FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

ENVIRONMENTAL IMPACT ASSESSMENT REPORT (EIAR) FOR THE PROPOSED COUMNAGAPPUL WIND FARM, CO. WATERFORD

Volume 2 – Main EIAR

Chapter 11 – Soils, Geology and Hydrogeology

Prepared for:

EMP Energy Limited (EMPower)

EMPower

Date: **October 2023**

Core House, Pouladuff Road, Cork, T12 D773, Ireland

T: +353 21 496 4133 | E: info@ftco.ie

CORK | DUBLIN | CARLOW

www.fehilytimoney.ie

TABLE OF CONTENTS

LIST OF APPENDICES (Volume III)

Appendix 2.1: Construction Environmental Management Plan (CEMP) including:

- CEMP Appendix A - Traffic Management Plan
- CEMP Appendix B - Grid Connection Construction Methodology
- CEMP Appendix C - Peat and Spoil Management Plan
- CEMP Appendix D - Surface Water Management Plan

Appendix 11-1: Geotechnical Assessment Report (GAR)

Appendix 11-2: General Site Photographs

LIST OF FIGURES (Volume IV)

LIST OF TABLES

11. SOILS, GEOLOGY AND HYDROGEOLOGY

11.1 Introduction

This chapter has been prepared to examine the potential impacts of the proposed Coumnagappul Wind Farm, associated grid connection and turbine delivery route on existing geological conditions within the study area. The study area is defined as the 'Site' Figure 2.2, Volume IV as well as a one kilometre corridor along either side of the TDR and GCR. The primary focus of this chapter is on the Site (to include the HDD crossing along the GCR), which has the most potential to impact the underlying geological and hydrogeological receptors. The GCR and the TDR are 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 minor excavation / accommodation works. The effects of the Project are considered, taking account of mitigation measures to reduce or eliminate any residual impacts on Soils, Geology and Hydrogeology. The assessment also considers the cumulative impacts associated with other nearby developments.

A detailed description of the project assessed in this EIAR is provided in Chapter 2 and is comprised of three main elements:

- The wind farm Site (referred to in this EIAR as the '**Site'**);
- The grid connection (referred to in this EIAR as the **'GCR'**);
- The turbine delivery route (referred to in this EIAR as the **'TDR'**).

The Site includes wind turbines, internal access tracks, a river crossing point and associated approach earthworks, hard standings, a permanent meteorological mast, on-site substation, internal electrical and communications cabling, temporary construction compound, drainage infrastructure and all associated works related to the construction of the Site. The GCR will consist entirely of underground 38kV cable and will connect the on-Site substation to the existing 110kV substation at Dungarvan. There will be one stream crossing along the GCR, which will require Horizontal Directional Drilling (HDD). The turbine delivery route includes all aspects of the route from the N29 at the Port of Waterford to the Site entrance including proposed temporary accommodation works to facilitate the delivery of wind turbine components.

11.2 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; and
- Assessment of residual impacts.

The assessment methodology and criteria are outlined in Section 11.2.4.

11.2.1 Relevant Guidance

The general 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;
- European Union (2000/60/EC) Water Framework Directive;
- European Union (2006/188/EC) Groundwater Directive;
- Government of Ireland (2010) European Communities Environmental Objectives (Groundwater) Regulations (S.I. No. 9 of 2010) as amended;
- Government of Ireland (2003) European Communities (Water Policy) Regulations (S.I. No. 722 of 2003) as amended;
- 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;
- Department of Environment, Heritage and Local Government (DoEHLG) (2006), Wind Farm Planning Guidelines;
- Irish Wind Energy Association (IWEA) (2012), Best Practice Guidelines for the Irish Wind Energy Industry.

11.2.2 Water Framework and Groundwater Directives, Status and Risk Assessment

The Water Framework Directive (WFD) provides for the protection, improvement and sustainable use of waters, including rivers, lakes, coastal waters, estuaries and groundwater within the EU Member States. It aims to prevent deterioration of these water bodies and enhance the status of aquatic ecosystems; promote sustainable water use; reduce pollution; and contribute to the mitigation of floods and droughts.

Under the Water Framework Directive large geographical areas of aquifer have been subdivided into smaller groundwater bodies (GWB) for them to be effectively managed.

The overriding purpose of the WFD is to achieve at least “good status” in all European waters and ensure that no further deterioration occurs in these waters. European waters are classified as groundwaters, rivers, lakes, transitional and coastal waters. The first cycle of river basin management planning, which covered the period 2009-2015, developed plans and associated programmes of measures based on eight River Basin Districts (RBDs) within the island of Ireland. These plans set ambitious targets that envisaged that most water bodies would achieve good status by 2015. Reference should also be made to the River Basin Management Plan 2018-2021 and the Draft River Basin Management Plan 2022-2027.

The Groundwater Directive establishes a regime which sets groundwater quality standards and introduces measures to prevent or limit inputs of pollutants into groundwater. The directive establishes quality criteria that take account of local characteristics and allows for further improvements to be made based on monitoring data and new scientific knowledge.

The directive thus represents a proportionate and scientifically sound response to the requirements of the Water Framework Directive (WFD) as it relates to assessments on chemical status of groundwater and the identification and reversal of significant and sustained upward trends in pollutant concentrations in groundwater.

11.2.3 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)	September 2020	Replied with comments related to Geo-heritage, Groundwater, mapping and resources, Geohazards and the use of Natural Resources (Minerals/Aggregates).
Geological Survey Ireland	August 2021	The Geological Survey Ireland had no specific comment or observations to make since last response. Recommended using Geological Survey Ireland's Publicly Available data sets, when conducting the EIAR, SEA, planning and scoping processes.

11.2.4 Impact Appraisal Methodology

As outlined in Section 11.1, the aim of this chapter is to identify the 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 these impacts.

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 including aerial photography and EPA and GSI online databases. This review was undertaken in June 2022. In addition to the desktop assessment, two Site walkovers (to include peat probing surveys) were undertaken in July 2020 and October 2022. The two site walkovers completed in 2020 and 2022 were undertaken by FT Graduate Geotechnical Engineer (Dana Aspel BSc. MSc, FGS, MIAH) and Chartered Principal Geologist (Aaron Clarke BSc. MSc. EurGeol, PGeo) respectively. The resulting data from these site walkovers are discussed in Section 11.3.9 of this Chapter. An intrusive ground investigation comprising trial pits and boreholes was undertaken by Ground Investigations Ireland Ltd. (GII) between December 2022 and January 2023. The results from this investigation are presented in Appendix 11-1. A summary of the ground investigation findings is presented in Section 11.3.10 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. The evaluation of the significance of the impacts was undertaken in accordance with the IGI guidance (2013).

Where potential impacts were identified, mitigation measures are proposed and will be implemented to minimise impacts on the environment to acceptable levels of significance. The residual impact from the Project was then re-appraised considering the mitigation measures. The residual impacts from the Project are presented in Section 11.7 of this chapter.

11.2.5 Evaluation Criteria

During each phase (construction, operation, maintenance and decommissioning) of the Project, several activities will take place on Site, some of which will have the potential to cause impacts on the geological regime at the proposed Site and the associated Soils, Geology and Hydrogeology. These potential impacts are discussed throughout this chapter. Mitigation measures where required are presented in Section 11.6.

11.2.5.1 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;

Magnitude	Criteria	Typical Example
		• Marginally economic extractable mineral resource.
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and/or soft organic soil underlying the site is moderate on a local scale.	• Contaminated soil on site with previous light industrial usage; • Small recent landfill site for mixed wastes; • Moderately drained and/or moderate fertility soils; • Small existing quarry or pit; • Sub- economic extractable mineral resource.
Low	Attribute has a low quality, significance or value on a local scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying the site is small on a local scale.	• Large historical and/or recent site for construction and demolition wastes; • Small historical and/or recent landfill site for construction and demolition wastes; • Poorly drained and/or low fertility soils; • Uneconomic extractable mineral resource.

Table 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 Tables 11-2 to 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, GCR and TDR are discussed in Section 11.5

11.2.6 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 Waterford [i]
- Groundwater Protection Scheme for County Waterford [ii]
- Aerial imagery from Google, Bing and OSi (Geohive)
- Waterford City and County Development Plan 2022-2028 [iii]
- Current and historical (6 inch and 25 inch) Ordnance Survey maps [iv]
- Waterford Renewables Energy Strategy 2016 – 2030 [v]
- Flood Risk Data [vi]
- Ecological Designations [vii]
- Mapping data of the area produced by the Geological Survey of Ireland (GSI) [viii]
    - *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*

- Datasets from the EPA [ix]
- European Union open datasets [x]

11.2.7 Site Investigations and Field Assessments

A series of site walkovers and peat probe surveys were undertaken by Engineering Geologists and Geotechnical Engineers working for Fehily Timoney and Company (FT) during July 2020 (Graduate Geotechnical Engineer - Dana Aspel, BSc MSc, FGS, MIAH), May 2021 (Senior Geotechnical Engineer – Alison Delahunty BE, MSc, CEng, MIEI) and October 2022 (Principal Geologist – Aaron Clarke BSc, MSc, EurGeol, PGeo). 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 wind farm 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.
- Recording of GPS co-ordinates of site investigation locations using a hand-held GPS.

