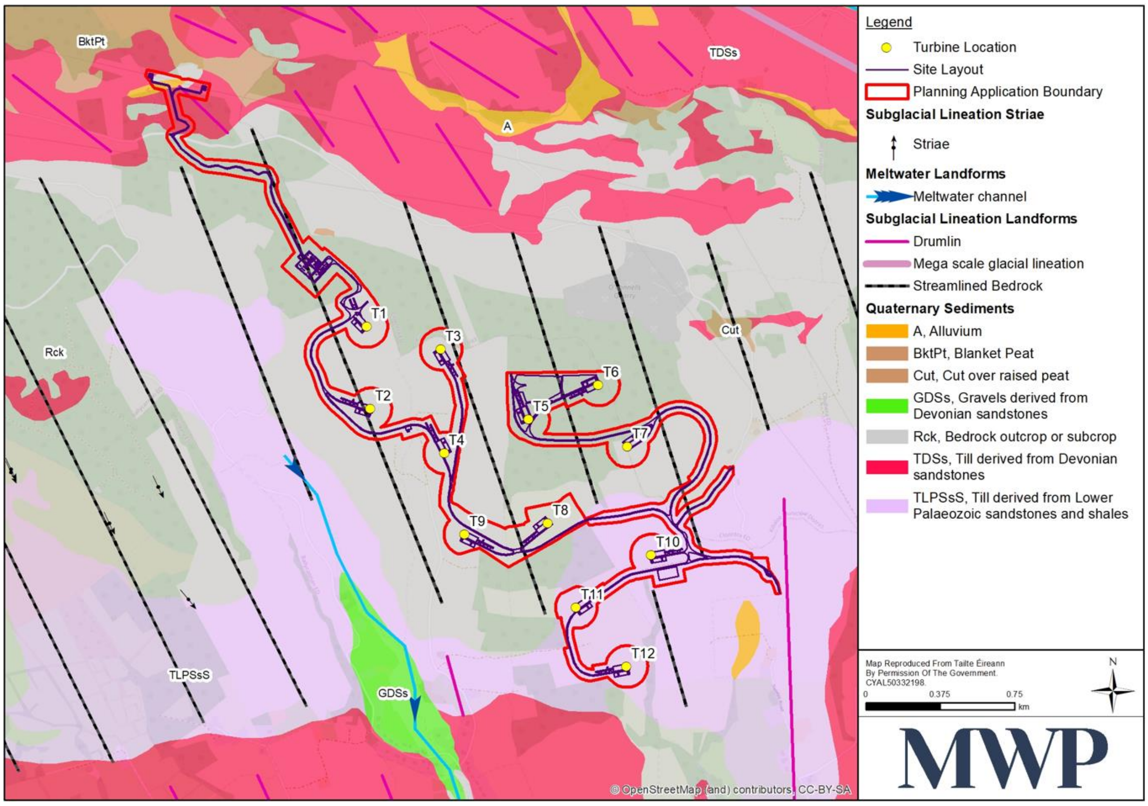

Figure 9-7: Quaternary Sediments and Geomorphology (source: GSI)

9.3.6.1 Grid Connection route and Substation

The predominant soil type mapped along the substation and grid connection route according to the Teagasc/EPA Soil maps available on the GSI online mapping system is: 'AminSW – *Shallow well drained mineral (Mainly acidic)'* with some part*s of:*

- *AminPD- Mineral poorly drained (Mainly Acidic)' 'AminSP – Shallow poorly drained mineral (Mainly acidic)*;
- *AminSP – Shallow poorly drained mineral (Mainly acidic*);
- *AlluvMIN – Alluvial (mineral)*; and
- *AminPDPT – Poorly drained mineral soils with peaty topsoil derived from mainly acidic parent materials*.

The Quaternary sediments along the substation and grid connection route shown on the GSI Mapping system includes:

- *TDSs- Till derived from Devonian Sandstones* with geomorphology of Drumlins;
- *Rck – Bedrock outcrop or subcrop;* and
- *Alluvium.*

9.3.7 Geological Heritage

The GSI partnered with National Parks and Wildlife Service (NPWS) to identify, protect and promote the geologically important areas under the Irish Geological Heritage (IGH) programme. A committee of expert geologists provided an initial list of sites which then undergo a process of survey, reporting and review, to provide recommendations regarding Natural Heritage Areas (NHA) status or otherwise. These are then audited by local county authorities along with the heritage council and fall under the protections of the Heritage Act 2018. These protected areas are differentiated based on themes varying from Karst, Palaeontology, Quaternary, Hydrogeology, and many others.

A review of the GSI Geological Heritage Database available on the GSI online mapping system indicates that there is an audited Geological Heritage Site (proposed for NHA designation) (feature name – Ballycar South) outside the project development boundary. The nearest mapped geological heritage sites (Figure 9-8) are provided in the following table, Table 9-3: Geological Heritage Sites in Proximity to Site (GSI online database).

Table 9-3: Geological Heritage Sites in Proximity to Site (GSI online database)

Feature Name	Feature Description	Distance from Site
Ballycar South	Ballycar South is significant because the rocks here have produced a diverse assemblage of brachiopods, corals, gastropods, trilobites, and bryozoans from the Silurian period, which are now not exposed at the surface.	200m, E

Ballyvorgal South	This is an uncommon Irish occurrence of an assemblage of deep-water fossils now found in rocks from the Upper Ordovician period all over the world.	6.7Km W
N18 Road Cut Ballykeeffe	A road cut section comprising exposure of Carboniferous limestone bedrock.	9.15 Km SW
Mungret Quarry	The site consists of a network of pit offshoots in a large active quarry which produces limestone for cement manufacture and holds the history of the largest quarry with great economic importance to the region.	9.6 Km SW
Carrigogunnell	The site is a rocky knoll comrprising of rocks of Lower Carboniferous Volcanoclastic, Tuff bands and basalt.	10.6 Km SW

Sites in close proximity, specifically Ballycar South Geological Heritage Site, are outside the proposed development site and will not be affected by the development (**Figure 9-9**). Ballycar South is described as having an important assemblage of marine fossils that are mostly unexposed. As the works will only be occurring within the development boundary and do not impinge on the geology heritage boundary, it will remain unaffected by the works.

