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ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED LITTLETON WIND FARM, CO. TIPPERARY

Volume 2 - Main EIAR

Chapter 8 - Land, Soils and Geology

Prepared for:
Littleton Wind Farm DAC

BnM | sse

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8. LAND, SOILS AND GEOLOGY

8.1 Introduction

This chapter has been prepared to examine the potential impacts of the proposed Littleton Wind Farm, associated grid connection and turbine delivery route on existing geological conditions within the study area. The effects of the proposed project are considered, taking account of mitigation measures to reduce or eliminate any residual impacts on land, soils, and geology. The assessment also considers the cumulative impacts associated with other nearby developments.

This chapter initially provides a description of the receiving environment of the Site and the potential impacts of the Proposed Wind Farm. When assessing the potential impacts, this assessment considers the significance of the environmental attributes, and the predicted scale, and duration of the likely effects.

A detailed description of the project assessed in this EIAR is provided in Chapter 4 and is comprised of three main elements:

- The 'Proposed Wind Farm' (also referred to in this EIAR as the **'Site '**);
- The 'Proposed Grid Connection' (also referred to in this EIAR as the **'GC'**);
- The 'Turbine Delivery Route' (also referred to in this EIAR as the **'TDR'**);
- The 'Biodiversity Enhancement and Management Plan Lands' (also referred to in this EIAR as the **'BEMP Lands'**);

A detailed description of the development is included in Chapter 4 (Volume 3)

Permission will be sought for a period of 10 years and a project lifetime of 35 years will be sought from the date of commissioning.

8.2 Statement of Authority

This chapter has been prepared by Doireann Tarrant, a Senior Project Engineer with FT. Doireann holds a MSc in Structural and Geotechnical Engineering. She has over 3 years' experience in Geotechnical Engineering to include preparation of EIAR Land, Soils and Geology chapters for renewable energy projects within Ireland.

This chapter has been reviewed by Aaron T. Clarke, a Principal Geologist with FT. Aaron is a Chartered Principal Geologist with a BSc in Earth Sciences from University of Galway and a MSc in Applied Geotechnics from Camborne School of Mines (University of Exeter). He is a professional member of the Institute of Geologists of Ireland (PGeo) and the European Federation of Geologists (EurGeol). Aaron has over 20 years post-graduate experience working in the fields of geoscience and ground engineering. He has experience working on renewable energy projects within the Irish market, preparing EIAR Soils, Geology and Hydrogeology chapters for renewable energy projects within Ireland.

8.3 Assessment Methodology

In summary the methodology adopted for this assessment includes:

- Review of appropriate guidance and legislation;
- Characterisation of the receiving environment;
- Review of the proposed project;
- Assessment of potential effects;
- Identification of mitigation measures;
- Assessment of residual impacts
- Assessment of cumulative impacts.

The assessment methodology and criteria are outlined in Section 8.3.5.

8.3.1 Relevant Policy and Guidance

The general EIA guidelines are listed in Chapter 1, other topic specific reference documents complied with in the preparation of this section include the following:

- NRA (2009), Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (Now known as Transport Infrastructure Ireland (TII)).
- IGI (2013), Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements
- Scottish Executive (2017) Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments, 2nd Edition.[1]
- EPA (2003), Towards Setting Guideline Values for the Protection of Groundwater in Ireland.
- EPA (2022), Guidelines on the Information to be Contained in Environmental Impact Assessment Reports.
- Irish Wind Energy Association (IWEA) (2012), Best Practice Guidelines for the Irish Wind Energy Industry.

8.3.2 Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties as summarised in Chapter 2 – Scoping, Consultation and Key Issues. Responses from the consultees identified a range of observations which have been taken into consideration in the preparation of the respective chapters of this EIAR. Specific issues raised during the scoping process with respect to Land, Soils and Geology are presented in Table 8-1:

[1] 1 This guidance document represents the current standard used in Ireland for peatland sites.

Table 8-1: Consultation Responses

Consultee	Response Date	Responses / Issues Raised
Geological Survey Ireland (GSI)	June 2025	Consider all appropriate guidelines, and data sources. Use of GSI data or maps should be attributed correctly.

8.3.3 Study Area

While the primary focus of the assessment is on land, soils, and geology within the Site, the study area extends 2km beyond the Site boundary, in accordance with IGI guidance (2013), and is illustrated in Figure 1.1.

8.3.4 Impact Appraisal Methodology

As outlined in Section 8.1, the aim of this assessment is to identify the impacts of the construction, operation and decommissioning of the Proposed Development and associated works on the existing land, soils and geology of the study area. The assessment also identifies appropriate mitigation measures to minimise any likely significant effects.

The following elements were examined to determine the potential effects of the Proposed Development on the land, soils and geology within the study area:

- Characterisation of the land, soils and geology underlying the proposed project;
- Evaluation of the potential impacts of the proposed project.

The baseline geological conditions and land characterisation within the study area were determined following a desktop review of publicly available information including aerial photography and EPA and GSI online databases. Findings from the desktop review are detailed in Section 8.4. Site walkovers and intrusive investigations were also conducted. The study area is defined as the area that could potentially experience effects from any element of the project including the Wind Farm Site, GC and TDR.

Following the assessment of the existing environment, the unmitigated impacts of the Proposed Development during the construction, operational and decommissioning phases on sensitive receptors identified were determined. The evaluation of the significance of effects was undertaken in accordance with the IGI guidance (2013).

Where likely significant effects were identified, mitigation measures are proposed and will be implemented. The residual effects from the Proposed Development were then re-appraised taking into account the recommended measures. The residual effects from the Proposed Development are presented in Section 8.8 of this chapter.

8.3.5 Evaluation Criteria

During each phase (construction, operation, and decommissioning) of the Proposed Development, several activities will take place on site, some of which will have the potential to cause significant effects on the geological regime at the proposed Site and the associated Land, Soil and Geology. Mitigation measures, where required, are presented in Section 8.7.

8.3.5.1 Assessment of Magnitude and Significance on Land Soils and Geology

An impact rating has been developed for each of the phases of the Proposed Development based on the Institute for Geologists Ireland (IGI) "Guidance for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements." In line with the IGI Guidance, the receiving environment (geological features) was first identified.

Using the NRA rating criteria in Appendix C of the IGI Guidance, the importance of the geological features is rated (Table 8-2) followed by an estimation of the magnitude of the effects on geological features (Table 8-3).

This determines the significance of the effect prior to application of mitigation measures as set out in Table 8-4.

Table 8-2: Criteria rating Site Importance of Geological Features (NRA, 2009)

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

Table 8-3: Estimation of Magnitude of Impact on Geological Features (NRA, 2009)

Magnitude	Criteria	Typical Example
Large Adverse	Results in loss of attribute	• Loss of high proportion of future quarry or pit reserves • Irreversible loss of high proportion of local high fertility soils • Removal of entirety of geological heritage feature • Requirement to excavate / remediate entire waste site • Requirement to excavate and replace high proportion of peat, organic soils, and/or soft mineral soils beneath alignment
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	• Loss of moderate proportion of future quarry or pit reserves • Removal of part of geological heritage feature • Irreversible loss of moderate proportion of local high fertility soils • Requirement to excavate / remediate significant proportion of waste site • Requirement to excavate and replace moderate proportion of peat, organic soils, and/or soft mineral soils beneath alignment
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	• Loss of small proportion of future quarry or pit reserves • Removal of small part of geological heritage feature • Irreversible loss of small proportion of local high fertility soils and/or • high proportion of local low fertility soils • Requirement to excavate / remediate small proportion of waste site • Requirement to excavate and replace small proportion of peat, organic soils, and/or soft mineral soils beneath alignment
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	• No measurable changes in attributes
Minor Beneficial	Results in minor improvement of attribute quality	• Minor enhancement of geological heritage feature
Moderate Beneficial	Results in moderate improvement of attribute quality	• Moderate enhancement of geological heritage feature
Major Beneficial	Results in major improvement of attribute quality	• Major enhancement of geological heritage feature

Table 8-4: Ratings of Significance of Impacts for Geology (NRA, 2009)

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

The determination of the significance of each impact for the proposed project is discussed in Section 8.6. The subsoil comprising peat and glacial till has been classified as '**High**' importance receptor due to the Site being located within Littleton Bog, Ballybeg Bog, Lanespark Bog and Derryvella Bog which is considered a County Geological Site (CGS) owing to the importance of the vegetation record held within the pollen of the peat. The bedrock has been defined as '**Medium**' importance receptor as it is not considered protected under the CGS classification.

8.3.6 Desk Study - Methodology

Prior to undertaking the site walkovers and intrusive site investigations, a desk study was undertaken to determine the baseline conditions within the study area and planning boundary to provide relevant background information. The desk top study involved an examination of the following sources of information:

- Bedrock Geology 1:100,000 Scale Map Series, Sheet 18; Geological Survey of Ireland (GSI, 1996)
- Tipperary County Development Plan 2022-2028
- Kilkenny County Development Plan 2021-2027
- Aerial imagery from Google, Bing and OSi (Geohive)
- Current and historical (6 inch and 25 inch) Ordnance Survey maps
- Mapping data of the area produced by the Geological Survey of Ireland (GSI)
    - Teagasc soils mapping
    - Quaternary subsoil geology
    - 100k bedrock geology
    - Karst features
    - Geological heritage features
    - Aggregate potential
    - Landslide susceptibility
- Datasets from the EPA
- Available LiDAR data (supplied by BnM)
- National Parks & Wildlife Services Public Map Viewer (www.npws.ie)

The above references were consulted in October 2025.

