8.0 LAND, SOILS AND GEOLOGY

8.1 INTRODUCTION

This chapter of the EIAR assesses the effects of the proposed Cloghercor Wind Farm project as described in Chapter 2 (Description of the Proposed Project) on the Land, Soils and Geology environment. Information on the existing soil and geological environment is presented as a baseline for the site. The potential effects of the development of the proposed wind farm and associated infrastructure are discussed along with recommended mitigation measures for each potential effect. Any residual and cumulative effects are also assessed.

8.1.1 Statement of Authority

TOBIN Consulting Engineers (TOBIN) have completed this chapter. TOBIN Hydrologists and Hydrogeologists are intimately familiar with the site characteristics for the Cloghercor Wind Farm, having worked on other wind farms including Lisheen, Bruckana and Derryadd set in various ground conditions and water environments. This chapter has been completed by John Dillon and Laura McGrath of TOBIN Consulting Engineers.

John Dillon (BSc., MSc., DIC, MCIWM, PGeo) is a hydrogeologist with 18 years' geological/hydrogeological experience in groundwater development, windfarm and major infrastructure developments. John has authored numerous Land, Soils and Geology chapters for EIARs for a range of projects.

Laura McGrath (BSc., MSc., PGeo) is a hydrogeologist with six years hydrogeological experience in groundwater resources, contaminated land, ground investigation and various infrastructure developments including wind farms. Laura has authored a number of Hydrology, Hydrogeology and Water Quality chapters for EIARs for various projects.

8.2 ASSESSMENT METHODOLOGY

The methodology used to produce this chapter included a review of relevant legislation and guidance, a desktop study, a site walkover, an initial intrusive investigation, an evaluation of potential effects, an evaluation of the significance of the effects, and an identification of measures to prevent and mitigate the effects.

8.2.1 Guidance and Legislative Review

This chapter has been prepared having regard to the following policy documents and legislation:

- S.I. 134 of 2013 and the Minerals Development Act 2017), the Planning and Development Act, and S.I. 600 of 2001 Planning and Development Regulations and as amended Amendments. These instruments implement EU Directive 2011/92/EU, on the assessment of the effects of certain public and private projects on the environment;
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment,
- S.I. No. 296 of 2018: European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018 which transposes the provisions of Directive 2014/52/EU into Irish law;
- S.I. No. 293 of 1988: European Communities (Quality of Salmonid Waters) Regulations;

- S.I. No. 272 of 2009: European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended by S.I. No. 296/2009; S.I. No. 386/2015; S.I. No. 327/2012; and S.I. No. 77/2019 and giving effect to Directive 2008/105/EC on environmental quality standards in the field of water policy and Directive 2000/60/EC establishing a framework for Community action in the field of water policy) and S.I. No. 722 of 2003 European Communities (Water Policy) Regulations which implement EU Water Framework Directive (2000/60/EC) establishing a framework for the Community action in the field of water policy and provide for implementation of 'daughter' Groundwater Directive (2006/118/EC) on the protection of groundwater against pollution and deterioration. Since 2000 water management in the EU has been directed by the Water Framework Directive (2000/60/EC) (as amended by Decision No. 2455/2011/EC; Directive 2008/32/EC; Directive 2008/105/EC; Directive 2009/31/EC; Directive 2013/39/EU; Council Directive 2013/64/EU; and Commission Directive 2014/101/EU (WFD). The WFD was given legal effect in Ireland by the European Communities (Water Policy) Regulations 2003 (S.I. No. 722 of 2003);
- S.I. No. 684 of 2007: Waste Water Discharge (Authorisation) Regulations 2017, resulting from EU Directive 80/68/EEC on the protection of groundwater against pollution caused by certain dangerous substances (the Groundwater Directive);S.I. No. 106 of 2007: European Communities (Drinking Water) Regulations 2007and S.I. No. 122 of 2014: European Communities (Drinking Water) Regulations 2014, arising from EU Directive 98/83/EC on the quality of water intended for human consumption (the Drinking Water Directive) and EU Directive 2000/60/EC;
- S.I. No. 9 of 2010: European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended by S.I. No. 389/2011; S.I. No. 149/2012; S.I. No. 366/2016; the Radiological Protection (Miscellaneous Provisions) Act 2014; and S.I. No. 366/2016); and,
- S.I. No. 296 of 2009: The European Communities Environmental Objectives (Freshwater Pearl Mussel) Regulations 2009 (as amended by S.I. No. 355 of 2018).

The assessment as described below was carried out in accordance with the following guidance and tailored accordingly based on professional judgement and expertise:

- Guidelines on the Information to be contained in Environmental Impact Assessment Reports (Environmental Protection Agency, 2022);
- Environmental Impact Assessment of National Road Schemes – A Practical Guide (National Roads Authority (NRA) 2008a);
- Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2008b);
- Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements (IGI 2013);
- Good practice guidelines on the control of water pollution from construction sites (Construction Industry Research and Information Association (CIRIA), 2001);
- Guidelines for Planning Authorities on 'The Planning System and Flood Risk; Management' published in November 2009, jointly by the Office of Public Works (OPW) and the then Department of Environment, Heritage and Local Government (DEHLG);
- Guideline on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes (NRA 2008c); and
- Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments, Natural Scotland Scottish Executive, 2nd Ed, 2017.

8.2.2 Desk Review

A desk study was undertaken in order to collate and review background information of the proposed project during the assessment. The information sources consulted are listed below:

- National Peatland Strategy (NPWS, 2015);
- Hydrological features (drains, silt ponds, outfalls) provided by Bord na Móna;
- Geological Survey of Ireland (GSI) online mapping;
- Environmental Protection Agency database (www.epa.ie);
- Teagasc SIS Map Viewer (www.gis.teagasc.ie/soils/map.php);
- Met Éireann Meteorological Databases (www.met.ie);
- National Parks and Wildlife Services Public Map Viewer (www.npws.ie);
- Water Framework Directives Catchments Map Viewer (www.catchments.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet No. 7; Geological Survey of Ireland;
- Geological Survey of Ireland – Groundwater Body Characterisation Reports;
- OPW Indicative Flood Maps (www.floodmaps.ie);
- Environmental protection Agency - HydroTool Map Viewer (www.watermaps.wfdireland.ie/HydroTool);
- CFRAM Preliminary Flood Risk Assessment (PFRA) maps (www.floodinfo.ie); and
- Department of Environment, Community and Local Government on-line mapping viewer (www.myplan.ie).

8.2.3 Field Surveys

Site surveys relating to the soil and geological environment and ground investigations were undertaken from November 2021 to November 2022. These included:

- A site walkover to review the ground conditions and assess the topography, geomorphology and requirements for further investigations carried out in November 2021 to September 2022;
- 21 No. trial pits at proposed turbine locations, potential substation locations, along access tracks and potential construction compounds;
- 600 Peat Probes;
- 35 No. Hand Shear Vane Tests;
- 2 No. rotary core boreholes
- Geotechnical testing including PSDs, Atterberg Limits, Moisture and Compact Tests;
- Logging of the soil layers and sampling of each stratum encountered; and
- Laboratory analyses of the samples collected during the above investigations.

Table 8-1 presents a breakdown of the site investigations works that were carried out as part of each site investigation.

Table 8-1: Summary of Site Investigation Works

Site Investigation No.	Date	Types of investigation carried out
TOBIN Consulting Engineers	November 2021, June 2022, August 2022, October 2022,	Site walkover and Peat probing
Ground Investigations Ireland	November 2021, June 2022 and October 2022	36 no. Trial Pits, 16 no. Russian Samples, 2 no. Rotary Core Boreholes and the Installation of 2 no. Groundwater Monitoring Wells

Ciaran Reilly	November 2021 and October 2022	Peat Stability Risk Assessment

8.2.4 Consultation

The EIAR Scoping and consultation activities were carried out in accordance with all relevant guidance documents as set out in Section 1.8. The purpose of scoping for the EIAR is to provide a framework for the approach to be taken by the individual specialists in carrying out their evaluations, identifying environmental aspects for which potential significant environmental impacts may arise. It also provides a framework for the consultation process and sets out the intended structure of the Final EIAR.

Responses were received from GSI, DAU, IFI and Irish Water. The most relevant consultation was with GSI and identified the requirement for the assessment of peat, geohazards and geological heritage sites. Their content is further summarised in Chapter 1.

8.2.5 Impact Assessment Methodology

The stepped approach to impact assessment proposed in the IGI guidelines (2013) and EPA (2022) is adopted for the evaluation of potential effects on the receiving environment. The baseline environment is assessed by characterising the site topographical, geological and geomorphologic regimes from the data acquired. Following on from the identification of the baseline environment, the available data is utilised to identify and categorise potential effects on the soils and geological environment as a result of the proposed project. These assessments are undertaken by:

- Undertaking materials calculations in terms of volumetric soil and subsoil excavation and reuse associated with development design;
- Assessing ground stability risks, in particular to peat stability;
- Assessing the combined data acquired and evaluating any likely effects on the soils, geology and ground stability; and
- Identifying effects and considering measures that would mitigate or reduce the identified effect.

The importance/sensitivity of the geological, hydrogeological and hydrological receptors was assessed on completion of the desk study and baseline assessment. Using the NRA Guidance presented in Appendix C of the IGI guidelines (2013), an estimation of the importance of the geological environments is set out in Table 8-2.

Table 8-2: Estimation of the Importance of Geological Attributes

Importance	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 route is significant on a national or regional scale.	• Geological feature rare 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	• Contaminated soil on site with previous heavy industrial usage. • Large recent landfill site for mixed wastes. • Geologically feature of high value on a local scale (County Geological Site).

Importance	Criteria	Typical Example
	underlying site is significant on a local scale.	• Well drained and / or high fertility soils. • Moderately sized existing quarry or pit. • Marginally economic extractable mineral resource
Medium	Attribute has a medium quality, significance or value on a local scale. Degree or extent of soil contamination is moderate on a local scale. Volume of peat and / or soft organic soil underlying 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 site is small on a local scale.	• Large historical and / or recent site for construction and demolition wastes. • Small historical and / or recent site for construction and demolition wastes. • Poorly drained and / or low fertility soils. • Uneconomically extractable mineral resource.

8.2.5.1 Overview of Impact Assessment Process

In this chapter, the potential effects on the geological environment resulting from the proposed project are evaluated and mitigation measures are proposed to reduce any significant effects. Based on the mitigation measures proposed, the significance of the residual effects on the geological environment is determined.

The significance of effects of the proposed project has been assessed in accordance with the EPA guidance document Guidelines on the Information to be contained in Environmental Impact Assessment Reports (May 2022). The magnitude of any effects takes into account the likely scale of the predicted change to the baseline conditions, resulting from the predicted effect and considers the duration of the effect i.e. temporary or permanent. Definitions of the magnitude of any effects are provided in Table 8-3.

Table 8-3: Definitions of the Magnitude of Effects (Adapted from EPA (2022) guidance and Box 5.1 from the NRAs Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes)

Magnitude	Criteria	Typical Example
Significant 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.

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

Potential effects may have a negative, neutral or positive effect on the geological environment.

Terms relating to the duration of effects are described in the EPA's Guidelines on the information to be included in Environmental Impact Assessment Reports (2022) as:

- Momentary Effects – Effects lasting from seconds to minutes;
- Brief Effects – Effects lasting less than a day;
- Temporary Effects – Effects lasting one year or less;
- Short term Effects – Effects lasting one to seven years;
- Medium term Effects – Effects lasting seven to fifteen years;
- Long term Effects – Effects lasting fifteen to sixty years;
- Permanent Effects – Effects lasting over sixty years; and
- Reversible Effects – Effects than can be undone, for example through remediation or restoration.

The likelihood of effects is necessary to know in order to identify a list of effects which are considered likely or unlikely. According to the EPA's guidelines (2022), likely effects are those *"that can reasonably be expected to occur because of the planned project if all mitigation measures are properly implemented"*. Conversely, unlikely effects are those *"that can reasonably be expected not to occur because of the planned project if all mitigation measures are properly implemented"*

Figure 8-1 below shows how comparison of the character of the predicted effect to the sensitivity of the receiving environment can determine the significance of the effect.