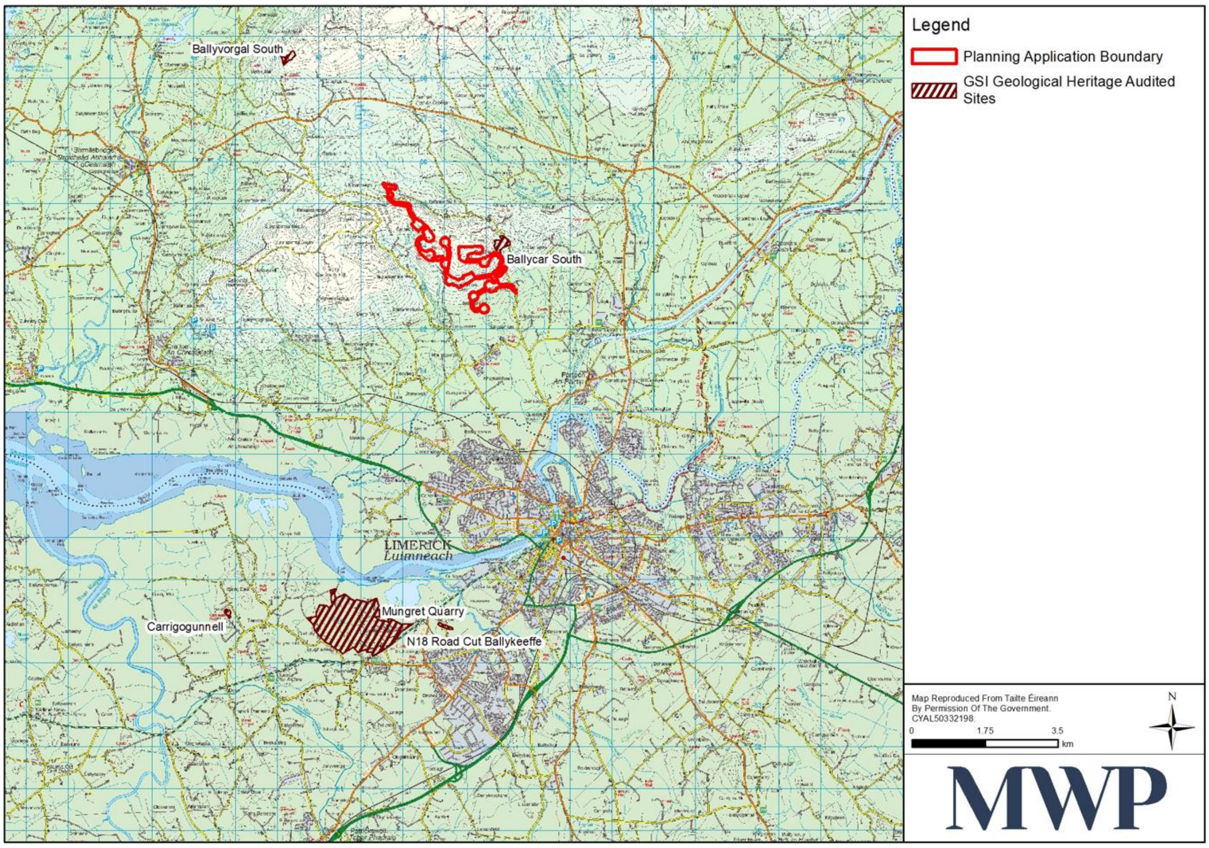

Figure 9-8: Geological Heritage areas (source: GSI)

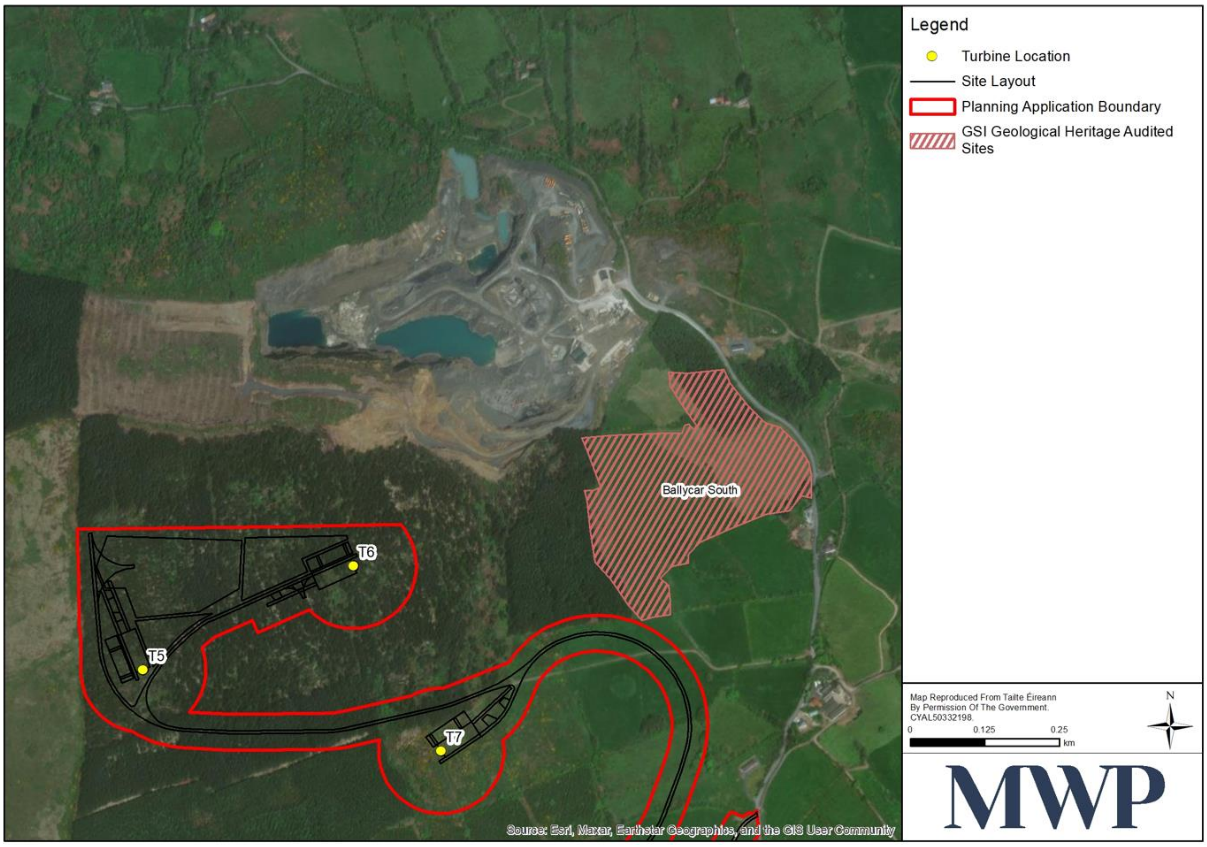

Figure 9-9: Geological Heritage – Ballycar South (source: GSI)

9.3.7.1 Grid Route and Substation

A review of the GSI Geological Heritage Database available on the GSI online mapping system indicates that there are no Geological Heritage sites present within the proposed grid connection route and substation footprint, with the closest site being Ballycar South, located approximately 2km to the southeast.