8.3.7 Site Investigations and Field Assessments

As part of the geotechnical assessment a site walkovers were undertaken by Fehily Timoney and Company (FT) in June 2023 and July 2025 to determine the baseline characteristics of the proposed Site. No historic GI data is available within the study area.

The site assessment works undertaken by FT comprised the following:

- Walk over inspections of the main site with recording of salient geomorphological features at proposed infrastructure locations;
- Peat depth probing and slope stability assessment at proposed turbine and access track locations;
- Measuring of slope angle at proposed turbine and infrastructure locations.
- Recording of GPS co-ordinates of site investigation locations using a hand-held GPS.

Peat probing was carried out by FT and Bord Na Mona between June 2021 and June 2025, and recorded depth of peat at 556 no. locations across the Site.

Intrusive site investigations were undertaken by Ground Investigations Ireland (GII) under the supervision of FT in between August 2021 and July 2025.The scope of the site investigations is summarised below with the information obtained referenced in this chapter:

18th July to 30th August 2022

Advancement of 28 No. trial pits to depths ranging from 0.9 m to 4.50 m below ground level (BGL) at proposed turbine locations. The factual report for this ground investigation was published by GII in October 2022.

Collection of samples for environmental and geotechnical testing.

5th and 6th April 2023

Advancement of 11 No. trial pits to depths ranging from 3.5 m to 4.50 m below ground level (BGL) at proposed peat repository areas. The factual report for this ground investigation was published by GII in June 2023.

Collection of samples for environmental and geotechnical testing.

17th and 18th October 2023

Advancement of 10 no. trial pits to depths ranging from 0.8m to 4.1m below ground level (BGL) The factual report for this ground investigation was published by GII in June 2023.

Collection of samples for environmental and geotechnical testing.

5th and 18th December 2023

Advancement of 7 No. rotary cores to a maximum depth of 12.4 m below ground level (BGL) at proposed locations for borrow pits and substation.

Collection of rock samples for geotechnical testing.

8.4 Receiving Environment

The existing environment is described hereunder. This includes descriptions of the underlying quaternary and bedrock geology, areas of geological heritage, areas of economic interest with respect to geological resources, and potential for soil contamination. This section also includes a summary of site-specific information obtained during site walkovers and intrusive site investigations undertaken as part of the baseline assessment works. For details of the existing land use on the Site see Chapter 4 Description of the Proposed Development and Chapter 5 Population and Human Health. The following sections form the basis of a Conceptual Site Model (CSM), detailing the interactions between the different receiving geological receptors.

8.4.1 Ecological Designation Areas

According to the National Parks and Wildlife Service (NPWS), there are no Special Areas of Conservation (SAC), National Heritage Areas (NHA) or Special Protection Areas (SPA) located within or in the vicinity of the Site. The nearest designation area is the River Barrow and River Nore SAC located 8.5km east of the Site. Additionally, the Lower River Suir SAC is located 9.6 km west of the Site. There is a proposed NHA (Kilcooly Abbey Lake) located 4.3 km east of the Site. The outline of the nearest designation areas can be seen in Figure 8.1.

8.4.2 Quaternary (Subsoil) Geology

The GSI online 1:50,000 scale Quaternary Geology map (Figure 8.2) shows that the Site comprises of the following:

- Cut over raised peat (Cut) present on most of the site, within the footprint of turbines and other infrastructure elements.
- The north-eastern part of the site, in the location of the borrow pit, comprises a Till derived from Limestone (TLs) and Bedrock outcrop or subcrop (Rck).

The GSI online 1:50,000 scale Teagasc Soils shows that the Site comprises of the following:

- Basin peat is present across the majority of the site. The topography is described as Flat and Undulating Lowland comprising mainly wet mineral and organic soils.
- The site is surrounded by Minimal Grey Brown Podzolics Till derived from Limestone Till. The soil is characterised as 'deep well drained mineral (mainly basic)' identified by the code BminDW.

8.4.3 Bedrock Geology

The GSI online 1:100,000 scale bedrock geology map (Figure 8.3) shows that the Site is underlain by the following formations:

- Ballysteen Formation – Dark muddy limestone, shale (BA).
- Lisduff Oolite Member (Ballysteen Formation) – thick bedded, pale-bluegrey, cross-bedded, well jointed oolite, with some crinoid ossicles and rare well-preserved calices (BAld);
- Waulsortian Limestone - Massive unbedded lime-mudstone (WA).
- Aghmacart Formation - Dark shaly micrite, peloidal limestone (AG).

The Ballysteen Formation covers the northern region of the site, which includes the footprint of turbines T01, T02, T03, T04 & T05. The dominant lithology is dark muddy limestone, shale.

The Lisduff Oolite Member (Ballysteen Formation) is a bedrock formation located within the Ballysteen Formation in the northeast of the Site, which includes the footprint of the Borrow Pit and comprises thick bedded, pale blue-grey, cross-bedded, well jointed oolite, with some crinoid ossicles and rare well-preserved calices.

The Waulsortian Limestones is located in the south region of the Site, which includes the footprints of turbines T06, T07, T08, T09 & T10.

The Aghmacart Formation is located in a small area at the most southern region of the Site, within the footprint of turbine T11.

A fault is found striking northwest-southeast across the site and is located approx. 250m northeast of turbine T01. Bedding is recorded to be dipping (20^{o}) to the east on this fault and (10^{o}) to the west of the fault.

8.4.4 Karst

The underlying bedrock (Waulsortian Formation) at the eastern extent of the proposed GC is prone to karstification. However, according to GSI datasets, there are no karst features mapped within the proposed Site. The nearest karst features are 2 no. swallow holes located approx. 2km southeast of the Site boundary near T08 (approx. 2.1km from this turbine). There are also 2 no. swallow holes located 3km west of the Site, an enclosed depression 4km northeast of the site boundary. The Karst Distribution map is shown in Figure 8.4.

The implications of karst features adjacent to the Site are described further in Chapter 9 - Hydrology and Hydrogeology.

8.4.5 Geomorphology and Topography

GSI Quaternary geomorphological mapping indicates that no mapped geomorphic features are present within the site boundary. The surrounding landscape is dominated by drumlin landforms with a predominant north–south orientation.

8.4.6 Geological Heritage

The GSI - Irish Geological Heritage Section (IGH) and NPWS (National Parks and Wildlife Service) have undertaken a programme to identify and select important geological and geomorphological sites throughout the country for designation as NHAs (Natural Heritage Areas). This is being addressed under 16 different geological themes. For each theme, a larger number of sites (from which to make the NHA selection) are being examined, to identify the most scientifically significant.

The criterion of designating the minimum number of sites to exemplify the theme means that many sites of national importance are not selected as the very best examples. However, a second tier of County Geological Sites (CGS) (as per the National Heritage Plan) means that many of these can be included in County Development Plans and receive a measure of recognition and protection through inclusion in the planning system.

The GSI Online Irish Geological Heritage database indicates that the Site is located within an area of specific geological heritage interest. Littleton Bog including Templeuohy Bog, Derryhogan Bog and Derryvilla Bog is considered a County Geological Site (CGS). The heritage site has been described as a bog which exists due to the geological and hydrogeological process of peat growth and may be designated a geological NHA owing to the importance of the vegetation record held within the pollen of the peat.

The distribution of Geological Heritage sites is shown on Figure 8.5.

8.4.7 Economic Geology

The GSI Online Minerals database shows no metallic occurrences within the Site. A metallic deposit has been recorded to reside in the Waulsortian formation, approximately 1.5km, north of the Site. The distribution of mineral occurrences and active quarries is shown on Figure 8-6.

The GSI Aggregates Mapping database contains no recorded data for granular aggregate potential within the Site. The crushed rock aggregate potential (Figure 8-7) within the Site ranges from Very Low to Moderate, with the majority of the Site classified as Low to Moderate.

8.4.8 Site Investigation Findings

As outlined in Section 8.3.7 a phased ground investigation was undertaken between August 2022 and December 2023 to determine the baseline geological and geotechnical characteristics of the Site. A total of 50 trial pits and 7 rotary core boreholes were completed.

The detailed findings and conclusions of the site walkovers and site investigation works are provided in Appendix 8.1 – Geotechnical and Peat Stability Assessment Report (Volume 3) and have generally confirmed the anticipated geology described in the Desk Study outlined in Section 8.4. Factual findings from the intrusive site investigations are presented in Appendices E to G of the Geotechnical and Peat Stability Assessment Report (Appendix 8.1 in Volume 3). A brief description of the ground conditions encountered during the site walkovers and site investigations completed during the assessment of the receiving environment is provided in the following section.

8.4.8.1 Proposed Turbine Locations

Trial pits were excavated at all the turbine locations, and a summary of ground and groundwater conditions are presented in Table 8-5.