Intrusive ground investigation undertaken by Ground Investigations Ireland (GII) between December 2022 and January 2023 and comprised:

- 21 no. trial pits
- 2 no. boreholes with groundwater monitoring well installations
- Geotechnical and geo-environmental testing

The works were supervised by Engineering Geologists working for FT (Senior Project Engineer - Emily Archer BSc, MSc) and GII (Senior Engineering Geologist - James Cashen BSc, EurGeol, PGeo).

Ground investigation findings are presented in the Geotechnical Assessment Report (GAR) in Appendix 11-1. GII's Factual Report, including exploratory hole logs, is included as an appendix within the GAR.

11.3 Receiving Environment

11.3.1 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.

In summary, the Site is underlain by a mantle of superficial deposits comprising Blanket Peat, Glacial Till and subordinate linear deposits of Alluvium (Figure 11.1). These linear deposits of Alluvium do not cross any of the Site's infrastructure with the exception of a river crossing at ITM coordinate E 624237, N 608600. Here the access road between turbines T08 and T12 crosses over the Colligan River, requiring a bridge structure and approach earthworks. These are in turn underlain by a sequence of Upper Devonian conglomerates, mudstones and sandstone (Figure 11.2). At several locations across the Site, bedrock is exposed at surface as outcrops. Scree deposits, resulting from freeze-thaw weathering of the bedrock, are also frequent, and are typically mapped in areas of higher elevation.

One HDD will be required at approximate ITM coordinate E 621231, N 608261 to cross a waterbody due to the need to take the cable route off road at an existing bridge, which has insufficient cover to accommodate the cable. This HDD crossing will be entirely within private lands, comprising agricultural grasslands, and will be constructed under the Skeheens Stream, approx. 1km west of the Site. The HDD location is underlain by Alluvium deposits, which are immediately flanked by Till deposits to the east and west (Figure 11.1). These are in-turn underlain by the Upper Devonian Ballytrasna Formation (Figure 11.2).

The following sections should be read in conjunction with the Conceptual Site Model (CSM) presented in Figure 11.3 and Figure 11.4, which illustrates an idealised source-pathway-receptor model for the Site.

11.3.2 Type of Geological/Hydrogeological Environment

Based on regional and site-specific information available the type of geological/hydrogeological environment as per the IGI Guidelines [xiii] is **Type A – Passive Geological/Hydrogeological Environments**. Type A environments, with respect to earthworks, require "*Invasive site works to characterise nature and thickness of soil and subsoil e.g. trial pits or auguring*".

11.3.3 Quaternary Deposits

The Geological Survey Ireland's (GSI) Quaternary Sediments mapping shows that large portions of the Site are covered by a mantle of Blanket Peat. A wide (170-400m) linear north-south trending swath of till derived from Devonian sandstone traverses the middle of the Site terminating approximately 400m south of Milk Hill. This stratum is anticipated to underlie much of the peat deposits. A narrow (approx. 30m in width) linear deposit of Alluvium, straddling the Colligan River (including the location of a proposed river crossing), runs along the eastern flank of the till. Similar deposits are found to the south of the Site along Coumavane Stream.

The remaining areas of the Site comprise bedrock outcrop/subcrop and scree deposits; the distribution of these strata reflect areas of higher more exposed elevations, which typically display a steeper topography.

The Quaternary geology of the proposed project and surrounding area is presented in Figure 11.1.

As presented in Figure 11.1:

- one turbine location (T04) is located within an area mapped as bedrock outcrop or subcrop;
- eight turbine locations (T01, T02, T06, T07, T08, T10, T11 and T12) are located within areas mapped as blanket peat; and
- one turbine location (T05) is located within areas mapped as Till derived from Devonian sandstones.

11.3.4 Bedrock Geology

The GSI 1:100,000 scale bedrock geology map (Figure 11.2) shows that the main wind farm Site is underlain by a conformable sequence of broadly northeast-southwest striking Upper Devonian rocks, described in Table 11-7. The south-eastern extent of the Site is underlain by the Treanearla Formation. These are followed by the Sheskin and Kilnafrehan Conglomerate Formations which make up much of the central portion of the Site. The north-western extent of the Site is underlain by the Ballytrasna Formation.

Table 11-7: Bedrock Geology (formations listed from youngest to oldest)

Formation Name	Lithological Description
Ballytrasna Formation	Dusky-red to purple mudstones with subordinate pale-red sandstones.
Kilnafrehan Conglomerate Formation	Thickly bedded (1-2m units) red, cobble grade conglomerates and conglomeratic coarse-sandstones. The sandstones are essentially non-felspathic and often contain purply-red intraformational siltstone clasts.
Sheskin Formation	Mudstone, sandstone, and subordinate pebbly sandstone and conglomerate. The pale purple-red mudstones are silty and often calcareous.
Treanearla Formation	A thick-bedded sequence of conglomerates and conglomeratic sandstones, with individual units often greater than 1.5m. The conglomerates are generally greenish and contain pebble and cobble grade clasts dominated by vein quartz.

11.3.5 Structural Geology

The Site's structural geology is dominated by two distinct features:

1. The northern limb of a regional east-west trending antiform, the core of which comprises the Treanearla Formation (the oldest in a sequence of the Devonian rocks that underly the Site). Typical bedding dip and dip direction range from 20 to 38° to the north-west.
2. An approximate east-west striking fault transects the southern portion of the Site. This fault displays 1.6km of apparent sinistral strike-slip displacement, and unconformably juxtaposes younger rocks against older rocks. Vertical displacement along this fault is unknown. Faults can create groundwater pathways through otherwise impermeable bedrock (Figure 11.4). However, it should be stated that the Site's infrastructure is all located to the north of this fault line. The closest infrastructure to the fault is the hardstand to turbine T11, which is located approximately 25m north-west of this mapped geological feature.

There are no GSI regional cross-sections available for the Site. The closest cross-section is the Clogheen – Ballymacoda section, located approximately 17km to the west of the Site.

11.3.6 Hydrogeology

11.3.6.1 Anticipated Groundwater Regime

The overburden deposits of till and peat have generally low to moderate permeability and may therefore act as a confining layer (where present), preventing the free movement of surface water to the underlying Locally Important Bedrock aquifer.

The topography of the Site forms a broad north-south trending steep sided valley, which in general slopes towards the south. Groundwater at the Site is expected to flow in the general direction of the topography and surface water courses, which again flow predominantly from north to south.

It is anticipated that, given the geology of the Site, most groundwater flow will occur within the upper tens of metres, recharging and discharging in local zones. Discharge will likely follow the surface water drainage system flowing south where it eventually enters the limestone dominated Dungarvan GWB.

11.3.6.2 Groundwater Vulnerability

Groundwater vulnerability, as defined by the GSI, is the term used to represent the intrinsic 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 GSI's Groundwater Vulnerability mapping within the Site ranges from 'X – Rock at or near Surface' to 'H – High'. Areas of 'E – Extreme' Groundwater Vulnerability are located around mapped bedrock outcrop or subcrop, where a thin mantle of blanket peat is present. Groundwater vulnerability distribution is presented in Figure 11.5.

Based on GSI's Groundwater Vulnerability mapping, Site walkovers and intrusive ground investigation, overburden deposits are generally <5.0m deep across the majority of the Site. The expected permeability for the subsoil is 'Moderate', but it may be locally 'High' within 'X' areas, due to the possible presence of shallow or outcropping weathered bedrock.

A summary of the groundwater vulnerability for the Site is presented in Table 11-8. This table outlines the standard ratings of vulnerability used by the GSI, with the existing Site conditions highlighted in green based on the findings of the Site investigations.

Table 11-8: Groundwater Vulnerability

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 -10.0 m	3.0 - 5.0 m
Moderate (M)	N/A	>10.0 m	5.0 - 10.0 m
Low (L)	N/A	N/A	>10 m

11.3.6.3 Groundwater Bodies Description

The proposed wind farm Site and a portion of the proposed grid connection are mainly located within the Kilrion Groundwater Body (GWB), but it also comprises a smaller area on the north belonging to the Comeragh GWB. The northernmost 100m of turbine T02 hardstand and approximately 1.8km of access road lie within the Comeragh GWB. Both GWBs are classified as poorly productive bedrock. The GWBs distribution are shown in Figure 11.6.

The descriptions of the GWBs within the study area have been taken from the 'Summary of Initial Characterisation' draft 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 outcrop rock encountered in walkovers and groundwater observations recorded on Site have been used to supplement and validate the published information.

