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ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED DERRYNADARRAGH WIND FARM, CO. KILDARE & CO. OFFALY

Volume 2 - Main EIAR

Chapter 11 - Soils, Geology and Hydrogeology

Prepared for:

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11. SOILS, GEOLOGY AND HYDROGEOLOGY

11.1 Introduction

This chapter has been prepared to examine the likely effects of the proposed Derrynadarragh Wind Farm, associated grid connection and turbine delivery route on existing geological and hydrogeological conditions within the study area. The study area is defined as the 'Site', as well as a one-kilometre corridor along either side of the Grid Connection (both defined below). The primary focus of this chapter is on the Site which has the most potential to impact the underlying geological and hydrogeological receptors. The GCR is also to be assessed, however their interaction with geological and hydrogeological receptors can be considered far less impactful as the works are proposed along existing roads and will require only minor excavation / accommodation works. The likely effects of the Project are assessed, taking account of mitigation measures to reduce or eliminate any residual effects on Soils, Geology and Hydrogeology. The assessment also considers the cumulative effects of the project together with other plans and projects.

This chapter initially provides a description of the receiving environment of the site and the likely significant impacts of the development. When assessing the likely significant 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 2 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 Development includes 9 no. wind turbines with a total height of 187 m with an underground cable connecting the 9 no. turbine wind farm development to the on-site substation, internal access tracks, hard standings, internal electrical and communications cabling, temporary construction compound and all associated works related to the construction of the proposed wind farm.

A detailed description of the project assessed in this EIAR is provided in Chapter 2.

11.2 Statement of Authority

This Chapter has been prepared by EurGeol Emily Archer PGeo of Fehily Timoney and Company.

Emily is a Chartered Senior Project Geotechnical Engineer with a BSc in Geology from University College Cork and an MSc in Applied Environmental Geoscience from University College Cork. She is a professional member of the Institute of Geologists of Ireland (PGeo) and the European Federation of Geologists (EurGeol). Emily has 7 years of post-graduate experience working in the fields of geoscience and ground engineering. She has experience working on renewable energy projects within the Irish market, preparing Soils, Geology and Hydrogeology EIAR chapters for wind farms sites.

Technical review of this chapter and supporting appendices has been completed by the following:

Tom Clayton MEng. (Distinction) Civil Engineering - a Chartered Engineer with 15 years of experience within the geotechnical sector with excellent skills in analytical design (including finite element analysis).Tom has expertise in transport geotechnics (for road, rail, underground rail schemes, active travel and greenway schemes), deep excavations and shafts (primarily in the Middle East and London) and Energy Geotechnics (both for solar and wind farms). Tom also specialises in earthwork stabilisation and has worked in asset management and design consultancy roles for both highways and rail projects.

Ian Higgins BSC. Engineering Geology, MSc. Geotechnical Engineering – a geotechnical engineer with 25 years' experience in the design and supervision of construction of bulk earthworks, soft ground engineering, geotechnical foundation design, geotechnical monitoring and reviewing, reinforced earth design and 3rd party checking of piling and ground improvement designs. Ian's experience also includes the design, supervision and interpretation of ground investigations, including desk studies, walkover surveys, hazard mapping of rock excavations and slopes. Ian has acted as reviewer for multiple wind energy EIARs.

11.3 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 cumulative impacts; and
- Assessment of residual impacts.

The assessment methodology and criteria are outlined in Section 11.3.4.

11.3.1 Relevant Guidance

The main EIA guidelines are listed in Chapter 1, other topic specific reference documents used 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;
- 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.

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

11.3.2 Relevant Legislation

The general EIA legislation are listed in Chapter 1, all relevant Irish and EU legislation has been complied with in the preparation of this section.

11.3.3 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 5 – 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 Soils, Geology and Hydrogeology are presented in Table 11-1:

Table 11-1: Consultation Responses

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

11.3.4 Impact Appraisal Methodology

As outlined in Section 11.1, this chapter identifies the potential impacts of the construction, operation and decommissioning of the proposed Project on the existing Soils, Geology and Hydrogeology 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 impacts of the Project on the Soils, Geology and Hydrogeology within the study area:

- Characterisation of the soils, geology and hydrogeology of the study area;
- Evaluation of the potential impacts of the Project.

The baseline geological and hydrogeological conditions within the study area were determined following a desktop review of publicly available information. This review was undertaken in March 2023. In addition to the desktop assessment, a site reconnaissance and follow-on peat probing survey were undertaken in May 2023 and September 2024, respectively. The site reconnaissance and peat probing survey was undertaken by an FT Senior Project Geotechnical Engineer (Emily Archer BSc. MSc.) and an FT Senior Project Engineer (Alan Whelan BEng).

The resulting data from these surveys are discussed in Section 11.4.9 of this Chapter. An intrusive ground investigation comprising trial pits was undertaken by Ground Investigations Ireland Ltd. (GII) in April 2025. The results from these surveys are presented in Appendix 11-1. A summary of the intrusive ground investigation findings is presented in Sections 11.4.10 of this Chapter.

Following the assessment of the existing environment, the unmitigated impacts of the Project during the construction, operational and decommissioning phases on sensitive receptors identified were determined. As part of the cumulative impact assessment, large scale developments within 20km of the Site were assessed. The evaluation of the significance of the impacts was undertaken in accordance with the IGI guidance (2013).

Where likely significant impacts were identified, mitigation measures are proposed in respect of negative impacts and will be implemented to minimise adverse effects on the environment. The residual effects from the Project were then re-appraised considering the mitigation measures as outlined in Section 11.7. The residual effects from the Project are presented in Section 11.8 of this chapter.

11.3.5 Evaluation Criteria

During each phase (construction, operation and maintenance, and decommissioning) of the Project, several activities will take place on Site, some of which will have the potential to cause effects on the geological regime at the proposed Site and the associated Soils, Geology and Hydrogeology. These potential effects are discussed throughout this chapter. Mitigation measures where required are presented in Section 11.7.

11.3.5.1 Assessment of Magnitude and Significance of Impact on Soils, Geology and Hydrogeology

An impact rating has been developed for each of the phases of the Project 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 and hydrogeological features are rated (Table 11-2 and Table 11-3) followed by an estimation of the magnitude of the impacts on geological and hydrogeological features (Table 11-4 and Table 11-5).

This determines the significance of the impact prior to application of mitigation measures as set out in Table 11-6.

Table 11-2: Criteria for 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.

Magnitude	Criteria	Typical Example
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 11-3: Criteria for Rating Site Importance of Hydrogeological Features (NRA, 2009)

Importance	Criteria	Typical Example
Extremely High	Attribute has a high quality or value on an international scale.	Groundwater supports river, wetland or surface water body ecosystem protected by EU legislation e.g. SAC or SPA status
Very High	Attribute has a high quality or value on a regional or national scale.	Regionally Important Aquifer with multiple wellfields. Groundwater supports river, wetland or surface water body ecosystem protected by national legislation – e.g. NHA status. Regionally important potable water source supplying >2500 homes Inner source protection area for regionally important water source.
High	Attribute has a high quality or value on a local scale.	Regionally Important Aquifer. Groundwater provides large proportion of baseflow to local rivers. Locally important potable water source supplying >1000 homes. Outer source protection area for regionally important water source. Inner source protection area for locally important water source.
Medium	Attribute has a medium quality or value on a local scale.	Locally Important Aquifer Potable water source supplying >50 homes. Outer source protection area for locally important water source.
Low	Attribute has a low quality or value on a local scale.	Poor Bedrock Aquifer. Potable water source supplying <50 homes.

Table 11-4: 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

Magnitude	Criteria	Typical Example
Major Beneficial	Results in major improvement of attribute quality	Major enhancement of geological heritage feature

Table 11-5: Estimation of Magnitude of Impact on Hydrogeological Features (NRA, 2009)

Magnitude	Criteria	Typical Example
Large Adverse	Results in loss of attribute and /or quality and integrity of attribute	Removal of large proportion of aquifer. Changes to aquifer or unsaturated zone resulting in extensive change to existing water supply springs and wells, river baseflow or ecosystems. Potential high risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >2% annually.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Removal of moderate proportion of aquifer. Changes to aquifer or unsaturated zone resulting in moderate change to existing water supply springs and wells, river baseflow or ecosystems. Potential medium risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >1% annually.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Removal of small proportion of aquifer. Changes to aquifer or unsaturated zone resulting in minor change to water supply springs and wells, river baseflow or ecosystems. Potential low risk of pollution to groundwater from routine run-off. Calculated risk of serious pollution incident >0.5% annually.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Calculated risk of serious pollution incident <0.5% annually.