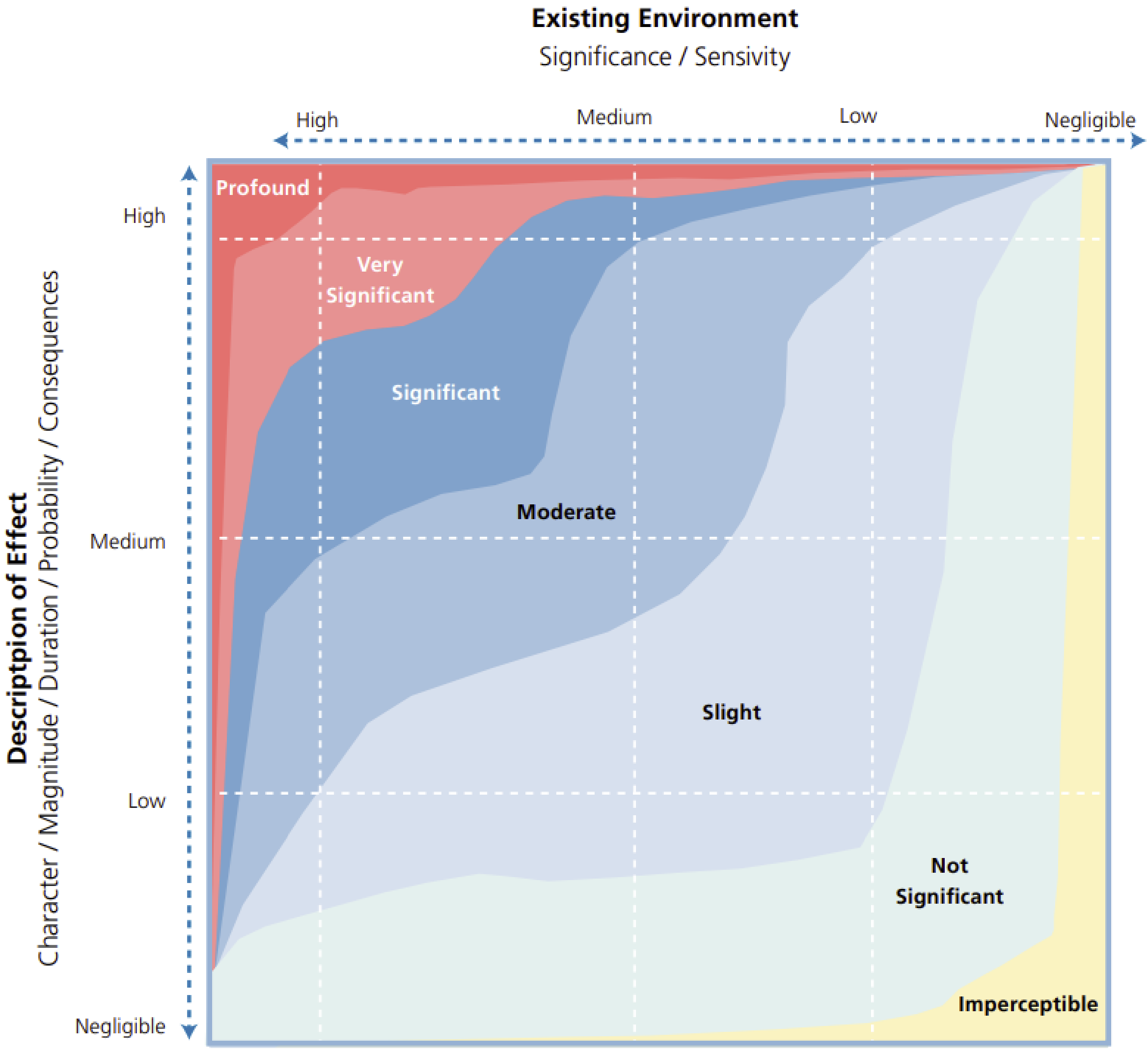


Figure 8-1: Significance of Effects Matric for EIARs (EPA, 2022)

In order for a potential effect to be realised, three factors must be present. There must be a source of a potential effect, a receptor which can be affected and a pathway or connection which allows the source to affect the receptor. Only when all three factors are present can an effect be realised.

8.3 RECEIVING ENVIRONMENT

The receiving environment is discussed in terms of landscape and topography (geomorphology), superficial and solid geology as well as peat stability.

8.3.1 Study Area

The regional review of geological conditions covers a zone of minimum 2km from the site boundary as suggested in the Institute of Geologists of Ireland (IGI) guidelines. This recommended minimum distance of 2km has been reviewed in the context of the geological/hydrogeological environment as well as the scale of peat extraction activities and increased to reflect the sensitivity of the subsurface, for example where karst systems are present, to a maximum distance of 2km from the site boundary.

8.3.2 Desk Review and Field Surveys

The soil and geology of the proposed Cloghercor Wind Farm site and the surrounding area was investigated through comprehensive desk studies and field inspections. A walkover survey of the site was carried out in order to identify geological features e.g., soil types and bedrock outcrops. Following the field surveys, the results were reviewed using GIS software in conjunction with publicly available hydrological and hydrogeological data from the Geological Survey of Ireland (GSI), Environmental Protection Agency (EPA) and Office of Public Works (OPW).

8.3.3 Site Description

The proposed site, located in Cloghercor townland, is 3.5km south of the Glenties, Co. Donegal. Figure 1-1 shows the site location with respect to the nearby towns and roads. The proposed project will comprise a wind farm consisting of 19 wind turbines on concrete foundations, with an overall blade tip height of between 185m to 200m, within an overall proposed project area (including biodiversity enhancement lands) of 2198 ha.

Internal access tracks are to be constructed to provide access to necessary locations within the site e.g., wind turbines and substation. There will be four borrow pits located on the site. The peat and soil removed from the area during the construction phase of the wind farm will be used to reinstate the borrow pits.

8.3.4 *Geological Environment*

Site Topography and Geomorphology

The site itself stretches from the Gweebarra River which runs along the western wind farm site boundary toward the mountainous area in the north, east and south of the site. The area is relatively hilly and slope angles can become quite steep. Cloghercor is located to the north-northeast of Glenties and the landscape is dominated by Croghleheen Mountain along the northwestern wind farm site boundary; Garfarretmoyle (also known as Cloghercor South) and Gaffaretcor Mountains and Derkbeg Hill along the southeastern wind farm site boundary; Cleengort Hill along the southwestern red line boundary.

The height and slope details for the mountains are as follows:

- Croghleheen Mountain has a peak of 385m AOD (above ordinance datum) which is located approximately 135m east of the site border and an approximate slope of 0.25m/m;
- Garfarretmoyle Mountain (Cloghercor South) has a peak of 301m AOD and an approximate slope of 0.25m/m;
- Gaffaretcor Mountain has a peak of 292m AOD which is located approximately 55m south of the site border and an approximate slope of 0.5m/m;
- Derkbeg Hill has a peak of 332m AOD which is located approximately 50m southeast of the site border and an approximate slope of 0.25m/m; and
- Cleengort Hill has a peak of 236m AOD which is located approximately 235m northwest of the site border and an approximate slope of 0.15m/m.

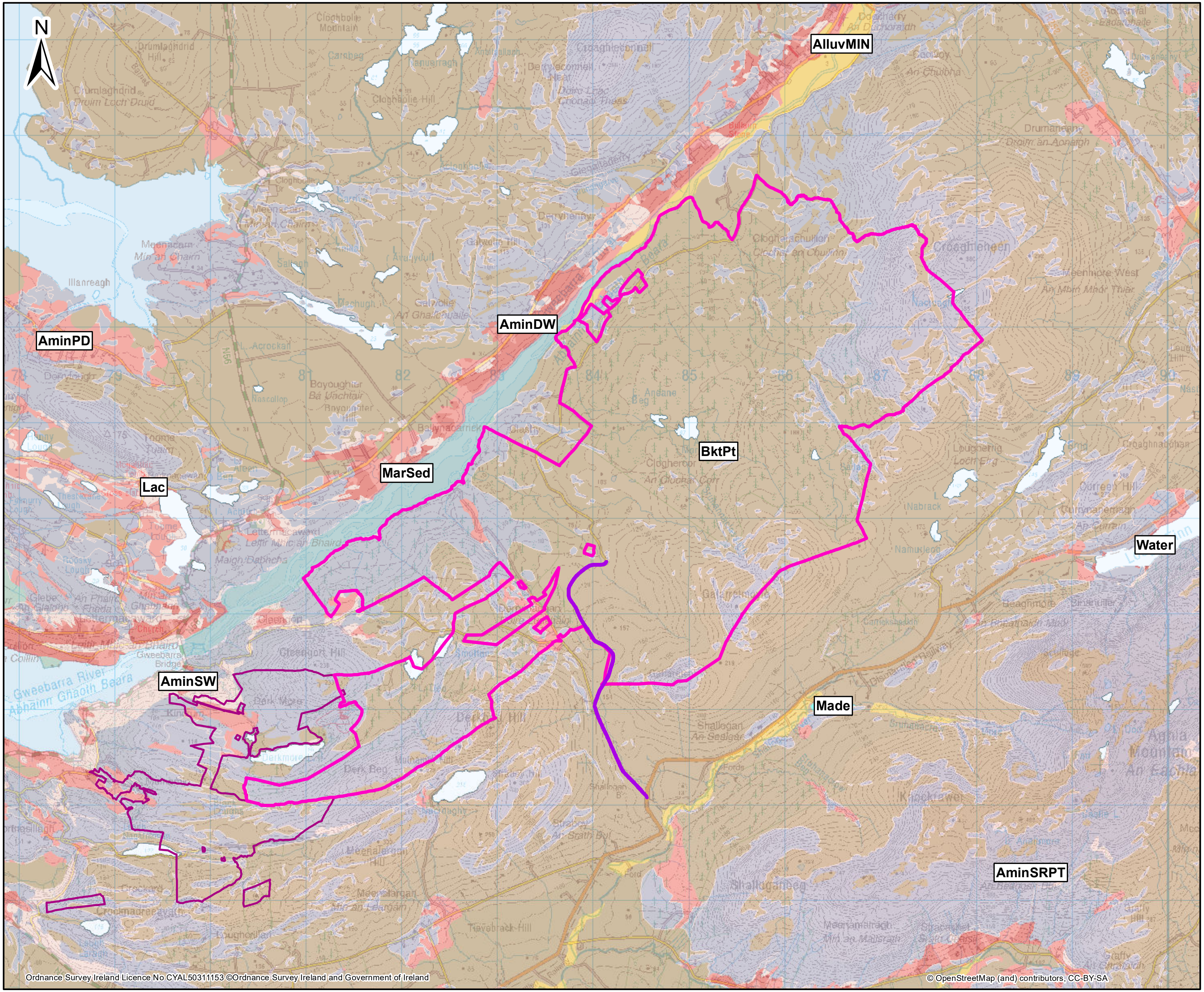
The site slopes upward from the Gweebarra River to the various mountain peaks along the northern, eastern and southern boundaries and ranges from 0m at the river to a maximum topographic high of 365m in the northeast of the site.

Land and Land-Use

A review of the Corine land use maps (EPA Maps, 2022), indicates that the land use within the site boundary is predominantly classified as “Coniferous forests” with areas alongside the northern, eastern and southern site boundaries and one area along the river classified as “Peat bogs” and areas along the river classified as “Transitional woodland scrub”. Aerial photography shows the land within the site boundary consisting of rugged grass and forest area with numerous rock outcrops.

Soils

Information on soils in the region was gathered from the Teagasc soils map. Cloghercor is dominated by shallow blanket peat and bedrock at surface with sporadic areas of granite till in the southern area of the site. Peat is an organic soil derived by the accumulation of partially decomposed plant matter in favourable locations, since the end of the last ice age. Peaty soils and peats cover the majority of the area of the proposed Cloghercor Wind Farm site. The soils present at Cloghercor and how they are distributed across the site is shown in Figure 8-2.



Legend *

- Proposed Wind Farm Site Boundary
- Turbine Delivery Route works
- Biodiversity Enhancement lands

Soils

- AlluvMIN - Mineral alluvium
- AminDW - Acid Brown Earths / Brown Podzolics
- AminPD - Surface water Gleys / Ground water Gleys Acidic
- AminSRPT - Podzols Peaty
- AminSW - Lithosols / Regosols
- BktPt - Blanket peat
- Lac
- Made
- MarSed
- Water

* all land identified is within Boundary of the Proposed Project

0 0.5 1 1.5 2
Kilometres

NOTES
1. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING
2. ALL DRAWINGS TO BE CHECKED BY THE CONTRACTOR ON SITE
3. ENGINEER TO BE INFORMED OF ANY DISCREPANCIES BEFORE ANY WORK COMMENCES
4. ALL LEVELS RELATE TO ORDNANCE SURVEY DATUM AT MALIN HEAD

A	08/03/2023	Final issue	S.P	J.D
Issue	Date	Description	By	Chkd.

Client:
Cloghercor Wind Farm ltd.