9.3.8 Economic Geology

According to the Geological Survey of Ireland (GSI), there are several quarries operating within 15km of the proposed development site in county Clare including:

- Ballycar Quarry – (GSI Quarry Number - CE001), located approx. 400m north of the site.
- Ballyquin Pit - (GSI Quarry Number – CE011), located approx. 9km northeast of the site.
- Dereen Sand and Gravel Pit - (GSI Quarry Number – LK007), located approx. 11km east of the site.
- Gooig Pit – (GSI Quarry Number – LK011), located approx. 12km east of the site.
- Bunratty Quarry – (GSI Quarry Number – CE013), located approx. 12km west of the site.

The location of the quarries in the area is shown in Figure 9-10. The closest quarry to the site is Ballycar Quarry which is located approximately 0.32km from the nearest point of the proposed development boundary.

According to the GSI, there are a number of recorded metallic and non-metallic mineral locations in the area. Recorded mineral locations (as seen as diamonds in **Figure 9-10** and **Figure 9-11**) are historic, current or potential future mining sites, which could be exploited. These include a detail for O'Connell's working quarry north of the site (labelled next to T3 but occurs north of the site), an old slate quarry (north of T3), and an abandoned slate quarry (east of T8). However, these mineral extraction locations will not affect the development of this site, nor will the construction of the proposed development sterilise any future mining activity in the area. All current mining/quarrying activities will occur outside the proposed development's site boundary. At planning submission, no additional mining licenses have been applied for in the area. Ballycar Quarry / O'Connell's Quarry will continue to operate as normal.

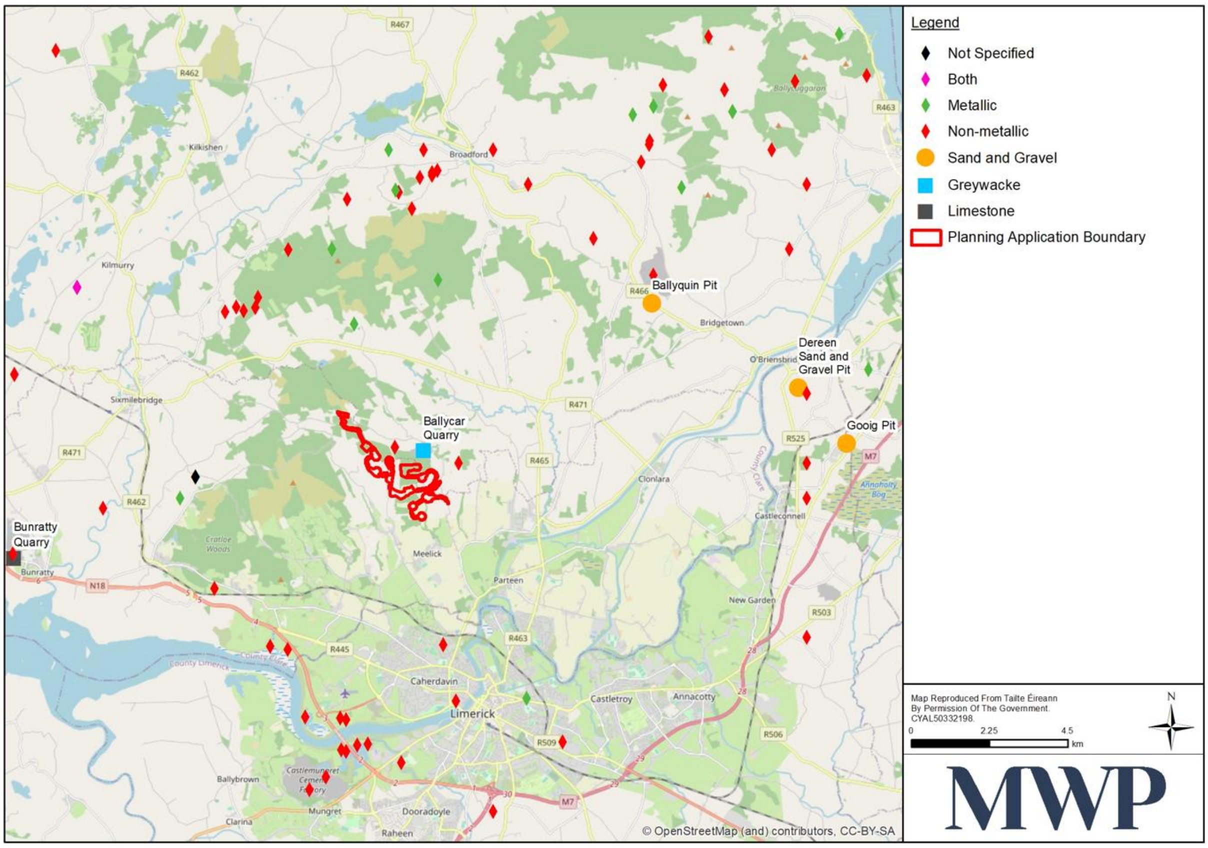

Figure 9-10: Economic geological sites in the southeast area of County Clare (source: GSI)