The matrix in Table 11-6 determines the significance of the impacts based on the importance and magnitude of the impacts as determined by Table 11-2 to Table 11-5 .

Table 11-6: Ratings of Significance of Impacts for Geology/Hydrogeology (NRA, 2009)

Importance of Attribute	Magnitude of Impact			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
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 Site and GCR are discussed in Section 9.6.

11.3.6 Desk Study

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

- Geology of Offaly
- Kildare County Development Plans 2023-2029
- Offaly County Development Plan 2021 – 2027
- Laois 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)
    - *Quaternary subsoil geology*
    - *100k bedrock geology*
    - *Karst features*
    - *Geological heritage features*
    - *Aggregate potential*
    - *Landslide susceptibility*
    - *Catchment & Management Units*
    - *Groundwater Bodies Status and Risk*
    - *Drinking Water Protection Areas*
    - *Groundwater Resources (Aquifers)*
    - *Groundwater Wells and Springs*
    - *Groundwater Vulnerability*
- Teagasc soil and subsoil database
- Datasets from the EPA

11.3.7 Site Investigations and Field Assessments

A Site reconnaissance and follow-on peat probing survey were undertaken in January and May 2023 and an additional peat probing survey was carried out in January 2025. The site reconnaissance and peat probing survey was undertaken by an FT Senior Project Geotechnical Engineer (EurGeol Emily Archer PGeo, BSc., MSc.) and an FT Senior Project Engineer (Alan Whelan, BEng). The purpose of these surveys was to determine the baseline characteristics of the Site.

The assessment works undertaken comprised the following:

- Walkover inspections of the Site with recording of salient geomorphological features at proposed infrastructure locations.
- Peat depth probing and slope stability assessment at proposed infrastructure locations and where peat deposits were encountered.

The intrusive ground investigation was undertaken by Ground Investigations Ireland (GII) in April 2025. The investigation comprised:

- 12 no. trial pits
- Geotechnical and geo-environmental testing

The intrusive ground investigation works were supervised by FT's Senior Project Geotechnical Engineer, Julian Borlado and GII's Chartered Senior Engineering Geologist, James Cashen (BSc, EurGeol, PGeo).

GII's Factual Report, including exploratory hole logs, is included in Appendix 11-1.

11.4 Receiving Environment

11.4.1 General

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, potential for soil contamination, aquifer classification, groundwater vulnerability and groundwater wells and springs. This section also includes a summary of site-specific information obtained during walkover surveys undertaken as part of the baseline assessment works. The following sections form the basis of a Conceptual Site Model (CSM), detailing the interactions between the different receiving geological and hydrogeological receptors.

11.4.2 Type of Geological/Hydrogeological Environment

Based on regional and site-specific information available the type of geological/hydrogeological environment as per Figure 2 of the IGI Guidelines is **Type D – Sensitive Geological / Hydrogeological Environments**.

11.4.3 Rating of Significance of Geological and Hydrogeological 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.

Based on the TII methodology (2009) the importance of the hydrogeological features at this site is rated as 'medium importance' based on the assessment that the attribute has a medium quality significance or value on a local scale. The aquifer is a locally important aquifer and is not widely used for public water supply or generally for potable use.

11.4.4 Quaternary Deposits

The GSI Quaternary mapping indicates the Site is predominantly underlain by a mantle of cut over raised peat (peat). The remaining areas of the Site are underlain by lake marl. In general, the Quaternary deposits across the Site can be categorised as being poorly drained.

The Quaternary geology of the proposed project and surrounding area is presented in Figure 11.1 in Appendix 4. Mapping shows the turbines and hardstands are underlain by the following Quaternary deposits:

- Cut over raised peat at turbines **2, 3, 4, 5, 6 and 7.**
- Lake marl at turbines **1, 8 and 9.**

11.4.5 Bedrock Geology

The GSI 1:100,000 scale bedrock mapping indicates the Site is entirely underlain by lower Carboniferous limestone. The Site is fully underlain by the Lucan Formation comprising dark grey-black, fine-grained limestone interbedded with shaly limestones and shales, known as 'calp'.

The Bedrock geology is presented in Figure 11.2 in Appendix 4

11.4.6 Hydrogeology

11.4.6.1 Aquifer Classification

Groundwater mapping (Figure 11.6 in Appendix 4) indicates that the entire Site is underlain by a Locally Important Aquifer – Moderately productive bedrock in local zones. The Site lies within the Cushina Groundwater Body (GWB) which is presented in Figure 11.4 in Appendix 4.

The description of the GWB's within the study area have been taken from the 'Summary of Initial Characterisation' reports for each defined GWB published by the GSI in accordance with the Groundwater Working Group Publication: Guidance Document GW2 (2003). The GWB Characterisation Reports are available from the GSI Public Data Viewer. Site specific data including depth to bedrock and subsoil type encountered during intrusive investigations have been used to supplement and validate the published information.

Table 11-7 presents a summary of the aquifer classification and characteristics underlying the study areas.

Table 11-7: Summary of Aquifer Classification and Characteristics

Aquifer Name	Groundwater Body (GWB)	GSI Aquifer Classification	Transmissivity (m^2/day)	Well Yields	Location
Unnamed	Cushina	Locally Important Aquifer – bedrock which is moderately productive in local zones	20-500	Moderate	All of site

11.4.6.2 Groundwater Wells and Resource Protection Zones

There are several wells recorded by the GSI within 500 m of the site. Based on GSI mapping, there is an accuracy of 100 to 1000 m for the well locations. The available details of these wells are summarised below in Table 11-8. There may also be additional wells in nearby houses that are not included in the GSI dataset. The groundwater wells are presented in Figure 11.6 in Appendix 4

Table 11-8: Summary of Wells near the Site Area

Well ID	Grid Co-Ordinates (ING from GSI)	Well Type	Well Use	Total Depth (m)	Depth to Bedrock (m)	Yield (m^3/day)	Yield Class
2321SEW021	E: 257360 N: 217370	Borehole	Domestic use only	13.4	12.2	32.7	Poor
2321SEW022	E: 257360 N: 217250	Borehole	Public Supply	28.6	3.2	3.9	Poor
2621SWW001	E: 260650 N: 217150	Borehole	Industrial	54.9	8.2	163.5	Good
2321SEW016	E: 259200 N: 213500	Borehole	Domestic use only	15.2	6.1	32.7	Poor

There are no Groundwater Protection Areas located within 10km of the site (Figure 11.5 in Appendix 4).

11.4.7 Karst Features

The GSI groundwater karst mapping (Figure 11.7 in Appendix 4) indicates there are no karst features identified within the site boundary and within 5km of the site. The closest karst features are 3 no. boreholes located approximately 8km south-west of the site.

11.4.8 Flood Risk

According to Flood Info interactive map viewer, there is a risk associated with fluvial flooding within the site, around the Cushina River. The CFRAMS flood extents extend through the east of the site for a “Medium” probability (1 in 100 year) event.

The nearest flood occurrence took place at Bracknagh, on the River Figile, approximately 1 km north east of the site. A flood risk assessment has been undertaken as part of this submission and is included in Appendix 12-1 of this EIAR.

11.4.9 Groundwater Vulnerability

Groundwater vulnerability, as defined by the GSI, is the term used to represent the intrinsic geological and hydrogeological characteristics that determine the ease of which groundwater could be contaminated by human activities. The vulnerability of an aquifer to contamination is influenced by the leaching characteristics of the topsoil, the permeability and thickness of the subsoil, the presence of an unsaturated zone, the type of aquifer, and the amount and form of recharge (the hydraulic process where water moved downward from surface water to groundwater).

Groundwater vulnerability is determined mainly according to the thickness and permeability of the subsoil that underlies the topsoil, as both properties strongly influence the travel times and attenuation process of contaminants that could be released into the subsurface from below the topsoil.

The groundwater vulnerability is variable across the site and ranges from 'Low' to 'Moderate' as classed by the GSI (Figure 11.3 in Appendix 4).

