Environmental Impact Assessment Report (EIAR)

Proposed Cahermurphy West Wind Farm, Co. Clare

Chapter 8: Land, Soils and Geology

DOCUMENT DETAILS

Client:	**FuturEnergy Ireland**
Project Title:	**Proposed Cahermurphy West Wind Farm**
Project Number:	**230843**
Document Title:	**Environmental Impact Assessment Report**
Document File Name:	**Ch.8 LSG – Final – 2026.02.26- 230843**
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Planning and Environmental Consultants

Rev	Status	Date	Author(s)	Approved By
F0	FINAL	26/02/2026	D Broderick	CMcG/M Gill

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8.1 Introduction

8.1.1 Background and Objectives

Hydro-Environmental Services (HES) was engaged by MKO to carry out an assessment of the potential likely and significant effects of the proposed Cahermurphy West Wind Farm and Grid Connection (Proposed Project) near Kilmihil in Co. Clare, on the Land, Soils and Geology aspects of the receiving environment.

The Proposed Project (Proposed Wind Farm and Grid Connection) is described in full in Chapter 4 of this EIAR.

For the purpose of this EIAR, where the 'Proposed Wind Farm' is referred to, this relates to all components within the Wind Farm Application under Section 37E of the Planning and Development Act 2000, as amended, as described in Section 4.1 of Chapter 4 and all associated lands. The Proposed Wind Farm works also includes the Turbine Delivery Route (TDR) work areas and Hen Harrier Enhancement areas.

Where 'Proposed Grid Connection' is referred to, this relates to all components within the Proposed Grid Connection Application under Section 182A of the Planning and Development Act 2000, as amended, as described in Section 4.1 of Chapter 4 and all associated lands.

Where 'the Site' is referred to, this relates to the primary study area for the Proposed Project, as delineated by the EIAR Site Boundary and includes the proposed Proposed Wind Farm and Proposed Grid Connection.

This report provides a baseline assessment of the environmental setting of the Proposed Project, as described in Chapter 4, in terms of Land, Soils and Geology and discusses the potential likely and significant effects as well as cumulative effects that the construction, operation and decommissioning of the Proposed Project will have. Where required, appropriate mitigation measures to avoid any identified significant effects to Land, Soils and Geology (i.e. natural resources) are implemented and the residual effects of the Proposed Project post-mitigation are assessed.

The Proposed Project Study Area with regard Land, Soils and Geology is within a 2km distance the EIAR Site Boundary as per IGI (2013) guidance. However, only direct effects on land, soils and geology within the EIAR Site Boundary are expected with regard the Proposed Project works (i.e. no indirect effects).

8.1.2 Statement of Authority

Hydro-Environmental Services (HES) are a specialist geological, hydrological, hydrogeological and environmental practice which delivers a range of water and environmental management consultancy services to the private and public sectors across Ireland and Northern Ireland. HES was established in 2005.

Our core areas of expertise and experience includes soils, subsoils and geology. We routinely complete impact assessments for land soils and geology, hydrology and hydrogeology for a large variety of project types.

This chapter of the EIAR was prepared by David Broderick and Michael Gill.

David Broderick (P. Geo., BSc, H. Dip Env Eng, MSc) is a Hydrogeologist with over 19 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland working mainly on groundwater and source protection studies David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has completed numerous geology and water sections for input into EIARs for a range of commercial developments. David has worked on the EIS/EIARs for Booltiagh WF, Cahermurphy WF, Glenmore WF, Crossmore WF and over 60 other wind farm related projects across the country.

Michael Gill (P. Geo., B.A.I., MSc, Dip. Geol., MIEI) is an Environmental Engineer/Hydrologist with over 24 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms in Ireland. He has also managed EIAR assessments for infrastructure projects and private residential and commercial developments. In addition, he has substantial experience in wastewater engineering and site suitability assessments, contaminated land investigation and assessment, wetland hydrology/hydrogeology, water resource assessments, surface water drainage design and SUDs design, and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIARs for Seven Hills Wind Farm, Glenmore Wind Farm, and Slievecallen Wind Farm, and over 100 other wind farm related projects across the country.

The Geotechnical and Peat Stability Assessment and Peat Management Plan were prepared by Fehily and Timoney (FT). The FT staff involved in the reporting were Ian Higgins (FT Principal Geotechnical Engineer, MSc. Geotechnical Engineering) and Alan Whelan (FT Project Engineer, BEng. Civil Engineering). Ian is a Technical Director with Fehily Timoney and has 25 years' experience in geotechnical engineering. Alan is a Senior Project Engineer with Fehily Timoney and has four years' experience in geotechnical engineering.

8.1.3 Relevant Legislation

The EIAR is prepared in accordance with the requirements of European Union Directive 2011/92/EU on the assessment of the effects of certain public and private projects on the environment (the 'EIA Directive') as amended by Directive 2014/52/EU. The requirements of the following legislation are complied with:

- Planning and Development Acts, 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- Directives 2011/92/EU and 2014/52/EU on the assessment of the effects of certain public and private projects on the environment, including Circular Letter PL 1/2017: Implementation of Directive 2014/52/EU on the effects of certain public and private projects on the environment (EIA Directive);
- European Communities (Environmental Impact Assessment) Regulations 1989 to 2017; and,
- S.I. No. 4/1995: The Heritage Act 1995, as amended.

8.1.4 Relevant Guidance

The Land, Soils and Geology Chapter of this EIAR was prepared in accordance with, where relevant, the guidance contained in the following documents:

- Environmental Protection Agency (2022): Guidelines on the Information to be contained in Environmental Impact Assessment Reports;
- Institute of Geologists Ireland (2013): Guidelines for the Preparation of Soils, Geology and Hydrogeology Chapters of Environmental Impact Statements;
- National Roads Authority (2008): Guidelines on Procedures for Assessment and Treatment of Geology, Hydrology and Hydrogeology for National Road Schemes;

- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018); and,
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended by 2014/52/EU), (European Commission 2017).

8.2 Methodology

8.2.1 Desk Study

A desk study of the Proposed Project Study Area was completed in advance of undertaking the walkover surveys and site investigations. This involved collecting all relevant geological data for the Proposed Project Study Area. This included consultation with the following data sources between January 2024 and February 2026:

- Environmental Protection Agency database (www.epa.ie);
- Geological Survey of Ireland - Groundwater and Geology Databases (www.gsi.ie);
- Geological Survey of Ireland – Geological Heritage site mapping (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 17 (Geology of Shannon Estuary). Geological Survey of Ireland (GSI, 1999);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets;
- General Soil Map of Ireland 2nd edition (www.epa.ie); and,
- Aerial Photography, 1:5000 and 6 inch base mapping.

8.2.2 Baseline Monitoring and Site Investigations

A walkover survey, including geological mapping and investigations of the Site, were undertaken by David Broderick of HES (refer to Section 8.1.2 above for qualifications and experience) on 11th September and 21st November 2019, 28th and 29th March, 26th April, 18th July 2024, and 29th July and 2rd October 2025.

The following geotechnical reports were prepared by Fehily and Timoney (FT) in support of the application:

- Geotechnical and Peat Stability Risk Assessment (**Appendix 8-1**)
- Peat and Spoil Management Plan (**Appendix 4-3**)

A total of no. 583 peat probes were carried out at the Site by FT, MKO and HES since 2019. Ground investigations were carried out at the Proposed Wind Farm by Irish Drilling Limited (IDL) under the supervision of FT in September 2019, with further ground investigation undertaken during January and September 2024. Ground investigations in the form of trial pits were carried out on the following dates:

- 18th and 19th September 2019 (14 no.);
- 3rd to the 9th January 2024 (17 no.); and,
- 30th September 2024 (5 no.).