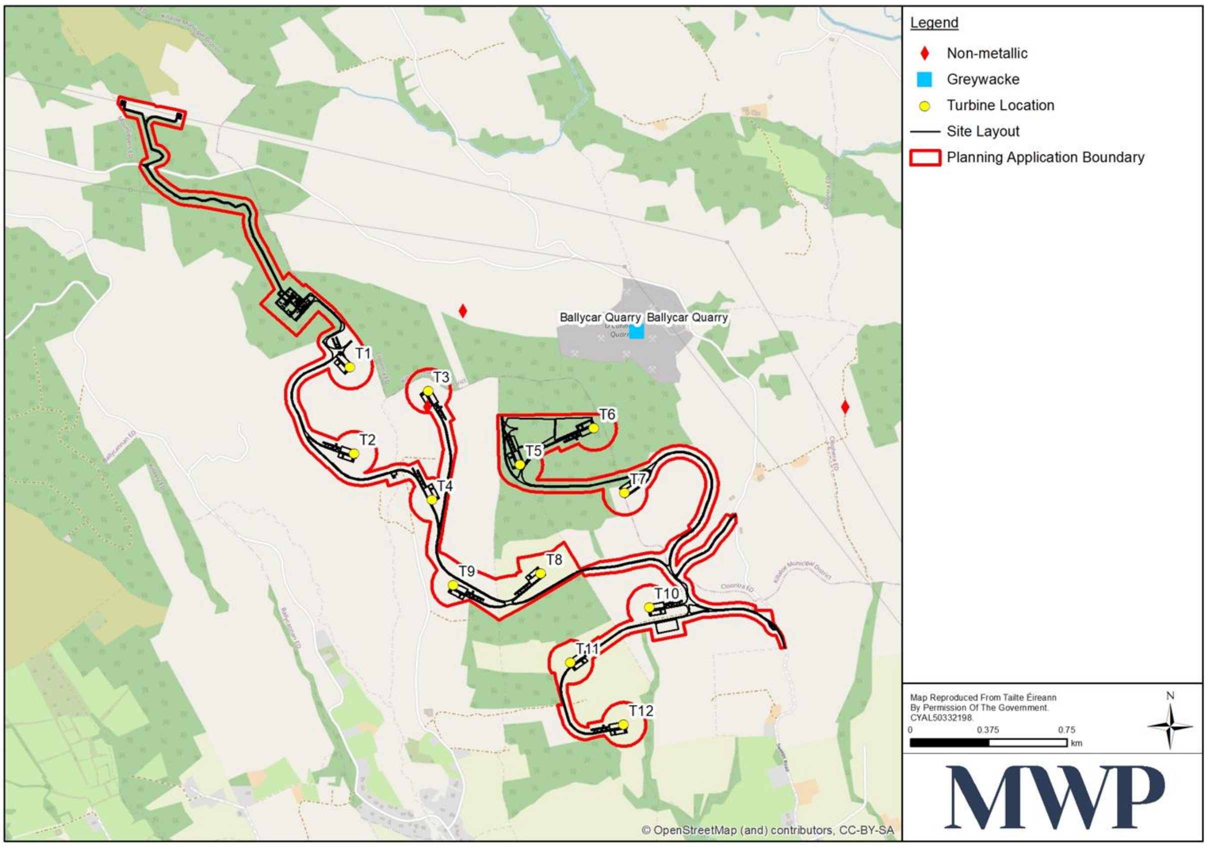

Figure 9-11: Economic geological sites located at or close to site (source: GSI)

9.3.8.1 Grid Connection Route and Substation

According to the GSI, there are no additional mineral locations and active quarries mapped within or in close proximity to the location of the proposed grid connection and substation, apart from those already outlined in Section 9.3.8.

9.3.9 Existing Slope Stability

A review of potential slope stability issues has been carried out for this site. A review of the GSI Landslide Event Maps and Quaternary Geology Maps was undertaken in conjunction with a site walkover by a competent Geotechnical Engineer.

From a desk-top review, the GSI's Landslide Events database has no records of any landslide events recorded within or in proximity to the development site. The three closest events include "Ayleacotty 2009" 16km northeast with the collapse of a steep railway bank, "Slieve Bearnagh 2003" 16km north with a peat flow onto the local road, and "Fort Henry 1948" 18km northeast with a riverbank rupture (Figure 9-12).

Previous landslides within wind farms (e.g. Meenbog, Derrybrien and Ballincollig Hill) have occurred within the peat material. No peat is mapped within the site on the GSI Quaternary Geology Maps (Figure 9-7). A localised area of peaty topsoil was noted in the north-western corner of the site between T1 and T2 during site visits. The extents of the peaty topsoil were mapped and peat probes were carried out and found an average thickness of 0.1 – 0.2m, rocky and pitted. A pocket of peaty topsoil of maximum 1m deep was recorded but does not occur within the site boundary. Peaty topsoil deposits were noted throughout the site and were not considered to constitute peat deposits, but rather a highly organic topsoil with peaty appearance. This peaty topsoil was found to be shallow and was avoided by the proposed infrastructure layout during the site design process. When designing the layout for the wind farm, the north western corner containing the deeper peaty topsoil was excluded. As no infrastructure is proposed within this area of the site, it was not deemed necessary to carry out a Peat Stability Risk Assessment for this site. Felling activities will take place during the works, and these areas do not have peat mapped within them.

No signs of past instability or incipient instability were noted during the site walkover.

Overall, there is no risk of peat instability at this site, or from felling activities, as the limited area of peat identified on site, is being completely avoided.