The groundwater vulnerability for the site area is presented in Table 11-9. This table outlines the standard ratings of vulnerability used by the GSI, with existing site conditions highlighted based on the findings of the site investigation.

Table 11-9: Groundwater Vulnerability Rating Matrix

Vulnerability Rating	Hydrogeological Conditions		
	Subsoil Permeability (Type) and Thickness		
	High Permeability (sand/gravel)	Moderate Permeability (sandy soil)	Low Permeability (clayey subsoil, clay, peat)
Extreme (E)	0 – 3.0 m	0 – 3.0 m	0 – 3.0 m
High (H)	> 3.0 m	3.0 – 10.0m	3.0 – 5.0 m
Moderate (M)	N/A	> 10.0 m	**5.0 – 10.0 m**
Low (L)	N/A	N/A	**> 10.0 m**

Notes: 1. N/A = not applicable.
2. Precise permeability values cannot be given at present.

11.4.10 Geological Heritage

The GSI's online Geological Heritage database indicates there are no audited or unaudited Geological Heritage Sites (GHSs) within the Site or along the GC. The closest GHSs are located approximately 6km to the north of the site (Clonkeen Mushroom Rock – An isolated upstanding rock in a grass field).

The TDR crosses through the Kilcormac Esker, just south of Ballinagar, Co. Offaly and crosses the Ballyduff and Clonmacnoise Eskers along the N52.

The distribution of Geological Heritage Sites is shown on Figure 11.8 in Appendix 4.

11.4.11 Economic Geology

The GSI Online Minerals Database accessed via the Public Data Viewer shows no quarries (active or historic) within 5km of the Site. Two mineral occurrences of calcite occur approximately 6km south of the Site. The distribution of these sites are presented in Figure 11.9 in Appendix 4.

The GSI Aggregates database indicates that there is a very low to low potential for crushed rock aggregate across the Site (Figure 11.10 in Appendix 4). There is generally a low potential for granular aggregate but only in localised areas to the east and across the centre of the Site (Figure 11.11 in Appendix 4).

No bedrock outcrops are mapped by the GSI within the Site. Similarly, no bedrock outcrops were observed during the site surveys.

11.4.12 Walkover Survey Findings

A peat probe survey was undertaken during January and May 2023 and an additional peat probing survey was carried out in January 2025. The survey work was completed by FT Senior Project Geotechnical Engineer Emily Archer (EurGeol, PGeo, BSc, MSc) who has over 7 years' professional experience and FT Senior Project Engineer Alan Whelan (BEng) who has over 6 years' professional experience. Findings from the peat probe survey indicates that peat occurs across the majority of the site, however it is predominantly shallow. The minimum, maximum and mean peat depth recorded out of 354 peat probe locations were 0.1m, 4.2m and 1m respectively. Approximately 94% of peat depths recorded as part of the peat probe survey were less than 2m.

A summary of the peat probe depths at the key infrastructure locations is presented in Table 11-10.

Table 11-10: Summary of site walkover findings at key infrastructure locations.

Infrastructure Element	Easting	Northing	Peat Depth (m)	Slope (°) Note 1
T01	659937	714994	0.5 – 0.8	2
T02	658662	716607	2 – 2.5	2
T03	659623	716518	0.4 – 0.6	2
T04	659622	715347	1 – 1.6	2
T05	659128	716060	2.4 – 3.1	2
T06	658384	715670	0.4 – 0.9	2
T07	659268	715518	0.2 – 0.4	2
T08	659680	715968	0.2 – 0.3	2
T09	660136	715709	0.1 – 0.3	2
Construction Compound	658226	716272	0.8 – 1.2	3
On-Site Substation	658367	716134	0.2 – 0.5	2
Note 1 – slope angles measured using a Suunto PM-5/360PC clinometer.				

Photographs taken during the site walkover survey are presented in Appendix 11-2.

11.4.13 Intrusive Ground Investigation Findings

The detailed findings and conclusions of the intrusive ground investigation is provided in Appendix 1 and generally confirm the anticipated geology described in the Desk Study.

Trial pits were excavated at the turbine, construction compound and substation locations. A summary of ground and groundwater conditions encountered during the intrusive ground investigation are presented in Table 11-11.

Table 11-11: Summary of ground and groundwater conditions within the trial pits

Hole ID	Peat		Soft to firm Clay / Silt		Coarse-Grained Till		Groundwater Strike (mbgl)	Infrastructure Element Tested
	From (mbgl)	To (mbgl)	From (mbgl)	To (mbgl)	From (mbgl)	To (mbgl)		
TP01	0.00	0.70	0.70	4.10			1.40 and 3.00	T01
TP02	0.00	1.90	1.90	3.80			3.80	T02
TP03	0.00	0.90	0.90	4.30			4.20	T03
TP04	0.00	0.40	0.40	4.20			0.80	T04
TP05	0.00	1.00	1.00	4.30				T05
TP06	0.00	0.50	0.50	4.20			3.30	T06
TP07	0.00	1.10	1.10	4.10				T07
TP08			0.00	4.30			3.50	T08
TP09			0.00	4.20			1.50	T09
TP10	0.00	1.80	1.80	2.80	2.80	3.30	2.90	Construction Compound
TP11	0.00	0.60	0.60	3.50				Substation
TP12	0.00	1.10	1.10	3.50			0.90	Substation

Key findings from the trial pitting are presented below:

- No bedrock was met during the excavation of the trial pits.
- A maximum peat depth of 1.90m bgl was encountered at turbine T02.
- The most dominant strata type recorded was fine-grained (cohesive) till, which was encountered in all 12 no. trial pits.
- Coarse-grained till was encountered in 1 no. trial pit (TP10).
- Groundwater strikes (typically described as seepages) were recorded in 9 no. trial pits at depths ranging from 0.80 to 4.20m bgl.

11.4.14 Existing Slope Stability

During the Site walkovers a series of hand-held probes were undertaken to determine the presence/depth of peat and/or soft soils within the Site.

A summary of the general topography and slopes at the Site are presented below.

11.4.14.1 Slope Stability Assessment

From a review of the GSI Landslide Susceptibility database, the Project and proposed infrastructure locations are within an area mapped as having a 'Low' landslide susceptibility. 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. A summary of the GSI landslide susceptibility with respect to the Project is provided in Figure 11.12 in Appendix 4.

Considering the above, it is therefore considered that the risk of landslide within the Site is negligible and insignificant .

11.4.14.2 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 following 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.*

A peat survey was carried out by an FT Senior Project Engineer (Emily Archer MSc.) during January and May 2023 and an additional peat probing survey was carried out in January 2025. Peat depths were taken using a handheld Van Walt peat probe at handheld turbine and associated infrastructure locations. The minimum, maximum and mean peat depth recorded out of 354 peat probe locations were 0.1m, 4.2m and 1m respectively. Approximately 94% of peat depths recorded as part of the peat probe survey were less than 2m.

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, and peat depth are in excess of 0.5m bgl, a peat stability assessment was warranted.

A geotechnical assessment has been undertaken using findings from the site walkover surveys and intrusive ground investigations and is presented in Appendix 2 – Peat Stability and Geotechnical Assessment Report. The analyses returned Factor of Safety Results of >1.3 for all infrastructure elements assessed, indicating the risk of peat landslide is insignificant / negligible.

11.4.15 Soil Contamination

There are no known areas of soil contamination on the Site. No evidence of soil contamination was noted during Site walkovers or during the intrusive ground investigation. A review of existing aerial photography and historic ordnance mapping show no indication of potential contamination from historic land use. Mapping indicates that the Site is located within an area where no historic industrial land uses were observed.

11.5 Characteristics of the Proposed Project

The proposed project will involve the removal of topsoil, peat and overburden for the construction of turbine foundations, hardstands, substation, temporary construction compounds, cable route and access roads.

Aggregate for construction of these access roads and hardstands will be imported to the Site.

Estimated volumes of overburden (peat and spoil) and bedrock to be removed are shown in Table 11-12 and Table 11-13 respectively. Excavated soil will be placed in designated spoil deposition areas, be used for reinstatement and landscaping works around the Site, as well as being used to improve the access roads.