According to interim classification work carried out as part of the Water Framework Directive and published by the EPA [ix] (2016-2021), the Kilrion and Comeragh GWBs are classified as having *'Good'* status in terms of quality and quantity. The overall risk result of '*Not At Risk'* is applied to the Kilrion and Comeragh GWBs.

A summary of the aquifer classifications are presented in Table 11-9.

Table 11-9: Summary of Aquifer Classifications & Characteriestics

GWB	European Code	Aquifer Category	Flow Regime	Transmissivity (m^2/day)
Kilrion	IE_SE_G_085	Locally Important Aquifer (LI) - Bedrock which is Moderately Productive only in Local Zones[1] (Same aquifer for both GWBs)	Poorly productive bedrock	1 - 10
Comeragh	IE_SE_G_154			

Kilrion GWB

The Kilrion GWB is situated in central Co. Waterford with varying topography. The Monavullagh Mountains, extending in a northeast to southwest direction are located in the centre of the GWB. Surface water flows from the peaks of the mountains through steep valleys radially from the centre.

The Kilrion GWB is comprised of purple mudstone with some sandstone, boulder-pebble size conglomerate, green thick bedded conglomerate and medium grained pink and purple sandstone.

The aquifer type within the Kilrion GWB is classified LI – locally important aquifer which is moderately productive in local zones.

According to the 'Summary of Initial Characterisation' report for the Kilrion GWB, the majority of groundwater flow may occur in the upper tens of metres, recharging and discharging in local zones. Groundwater flow paths are considered to be short and the bedrock is not considered to constitute a major aquifer. Groundwater is considered to be young.

Comeragh GWB

A GWB Characterisation Report has not been prepared by the GSI for the Comeragh GWB.

It should be noted that the adjoining Knockmealdown GWB located to the south of the Comeragh GWB and to the west of the site and Kilrion GWB will likely display similar groundwater characteristics. This is based on similarities in geological composition between the Knockmealdown and Comeragh GWBs. Knockmealdown GWB is described as having poorly productive bedrock with respect to its flow regime. The aquifer classification of this GWB is typically classified as LI - locally important aquifer which is moderately productive in local zones. Groundwater flow paths are described as limited within the top 10m of the surface. Groundwater flow occurs in faults and joints, typically within the upper weathered zone with flow paths not usually exceeding a few hundred of metres in length.

11.3.6.4 Groundwater Supply Sources

A review of published information on groundwater supply sources within the study area was undertaken to identify potential groundwater dependant receptors at potential risk from the Project. These include group water schemes (GWS), source protection zones and private supply wells with information on these features obtained from the GSI Groundwater database.

11.3.6.5 Public Water Supplies and Source Protection Zones

The GSI maintains a database of Public Supply Source Protection Areas. From a review of the database there are no Public Water Supplies (PWS's) or Public Supply Source Protection Areas within the Site boundary.

There are however 6 No. Source Protection Areas for public water supply schemes within 20km of the wind farm Site, and these are:

- Ballyrohan, approximately 2km west;
- Poulnagunoge, approximately 9.6km north;
- Dungarvan, approximately 9.8km south;
- Kilmacthomas, approximately 12km southeast
- Lismore, Cappoquin, Ballyduff, approximately 12.7km southwest; and

- Cappoquin, approximately 14.1km southwest.

The southernmost 5km of the proposed GCR is located within the Dungarvan PWS.

These Public Supply Source Protection Areas are presented in Figure 11.7.

11.3.6.6 Group Water Schemes and Source Protection Zones

Based on a review of the current EPA and GSI groundwater databases, there are no Group Water Schemes (GWS) within the boundary of the Site. There are no GWS in the groundwater catchment area in which the wind farm Site is located either. However, there are two GWS's within 20km of the Site. These are:

- Moonminane, approximately 10 km east. It has a surface of 0.06 km^2.
- Ballydurn, approximately 15km east. It has a surface of 0.42 km^2.

Group Water Schemes Protection Areas are presented in Figure 11.7.

11.3.6.7 Groundwater Wells and Springs

Based on a review of the GSI Groundwater Wells and Springs database there are 4 no. groundwater wells recorded within 1 km of the Site. In addition, there are a further 22 no. groundwater wells recorded within 1km of the proposed GCR. The locations of these groundwater wells are presented in Figure 11.8.

Table 11-10 outlines the details of groundwater wells and springs held within the GSI dataset.

Table 11-10: Summary of Wells with 1km of the Project

Location ID	Easting	Northing	Type	Total Depth (m BGL)	Current Use	Yield Class	GSI Location Accuracy (m)	Nearest Infrastructure ID measured from edge of the well boundary (approx. distance, km)
2011SEW015	623545	611543	Borehole	29	Domestic only	Moderate	1,000	T01 (0.99)
2011SEW030	624945	612053	Borehole	45.7	Agri & domestic	Poor	1,000	T02 (1.35)
2009NEW001	622320	606608	Borehole	21.3	Domestic only	Poor	1,000	T12 (1.68)
2009NEW003	622254	606495	Borehole	29.3	Domestic only	Poor	1,000	T12 (1.81)

Location ID	Easting	Northing	Type	Total Depth (m BGL)	Current Use	Yield Class	GSI Location Accuracy (m)	Nearest Infrastructure ID measured from edge of the well boundary (approx. distance, km)
2009NEW022	603855	621236	Borehole	25.3	Unknown	Poor	1,000	GCR (0.0)
2009NEW010	603605	620906	Borehole	26.8	Unknown	Poor	1,000	GCR (0.0)
2009NEW043	621746	603704	Borehole	39.6	Agri & domestic	Moderate	50	GCR (0.86)
2009NEW021	603145	621995	Borehole	21.3	Unknown	Moderate	1,000	GCR (0.74)
2009NEW012	602655	621736	Borehole	24.1	Unknown	Poor	1,000	GCR (0.86)
2009NEW020	602565	619986	Borehole	23.8	Unknown	Moderate	1,000	GCR (0.0)
2009NEW009	600496	620436	Borehole	27.4	Unknown	Poor	1,000	GCR (0.0)
2009NEW024	600326	620406	Borehole	24.4	Unknown	Moderate	1,000	GCR (0.0)
2009NEW025	600086	620766	Borehole	27.4	Unknown	Moderate	1,000	GCR (0.0)
2009SEW005	599646	619206	Borehole	24.4	Unknown	Poor	1,000	GCR (0.74)
2009SEW008	598286	620946	Borehole	22.9	Unknown	Poor	1,000	GCR (0.0)
2009SEW003	597556	622225	Borehole	28.3	Unknown	Good	1,000	GCR (0.64)

Location ID	Easting	Northing	Type	Total Depth (m BGL)	Current Use	Yield Class	GSI Location Accuracy (m)	Nearest Infrastructure ID measured from edge of the well boundary (approx. distance, km)
2009SEW028	597036	620166	Borehole	31.1	Unknown	Poor	1,000	GCR (0.46)
2009SEW086	596956	621196	Borehole	44.2	Agri & domestic use	Poor	1,000	GCR (0.0)
2009SEW060	621395	597356	Borehole	24.9	Unknown	Unknown	20	GCR (0.28)
2009SEW059	596576	622465	Borehole	26.8	Unknown	Poor	1,000	GCR (0.36)
2009SEW058	622,215	594,957	Borehole	16.9	Public supply (Co Co)	Unknown	20	GCR (0.43)
2009SEW037	595617	623385	Borehole	14.6	Unknown	Poor	1,000	GCR (0.0)
2009SEW070	623595	594677	Borehole	13.5	Public supply (Co Co)	Excellent	20	GCR (0.46)

11.3.6.8 Karst Features

According to the GSI mapping, there are no karst features recorded within the Site or the wider study area. Karst features are not likely to occur within the Site or broader study area due to the absence of carbonate bedrock. The closest mapped karst feature is a swallow hole within Waulsortian Limestone located approximately 10km west-northwest of the Site.

11.3.7 Geological Heritage

The GSI's Geological Heritage (Geo-heritage) division, have undertaken a programme to identify and select important geological and geomorphological Sites throughout the country for designation as NHAs (Natural Heritage Areas). This is being addressed under 16 different geological themes. For each theme, a larger number of sites (from which to make the NHA selection) are being examined, to identify the most scientifically significant. The criterion of designating the minimum number of sites to exemplify the theme means that many sites of national importance are not selected as the very best examples. However, a second tier of County Geological Sites (CGS) (as per the National Heritage Plan) means that many of these can be included in County Development Plans and receive a measure of recognition and protection through inclusion in the planning system.