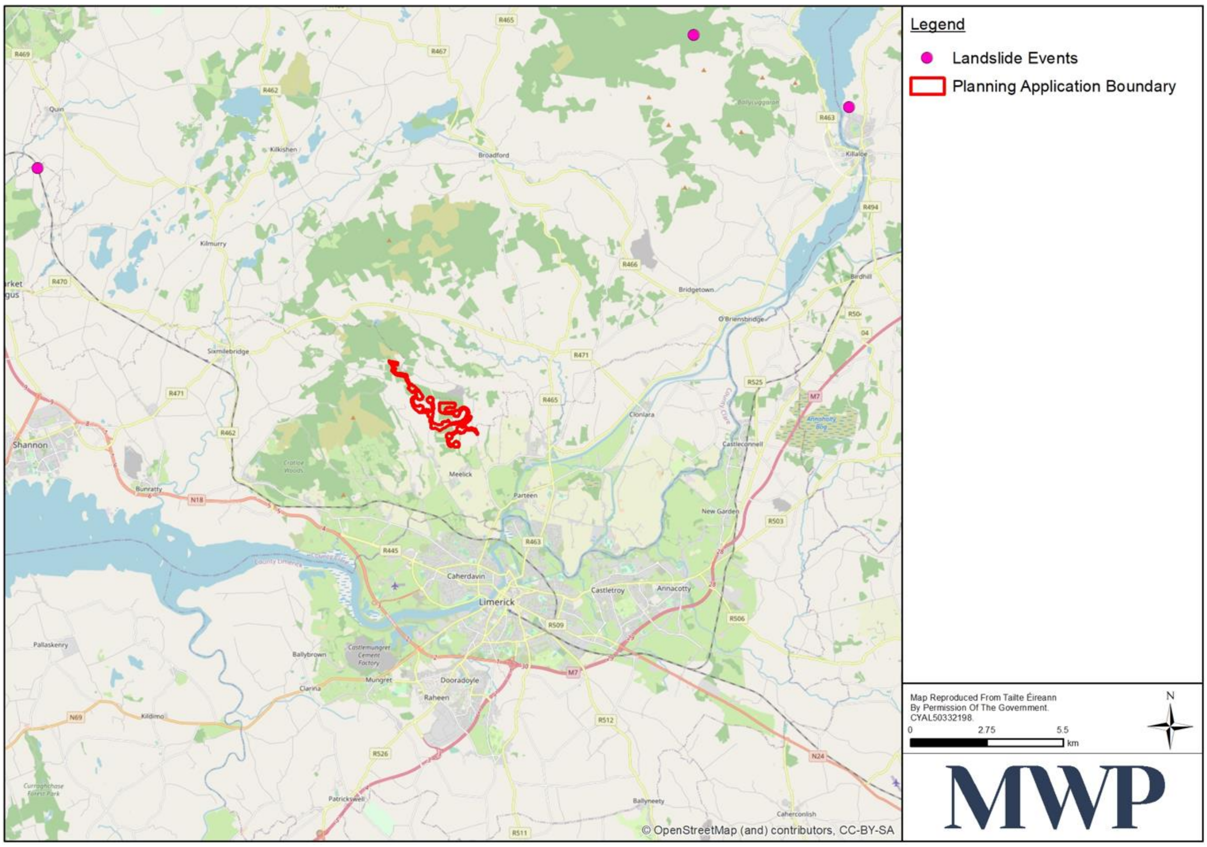

Figure 9-12: **Historic Landslide Events (source: GSI)**

9.3.10 Extraction and Deposition Areas

There are no existing extraction or deposition areas onsite. For the purposes of minimising HGV volumes, use of existing resources will be utilised for procuring construction material. One borrow pit location will be opened during the course of the works, which will also act as a deposition area. A further two deposition areas will also be established. The borrow pit proposed within the site will be used to obtain approximately 165,000m^3 of site won stone aggregate for use in the construction of the wind farm. Blasting at the borrow pit may be necessary to enable excavation of the rock in the borrow pit and increase production rates to match the construction programme. Any blasting will be carried out by a suitably qualified specialist under licence. Blasting, and mitigation measures associated with the process, are discussed in further detail in this chapter and **Chapter 10 Noise and Vibration** of this **EIAR**.

9.4 Assessment of Effects

This section details the potential effects on the land and soils environment from the proposed development. The changes proposed on-site comprise a number of elements including excavation for construction of the turbine hardstands, construction of a new access track system, excavation of a borrow pit, construction of three deposition areas (one at the borrow pit location), construction of a met mast and construction of a substation and grid connection. The relevant works are further discussed in the following sections. The following sections considers the phases of construction and operation of the proposed development in relation to land, soil and geology.

9.4.1 Construction Phase

The predicted effects on soils and land for the proposed development are discussed in the following sections. The activities that can cause damage to the existing geological environment may indirectly effect the aquatic environment without appropriate mitigation measures where required, as discussed in **Chapter 8 Water**.

The proposed development will involve removal of soil, subsoil, and bedrock for facilitating the construction of elements of the proposed development such as access tracks and hardstand emplacements. The aggregates (rock, stone, gravel, sand) used during construction of the access tracks, hardstands and substation will be extracted from the proposed on-site borrow pit. Large amounts of aggregates, concrete, and steel will be used during construction. Concrete and additional aggregate materials will be sourced from authorised facilities. The following quarries in County Clare are in close proximity to the proposed site:

- Bobby O'Connell & Sons Ltd Quarry;
- Roadstone Bunratty; and
- Jim Bolton Sand and Gravel Ltd.

These are the most likely sources to be used.

Estimated volumes of material and spoil are presented in **Chapter 3 Civil Engineering.** Not all of the soil/stone excavated will be sent to disposal areas, some will be used for reinstatement and landscaping works around the site. Bedrock excavated during cut-and-fill works will be used for filling along the development footprint. Excess material will be stored in the on-site deposition areas.

Any potential waste soil will be notified under Article 27 (European Communities (Waste Directive) Regulations 2011) or treated to comply with Article 28 (European Communities (Waste Directive) Regulations 2011) if practicable. 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.

9.4.1.1 Change of Land Use

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 thus preventing any additional further land use potential.

The majority of the development boundary consists of pastures while more elevated areas of the site surrounding turbines T5, T6, the borrow pit, the deposition areas and the substation are composed of coniferous forest, which is owned and managed commercially. During the construction phase of the works, material will be excavated, moved, altered, or compacted and will influence the existing land use requirements. In this respect, land use will change over the course of the construction phase from existing forestry and pastural activities to a functioning wind farm, however existing forestry and agricultural activities will remain during construction/operation/decommissioning outside of the proposed development site boundary.

The proposed works require the construction of turbine bases, hardstands, permanent meteorological mast, substation, internal access tracks, cable trenches, and grid connection.

With the removal of soil and subsoil from the construction areas, there will be slight alteration to site topography. However, these changes will be imperceptible concerning the land and landscape of the proposed development. All excavations will be reinstated to ground level/existing level.

The surrounding land use, outside the proposed development site, is a mixture of rural farmland and low-density residential settlement.

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) environmental regime in a manner that is consistent with emerging baseline trends. It will have ***negative, moderate, short-term effect*** from the change of land use within the wind farm site and along the grid connection route. Similarly, during decommissioning there is likely to be temporary disruptions to land uses and access. Mitigation measures are outlined in **Section 9.5.1.1**.

9.4.1.2 Effects on Soil and Geology

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;
- 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 waste disposal occurs;
- other construction activities such as vehicular movement and heavy machinery with large tyre threads remove topsoil and soils from excavations; and

- heavy rainfall causes soil to mobilise.

During the construction phase, volumes of soil, subsoil and bedrock will be excavated, moved, altered and/or removed from certain areas of the site. 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, meteorological mast, substation, grid connection, access tracks and drainage accommodation works. This will result in permanent removal of material at excavation locations. Stone (outside of that sourced from the on-site borrow pit) required for the construction of new access tracks, construction compound and drainage will be imported from local quarries, where required.

The total volume of excavated material for the proposed development is approximately 418,300m^3. All material volume estimates can be found in **Table 3-2** in **Chapter 3 Civil Engineering** of this EIAR.

Excavation, material management, and vehicular movement activities will be managed during construction as detailed in the **Construction Environmental Management Plan (CEMP)** (**Appendix 2A**).

Soil Compaction

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.

If poor ground conditions are encountered during excavation and a significant depth to sub-formation is required, a 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. Once all the holes have been bored, reinforcement steel is inserted into each hole with concrete poured afterwards. The potential effects associated with piling relate to soil compaction and spoil generation. Piling if required, will be limited and will not produce significant volumes of spoil. Any spoil arising from piling will be removed for recovery to the on-site deposition areas.

Soil compaction as part of construction works, including soil improvement works which often require compaction of subsurface material to reach grade, are not included in these effects.

Slope Stability

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 (Landslides in Ireland, (GSI, 2006)). A slip is defined as a small movement of soil, debris, earth, or rock down a slope. It can take the form of 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 a development, particularly in excavations, material movement, earthworks, and storage of material on site. Without appropriate mitigation measures as outlined in further sections, this can result in 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 and 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.

There will be a requirement to construct new slopes due to the topography of the proposed development site. The slopes have been designed and will be constructed in compliance with best practice and industry standards. The slopes will be landscaped with topsoil and vegetation to support their stability.

Stockpiled material is at risk of slipping if no mitigation measures are implemented. A desk study and fieldwork were completed over a number of weeks in 2021 and 2022. The extensive fieldwork completed on site included peat probing, topographical survey, LiDAR and identification of water features on the site, all of which can have an impact on slope stability.