Project:
Cloghercor Wind Farm

Title:
Figure 8-2:
Soils Map

Scale @ A4: 1:50,000

Prepared by: S.Pezzetta
Checked: J.Dillon
Date: March 2023

Project Director: O.Fitzpatrick

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Draft: A

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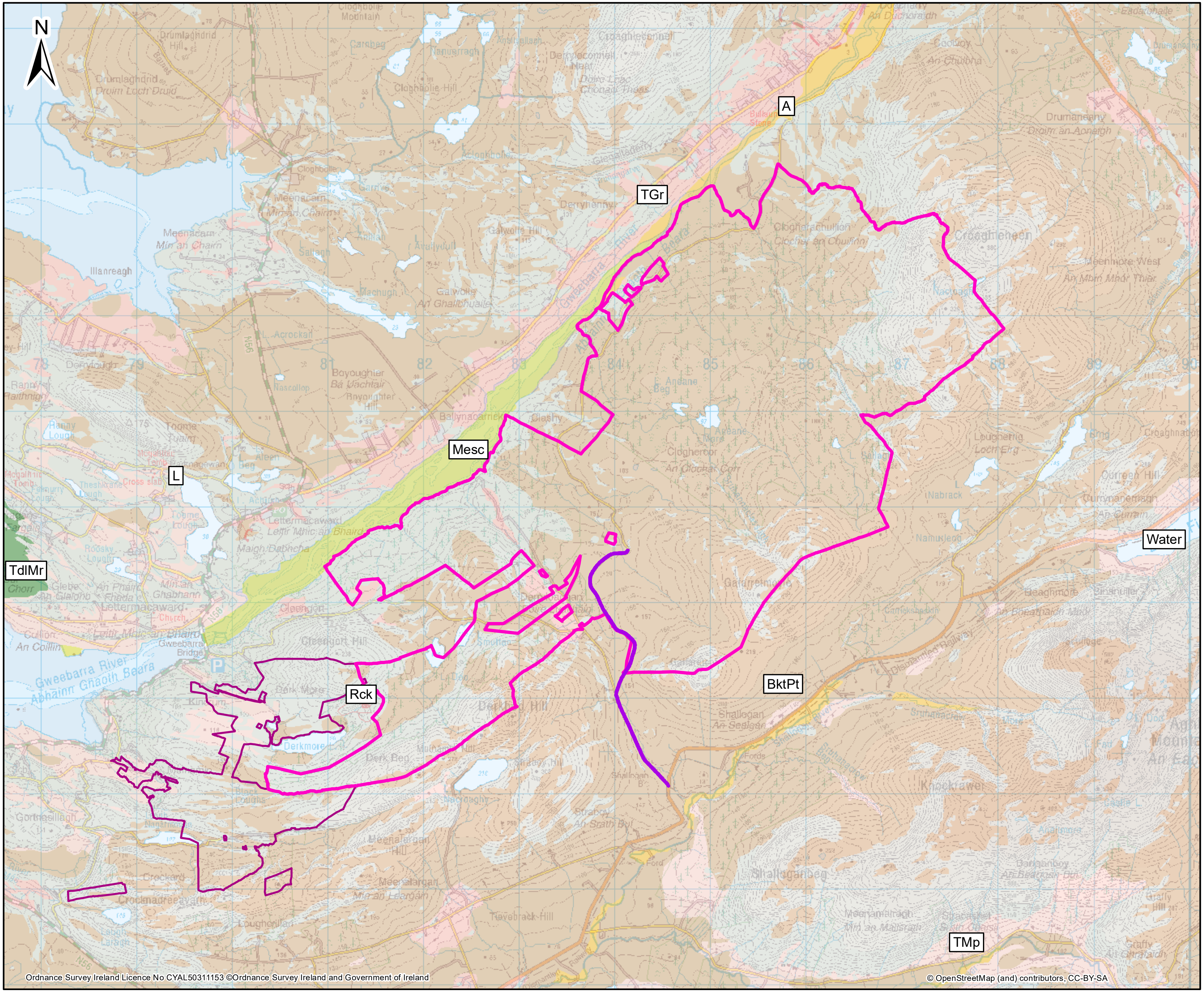
Subsoils and Quaternary Sediments

Information on subsoils and Quaternary sediments in the region was gathered from the GSI and EPA Map Viewers. The following subsoils and Quaternary sediments are present within the site boundary (Figure 8-3):

- Blanket Peat (BktPt);
- Bedrock Outcrop or subcrop (Rck);
- Till derived from granites (TGr) and
- Alluvium (A).

As mentioned in the above soils section the majority of the site is underlain by blanket peat bog. The till derived from granite is found in the south west of the site and alluvium is found along the banks of the Gweebarra River. It is noted that estuarine silts and clays are mapped along the Gweebarra River but not within the site boundary.

Typically, the site is underlain by subsoils with low permeability which correspond to 'WET' drainage patterns. Areas where the rock is at or near the ground surface are areas where there is little to no subsoil present and result in extreme groundwater vulnerability (discussed in Chapter 9 – Hydrology and Hydrogeology).



Legend *

- Proposed Wind Farm Site Boundary
- Turbine Delivery Route works
- Biodiversity Enhancement lands

Subsoils

- A, Alluvium
- BktPt, Blanket Peat
- L, Lacustrine sediments
- Mesc, Esturine silts and clays
- Rck, Bedrock outcrop or subcrop
- TGr, Till derived from granites
- TMp, Till derived from Metamorphic rocks
- TdlMr, Tidal Marsh
- Water

* all land identified is within Boundary of the Proposed Project

0 0.5 1 1.5 2
Kilometres

NOTES
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Issue	Date	Description	By	Chkd.
A	08/03/2023	Final issue	S.P	J.D

Client: Cloghercor Wind Farm ltd.

Project: Cloghercor Wind Farm

Title: Figure 8-3: Subsoils Map

Scale @ A4: 1:50,000

Prepared by: S.Pezzetta | Checked: J.Dillon | Date: March 2023

Project Director: O.Fitzpatrick

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8.3.5 Ground Investigation

A ground investigation (GI) of the project area was carried out in November 2021 and October 2022. All works were completed using Ground Investigation Ireland (GII) plant and logging was completed by GII engineering geologist. The following scope was completed as a part of the GI, as summarised in Table 8-4:

- 36 No. trial pits were carried out at each proposed turbine location, grid connection, substations and at the identified borrow pit locations;
- 2 No. Rotary core boreholes completed to a maximum depth of 10 mbgl at 2 No. Borrow Pits;
- 1 No. groundwater monitoring wells were installed;
- Geotechnical laboratory testing.
- A total of over 450 no. peat probes were undertaken by TOBIN, CRA and GII within the proposed wind farm footprint area (summary peat depth maps are shown as Figure 8-2 and Figure 8-3).
- Peat depths recorded within the proposed infrastructure envelope ranged from 0 to 4.0m with an average of 1.2m. Peat depths recorded at the turbine locations varied from 0.25 to 2.7m with an average depth of 1.1m.
- With respect to the existing and proposed access roads, peat depths are typically less than 3m with localised depths of up to 4m. Approximately 4km of existing access roads are present across the site and based on records have been in operation for a number of years. The GI indicated that the site is generally covered by peat, overlying slightly clayey sandy Gravels which overlie granitic bedrock. In a number of areas peat lies directly onto the undulating bedrock surface. Locations of the SI are shown within the ground investigation report, presented in Appendix 8-1.

Table 8-4: Turbine Summary

TURBINES	Peat Depth	Slope (degrees)	Underlying soils and Bedrock
Turbine 1	0.9	1.7	Granite Bedrock
Turbine 2	0.5	9.6	Granite Bedrock
Turbine 3	1.1 to 1.4	7.4	Gravelly till over Granite Bedrock
Turbine 4	1.4	1.9	Gravelly till over Granite Bedrock
Turbine 5	0.87	8.6	Gravelly till over Granite Bedrock
Turbine 6	1.7 to 2.6	1.9	Granite Bedrock
Turbine 7	1.1 to 1.3	3.4	Granite Bedrock
Turbine 8	0.48	7.1	Granite Bedrock
Turbine 9	0.97 to 1.1	4.0	Granite Bedrock
Turbine 10	0.6	2.5	Granite Bedrock
Turbine 11	1.73	2.5	Granite Bedrock
Turbine 12	0.97 to 2.73	3.8	Granite Bedrock
Turbine 13	0.8 to 1.1	1.1	Granite Bedrock
Turbine 14	0.25 to 1.4	2.4	Granite Bedrock
Turbine 15	0.51 to 0.88	7.4	Granite Bedrock
Turbine 16	0.77 to 1.64	1.1	Granite Bedrock

Turbine 17	0.85 to 1.83	2.7	Granite Bedrock
Turbine 18	0.9 to 2	0.8	Granite Bedrock
Turbine 19	0.9 to 1.14	6.7	Granite Bedrock
Borrow Pit A	0.5 to 0.8	3	Gravelly till over Granite Bedrock
Borrow Pit B	0.5 to 0.9	6	Gravelly till over Granite Bedrock
Borrow Pit C	0.7 to 0.9m	2	Granite Bedrock
Borrow Pit D	0.2 to 0.9m	4	Granite Bedrock

8.3.6 Laboratory Test Results

During the ground investigation, samples were taken for laboratory testing at each trial pit and borehole location. The tests carried out included:

- Moisture content
- Atterberg limits
- Particle size distribution by wet sieving
- Particle size distribution by hydrometer
- Organic Matter

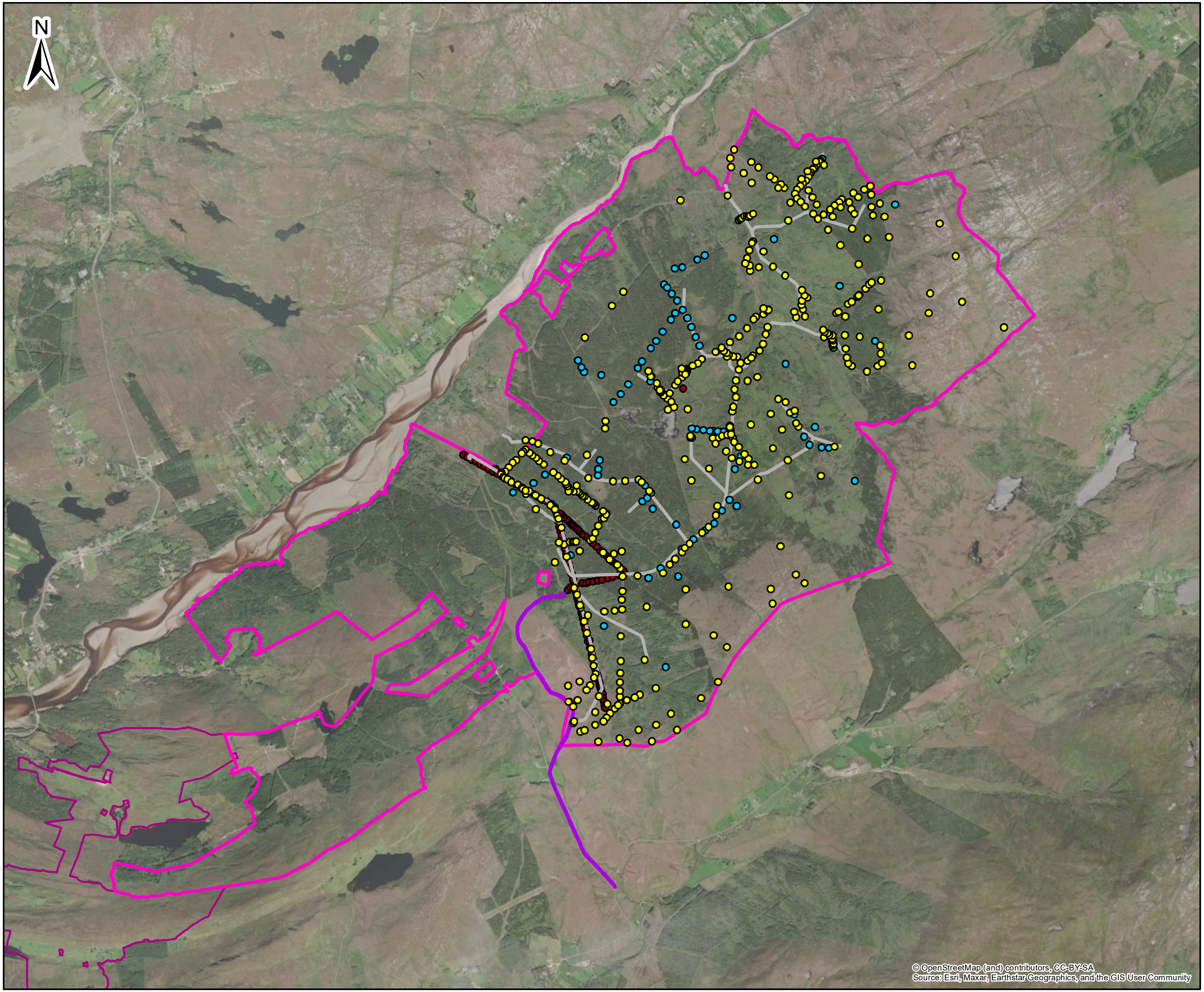
Results are included in Appendix 8-1.

8.3.7 Mineral / Aggregate Resources

There are no active quarries on the site. The GSI data indicate that a crushed rock aggregate potential location is present within the site area and classified with a moderate crushed rock aggregate potential.

A historical (currently inactive) quarry lies approximately 1.8km to the north-east of the northern site boundary. No active mineral or aggregate sources have been identified by GSI data within 2km of the site boundary.

The GSI online Aggregate Potential Mapping Database shows that the proposed project site is located within an area mapped as being typically Moderate in terms of crushed rock aggregate potential. The underlying gravel subsoil has a moderate aggregate potential and could be utilised for subbase material.



Legend *

- Proposed Wind Farm Site Boundary
- Turbine Delivery Route works
- Biodiversity Enhancement lands
- June 22 data
- Sept 22 data
- TLI Probes
- Internal Roads

* all land identified is within Boundary of the Proposed Project

0 0.25 0.5 0.75 1
Kilometres

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A	08/03/2023	Final issue	S.P	J.D
Issue	Date	Description	By	Chkd.

Client:
Cloghercor Wind Farm ltd.