Table 8-5: Summary of Geology Encountered at Turbine Locations

Hole ID	Strata depth from to (m BGL)						Groundwater Strike (m BGL)
	Topsoil/Made Ground	Peat	Cohesive Glacial Till	Gravel Deposits	Possible Bedrock	Bedrock	
T01 (TP-47)	-	0.00-1.90	1.90-4.50	-	-	-	1.00 & 2.70
T02 (TP-05)	0.00-0.10	0.10-1.10	1.10-2.00	2.0-3.20	-	-	1.20 & 1.60
T03 (TP-06)	0.00-0.65	0.65-1.50	1.50-4.00	-	-	-	2.70
T04 (TP-07)	-	0.00-1.30	1.30-4.50	-	-	-	2.50 & 3.70
T05 (TP-08)	-	0.00-1.80	1.80-4.50	-	-	-	1.2
T06 (TP-09)	-	0.0-1.20	1.20-3.00	3.00-3.20	-	-	3.00
T07 (TP-10)	-	0.0-1.60	1.60-4.50	-	-	-	3.00
T08 (TP-11)	-	0.00-3.00	3.00-3.80	3.80-4.50	-	-	3.00
T09 (TP-12)	-	0.00-0.65	0.65-2.00	2.00-3.00	-	-	2.00 & 3.00
T10 (TP-13)	-	0.00-0.80	1.80-2.80	0.80-1.80	-	-	2.60 & 2.80
T11 (TP-14)	-	0.00-0.90	0.90-4.50	-	-	-	3.80
	Note 1 – Obstruction, as possible rock. Note 2 – Unable to progress TP through very stiff strata and boulders.						

Ground conditions at the turbine locations generally comprises Peat overlying Cohesive Glacial Till overlying Gravel deposits. The depth of bedrock was not proven in the trial pits.

Peat was encountered at each turbine location and was generally described as slightly clayey psuedo-fibrous PEAT. The thickness of peat at the turbine locations ranged from 0.65m to 3.00m. MADE GROUND comprised of displaced peat was encountered in TP-06 under T03 described as dark brown slightly clayey amorphous Peat with roots.

The Cohesive Glacial Till deposits were encountered beneath peat at most locations and were typically described as very soft CLAY and SILT with a varying coarse-grained component. The thickness of this stratum ranged from 0.80m to 3.20m, beneath the turbine locations. The thickness of this stratum was not proven beneath T01, T03, T04, T05, T07 and T11.

Gravel Deposits were encountered beneath the cohesive glacial till at T02, T06, T08, T09 and T10. This material was described as a grey slightly sandy silty clayey subangular to subrounded fine to coarse GRAVEL with occasional cobbles and boulders.

Where trial pits were terminated before the scheduled depth the reason was described as unstable trial pit walls. There was no evidence of possible bedrock in the trial pits.

Groundwater strikes were recorded in several of the exploratory holes (Table 8-5) at depths ranging from 1.00 to 3.80m bgl. These readings were taken as each exploratory hole was being advanced and therefore do not reflect potential seasonal groundwater variations.

8.4.8.2 Proposed Substation Location

A summary of ground and groundwater conditions at the proposed substation location are presented in Table 8-6.

Table 8-6: Summary of Geology Encountered at Proposed Substation Location

Hole ID	Strata depth from to (m BGL)					Groundwater Strike (m BGL)
	Topsoil	Peat	Cohesive Glacial Till	Gravel Deposits	Bedrock	
TP-42	-	-	0.00-4.50		-	1.20
BH02	-	0.00-3.50	3.50-5.00	5.00-6.50	-	-

Ground conditions at the substation location (TP-42) comprise very soft clayey psuedo-fibrous PEAT to 3.10m, underly by soft grey sandy gravelly clayey SILT to 4.0m, underlain by soft grey sandy gravelly silty CLAY with medium cobble content. The thickness of the cohesive glacial till layer was not proven as this trial pit was terminated at the scheduled depth. Bedrock was unproven in rotary core borehole BH02.

8.4.9 Existing Slope Stability

From a review of the GSI Landslide Susceptibility (Figure 8.8), the Site and proposed infrastructure locations are exclusively within an area mapped as having a 'Low' landslide susceptibility. GSI Physiographic mapping shows the Site is located completely within a bog plain (Figure 8.9) and the land immediately surrounding is flat to gently undulating ice-moulded topography.

In addition, desktop review of available aerial photography and site reconnaissance findings did not identify evidence of slope instability and there are no historical records of landslide activity within 5km of the Site on the GSI database. Therefore, the risk of landslide within the Site is 'Negligible and Insignificant'. A geotechnical assessment was done using findings from the site walkover surveys and the intrusive ground investigations and the results are presented in Appendix 8.1 Geotechnical and Peat Stability Assessment Report (GAR).

8.4.10 Peat Stability Assessment

Following the site walkover and given the presence of peat deposits within the Site, a review of the published checklist for peat landslide hazard and risk assessment was carried out. This was undertaken in accordance with the best practice guidance: Scottish Executive – Peat Landslide Hazard and Risk Assessments (2017).

The potential for a landslide risk is defined in the Scottish Executive "Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments" (2017) as the following:

- Peat is present at the development Site in excess of 0.5 m depth, and;
- There is evidence of current or historical landslide activity at the Site, or;
- Slopes > 2° are present on-Site, or;
- The works will impinge on the peat covered areas and cannot be relocated to avoid peat covered areas.

As such and in accordance with the Scottish Executive Best Practice Guide for Proposed Electricity Generation Developments (2017), as the works will impinge on the peat covered areas and cannot be relocated to avoid peat covered areas, the slopes are >2^{O}, and peat depth are in excess of 0.5m bgl, a peat stability assessment was warranted. A geotechnical assessment was undertaken using findings from the site walkover surveys and intrusive ground investigations and is presented in Appendix 8.1 –Geotechnical and Peat Stability Assessment Report (GAR). The drained and undrained stability analysis returned Factor of Safety Results of >1.3 for all infrastructure elements assessed, indicating the risk of peat landslide is 'Negligible and Insignificant'.

8.4.11 Topography of the Main Wind Farm Site

Based on the Tailte Éireann Discovery Series mapping the topography of the Site ranges from 117 to 130 mOD. Extensive peat extraction has been carried out across the Site leaving the topography of the Site relatively flat.

8.4.12 Type of Geological Environment

Based on the available data, the study area has been classified as a "Type B", naturally dynamic hydrogeological environment in accordance with the IGI Guidelines.

8.4.13 Rating of Significance of Geological Attributes

Based on the TII (previously NRA) methodology (2009), criteria for rating site importance of geological features, the importance of the bedrock and soil features at this site is rated as 'Low Importance' due to local geological attribute has a low quality, significance or value on a local scale.

8.5 Characteristics of Proposed Project

The Proposed Development will involve removal of topsoil, peat, overburden and bedrock (where present) for construction of access tracks, turbine foundations, internal cable network and grid connection, hardstanding emplacement, substation, crane hardstands, construction compounds, and met mast installation.

Aggregate and crushed rock for construction will be sourced from local authorised quarries and on-site borrow pits.

Estimated volumes of overburden (topsoil and mineral soil) to be removed are shown in Table 8-7. Excavated material will be used for reinstatement and landscaping works around the site, as well as for berm creation alongside the access tracks. Rock excavated from excavations will be reused within the access tracks and hardstands.

Table 8-7: Estimated Excavation Volumes

Infrastructure Element Note 1	Typical Dimensions	Peat Volume Note 2	Spoil Volume (m^3)
11 no. Turbines and Hardstands	37m diameter excavation footprint for turbine foundation	98,266	71,798
Internal Access Tracks (to Include On-Site Electrical Cable Trenches)	Assumed 6m running surface with 7m wide development footprint.	2,898	15,840
Temporary Construction Compounds	5 no. Hard standing areas (total area 12,921m2).	0	0
Main CBoP and TSA Compound	Total area 7,500m^2	0	2,475
Amenity Car Park	22m x 46m area	0	0
Substation	10,275m^2	12,230	3,391
1 no. Met Mast	Combined area (744m^2)	684	246
Security Cabin (Longford Pass)	2.5m x 7.0m	68	6
Security Cabin (L211 Derryvella)	2.5m x 7.0m	0	6
Borrow Pit	Total area 78,090m^2	0	190,087
Peat Repository Areas	Total area 81,577m^2	0	0
Total Volumes (m^3)		114,146	283,849
Total Peat and Spoil Volumes Combined (m^3)		397,995m^3	

Note 1 - The location of the infrastructure elements on site are shown on Figure 1.1, Volume IV.

Note 2 - A factor of 10% (bulking factor of 5% and contingency factor of 5%) has been applied to the excavated rock volumes to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the site.

Table 8-8: Borrow Pit Rock Volumes

Borrow Pit No.	Typical Dimensions	Anticipated Rock Volume (m^3) Note 1
Borrow Pit 1	77,635 m^2 footprint	317,100
Total Volume of Rock (m^3)		**317,100**
Note 1 - A factor of 15% (bulking factor of 10% and contingency factor of 5%) has been applied to the excavated rock volumes to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the site.		