Summary

Soil erosion, compaction and slope stability represent ***negative moderate short-term effects*** on the land and soils environment, without the implementation of appropriate mitigation measures, which can be found in **Section 9.5.1.2**.

The effects on the underlying bedrock geology arising from the construction phase are considered to be a ***negative, not-significant, short-term effect***.

9.4.1.3 Accidental Spills & Contamination/Pollution

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 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 of fuels and lubricants during routine plant use can also be a pollution risk. 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.

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)** has been included in **Appendix 2B** which reduces any risk of sediment release to surface waters.

Without appropriate mitigation measures, contamination from accidental spills of hydrocarbons, cement or contaminated waters represents a ***negative, significant, short-term, 'Worst-case' effect*** on the land and soils environment, and a ***negative, significant, short-term, indirect, cumulative effect*** to the geological and hydrogeological environment. Mitigation measures to limit this can be found in **Section 9.5.1.3**.

9.4.1.4 Effects from Rock Blasting

Blasting at turbine locations and hardstands may be necessary to enable excavation of the rock if encountered at less than 3m depth. Any blasting will be carried out by a suitably qualified specialist under licence with a suite of mitigation measures in place. Blasting, and mitigation measures associated with the process, are discussed in further detail in the **Chapters 6 Biodiversity** and **Chapter 10 Noise and Vibration** of this **EIAR**.

Blasting may be required at the borrow pit, turbine foundations and access track cuttings. If blasting at these locations is required, it will result in some level of ground vibration and air overpressure. If uncontrolled and not properly mitigated, this could result in soil liquefaction in the vicinity of the blast hole and could contribute to slope instability. The intensity of vibration will depend on a number of factors including rock type and structure, weight/timing of explosive and distance from the blast site. The seismic wave parameters used for correlation with structural damage is the peak particle velocity (ppv). It has been found that the safe limit for ppv below which structural damage is unlikely to occur is 50mm/s. British Standard BS 7385 Part 2: 1993, which provides guidance on vibration measurement, states that loose/waterlogged/cohesionless soils start to become vulnerable to liquefaction at ppv values of about 10 mm/s. The publication "Rock Engineering Guides to Good Practice Road Rock Slope Engineering" (Transport Research Laboratory 2000) refers to the range of ppv experienced for a wide variety of civil engineering projects, and shows that a ppv of > 10 mm/s is generally only experienced within 20 m of the blast holes if not properly mitigated. Rock blasting also has the potential to result in excessive dust within the vicinity of the turbine bases or borrow pit which may affect the soils or nearby aquatic environment, without appropriate planning and mitigation. The potential human and structural impacts associated with noise and vibration is dealt with in **Chapter 5 Population and Human Health**, **Chapter 10 Noise** and **Chapter 14 Air and Climate** of this EIAR.

It is considered that without the implementation of mitigation measures, rock blasting has the potential to alter a sensitive aspect of the land and soils environment by its structure (internal and external, which may involve landmass removal and replacement), extent, duration, or intensity. This represents a ***negative, significant, short-term, direct effect*** on the land and soils environment. Mitigation measures to limit this can be found in **Section 9.5.1.4.**

9.4.1.5 Effects from Tree Felling

Forestry will be removed within the proposed development to facilitate construction and operation. Two turbines, T5 and T6, approximately 1400m of access tracks and the substation and grid connection, are located within forestry areas. Two turbines, T3 and T7, are located in areas in close proximity to forestry. Permanent felling of approx. 15.97ha is required for the construction and operation of these turbines, as well as the hardstands, crane pads, access tracks, borrow pit, deposition areas and substation/grid connection.

The majority of the forested area is located within commercially owned afforested land which has been certified to the Forest Stewardship Council (FSC) forest management standard. This certification assures that they are managed in accordance with strict environmental, social and economic criteria. These standards have been applied in the approach to this project development and design. Certified entities must adhere to strict environmental conditions in order to maintain FSC certification. 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, albeit forestry felled for wind energy projects is excluded from FSC certification if carried out during the construction phase.

The main effects arising from tree felling involve effects to soil (see 9.4.1.2 Effects on Soil and Geology). Landscaping, soil excavation, and root and stump harvesting can cause extensive soil disturbance and expose underlying overburden which 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 induce soil loading and compression of soft deposits which may influence surface water runoff and soil erosion rates.

Without appropriate mitigation measures, tree felling operations has the potential to have an effect which can cause noticeable changes in the character of the land and soils environment, affecting its sensitivities. This represents a ***negative, slight, short-term, direct effect.*** Mitigation measures to limit this can be found in Section 9.5.1.5.

9.4.1.6 Grid Connection Route and Substation

Excavation of soils, subsoils and bedrock will be required along the grid route and for the substation. These works will result in temporary and transient disturbance of access tracks, a 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.

All excavations along the grid connection route will be reinstated to existing ground/road level.

The land use along the grid connection and surrounding areas comprises mainly of conifer forestry, and a public road crossing. 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.

There will be a requirement to excavate some existing ground around the substation, particularly along the access track to the substation. There will also be a requirement to construct new slopes along the raised substation platform due to the topography of the proposed substation location. Topsoil at the substation site will be removed and replaced with site won compacted crushed rock or granular fill. Formation of the substation compound will be achieved where the compound will be constructed with compacted layers of suitable hardcore. It is anticipated that 12,000m^3 of soil will be excavated for the substation area. It is proposed to topsoil and revegetate the cut and fill slopes required for the substation platform. The land use around the substation area consists of coniferous forestry.

Without mitigation, the grid connection and substation construction works will have a ***negative, slight, short-term, effect*** for public road users and local landowners in the vicinity of the route. This will mainly occur for public road users during a short period of time, 1 to 2 days, when the grid connection works cross the local road north of the wind farm site. Mitigation measures to limit this can be found in Section 9.5.1.5.

9.4.2 Operational Phase

9.4.2.1 Change of Land Use

All potential effects to land and land use will occur during the proposed development construction phase. 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. Only a relatively small area of commercial forestry, approximately 15.97ha of the proposed development site, will be permanently displaced in the footprint of the wind farm infrastructure. This loss of land use will not be significant.

It is considered that during the operational phase, land use change will have an effect on the land and soils environment which causes noticeable changes in the character of the environment but without significant consequences. The transition to the production of renewable energy represents a ***positive, not significant, long-term direct 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 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.

9.4.2.2 Effects on Soil and Geology

The potential effect on the land and soils of the site due to excavations will be significantly lower during operation and maintenance, as the majority of excavations will have been reinstated. Some erosion of soil will continue early into the operation phase, however as vegetation becomes established and equilibrium is achieved, erosion rates will reduce to pre-construction levels. Landscaping and revegetation of excavated areas, the deposition areas, and areas over the hardstand footprint represents a ***positive, slight, long-term direct effect*** to the land and soils environment, when compared to existing baseline conditions. All vehicular movement during operation and maintenance will be restricted to the areas of hardstanding and existing/newly constructed access tracks. 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 Chapter 8 Water), however as areas are reinstated and 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.