The GSI's online Geological Heritage database identifies the Comeragh Mountains as a County Geological Site (CGS), comprising a mountain plateau which is heavily ice-sculpted with corries. They have been shaped and moulded during the Quaternary (Ice Age) by glacier ice. This is described as an audited site which must be protected from being damaged or deteriorated during the project execution. The site is also recommended for Geological NHA status. The Wind Farm Site is located fully outside of the Comeragh Mountains CGS.

The distribution of Geological Heritage Sites is shown on Figure 11.9.

11.3.8 Economic Geology

The GSI Online Minerals Database accessed via the Public Data Viewer shows no quarries (active or historic) or mineral occurrences within 5km of the Site (Figure 11.10).

The GSI Aggregates database indicates that there is a very low to moderate potential for crushed rock aggregate across the Site (Figure 11.11). There is generally a low to moderate potential for granular aggregate with only localised areas displaying a high aggregate potential (Figure 11.12). The scree deposits and to a lesser extent the Alluvium are the main source of granular aggregate across the Site.

Frequent rock outcrops within the Site have been identified in GSI bedrock map (1:100.000) and through site visits, typically identified as either medium to thick bedded mudstone of the Ballytrasna Formation or thick bedded to massive coarse sandstone and conglomerates of the Kilnafrehan Conglomerate Formation. Therefore, there is potential to extract crushed rock as a source of Class 1 general fill within the Site. A borrow pit location has been identified at ITM coordinates E 624586, N 610370, and will be discussed further in Section 11.6.2.2 of this Chapter.

11.3.9 Walkover Survey Findings

Findings from the walkover surveys confirm the Site is predominantly underlain by a thin mantle of blanket peat. The minimum, maximum and mean peat depth recorded out of 200 peat probe locations were 0.0, 0.7 and 0.14m respectively. In general, thinner peat layers were encountered in areas of higher elevation/steeper terrain. Approximately 96% of the peat depths recorded across the Site were less than 0.5m. Where peat depths of >0.50m were encountered, these are considered to be isolated occurrences, which showed little to no lateral persistence and were not located in the vicinity of any proposed wind farm infrastructure.

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

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

Infrastructure Element	Easting	Northing	Peat Depth (m)	Slope (°)
T01	623835	610089	0.10	3
T02	624451	610261	0.20	12
T04	623768	609484	0.00	7
T05	624336	609617	0.00	12
T06	624980	609599	0.35	12
T07	624818	608984	0.05	13
T08	624438	608381	0.05	7
T10	624741	608021	0.10	15
T11	625250	607860	0.15	13
T12	623731	608209	0.10	12
Colligan River Crossing Point (East Bank)	624257	608606	0.25	16
Colligan River Crossing Point (West Bank)	624216	608590	0.00	9
Borrow Pit	624463	610466	0.20	2
On-Site Substation	624063	609128	0.00	16

Photographs taken during the October 2022 site walkover survey are presented in Appendix 11-2.

11.3.10 Intrusive Ground Investigation Findings

The detailed findings and conclusions of the intrusive ground investigation is provided in Appendix 11-1 – Geotechnical Assessment Report (GAR) and generally confirm the anticipated geology described in the Desk Study.

Trial pits were excavated at the turbine, met mast, substation, borrow pit and river crossing point locations. Boreholes were advanced at the proposed borrow pit location and at the proposed Colligan River crossing point. A summary of ground and groundwater conditions encountered during the intrusive ground investigation are presented in Table 11-12.

Table 11-12: Site Assessment Summary

Site Element (Hole ID)	Strata Depth From To (m bgl)						Groundwater Strike (m bgl)
	Peat	Fine Grained Till	Coarse Grained Till	Very Course Grained (>200mm) Till	Possible Bedrock Note1	Confirmed Bedrock	
T01 (TP-01)	0.00-0.15	0.15-1.50	-	1.5-3.00	3.00	-	1.50
T02 (TP-02)	0.00-0.25	0.25-2.40 Note 2	-	-	2.40	-	2.20
T04 (TP-03)	0.00-0.15	-	0.15-2.10	-	2.10	-	Dry
T05 (TP-04)	0.00-0.35	0.35-1.70	1.70-3.10	-	3.10	-	Dry
T06 (TP-05)	0.00-0.45	0.45-0.80	0.80-2.00	-	2.00	-	0.80
T07 (TP-06)	0.00-0.30	0.30-4.20	-	-	4.20	-	Dry
T08 (TP-14)	0.00-0.30	0.30-1.50	1.50-2.00	2.00-3.00	3.00	-	Dry
T10 (TP-15)	0.00-0.20	0.20-1.00	1.00-4.30	-	4.30	-	3.80
T11 (TP-16)	0.00-0.20	0.20-4.00	-	-	4.00	-	Dry
T12 (TP-13)	0.00-0.20	0.20-3.40	-	-	3.40	-	1.20
Met Mast (TP-22)	0.00-0.40	0.40-3.50	-	3.50-3.80	3.80	-	3.70
Colligan River Crossing Point (TP-12 and BH-04)	0.00-0.80 Note 3 (TP-12) 0.00-0.25 (BH-04)	0.80-1.30 (TP-12) 6.50-14.00 (BH-04)	1.30-3.60 (TP-12) 0.25-6.50 (BH-04)	-	3.60 (TP-12)	14.00-20.00 (BH-04)	1.80 (TP-12) Dry (BH-04)
Borrow Pit (TP-21 and BH-03)	0.00-0.20 (TP-21) 0.00-0.30 (BH-03)	-	0.20-2.50 (TP-21) 0.30-1.90 (BH-03)	-	2.50 (TP-21)	1.90-10.00 (BH-03)	1.00 (TP-21) Dry (BH-03)

Site Element (Hole ID)	Strata Depth From To (m bgl)						Groundwater Strike (m bgl)
	Peat	Fine Grained Till	Coarse Grained Till	Very Course Grained (>200mm) Till	Possible Bedrock Note1	Confirmed Bedrock	
On-Site Substation (TP-007 to TP-11)	0.00-0.15 (TP-07) 0.00-0.20 (TP-08) 0.00-0.40 (TP-09) 0.00-0.25 (TP-10) 0.00-0.20 (TP-11)	0.15-3.00 (TP-07) 0.20-3.00 (TP-08) 0.40-3.50 (TP-09) 0.25-1.80 (TP-10) 0.20-2.80 (TP-11)	1.80-3.70 (TP-10)	-	3.00 (TP-07) 3.00 (TP-08) 3.50 (TP-09) 3.70 (TP-10) 2.80 (TP-11)	-	Dry (TP-7) 1.00 (TP-08) Dry (TP-9) Dry (TP-10) Dry (TP-11)

Note 1 – typically described as COBBLES and BOULDERS at the base of trial pits. Trial pits terminated on these horizons and they were recorded as "Possible boulders of bedrock".
Note 2 – stratum interbedded with coarse-grained till.
Note 3 – 0.80m deep peat deposit localised to area adjacent to Colligan River. Adjacent peat probe locations show peat depths of 0.25 to 0.30m.

Ground conditions at key infrastructure locations generally comprise a thin mantle of peat over Glacial Till, which in turn is underlain by bedrock.

Peat deposits (where present) range in thickness from 0.15 to 0.80m with a mean and median peat thickness of 0.30 and 0.25m respectively. The deepest deposits are located adjacent to the Colligan River and are considered to be an isolated occurrence and not representative of the whole Site.

The Till deposits, which were found to comprise both fine and coarse grained material, were typically encountered immediately beneath the Blanket Peat to depths not exceeding of 4.3m.

However, in borehole BH-04 (located to the west of the proposed Colligan River crossing), Till was encountered between 0.25 and 14m bgl and was recorded as a dense GRAVEL, over very stiff CLAY and SILT. These thickened Till deposits are not typical of the overall Site and are likely a result of phased depositional episodes within the Colligan River valley base.

At the proposed borrow pit location bedrock was encountered at 1.90m bgl (BH-03). Bedrock comprised medium strong, thickly bedded, red fine-grained sandstone of the Ballytrasna Formation. Two distinct discontinuity sets were recorded within the sandstone with orientations of sub-horizontal to sub-vertical and spacings ranging from close (60-200mm) to wide (600-2000mm).

11.3.11 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. From a desktop review of the proposed GCR, most of the route is situated within existing public highway. As such, and given the limited extent of lateral and vertical excavations it was not considered a risk was posed to slope stability along the grid connection route.

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

11.3.11.1 Topography of the Site

The topography across the Site is defined by a series of ice sculpted mountain ridges, peaks and valleys. Elevations range from 450m (at Milk Hill) to 190m AOD. In general, the proposed Site can be described as having very gentle to moderate slopes.

Slopes at the proposed turbine locations range from 3 to 15°.

Slopes at the proposed Colligan River crossing range from between 9 and 16° and form an approximate 5m deep and 20-30m wide north-south trending river valley. The valley walls were heavily vegetated with predominantly ferns. Washed Till (gravel, cobbles and boulders) was exposed within the bed of the Colligan River.