The trial pits (36 no. in total) were carried out at various locations across the Proposed Wind Farm to provide information on the ground conditions and depth to bedrock. In addition, two rotary cored boreholes were undertaken at the 2 no. proposed borrow pit locations (BP1 and BP2) on the 3rd and 4th January 2024 as confirmatory investigations.

The objectives of the intrusive site investigations included mapping the distribution and depth of peat and mineral subsoils at the Proposed Wind Farm along with assessing the mineral subsoil / bedrock conditions at key Proposed Project locations (i.e. proposed turbines, temporary construction compound,

existing and proposed access roads, peat and peat/spoil repository areas, borrow pits and substation). This robust data set was used to inform the impact assessment and final layout design.

In summary, site investigations to address the Land, Soil and Geology section of the EIAR included the following:

- Walkover surveys and geological mapping of the Site area were undertaken to assess general ground conditions;
- A total of 583 no. peat probes were undertaken by HES, MKO and FT to determine the thickness and geomorphology of the peat overlying parts of the Site;
- Trial pitting (36 no.) by FT and gouge cores (10 no.) by HES to investigate soil, peat and mineral subsoil lithology as well as depth to bedrock;
- Investigation drilling by IDL (2 no. boreholes under supervision of FT) to determine the full geological profile of the Site (i.e. peat, mineral subsoil and bedrock profile) and groundwater conditions;
- Laboratory testing (classification testing for overburden material rock strength testing); and,
- Mineral subsoils and peat were logged according to BS: 5930 and Von Post Scale respectively.

The Geotechnical and Peat Stability Assessment report prepared by FT (which includes the IDL trial pit and borehole logs) is included as **Appendix 8-1** of this EIAR.

8.2.3 Scoping and Consultation

The scope for this chapter of the EIAR has also been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process and the list of Consultees is outlined in Section 2.5 of this EIAR.

The Geological Survey of Ireland (GSI) and the Health Service Executive (HSE) were the only bodies to repond with regard matters relating to land, soils and geology as summarised in **Table 8-1** below.

Also, the GSI provided a standard response which recommended the use of their publicly available geological data sets in the preparation of the EIAR. These data sets, available to view at www.gsi.ie, have been used in the preparation of this chapter as detailed in Section 8.2.1 above.

Table 8-1 Summary Scoping Responses

Consultee	Matters Raised - Description	Addressed in Sections
Geological Survey of Ireland (GSI)	*"County Geological Sites (CGSs); The audit for Co. Clare was completed in 2005. Our records show that there are no CGSs in the vicinity of the proposed EIAR Site Boundary".*	Section 8.3.6
HSE	*"A detailed assessment of the current ground stability of the site for the proposed windfarm development and all proposed mitigation measures should be detailed in the EIAR. The assessment should include the impact construction work may have on the future stability of ground conditions, taking into consideration extreme weather events, site drainage and the potential for soil erosion".* *"Information should be provided on the make and model of the turbines and on construction details for the turbine foundations, including the depth*	Sections 8.3.3.2, 8.3.3.3, 8.3.4.2, 8.3.4.3, 8.3.9, 8.3.10, 8.7.2.4 and 8.7.2.5 **Appendix 8-1** Geotechnical and Peat Stability Assessment **Appendix 4-3** Peat and Spoil Management Plan

Consultee	Matters Raised - Description	Addressed in Sections
	and volume of concrete required. An accurate assessment of the potential impacts of the foundations on water quality and peat stability cannot be undertaken without this information".	

8.2.4 Impact Assessment Methodology

Using information from the desk study and data from the site investigation, an estimation of the importance of the soil and geological environment within the study area is assessed using the criteria set out in **Table 8-2** (NRA, 2008).

Table 8-2 Estimation of Importance of Soil and Geology Criteria (NRA, 2008)

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 underlying site is significant on a local scale.	Contaminated soil on site with previous heavy industrial usage. Large recent landfill site for mixed wastes Geological feature of high value on a local scale (County Geological Site). Well drained and/or highly 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.	Large historical and/or recent site for construction and demolition wastes. Small historical and/or recent landfill site

Importance	Criteria	Typical Example
	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.	for construction and demolition wastes. Poorly drained and/or low fertility soils. Uneconomically extractable mineral Resource.

The guideline criteria (EPA, 2022) for the assessment of impacts require that likely impacts are described with respect to their extent, magnitude, complexity, probability, duration, frequency, reversibility and transfrontier nature (if applicable). The descriptors used in this environmental impact assessment report are those set out in EPA (2002) Glossary of Impacts as shown in Chapter 1 of this EIAR. In addition, the two impact characteristics proximity and probability are described for each impact and these are defined in **Table 8-3**.

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of impacts are related to examples of potential impacts on the hydrology and morphology[1] of the existing environment, as listed in **Table 8-4.**

Table 8-3 Additional Impact Characteristics.

Impact Characteristic	Degree/ Nature	Description
Proximity	› Direct	An impact which occurs within the area of the proposed project, as a direct result of the proposed project.
	› Indirect	An impact which is caused by the interaction of effects, or by off-site developments.
Probability	› Unlikely	A low likelihood of occurrence of the impact.
	› Likely	A medium likelihood of occurrence of the impact.

Table 8-4 Impact descriptors related to the receiving environment.

Impact Characteristics		Potential Geological and Hydrological Impacts
Quality	Significance	
Negative only	› Profound	Widespread permanent impact on: › The extent or morphology of a cSAC. › Regionally important aquifers. › Extents of floodplains. Mitigation measures are unlikely to remove such impacts.

[1] *Geological form or structure*

Impact Characteristics		Potential Geological and Hydrological Impacts
Quality	Significance	
Positive or Negative	› Significant	Local or widespread time dependent impacts on: › The extent or morphology of a cSAC / ecologically important area. › A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features). › Extent of floodplains. Widespread permanent impacts on the extent or morphology of an NHA/ecologically important area. Mitigation measures (to design) will reduce but not completely remove the impact – residual impacts will occur.
Positive or Negative	› Moderate	Local time dependent impacts on: › The extent or morphology of a cSAC / NHA / ecologically important area. › A minor hydrogeological feature. › Extent of floodplains. Mitigation measures can mitigate the impact OR residual impacts occur, but these are consistent with existing or emerging trends.
Positive, Negative or Neutral	› Slight	Local perceptible time dependent impacts not requiring mitigation.
Neutral	› Imperceptible	No impacts, or impacts which are beneath levels of perception, within normal bounds of variation, or within the bounds of measurement or forecasting error.

8.2.5 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Land, Soils and Geology Chapter of the EIAR. The site investigations and follow up monitoring carried out were detailed and exhaustive for the purpose of assessing effects on Land, Soils and Geology and also for Proposed Project infrastructure design.

8.3 Existing Environment

8.3.1 Site Description and Topography

The Proposed Wind Farm is located approximately 4.3km northwest of Kilmihil and 4.7km northeast of Creegh, Co. Clare.

The Proposed Wind Farm is accessed via local roads from the R483 Regional Road, which travels north-south ~3.2km to the west of the proposed Proposed Wind Farm, the R484 Regional Road which travels east-west between Kilmihil and Creegh and the L-2048 local road, which travels in a northeast-southwest direction between Kilmaley and Creegh.

The Proposed Wind Farm itself is served by several kilometers of existing forestry tracks that enter mainly from the west. These existing forestry tracks have been in operation for a significant number of years. It is proposed that up to 5km of these existing tracks will be utilised by the Proposed Wind Farm.

The Proposed Wind Farm comprises mainly of coniferous forestry planted on blanket bog with some poorly draining agricultural land on the east of the Site along with turbary peat cutting. The existing Cahermurphy Windfarm is located immediately to the east of the proposed Proposed Wind Farm.