Project:
Cloghercor Wind Farm

Title:
Figure 8-4
GII -
Site Investigation locations

Scale @ A4: 1:40,000

Prepared by: S.Pezzetta
Checked: J.Dillon
Date: March 2023

Project Director: O.Fitzpatrick

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Bedrock Geology

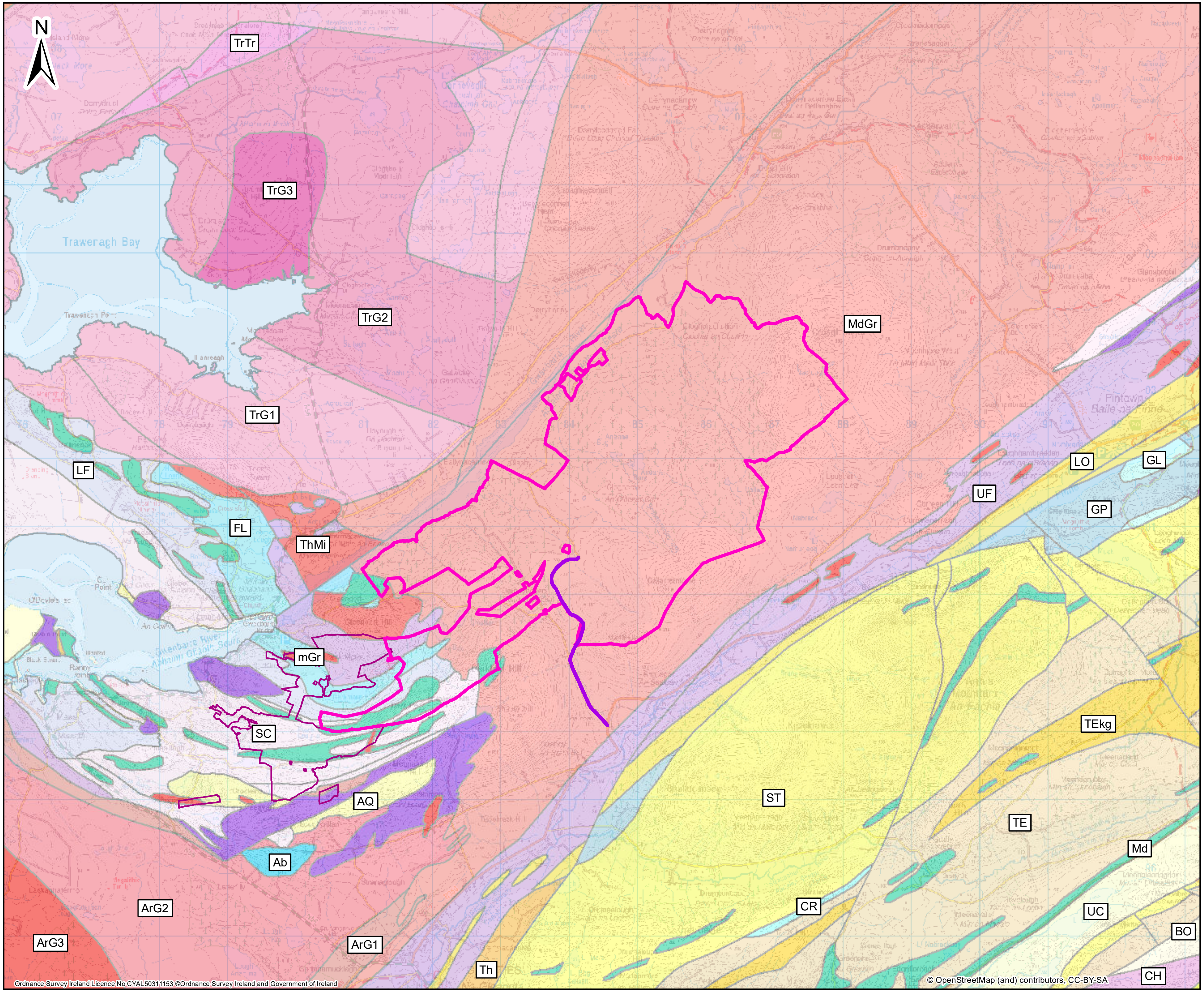
Information on the bedrock geology was obtained from the Geology of Donegal, Sheet No. 3 (1:100,000), that is now available in the Geological Survey of Ireland (GSI) Web Viewer. The bedrock geology underlying the proposed wind farm site is shown in Figure 8-5 below.

The Main Donegal Granite Formation which consists of coarse biotite granite and granodiorite is the dominant bedrock within the site boundary and is present in the western, eastern, centre and northern areas of the site.

A fault running in a general southwest to northeast direction is located along the length of the Gweebarra River adjacent to the western site boundary. Tertiary dolerite dykes are present in the northeast, northwest and southwest areas of the site and are orientated in a northwest to southeast direction across the site. Bedrock outcrops are present throughout the site.

There is a variety of bedrock formations underlying the south-western area of the Cloghercor site and includes:

- Metadolerite;
- The Sessiagh-Clonmass Formation which consists of quartzite, dolomitic marble and schist;
- The Lower Falcarragh Pelite Formation which consists of grey carboniferous pelitic schist;
- The Falcarragh Limestone Formation which consists of blue-grey banded marble with pelite partings;
- The Upper Falcarragh Pelite Formation which consists of pelitic, semi-pelitic, psammitic schist; and
- The Thorr Granite migmatitic facies which consist of migmatitic granite.



Legend *

- Proposed Wind Farm Site Boundary
- Turbine Delivery Route works
- Biodiversity Enhancement lands

Bedrock Geology

- Ards Quartzite Formation
- Boultypatrick (Grit) Formation
- Cranford Limestone Formation
- Croaghubbrid Pelite Formation
- Croveenananta Formation
- Falcarragh Limestone Formation
- Glencolumbkille Limestone Formation
- Glencolumbkille Pelite Formation
- Ardara Granite, G1 variety
- Ardara Granite, G2 variety
- Ardara Granite, G3 variety
- Thorr Granite
- Thorr Granite migmatitic facies
- Main Donegal Granite
- Microgranite and related rocks
- Trawenagh Bay Biotite Granite
- Trawenagh Bay Biotite-muscov. Grani
- Trawenagh Bay Biotite-muscov. Grani
- Trawenagh Bay Aplogranite
- Trawenagh Bay Transitional G1/G2 Gr
- Lower Falcarragh Pelite Formation
- Loughros Formation
- Appinite suite
- Appinite suite intrusive breccia
- Metadolerite
- Port Askaig Formation
- Sessiagh-Clonmass Formation
- Slieve Tooey Quartzite Formation
- Termon Formation
- Knockletteragh Member
- Upper Crana Quartzite Formation
- Upper Falcarragh Pelite Formation

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Kilometres

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Figure 8-5
Bedrock Geology Map

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Mineral/Aggregate Resources

There is a high potential for mineral and aggregate resource occurrences in close proximity to the site. This is shown by a number of mineral localities located in the area and also the presence of historic quarries within 10km of the proposed wind farm site. There are no active quarries within 5km of the site.

There are a number of recorded metallic and non-metallic mineral localities on the site and they consist of 29 No. metallic locations, 2 No. non-metallic locations and 2 No. locations where both metallic and non-metallic minerals are located.

The metallic mineral locations are uranium and uraninite located in the main radiometric zone of the Main Donegal Granite; pitchblende and uranium located in pitchblende veinlets cut hornfelsed schist rafts in the Main Donegal Granite and molybdenum located in the Main Donegal Granite as flakes of molybdenite with garnet. These minerals are located across the site but generally in the centre and northeastern areas of the site, and appear to follow a general southwest to northeast trend.

The non-metallic mineral resources are pegmatitie and feldspar contained within a granite pegmatite and are located in the west of the site.

Geological Heritage

The GSI provides scientific appraisal and interpretive advice on geological and geomorphological sites and is responsible for the identification of important sites that are capable of being conserved as Natural Heritage Areas (NHA).

According to the Geological Survey of Ireland Spatial Resources, there are no designated geological heritage sites within the proposed project boundary. However, the nearest site is the Pollnapaste Caves (Site Code: DL034) site located approximately 680m north and approximately 940m west of the southwestern site boundary. The caves are separated from the site by Cleengort Hill, but connected to the southwestern area of the site by the Derk More and the Mulnamin Beg streams, which both flow into Derkmore Lough and through the Pollnapaste Caves geological heritage site.

The main geological interest in the Pollnapaste Caves geological heritage site are several karst features including sinkholes, a wet and dry cave, springs and river capture which have unusually developed within Dalradian marble. It is noted that these features are not included on the GSI karst feature database. Dalradian Marbles do not underlie the proposed infrastructure.

8.3.8 Contaminated Land

An evaluation was undertaken to determine the presence and extent of potentially contaminated land in the study area. This evaluation is based on the identification of potential sources, pathways and receptors. As the site is predominantly peatland, the potential for contamination is very low. No evidence of hydrocarbons was encountered during the site investigation works.

A review of the EPA website for existing and historic licensed and illegal waste activities, mines and industries was carried out to identify any potential contamination sources present in the area and to identify any potential contaminating activities near the proposed project. No potential contaminated sites were found.

Waste Facilities

The EPA/WFD online water maps contain a points dataset of the location of current Waste facilities (including licensed, applied, surrendered, rejected etc.) In 1996 the EPA began licensing certain activities in the waste sector. These include landfills, transfer stations, hazardous waste disposal and other significant waste disposal and recovery activities. There are no waste facility licences recorded within 10km of the site boundary.

Industrial Emissions Licences (IEL)

The EPA/WFD online water maps contain a point dataset of Industrial Emissions Licensing facilities. The EPA is the competent authority for granting and enforcing Industrial Emissions Licences (IEL) for specified industrial and agriculture activities listed in the First Schedule to the Environmental Protection Agency Act 1992 as amended. There are no Industrial Emissions Licences within 10km of the site boundary.

Integrated Pollution Control (IPC) Sites

The EPA/WFD online water maps contain a points dataset of Integrated Pollution Control (IPC) sites. The EPA has been licensing certain activities since 1994. IPC licensing is governed by the Environmental Protection Agency Act 1992 as amended. Detailed procedures concerning the IPC licensing process are set out in the EPA Act 1992 as amended, and the associated licensing regulations. IPC licences aim to prevent or reduce emissions to air, water and land, reduce waste and use energy/resources efficiently. An IPC licence is a single integrated licence which covers all emissions from the facility and its environmental management. All related operations that the licence holder carries in connection with the activity are controlled by this licence. There are no IPC licenced sites within 10km of the site boundary.

8.3.9 EPA/GSI Source Protection Zones

As reported by the EPA and the GSI, groundwater sources, particularly public, group scheme and industrial supplies, are of critical importance in many regions. Consequently, the objective of Source Protection Zones is to provide protection by placing tighter controls on activities within all or part of the zone of contribution (ZOC) of the source. According to the GSI/EPA Source Protection Zone Map, there are no Source Protection Zones within 10km of the site boundary.

8.3.10 Ground Investigation and Slope Stability

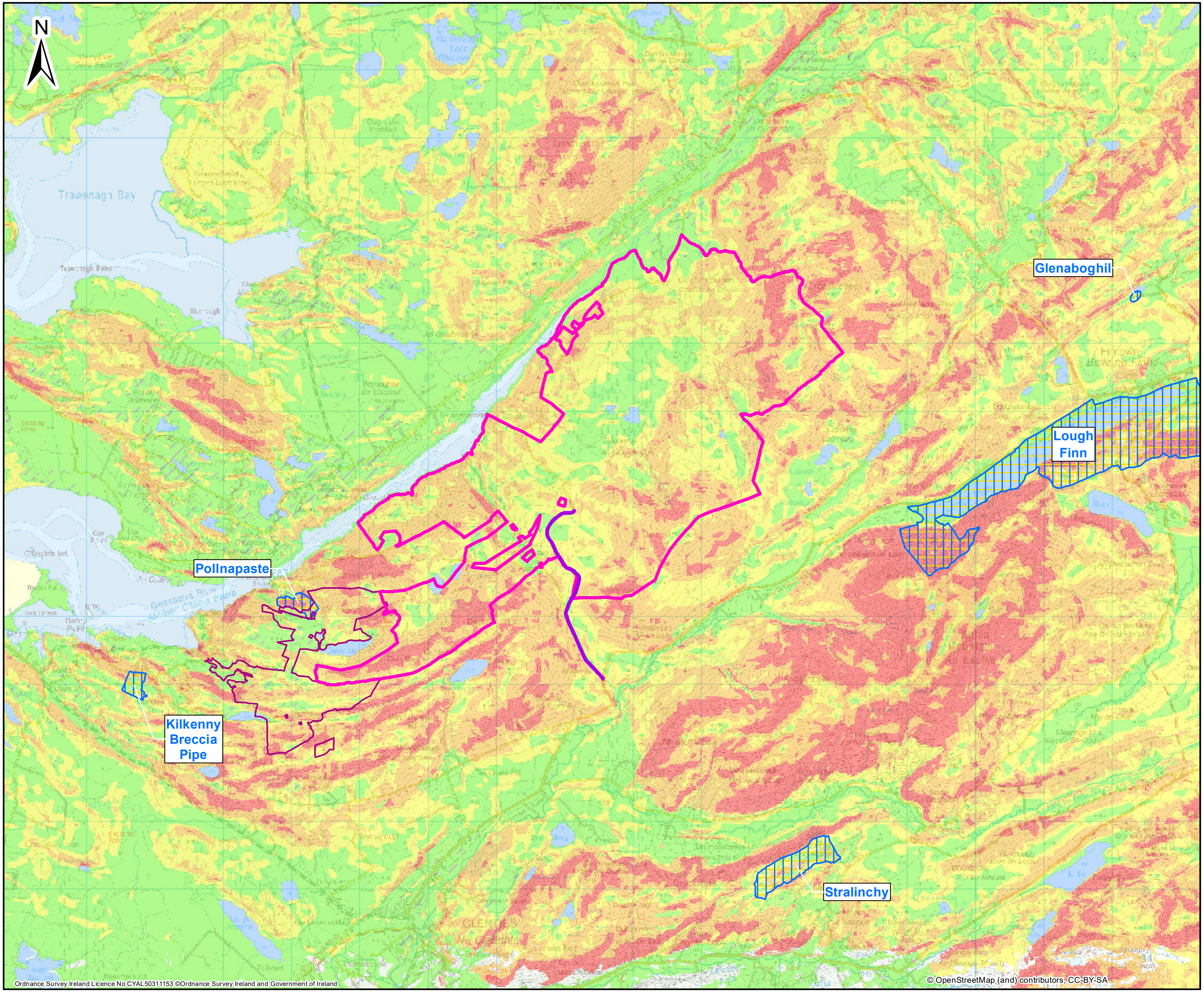
Site investigations have been carried out across the Cloghercor site area. Examples of the various site investigation methods include trial pitting, peat probing and rotary core boreholes. These processes have confirmed the geology indicated in the previous sections.