Slopes at the proposed substation location range from 8 to 16°.

Slopes at the proposed borrow pit location are typically <2°.

11.3.11.2 Slope Stability Assessment

From a review of the GSI Landslide Susceptibility database, the Project and proposed infrastructure locations are generally located within areas of 'Low' to 'Moderate High' susceptibility, with localised areas classified as 'High'. A summary of the GSI landslide susceptibility with respect to the Project is provided in Figure 11.13.

Turbines T2, T7, T8, T10, T11 and T12 and portions of the access roads linking these turbines are all located in areas mapped as having a 'Moderately High' to 'High' landslide susceptibility. These areas directly correlate with mapped Blanket Peat deposits. Field observations at these locations recorded slope angles ranging from 6 to 15° and peat depths of between 0.2 and 0.3m with no evidence of historic slope instability observed. In addition, desktop review of available aerial photography did not identify evidence of slope instability. It is therefore considered that the risk of landslide at the turbine locations and along the access tracks is considered to be negligible and that the GSI Landslide Susceptibility Classification rating at these locations does not accurately reflect actual ground conditions encountered on site i.e. shallow peat or complete absence of peat deposits.

The remaining turbines, substation, met mast, Colligan river crossing point, construction compound areas and borrow pit are all located in areas mapped as having a 'Moderately Low' to 'Low' landslide susceptibility. Conditions observed through field assessments are reflective of same.

Field observations indicate that the deeper peat deposits encountered at the Colligan River crossing (discussed in Section 11.3.10) are isolated and not laterally continuous. They are therefore considered to pose a negligible risk with respect to slope instability.

No evidence of slope instability was observed at the Site and there are no historical records of landslide activity within 1km of the Site on the GSI database.

A geotechnical assessment has been undertaken using findings from the site walkover surveys and intrusive ground investigations and is presented in Appendix 11-1 – Geotechnical Assessment Report (GAR).

11.3.11.3 Peat Stability Assessment

Following the Site walkover and given the presence of small areas of peat deposits and peaty topsoil 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 Chartered Principal Geologist (Aaron Clarke BSc., MSc. EurGeol., PGeo.) in October 2022. Peat depths were taken using a hand held Van Walt peat probe at proposed turbine and associated infrastructure locations. Results from the survey indicate that peat depths were generally very thin and characteristic of a highly organic Topsoil with a Peaty appearance. Depths ranged from 0.05 to 0.6m with mean and median values of 0.12 and 0.10m respectively.

The deepest deposit (0.60m) was encountered in the banks of a stream at ITM coordinates E 624238, N 608607 and is immediately flanked by shallow deposits to the east and west of 0.25 and 0.0m respectively. The survey results show this to be an outlier and not representative of peat depths across the Site. It will therefore be discounted. The next deepest deposit encountered was 0.40m.

As such and in accordance with the Scottish Executive Best Practice Guide for Proposed Electricity Generation Developments (2017), as peat deposits at the proposed turbine locations were <0.5m in depth a peat stability assessment was not warranted.

11.3.12 Soil Contamination

There are no known areas of soil contamination on the Site or the grid connection route. No evidence of soil contamination was noted during Site walkovers or during the intrusive ground investigation. As agricultural/forestry equipment is used across some of the Site it is possible that minor fuel spills and leaks have occurred locally in the past.

Further, due to the presence of local roads within the study area and along the proposed grid connection route there is a risk of fuel leakages and other highway related contamination in the upper soils.

The nearest active EPA Licenced Waste Facility is Dungarvan Waste Disposal Site (EPA Licence W0032-03), located approximately 12km to the south of the study area (624356E 594726N).

11.4 Characteristics of the Proposed Project

The proposed project will involve the removal of topsoil, peat, overburden and bedrock (where present) for the construction of turbine foundations, hardstands, met mast, substation, temporary construction compounds, river crossing, cable route and access roads.

Bedrock for construction of these access roads and hardstands will be sourced from the Site borrow pit. It is proposed that the borrow pit will be reinstated using spoil material excavated on-Site. An estimate of excavatability after Pettifer and Fookes (1994) was taken using both rock strength (taken from laboratory testing) and discontinuity spacing. This assessment indicates that the likely excavation method would be "Easy Ripping" using a D5 or D6 sized dozer. Blasting will not be required.

Estimated volumes of overburden (topsoil and spoil) and bedrock to be removed are shown in Table 11-13 and Table 11-14 respectively. Not all the spoil excavated will be sent to the borrow pit, a portion will be used for reinstatement and landscaping works around the Site, as well as being side cast alongside the access roads. Rock excavated from hardstand excavations will be reused within the access tracks and hardstands.

Settlement ponds (within the wind farm Site) where constructed will be volume neutral, i.e. all material excavated will be used to form side bunds and landscaping around the ponds. There will be no excess material from settlement pond construction. The material will also be reinstated during decommissioning where appropriate.

A single HDD is to be advanced beneath the Skeheens Stream. This will result in the displacement of a nominal quantity of Alluvium from beneath the stream bed.

Table 11-13: Estimated excavation volumes

Infrastructue Element (1)	Typical Dimensions	Peat Volume (m3) (2)	Spoil (non-peat) Volume (m3) (2)	Comment
10 no. Turbines and Hardstands	22m diameter excavation footprint for turbine foundation with 7,600m2 hardstand area.	14,364	101,772	Hardstanding area and foundation footprint.
Access Roads (to include Colligan River Crossing Earthworks)	Assumed 5m running surface with 6m wide development footprint.	10,368	16,530	Upgrade of New and Construction of existing roads required.
Temporary Construction Compound	18,000m2 footprint	3,240	3,240	2 no. TCC areas proposed
Substation	9,288m2 footprint	2,325	18,329	

Infrastructue Element (1)	Typical Dimensions	Peat Volume (m3) (2)	Spoil (non-peat) Volume (m3) (2)	Comment
Met Mast and Hardstand	Foundation area of 100m2 with an excavation depth of 1.5m. Hardstand area of 900m2 with an excavation depth of 0.30m.	0	180	Foundation and Hardstanding areas.
Borrow Pit	150m (L) x 100m (W) x 14m (D).	2,970	34,650	Peat and Soil volumes only. See Table 11-14 for rock volumes
	Total =	36,831	174,701	Total = 211,532m3 (peat and spoil volume)

Note (1) A factor of 20% (bulking factor of 15% and contingency factor of 5%) has been applied to the excavated soil volumes to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the Site.

Note (2) It should be noted that the soil volumes given in Table 11-13 are indicative and for information purposes only, and subject to detailed estimates.

Table 11-14: Borrow Pit Rock Volumes

Element (1)	Typical Dimensions	Rock Volume (m3) (2)	Comment
Borrow Pit	150m (L) x 100m (W) x 14m (D).	239,580	Rock depth at approximately 1.9m bgl (taken from BH-03)

Note (1) The location of the infrastructure elements on site are shown on Figure 2.2.

Note (2) A factor of 20% (bulking factor of 15% and contingency factor of 5%) has been applied to the excavated peat and spoil volumes to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the site.

Table 11-15: Anticipated stone volumes necessary for construction

Infrastructure Element	Typical Dimensions	Stone Volume (m^3)	Average Stone Depth (m)
10 no. Turbines	22m diameter excavation footprint for turbine foundation	2,375	3
10 no. Turbine Hardstands	Hardstand area (7,600m^2)	168,911	0.5
Substation	Assumed 9,288m^2 footprint	22,145	Varies

Infrastructure Element	Typical Dimensions	Stone Volume (m^3)	Average Stone Depth (m)
Access Roads, turning bays and earthworks for Colligan River Crossing	Assumed 5m running surface with 6m wide development footprint for the access roads.	33,009	Varies
Temporary Construction Compound	Footprint of 18,000m^2	6,750	0.3
Met Mast Foundation and Hardstand	Hardstanding area of 16m^2	525	1.5m foundation / 0.3m hardstand area
	Total	233,715	Fill to be sourced from the on-site borrow pit.

Note: A contingency factor of 25% stone volumes to allow for a variation in ground conditions across the Site.

11.5 Potential Effects

The potential effects 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 potential impacts are assessed in accordance with the evaluation criteria outlined in Section 11.2. The unmitigated potential impacts are summarised in Table 11-19 and Table 11-20. The proposed mitigation measures are then considered to reduce or eliminate potential impacts.

11.5.1 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 largely unaltered as a result.

11.5.2 Construction Phase

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

11.5.2.1 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, two temporary construction compounds are located to the immediate north of the substation and at the far western extent of the site (Figure 2.2). These will also require removal of vegetation and topsoil prior to construction.

Permanent felling of approximately 5.4 ha of coniferous forestry is required at the main entrance to the wind farm and along the internal access track for approximately 1.2km. 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 within the proposed wind farm site was originally planted as a commercial crop 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 impacts to surface water discharges from felling activities are discussed in Chapter 10 Hydrology and Water Quality of the EIAR.