The elevation of the Proposed Wind Farm site, which has a total area of ~375ha, ranges between 80 – 150mOD (metres above Ordnance Datum) with the overall drop in elevation towards the west. The Proposed Wind Farm infrastructure is located across an east – west orientated ridge which slopes away to the north, south and west within the Proposed Wind Farm. The majority of the ridge slopes steadily in a south-westerly direction from the topographic high point which exists on the east of the Proposed Wind Farm (150m OD). The north facing aspect of the ridge slopes more steeply to the northwest. The lower-lying lands to the north and south of the ridge have a more undulating topography.

The Proposed Grid Connection includes for underground 110kV (kilovolt) electrical cabling from the proposed on-site 110kV electrical substation within the Proposed Wind Farm to the existing Moneypoint 110kV electrical substation in the townlands of Carrowdotia South and Carrowdotia North, south County Clare. The underground cable route measures approximately 25km in length and is located mainly within the corridor of third class public roads along with some agricultural land.

The proposed Turbine Delivery Route (TDR) to the Proposed Wind Farm is from Shannon Foynes Port, via the N68 National Secondary Road. This will require accommodation works such as minor road widening (3 no. locations) and temporary access road construction through agricultural land (3 no. locations) between the N68 and the Proposed Wind Farm.

A total of 123.74ha of Hen Harrier Enhancement lands are being proposed for the benefit of hen harrier. The proposed Hen Harrier Enhancement lands comprise areas of heath/bog, forestry, scrub and grassland located to the northeast of the Proposed Wind Farm, just south of Doo Lough.

The Hen Harrier Enhancement lands comprise 6 no. separate parcels of forestry dominated as well as agricultural lands that extend approximately 7km inland to the northwest of the Proposed Wind Farm.

8.3.2 Land Cover and Land Use

Accordidng to EPA Corine mapping (2018) mapping, the Proposed Wind Farm comprises forest and semi-natural areas, agricultural land and wetlands. The Proposed Grid Connection and TDR route is largely surrounded by agricultural land with pockets of forest and semi-natural areas and wetlands.

Current land-use on the Proposed Wind Farm comprises coniferous forestry under Coillte management, peat bog and third-party lands currently being used for agriculture and forestry.

Current land-use along the Proposed Grid Connection comprises primarily of public road corridor, as well as some instances of private land. The TDR also uses sections of private agricultural lands at the accomodation and temporary access road works areas.

Land-use in the wider landscape comprises a mix of agriculture, low density residential, renewable energy generation and commercial forestry.

8.3.3 Soils and Subsoils

8.3.3.1 GSI Mapping

The published Teagasc soils map (www.gsi.ie) for the Proposed Wind Farm shows that blanket peat is the dominant soil type with areas of poorly draining mineral soil (AminPD) and poorly drained peaty soil (AminPDPT) being mapped along the central ridgeline, the west and southeast of the Proposed Wind Farm.

According to GSI subsoil mapping (www.gsi.ie), blanket peat is mapped to underlie most of the Proposed Wind Farm with glacial till derived from Namurian sandstones and shales (TNSSs) mapped along the central ridgeline and on the west of the Proposed Wind Farm. Bedrock outcrop or subcrop is mapped on the southeast along with some pockets of gravels. GSI subsoil mapping is shown as **Figure 8-1** below.

Similar subsoils types to those present at the Proposed Wind Farm are mapped along the Proposed Grid Connection and TDR. However, the TDR accommodation works and temporary access road works area located in areas mapped as Namurian sandstones and shales glacial tills.

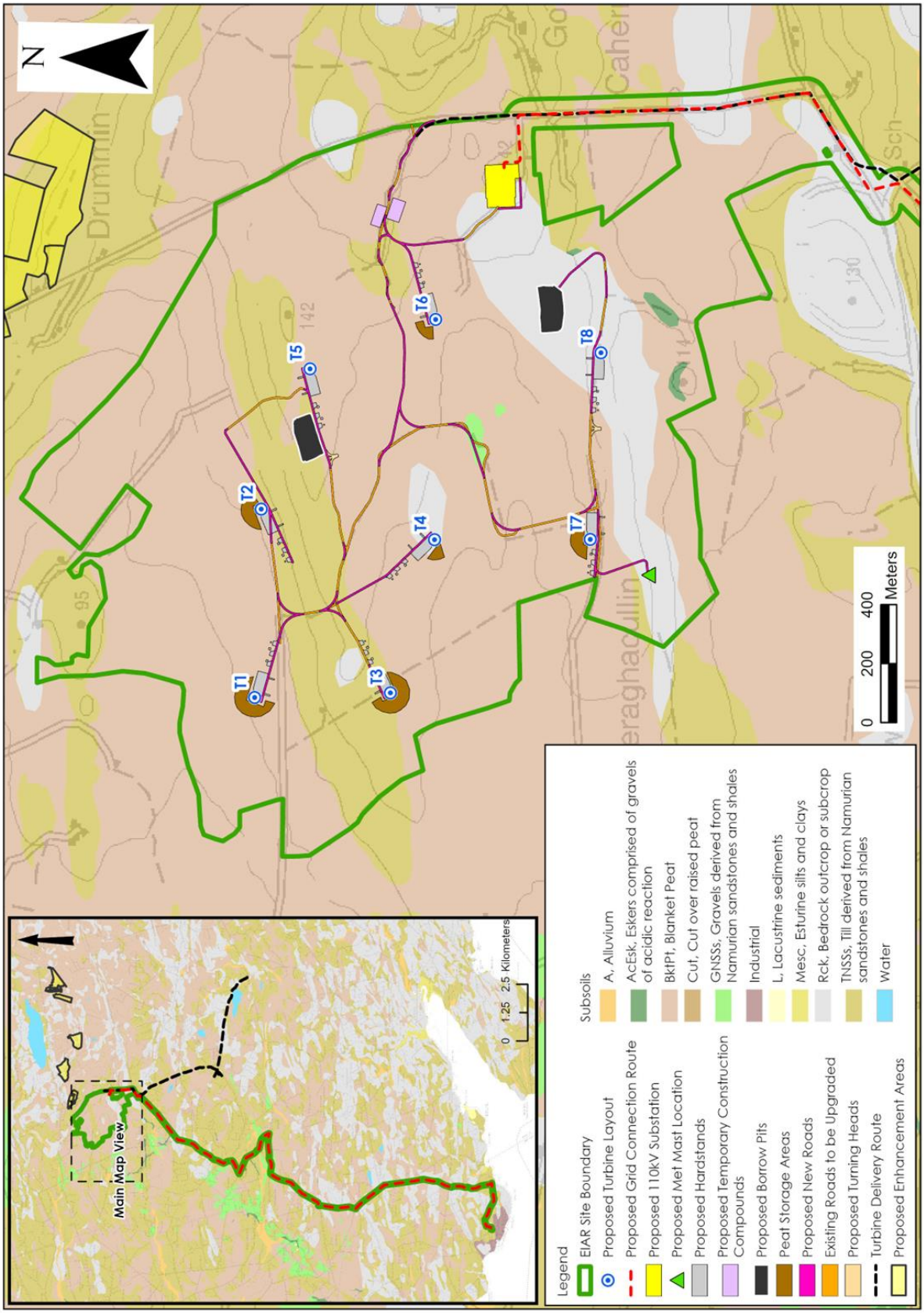

Figure 8-1: GSI Subsoils Mapping

8.3.3.2 Peat Depth Probing

A total of 583 no. peat depth probes were carried out at the Proposed Wind Farm by FT, MKO and HES since 2019. Peat depths recorded across the proposed Proposed Wind Farm ranged from 0.1 to 6.1m with an average depth of 0.7m. This is considered shallow for upland blanket bog.

Approximately 55% of recorded peat depth were less than 0.5m, 74% less than 1m and with 91% of less than 2.0m. A number of localised readings (around 3%) were recorded where peat depths were between 3.0 and 6.1m. The deepest peat area was recorded within the Proposed Hen Harrier Enhancement Lands, where no permanent development is proposed. A peat depth distribution plot for all 583 no. data points is shown as **Figure 8-2** below.