The site is covered in blanket bog peat which is generally shallower than 3m in thickness. The ground investigations indicated that the site is generally covered in peat which often overlies sandy, gravelly clay and clayey, sandy gravel before bedrock. Bedrock in the area is quite shallow and mostly occurs within 3m of ground level as indicated by trial pitting. Only one trial pit identified bedrock deeper than this at 3.3mbgl (m below ground level).

Geohazards (Landslides)

Based on the GSI Landslides Database, there are no landslide events recorded within the site boundary.

Recorded geohazard events, primarily landslides, were queried in areas at and surrounding the site boundary. Much of the Cloghercor site has been recorded to have low to moderately high susceptibility to landslides by the GSI. Figure 8-6 shows the landslide susceptibility classification of the region. The western portion of the site is predominantly classified as low to moderately high landslide susceptibility, while small areas of high landslide susceptibility are located in the northern, eastern and southern areas of the site where the mountains are located.



Legend*

- Proposed Wind Farm Site Boundary
- Turbine Delivery Route works
- Biodiversity Enhancement lands
- GSI - Geological Heritage Audited Sites

Landslide Susceptibility

- Low
- Low (inferred)
- Moderately Low
- Moderately Low (inferred)
- Moderately High
- Moderately High (inferred)
- High
- High (inferred)
- Made
- Water

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0 0.5 1 1.5 2
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Figure 8-6
Landslide Susceptibility Map

Scale @ A4: 1:70,000

Prepared by: S.Pezzetta
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Date: March 2023

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Peat and Slope Stability

A detailed technical review of peat and slope stability risks was carried out in order to identify more accurate location specific risks across the site. Details of the PSRA are included in Appendix 2-9.

Site investigations in the form of trial pitting, boreholes and peat probing was undertaken on the site. Areas of deeper peat were associated with the proposed cable route and isolated pockets to the northwest of Lough Aneans. Generally, the low slope angles and shallow peat thickness in the south of the site suggest that construction on the site, outside of the substantial risk areas, pose a low risk. Development may take place on the lower three categories of Peat stability risk, with increasing mitigation measures for significant and substantial categories. Development on serious risk category locations should not take place.

The evaluation of the peat stability at the site was carried out in accordance with the document "Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments – Second edition" (Scottish Government, 2017).

The geotechnical and peat stability assessment at the site included the following activities:

- Desk Study,
- Site reconnaissance including peat depth measurement,
- Review of ground investigation carried out at the site by Ground investigations Ireland (GII),
- Review of digital surface model data,
- Peat stability assessment using a qualitative approach, and
- Peat stability assessment using a deterministic approach.

Based on a range of published guidance including Long (2005) and O'Kelly and Zhang (2013), the Peat was assumed to have effective stress parameter values ϕ' = 28° and c' = 4kPa. A bulk weight of 10kN/m^3 is assumed for the Peat based on comparable experience.

The results of the analysis are shown in Appendix 2-9. All overdesign factors were greater than 1.0, indicating that the stability is satisfactory in both short term (undrained) and long term (drained) condition. Hence, a "low" risk rating for peat instability is appropriate for the proposed project. Overdesign factors replace Factor of safety in accordance with Eurocode 7 Geotechnical design - Part 1 (I.S. EN 1997-1:2004/NA:2015).

8.3.11 Karst Features

Site walkovers along with the GSI Map Viewer were used to identify and describe the karst features present in the region. According to the GSI viewer there are no groundwater karst features present with the site boundary. While the site is underlain by granite, areas of karst prone rocks are located c.1km to the west of the project area.

Karst features including a wet and dry cave, sinkholes, springs and river capture exist at the Pollnapaste Caves Geological Heritage Site located approximately 680m north of the southeastern boundary. There are no turbines or significant infrastructure in areas prone to karstification. The Turbines are not hydraulically connected to the Derk More and Milnamin Beg streams. Refer to Geological Heritage within section 8.3.7 for more information.

8.3.12 Borrow Pits/Peat Deposition

Four borrow pits are proposed for the Cloghercor Wind Farm. The borrow pits are located in areas of granite bedrock classified as the Main Donegal Granite Formation. The Main Donegal Granite comprises Coarse biotite granite & granodiorite. The Main Donegal Granite also contains dolerite dykes running north south through the site. BH2 completed at Borrow Pit C, encountered medium strong to strong red medium to coarsely crystalline GRANITE. BH3 completed at Borrow Pit B, encountered 1m of weathered bedrock overlying medium strong to strong dark grey coarsely crystalline GRANODIORITE. Rock is close to the surface at Borrow Pit A and C. Frequent bedrock exposures throughout the site comprised light grey to red, fine to coarse-grained GRANITE.

Upon completion of extraction, The borrow pits will be used for peat deposition. Peat removed from turbine locations and access roads will be used for landscaping, placed alongside designated access roads and used to reinstate the proposed borrow pits.

8.4 POTENTIAL EFFECTS

This section provides an assessment of the environmental effects of the proposed wind farm project on the Land, Soils and Geology environment within the study area that extends 2km from the site boundary.

8.4.1 Do-Nothing Scenario

As outlined in the Guidelines on the Information to be Contained in Environmental Impact Assessment Reports (EPA, 2022), the description of Do-Nothing effects relates to the environment as it would be in the future should the subject project not be carried out. If the development of the proposed wind farm does not take place, the site will most likely continue to look like it does today. There would be no major changes in land-use. Sheep farming, forestry, localised peat cutting/peat harvesting characterise the region. In a 'do-nothing' scenario there would be no significant impact to the land, soils and geology environment.

8.4.2 Potential Impacts - Construction Phase

The proposed project is characterised by the following civil engineering works to provide the necessary infrastructure to complete the wind farm as described in Chapter 2, Description of the Proposed Project:

- Construction of access tracks (permanent) to the wind turbines, construction compound, met mast and substation;
- Construction of temporary compounds including hard stands, construction material storage areas and site offices;
- Management of excavated materials;
- Excavation for turbine foundations, hardstanding foundations, substation foundations and met masts;
- Excavation of borrow pits, processing of materials and reinstatement;
- Excavation for cable ducts onsite and along the grid connection; and
- Construction of surface water drainage system along the new internal access tracks.

The direct and indirect effects of the construction activities, and their expected duration are discussed further in the following sections. The effect on land-use and on natural resources required to carry out the works which relate to land, soils and geology is also discussed.

8.4.2.1 Geological Heritage Sites

There are no designated geological heritage sites at the proposed project site. The proposed project has avoided direct impact on geological heritage sites. There are no potential impacts on geological heritage sites.

8.4.2.2 Land Use

The site of the proposed wind farm is predominantly covered in actively managed coniferous forestry plantations, rough grassland and bog. There is an extensive network of existing access roads across the site to facilitate the ongoing forestry operations. Soils excavated will be reused within the site for landscaping purposes and borrow pit reinstatement, therefore the potential impact on forestry/agricultural soils is a negative, slight, direct, likely, permanent effect on land use.

The permanent footprint of the proposed project measures approximately 27 ha in a 1945ha site, representing approximately 1.4% of the site of the proposed wind farm. The proposed project makes use of existing access tracks thereby further minimising the potential for land use impacts.

The total area of forestry to be felled is estimated to be between approximately 69.8 ha and 90.9 ha, of which approximately 12.6 ha will be replanted on site at the end of the construction phase (at the temporary construction compounds and reinstated borrow pits). As a commercial crop, this forestry is scheduled to be felled in the future regardless of the proposed wind farm being constructed or not.

Within the permanently felled area, there will be some windfarm infrastructure (i.e., the permanent footprint mentioned above) in addition to the regeneration of areas of low scrub and grassland vegetation. Potential impacts of forest felling include compaction and rutting of soils. The main impact of the wind farm with regard to land and natural resources is the use of borrow pit material and the removal of vegetation and topsoil. It is anticipated that the removed vegetation would be transferred to stockpiles for re-use and any soils would be reused along the edges of the proposed project and in the borrow pits. Low ground pressure machinery is to be used for all felling operations. The brash will be left to decompose. For the footprint of the proposed infrastructure there will be full tree removal to facilitate the windfarm development infrastructure. Due to the fact there are many ages classes that are to be felled i.e. commercial and non-commercial timber, it is envisaged that any commercial timber will be removed from the site for haulage to a timber sawmill.

As a result of the change in land use at the proposed project, it is considered that there will be a slight negative and permanent impact due to soil stripping and borrow pit reinstatement/landscaping works.

8.4.2.3 Construction of Access Tracks and Hardstands

Access tracks will be needed to accommodate the construction works and provide access to turbine locations for the whole life cycle of the wind farm. The access tracks will be constructed using site won material as subbase and unbound crushed aggregates and incorporate drainage to maintain the performance of the pavement during wet weather. The access tracks will be constructed as founded or floating roads. Founded roads are excavated down to and constructed up from a competent geological stratum, whereas floated roads are built directly on top of the peat and soft soils.

Ground investigation in the form of trial pitting, gouge augers and peat probing have been carried out along the proposed access routes to inform the depth of excavation and upfill required for the access tracks. Volume calculations provide an approximate estimation of fill required for the roads and hardstand areas. It is estimated as 184,700 m^3 of material, to be transported to the required location.

Material from the onsite borrow pits will be utilised in the subbase for the windfarm. Surface dressing/capping material will be imported from locally approved quarries. The potential effect of extracting additional volumes of material from external quarries include extra pressure on transport routes and more fuel consumption. This is discussed in Chapter 16 - Traffic and Transport.

Soil sealing is the covering of a soil with an impermeable material; it often affects agricultural/forestry land, puts biodiversity at risk and increases the risk of flooding. This is an inevitable direct effect to some extent of most types of construction. Permeable geotextile is placed at the base of access tracks, along with other infrastructure, as part of their typical design. However, this will have an slight, negative, permanent effect due to the relatively small footprint of infrastructure and its location.

Overall, the construction of the temporary and permanent roads presents a minor, permanent, negative effect.

8.4.2.4 Construction of Temporary Construction Compounds including Hardstanding, Construction Material Storage Areas and Site Offices

At the commencement of the construction phase a construction compound will be constructed to provide office space, welfare facilities, concrete wash out areas, hardstands for storing materials and hazardous materials.

Volume calculations provide an estimation of fill required for the temporary compound area. It is likely that this material volume will be imported from locally approved quarries or from onsite borrow pits. As discussed previously, there are potential effects to extraction of materials on site and also from local quarries. The construction of the substation is anticipated to have negative effects due to the need for extracting material from registered quarries including Ballintra Quarry, Donegal Stone, Kiltole Quarry and Fawnmore Quarry. The potential impact is negative, slight, direct, likely, permanent effect on land use. The compound will be landscaped after the construction phase. The construction of the temporary compounds presents a not significant, permanent, negative effect. There is a potential for effects on groundwater as a result of washing out of concrete (see Chapter 9 – Hydrogeology and Hydrology for details). The potential impact is negative, slight, direct, likely, permanent effect on land use.

8.4.2.5 Borrow Pit

Underlying the peat, 1.5m of slightly silty sandy GRAVEL is present with occasional/frequent cobbles and boulders in Borrow Pit B. Borrow Pit A and C are underlain by granitic bedrock. Bedrock typically is 1m below ground level. The borrow pits comprise mostly shallow peat soils underlain by granite bedrock.

An initial site walkover was undertaken, and a review of the previous site investigations carried out by Ground Investigations Ireland have been carried out. The borrow pit selection was based on the following factors:

- Avoidance of potential ecological receptors include intact blanket bogs and fens;
- Avoidance of deeper peat where possible; and
- Location near areas of known granite exposures.

There are four areas considered for the borrow pit location. All four are located in coniferous forestry. The total combined borrow pit area extends to 9.4 ha. There are no invasives species encountered in the four borrow pits.