Table 8-9: Anticipated Stone Volumes Necessary for Construction

Infrastructure Element	Typical Dimensions	Average Stone Depth (m)	Stone Volumes (m^3) Note
11 no. Turbines	707 m^2	0.5	4,469
11 no. Hardstands	6,422 m^2	1.8	150,014
Internal Access Tracks	Varies	0.8	121,737
Temporary Construction Compounds	4 no. Hard standing areas (total area 12,921m^2).	1.0	14,974
Main CBoP and TSA Compound	7,500m^2	1.0	8,625
Amenity Car Park	22m x 46m area	1.0	1,222
Substation	10,275m^2	1.0	14,209
1 no. Met Mast	Combined area (744m^2)	1.0	856
Security Cabin (Longford Pass)	2.5m x 7.0m	1.0	21
Security Cabin (L211 Derryvella)	2.5m x 7.0m	1.0	21
Total Volume of Stone (m^3)			316,148

8.6 Potential Effects

The potential effects on the underlying land, soils and geology at the proposed project are assessed in the following sections for the activities associated within each phase (construction, operation, and decommissioning) for the Proposed Development as described in Chapter 4.

The importance of the soils and geology receptors are summarised in Table 8-10.

Table 8-10: Receptor Importance

Receptors	Activity	Importance	Rational
Geological - Peat deposits/organic soils and glacial till deposits	Construction, Operational & Decommissioning Phases	High	Site is identified as an area of specific geological heritage interest and comprises poorly drained / low fertility soils.
Bedrock	Construction, Operational & Decommissioning Phases	Medium	Limestone
Local quarries (crushed rock and granular aggregate)	Cumulative	Low	Supply of imported stone to the Site from local quarries. Depleting off-site resources.

The magnitude of the impact from these works on the soils and geology receptors have been considered separately in the following sections.

The potential effects are assessed in accordance with the evaluation criteria outlined in Section 8.3.5. The unmitigated potential effects are summarised in Table 8-14. The proposed mitigation measures are then considered to reduce or eliminate potential effects.

8.6.1 Do Nothing Impact

Please note that irrespective of the consenting of the Proposed Wind Farm the remaining measures outlined in the Rehabilitation Plans, i.e. monitoring of the Littleton, Longfordpass and Lanespark Phase 1 measures and enhanced Phase 2 measures at nearby Ballybeg and Derryvella bogs, will continue to be implemented by BnM in agreement with the EPA. Please see Appendix 2.1 (Volume 3 of the EIAR) and Section 2.2.1 of Chapter 2 of the EIAR for further detail.

In this scenario, no additional land take, soil disturbance, peat excavation, or ground engineering works associated with the Proposed Wind Farm would occur. The landform, soil profile and geological environment would continue to evolve naturally under existing management practices, including progressive re-vegetation of cutaway areas, natural colonisation of wetland and scrub habitats, and stabilisation of exposed peat surfaces. As a result, the impact on Land, Soils and Geology would remain unchanged, with no new effects beyond those already occurring under the current licenced rehabilitation regime.

8.6.2 Likely Future Receiving Environment

The environment will change, even without the construction of the proposed project. However, any such changes in the natural environment will be small in nature and will not affect the current classification of the site as a naturally dynamic hydrogeological environment, nor will it impact on the current importance rating of the site in terms of geology (low).

8.6.3 Construction Phase

The following on-site activities have been identified as the sources of potential impacts on the existing geological conditions during the construction phase of the Proposed Development:

8.6.3.1 Site Clearance

Vegetation clearance including superficial topsoil and peat clearance will be undertaken at the turbine and all ancillary infrastructure locations across the Site. In addition to the permanent infrastructure, 4 no. temporary construction compounds are proposed within the Site (Figure 1.1, Volume IV). These will also require removal of vegetation, peat and topsoil prior to construction.

No forestry felling will be required at infrastructure locations therefore these works are not subject to a Felling Licence Application to the Forest Service prior to construction as per the Forest Service's policy (S.I. No. 191/2017) on granting felling licenses for wind farm developments.

Proposed site clearance will involve the use of heavy plant machinery and exposure of underlying soils to surface water runoff, which could result in soil erosion. This also could lead to an increase in sediment and nutrient concentrations in the surface water run-off which may in turn impact groundwater in the Locally Important Aquifer beneath the proposed development site.

The use of plant and machinery during site clearance works will require the storage and use of fuels and oils. Their storage and use present potential for spills and leaks which could contaminate underlying exposed soils and groundwater.

The Magnitude of the impact from these works on the soils receptors is considered to be '**Moderate adverse**' in nature. The importance of the soils receptors (subsoils) is considered to be '**High**' throughout the proposed site. The magnitude of these potential impacts, prior to mitigation, is considered to be of '**Significant/Moderate**' significance.

The Impact Classification is negative, significant/moderate, permanent, direct, and high probability (Likely Effects).

8.6.3.2 Earthworks (Turbine and Borrow Pit Excavations)

The Proposed Development will require construction phase earthworks associated with the excavation of turbine bases, removal of overburden deposits for the construction of turbine foundations, temporary site compound, sub-station, turbine hard standings, internal access tracks and permanent met mast.

As such there is the potential for impact to Land, Soils and Geology from the excavation and movement of existing overburden deposits during the construction phase of the Proposed Development.

The following earthworks excavations will be required:

- Excavation of Topsoil deposits;
- Excavation of Peat Deposits
- Excavation of Glacial Till;
- Excavation of bedrock at the Borrow Pit location.

The following filling and material deposition operations will be required:

- Deposition of surplus topsoil and spoil in berms for reinstatement purposes around turbine bases hardstands, along access tracks and in designated peat repository areas. Material placed alongside access tracks will not exceed 1m in height and will be shaped and sealed to prevent the ingress of water.
- Deposition of surplus topsoil and spoil in proposed borrow pits after site won material is excavated.
- Importation and Filling of site won and imported General Fill and Engineering Aggregates.

Following the completion of site investigations and consideration of wind turbine manufacturer specifications for wind turbines of the size proposed at Littleton Wind Farm, it is expected that wind turbine foundations shall be reinforced concrete gravity foundations with depths of 3.65m and diameters of 30m. Flexibility of +/- 1.5m in the finished levels is required to allow for sloping topography and ground conditions. Ideally, a suitable bearing stratum is encountered within 3m from ground surface so that the turbine foundation can be finished at / near existing ground level. Where deeper excavations (3-5m) are required to reach a suitable bearing stratum, soil replacement (engineered fill) is used to bring up the excavation so that the turbine foundation is finished at / near existing ground level.

The Proposed Development includes 1 no. borrow pit. It is anticipated that this borrow pit will obtain the required volume of stone required for the Proposed Development, see Table 8-8 and Table 8-9.

Surplus Topsoil, Gravel deposits and Glacial Till recovered from excavations will be used for the reinstatement proposed around turbine bases, hardstands, and the temporary construction compound. There are 6 no. proposed peat repository areas across the site where surplus peat will be stored permanently, to a maximum height of 1m. All associated quantities have been calculated in Section 8.5 and no excavated material will leave the Site.

It is proposed that all on-site materials excavated shall be retained on Site and re-used where suitable as part of the construction phase to minimise the import materials requirements.

Direct impacts to the existing geological regime associated with the construction phase of the Proposed Development are:

- Soil compaction may occur due to movement of construction traffic. This will occur particularly within areas of highly compressible soft deposits which are left in-situ during the construction phase. This could lead to an increase in surface water runoff due to reduced infiltration of rainfall and subsequently to an increase in erosion of overburden deposits left in-situ.
- The use of plant and machinery during construction will require the storage and use of fuels and oils. Their storage and use present potential for spills and leaks which could contaminate underlying exposed soils.
- During construction, imported engineering fill and excavated soils will be exposed in excavations and in temporary stockpiles. These soils will be subject to erosion by wind and rain which could deposit silt in streams with an indirect impact on surface water quality.
- The extraction of aggregate and rock from off-site quarries will represent a reduction in the availability of an exhaustible resource.

The Magnitude of the impact from these earthworks' activities on soil receptors is considered to be '**Moderate Adverse'** in nature. The importance of the soils receptors (subsoils) is considered to be '**High'** throughout the proposed site. The magnitude of these potential impacts, prior to mitigation, is considered to be of '**Significant/Moderate**' significance.

The Impact Classification is negative, moderate significance, permanent, direct, and high probability (Likely Effects).

The Magnitude of the impact from these earthworks' activities on geology receptors is considered to be '**Small Adverse'** in nature. The importance of the geology receptors (bedrock) is considered to be '**Medium'** throughout the proposed site. The magnitude of these potential impacts, prior to mitigation, is considered to be of '**Slight**' significance.

The Impact Classification is neutral, slight significance, permanent, direct, and high probability (Likely Effects).

8.6.3.3 Slope Stability

The site topography is predominantly flat, with no existing gradients of sufficient magnitude to pose inherent slope stability concerns. The gentle natural slopes across the area, typically ranging from approximately 2° to 4°, are not anticipated to generate significant global stability issues and any potential instability would be limited to localised zones.

However, during the construction phase, both temporary and permanent earthworks arising from the excavation and placement of peat and mineral spoil along access tracks and at proposed infrastructure locations will introduce manmade slopes that may be susceptible to instability. These engineered slopes should therefore be subject to appropriate geotechnical assessment to ensure adequate stability under both construction and long-term operational conditions.

The Proposed Development and proposed infrastructure locations are generally located within areas of 'Low' susceptibility as classified by the GSI. Therefore, it is considered that construction activities at these locations pose a low risk to receptors from potential landslide/slope failures. In addition, results from the two site walkover surveys show no evidence of recent or historic landslides. No failures within the underlying till deposits were recorded.