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 'Medium'. 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.

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, medium-term, direct and will have likely effects.

11.5.2.2 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, borrow pit, internal access roads and permanent met mast.

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

The following earthworks excavations will be required:

- Excavation of Topsoil/thin Blanket Peat deposits;
- Excavation of Glacial Till to bedrock (as required);
- Excavation of bedrock at Turbine and Met Mast bases, On-Site Substation, and at the borrow pit.

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, borrow pit 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 consideration of wind turbine manufacturer specifications, it is expected that wind turbine foundations shall be reinforced concrete gravity foundations with depths of 3m and diameters of approx. 22m. Ideally, a suitable bearing stratum is encountered within 3m from ground surface so that the turbine foundation can be finished at / near existing ground level. The ground investigation findings (Table 11-12) indicate that coarse-grained Till deposits are typically encountered at depths of 3m at the turbine locations. However, where deeper excavations (3-5m) are required to reach a suitable bearing stratum, soil replacement (engineered fill) will be used to bring up the excavation so that the turbine foundation is finished at / near existing ground level.

The proposed borrow pit location has been identified as a source of site won general fill for construction activities. The location was selected as potential sources of general fill (Class 1 material) for the Site using the criteria of shallow bedrock depths, limited Blanket Peat deposits, low landslide susceptibility and proximity to existing access tracks and proposed infrastructure.

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

The proposed borrow pit will have a footprint area of approximately 16,500m^2 and a depth of 6m. This will provide a potential volume of approximately 91,387m^3 of site-won granular fill, which when combined with bedrock excavated at hardstand locations will provide sufficient fill material for the proposed access roads and hardstands. A breakdown of volumes is provided in Section 11.4.

At the borrow pit location approximately 7,613m^3 of overburden material will be required to be stripped to access the underlying deposits. This material will be temporarily stockpiled adjacent to the borrow pit prior to re-use in the reinstatement of the borrow pit. No permanent stockpiles of material will remain after construction.

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.

Surplus Topsoil/Peat and Glacial Till recovered from excavations will be used for the reinstatement of the proposed borrow pit(s) and for reinstatement proposed around turbine bases, hardstands and the temporary construction compound. All associated quantities have been calculated in Section 11.4 and no excavated material will leave the main wind farm Site.

Direct impacts 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 the borrow pit will represent a reduction in the availability of an exhaustible resource.
- 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 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 '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, permanent, direct and will have likely effects.

Direct impacts 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. The aquifer underlying the Site and the majority of the proposed grid connection route is classified by the GSI as having 'High' to 'Extreme' vulnerability with areas of exposed bedrock also present in these areas. 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 if high groundwater is encountered. Groundwater levels recorded during the 2022 ground investigation (Table 11-12) range from 0.80 (T06) and 3.8m (T10) bgl with several exploratory hole locations recorded as being dry on completion. 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 borrow pit, and 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. It is possible however that perched groundwater may exist locally within overburden deposits or weathered bedrock. 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.

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, permanent, direct and will have likely effects.

11.5.2.3 Slope Stability

The Project and proposed infrastructure locations are generally located within areas of 'Low' to 'Moderately High' landslide susceptibility. However, results from the site walkover surveys show no evidence of recent or historic landslides. No failures within the underlying till deposits were recorded. Till underlying proposed turbine locations and associated infrastructure is relatively shallow thereby reducing any significant risk of slope failure.

Given the sporadic and shallow nature (on average 0.15m thick) of blanket peat deposits across the Site, and in accordance with the guidance in the Scottish Executive – Peat Landslide Hazard and Risk Assessments (2017), a peat stability analysis is not warranted.

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. However, due to the very thin deposits of peat throughout the site (as discussed in Section 11.3.11.3), which is more representative of an organic topsoil, the risk of peat slide is considered to be low.

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 'Medium'. The rating of these potential impacts, prior to mitigation, is considered to be of **Moderate 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.

11.5.2.4 Internal Access Roads and Hardstands

There will be approximately 25.43km of new internal access tracks associated with the Site and approximately 2,580m of existing track upgrade. Hardstand areas will be provided at each turbine location.

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 site-won and imported General Fill and Engineering Aggregates.

It is anticipated that the stone required for the construction of the internal access roads, hardstands, temporary construction compound and the substation will be sourced from the on-site borrow pit with material for the finishing layer on the access roads and hardstands 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 are presented in Table 11-15.

Table 11-16: Nearest Supplier of TII Series 600 Stone Products.

Quarry	Approx. Distance from Site (km)	Products	Rock Type
Whitechurch, Cappagh, Co. Waterford (Roadstone Ltd.)	22	Crushed Rock (TII Series 600 and 800 materials)	Waulsortian Limestone (massive unbedded limestone)
Gortnahown Stone Quarry, Mitchelstown, Co. Cork.	64	Crushed Rock (TII Series 600 and 800 materials)	Kiltorcan Formation (Sandstone and Mudstone)

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 '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, 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. The aquifer underlying the proposed wind farm Site and the majority of the proposed grid connection route is classified by the GSI as ranging from 'High' to 'Extreme' with areas of exposed bedrock also present in these areas. 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, permanent, direct and will have likely effects.

11.5.2.5 Internal Cabling and Grid Connection Route (GCR)

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 before being exported to the grid via a high voltage (110kV) buried cable to the existing Dungarvan substation.

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

A similar construction methodology will apply for cable trenches laid within 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.

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 throughout the majority of the proposed grid connection route.
- 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 are not suitable for reuse as backfill or deposition on Site, this material 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 'Medium'. 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.

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, permanent, direct and will have likely effects. The southernmost 2km of the GCR passes through a Regionally Important Aquifer (part of the Dungarvan GWB, which is described as being karstic in nature), increasing the importance to "High". The rating, prior to mitigation, for this small portion of the GCR can then be considered to be of **Moderate/Slight significance**. The Impact Classification remains the same.

11.5.2.6 Horizontal Directional Drilling (HDD)

HDD will be employed at one location (ITM coordinate E 621231, N 608261) to cross a waterbody as described in Chapter 2 of the EIAR. This HDD crossing will be entirely within private lands which comprise agricultural grasslands and will be under the Skeheens Stream.

The operation shall be carried out by an experienced HDD specialist and is expected to take place in a single day.

The process will involve setting up a small, tracked drilling rig on one side of the surface water feature. A shallow starter pit will be excavated at the point of entry and shall be located at a sufficient distance from the stream to achieve a depth of at least 2m below the level of the watercourse.

A pilot hole will be bored as per the agreed alignment and shall be tracked and controlled using a transmitter in the drill head. By tracking the depth, position and pitch of the drill head the operator can accurately steer the line of the drilling operation. Typically, the drilling operation is lubricated using a fluid. When the pilot hole has been drilled to the correct profile, its diameter is increased, if necessary, to match the external diameter if the cable duct. The flexible plastic ducting is then pulled through the pre-drilled hole and sealed at each end until required for cable installation.

Direct impacts to the existing environment associated with the proposed HDD works include:

- Potential for contamination to groundwater from spills/leakages during construction phase earthworks and HDD operations. The use of construction plant and associated refuelling and storage of fuels and hydrocarbons with potential for spills or leaks could result in contamination of the underlying aquifers.
- Potential for overburden collapse at the proposed HDD location during the advancement of the HDD bore.
- Potential for drilling fluids to penetrate into fractured bedrock or superficial deposits – otherwise known as 'frack-out'.

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 'Medium'. The magnitude of these potential impacts, prior to mitigation, is considered to be of **Slight significance.** The Impact Classification is negative, temporary, 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, temporary, direct and will have likely effects.

11.5.2.7 Turbine Delivery Route (TDR)

The proposed turbine delivery route (TDR) will be from Port of Waterford as described in more detail in Chapter 14 (Traffic and Transportation) of this EIAR.

Accommodation works required along the TDR are presented in Table 11-16 .

Table 11-17: Proposed Accommodation Works along the TDR

POI Ref.	Description of Works
POI 02: N29 / R711 Slieverue Roundabout	Load bearing surface through the centre of the roundabout island. Temporary removal of crash barrier and centre island furniture.
POI 03: N29 / N25 Luffany Roundabout	N29 / N25 Luffany Roundabout - Preparation of local load bearing surfaces for vehicle over-run. Temporary removal of all obstruction including crash barrier and street lights.
POI 05: N25 / R680 Carrick Road Roundabout:	Load bearing surface through the centre of the roundabout island.
POI 06: N25 / N72 Junction	Preparation of local load bearing surface through built out green area. Removal of street furniture.
POI 07: R672 / N72 Junction	Preparation of local load bearing surface through cycle lane and ghost island hatched area. Temporary removal of all street furniture along cycle lane to facilitate vehicle overrun and to avoid local monument.
POI 08: N72 / R672 Junction	Preparation of local load bearing surface through cycle lane and pedestrian footway. Temporary removal of all street furniture.
POI 09: R672 Ballymacmague South	Road widening required for turbine blades at right curve. Trailer suspension raise to oversail the verge.
POI 10: R672 Colligan	Will require third party land take. Load bearing surface to be laid.
POI 12: R672 Colligan	Will require third party land take. Load bearing surface to be laid. Hedge, wall section and fence will be removed.
POI 14: R672 North of Garrycline	Will require third party land take. Load bearing surface to be laid. Trees and vegetation will be removed.