The average peat depth recorded at the proposed 8 no. turbine locations varied from 0.25 to 1.6m. Please refer to the **Table 8-5** for peat depths at turbine locations. The overall average peat depth across the 8 no. turbines was 1m.

With respect to the new proposed access roads, peat depths are typically less than 1.0m (average 0.55m) with localised depths of up to 3.3m recorded at a stream crossing to the north of T07.

At the 2 no. proposed borrow pit locations, peat depths are very shallow (<0.5m).

A summary of peat depths at the Proposed Wind Farm infrastructure is shown on **Table 8-5** below. A summary peat depth map for the Proposed Wind Farm is shown as **Figure 8-3** below.

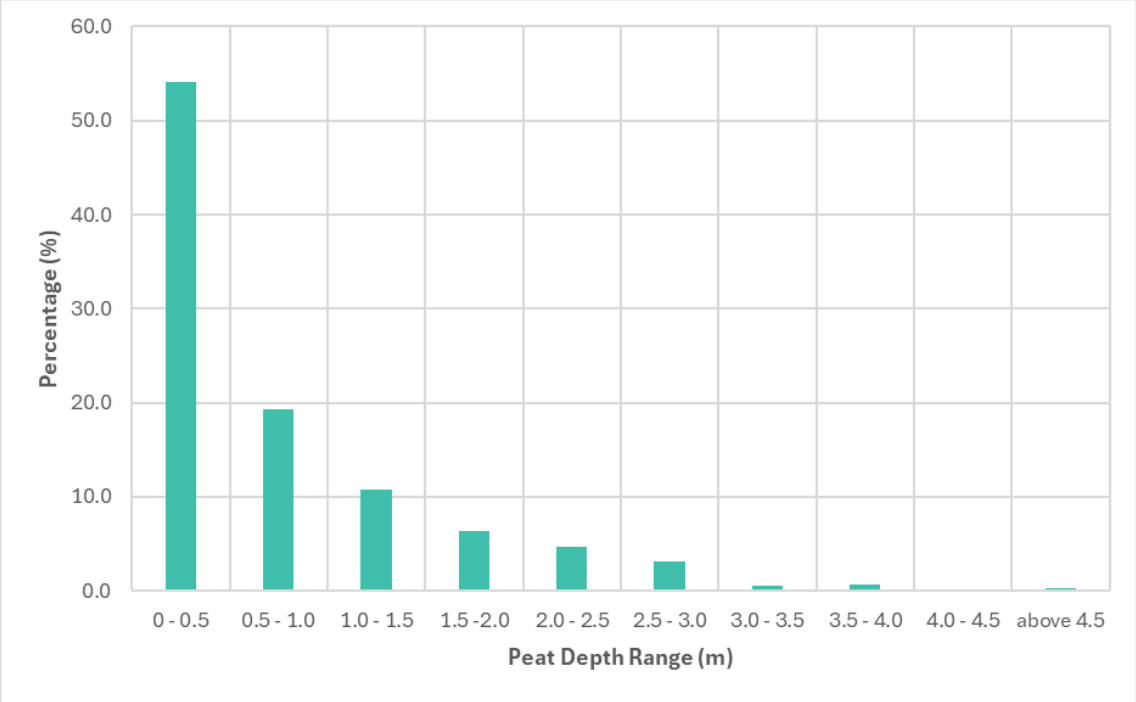

Figure 8-2: Peat Depth Distributiton Plot

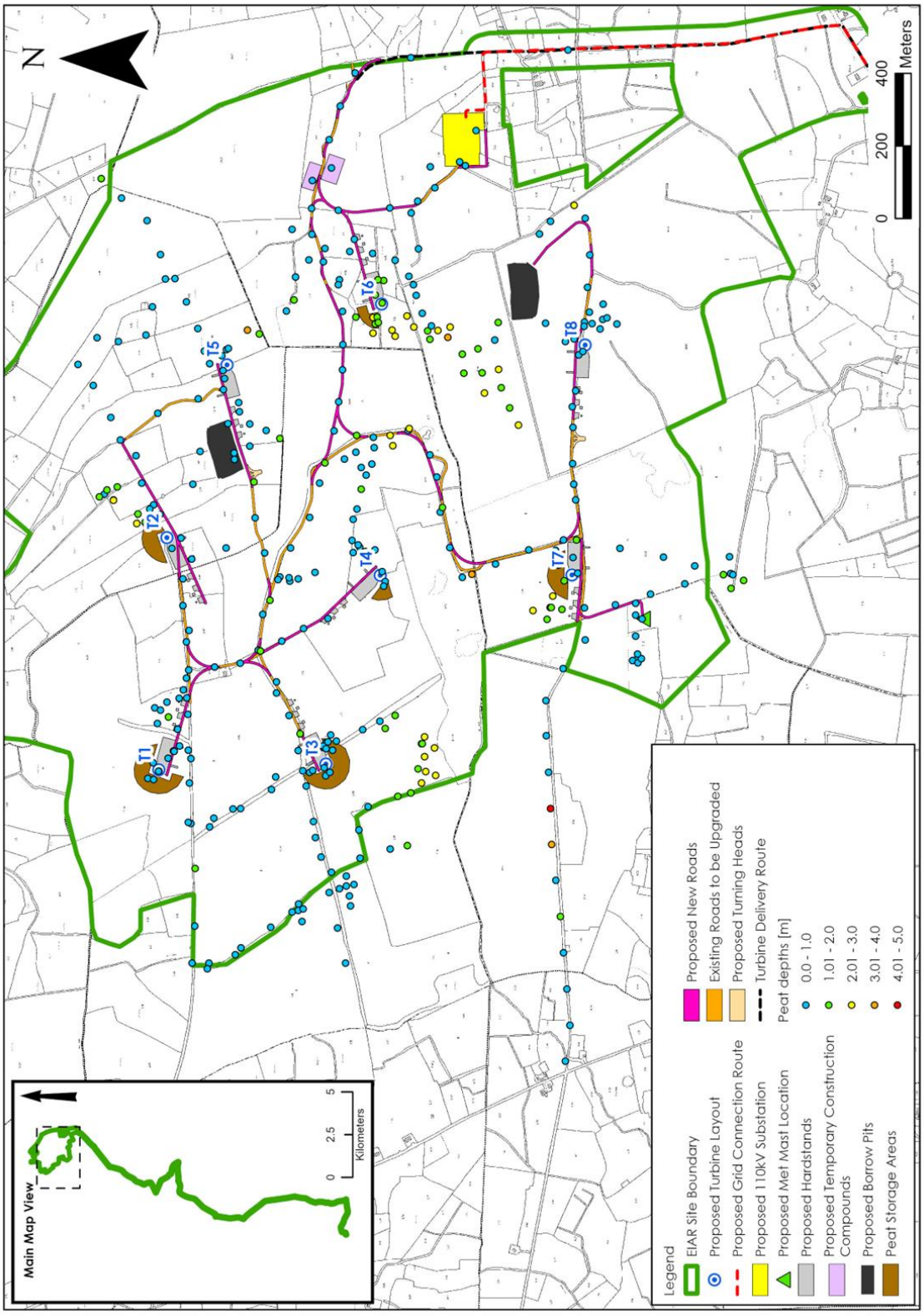

Figure 8-3: Summary Peat Depth Map

8.3.3.3 Trial Pit Investigations

The ground investigation by IDL comprised 14 no. trial pits (2019), 17 no. trial pits (January 2024) and 5 no. trial pits (September 2024) with associated laboratory testing. The trial pits were carried out at various locations across the proposed Proposed Wind Farm to provide information on the ground conditions, and to investigate the potential to develop borrow pits within the Proposed Wind Farm. A site investigation map is shown as **Figure 8-4** below.