Groundwater levels were >2m bgl. No significant dewatering is anticipated in the borrow pits. Much of the materials up to 5m below ground level (gravelly soils and weathered bedrock) are accessible with conventional excavators. A summary of the potential volumes is included in Table 8-5 below. In terms of suitability, Area B is the most suitable for material.

Table 8-5: Borrow Pit - Potential Material Volumes and Summary of the Area Characteristics

Area	Peat Depth (m)	Area (Ha)	Bedrock Type	Potential Volume (m^3)	Ecological/Other Constraints
A	0.18 to 2.1m	2.5	Main Donegal Granite	>150,000m^3 >250,000t	Located within a coniferous plantation
B	0.4 to 1m	4.7	Main Donegal Granite	>200,000m^3 >250,000t	Located within a coniferous plantation
C	0.2 to 1m	1.1	Main Donegal Granite	>100,000m^3 >140,000t	Located within a coniferous plantation
D	0.25 to 0.9m increasing to 4 to the eastern end of the borrow pit	1.3	Main Donegal Granite	>50,000 m3 >165,000 tonnes	Located within a coniferous plantation

The potential effect is a negative, slight, direct, likely, permanent effect.

8.4.2.6 Management of Excavated Materials

The handling, management and re-use of excavated materials are of importance during the construction phase of the project. Excavated material will arise from all infrastructure elements of the windfarm e.g., bases, access tracks and hardstanding. There is potential for a moderate negative effect on soil due to erosion of inappropriately handled excavated materials. The relatively flat topography in certain areas of the site limits the risk of erosion or sediment release to surface waters, however a robust sediment and erosion plan is proposed to effectively reduce the risk of sediment release to surface waters in the more undulated areas of the site that are more susceptible to landslides.

It is intended that unsuitable founding soils and peat will be placed adjacent to works locations. The height of berms and thickness of peat and unsuitably found soils that are side cast will not be greater than 0.5m. Where necessary, some of these soils will be transported to the borrow pit areas which can be used as peat repositories when they have been fully extracted. For the proposed substation, approximately 20,500m^3 of peat will be excavated and placed in the borrow pits. This action is expected to have a not significant, short-term negative effect.

For works along the grid connection, the excavated material will be cast to the side to be reused as backfilling material where appropriate. This material will not be stored in the vicinity of any watercourse. It will be cast on the upgradient side of the trench, so if any runoff did occur it would run into the downgradient trench. Excess material will be used on the site of the proposed project for landscaping and reinstatement, or, if required, will be sent to a licensed/permitted facility such as Glen Stone Company Ltd and Donegal Waste And Recycle Ltd. Where contaminants are found, the material will be removed from site and disposed at an appropriately licenced facility. This action is expected to have a not significant, short-term negative effect.

Minimal excavations will be required for the TDR. At road/junction accommodation works and the blade transfer area along the TDR, the topsoil will be side-cast and smoothed off with the back of an excavator bucket, battered to minimise the potential for runoff. This soil will be used for reinstatement after the turbine delivery is complete. These works areas are minimally sized, and excavation depths are expected to be minimal. Where suitable conditions are not present to allow side-casting, the soils will be disposed of at a suitable licensed facility. This action is expected to have a not significant, short-term negative effect. Hardcore will also be placed directly on the topsoil at works areas of the TDR, no excavated material will be generated however the soil properties will strengthen and level the required area.

8.4.2.7 Excavations for Turbine Foundations

As a part of the ground investigations, the material encountered at the trial pit locations generally consisted of silty sandy to very sandy GRAVEL with occasional/frequent subangular cobbles and boulders underlying a layer of PEAT. The peat deposits, require removal for the wind turbine foundations. Deeper excavations to more competent material may be required to construct the turbine foundations. Based on the ground investigation the proposed foundations will be gravity foundations with some piles.

The majority of turbine locations were found to be underlain by shallow peaty soil/peat overlying bedrock. Turbine 3 and Turbine 6 are underlain by softer soils. Turbine 6 was found to have sandy gravelly silty peaty clay with soft peat on top. It is noted that the depth to bedrock close to this can be up to 4m according to Trial Pit 20. Turbine 3 is completely underlain by peat which sits immediately on top of bedrock. Bedrock here is shallow at less than 2.5m depth. Areas of shallow soft ground will be removed for turbine construction on founded competent ground/bedrock.

Deep excavations to more competent material will be required to construct the turbine foundations at Turbine 6. Additional fill material will be needed to upfill the excavation to the levels required for the wind turbine at Turbine 6.

Volume calculations provide an estimation of fill required for all the turbine foundations on the assumption piling of the turbine locations are required, which results in a conservative assessment. It is estimated as 1,000m^3 of concrete. Material for the construction works will be sourced from site and locally approved quarries.

The potential effect on soils and geology is considered to be not significant, permanent and negative.

8.4.2.8 Excavations for Hardstanding Foundations

The environmental effects of the construction of the hardstanding foundations are similar to that of the founded access tracks as discussed above. Ground investigation in the form of trial pitting has been carried out along the proposed hardstanding locations to inform the depth of excavation and upfill required. Volume calculations provide an approximate estimation of fill required for all of the hardstanding foundations. It is estimated as 144,700m^3 of material to be transported to the site.

Similar to the above, the material will be sourced from local quarries including Ballintra Quarry, Donegal Stone, Kiltole Quarry and Fawnmore Quarry. The potential effects here are considered to be not significant, permanent and negative.

8.4.2.9 Excavation for Substation Foundation

The construction of the substation foundation will require removal of peat and soil to a competent founding layer and upfilling with concrete or structural fill to the required finished floor level. Ground investigations at the substation locations have been undertaken for the purposes of the EIAR and have been used to inform the depth of excavation and upfill required.

Both substation options have peaty soils. The western option has slightly more peat, but overall depths rarely exceed 1m (0.7m on average).

Volume calculations provide an estimation of fill required for the foundations for the substation assuming spread foundations are used where they are founded on competent material.

The construction of the substation is anticipated to have negative effects due to the need for extracting material from registered quarries including Ballintra Quarry, Donegal Stone, Kiltole Quarry and Fawnmore Quarry. These effects are considered to be slight, permanent and negative.

8.4.2.10 Excavation for Met Mast

The construction of a met mast will require removal of topsoil and subsoil to a competent founding layer and upfilling with concrete or structural fill to the required foundation formation level. A crane hardstanding will also be required to install the met mast. This will be similar but smaller than those constructed at the turbines. The proposed met mast is located to the west of the main works area, within a small forest clearing. A short track will be constructed to the location. Peat on the access track and met mast is between 1.1m and 1.4m.

Volume calculations provide a rough estimation of fill required for the foundations and crane pad for the met mast, assuming spread foundations are used where it is founded on competent material. The volume of material required for the met mast is minimal (<100 m^3 material).

8.4.2.11 Material Calculations

Volume calculations provide an approximate estimation of stone fill required for all of the foundations of 209,700m^3. A summary table (Table 8-6) is provided below with the approximate volumes of stone material necessary for infrastructure.

Table 8-6: Construction Volume Summary

Area	Volume of Stone Fill Required (m^3)
Access Tracks	40,000
Substation and Compound Groundworks	28,000
Turbine Hardstanding	141,700
Total	**209,700**

In excess of 177,600 m3 is available in the borrow pits. the substation and construction compounds, all material will come from on-site borrow pits. In terms of material required from off-site sources, the following are the approximate estimates of the material requirements:

- Internal Access Tracks – 40,000m^3 of which 34,000m^3 will come from onsite borrow pits;
- Substation and Construction Compounds – 28,000m^3 of which 24,000m^3 will come from onsite borrow pits;
- Turbine Foundations – 20,200m^3 from external source; and
- Turbine Hardstand, Blade set-down area and vehicle turning area – 144,700m^3 of which 120,000m^3 will come from onsite borrow pits.

Overall, the construction of the access tracks and hardstands for site infrastructure including temporary compounds, material storage areas, met mast and substation where the impact is considered to be similar, presents a not significant, long-term, negative effect.

8.4.2.12 Grid Connection

Each turbine will connect by underground cable to the on-site substation and from there to the national electricity grid. It is proposed to construct one onsite 110kV electricity substation within the site, as shown on the site layout in Figure 2-1 and the site layout drawings in Appendix 1-1. This will provide a connection point between the wind farm and the proposed grid connection point at the existing 110kV overhead line in Cloghercor.

All grid-connection cable laying works will be carried out as per EirGrid requirements, which have been described in Chapter 2 (Description of the Proposed Project) and in accordance with the Typical Trench Bedding Details provided in Appendix 2-3 of this EIAR.

The grid connection will be laid beneath the ground surface. A verification condition survey will be carried out for all parts of the route. A trench will be opened using an excavator to accommodate the formation. The excavated material will be reused as backfilling material where appropriate. This material will not be stored in the vicinity of any watercourse. Excess material will be used on the site of the proposed project for local landscaping and borrow pit reinstatement, further detail is provided in Chapter 2 (Description of Proposed Project).

Overall, the excavation required for the grid connection will have an imperceptible, temporary and neutral environmental effect on the soils and the geology of the area.

8.4.2.13 Amenity areas

The recreation and amenity proposals include the construction of amenity walkways which will be looped throughout the site (1-2m wide, floating road construction), and a proposed visitor car park located adjacent to an existing local road, approximately 700m north of T13. Locations of the Amenity Tracks are show on Drawing 10798-2070, within Appendix 1-1, and further detail in Appendix 2-6 (Recreational Development Plan). It is proposed that amenity traffic will access the site from the north. The proposed construction methodology for the amenity walkways is by founded and floating road construction, with some excavation or spoil generation. Walkways and the car park will be created on the existing rock surface by adding crushed stone. The potential effect is negative, slight to negligible, direct, likely, permanent effect.

8.4.2.14 Turbine Delivery Route

Temporary accommodation works are required along the turbine delivery route such as hedge or tree cutting, temporary relocation of poles, signage and local road widening. Some areas of temporary hardstanding/surfacing will also be required.

Where a temporary surface is needed for the turbine delivery route, works will start with the clearing of any vegetation, and the topsoil will be stripped and either used locally for landscaping purposes, or disposed of at a permitted/licensed facility. Where local use for landscaping does occur, it will be smoothed off with the back of a bucket and seeded with a suitable grass seed mix. It is anticipated that the volume of excess material generated will be relatively small and the majority of excavated topsoil will be used locally for landscaping. Any excess excavated material which needs to be taken off site will be taken to a licensed/permitted waste facility as outlined in Section 8.4.2.6. Suitable fill material (broken stone and clause 804) will be used to create a firm running area for the passage of turbine delivery vehicles. The areas will be fenced off when the delivery is not occurring. After the delivery of turbines to site, a stock proof fence or crash barrier will be erected between the hardstand surface and the road, or the site will be re-instated to the original condition, and any removed vegetation will be reseeded/replanted with a similar native species composition.

Any upgrades to the road will be carried out well in advance of turbine deliveries. The impact mechanisms include excavation and vehicle movements which has the potential to affect the subsoil and surface water environments.

The potential impact on soils and geology is negative, direct, not significant and short term.

8.4.2.15 Peat and Soil Stability

A detailed technical review of peat and slope stability risks was carried out in order to identify more accurate location specific risks across the site. Details of the PSRA are included in Appendix 2-9.

Site investigations in the form of trial pitting, boreholes and peat probing at the proposed windfarm. Areas of deeper peat were associated with the proposed cable route and isolated pockets to the northwest of Lough Aneans. Generally, the low slope angles and shallow peat thickness in the south of the site suggest that construction on the site, outside of the substantial risk areas, pose a low risk. Development may take place on the lower three categories of Peat stability risk, with increasing mitigation measures for significant and substantial categories. Development on serious risk category locations should not take place. The site terrain is undulating/rolling terrain and topographically confined, limiting the potential and scale of peat slide and debris runout distances.

The evaluation of the peat stability at the site was carried out in accordance with the document "Peat Landslide Hazard and Risk Assessments, Best Practice Guide for Proposed Electricity Generation Developments – Second edition" (Scottish Government, 2017).

The geotechnical and peat stability assessment at the site included the following activities:

- Desk Study,
- Site reconnaissance including peat depth measurement,
- Review of ground investigation carried out at the site by Ground investigations Ireland (GII),
- Review of digital surface model data,
- Peat stability assessment using a qualitative approach, and
- Peat stability assessment using a deterministic approach.

Based on a range of published guidance including Long (2005) and O'Kelly and Zhang (2013), the Peat was assumed to have effective stress parameter values ϕ' = 28° and c' = 4kPa.

A Spoil and Peat Management Plan (SPMP) has been prepared for the project– See Appendix 8-2. Recommendations made in this report and in the PMP will be implemented in full during the design and construction stage of the proposed project. Best practice guidance[1] regarding the management of Peat and soil will be inherent in the construction phase of the project.

The potential effect is slight to negligible, direct, unlikely, long term effect.