Table 11-12: Estimated excavation volumes of Peat and Spoil

Infrastructure Element [(1)]	Proposed Dimensions	Peat Volume (m^3) [(2)]	Spoil (non-peat) Volume (m^3) [(2)]	Comment
9 no. Turbines and Hardstands	27m diameter excavation footprint (25m wide base with 1m of working space around the perimeter of the base) for turbine foundation with 80 x 33.5m hardstand area.	30,449	18,921	Hardstanding area and foundation footprint
Access Roads	Assumed 5m running surface with 6m wide development footprint.	13,776	9,184	
Substation	Hardstanding area of 140 x 85m.	2,881	2881	
Temporary Construction Compounds (x2)	Footprint of 70 x 40m for both	4313	5176	
GCR	The route will run through 9.1 km of existing public road, 0.3km in existing tracks and 2km in new access tracks on the wind farm site.	3450		Details provided by client. The Peat depths along the road and tracks were determined following a Ground penetration radar survey of the route.

Infrastructure Element [1]	Proposed Dimensions	Peat Volume (m^3) [2]	Spoil (non-peat) Volume (m^3) [2]	Comment
	The trench will be 1.35m deep and 0.60m wide along with 15 joint bays of 6.5mx 2.5m wide. Peat will be extracted down to suitable bearing stratum.			
	Total =	**54,869m^3**	**36,162m^3**	**Total peat and spoil = 91,031m^3**

Note 1 – Abulking factor of 15 and 10% has been applied to the excavated peat and non-peat soils respectively. This allows for expected increase in volume upon excavation and to allow for a variation in ground conditions across the Site.
Note 2 – Soil volumes given in this table are indicative and for information purposes only, and subject to detailed estimates

Table 11-13: Anticipated stone volumes necessary for construction

Infrastructure Element	Typical Dimensions	Stone Volume ($m3$) [1, 2]	Comment
9 no. Turbines and Hardstands	27m diameter excavation footprint (25m wide base with 1m of working space around the perimeter of the base) for turbine foundation with 80 x 33.5m hardstand area.	28,826	Hardstanding area and foundation footprint. Allowance included for mini-crane pads and blade finger hardstands associated with the main hardstand, plus allowance for side slopes in areas of fill.
Access Tracks	Assumed 5m running surface with 6m wide development footprint.	52,305	Allowance includes for widening on bends, at junctions, laybys, and tie-ins to hardstands.
Substation	Hardstanding area of 140 x 85m.	9,185	
Temporary Construction Compounds (x2)	Footprint of 70 x 40m for both	5500	-
GCR	Provided by client		
	Total =	**95,816m^3**	

Note 1 – Acontingency factor of 25% stone volumes is included to allow for a variation in ground conditions across the Site.
Note 2 – Stone volumes given in this table are indicative and for information purposes only, and subject to detailed estimates.

11.6 Likely Impacts

The likely impacts on the underlying soils, geology and hydrogeology at the Site are assessed in the following sections for the activities associated within each phase (Construction, Operation and Decommissioning) for the Project as described in Chapter 2.

The likely impacts are assessed in accordance with the evaluation criteria outlined in Section 11.3. The unmitigated likely impacts are summarised in Table 11-17 and Table 11-18. The proposed mitigation measures are then considered to reduce or eliminate likely negative significant impacts/effects.

The importance of the soils, geology and groundwater receptors are summarised in Table 11-14.

Table 11-14: Receptor Importance

Receptors	Activity	Importance	Rational
Geological - Peat deposits/organic soils and glacial till deposits	Construction, Operational & Decommissioning Phases	Low	Site comprises poorly drained / low fertility soils.
Local quarries (crushed rock and granular aggregate)	Cumulative	Medium	Supply of imported stone to the Site from local quarries. Depleting off-site resources.
Hydrogeological - Locally Important Aquifer – Moderately productive bedrock in local zones, groundwater wells and springs, and surface water bodies.	All activities	High	Underlying bedrock is a Locally Important Aquifer.

11.6.1 Do Nothing Impact

If the proposed Wind Farm were not constructed, it is likely that the current land uses will continue for the foreseeable future. The impact on the Soils, Geology and Hydrogeology would remain unaltered as a result.

11.6.2 Likely Future Receiving Environment

The environment will likely change, even without the construction of the proposed project. However, any such changes in the natural environment will be minor and will not alter the current classification of the site as a passive geological/hydrogeological environment, nor will it change on the current importance rating of the site in terms of geology (low) or hydrogeology (medium).

11.6.3 Construction Phase

The following on-Site activities have been identified as the sources of potential effects on the existing geological and hydrogeological conditions during the construction phase of the Project:

11.6.3.1 Site Clearance

Topsoil and vegetation clearance will be undertaken at the turbine and all ancillary infrastructure locations across the Site. In addition to the permanent infrastructure, 2 no. temporary construction compounds are proposed within the Site as well as a lay-down area at the new site access on the R419 road. These will also require removal of vegetation and topsoil prior to construction.

Permanent felling of approximately 6.01 ha of conifer plantation forestry is required at T02 and along the new access track at the site entrance. The proposed areas to be felled are described further in Chapter 2, Description of the Project.

It should be noted that the clear-felling of trees in the State requires a felling licence. The Forest Service of the Department of Agriculture, Food & the Marine is Ireland's national forest authority and is responsible for all forest licensing which is governed by the Forestry Act 2014 as amended and the Forestry Regulations 2017 (S.I. No. 191 of 2017). A felling licence will include the provision of relevant replant lands (afforestation area) to be planted in lieu of the proposed tree felling on the site. The associated afforestation of alternative lands equivalent in area to those lands being permanently clear-felled is also subject to licensing ('afforestation licensing').

It should be noted that the forestry to be felled within the Site was originally planted as commercial crops and will be felled and replanted in the coming years should the project not proceed.

Proposed tree felling will involve the use of heavy felling 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 Site.

The use of plant and machinery during tree felling 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.

Further assessment of potential effects to surface water discharges from felling activities are discussed in Chapter 12 Hydrology and Water Quality of the EIAR.

The Magnitude of the effects from these works on the soils and geology receptors is considered to be '**Small Adverse**' in nature. The importance is considered to be '**Low**'. The rating of these potential effects, prior to mitigation, is considered to be of '**Imperceptible**' significance. The Impact Classification is negative, direct, long-term and will have likely minor effects.

The Magnitude of the impact from these works on groundwater receptors is considered to be '**Small Adverse**' in nature. The importance is considered to be '**Medium**'. The rating of these potential effects, prior to mitigation, is considered to be of '**Slight**' significance. The Impact Classification is negative, short-term, direct and will have likely minor effects.

11.6.3.2 Earthworks

The Site will require construction phase earthworks associated with the excavation of turbine bases, removal of overburden deposits for the construction of turbine foundations, temporary site compounds, substation, turbine hard standings and internal access roads.

As such there is the potential for impact to Soils, Geology and Hydrogeology from the excavation and movement of existing superficial Peat deposits, Glacial Till deposits and bedrock during the construction phase of the Site.

The following earthworks excavations will be required:

- Excavation of Topsoil
- Excavation of Peat deposits
- Excavation of Glacial Till
- Construction of a 2.1km long floating road

The following filling and material deposition operations will be required:

- Deposition of surplus topsoil/peat and spoil in berms for reinstatement purposes around turbine bases hardstands, and along access roads. Material placed alongside access roads will generally not exceed 1m in height and will be shaped and sealed to prevent the ingress of water.
- Importation and filling of site won and imported General Fill and Engineering Aggregates.

Based on information derived from the preliminary site investigation and site reconnaissance and taking into consideration wind turbine manufacturer specifications, it is expected that wind turbine foundations shall be piled. A minimum of 3m of peat/spoil shall be removed to allow for construction of the piled turbine bases. The piles to be constructed will be large diameter reinforced concrete and will range in diameter from 600 to 1200mm. Between 14 and 16 piles will be used at each piled turbine foundation. For the piled foundations it will be necessary to embed the piles directly into the bedrock using rock sockets.

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. The Project will comply with Priority Pathway Action Plans (PPAP) relating to invasive species, soils and spoil where appropriate. Relevant testing on imported material will be carried out as necessary to ensure all material used on site meets the relevant requirements.

Surplus Topsoil and Glacial Till recovered from excavations will be used for the reinstatement proposed around turbine bases, hardstands, landscaping, temporary construction compounds and peat deposition areas. All associated quantities have been calculated in Section 11.4 and no excavated material will leave the proposed Wind Farm site.