The Geotechnical and Peat Stability Assessment report prepared by FT (which includes the IDL trial pit and borehole logs) is included as **Appendix 8-1** of this EIAR.

Mineral subsoils were typically described as firm to stiff, slightly sandy, gravelly SILT/CLAY or SILT over silty sandy GRAVEL which is underlain by presumed bedrock or cobbles and boulders at some locations.

Obstruction (refusal) on bedrock (presumed) was recorded in 17 of the 36 no. trial pits (47%). The bedrock was typically described as weathered and presenting as angular gravel and cobbles of shale/siltstone. The depth to bedrock at the 17 no. locations ranged between 0.3m and 4.1m with an average of 1.6m. Trial pits that encountered bedrock were distributed throughout the Site indicating relatively shallow bedrock across the overall Proposed Project footprint area.

Also, obstruction/refusal on boulders was recorded at another 7 no. locations which likely indicates the top of bedrock is close underneath. Obstruction/refusal means the trial pit could not be progressed deeper due to competent ground.

Bedrock was met at 4 no. turbine locations (T2, T3, T5 and T6) with depths ranging from 0.8m (T2) to 3mbgl (metres below ground level) (T6). Where bedrock was not presumed, refusal was typically on cobbles and boulders suggesting top rock is close at the other 4 no. turbine locations.

Bedrock was also encountered at the 2 no. proposed borrow pit locations (BP1 and BP2) where overburden depths of 2.4m and 0.5m were confirmed respectively. Competent bedrock at depth was then confirmed by investigation drilling (see Section 8.3.4.3) down to a depth of 17mbgl.

Bedrock below the proposed substation location was encountered at 3.7m during trial pitting.

A summary of trial pit investigations at the Proposed Wind Farm infrastructure is shown on **Table 8-5** below.

Table 8-5 Summary of Trial Pit Investigations at Proposed Wind Farm Infrastructure

Location ID	Site Investigation ID	Probe Average Peat Depth (m)	Presumed Depth to Bedrock (mbgl)	Summary of Mineral Subsoil Lithology
T1	TP02	0.5	>3.3	GRAVEL with cobbles and boulders
T2	TP02 & TP04A	0.25	0.8 - 1.45	SILT over cobbles and boulders
T3	TP01A	0.45	0.9	Gravelly sandy SILT
T4	GCT4	1.1	ND	Gravelly SILT
T5	TP15A	0.35	1.2	SILT over GRAVEL with cobbles and bounders
T6	TP04	1.6	3	Gravelly SILT over GRAVEL with cobbles and bounders
T7	TP11A	0.7	>3.1	Peat SILT over GRAVEL with cobbles and bounders
T8	TP16A	0.4	>1.7	Gravelly SILT over SAND & GRAVEL with cobbles and boulders
Substation	SS01-TP01	0.1	3.7	Slighty gravelly SILT over GRAVEL with cobbles and boulders
Construction Compound	TP05	0.5	>2.90	Gravelly SILT with occasional cobbles and boulders
Borrow Pit 1	TP03 & BP01	0.35	2.4 – 4.1	SILT and GRAVEL/GRAVEL with frequent cobbles and boulders
Borrow Pit 2	TP06A, TP06B & BP2	0.45	0.5	SILT with cobbles and boulders

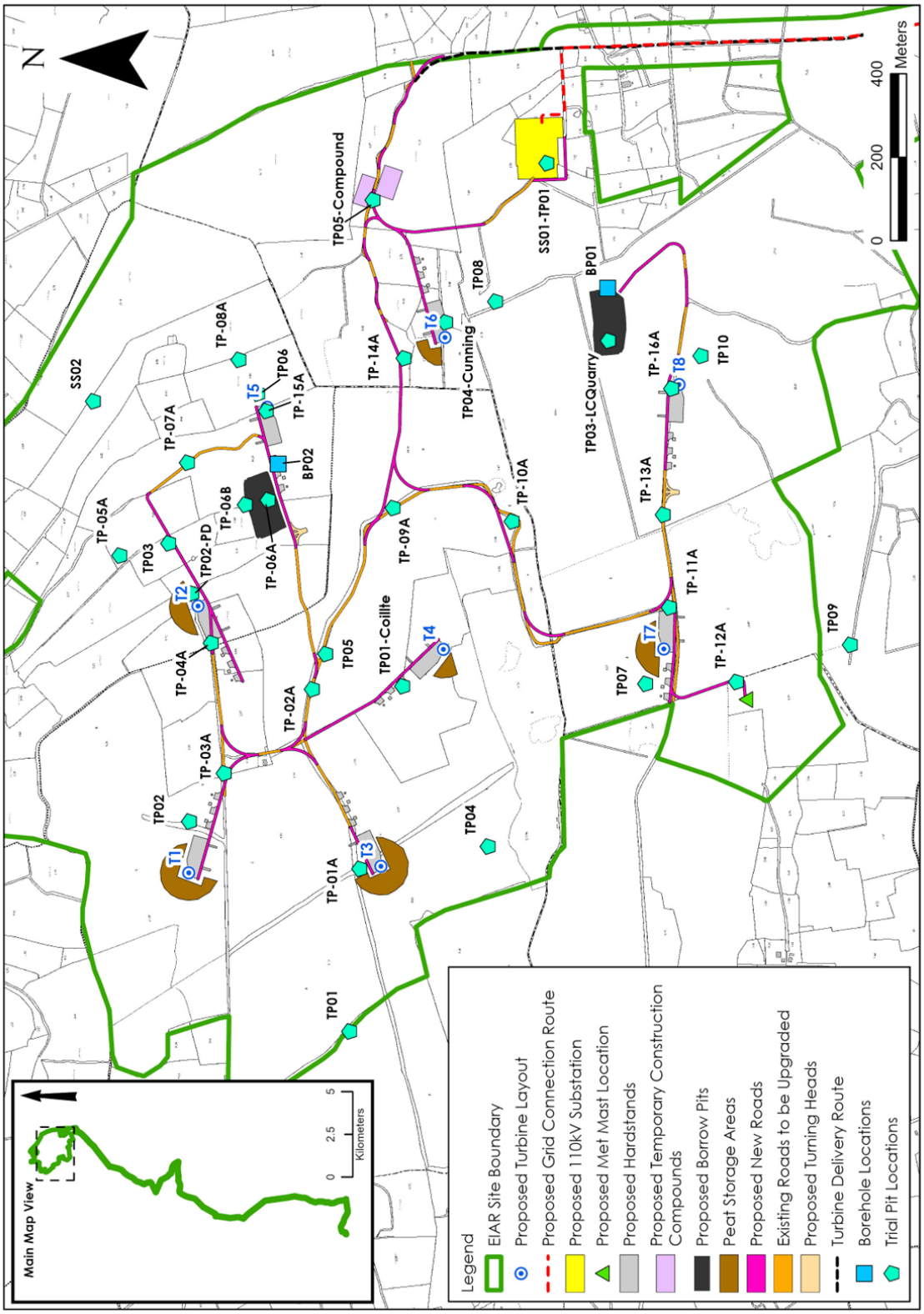

Figure 8-4: Proposed Wind Farm Investigation Map

8.3.4 Bedrock Geology

8.3.4.1 GSI Mapping

According to GSI bedrock mapping, the majority of the Proposed Wind Farm (including all Proposed Wind Farm infrastructure) is underlain by the Gull Island Formation which is described as grey Namurian SILTSTONE and SANDSTONE. Refer to **Figure 8-5** for GSI bedrock mapping.

Smaller portions of the Proposed Wind Farm on the northwest and southeast are mapped to be underlain by the Central Clare Group which is described as SANDSTONE, SILTSTONE & MUDSTONE (Namurian Undifferentiated).

There are some bedrock exposures visible along the central ridgeline of the Proposed Wind Farm near proposed Borrow Pit no. 2, where the bedrock was noted to comprise of broken, slightly weathered, blocky SANDSTONE clasts (refer to **Plate 8-1** below).