POI Ref.	Description of Works
POI 15: West of Colligan	Will require third party land take. Load bearing surface to be laid. Temporary removal of all street furniture. Trailer suspension raise to oversail the verge.
POI 16: Hickeys Cross Road	Will require third party land take. Load bearing surface to be laid. Temporary removal of all street furniture.
POI 17: Bryan's Cross Roads	Will require third party land take. Temporary removal of all street furniture. Verge reprofiling will be required. Trailer suspension raise to oversail bridge parapet.
POI 18: Sweep Crossroads	Will require third party land take on both sides of the road. Trailer suspension raise to oversail stone wall. Utility pole and hedge to be removed.
POI 19: West of Blaentasour	Road widening required to a minimum driveable surface of 4.5m and clearance of 5.5m corridor. Vegetation trimming required.

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

The Magnitude of the impact from these works is considered to be Small Adverse in nature. The importance of the soils and geology receptors (peat, subsoils, bedrock) is considered to be 'Medium'. The magnitude 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.

Following the identification of the potential direct impacts during the construction phase, as outlined above, mitigation measures to reduce the risk to an acceptable level are discussed in Section 11.6.2 of this Chapter.

11.5.3 Operational Phase Effects

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

11.5.3.1 Potential Direct Impacts

Very few potential direct impacts 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 grid transformer in the Proposed Substation and transformers in each proposed wind turbine will be oil cooled. There is potential for spills / leaks of oils/battery fluids from this equipment resulting in contamination of soils and groundwater.

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 '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.

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.

11.5.3.2 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 '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.

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.

11.5.4 Decommissioning Phase Effects

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

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

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

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 '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.

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.

11.5.5 Cumulative Effects

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 and GCR:

- Waterford County Council (WCC);
- Tipperary County Council (TCC);
- An Bord Pleanála (ABP).

Relevant projects, that are likely to have an impact on the Soils, Geology and Hydrogeology, in proximity to the Site, GCR and the enabling TDR works are listed in Table 11-17:

Table 11-18: Potential Cumulative Impact from other Developments

Development (Application No.)	Distance from the Site (km)	Status	Interface
Kilnagrance Wind Farm (Private – 1 no. turbine)	14 (E)	In operation (since 2016)	Groundwater, subsoils and bedrock
Tierney Wind Farm (Private – 1 no. turbine)	5.1 (W)	In operation (since 2015)	Groundwater, subsoils and bedrock
Woodhouse Wind Farm (ESB – 8 no. turbines)	17.2 (SW)	In operation (since 2015)	Groundwater, subsoils and bedrock
Knocknamona Wind Farm (8 no. turbines)	17.5 (SW)	Conditional	Groundwater, subsoils and bedrock
Roberstown Wind Farm Development (10208)	9.44 (SE)	Conditional	Groundwater, subsoils and bedrock
Mothel & Curraghduff 30 MW Solar Farm (19183)	14.7 (NE)	Conditional	Groundwater, subsoils and bedrock
Poulbautia Solar Farm (18598)	11.8 (SW)	Conditional	Groundwater, subsoils and bedrock
Kilcannon 5MW Solar Farm (15614)	12.3 (SW)	Conditional	Groundwater, subsoils and bedrock
Drumroe Solar Farm (16126)	146 (SW)	Conditional	Groundwater, subsoils and bedrock

Development (Application No.)	Distance from the Site (km)	Status	Interface
Clashganny and Coolroe Solar Farm (16548)	19.5 (NE)	Conditional	Groundwater, subsoils and bedrock
Killadangan 5MW Solar Farm (17156)	11.8 (S)	Conditional	Groundwater, subsoils and bedrock
Horsepasture/Doon 11MW Solar Farm (16601136, 211051, 18601037)	17 (N)	Conditional	Groundwater, subsoils and bedrock
Ballyboe 12MW Solar Farm (19600239, 21403)	17.4 (N)	Conditional	Groundwater, subsoils and bedrock
Loughlohery Solar Farm (2253)	19.7 (NW)	Conditional	Groundwater, subsoils and bedrock
Deerpark 3.6MW Solar Farm (17600928)	19.5 (NE)	Conditional	Groundwater, subsoils and bedrock
Monaraha Solar Farm (2260376)	20 NW	Conditional	Groundwater, subsoils and bedrock
Dyrick Hill Wind Farm Development (312434)	8.9 (W)	Strategic Infrastructure Development	Groundwater, subsoils and bedrock
Shandon Road, Dungarvan Residential Development (17579)	14.2 (S)	Conditional	Groundwater, subsoils and bedrock
Glenconnor Residential Development (19601108)	12.4 (N)	Conditional	Groundwater, subsoils and bedrock
Waterford Road, Carrickbeg Residential Development (19601226)	18.1 (NE)	Conditional	Groundwater, subsoils and bedrock

The proposed large-scale developments summarised in Table 11-17 have been considered. If construction 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. For example, Dyrick Hill Wind Farm may use Cappagh Quarry if insufficient site-won material is available. Cappagh Quarry is also a potential source of crushed rock aggregate for the Site.

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 'Medium’. 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.

11.5.6 Summary of Potential Impacts

A summary of unmitigated potential impacts on soils and geology attributes from the Site is provided in Table 11-18 with the potential impacts on hydrogeological attributes provided in Table 11-19.

Table 11-19: Summary of Potential Unmitigated Impact Significance on Soils, Geology and Hydrogeology Attributes

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.	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight
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.	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Slope Failure.	Localised peat deposits/organic soils Glacial Till deposits and bedrock. Site Operatives. Existing Infrastructure and nearby residential areas.	Medium	Moderate Adverse	Moderate

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	Localised peat deposits/organic soils Glacial Till deposits and bedrock. Local quarries.	Medium	Small 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	Localised peat deposits/organic soils Glacial Till deposits and bedrock. Local quarries	Medium	Small 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	Localised peat deposits/organic soils Glacial Till deposits and bedrock. Local quarries. Licenced waste facilities	Medium	Small Adverse	Slight
Horizontal Directional Drilling (HDD) at a water crossing point.	Potential for overburden collapse	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				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.	Localised peat deposits/organic soils Glacial Till deposits and bedrock. Local quarries. Licenced waste facilities	Medium	Small Adverse	Slight
Operational Phase					
Construction traffic for maintenance purposes.	Minor accidental leaks or spills of fuel/oil	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight
Operation of substation	Spills, leaks of oils/battery fluids.	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight
Maintenance of access tracks	Importation of engineering fill from local quarries	Local quarries	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				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.	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight
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)	Medium	Small Adverse	Slight

Table 11-20: 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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Slope Failure.	Locally Important Bedrock Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight

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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight Note 1
Horizontal Directional Drilling (HDD) at a water crossing point.	Potential for ground water pollution from boring activities. Potential for contamination to groundwater from spills/leakages during construction phase drilling operations.	Locally Important Bedrock Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight
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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight

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	Locally Important Bedrock Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Negligible	Imperceptible
Operation of substation	Spills, leaks of oils/battery fluids.	Locally Important Bedrock Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	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 Aquifers. Groundwater Wells and Springs. Surface water bodies.	Medium	Small Adverse	Slight

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation	
				Magnitude	Significance
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 Aquifers. Groundwater Wells and Springs. Surface water bodies.	Medium	Negligible	Imperceptible

Note 1 - The southernmost 2km of the GCR passes through a Regionally Important Aquifer, increasing the importance to "High". The rating, prior to mitigation, for this small portion of the GCR can then be considered to be of ***Moderate/Slight significance***

11.6 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 i which is contained in Appendix 2.1 of Volume III.

11.6.1 Mitigation by Design and Best Practice

With regard to the Project, detailed design and best practice will be implemented as follows:

In order to reduce the impacts on 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 already been undertaken at the preliminary design stage to apply risk avoidance by design which included:

- Peat probing, site walkover surveys and intrusive ground investigation 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 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 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 required on Site to supervise the works.
- A detailed method statement 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 programming of the works such that earthworks are not scheduled during severe weather conditions. Where such weather is forecast, suitable measures will be taken to secure the works.

11.6.2 Construction Phase

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

11.6.2.1 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 potential impacts 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.