It is considered that without the implementation of mitigation measures, these effects on soil and geology will causes noticeable changes in the character of the land and soils environment without affecting its sensitivities. This represents a ***negative, slight, long-term direct effect***. Mitigation measures to limit this can be found in Section 9.5.2.2.

9.4.2.3 Accidental Spills and Contamination/Pollution

There is the 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.

It is considered that without the implementation of mitigation measures, these effects from spills and pollution will have the potential to alter the character of land and soils environmental. This represents a ***negative, moderate, direct, unlikely, long-term effect***. Mitigation measures to limit this can be found in Section 9.5.2.3.

9.4.2.4 Grid Connection Route and Substation

Minor excavations of replaced soils, subsoils, trench backfill material could be required along the grid connection route and substation areas if a fault occurred during the operational phase, which is highly unlikely. These works would be temporary and short in duration. Any material excavated during such works would however be reinstated back into the trench.

The majority of the grid connection is on existing private access tracks. There is an area of conifer forestry which will be permanently displaced in the footprint of the substation. All felled trees as part of the proposed development will be replanted on suitable sites and therefore change in land use associated with the substation will not be considered significant.

It is considered that without the implementation of mitigation measures, effects arising from the grid connection and substation works will cause noticeable changes in the character of the environment but without significant consequences. This represents a ***negative, not-significant, temporary, direct effect*** on the soils, subsoils, and bedrock environment. Mitigation measures to limit this can be found in Section 9.5.2.4.

9.4.3 Decommissioning Phase

The potential effects associated with the decommissioning of the proposed development will be similar to those associated with construction (i.e. soils, subsoils and bedrock excavation, potential contamination by leaks and spills, erosion of exposed subsoils), however significantly reduced in magnitude.

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. As such, the decommissioning phase of the project will require minimal earthworks. 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 and disposal 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*.

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, slight, long-term effect***.

9.4.4 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.

9.4.5 Cumulative Effects

Consideration has been given to the cumulative effects resulting from interactions with other surrounding developments and activities. With the exception of places where gravity is a role (on slopes) soils, geology, and land use have a largely static nature, which limits the possibility for cumulative consequences. Nonetheless, these effects may be increased by external causes, which could be organic or man-made, as was previously mentioned (wind, water, ice, etc.).

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

Wind turbines identified within 25km of the proposed Ballycar development are listed below:

- Limerick Blow Moulding, Parteen (single turbine) (existing) (permission for retention and changing of position granted);
- Vistakon (single turbine) (existing);
- Castlewaller (Permitted but not constructed);
- Carrownagowan (Permitted, under Judicial Review);
- Carrownagowan Wind Farm Grid Connection (Submitted)
- Fahy Beg (Refused, Appealed to An Bord Pleanala).

The nearest solar farms to the proposed development are listed as follows:

- Drummin Solar Farm – c. 309,008 m^2 of solar photovoltaic panels, a 38 kV electrical substation and other ancillary works (Permitted by Clare County Council but not yet constructed);
- Ballyglass Solar Farm – c. 265,000 m^2 of solar panels on ground mounted frames and other ancillary works (Permitted by Clare County Council, Appealed to An Bord Pleanála).

Drummin Solar farm is located approximately 2km east of the proposed development while Ballyglass is located approximately 4km east. The potential for cumulative effects are considered in the relevant chapters of this EIAR.

Due to the localised nature of the proposed construction works, there is no potential for significant cumulative effects in-combination with any other local developments (refer to **Chapter 2** and above) on the land, soils and geology environment. As erosion, sedimentation and contamination of the soils has the potential to enter watercourses and aquifers within the site, the cumulative effect with the adjacent developments is also be considered. The hydrological pathway is assessed in Chapter 8 Water.

Bobby O'Connell and Sons Ltd. quarry have lodged several planning permissions for expansion of the southern flank of their quarry, which borders the northern perimeter of the proposed development site. Any works that are to commence are to be confined within the quarry and shall not expand into the proposed development area. Mining activities relating to the quarry, namely blasting, quarrying, excavation works, and processing will occur and will be confined to within the quarry boundary. During the construction process of turbine foundations, blasting may be necessary if rockhead is less than 3mbgl. Details of the effects from rock blasting can be found in Section 9.4.1.4.

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

The construction of the substation will require an excavation of 12,000m^3 of soil which will be replaced with site won compacted crushed rock or granular fill. The cut and fill slopes will be landscaped and revegetated.

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 a ***negative, not-significant, long-term effect***.

9.5 Mitigation and Monitoring Measures

Appropriate mitigation measures to avoid, or significantly reduce any potential effects during the construction, operational and decommissioning phases of the proposed development are outlined in this section.

The primary mitigation measure employed has been the design of the wind farm in terms of locating the turbines, access tracks, and other proposed infrastructure in order to reduce the effects on land and soils.

9.5.1 Construction Phase

9.5.1.1 Mitigation Measures for Land Use

The overall footprint of the proposed development is approximately 30% of the planning application boundary. 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 minimized to avoid unnecessary soil sealing, disruption etc. Material extraction will be minimised as much as possible. 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. A minimal volume of material will be imported to accommodate the works. This material is required for access track construction, hardstand construction and other structures, such as the compound and storage facilities. 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 foundations 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 wind farm such that it can be used again for agricultural/pastural and/or forestry purposes. The land outside the development footprint, will not be affected by the development, and current land use practices (agriculture/forestry) 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 wind farm 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 wind farm. 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 connection route was designed to minimise the length of cabling to connect the wind farm to the grid, with the majority of the route within existing tracks, thereby not significantly impacting on current land use.

9.5.1.2 Mitigation Measures for Soil and Geology

Soil Erosion

Materials used during the construction phase of the proposed development will be managed in line with the approved CEMP which can be found in Appendix 2A. The CEMP includes site management controls to mitigate for soil erosion.

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.

Excavations for turbine foundations 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 is likely to 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 Chapter 3 Civil Engineering and the CEMP.

Drainage will be constructed in parallel with access track construction and turbine excavation, including drains and stilling ponds, etc. A combination of new and upgraded drainage networks will be installed within the site. The existing drainage network will be upgraded, where necessary, and settlement ponds and sediment traps installed 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 Chapter 3 Civil Engineering of this EIAR. Temporary works will be such that they do not adversely interfere with existing drainage channels/regimes.

Temporary stockpiles of excavated spoil, 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 **Chapter 3 Civil Engineering** of this EIAR.