The depth of peat across the site was measured between 0.0m to 6.0m, therefore a peat stability risk assessment is required in accordance with the guidance in the Scottish Executive – Peat Landslide Hazard and Risk Assessments (2017). The peat stability risk assessment at each infrastructure location identified a number of mitigation/control measures to reduce the potential risk of peat failure, which can be found in Appendix 8.1 (Volume 3).

The excavation and stockpiling of overburden and bedrock as part of the Proposed Development may potentially lead to slope failures in unstable ground.

Direct impacts to the existing environment associated with potential slope instability and failure include:

- Slope failures have the potential to impact the existing geological conditions from the removal and deposition of landslide/slope failure material and the exposure of underlying overburden deposits and bedrock to an increase in surface water runoff and subsequent increase in erosion. Slope failure also has the potential to have an impact on the safety of construction workers that could be in the vicinity of a landslide/slope failure event, existing infrastructure (access tracks) and nearby urban areas.
- The effect of a slope failure could potentially result in the influx of acidic and/or peat laden waters into downgradient surface water features resulting in a decrease in the receiving water's pH values. This may impact groundwater quality in the underlying Locally Important Aquifer and in any groundwater abstractions in the vicinity of a landslide event.

The Magnitude of the impact from earthworks activities on slope stability is considered to be '**Moderate Adverse**' in nature. The importance of the soils receptors subsoils is considered to be '**High**' throughout the Site. The magnitude of these potential impacts, prior to mitigation, is considered to be of '**Significant/Moderate** significance.

The Impact Classification is negative, moderate significance, short term, direct and low probability (Unlikely Effects).

The Magnitude of the impact from earthworks activities on slope stability is considered to be '**Small Adverse**' in nature. The importance of the geology receptors (bedrock) is considered to be '**Medium**' throughout the Site. The magnitude of these potential impacts, prior to mitigation, is considered to be of '**Slight**' significance.

The Impact Classification is negative, slight, long term, direct and low probability (Unlikely Effects).

8.6.3.4 Internal Access Tracks and Hardstands

There will be approximately 18.39km of internal access tracks and amenity tracks associated with the Site. This will be a combination of existing track upgrade and construction of new tracks; approximately 15.45km of new track construction and approximately 2.95km of existing track upgrade. Hardstand areas will be provided at each turbine location.

All access tracks will be approximately 6.0m wide along straight sections and wider at bends and as required as shown on planning application drawings. Amenity tracks will be approximately 3.0m wide along straight sections and wider at bends as required. The tracks will be finished with a well graded aggregate. The drainage system will be installed adjacent to the internal access tracks. Existing drainage infrastructure will be maintained and upgraded where necessary.

The following filling and material deposition operations will be required:

- Deposition of surplus Topsoil, Gravel and Glacial Till deposits in landscaping berms for reinstatement purposes around hardstands, temporary construction compound and substation compound.
- Use of site won and imported General Fill and Engineering Aggregates.

It is anticipated that the stone required for the construction of the internal access tracks, hardstands, temporary construction compound and the substation will be sourced from local authorised quarries and from the proposed borrow pit on-site. The general fill (Class 1) used for access tracks and infrastructure foundations will be site won and the finishing layers will be imported from local quarries.

The likely off-site, source quarries for the supply of imported crushed rock aggregate during the construction phase of the development are presented in Table 8-11.

Table 8-11: Source Quarries for Imported Aggregate (Crushed Rock)

Name	Distance from site	Products	Rock type
Gleesons Quarries	9km (W)	Series 600 Clauses 804, and Clause 810	Limestone
Roadstone Killough	13km (SW)	Series 600 Clauses 803, 804, 805 and 806 crushed rock aggregate.	Limestone

Typically, access track formation will consist of a minimum 500mm hardcore on a geotextile membrane. The proposed construction methodology for newly constructed tracks will be as follows:

- The formation will be prepared to receive the geotextile membrane.
- Stone will be placed and compacted in layers to minimum 500mm depth.
- A drainage ditch will be formed, within the excavated width and along the sides of the track.
- Surplus excavated material will be placed along the side of sections of the tracks and dressed to blend in with surrounding landscaping and partially obscure sight of the track.

Direct impacts to the existing geological regime associated with the construction of proposed access tracks and hardstands are:

- Soil compaction may occur due to movement of construction traffic. This will occur particularly within areas of highly compressible soft deposits which are left in-situ during the construction phase. This could lead to an increase in surface water runoff due to reduced infiltration of rainfall and subsequently to an increase in erosion of overburden deposits left in-situ.
- The use of plant and machinery during construction will require the storage and use of fuels and oils. Their storage and use present potential for spills and leaks which could contaminate underlying exposed soils.
- During construction, imported engineering fill and excavated soils will be exposed in excavations and in temporary stockpiles. These soils will be subject to erosion by wind and rain which could deposit silt in streams with an indirect impact on surface water quality.

The Magnitude of the impact from these works on the soil receptors is considered to be '**Small Adverse**' in nature. The importance of the soils and geology receptors (subsoils) is considered to be '**High**' throughout the proposed Site. The magnitude of these potential impacts, prior to mitigation, is considered to be of '**Moderate/Slight**' significance.

The Impact Classification is negative, slight, permanent, direct, and high probability (Likely Effects).

8.6.3.5 Internal Cabling and Grid Connection

As outlined in Chapter 4 of this EIAR, electricity generated from wind turbines shall be collected at medium voltage (33kV) by an internal circuit of buried cables which will follow on-site access tracks. This circuit shall be terminated at a proposed on-site substation before being exported to the grid via a 110kV buried cable to the existing Substation at Ballyragget, Co.Kilkenny substation.

Connection works will involve the installation of ducting, joint bays, drainage and ancillary infrastructure and the subsequent running of cables along the existing road network. For cable trenches located in public roads, the contractor will excavate cable trenches and then lay high density polyethylene (HDPE) ducting in the trench in a surround of cement bound material (CBM). Back-filling and reinstatement in public roads will be to a specification to be agreed with the road authority.

A similar construction methodology will apply for cable trenches laid within site access tracks. In this case the cable-ducts will be laid when the track is being constructed and will follow the edge of the site access tracks. The trenches within these locations will be backfilled using the excavated material. Excavated peat and spoil volumes from on-site electrical cable trenching is presented in Table 8-7.

Direct impacts to the existing environment associated with the proposed internal cabling and GC works include:

- The GC, associated excavations and ducting may present a preferential pathway for the movement of groundwater and/or contamination in the subsurface. However, the subsoil at the proposed development is predominantly Glacial Till which has a low permeability throughout the majority of the GC.
- The excavations for the GC trenches and joint bays can have a direct impact on the exposed soils (to include excavation and reinstatement of peat deposits) and rock in the form of increased erosion from surface water ingress.
- Where the material excavated from the GC excavations are not suitable for reuse as backfill or deposition on site this material will be disposed of at a facility licenced (subject to environmental testing and classification) to accept this waste type.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be '**Small Adverse'** in nature. The importance of the soil receptors (subsoils) is considered to be '**High**' throughout the proposed site. The magnitude of these potential impacts, prior to mitigation, is considered to be of '**Moderate/Slight**' significance.

The Impact Classification is negative, moderate/slight significance, permanent, direct, and high probability (Likely Effects).

8.6.3.6 Turbine Delivery Route (TDR)

The proposed turbine delivery route (TDR) will be from Foynes Port as described in more detail in Chapter 4 of this EIAR. The TDR passes through the townlands of Islands, Mountfinn, Urlingford, Fennor, Graiguepadeen, and Longford Pass North and Longford Pass East.

Key elements of the temporary accommodation work for the delivery of turbines are summarised in Table 8-12 below.

Table 8-12: TDR Temporary Accommodation Works

TDR Node Reference Number (POI)	Location	Summary Description of Proposed Temporary Accommodation Works
18	M8 / R693 Roundabout	Removal of two lighting columns and road signs and vegetation clearance to facilitate oversail. Load bearing surface to be laid.
19	R693 / R639 Roundabout	Removal of lighting columns, road signs and tree clearance and laying of load bearing surfacing.
20	R639 Splitter Island	Removal of traffic calming bollards and a load bearing surface to be laid.

The accommodation works associated with the TDR route will include the localised excavation of existing overburden deposits. The potential impact would be from the exposure of the overburden to erosion via surface water ingress during the works.

The Magnitude of the impact from these works on the soil receptors is considered to be '**Small Adverse'** in nature. The importance of the soils receptors (subsoils) is considered to be '**High**'. The magnitude of these potential impacts, prior to mitigation, is considered to be of '**Moderate/Slight**' significance.

The Impact Classification is negative, moderate/slight, permanent, direct, and high probability (Likely Effects).

8.6.4 Operational Phase

The potential impacts on land, soils, and geology from the operation of the proposed project are outlined below.

8.6.4.1 Potential Direct Impacts

Very few potential direct impacts are envisaged during the operational phase of the proposed project. These are:

- Some construction traffic may be necessary for maintenance of turbines, hardstands and access tracks which could result in minor accidental leaks or spills of fuel/oil.
- The grid transformer in the substation and transformers in each turbine are oil cooled. A back up battery energy storage system along with ancillary civil and electrical infrastructure will also be located at the proposed substation. There is potential for spills/leaks of oils/battery fluids from this equipment resulting in contamination of soils and groundwater.