Direct effects to the existing geological regime associated with the construction phase of the Site 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.
- The extraction of rock from off-site quarries will represent a reduction in the availability of an exhaustible resource. Imported crushed rock will be required for material such as Class 1 (general fill) 6F2 (capping), 6N1 (Fill to structures) and 6N2 (fill below structures).

The Magnitude of the impact from these works on the soils and geology receptors is considered to be '**Moderate Adverse**' in nature. The importance is considered to be '**Low**'. The rating of these potential effects, prior to mitigation, is considered to be of '**Slight**' significance. The Impact Classification is negative, permanent, direct and will have likely minor effects.

Direct effects to the existing hydrogeological regime associated with earthworks with respect to the construction phase of the Site are:

- Potential for groundwater pollution from the removal of overburden deposits. It is proposed to remove the overlying soft ground and Glacial Till deposits as outlined in the proposed design.
- The vulnerability of the aquifer to groundwater pollution particularly during construction stage will be increased as overburden is removed thus reducing the level of protection from potential pollution sources.
- Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Soil erosion as a result of exposure of soils in open excavations and temporary storage of excavated materials represents a potential impact to the underlying groundwater aquifer.
- Reduction in groundwater levels from dewatering of excavations as required during the construction stage of foundations if high groundwater is encountered. Groundwater levels within the trial pits ranged from 0.80 to 4.20m bgl. It is anticipated that any drawdown of groundwater levels would be localised to the proposed areas of excavation. This impact is most likely during the excavation of the turbine and substation foundations. There are no groundwater supply wells recorded in the immediate vicinity of the Site. It is considered that other excavations associated with temporary construction compound and grid connection trenches will not extend into the underlying bedrock aquifers. Upon completion of the construction phase, it is considered that groundwater levels will revert to the pre-construction situation when there is no longer a requirement to control groundwater levels.

In relation to groundwater, it is worth noting that the overlying glacial till was typically recorded as fine grained and is therefore considered to have a relatively low permeability.

The Magnitude of the impact from these works on groundwater receptors is considered to be '**Small Adverse'** in nature. The importance is considered to be '**Medium**'. The rating of these potential effects, prior to mitigation (mitigation measures are described in Section 11.7), is considered to be of '**Slight**' significance. The Impact Classification is negative, short term, direct and will likely have minor effects.

11.6.3.3 Slope Stability

The Project and proposed infrastructure locations are generally located within areas predominantly mapped as having a 'Low' landslide susceptibility. Results from the site reconnaissance surveys show no evidence of recent or historic landslides. No failures within the underlying till deposits were recorded.

Due to the presence of deep peat on Site and in accordance with guidance in the Scottish Executive – Peat Landslide Hazard and Risk Assessments (2017), a peat stability analysis was undertaken as part of the Peat Stability and Geotechnical Assessment Report (Appendix 11-1). Results from this assessment show a low likelihood of instability within peat deposits across the Site.

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 (roads, access tracks, turbines) and nearby residents / properties.
- The impact 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 these works on the soils and geology receptors is considered to be '**Moderate Adverse**' in nature. The importance is considered to be '**Low**'. The rating of these potential impacts, prior to mitigation, is considered to be of '**Slight**' significance. The Impact Classification is negative, short term, direct and will have unlikely effects.

The Magnitude of the impact from these works on groundwater receptors is considered to be '**Small Adverse**' in nature. The importance is considered to be '**Medium**'. The rating of these potential impacts, prior to mitigation, is considered to be of '**Slight**' significance. The Impact Classification is negative, short-term, direct and will have unlikely effects.

11.6.3.4 Internal Access Roads and Hardstands

There will be approximately 9,910m (approx. 2,100m of this to be floated) of new internal access tracks associated with the Site and approximately 550m of existing track upgrade.

All access tracks will be approximately 5m wide along straight sections and wider at bends and 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, peat and Glacial Till deposits in berms for reinstatement purposes around, hardstands, temporary construction compound and substation compound.
- Importation and Filling of imported General Fill and Engineering Aggregates.

It is anticipated that the stone required for the construction of the internal access roads, hardstands, temporary construction compounds and the substation will be imported from quarries in the vicinity.

The likely off-site, source quarries for the supply of imported crushed rock aggregate during the construction phase of the Project is presented in Table 11-15.

Table 11-15: Nearest Supplier of TII Series 600 Stone Products.

Quarry	Approx. Distance from Site (km)	Products
Kilsaran, Portlaoise	25 (S)	Crushed Rock (TII Series 600 and 800 materials)
Kilsaran, The Curragh	20 (E)	Crushed Rock (TII Series 600 and 800 materials)

Typically, access track formation will consist of a minimum 500mm hardcore on a geotextile membrane. The likely 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 soils and geology receptors is considered to be '**Moderate Adverse**' in nature. The importance is considered to be '**Low**'. The rating of these potential impacts, prior to mitigation, is considered to be of '**Slight**' significance. The Impact Classification is negative, permanent, direct and will have likely effects.

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

- Potential for groundwater pollution from the removal of overburden deposits. It is proposed to remove the overlying soft ground and Glacial Till deposits as outlined in the proposed design.
- The vulnerability of the aquifer to groundwater pollution particularly during construction stage will be increased as overburden is removed thus reducing the level of protection from potential pollution sources.

- Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Soil erosion as a result of exposure of soils in open excavations and temporary storage of excavated materials represents a potential impact to the underlying groundwater aquifer.
- Potential for groundwater pollution from the use of cement-based compounds during the construction phase.

The Magnitude of the impact from these works on the groundwater receptors is considered to be '**Small Adverse**' in nature. The importance is considered to be '**Medium'**. The rating of these potential impacts, prior to mitigation, is considered to be of '**Slight**' significance. The Impact Classification is negative, short term, direct and will have likely effects.

11.6.3.5 Internal Cabling and Grid Connection

As outlined in Chapter 2 of this EIAR, electricity generated from wind turbines shall be collected at medium voltage 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.

Connection works will involve the installation of ducting, joint bays, drainage and ancillary infrastructure and the subsequent running of cables within existing agricultural fields to the proposed loop-in grid connection point. For cable trenches crossing public roads, the contractor shall 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 the Site's access tracks. In this case the cable-ducts will generally be laid when the track is being constructed and will follow the edge of the Site access tracks. The trenches within these locations will generally be backfilled using the excavated material.

The Proposed Grid Connection (GC) identified to supply power from the proposed development to the Irish National Electricity Grid will exit the site to the south and follow the public road to Bracklone Substation (currently under construction) through the following townlands; Derrylea, Inchacooly, Ballyhast, and Loughmansland Glebe. The grid connection will require 11.4 km of underground 110kV electrical cabling and the route will pass through the townlands of Cushina in County Offaly; Derrylea, and Inchacooly in County Kildare, and Coolnaferagh, Ullard or Controversyland, Clonanny, Lea, Loughmansland Glebe, and Bracklone in County Laois. Works for the grid connection will involve trenching, laying of ducting, installing 15 no. joint bays and 5 no. watercourse crossing, pulling cables and the back filling of trenches and reinstatement works. The route which will run through 9.1 Km of existing public road, 0.3km in existing tracks and 2km in new access tracks on the wind farm site.

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

- The proposed grid connection, associated excavations and ducting may present a preferential pathway for the movement of groundwater and/or contamination in the subsurface. However, the subsoil is predominantly Glacial Till which has a low to medium permeability.
- The excavations for the grid connection trenches and joint bays can have a direct impact on the exposed soils and rock in the form of increased erosion from surface water ingress.

- Where the material excavated from the proposed grid connection excavations is not suitable for reuse as backfill or deposition on Site, this material shall be used as a byproduct for reuse elsewhere if possible, and if not shall 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 is considered to be '**Low**'. The rating of these potential impacts, prior to mitigation, is considered to be of '**Imperceptible**' significance. The Impact Classification is negative, permanent, direct and will have likely effects.

The Magnitude of the impact from these works on the groundwater receptors is considered to be '**Small Adverse**' in nature. The importance is considered to be '**Medium**'. The rating of these potential impacts, prior to mitigation, is considered to be of '**Slight**' significance. The Impact Classification is negative, short term, direct and will have likely effects.