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

Site Clearance

As outlined in Section 11.5.2.1 potential impacts 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 Locally Important Aquifer beneath the Site. It should be noted that the amount of vegetation clearance in relation to commercial forestry is small (5.4 ha) and its effect 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 are summarised in Chapter 12 and are also outlined in S 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 will include sediment control in the form of swales, interceptor ditches and settlement ponds. Additional standard construction management will be employed 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 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.

11.6.2.2 Earthworks

The Site will be constructed in a phased manner to reduce the potential impacts 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 works.

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

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

This will include:

- Use of suitable Site won material (crushed rock) as general fill in the construction of access tracks, hardstands and in reinstatement around turbine foundations.
- Surplus overburden will be re-used on Site in the form of landscaping and for reinstatement purposes at the proposed borrow pit.

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

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

All temporary cuts/excavations will be 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.

11.6.2.3 Control of Sediment Laden Runoff

The potential impacts 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.

Specific mitigation measures for the proposed HDD location are summarised in Chapter 12 and include:

- The depth of the bore should be at least 3m below the level of the public road and stream bed so as not to conflict with the road drainage and watercourse;
- Inert, biodegradable drilling fluid will be used;
- There will be no refuelling within 50m of the watercourse.

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

To minimise the impact 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 undertaken 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.

11.6.2.4 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.

11.6.2.5 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. However, it should be noted that the deepest peat deposits adjacent to a turbine attained a depth of 0.35m (located at turbine T06).
- 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.

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.

11.6.2.6 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.

The GSI holds records of groundwater wells in the vicinity of and Public Water Supplies (Dungarvan) within the proposed grid connection route. However, trenches are shallow (1.2 m deep) and will only be open for a short period.

Depending on the ground conditions, presence of services, traffic management required, weather conditions, etc., the rate of installation of cable ducting would vary between 50m and 100m per day. Dewatering is therefore unlikely to be required and no impacts on wells or the Dungarvan PWS is envisaged.

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.

11.6.3 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.

11.6.4 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.

11.6.5 Cumulative

During the construction of the Project there will be the requirement for the importation of engineered fill from source quarries and potential for disposal of materials unsuitable for reuse at licensed facilities. Should these coincide with demand for imported aggregate for maintenance works at the proposed Dyrick Hill Wind Farm Wind Farm (ESB) there would be a cumulative impact in terms of demands placed on local quarries for aggregate.

There is potential for the construction of both the Site and Dyrick Hill Wind Farm to coincide. This may put undue strain on the crushed rock aggregate resources at Cappagh Quarry (Roadstone Ltd.) during the construction phase. As such, it is considered there will be an **Slight** cumulative impact during the construction phase of the development.

No significant, direct negative cumulative effects 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.

11.7 Residual Impacts

It can be observed from Table 11-20 and Table 11-21 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 11-21: Residual Impact Significance for Sensitive Geological Attributes

Activity	Potential Impact	Receptor	Importance	Prior to 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.	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight	Negligible	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.	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Slope Failure.	Localised peat deposits/organic soils Glacial Till deposits and bedrock. Site Operatives. Existing Infrastructure and nearby residential areas.	Medium	Moderate Adverse	Moderate	Negligible	Imperceptible
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	Localised peat deposits/organic soils Glacial Till deposits and bedrock. Local quarries.	Medium	Small Adverse	Slight	Negligible	Imperceptible
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	Localised peat deposits/organic soils Glacial Till deposits and bedrock. Local quarries	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	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	Localised peat deposits/organic soils Glacial Till deposits and bedrock. Local quarries. Licenced waste facilities	Medium	Small Adverse	Slight	Negligible	Imperceptible
Horizontal Directional Drilling (HDD) at a water crossing point.	Potential for overburden collapse	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight	Negligible	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.	Localised peat deposits/organic soils Glacial Till deposits and bedrock. Local quarries. Licenced waste facilities.	Medium	Small Adverse	Slight	Negligible	Imperceptible

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
Operational Phase							
Construction traffic for maintenance purposes.	Minor accidental leaks or spills of fuel/oil	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Operation of substation	Spills, leaks of oils/battery fluids.	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Maintenance of access tracks	Importation of engineering fill from local quarries	Local quarries	Medium	Small Adverse	Slight	Negligible	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.	Localised peat deposits/organic soils Glacial Till deposits and bedrock.	Medium	Small Adverse	Slight	Negligible	Imperceptible
Cumulative Impacts							

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
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)	Medium	Small Adverse	Slight	Small Adverse	Slight

Table 11-22: Residual Impact Significance for Sensitive Hydrogeological Attributes

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
Construction Phase							
Site Clearance	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 Aquifers. 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 Aquifers. 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
Earthworks associated with the construction of the proposed turbines and associated infrastructure.	Slope Failure.	Locally Important Bedrock Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight	Negligible	Imperceptible
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 Aquifers. 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 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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight	Negligible	Imperceptible
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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight [Note 1]	Negligible	Imperceptible
Horizontal Directional Drilling (HDD) at a water crossing point.	Potential for ground water pollution from boring activities. Potential for contamination to groundwater from spills/leakages during construction phase drilling operations.	Locally Important Bedrock Aquifers. 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
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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight	Negligible	Imperceptible
Operational Phase							
Construction traffic for maintenance purposes.	Minor accidental leaks or spills of fuel/oil	Locally Important Bedrock Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Negligible	Imperceptible	Negligible	Imperceptible
Operation of substation	Spills, leaks of oils/battery fluids.	Locally Important Bedrock Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Negligible	Imperceptible	Negligible	Imperceptible
Decommissioning Phase							

Activity	Potential Impact	Receptor	Importance	Prior to Mitigation		Post Mitigation	
				Magnitude	Significance	Magnitude	Significance
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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Small Adverse	Slight	Negligible	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 Aquifers. Groundwater Wells and Springs. Surface water bodies	Medium	Negligible	Imperceptible	Negligible	Imperceptible

Note 1 - The southernmost 2km of the GCR passes through a Regionally Important Aquifer, increasing the importance to "High". The rating, prior to mitigation, for this small portion of the GCR can then be considered to be of **Moderate/Slight significance**.

11.8 Conclusions

A study has been undertaken which has identified the principal impacts of the construction of the proposed project in relation to the Soils, Geology and Hydrogeology.

The assessment of Soils, Geology and Hydrogeology has established a baseline for the receiving environment for the impact assessment. Potential impacts were considered for the construction, operational and decommissioning phases of the Project as well as potential residual and cumulative impacts. Mitigation measures have been proposed where relevant.

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

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

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. Only thin, superficial deposits of peat/ organic soils were encountered.

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

With mitigation measures, outlined in Section 11.6, put in place during construction, operational and decommissioning stage the Project will have an imperceptible impact on the soils, geology and hydrogeology.

11.9 References

i. Sleeman, Andy & McConnell, Brien. (1995). *Geology of East Cork – Waterford. A Geological Description of East Cork, Waterford and Adjoining Parts of Tipperary and Limerick to Accompany the Bedrock Geology 1:100,000 Scale Map Series, Sheet 22,* Geology of East Cork – Waterford. 1995.

ii. GSI. *County Waterford Groundwater Protection Scheme Report* https://secure.dccae.gov.ie/GSI_DOWNLOAD/Groundwater/Reports/GWPS/WD_GWPS_MainReport_Aug1998.pdf

iii. Waterford County Council. *Waterford City and County Devleopment Plant 2022-2028.* *https://www.waterfordcouncil.ie/media/plans_strategies/development-plan/index.htm*

iv. OSI. Online Historic Maps. *Ordnance Survey of Ireland* OSI. http://map.geohive.ie/.

v. Waterford County Council. *Renewable Energy Strategy for Waterford City & County . 2016-2030.* https://www.waterfordcouncil.ie/media/plans-strategies/renewable-energy-strategy/RenewableEnergyStrategy2016-2030.pdf

vi. FloodInfo. Flood Risk Data – Interactive Map Viewer. https://www.floodinfo.ie/map/floodmaps/#

vii. NPWS. NPWS Map Viewer. http://webgis.npws.ie/npwsviewer/

viii. GSI. Online Data Viewer. Geological Survey of Ireland. https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228

ix. EPA. Online Database Viewer. Environmental Protection Agency Ireland. https://gis.epa.ie/EPAMaps/

x. EU. European Union. Digital Elevation Model over Europe. https://data.europa.eu/euodp/en/data/dataset/data_eu-dem

FEHILY TIMONEY

**CONSULTANTS IN ENGINEERING,
ENVIRONMENTAL SCIENCE
& PLANNING**

www.fehilytimoney.ie

Cork Dublin Carlow

HEALTH & SAFETY I.S. ISO 45001:2018 NSAI Certified
QUALITY ISO 9001:2015 NSAI Certified
ENVIRONMENT ISO 14001:2015 NSAI Certified