A thin band of marine goniatite rock seperates the Gull Island Formation from the Central Clare Group to the south and west.

The majority of the Proposed Grid Connection route and TDR are also underlain by Central Clare Group with small sections along the central section of the route underlain by the Gull Island Formation.

There are no mapped fault lines on the Site or the immediate surrounding study area.

Plate 8-1: Bedrock Exposures at Proposed Borrow Pit 2 (Photograph taken from south of BP location)

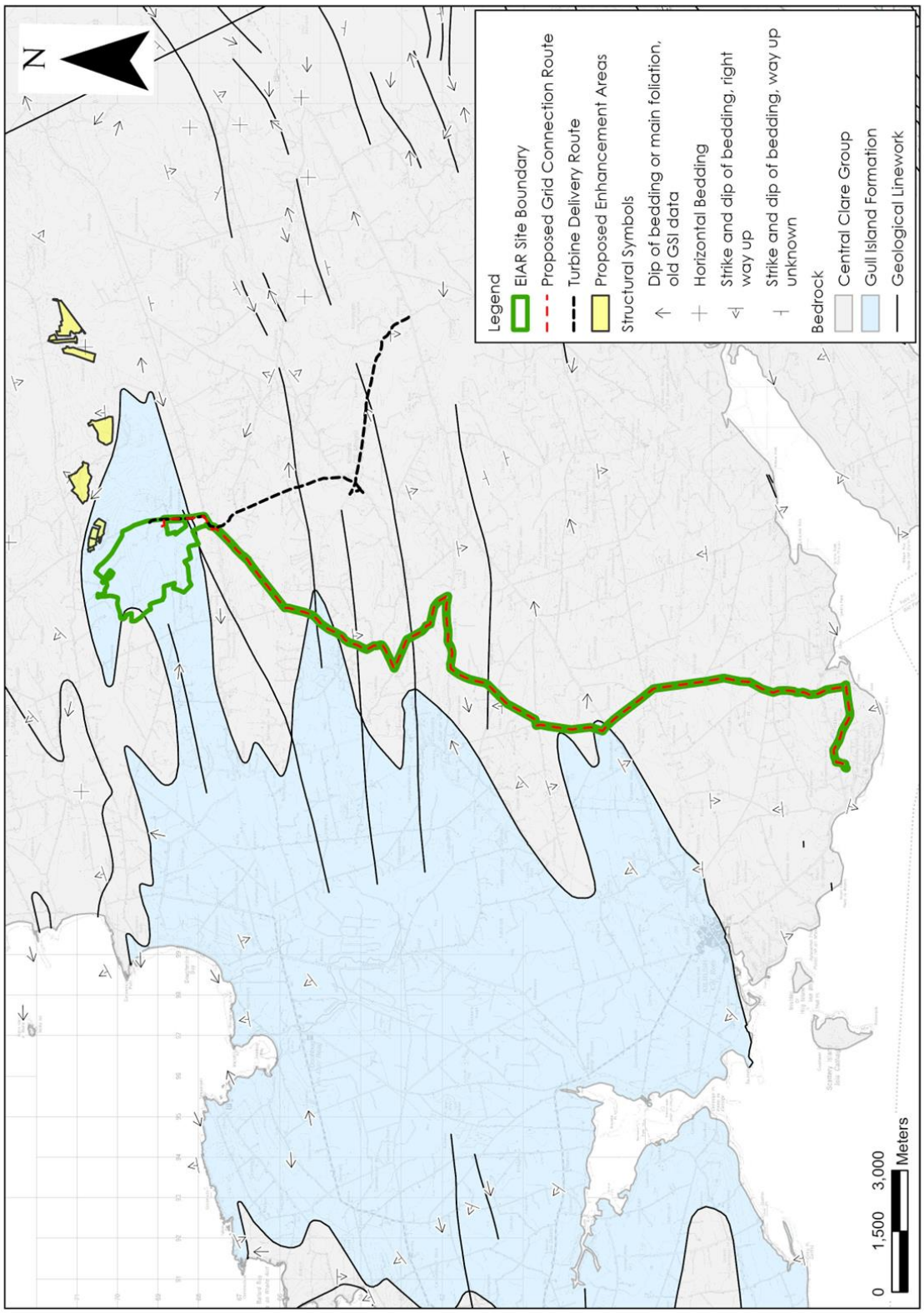

Figure 8-5 : GSI Bedrock Geology Map

8.3.4.2 Trial Pit Investigations

Weathered bedrock was encountered in 17 of the 36 nos. trial pits (47%). The weathered bedrock was described as angular gravel and cobbles of SHALE/SILTSTONE.

Obstruction/refusal on boulders was recorded at another 7 no. locations which likely indicates the top of bedrock is close underneath.

8.3.4.3 Rotary Core Drilling

1 no. rotary cored borehole was undertaken at each of the 2 no. proposed borrow pit locations (BP01 and BP02) on the 3rd and 4th January 2024 to confirm the suitability of the rock as a base layer for hardstand and access road construction. Refer to **Figure 8-4** above for the borehole locations.

The drilling also confirmed the competency of the underlying bedrock for the purpose of permanent peat storage at the borrow pits post construction.

A summary of the drilling logs is shown in **Table 8-6** below. Refer to **Appendix 8-1** for the complete IDL drilling logs.

RC-BP1 was drilled to a depth of 17m and encountered weathered SILTSTONE between 3.9 and 4.5mbgl. Strong to medium dark grey SILTSTONE was encountered for the remainder of the hole down to 17mbgl (107.7m OD).

RC-BP2 encountered strong, greenish grey SANDSTONE between 2.6 and 5.4mbgl. Weak to medium strong dark grey SILTSTONE was encountered for the remainder of the hole down to 17.1mbgl (112.8m OD).

No fractures, faults or jointing (i.e. potential groundwater flowpaths) were encountered at either drilling location. Total Core Recovery (TCR) was 100% in both boreholes, while Solid Core Recovery (SCR) was 94%.

Table 8-6 Summary of Borrow Pit Drilling Investtigations

BH ID	Depth Range (m bgl)	Summary Description
RC-BP01	0 – 3.9 3.9 to 4.5 4.5 to 17	Overburden Non-intact weathered bedrock (fine grained SILTSTONE). Strong to medium strong, thinly bedded, dark grey, fined grained SILTSTONE.
RC-BP02	0 - 2.6 2.6 to 5.4 5.4 to 17.1	Overburden Strong thinly bedded greenish grey fine and medium grained SANDSTONE. Weak and medium strong, locally strong thinly bedded grey and dark grey fine grained SILTSTONE.

8.3.5 Geological Resource Importance

The siltstone/sandstone bedrock at the Proposed Wind Farm can be classified as being of "Low" importance because it is locally abundant. The bedrock could be used on a "sub-economic" local scale for construction purposes.

The peat deposits at the Proposed Wind Farm are classified as "Low" importance as the peat is not designated in this area and is significantly degraded in most places at the site as a result of forestry related drainage, rill ploughing and turbary peat cutting. Similar peat depoists are also locally abundant in the study area. Refer to **Table 8-2** above for criteria.

8.3.6 Geological Heritage Sites and Designated Sites

There are no GSI mapped County Geological Heritage sites within 10km of the Site.

Within the Republic of Ireland designated sites include Natural Heritage Areas (NHAs), Proposed Natural Heritage Areas (pNHAs), Special Areas of Conservation (SACs), candidate Special Areas of Conservation (cSAC) and Special Protection Areas (SPAs). The Proposed Project site does not interact with any designated site.

Designated sites downstream of the Site include the Mid-Clare Coast SPA (Site Code 004182), Carrowmore Point to Spanish Point and Islands SAC (Site Code 001021), White Strand/Carrowmore Marsh pNHA (Site Code 001007), Carrowmore Dunes (Side Code 002250), River Shannon and River Fergus SPA (Site Code 004077) and Lower River Shannon SAC (i.e. Shannon Estuary).