11.6.4 Operational Phase Impacts

The potential impacts on land, soils, geology & hydrogeology from the operation of the Project are outlined below.

11.6.4.1 Potential Direct Effects

Very few potential direct effects are envisaged during the operational phase of the 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 Magnitude of the effect from these works on the soils and geology receptors is considered to be '**Small Adverse'** in nature. The importance is considered to be '**Low**'. The rating of these potential impacts, prior to mitigation, is considered to be of '**Imperceptible**' significance. The Impact Classification is negative, short-term, direct and has unlikely effects.

The Magnitude of the impact from these works on the groundwater receptors is considered to be '**Negligible**' in nature. The importance is considered to be '**Medium**'. The rating of these potential impacts, prior to mitigation, is considered to be of '**Imperceptible**' significance. The Impact Classification is negative, short-term, direct and has unlikely effects.

11.6.4.2 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 11.5.2.4.

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 '**Low'.** The rating of these potential impacts, prior to mitigation, is considered to be of '**Imperceptible**' significance. The Impact Classification is negative, short-term, direct and has unlikely effects.

The Magnitude of the impact from these works on the groundwater receptors is considered to be '**Negligible**' in nature. The importance is considered to be '**Medium**'. The rating of these potential impacts, prior to mitigation, is considered to be of '**Imperceptible**' significance. The Impact Classification is negative, short-term, direct and has unlikely effects.

11.6.5 Decommissioning Phase Impacts

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 could be done by covering with topsoil 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 3 to 5 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 disturbanc*e". 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. In a case where access tracks can not be left in place they will be removed with the subsoil reinstated and topsoil replaced.

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*'.

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 '**Low'**. The rating of these potential impacts, prior to mitigation, is considered to be of '**Imperceptible**' significance. The Impact Classification is negative, short-term, direct and has unlikely effects.

The Magnitude of the impact from these works on the groundwater receptors is considered to be **'Small Adverse'** in nature. The importance is considered to be '**Medium**'. The rating of these potential impacts, prior to mitigation, is considered to be of '**Slight**' significance. The Impact Classification is negative, short-term, direct and has unlikely effects.

11.6.6 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:

- Offaly County Council (OCC);
- Laois County Council (LCC);
- Kildare County Council (KCC); and
- An Bord Pleanála (ABP).

Relevant projects, that are likely to have an impact on the Land, Soils, Geology and Hydrogeology, in proximity to the Site and GCR are listed in Table 11-16.

Table 11-16: Potential Cumulative Impact from other Developments.

Development (Application No.)	Distance from the Site (km)	Status	Interface
Trascan and Clondoolusk Solar Farm (ABP ref. 310367)	10.0	Granted	Groundwater, subsoils and bedrock.
Moanvane Wind Farm (ABP ref. 301619)	14.0	Granted	Groundwater, subsoils and bedrock.
Cushina Wind Farm (ABP ref. 319344-24	5.0	Granted	Groundwater, subsoils and bedrock.

The proposed large-scale developments summarised in Table 11-24 have been considered. If construction/ maintenance works for these projects overlap or run concurrently with the development of the Site there may be a supply issue with local quarries providing imported aggregate.

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 '**Low**'. The rating of this potential cumulative impact is considered to be of '**Slight**' significance. The Impact Classification is negative, short-term, indirect and has unlikely effects.

There is the potential for groundwater pollution from run-off impacting on the groundwater receptor from the development sites. The Magnitude of the impact from these works on the groundwater receptors is considered to be '**Negligible**' in nature. The importance is considered to be '**Medium**'. The rating of this potential cumulative impact is considered to be of '**Imperceptible**' significance. The Impact Classification is negative, short-term, indirect and has unlikely effects.

1.1.1 Summary of Potential Impacts

A summary of unmitigated potential impacts on soils and geology attributes from the Site is provided in Table 11-17 with the potential impacts on hydrogeological attributes provided in Table 11-18.

Table 11-17: Summary of Potential Unmitigated Impact Significance on Soils & Geology

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Construction Phase					
Site Clearance	Exposure of underlying overburden leading to increased erosion. Felling machinery resulting soil compaction of soft deposits and an increase in surface water runoff resulting in increased erosion of exposed soils.	Peat deposits/organic soils, Glacial Till deposits and bedrock.	Low	Small Adverse	Imperceptible
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Removal of overburden material, open excavations and subsequent exposure underlying overburden and bedrock leading to increased erosion. 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.	Peat deposits/organic soils Glacial Till deposits and bedrock.	Low	Moderate Adverse	Slight
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Slope Failure.	Peat deposits/organic soils Glacial Till deposits and bedrock. Site Operatives. Existing Infrastructure and nearby residential areas.	Low	Moderate Adverse	Slight

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

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Operational Phase					
Construction traffic for maintenance purposes.	Minor accidental leaks or spills of fuel/oil	Peat deposits/organic soils Glacial Till deposits and bedrock.	Low	Small Adverse	Imperceptible
Operation of substation	Spills, leaks of oils/battery fluids.	Peat deposits/organic soils Glacial Till deposits and bedrock.	Low	Small Adverse	Imperceptible
Maintenance of access tracks	Importation of engineering fill from local quarries	Local quarries	Low	Small Adverse	Imperceptible
Decommissioning Phase					
Removal of Turbines and Hardstands.	Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils.	Peat deposits/organic soils Glacial Till deposits and bedrock.	Low	Small Adverse	Imperceptible
Cumulative Impacts					
Large-scale developments within 20km of the Project Site occurring concurrently with construction of the Site.	Strain on supply and reduction of a finite aggregate resource.	Local quarries (crushed rock and granular aggregate)	Low	Small Adverse	Imperceptible

Table 11-18: Summary of Potential Unmitigated Impact Significance on Hydrogeology

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Construction Phase					
Felling Activities	Exposure of soils and bedrock to surface water runoff. An increase in sediment and nutrient concentrations within the surface water impacting the underlying aquifer. Spills, leaks of fuels and oils from forestry machinery which could contaminate the groundwater.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Moderate/Slight
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Moderate/Slight
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Slope Failure.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Construction of Turbine and Substation Foundations	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Moderate/Slight
Construction of Internal Site Access Roads, Hardstands and Temporary Compound	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Potential for ground water pollution from the use of cement-based compounds during the construction phase.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Moderate/Slight
Construction of the Grid Connection and Internal Cabling	Potential for ground water pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Moderate/Slight

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Accommodation works along TDR	Potential for ground water pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase accommodation works.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Negligible	Imperceptible
Operational Phase					
Construction traffic for maintenance purposes.	Minor accidental leaks or spills of fuel/oil	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Negligible	Imperceptible
Operation of substation	Spills, leaks of oils/battery fluids.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
Decommissioning Phase					
Removal of Turbines and Hardstands.	Potential for groundwater pollution from the disturbance of overburden deposits Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during decommissioning phase earthworks.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Imperceptible
Cumulative Impacts					
Large-scale developments within 20km of the Project Site occurring concurrently with construction of the Site.	Potential for groundwater pollution from runoff.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Imperceptible

11.7 Mitigation Measures

The following section outlines appropriate mitigation measures by design and best practice to avoid or reduce the potential impact of the Project. Further details are given in the CEMP which is contained in Appendix 2.1 of Volume III.

11.7.1 Mitigation by Design and Best Practice

With regard to the Project, detailed design and best practice has been implemented as follows:

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

- Peat probing, site walkover surveys intrusive and non-intrusive ground investigations to identify geotechnical constraints (e.g. peat deposits and evidence of historic landslip) likely to adversely affect the design of the Site.
- Relocation and micro-siting of turbines, hardstanding's and access roads based on the site assessments and geotechnical assessments in order to reduce, inter alia, ground risk associated with the Site.
- 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:

- The Project has been designed in accordance with best practice methodologies to include (but not limited to) guidance documents from the EPA, IGI, Office of the Planning Regulator and the Scottish Executive.
- 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.
- Given that the works comprise a significant proportion of excavation and earthworks, suitably qualified and experienced geotechnical personnel will be employed on Site to supervise the works.
- A detailed method statement compliant with best practice methodologies for each element of the works will be prepared by the Contractor prior to any element of the work being carried out. These method statements shall be reviewed and approved by a qualified geotechnical engineer.
- The Contract will require flexibility when scheduling the works such that earthworks are not undertaken during severe weather conditions. Where such weather is forecast, suitable measures will be taken to secure the works.