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 connection route will be used to reinstate the area around the cable trench following backfilling of the trench with approved materials. Any excess material from the grid connection route will be removed and disposed of to the onsite deposition areas or to an appropriate facility licensed to accept such waste.

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 weekly by the Environmental Manager and cleaned regularly as required as directed by the Environmental Manager.

Soil Compaction

The **CEMP** includes minimum site management controls to reduce and mitigate for compaction.

A **Traffic Management Plan (TMP)** (**Appendix 2D**) 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 **Chapter 8 Water**).

Slope Stability

All temporary cuts/excavations will be carried out such that they are stable or adequately supported. Temporary works will be such that they do not adversely interfere with existing drainage channels/regimes.

All site excavations and construction will be supervised by a suitably competent and experienced engineer. 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 three closest events include "Ayleacotty 2009" 16km northeast, with the collapse of a steep railway bank, "Slieve Bearnagh 2003" 16km north, with a peat flow onto the local road, and "Fort Henry 1948" 18km northeast, with a riverbank rupture.

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 (such as the proposed temporary site compound) and will not be positioned or trafficked in a manner that would surcharge existing or newly-formed slopes.

9.5.1.3 Mitigation Measures for Accidental Spills and Contamination/Pollution

The **CEMP (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 (Appendix 2A).** The proposed surface water drainage is summarised in **Chapter 3 Civil Engineering**, **Chapter 8 Water** and **Chapter 15 Material Assets**.

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 **Appendix 2A**.

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 bowsers. The refuelling bowser will be operated by trained personnel. The bowser 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 bowsers, 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 and 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. 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 and 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 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.

9.5.1.4 Mitigation Measures for Rock Blasting

As part of the constraints led design process, the borrow pit and the most northerly 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 Chapter 3 Civil Engineering of this EIAR. Turbines and infrastructure in these areas are deemed to have low susceptibility to landslides. In order to further mitigate against possible slope instability close to the borrow pit, blasting will not occur after periods of heavy rainfall. 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 within the borrow pit 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. To mitigate against the risk of slope failure occurring, blasting will not be permitted at turbine locations unless robust mitigation measures are put in place. Blasting for the access track cuttings and hardstands will be subject to the same rigorous controls as that proposed at borrow pit and turbine foundation locations. To mitigate against the risk of excessive dust within the vicinity of the borrow pit, the blast areas will be lightly sprayed with water prior to blasting. 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. Clare 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 and in consultation with Clare County Council, An Garda Síochána and adjoining landowners. Blasting will not occur at the same time as blasting at the adjoining quarry. Additionally, the NPWS and any other required consultees will be consulted as part of the general consultation and blasting permitting process, in order to keep them informed of any blasting proposals for the site.

9.5.1.5 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.

At the end of the forestry lifetime in the felling areas, the felling will be subject to the requirements of a felling licence and adherence to the environmental mitigation measures associated with the licence.

9.5.1.6 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 (Appendix 2A).

9.5.2 Operation Phase

9.5.2.1 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.

9.5.2.2 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 small.

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. Refer to EIAR Chapter 8 Water for further details in relation to hydrology and hydrogeology.

9.5.2.3 Mitigation Measures for Accidental Spills and Contamination/Pollution

Mitigation measures for oils and fuels remain the same as the construction phase, however 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 fuels 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.

9.5.2.4 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.

9.5.3 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.

9.5.4 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.

9.6 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 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.

9.6.1 Peat Stability

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.

As no infrastructure is proposed within the localised area of the site containing minimal peat depths, it was not deemed necessary to carry out a Peat Stability Risk Assessment for this proposed development. Felling activities will take place during the works, and these areas do not have peat mapped within them.

No signs of past instability or incipient instability were noted during the site walkover.

Overall, there is no risk of peat instability at the proposed development site, or from felling activities, as the limited area of peat identified on site, is being completely avoided.

9.7 Residual Effects

No significant residual effects on land and soils are likely.

Table 9-4: Residual Effects

EFFECT (PRE-MITIGATION)	RECEPTOR	EFFECT (PRE-MITIGATION)	MITIGATION MEASURES	RESIDUAL EFFECT (POST-MITIGATION)					
				QUALITY OF EFFECT	SIGNIFICANCE	SPATIAL EXTENT	DURATION	OTHER RELEVANT CRITERIA	LIKELIHOOD
CONSTRUCTION									
Change of Land Use	Land, Soils	Negative, moderate, short-term, direct effect	9.5.1.1	Negative	Not significant	Local	Short-term	Direct	Likely
Effects on Soil and Geology	Soil	Negative, moderate, short-term effect	9.5.1.2	Negative	Not significant / Slight	Local	Short-term	Direct	Likely
	Geology	Negative, not-significant, short-term effect		Negative	Imperceptible	Local	Short-term	Direct	Unlikely
Accidental spills & contamination/pollution	Land and Soils	Negative, significant, short-term, 'Worst-case' effect	9.5.1.3	Negative	Slight	Localised	Short-term	Direct	Unlikely
	Geology and Hydrogeology	Negative, significant, short-term, indirect effect		Negative	Not significant	Localised	Short-term	Indirect	Unlikely
Effects from Rock Blasting	Soils and Geology	Negative, significant,	9.5.1.4	Negative	Not significant	Localised	Short-term	Direct, Cumulative	Likely

EFFECT (PRE-MITIGATION)	RECEPTOR	EFFECT (PRE-MITIGATION)	MITIGATION MEASURES	RESIDUAL EFFECT (POST-MITIGATION)					
				QUALITY OF EFFECT	SIGNIFICANCE	SPATIAL EXTENT	DURATION	OTHER RELEVANT CRITERIA	LIKELIHOOD
		short-term, direct effect							
Effects from Tree Felling	Land and Soils	Negative, slight, short term, direct effect	9.5.1.5	Negative	Not significant	Localised	Short-term	Direct	Likely
Grid Connection and Substation – Effects Arising	Land and Soils	Negative, slight, temporary, effect	9.5.1.5	Negative	Not significant	Localised	Temporary	Direct	Likely
OPERATIONAL									
Change of Land Use	Land	Negative, slight, long-term direct effect	9.5.2.1	Negative	Not significant	Localised	Long-term	Direct, Cumulative	Likely
Effects on Soil and Geology	Soils and Geology	Negative, slight, long-term direct effect	9.5.2.2	Negative	Not significant	Localised	Long-term	Direct	Likely
Accidental spills & contamination/pollution	Land, soils, geology, hydrogeology	Negative, moderate, direct, unlikely, long-term	9.5.2.3	Negative	Not significant	Localised	Long-term	Direct	Unlikely
Grid Connection and Substation – Effects Arising	Land and Soils	Negative, not-significant, direct, low probability temporary effect	9.5.2.4	Negative	Imperceptible	Localised	Temporary	Direct	Likely

9.8 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.

9.9 References

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