[1] https://www.nature.scot/doc/guidance-good-practice-during-wind-farm-construction

8.4.2.16 Hydrocarbon Release

Wherever there are vehicles and plant in use, there is the potential for hydrocarbon release which may contaminate the soil and subsoil. A spill has the potential to indirectly pollute water, if the soil and subsoil act as a pathway from any source of pollution. Any spill of fuel or oil would potentially present a moderate, long-term negative effect on the soil and geological environment. Good site practice can mitigate any effect (Refer to Section 8.5 Mitigation Measures). Further details are included in Section 9 Water.

8.4.3 Potential Impacts – Operational Phase

During the operation phase of the project, no new effects on the soil and geological environment will arise. Any hydrocarbon or oil spills related to the maintenance of the site (access tracks, substation, and turbines) have the potential to negatively affect the ground directly. However, mitigation measures and management controls will negate risk (Refer to Section 8.5).

A few direct impacts are possible during the operational phase of the proposed project. These are as follows:

- Some construction traffic may be necessary for maintenance of the site (access tracks, substations and turbines) which could result in minor accidental leaks or spills of fuels/ oils affecting the ground and water;
- The transformer in the substation and transformers in each turbine are oil cooled. There is potential for spills and leaks of oils from this equipment resulting in contamination of soils and water.

The direct operational impacts have the potential to negatively affect the ground or water directly. However, mitigation measures and management controls will negate this risk.

In relation to indirect impacts, small volumes of additional unbound crushed aggregate material may be required during the operation phase where roads/tracks have settled on the subsoil and to resurface unbound roads. Aggregate required will only be sourced from quarries which are listed on the register maintained by the local authority. This will place intermittent minor demand on local resources. It is expected that only small quantities of unbound crushed aggregates may be needed. The resurfacing of roads will therefore pose an imperceptible negative short-term or long-term effect.

The effects of operation on natural resources such as land, soils and geology will be imperceptible and long-term. The effects are similar to those of the 'do nothing scenario'. Forestry and sheep farming will continue during the operation of the wind farm. There are no cumulative impacts on the soils and geology environment envisaged during the operational stage, as there will be no significant movement of soils/subsoils, or construction works, during this period.

8.4.4 Potential Impacts – Decommissioning Phase

In general, the potential effects associated with decommissioning will be similar to those associated with construction but of reduced magnitude because extensive excavation, and wet concrete handling will not be required. Limited potential environmental effects of stockpiling and contamination by fuel leaks will remain during decommissioning. The potential for impact as a result is slight to not significant.

Turbine foundations and the grid connection infrastructure will remain in place underground and would be covered with earth and allowed to revegetate or reseed as appropriate. The site access tracks will be in use for additional purposes to the operation of the wind farm (forestry access and recreational use) by the time the decommissioning of the project is to be considered, and therefore will remain in-situ for future use.

In most cases, and certainly for granular based tracks (but also concrete and asphalt) these materials are mostly inert and stable over the long-term, so will not pose a contamination risk if left in-situ. The substation will be retained as a permanent structure and will not be decommissioned. The replanted forestry lands will not be decommissioned as they will continue as forestry.

8.4.5 Major Accidents/Disasters

As part of the requirements of the EIA Directive, the Applicant is requested to consider the 'Expected Significant Adverse Effects of the project on the environment deriving from the vulnerability of the project to risks of major accidents and/or disasters which are relevant to the project concerned.'

This section describes the expected significant effects on the environment arising from the vulnerability of the proposed project to risks of major accidents and/or natural disasters which are relevant to the project. As set out in the EIA guidance there are two main considerations:

- The potential of the project to cause accidents and/or disasters, including implications for human health, cultural heritage, and the environment;
- The vulnerability of the project to potential disasters/accidents, including the risk to the project of both natural disasters (e.g., flooding) and man-made disasters (e.g. technological disasters).

The potential for a landslide will be avoided through the implementation of the mitigation measures (see Section 8.5) and geotechnical supervision. The proposed project is not located in an area prone to landslides. Refer to Appendix 2-9 for the Peat Stability Risk Assessment.

In relation to major accidents, the following geological hazards do not occur on the site:

- Earthquakes do not occur in a sufficient intensity (Magnitude >4.0) in Ireland.

8.5 MITIGATION MEASURES

Mitigation measures for the construction, operation and decommissioning of Cloghercor Wind Farm to avoid or reduce the potential effect of the proposed project are presented below. A number of mitigation measures considered for soil and geology are similar to those relating to hydrology and hydrogeology, further detail can be found in Chapter 9 'Hydrology and Hydrogeology'.

8.5.1 Mitigation by Avoidance

The opportunity to mitigate any effect is greatest at the design period. In this respect Orsted/FuturEnergy Ireland carried out a detailed site selection process. Further details are included in Chapter 3 – Reasonable Alternatives. This process identified deep peat as a specific constraint. Existing access tracks were utilised and areas of near intact or remnant bog were avoided.

Finally, floating roads will be used where founded roads are unsuitable. However, there are some risks that cannot be mitigated through design and need to be managed during construction, operation and decommissioning.

8.5.2 Mitigation Measures – Construction Phase

Prior to commencement of construction work the contractor will agree a Construction Environment Management Plan (CEMP) with Donegal County Council. A CEMP has been drafted for inclusion within Appendix 2-2. The CEMP details the procedures prescribed to prevent, control and mitigate potential environmental impacts from the construction of the works and details procedures and method statements for the management of specific issues.

All contractors involved in the development of the project will be required to comply with good construction practice, as described in guidance provided by the Environment Agency for England and Wales in their publication entitled 'Pollution Prevention Guideline (PPG6) Working at Construction and Demolition Sites' will be used as a baseline for this purpose.

The construction of the project has the potential (with no mitigation) to cause "not significant" to "moderate" short-term to long-term effects to the soil and geology of the proposed project site. Implementing mitigation measures detailed below will reduce the significance of the effects. The mitigation measures have been based on CIRIA (Construction Industry Research and Information Association, UK) technical guidance on water pollution control and on current accepted best practice (CIRIA, 2001).

Good site practice will be applied to ensure no fuels, oils, wastes or any other substances are stored in a manner on site in which they may spill and enter the ground. Dedicated, bunded storage areas will be used for all fuels or hazardous substances. Excavation works will be monitored by a suitably qualified and experienced geotechnical engineer or engineering geologist. The earthworks will not be scheduled to be carried out during severe weather conditions.

8.5.2.1 Geological Heritage

No works are required in geological heritage areas as part of the project and therefore no mitigation is required for geological heritage areas.

8.5.2.2 Land-Use

It is intended that surplus soils and subsoils will be reused for site landscaping and used to reinstate the borrow pits. Temporary stockpiling from excavations will be avoided near sensitive receptors such as watercourses. All of the excavated soils will be used for local landscaping or for borrow pit reinstatement.

Replacement replanting of forestry in Ireland is subject to licence in compliance with the Forestry Act 2014 as amended. The consent for such replanting is covered by statutory instrument S.I. No. 191/2017 Forestry Regulations 2017. As it is proposed to fell between 69.8 and 90.9 ha of coniferous forestry for the proposed project. A total of 12.6 ha will be replanted on site at the end of the construction phase (at the temporary construction compounds and reinstated borrow pits). In order to minimise the potential impacts to land-use, the following mitigation measures are proposed:

- Minimising areas for earthworks thereby reducing land take requirements;
- Restricting areas for construction works and temporary storage to a minimum;

- Retention of all existing perimeter planting and re-generating vegetation where possible and protect in areas close to construction works;
- Disturbance of existing vegetation will be minimised where possible and proposed planting will help integrate the proposed project into the current land use;
- The handling, storage and re-use of excavated materials are of importance during the construction phase of the project. Stockpiles will be located away from the watercourses and drainage ditches. Topsoil and subsoils will be stored near the landscaping and in the reinstatement of borrow pit areas. Topsoil will be stockpiled no higher than 2.5m and follow the recommendations set out in the NRA Guidelines for the Management of Waste from National Road Construction Projects (NRA, 2014);
- Turves will be stored turf side up and must not be allowed to dry out;
- No permanent spoil or stockpiles will be left on site;
- The method for restoration of excavated or disturbed areas is to encourage stabilisation and early establishment of vegetation cover, where available, vegetative sods/turves or other topsoil in keeping with the surrounding vegetation type will be used to provide a dressing for the final surface; and
- To prevent erosion and run-off and to facilitate vegetation reinstatement, any sloped embankment will be graded such that the slope angle is not too steep and that embankments match the surrounding ground profile.

8.5.2.3 Soil Management

The disturbance of soil, subsoil and bedrock is an unavoidable effect of the project, but every effort will be made to ensure that the amount of earth materials excavated is kept to a minimum in order to limit the effect on the geological aspects of the site. The management of geological materials is an important component of controlling dust and sediment and erosion control. Excavated peat will typically be moved short distances from the point of extraction and will be used locally for landscaping. Landscaping areas will be sealed and levelled using the back of an excavator bucket to prevent erosion. Where possible, the upper vegetative layer will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the landscaped peat. These measures will prevent the erosion of peat in the short and long term. Peat, overburden, and rock will be reused where possible on site to reinstate borrow pits and other excavations where appropriate

Peat soils will be placed in the borrow pit area will be required, which has been designed to be fully stable. The borrow pits are located away from sensitive receptors; the deposition has been designed to be completed in phases and will include specific drainage and silt controls. On completion the borrow pit surfaces will be stabilised by the establishment of natural peat land vegetation. Peat deposition will be at the borrow pit locations.

Where mineral soils are encountered in the excavation and construction of site roads, bases, etc, this material will be stockpiled for assessment and subsequent re-use. Where mineral soil is not directly suitable for construction it will be used for reinstatement works and will be used to reprofile the borrow pits.

Exposed soils can lead to the generation of dust in dry windy conditions or silty run-off in wet conditions. Dust generation will be controlled by wetting soil surface in dry conditions or by covering soil stockpiles with geomembrane. If long term storage is required for reusable soil, particularly where such storage will span spring and summer periods the stockpile will be revegetated. To control generation of silt run off soil stockpiles will be surrounded by either silt fencing or toe drain or will be covered. Surface run off from across the construction site will be directed to surface water control areas which will include siltation ponds or similar.

As part of the proposed works four borrow pits are proposed to obtain materials suitable for construction, the purposes of which is to minimise the need for import of aggregates from elsewhere, reducing the project's environmental footprint.

The site construction will utilise the permanent access track network for access and egress, and this access will be constructed in advance of other ground works in a sequential manner.

8.5.2.4 Excavations Management

The disturbance and excavation of soil, subsoil and bedrock is an unavoidable effect of the project, but every effort will be made to ensure that the amount of earth materials excavated is kept to a minimum in order to limit the effect on the geological aspects of the site. The management of geological materials and spoil is an important component of controlling dust and sediment and erosion control. Excavated soils and bedrock will only be moved short distances from the point of extraction and will be used locally for landscaping. Landscaping areas will be sealed and levelled using the back of an excavator bucket to prevent erosion. The upper vegetative layer will be stored with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the landscaped soils.

These measures will prevent the erosion of soil in the short and long term. Soils, overburden, and rock will be reused on site to reinstate any excavations where appropriate.

To ensure slope stability, excavations will be battered back (sloped) to between 1:1.5 and 1:2 depending on depth and type of material. Permanent slopes will generally be less than 1:3. The works programme for the construction stage of the proposed project will also take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecasted. Works will be suspended if forecasting suggests any of the following is likely to occur:

- >10mm/hr (i.e., high intensity local rainfall events);
- >25mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or
- >Half monthly average rainfall in any 7 days.

Prior to works being suspended the following control measures will be completed:

- Secure all open excavations;
- Provide temporary or emergency drainage to prevent back-up of surface runoff; and
- Avoid working during heavy rainfall and for up to 24 hours after heavy events to ensure drainage systems are not overloaded.

Mitigation measures will be put in place during the construction of the scheme to reduce the likelihood of an open excavation collapsing. Mitigation measures include construction of a granular berm or temporary sheet pile wall to support the soil during construction. An assessment was undertaken of the suitability of the ground to support the proposed project. Where there is a lower factor of safety, mitigation will be implemented to reduce risk.

Excavation works will be monitored by a suitably qualified and experienced geotechnical engineer or engineering geologist. The earthworks will not be scheduled to be carried out during severe weather conditions. Subject to landowner permission, selected private water supply wells at representative locations closest to turbine and borrow pit locations around the site will be monitored for water level and quality pre-construction and during the construction phase. Further details are included in Chapter 9 (Hydrology and Hydrogeology).

Following these mitigation measures, the resultant effect will be not significant and negative.

8.5.2.5 Materials and Fuels

Concrete and similar other products may give rise to alkali effluents that may impact on receiving waters. Therefore, waste concrete and wash waters need to be disposed of in dedicated areas where the waste material can be neutralised and collected for appropriate disposal or reuse.

Fuel storage and fuelling facilities will be required at several fixed locations and at mobile locations around the site, given the size of the project site it is impractical to track large plant to a single fixed facility. Fuel storage and any oil storage will be carried out in accordance with the Enterprise Ireland Best Practice Guide BPGCS005 Oil Storage Guidelines and EPA (2004) Guidance The Storage and Transfer of Materials for Scheduled Activities. Fuel and oil storage at fixed locations will be in a fixed tank, undercover and within a steel or concrete bund. An impermeable bunded refuelling area will be constructed adjacent to the fixed fuel storage areas. Double skinned plastic tanks will not be acceptable at the site for any purpose unless they are placed within fixed concrete or steel external bunds.