11.7.2 Construction Phase

The following sections outline appropriate mitigation measures to avoid or reduce the potential impact of the Project.

11.7.2.1 Construction Environmental Management Plan

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

The CEMP sets out the key environmental management measures associated with the construction, operation and decommissioning of the Project, to ensure that during these phases of the development, the environment is protected, and any likely significant effects are minimized. The final 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 for review.

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

Site Clearance

As outlined in Section 11.5.2.1, potential effects to the existing environment from the proposed site 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. 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 Regionally Important Aquifer – Karstified (conduit) beneath the Site. It should be noted that the amount of vegetation clearance in relation to commercial forestry is small (6.01 ha) and its impact on the underlying soils, geology and hydrogeology receptors is considered to be negligible.

One of the primary mitigation measures to be employed at the construction phase of the development is the management of silt laden runoff. The potential impact from silt laden surface water runoff from increased erosion of exposed overburden deposits has been assessed, particularly at new and existing drainage locations and where vegetation clearance works are proposed and is included in Chapter 12 – Hydrology and Water Quality.

Details of the proposed Surface Water Management System and associated mitigation measures, which will be implemented during the construction phase, are summarised in Chapter 12 and are also outlined in the CEMP, which is contained in Appendix 2.1 of Volume III.

Best practices will be employed in the prevention of silt laden run-off from entering watercourses as discussed in Chapter 12. Best practice measures included in the design include sediment control in the form of swales, interceptor ditches and settlement ponds. Additional standard construction management will be employed where appropriate such as CIRIA C648 (Control of water pollution from linear construction projects), CIRIA C532 (Control of water pollution from construction sites) and CIRIA C753 (SuDS Manual).

The use of plant and machinery during worksite clearance works and throughout the construction will require the storage and use of fuels and oils, which will only be stored at the construction compound areas in designated bunded areas. 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 the CEMP, which is contained in Appendix 2.1 of Volume III.

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

Refuelling will be carried out using fuel trucks, which will bring fuel to the felling plant and equipment. 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.
- Appropriately sized plant nappies will be used for all mobile equipment e.g. generators and pumps.
- 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 the CEMP.
- Only designated trained operators will be authorised to refuel plant on Site.
- Taps, nozzles and valves will be fitted with locking systems.

11.7.2.2 Earthworks

The Site will be constructed in a phased manner to reduce the potential effects of the Project on the Soils, Geology and Hydrogeology. 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 required on site to supervise the earthworks phase of construction.

Details of the proposed methodology and mitigation measures are summarised below and are also outlined in the CEMP in Appendix 2.1 of Volume III.

One of the primary mitigation measures employed at the preliminary design stage is the prevention of volumes of excavated overburden deposits to be exported off-site. All excavated overburden will be retained on-site.

This will include:

- Use of suitable Site won material as general fill in the construction of access tracks, hardstands and in reinstatement around turbine foundations.
- Surplus overburden will be re-used on Site in the form of landscaping and for reinstatement purposes or placed within the designated peat and spoil management areas.

Surplus overburden deposits excavated during the course of the works will be temporarily stored 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 Site. Temporary stockpiles will be shaped and sealed to prevent the ingress of water from rainfall.

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 carried out from access tracks as they are constructed in order to reduce the compaction of soft ground.

To mitigate against erosion of the exposed soil, 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, bedrock and groundwater refuelling of machinery and plant will only occur at designated refuelling areas.

All temporary cuts/excavations will be carried out 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 construction of the wind farm main infrastructural elements shall be overseen by either a geotechnical engineer or engineering geologist.

11.7.2.3 Control of Sediment Laden Runoff

The potential effects from silt laden surface water runoff from increased erosion of exposed overburden deposits has been assessed where earthworks and site clearance are proposed and are described in Chapter 12.

Details of the proposed Surface Water Management System and mitigation measures are summarised in Chapter 12 and are also outlined in the CEMP in Appendix 2.1 of Volume III.

Best practices will be employed in the prevention of silt laden run-off from entering watercourses as discussed in Chapter 12.

To minimise the effect to surface water quality, existing drainage (including forestry drainage) 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 12 of this EIAR discusses surface water issues in more detail.

11.7.2.4 Measures for Spills

Details of oil spill protection measures and emergency spill response procedures are outlined in the CEMP which is contained in Appendix 2.1 of Volume III.

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 carried out from these tanks or from delivery vehicles at designated refuelling areas. Specific mitigation measures relating to the management of hydrocarbons are as follows:

- Fuels, lubricants and hydraulic fluids for equipment used on the Site shall be carefully handled to avoid spillage.
- Any spillage of fuels, lubricants or hydraulic oils shall be immediately contained, and the contaminated soil removed from the Site and properly disposed of;
- Waste oils and hydraulic fluids shall 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, shall be kept within the construction area and in each item of plant to deal with any accidental spillage.

11.7.2.5 Slope Stability

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

- The works will be designed and 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 turbine excavations. Drains will divert surface water and groundwater away from excavations into the proposed surface drainage network. Uncontrolled, direct and concentrated discharges of water onto the ground surface will be avoided.
- Loading or stockpiling 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.
- Turbines located in areas adjacent to peat deposits will incorporate drainage measures such that surface water will be drained away from the peat and will not be allowed to collect adjacent to the peat mass.
- Excavation will be carried out from access roads or hardstanding areas to avoid tracking of construction plant across areas of soft ground/peat.
- A detailed assessment of the stability of conditions at proposed infrastructure locations will be undertaken by a suitably qualified and experienced geotechnical engineer prior to the commencement of all excavations to ensure these activities do not result in or contribute to slope failure.
- 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 (status orange or higher) is forecast by Met Eireann. A rainfall gauge will be installed on Site to provide a record of rainfall intensity. An inspection of Site stability and drainage by the Geotechnical Engineer will be carried out on Site when a daily rainfall of over 25mm 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) 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 will be given in the CEMP included in Appendix 2.1 of Volume III of this EIAR.

Prior to the progression of the project to detailed design and to inform the detailed design of the Project, the developer shall also ensure that:

- Confirmatory ground investigation works are undertaken, and these should be tailored to the engineering requirements of the Project.
- The Project will be developed to full detailed design prior to construction to minimise the risk of ground instability.
- Adequate time is afforded to any designers or contractors involved in the execution of the confirmatory ground investigation works; detailed design and construction works.

11.7.2.6 Groundwater

To mitigate against the increased vulnerability of the underlying aquifer to groundwater pollution, all excavations will be constructed and backfilled as quickly as possible. Excavations will stop during or prior to heavy rainfall events (status orange or higher). Details of mitigation measures related to spills and fuel storage are outlined in Chapter 12 - Hydrology and Water Quality.

The dewatering of the foundation excavations is not expected to cause interference with domestic wells in the area, due to large offset distances to known wells, relatively shallow depths of excavation and temporary short-term nature of dewatering, if required. To monitor groundwater during the construction phase groundwater monitoring wells will be installed between areas of deeper excavations and sensitive groundwater receptors, such as areas of shallow bedrock. The wells will be used to monitor groundwater levels and quality to assess any potential impacts during the construction works.

The GSI Wells and Springs database is not complete; it is therefore probable that there are other wells in addition to those in the GSI databases, but are generally associated with houses, the offset to which from the turbines is a minimum of 750m. Given the limited depth of the excavations during the construction phase and the distance to sensitive groundwater receptors the potential risk posed to groundwater supply wells is considered to be **Imperceptible** following the implementation of mitigation measures discussed above.

If, however, in the exceedingly unlikely event of a previously unknown domestic well being impacted by the proposed development, an alternative supply will be provided – either a connection to mains water or a replacement well will be drilled.

Grid connection and internal cable trenches could provide preferential pathways for groundwater and contaminant movement. Trenches will be excavated during dry periods where possible in short sections and left open for minimal periods, to avoid acting as a conduit for surface water flows. To further mitigate the risk of cable trenches becoming preferential pathways, clay plugs (or other low permeability material) will be installed at intervals along the trench to stop/inhibit water movement.

11.7.3 Mitigation Measures during Operation

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

There is a low risk to the geology receptors from compaction of soils due to the movement of HGVs and maintenance vehicles. All site traffic will be limited to access tracks, thereby reducing the area over which compaction of the underlying natural soils can occur.