These designated sites are located approximately 7.5km to the west of the Proposed Wind Farm.

The Cragnashingaun Bogs NHA (Site Code: 002400) is located 2.3km east of the Proposed Wind Farm infrastructure, however, one of the Hen Harrier Enhancement areas is located within Cragnashingaun Bogs NHA.

Refer to **Figure 8-6** below for designated sites and County Geological Heritage sites.

Hydrologically connected Designated Sites downstream of the Site are assessed in Chapter 9 (Hydrology/hydrogeology).

8.3.7 Soil Contamination

There are no known areas of soil contamination on the Site. During the site walkovers and extensive site investigations, no areas of contamination concern were identified.

According to the EPA online mapping (http://gis.epa.ie/Envision), there are no licensed waste facilities on or within the immediate environs of the Site.

There are no historic mines at or in the immediate vicinity of the Site that could potentially have contaminated tailings.

8.3.8 Economic Geology

The GSI online Aggregate Potential Mapping Database shows that the Proposed Wind Farm is located within an area mapped as being typically Low to Moderate in terms of crushed rock aggregate potential and with no potential for granular aggregate potential (i.e. potential for gravel reserves).

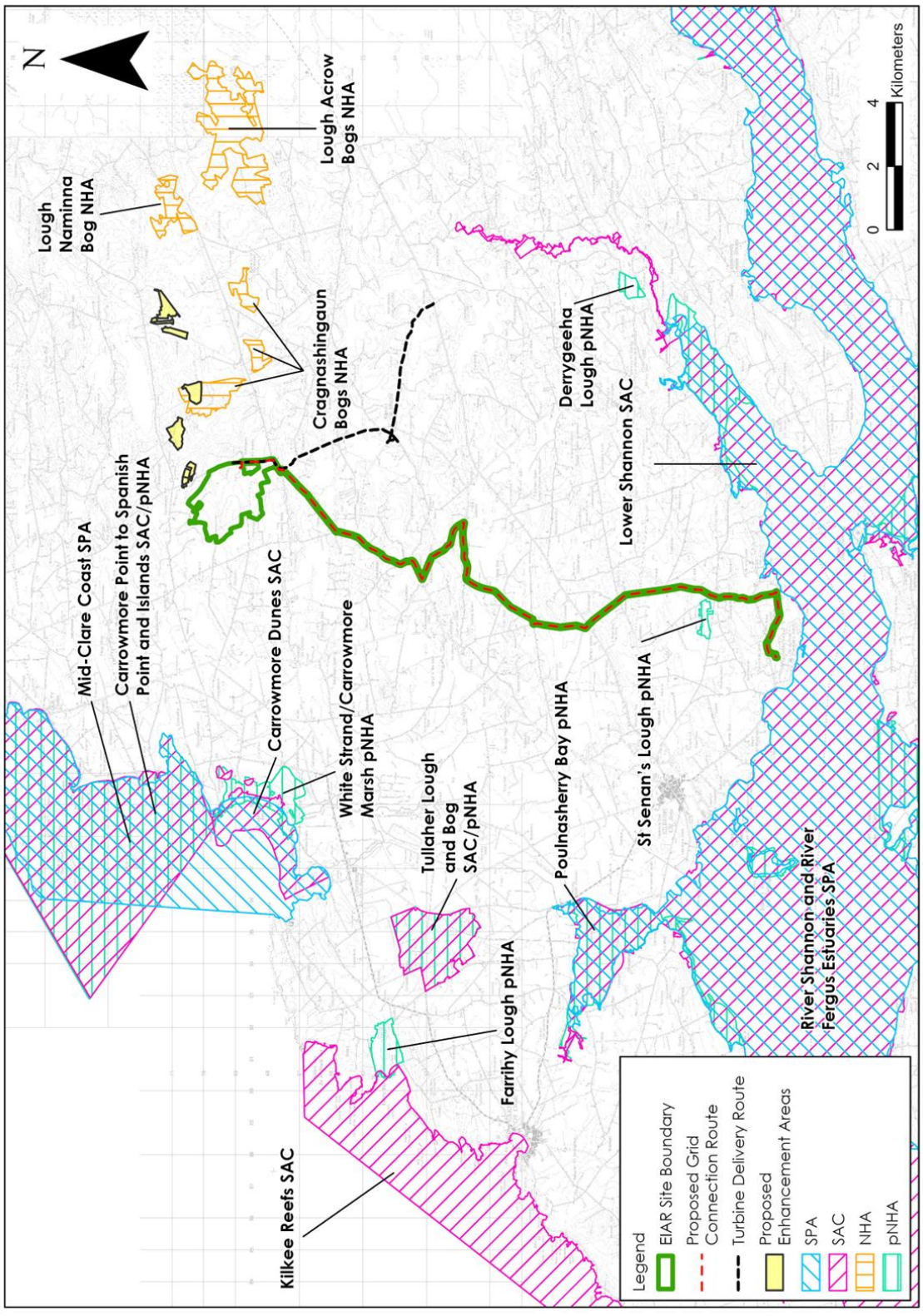

Figure 8-6 : Designated Sites and Geological Heritage Sites

8.3.9 Geohazards

The GSI Landslide database (www.gsi.ie) does not record any historic landslides in the vicinity of the Site or in the surrounding lands.

The GSI Landslide Susceptibility Map (www.gsi.ie) classifies the probability of a landslide occurring at a given location. The Proposed Wind Farm is mapped as having Low to Moderately High susceptibility which would be typical given the presence of blanket bog.

Refer to Section 8.3.10 below for a summary of the Geotechnical and Peat Stability Risk Assessment (**Appendix 8-1**) which was carried out by FT. All Proposed Project infrastructure elements are located in areas of low risk of peat instability. There is no possibility of karst features being present due to the bedrock geology type.

8.3.10 Peat Stability Assessment

A Geotechnical and Peat Stability Assessment Report (FT, February 2026) is attached in **Appendix 8-1**. Summary data and conclusions from that report are provided below.

8.3.10.1 Introduction

Fehily Timoney and Company (FT) was engaged to undertake a geotechnical and peat stability assessment of the Proposed Wind Farm. Given the absence of peat along the Propsoed Grid Connection route, and the fact that 96% of the route lies within the public road corridor, this component of the Proposed Project was not modelled due to an absence of peat or stability issues.

Hydrological, hydrogeological and ecological factors were also assessed in the Geotechnical and Peat Stability Assessment Report, and interaction between FT, HES and MKO was undertaken throughout the iterative design process. The assessment was done in accordance with guidance contained in Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (PLHRAG, Scottish Government, 2017).

A constraints study was initially undertaken by the Environmental (MKO), Hydrological (HES) and Ecological (MKO) members of the project design team to determine the developable area on the Site, prior to the site reconnaissance by engineering geologists/geotechnical engineers from FT.

8.3.10.2 Hydrological Considerations

The hydrological factors with regard to peat stability were assessed using a combination of desk study data, aerial photography (historical and contemporary), topographic lidar data flow path drainage analysis, site walkovers, field drainage mapping and gouge coring. Detailed drainage maps were prepared along with hydrological constraints mapping for on-site drainage features and wet areas.

Many of the pre-conditions as described by (PLHRAG, Scottish Government, 2017) are hydrological in nature and are listed in the guidance as follows:

- Impeded drainage caused by a peat layer overlying an impervious clay or mineral base (hydrological discontinuity, especially an iron pan at the base of the peat deposit);
- A convex slope or a slope with a break of slope at its head (concentration of subsurface flow);
- Proximity to local drainage, either from flushes, pipes or streams (supply of water); and,

- Connectivity between surface drainage and the peat/impervious interface (mechanism for generation of excess pore pressures).