The Magnitude of these impacts is considered to be '**Small Adverse**' in nature. The importance of the soil receptors (subsoils) is considered to be '**High**' throughout the Site. The magnitude of these potential impacts, prior to mitigation, is considered to be of '**Moderate/Slight**' significance.

The Impact Classification is negative, slight significance, shot-term, direct and low probability (Unlikely Effects).

8.6.4.2 Potential Indirect Impacts

A small amount of granular material may be required to maintain access tracks during operation which will place intermittent minor demand on local quarries listed in Section 8.6.3.4.

The Magnitude of the impact from these works on the geology receptors is considered to be '**Small Adverse'** in nature. The importance of the geology receptors (subsoils, bedrock) is considered to be '**Low**'. The magnitude of these potential impacts, prior to mitigation, is considered to be of '**Imperceptible**' Significance.

The Impact Classification is negative, imperceptible significance, shot-term, indirect and low probability (Unlikely Effects).

8.6.5 Decommissioning Phase

The potential impacts associated with decommissioning will be similar to those associated with construction but of reduced magnitude.

During decommissioning, it may be possible to reverse or at least reduce some of the impacts caused during construction by rehabilitating construction areas such as turbine bases and hardstanding areas. This will be done by covering with topsoil and peat to encourage vegetation growth and reduce run-off and sedimentation.

Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude. Nevertheless, as noted in the Scottish Natural Heritage guidance on restoration and decommissioning of onshore wind farms (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change.

Some of the impacts associated with reinstatement of the Site (excavation of turbine bases, access tracks etc.) will be avoided by leaving these in place where possible. The Irish Wind Energy Association (IWEA) (11) states that when decommissioning a wind farm "the concrete bases could be removed, but it may be better to leave them under the ground, as this causes less disturbance". It is proposed to leave the access tracks in-situ at the decommissioning stage. IWEA also state that "it may be best" to leave site tracks in-situ depending on the size and geography of the Proposed Development.

It is therefore 'best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm'.

GC ducts and cables will be left in the ground, therefore no potential impacts during decommissioning stage are likely to occur.

The Magnitude of the impact from these works on the soils and geology receptors is considered to be '**Small Adverse'** in nature. The importance is considered to be '**High**'. The rating of these potential impacts, prior to mitigation, is considered to be of '**Moderate/Slight**' significance.

The Impact Classification is negative, short-term, direct and has unlikely effects.

8.6.6 Potential Cumulative Impacts

As part of the assessment of cumulative impacts, planning searches were undertaken using the following online planning enquiry portals to search for large scale developments within 20km of the site. Searches were limited to planning submissions within the past 10 years:

- Tipperary County Council;
- Kilkenny County Council;
- An Coimisiún Pleanála.

The majority of the applications were of a scale and/or distance that they would not cause a cumulative effect in relation to land, soils, and geology.

Relevant projects, which are likely to have an impact on the Land, Soils & Geology, in proximity to the proposed project are summarised in Table 8-13 and are described in detail in Volume 3, Appendix 1.2 (Developments Considered for Cumulative Assessment).

Table 8-13: Potential Cumulative Impact from other Developments

Development	Distance to Proposed project (km)	Status	Interface	Potential Cumulative Impact
Recreational Shared Cycle Path and Walkway (Ref. 2560154 / ACP 323662-25)	0.02 (on Ballybeg Bog)	Granted	Existing BnM peatlands / former rail bed; local groundworks (track formation, crossings, SuDS at gateways)	Imperceptible to Slight – localised peat/soil disturbance and compaction during construction; potential micro-scale drainage/rewetting interaction but short-term and reversible.
Farranrory Wind Farm – 38 kV Underground Cable Route (Ref. 21627)	Within part of assessed grid route	Granted Permission	Shared/overlapping road corridor sections (trenching, joint bays, ancillary works)	Slight - cumulative ground disturbance where corridors overlap (repeat excavation/reinstatement) ; minor increased risk of local settlement/soil structure degradation and spill risk during concurrent works; reversible.

Development	Distance to Proposed project (km)	Status	Interface	Potential Cumulative Impact
Farranrory Grid Route Amendments (Ref. 2360248)	Within part of assessed grid route	Granted Permission	Same corridor as above; increased joint bays and minor route adjustments	Slight – as above; additional joint bays marginally increase cumulative excavation footprint and duration at localised points; residual effects imperceptible.
Urlingford Mixed-Use (Residential completion + Business Park) (Ref. 20685)	Adjacent to GC	Grant of Permission	Service corridors/roads/attenuation/pumping works near grid route	Imperceptible to Slight – localised cumulative ground disturbance where GC works interface with new services/roads (verges/utility corridors); temporary and reversible.
Togher Crescent Wastewater Pumping Station Upgrade (Ref. 2460666)	Adjacent to GC	Granted Permission	Local trenching/rising main and access works near GC corridor	Imperceptible to Slight – potential short-term cumulative disturbance of roadside soils and made ground if constructed concurrently with GC works; reversible.
Anaerobic Digesters + Biogas Pipeline (Ref. 22687 / APB-316132-23)	Proximate to GC	Granted (after 3rd party appeal)	Linear pipeline works and HDD elements proximate to GC corridor	Slight (localised) – potential cumulative subsurface disturbance at specific corridor crossings/road sections; temporary and reversible.

The ongoing and proposed bog rehabilitation and decommissioning measures implemented by Bord na Móna, including standard rehabilitation works and any future enhanced peatland restoration measures (e.g. PCAS), are not considered to give rise to significant cumulative effects on land, soils or geology when assessed alongside the Proposed Development. Rehabilitation activities are long-established at the Site, are undertaken in accordance with IPC licence requirements and best practice, and are focused on rewetting, stabilisation and revegetation of peatland substrates. The footprint of the Proposed Development represents a very small proportion of the wider bog complex, and rehabilitation measures will be integrated around and between infrastructure elements. As such, these measures will not result in material additional disturbance to geological or soil receptors and are expected to have either neutral or beneficial effects, particularly in terms of substrate stability and hydrological attenuation. Accordingly, cumulative effects on land, soils and geology are assessed as negligible and no further assessment is required.

8.6.7 Summary of Potential Impacts

A summary of unmitigated potential impacts on land, soils and geology attributes from the Proposed Development is provided in Table 8-14.

Table 8-14: Summary of Potential Unmitigated Impact Significance on Land, Soils and Geology

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Construction Phase					
Site Clearance	Exposure of underlying overburden leading to increased erosion. Plant machinery resulting soil compaction of soft deposits and an increase in surface water runoff resulting in increased erosion of exposed soils.	Localized organic soils and Glacial Till deposits.	High	Moderate Adverse	Significant/Moderate
Earthworks (Turbine bases)	Removal of overburden material, open excavations and subsequent exposure underlying overburden and bedrock leading to increased erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill and concrete.	Localized organic soils and Glacial Till deposits.	High	Moderate Adverse	Significant/Moderate
		Bedrock.	Medium	Small Adverse	Slight
Earthworks associated with the construction of the proposed project and associated infrastructure	Slope Failure.	Localized organic soils and Glacial Till deposits and bedrock	High	Moderate Adverse	Significant/Moderate
		Bedrock.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Construction of Internal Site Access Tracks, Hardstands, Temporary Compound, Substation	Open excavations, increased runoff causing erosion of underlying overburden and bedrock. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill.	Localized organic soils and Glacial Till deposits Bedrock Local quarries	High	Small Adverse	Moderate/Slight
Internal Cabling and Grid Connection	Removal of overburden material and exposure of underlying subsoil and bedrock to erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill and concrete products. Disposal of surplus excavated material to licenced facility.	Localized organic soils and Glacial Till deposits and bedrock. Local quarries Licenced Waste Facilities	High	Small Adverse	Moderate/Slight
Accommodation works along TDR	Removal of overburden material and exposure of underlying subsoil to erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill. Disposal of surplus excavated material to licenced facility.	Subsoils. Bedrock. Local quarries. Licenced waste facilities.	High	Small Adverse	Moderate/Slight

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Operational Phase					
Construction traffic for maintenance of turbines, hardstands, and access tracks. Operation of substation and turbines.	Release of hydrocarbons or fuel spill	Localized organic soils and Glacial Till deposits and bedrock.	High	Small Adverse	Moderate/Slight
Maintenance of access tracks	Importation of engineering fill	Local quarries	Low	Small Adverse	Imperceptible
Decommissioning Phase					
Removal of Turbines and Hardstands	Construction traffic resulting in soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils.	Localized organic soils and Glacial Till deposits and bedrock.	High	Small Adverse	Moderate/Slight
Cumulative Impacts					
Construction of the proposed project and associated infrastructure	Cumulative impacts on local quarries from extraction of fill for proposed project	Local quarries	Low	Small Adverse	Imperceptible

8.7 Mitigation Measures

The following section outlines appropriate mitigation measures by design and best practice to avoid or reduce the potential impact of the proposed project. Further details are given in Section 4.3 of the CEMP, which is contained in Appendix 4.1 of Volume 3.

8.7.1 Mitigation by Design and Best Practice

With regard to the proposed project, design and best practice has been and will be implemented as follows:

The primary mitigation measure employed has been the design of the site in terms of locating the turbines, access tracks, material storage areas and other site infrastructure within an area comprising existing agricultural pastoral land and a post commercial bog where the soils are extensively worked and drained.