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 carried out from these tanks or from delivery vehicles. Specific mitigation measures relating to the management of hydrocarbons are as follows:

- Fuels, lubricants and hydraulic fluids for equipment used on the Site shall be carefully handled to avoid spillage.
- Any spillage of fuels, lubricants or hydraulic oils shall be immediately contained, and the contaminated soil removed from the Site and properly disposed of;
- Waste oils and hydraulic fluids shall 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 storage areas and in each item of plant / vehicle 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 wind farm, 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.

11.7.4 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 and cover with overburden material (which will have been placed at the sides of roads and hardstanding to turbines) to allow for re-vegetation of the development Site.

However, if removal is deemed to be required by the respective Planning 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.

11.7.5 Cumulative Impacts

During the construction of the Project there will be the requirement for the importation of engineered fill from source quarries and the potential for disposal of materials unsuitable for reuse at licensed facilities which would be a cumulative impact in terms of demands placed on local quarries for aggregate and an increase in traffic as hauliers take away any unsuitable material and as hauliers deliver the engineered fill from local quarries.

As such, it is considered there will be an '**Slight**' cumulative impact during the construction phase of the development.

No significant, direct negative cumulative impacts are envisaged during the operation or decommissioning phase of the Project. As such no mitigation measures are required with respect to potential cumulative impacts of the Project.

11.8 Residual Effects

It can be observed from Table 11-19 and Table 11-20 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 Project. Mitigation measures shall be monitored throughout the construction and operational phases.

The 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 Project by placing demand on existing quarries and available void space at licensed facilities during the construction phase of the development.

Table 11-19: Summary of Residual Impact Significance on Geological Receptors

Activity	Potential Impact	Receptor	Importance	Pre-Mitigation		Post-Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction Phase							
Site Clearance	Exposure of underlying overburden leading to increased erosion. Felling machinery resulting soil compaction of soft deposits and an increase in surface water runoff resulting in increased erosion of exposed soils.	Peat deposits/ organic soils Glacial Till deposits and bedrock.	Low	Small Adverse	Imperceptible	Negligible	Imperceptible and insignificant
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Removal of overburden material, open excavations and subsequent exposure underlying overburden and bedrock leading to increased erosion. 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.	Peat deposits/ organic soils Glacial Till deposits and bedrock.	Low	Moderate Adverse	Slight	Small Adverse	Imperceptible and insignificant
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Slope Failure.	Peat deposits/ organic soils Glacial Till deposits and bedrock. Site Operatives. Existing Infrastructure and nearby residential areas.	Low	Moderate Adverse	Slight	Small Adverse	Imperceptible and insignificant

Activity	Potential Impact	Receptor	Importance	Pre-Mitigation		Post-Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction of Turbine and Substation Foundations	Open excavations, increased runoff causing erosion of underlying overburden and bedrock. 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 products	Peat deposits/ organic soils Glacial Till deposits and bedrock. Local quarries.	Low	Moderate Adverse	Slight	Small Adverse	Imperceptible and insignificant
Construction of Internal Site Access Roads, Hardstands and Temporary Compound	Open excavations, increased runoff causing erosion of underlying overburden and bedrock. Construction traffic resulting in soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils. Importation of engineering fill	Peat deposits/ organic soils Glacial Till deposits and bedrock. Local quarries	Low	Moderate Adverse	Slight	Small Adverse	Imperceptible and insignificant
Construction of the Grid Connection and Internal Cabling	Removal of overburden material and exposure underlying Clay and Bedrock to erosion. 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 products Disposal of surplus excavated material to licenced facility	Peat deposits/ organic soils Glacial Till deposits and bedrock. Local quarries. Licenced waste facilities	Low	Small Adverse	Imperceptible	Negligible	Imperceptible and insignificant

Activity	Potential Impact	Receptor	Importance	Pre-Mitigation		Post-Mitigation	
				Magnitude	Significance	Magnitude	Significance
Accommodation works along TDR	Removal of overburden material and exposure of underlying superficial deposits 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.	Peat deposits/ organic soils Glacial Till deposits and bedrock. Local quarries. Licenced waste facilities.	Low	Small Adverse	Imperceptible	Negligible	Imperceptible
Operational Phase							
Construction traffic for maintenance purposes.	Minor accidental leaks or spills of fuel/oil	Peat deposits/ organic soils Glacial Till deposits and bedrock.	Low	Small Adverse	Imperceptible	Negligible	Imperceptible
Operation of substation	Spills, leaks of oils/battery fluids.	Peat deposits/ organic soils Glacial Till deposits and bedrock.	Low	Small Adverse	Imperceptible	Negligible	Imperceptible
Maintenance of access tracks	Importation of engineering fill from local quarries	Local quarries	Low	Small Adverse	Imperceptible	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Importance	Pre-Mitigation		Post-Mitigation	
				Magnitude	Significance	Magnitude	Significance
Decommissioning Phase							
Removal of Turbines and Hardstands.	Construction traffic resulting soil compaction and increase in surface water runoff resulting in increased erosion of exposed soils.	Peat deposits/ organic soils Glacial Till deposits and bedrock.	Low	Small Adverse	Imperceptible	Negligible	Imperceptible
Cumulative Effects							
Large-scale developments within 20km of the Project Site occurring concurrently with construction of the Site.	Strain on supply and reduction of a finite aggregate resource.	Local quarries (crushed rock and granular aggregate)	Low	Small Adverse	Slight	Negligible	Imperceptible

Table 11-20: Summary of Residual Impact Significance on Hydrogeological Receptors

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction Phase							
Felling Activities	Exposure of soils and bedrock to surface water runoff. An increase in sediment and nutrient concentrations within the surface water impacting the underlying aquifer. Spills, leaks of fuels and oils from forestry machinery which could contaminate the groundwater.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Slope Failure.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction of Turbine and Substation Foundations	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Reduction in groundwater levels from dewatering of excavation as required during the construction phase.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Construction of Internal Site Access Roads, Hardstands and Temporary Compound	Potential for groundwater pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks. Potential for ground water pollution from the use of cement-based compounds during the construction phase.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction of the Grid Connection and Internal Cabling	Potential for ground water pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase earthworks.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Accommodation works along TDR	Potential for ground water pollution from the removal of overburden deposits. Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during construction phase accommodation works.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Negligible	Imperceptible	Negligible	Imperceptible
Operational Phase							
Construction traffic for maintenance purposes.	Minor accidental leaks or spills of fuel/oil	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Negligible	Imperceptible	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
Operation of substation	Spills, leaks of oils/battery fluids.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Negligible	Imperceptible	Negligible	Imperceptible
Decommissioning Phase							
Removal of Turbines and Hardstands.	Potential for groundwater pollution from the disturbance of overburden deposits Potential for silt infiltration to groundwater as a result of increased surface runoff and reduced protection of the aquifer. Potential for contamination to groundwater from spills/leakages during decommissioning phase earthworks.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Cumulative Effects							
Large-scale developments within 20km of the Project Site occurring concurrently with construction of the Site.	Potential for groundwater pollution from runoff.	Locally Important Bedrock Aquifer Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Slight	Negligible	Imperceptible

11.9 Conclusions

A study has been undertaken which has identified likely significant effects of the construction operation and decommissioning of the proposed project in relation to the Land, Soils, Geology and Hydrogeology.

The assessment of Land, Soils, Geology and Hydrogeology has established a baseline for the receiving environment for the impact assessment. Likely significant effects were considered for the construction, operational and decommissioning phases of the Project as well as potential residual and cumulative effects. Mitigation measures have been proposed where relevant to prevent or reduce significant adverse effects. It has been concluded that the proposed project alone and in combination with other plans and projects is not likely to have any significant adverse effect on the environment in terms of land, soil, geology and hydrogeology, and that it is not likely to pose a significant risk of a landslide.

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

Findings from the site walkover surveys indicates no visual evidence of historic or contemporary landslides or ground instability at or adjacent to the proposed infrastructure locations.

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

The Project alone and in combination with other plans and projects is not likely to have any significant, negative cumulative effects with other existing, permitted or proposed developments.

With mitigation measures, outlined in Section 11.7, put in place during construction, operational and decommissioning stage the Project will have an '**imperceptible**' impact and effect on the Site's geological and hydrogeological receptors.

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