Each fixed fuel and oil storage bunds shall be sized to hold 110 % of the oil volume of the largest tank therein. The fixed fuel and oil storage bunds shall be blind sumped. The rainwater pumped from each bund shall be discharged to the surface water drainage system via an oil interceptor.

In the event of a spill, the liquid contained in the bund shall be removed by a liquid waste tanker, as will be the contents of the surface water drainage system and oil interceptor. Where refuelling is required on site away from fixed storage locations this will only be carried out utilising steel intrinsically bunded mobile fuel bowsers. At site refuelling locations, where possible, refuelling will take place within mobile bunds, but at a minimum fuel line from the bowser to the plant being fuelled will be contained by drip trays.

Generators and associated fuel tanks to be used at the site shall either be placed within bunds as per fuel storage tanks or shall be integrated units (i.e., fuel tank and generator in one unit) that are intrinsically bunded. No external tanks and associated fuel lines shall be permitted on site unless these are housed within a fixed bund with the generator.

The contractor's yard/maintenance yard shall incorporate a bund for the storage of small vehicles and oil filled equipment, such as hand portable generators, pumps, etc. Storage of small volume oils or chemicals, in barrels, IBCs, etc, will be stored in a covered bunded area. Where barrels or other containers are required at work locations these shall be stored in enclosed bunded cabinets, and drip trays shall be used where distribution of the material is required.

The main storage areas for oil filled equipment, vehicles, plant, etc, will be located on an impermeable surface and the discharge of surface water from these areas will be via oil interceptors. An oil spill response plan will be implemented for the construction works and appropriate containment equipment will be available at work locations in the event of a spillage. Oil spill response will form part of site personnel induction and training at the site.

All wastes generated on site will be segregated so that where possible and appropriate materials are re-used on site. Based on the EPA Waste National Statistics – Summary Report for 2020, the average annual municipal waste generated per person in Ireland was 645kg[2]. As

[2] National Waste Statistics – Summary report for 2020, EPA. [Accessed December 2022 EPA_National_Waste_Stats_Summary_Report_2020.pdf]

the municipal waste average accounts for household waste collections, an assumption of 50% of this average has been taken for an employee onsite during construction. Based on a 2 year construction period and an average of 100 construction staff (Chapter 2, Section 2.9.1 references 96-139 staff during peak construction) each year, the maximum municipal waste generated for the proposed project is expected to be in region of 64,500kg. This is a worse-case assessment for the site based on national statistics for the average person. Of this total, according to the national statistics total, 41% will be recycled, 43% thermally treated and 16% send to landfill, equating to the following over the construction period for the proposed project.

Waste will be collected by a licenced commercial waste management contractor on a regular basis (as required) over the course of the 2year construction period.

Wastewater from the staff welfare facilities will be managed by means of a sealed storage tank, with all wastewater being tankered off-site occasionally (as required) by a permitted waste collector to a wastewater treatment plant – See Chapter 11 Material Assets.

8.5.2.6 Transmission Lines and Cabling

Construction of internal electricity transmission lines and cables will present similar, but lower-level risks, to the construction risks outlined above, and the same mitigation measures will be adopted as above.

Before commencement of construction works the contractor will draw up detailed Method Statements which will be informed by all the Construction Methodology, environmental protection measures included within the planning application and EIAR, any subsequent measures required by planning conditions which will be imposed, and the guidance documents listed in Section 8.2. This method statement will be adhered to by the contractors and will be overseen by the Project Manager, Environmental Manager, and ECoW as appropriate.

8.5.2.7 Slope Stability

The Peat Stability Risk Assessment concluded that there is a Negligible to Low Risk to the project, therefore no further design measures are considered necessary (Appendix 2-9).

The risk of peat instability has been minimised and mitigated by optimising the design of the wind farm, by choosing a safe and controlled construction methodology, by having a rigorous documentation and quality control system during construction and by controlling construction activities carefully. Zonal Peat Stability Risk Assessments (ZPSA) will be undertaken to account for prevailing weather conditions in specific areas of significant risk identified at detailed design level.

Given the scale of the project a major consideration for the project at this site is the management of the materials excavated as part of the construction works. To this end and in order to further mitigate against any risk of Peat instability, it is proposed to place peat and spoil material in areas of insignificant risk. Side casting of peat in areas of higher risk will not take place unless retained by a designed structure. Borrow pit areas will also form part of the Peat management solution, and this will be located in the borrow pits. A Spoil and Peat Management Plan for the various phases of the development will be designed and maintained over the course of the project.

Based on the recommendations and control measures given in the Peat Stability Risk Assessment (Appendix 2-9) report being strictly adhered to during construction and the detailed stability assessment carried out for the peat slopes which showed that the site has an acceptable margin of safety, there is a low risk of peat instability/failure at the proposed project site. All recommendations will be implemented in full.

The risk assessment at each turbine location identified a number of control measures to reduce further the potential risk of peat failure. Access roads to turbines will be subject to the same relevant control measures that apply to the nearest turbine as detailed in the Peat Stability Assessment Report.

The following measures are proposed for this site.

- Appointment of experienced and competent contractors;
- Geotechnical Engineer to provide a Geotechnical Induction to all contractor supervisory staff.
- Appoint a Site Geotechnical Supervisor to carry out supervision of site works as required. The Site Geotechnical Supervisor will be required to inspect that works are carried in accordance with the requirements of the PSRA, identifying new risks and ensuring all method statements for works are in place and certified.
- Retain a Site Geotechnical Folder which contains all the information relevant to the geotechnical aspects of the site including but not limited to GRR, site investigation information, method statements etc.
- Contractor to develop a Method Statement for the works to be carried out in each of the PSRA areas ensuring implementation of the required mitigating measures.
- Client's Geotechnical Engineer/Site Geotechnical Supervisor to approve the method statement.
- Contractor to provide tool box talks and on-site supervision prior to and during the works.
- Daily sign off by supervising staff on completed works.
- Prevent undercutting of slopes and unsupported excavations;
- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground as detailed in the PSRA – Appendix 2-9;
- Allocate sufficient time for the project (be aware that decreasing the construction time has the potential to increase the risk of initiating a peat movement);
- Ensure construction method statements are followed or where agreed modified/
- developed; and,
- Develop a Geotechnical Risk Register as part of detailed design and revise and amend throughout the construction progresses.

The management of peat stability will be ongoing throughout the construction and operational stages of the project and will be managed through the use of a geotechnical risk register.

8.5.3 Mitigation Measures – Operational Phase

Operational activities at the site will focus on the maintenance of wind turbines and associated infrastructure. Oil filled components of the wind turbines will need to be periodically refurbished and replaced.

To facilitate operational activities at the site fuel and oil storage will be required, primarily in the permanent maintenance/contractors' compound, although remote use of fuel and oil will be required from time to time. Fuel and oil storage and handling requirements will be as detailed for construction, with permanent fuel and oil storage located within permanent covered bunds.

Electrical apparatus, such as transformers, will be required within the substations, all such oil containing electrical apparatus shall be constructed within permanent concrete bunds that shall have been constructed and tested to provide containment. Each bund shall be sized to hold 110% of the oil volume within the electrical apparatus it encloses. The bunds shall be blind sumped and alarmed to allow the regular removal of clean rainwater by means of a pump. In the event of a spill, the liquid contained in the bund shall be removed by liquid waste tanker, as will be the contents of the surface water drainage system and oil interceptor.

The oil interceptors at the site substation and carpark shall be subject to a regular inspection and de-sludging to ensure that they retain full operational efficiency. An oil spill response plan will be developed for the site. Site operatives will receive appropriate training and materials shall be available on site to immediately respond to any fuel or oil spill.

In summary, with regards to fuel, the proposed mitigation measures during the operational phase are as follows;

- Minimal refuelling or maintenance of operational vehicles or plant will take place on site. Off-site refuelling will occur at a controlled fuelling station;
- On site re-fuelling will be undertaken using a double skinned bowser with spill kits on the ready for accidental leakages or spillages;
- Re-fuelling will be undertaken by suitably trained personnel only; and
- Fuels stored on site will be minimised. Storage areas where required will be bunded appropriately for the fuel storage volume for the time period of the operation and fitted with a storm drainage system and an appropriate oil interceptor.

The majority of the proposed project site will be accessed from the project's permanent road network, however some low maintenance project elements, will require access and egress. In such event the access and egress will be undertaken using the approach outlined for construction.

The following outlines an overview of the tasks for the operation and maintenance phase:

- Peatland Health and Safety training at the Proposed wind farm for operational staff by incorporating the issue into the Site Induction. Induction to include risk assessment information (peat instability indicators, best practice and emergency procedures) in toolbox talks with relevant staff. Communication of residual peat risk to appropriate site operatives.
- Ongoing monitoring of residual risks and maintenance if required. Such items will consist of regular inspection of drains to prevent blockages, inspections of specific areas after a significant rainfall event.

Welfare facilities will be provided at the Contractor/Maintenance compound, and at substation locations. These welfare facilities will produce foul effluent and these effluents will be treated through the construction of proprietary wastewater treatment systems. These wastewater treatment systems shall be subject to yearly inspection and maintained as required.

8.5.4 Mitigation Measures - Decommissioning Phase

Decommissioning will comprise the removal of non-reusable power generation devices and infrastructure to ground level, it is assumed that below ground cabling, etc, would be left in-situ.

Internal access roads could be removed although the Irish Wind Energy Association suggest there may be benefits to leaving them in place (IWEA, 2017). Furthermore, in the context that almost all of the internal roads will have a dual function of providing access to the turbines and amenity trackways it is intended that all of the roadways will be retained.

Concrete bases will be left in the ground, covered with topsoil, and allowed to naturally re-seed in line with IWEA best practises (IWEA, 2017). The area around the bases will be rehabilitated by covering it with locally sourced soil in order to regenerate the vegetation. This will also reduce run-off and sedimentation effects.

A fuel management plan to avoid contamination by fuel leakage during decommissioning works will be implemented as per the construction phase mitigation measures.

The risks arising from the decommissioning of the site would be less than those for construction, but mitigation measures for decommissioning will conform to those given for construction and are anticipated to be fully protective of the environment.

8.6 CUMULATIVE EFFECTS

Cumulative effects of this project with other developments in the region, as discussed in Chapter 4 -Policy, Planning and Development Context, relate to the effects on land, soils and geology. Due to the use of on-site borrow pits, the demand for external aggregate (natural resources) for roads is greatly reduced, therefore limiting the potential for cumulative impacts.

Overall It is not envisaged that there will be any significant effects in relation to soils and geology during construction. This is due to the efficient design along with the material management such as using onsite borrow pits which will ensure optimisation of the volume of materials required to be imported to site. This will mitigate any cumulative effects relating to importing of material and use of public roads as haul roads.

The felling of forestry and the replanted forestry has been assessed in terms of cumulative impact with the windfarm site, grid connection and TDR works. Chapter 16 - Traffic and Transport details the scenarios whereby the materials will be imported onto site and assesses the potential for cumulative effects. There is no significant cumulative geological or hydrogeological effect with the proposed project anticipated.

All developments and planning applications listed in Chapter 4 of this EIAR (Planning Policy and Development Context) were considered for their potential cumulative effects.

8.7 RESIDUAL EFFECT

The replacement of cutover peat, soil, subsoils, and rock with gravels and concrete for the construction of the infrastructure (temporary and permanent) will result in a change in ground conditions within the proposed project site. Overall, this residual effect is non-significant and permanent and negative.

Deposits of peat occur onsite. However, it is considered that these risks can be managed effectively through the comprehensive measures proposed which will be implemented in full to secure the short-term and long-term stability of the proposed earthworks including turbine and substation foundations and access roads. The site investigation data and stability assessment showed that there are stability issues that will be effectively managed during the construction of the project, by the prescribed mitigation measures. Following mitigation procedures, the residual effect in relation to peat stability will be not significant, short-term and negative as well as being localised to excavations carried out during the construction phase.

All other potential effects on the soil and geological environment will be mitigated through good site practice on vehicular movements, management of pollutant fluids, sustainable use of soils etc. Overall, the residual effects from these aspects will be not significant to imperceptible, permanent and negative.

8.8 CONCLUSIONS

Overall, the development of Cloghercor Wind Farm will not have a significant negative impact on the soil and geological environment based on the mitigation measures that will be put in place and managed appropriately throughout the lifecycle of the wind farm.

Topography, along with the soils and underlying geology varies throughout the site. Generally, the site comprises 1.2m peat thickness underlain by silty sand GRAVELS with angular cobbles and boulders. Bedrock in the region is quite shallow and commonly occurs within 2m of ground level.

Peat instability is also assessed the site. There is no evidence of peat instability on the site as a result of previous development. As per the mitigation measures discussed above, areas of deep peat are avoided during construction thus minimising the risk of such an event. The outline design of the proposed project has sought to minimise peat stability risks.

The principal risks associated with soil and geology at the site are the management of soils, and the loss of construction and operational materials (concrete, fuel and oil, etc) to water. It is expected that these risks can be fully mitigated through the adoption of construction and operational good practice.

Hence, it is not expected that the project will give rise to any significant residual effects with regard to soil and geology.