In order to reduce the impacts on geology and slope stability, infrastructure has been primarily located within areas of thinner soft ground and low slope gradients. Extensive work has already been undertaken at the preliminary design stage to apply risk avoidance by design which included:

- Peat probing and site walkover surveys to identify geotechnical constraints likely to adversely affect the design of the site;
- Excavation of trial pits to establish ground and groundwater conditions;
- Preparation of Slope Stability Assessments, included in the Geotechnical and Peat Stability Assessment Report, Appendix 8.1 of this EIAR;
- Repositioning of turbines, hardstandings and access tracks based on the site assessments and geotechnical assessments in order to reduce ground risk associated with the proposed project;
- The works have been designed and checked by geotechnical and civil engineers, who are suitably qualified and experienced in excavation and earthworks design and construction methodologies. Details of experience and competence is included in Chapter 1.

The following will also be implemented:

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

8.7.2 Construction Phase

The following sections outline appropriate mitigation measures to avoid or reduce the potential impact of the proposed project during the construction phase.

8.7.2.1 Construction Environmental Management Plan (CEMP)

A Construction Environmental Management Plan (CEMP) has been prepared for the proposed project and is included in Volume 3, Appendix 4.1. The CEMP defines the work practices, environmental management procedures and management responsibilities relating to the construction phase of the proposed project.

The CEMP sets out the key environmental management measures associated with the construction, operation and decommissioning of the site, to ensure that during these phases of the development, the environment is protected, and any potential impacts are minimised. The CEMP will be developed further at the construction stage, on the appointment of the main contractor to the project to address the requirements of any relevant planning conditions, including any additional mitigation measures that are conditioned and shall be submitted to the planning authority.

Reference to relevant sections of the CEMP with respect to the mitigation of potential impacts to Land, Soils and Geology from the proposed project are outlined below.

8.7.2.2 Site Clearance

As outlined in Section 8.6.3.1 potential impacts to the existing environment from the proposed vegetation and shrub clearance works have been identified. The works will lead to the exposure of underlying soils to surface water runoff, which could result in soil erosion. The use of site clearance works will require the storage and use of fuels and oils. Details of oil spill protection measures adjacent to sensitive receptors and emergency spill response procedures which will be implemented during the construction phase are outlined in Section 4.3.5 of the CEMP which is contained in Appendix 4.1 of Volume 3.

Storage tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled.

Refuelling of plant and equipment will be conducted from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

Any diesel, fuel or hydraulic oils stored on site will be stored in bunded storage tanks – the bund area will have a volume of at least 110 % of the volume of such materials stored.

Refuelling of plant during construction will only be conducted at designated refuelling station locations on site.

Emergency drip trays and spill kits will be kept available on site, to ensure that any spills from vehicles are contained and removed off site. The emergency response procedure is provided in Section 1.8 of SWMP.

The magnitude of the impact on the underlying soil receptors post mitigation is considered to be '**Small Adverse**'. The importance of the soil receptor (subsoil) is considered to be '**High**' throughout the proposed Site. The significance of the impact is therefore classified as **'Moderate/Slight**'.

8.7.2.3 Earthworks

The project will be constructed in a phased manner to reduce the potential impacts of the project on the Land, Soils and Geology. Phased construction reduces the amount of open, exposed excavations at any one time. Given that the works comprises a significant proportion of excavation and earthworks, suitably qualified and experienced geotechnical personnel will be present on site to supervise the works throughout the earthworks phase of construction.

Details of the proposed methodology and mitigation measures are summarised below and are also outlined in Section 4.3.4 of the CEMP in Appendix 4.1 of Volume 3.

One of the primary mitigation measures employed at the preliminary design stage was the minimisation of volumes of excavated overburden deposits to be exported off site. All excavated peat and spoil will be retained on-site.

This will include:

- Use of suitable site won material (Crushed Rock) as general fill in the construction of access tracks, hardstands and in reinstatement around turbine foundations;
- Surplus overburden will be re-used on site in the form of landscaping.

Surplus overburden deposits excavated during the course of the works will be temporarily stored in a level area adjacent to the construction phase excavations prior to reuse.

Some temporary stockpiles (not exceeding 2m in height) of material will be necessary adjacent to the excavation areas prior to reinstatement, however no long-term stockpiles of material will remain after construction and no surplus/waste soil or rock will be removed from the proposed project site. Temporary stockpiles will be shaped and sealed to prevent the ingress of water from rainfall and placed away from open excavations, sloping / soft ground as not to create an instability risk during temporary works.

To mitigate against the compaction of soil at the site, prior to the commencement of any earthworks, the work corridor will be pegged, and machinery will stay within this corridor so that soils outside the work area are not damaged. Excavations will then be conducted from access tracks as they are constructed in order to reduce the compaction of soft ground.

To mitigate against erosion of the exposed soil or rock, all excavations will be constructed and backfilled as quickly as possible. Excavations will stop during or prior to heavy rainfall events (>10mm/hour).

To mitigate against possible contamination of the exposed soils and bedrock, refuelling of machinery and plant will only occur at designated refuelling areas.

Soil excavated from trenches along the GCR will be taken to a licenced facility for disposal or recycling where required. If feasible, the upper layers of tarmac and asphalt will be excavated separately to the lower engineered fill layers. The lower engineered fill layers will be reused. The tarmac/asphalt layers will be taken to a licenced facility for disposal or recycling.

All temporary cuts/excavations will be conducted such that they are stable or adequately supported. Gravel fill will be used to provide additional support to temporary cuts/excavations where appropriate. Unstable temporary cuts/excavations will not be left unsupported. Where appropriate and necessary, temporary cuts and excavations will be protected against the ingress of water or erosion.

The magnitude of the impact on the underlying soil receptors post mitigation is considered to be '**Small Adverse**'. The importance of the soil receptor (subsoil) is considered to be '**High**' throughout the proposed Site. The significance of the impact is therefore classified as **'Moderate/Slight**'.

The magnitude of the impact on the underlying geology receptors post mitigation is considered to be '**Negligible**'. The importance of the geology receptor (local quarries) is considered to be '**Low**' throughout the proposed Site. The significance of the impact is therefore classified as '**Imperceptible**'.

8.7.2.4 Control of Sediment Laden Runoff

The potential impact from silt laden surface water runoff from increased erosion of exposed overburden deposits will be addressed particularly at drainage locations and where earthworks and vegetation clearance are proposed.

Details of the proposed Surface Water Management System and mitigation measures is summarised below and are also outlined in Section 4.3.5 of the CEMP in Appendix 4.1 of Volume 3.

Best practices will be employed in the prevention of silt laden run-off from entering watercourses as discussed below.

To minimise the impact to surface water quality will be maintained outside the immediate site area, and where appropriate, additional site drainage and settlement ponds will be installed as required prior to construction activities. Silt fencing will be installed in new drainage and monitoring of water quality will be undertaken by the Contractor during the construction phase.

Final drainage will be constructed following the completion of these activities with silt fencing maintained until such time as a vegetation cover has become established. Chapter 9 of this EIAR discusses surface water issues in more detail.

The magnitude of the impact on the underlying soil receptors post mitigation is considered to be '**Negligible**'. The importance of the soil receptor (subsoil) is considered to be '**High**' throughout the proposed Site. The significance of the impact is therefore classified as **'Imperceptible**'.

8.7.2.5 Measures for Spills

Details of oil spill protection measures adjacent to sensitive receptors and emergency spill response procedures are outlined in Section 4.3.5 of the CEMP which is contained in Appendix 4.1 of Volume 3.

Storage tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled. Refuelling of construction vehicles will be conducted from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

- Fuels, lubricants, and hydraulic fluids for equipment used on the construction site will be carefully handled to avoid spillage.
- Any spillage of fuels, lubricants or hydraulic oils will be immediately contained, and the contaminated soil removed from the site and properly disposed of;
- Waste oils and hydraulic fluids will be collected in leak-proof containers and removed from the site for disposal or re-cycling; and

Appropriate spill control equipment, such as oil soakage pads, will be kept within the construction area and in each item of plant to deal with any accidental spillage.

The magnitude of the impact on the underlying soil receptors post mitigation is considered to be '**Negligible**'. The importance of the soil receptor (subsoil) is considered to be '**High**' throughout the proposed Site. The significance of the impact is therefore classified as '**Imperceptible**'.

8.7.2.6 Slope Stability

With regard to slope stability issues, detailed design and construction phase best practice will be implemented as follows:

- The earthworks will be supervised by a suitably qualified and experienced geotechnical engineer or engineering geologist, and hydrologist or drainage engineer.
- Drainage infrastructure will be put in place in advance of excavations. Drains will divert surface water and groundwater away from excavations into the existing and proposed surface drainage network. Uncontrolled, direct, and concentrated discharges of water onto the ground surface will be avoided.
- Loading or stockpiling of materials on the surface of soft ground will be avoided. Loading or stockpiling on other deposits will not be undertaken without first establishing the adequacy of the ground to support loads by an appropriately qualified geotechnical engineer experienced in construction within upland conditions. No stockpiling of material shall take place on steep excavated slopes.
- Excavation will be conducted from access tracks or hardstanding areas to avoid tracking of construction plant across areas of soft ground.
- An assessment of the stability at proposed infrastructure locations has been carried out as part of this EIAR based on worst case conditions in accordance with the principals of Eurocode 7 (IS EN 1997-1) A further assessment will be undertaken at detailed design stage by a suitably qualified and experienced geotechnical engineer prior to the commencement of all excavations to confirm the findings of this assessment.
- Blasting of rock will not be permitted.
- Excavations which could have the potential to undermine the up-slope component of an existing slope will be sufficiently supported to resist lateral slippage and careful attention will be given to the existing drainage.
- Earthworks will not be commenced when heavy or sustained rainfall (orange or red weather warnings) is forecast. A series of rainfall gauges will be installed across the site to provide a record of rainfall intensity. An inspection of site stability and drainage by the Geotechnical Engineer will be conducted on site when a daily rainfall of over 10mm/hr or 25mm/day is recorded on site, works will only recommence after heavy rain with the prior approval of the Geotechnical Engineer following their inspection.
- An emergency plan (included in Section 6 of the CEMP – Appendix 4.1 of Volume 3 of this EIAR) will be updated at pre-construction stage detailing the action plan which would be implemented in the unlikely event of a landslide/slope failure. Should a landslide/slope failure occur or if signs of instability/ground movement are observed, work will cease immediately.

Further details are given in the CEMP included in Appendix 4.1 of Volume 3 of this EIAR.

Adequate time is afforded to any designers or contractors involved in the execution of the confirmatory ground investigation works; detailed design and construction works.

The magnitude of the impact on the underlying soil receptors post mitigation is considered to be '**Small Adverse'**. The importance of the soil receptor (subsoil) is considered to be '**High**' throughout the proposed Site. The significance of the impact is therefore classified as **'Moderate/Slight**'.

The magnitude of the impact on the underlying geology receptors post mitigation is considered to be '**Negligible**'. The importance of the geology receptor (local quarries) is considered to be '**Low**' throughout the proposed Site. The significance of the impact is therefore classified as '**Imperceptible**'.

8.7.3 Mitigation Measures during Operation

It is not envisaged that the operation of the proposed project will result in significant impacts on the geological regimes within the study area, as there will be no further disturbance of overburden post-construction.

The main potential impact during the operation phase would be the risk to groundwater from contamination from spills. Storage tanks, used to store fuel for the various items of machinery, will be self-contained and double-walled.

Refuelling of maintenance vehicles will be conducted from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

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

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

The magnitude of the impact on the underlying soil receptors post mitigation is considered to be '**Negligible'**. The importance of the soil receptor (subsoil) is considered to be '**High**' throughout the proposed Site. The significance of the impact is therefore classified as **'Imperceptible**'.

The magnitude of the impact on the underlying geology receptors post mitigation is considered to be '**Negligible**'. The importance of the geology receptor (local quarries) is considered to be '**Low**' throughout the proposed Site. The significance of the impact is therefore classified as '**Imperceptible**'.

8.7.4 Mitigation Measures during Decommissioning

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

Some of the impacts associated with reinstatement of the site (excavation of turbine bases, access tracks etc.) will be avoided by leaving these in place where possible. The Irish Wind Energy Association (IWEA) (11) states that when decommissioning a wind farm "the concrete bases could be removed, but it may be better to leave them under the ground, as this causes less disturbance". It is proposed to leave the access tracks in-situ at the decommissioning stage. IWEA also state that "it may be best" to leave site tracks in-situ depending on the size and geography of the development.

It is considered that leaving the turbine foundations, access tracks and hardstanding areas in-situ will cause less environmental damage than removing and recycling them. It is proposed to retain these elements of the construction. Turbine bases will be covered with overburden material to allow for re-vegetation of the development site. It is proposed that the internal site access tracks and hardstanding's will be left in place and the land reinstated at these locations. The GCR infrastructure including substations and ancillary electrical equipment shall form part of the national grid and will be left in-situ.

Removal of this infrastructure would result in considerable disruption to the local environment in terms of increased sedimentation, erosion, dust, noise, traffic, and an increased possibility of contamination of the local water table. However, if removal is deemed to be required by the respective local authority all infrastructure will be removed with mitigation measures similar to those during construction being employed.

Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures outlined above.

The magnitude of the impact on the underlying soil receptors post mitigation is considered to be '**Negligible**'. The importance of the geology receptor (subsoils) is considered to be '**High**' throughout the proposed Site. The significance of the impact is therefore classified as '**Imperceptible**'.

8.7.5 Cumulative Effects

During the construction of the proposed project there will be the requirement for the importation of a portion of the engineered fill from source quarries. Should these coincide with demand for imported aggregate for construction works at the proposed developments listed in Table 8-13 there would a cumulative impact in terms of demands placed on local quarries for aggregate. As such, it is considered there will be a Slight cumulative impact during construction stage.

No significant, negative cumulative effects are envisaged during the operation or decommissioning phase of the proposed project. As such no mitigation measures are required with respect to potential cumulative impacts of the proposed project. The post mitigation effect on the underlying soils and geology receptors is considered to be '**Small Adverse** and **Slight**'.

8.8 Residual Effects

It can be observed from Table 8-15 that, following the implementation of mitigation measures, the residual impact significance to the receiving environment would be imperceptible during the construction period and imperceptible during the operation of the proposed development. Mitigation measures will be monitored throughout the construction, operational and decommissioning phases.

The proposed project is not expected to contribute to any significant, negative cumulative effects of other existing or known developments in the vicinity. Slight residual cumulative effects from the excavation of fill material from local quarries and disposal of material deemed unsuitable for reuse are considered to result from the proposed project by placing demand on existing quarries and available void space at licensed facilities during the construction phase of the project.

Table 8-15: Residual Impact Significance for Sensitive Geological Attributes

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction Phase							
Site Clearance	Exposure of underlying overburden leading to increased erosion. Plant machinery resulting soil compaction of soft deposits and an increase in surface water runoff resulting in increased erosion of exposed soils.	Localised organic soils and Glacial Till deposits.	High	Moderate Adverse	Significant /Moderate	Small Adverse	Moderate/Slight
Earthworks (Turbine bases)	Removal of overburden material, open excavations and subsequent exposure underlying overburden and bedrock leading to increased erosion.	Localised organic soils and Glacial Till deposits	High	Moderate Adverse	Significant /Moderate	Small Adverse	Moderate/Slight
		Bedrock	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
	Construction traffic resulting in soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill and concrete						
Earthworks associated with the construction of the proposed project and associated infrastructure	Slope Failure	Localised organic soils and Glacial Till deposits	High	Moderate Adverse	Significant/Moderate	Small Adverse	Moderate/Slight
		Bedrock	Medium	Small Adverse	Slight	Negligible	Imperceptible
Construction of Internal Site Access Tracks, Hardstands, Temporary Compound, Substation	Open excavations, increased runoff causing erosion of underlying overburden and bedrock.	Localised organic soils and Glacial Till deposits.	High	Small Adverse	Moderate/Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
	Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill.						
Internal Cabling and Grid Connection	Removal of overburden material and exposure of underlying subsoil and bedrock to erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill and concrete products.	Localised organic soils and Glacial Till deposits, and bedrock. Local quarries Licenced Waste Facilities	High	Small Adverse	Moderate/Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
	Disposal of surplus excavated material to licenced facility.						
Accommodation works along TDR	Removal of overburden material and exposure of underlying subsoil and bedrock to erosion. Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill. Disposal of surplus excavated material to licenced facility	Subsoils. Bedrock. Local quarries. Licenced waste facilities.	High	Small Adverse	Moderate/Slight	Negligible	Imperceptible
Operational Phase							

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction traffic for maintenance of turbines, hardstands, and access tracks. Operation of substation and turbines.	Release of hydrocarbons or fuel spill	Localised organic soils, Glacial Till deposits and bedrock.	High	Small Adverse	Slight	Negligible	Imperceptible
Maintenance of access tracks	Importation of engineering fill	Local quarries	Low	Small Adverse	Imperceptible	Negligible	Imperceptible
Decommissioning Phase							

Activity	Potential Impact	Receptor	Sensitivity	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
Removal of Turbines and Hardstands	Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils.	Localised organic soils, Glacial Till deposits and bedrock.	High	Small Adverse	Moderate/Slight	Negligible	Imperceptible

8.9 Conclusions

The assessment of Land, Soil & Geology has established a baseline for the receiving environment for the impact assessment. Potential impacts were assessed for the construction, operational and decommissioning phases of the proposed development as well as potential residual and cumulative impacts. Mitigation measures have been proposed where relevant.

The proposed development site is not a sensitive site in terms of land, soil and geology and poses a low risk for landslide.

A number of potential impacts have been identified associated with the excavation of soil and rock on the site. The significance of these potential impacts is assessed as being slight to significant/moderate significance prior to mitigation.

The findings of the Geotechnical and Peat Stability Assessment Report (Appendix 8.1) showed that the proposed development site has an acceptable margin of safety and is suitable for the proposed development.

The site is not expected to result in any significant, negative cumulative effects with other existing or permitted developments in the vicinity.

With mitigation measures, outlined in Section 8.7, put in place during construction, operational and decommissioning stage the proposed development will have imperceptible to moderate/slight significance on the land, soils and geology.

8.10 References

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