Identifying any pre-conditions at the Proposed Wind Farm was a key part of the hydrological constraints assessment carried out in conjunction with project design team.

8.3.10.3 Peat Slides – Lessons Learned

This peat stability assessment has been undertaken taking into account peat failures that have occurred on peatland sites (such as recent failures at Shass Mountain 2020, Co. Leitrim and Meenbog 2020, Co. Donegal) on a national level. The lessons learned from both peat slide events have been incorporated into the design of this project and the construction methodologies to be implemented. The Meenbog failure occurred during the construction of a section of floating road on sidelong ground in an area of weak peat. It is important that the existing site drainage is maintained during construction to avoid a similar failure to that on Shass Mountain, which occurred following heavy rainfall, and this is referenced in the Risk Assessments for the turbines/access roads.

8.3.10.4 Peat Stability - Desk Study

The GSI Landslide Susceptibility Map (www.gsi.ie) classifies the probability of a landslide occurring. The landslide susceptibility of the proposed Proposed Wind Farm was classified by the GSI (2024) as ranging from “low” to “moderately high” susceptibility, which is expected given the terrain present (Blanket bog). This assessment is provided by the GSI as guide to the relative susceptibility of an area. The GSI mapping should not be treated as “Hazard” maps which show the potential to cause damage by frequency/probability or intensity or “Risk” maps which shows loss potential.

There are no recorded peat failures within and adjacent to the Proposed Project site recorded on the GSI database (GSI, 2024). The nearest recorded slope failure is located approximately 25km southeast of the study area. The failure recorded occurred in Ballyhahill, Co. Limerick. The slope failure in this area was an embankment landslide, the mechanism is undefined. An additional slope failure occurred approximately 29km northwest of the study area. The failure recorded occurred in Doonnagore, Co. Clare. The slope failure in this area was an embankment landslide, the mechanism is undefined.

8.3.10.5 Peat Stability Analysis

An analysis of peat sliding was carried out at all the main infrastructure locations across the proposed Proposed Wind Farm. The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes. The FoS provides a direct measure of the degree of stability of the slope. A FoS of less than 1.0 indicates that a slope is unstable, a FoS of greater than 1.0 indicates a stable slope.

The acceptable safe range for FoS typically ranges from 1.3 to 1.4. The previous code of practice for earthworks BS 6031:1981 (BSI, 1981), provided advice on design of earthworks slopes. It stated that for a first-time failure with a good standard of site investigation the design FoS should be greater than 1.3. For the purposes of this assessment, a design FoS of 1.4 has been adopted, as a precautionary approach.

Eurocode 7 (EC7) (IS EN 1997-1:2005) now serves as the reference document and the basis for design geotechnical engineering works. The design philosophy used in EC7 applies partial factors to soil parameters, actions and resistances. Unlike the traditional approach, EC7 does not provide a direct measure of stability, since global Factors of Safety are not used.

As such, and in order to provide a direct measure of the level of safety on a site, EC7 partial factors have not been used in this stability assessment. The results are given in terms of FoS.

The assigned probability of instability associated with a given FoS value is described in **Table 8-7** below. Hydrological and hydrogeological factors were also assessed in the Geotechnical and Peat Stability Assessment Report, and interaction between FT and HES was undertaken throughout the iterative design process.

No peat failures/landslides are recorded at or adjacent to the Proposed Wind Farm which suggests that site conditions do not pre-dispose themselves to failures/landslides.

The hand vane results indicate undrained shear strengths in the range 8 to 56kPa, with an average value of ~28kPa. The strengths recorded would be typical of well drained peat as is present at the Proposed Wind Farm. The lowest peat strength was recorded in an area of deep peat (6.1m) where no Proposed Wind Farm development is proposed and as such is not considered representative of the peat strength across the Proposed Wind Farm.

Table 8-7: Probability Scale for Factor of Safety.

Scale	Factor of Safety	Stability
1	> 1.40 or greater	Acceptable
2	> 1.0 to 1.4	Marginally Stable
3	> <1.0	Unstable

8.3.10.6 Peat Stability Assessment Results

Stability of a peat slope is dependent on several factors working in combination. The main factors that influence peat stability are slope angle, shear strength of peat, depth of peat, pore water pressure and loading conditions.

An adverse combination of factors could potentially result in peat sliding. An adverse condition of one of the above-mentioned factors alone is unlikely to result in peat failure. The infinite slope model (Skempton and DeLory, 1957) is used to combine these factors to determine a factor of safety for peat sliding. This model is based on a translational slide, which is a reasonable representation of the dominant mode of movement for peat failures.

To assess the factor of safety for a peat slide, an undrained[2] (short-term stability) and drained (long-term stability) analysis has been undertaken to determine the stability of the peat slopes on site.

The undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.

The drained loading condition applies in the long-term. The condition examines the effect of in particular, the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

As mentioned above, the Geotechnical and Peat Stability Assessment Report is attached in **Appendix 8-1**.

[2] *For the stability analysis two load conditions were examined, namely*

Condition (1): *no surcharge loading*
Condition (2): *surcharge of 10 kPa, equivalent to 1 m of stockpiled peat assumed as a worst case.*

8.3.10.6.1 Undrained Analysis

A summary of undrained analysis results are presented in **Table 8-8.** As outlined above the undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.

The undrained analysis for load condition 2 is considered the most critical load case as most peat failures occur in the short term upon loading of the peat surface.

The calculated FoS for load condition 1 is in excess of 1.40 for each of the locations (227 no. locations) analysed with a range of FoS of 2.16 to 343.84, indicating a low risk of peat instability. The FoS at the proposed infrastructure locations (wind turbines, substation, met mast, construction compounds and peat and spoil storage areas) ranged from 4.35 to 85.96 which is significantly above the 1.4 threshold.

The calculated FoS for load condition 2 is in excess of 1.40 for each of the locations (227 no. locations), analysed with a range of FoS of 1.72 to 31.26, indicating a low risk of peat instability. The FoS at the proposed infrastructure locations (wind turbines, substation, met mast, construction compounds and peat and spoil storage areas) ranged from 3.04 to 24.56 which is significantly above the 1.4 threshold.

Table 8-8: Summary Factor of Safety Results (undrained condition)

Turbine No./Waypoint	Factor of Safety for Load Condition	
	Condition (1)	Condition (2)
T1	12.76	6.04
T2	7.02	2.34
T3	85.96	24.56
T4	7.68	3.64
T5	14.37	5.39
T6	9.56	6.14
T7	5.74	3.83
T8	4.35	2.18
Substation	28.86	4.81
Met Mast	10.88	3.11
Construction Compound	17.24	5.75
Borrow Pit 1	13.82	4.61
Borrow Pit 2	6.41	3.04
T1 Storage Area	n/a	6.04
T2 Storage Area	n/a	2.34

Turbine No./Waypoint	Factor of Safety for Load Condition	
	Condition (1)	Condition (2)
T3 Storage Area	n/a	24.56
T4 Storage Area	n/a	3.64
T6 Storage Area	n/a	6.14
T7 Storage Area	n/a	3.83
Enhancement Area 1	3.28	2.55
Enhancement Area 2	2.16	1.72
Enhancement Area 3	3.25	1.89

8.3.10.6.2 *Drained Analysis*

Summary of drained analysis results are presented in **Table 8-9**. As outlined above, the drained loading condition applies in the long-term. The condition examines the effect of in particular, the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

The calculated FoS for load condition 1 is in excess of 1.40 for each of the locations (227 no. locations) analysed with a range of FoS of 1.44 to 229.23, indicating a low risk of peat instability. The FoS at the proposed infrastructure locations (wind turbines, substation, met mast, construction compounds and peat and spoil storage areas) ranged from 6.22 to 84.02.

The calculated FoS for load condition 2 is in excess of 1.40 for each of the locations (227 no. locations) analysed with a range of FoS of 2.48 to 45.13, indicating a low risk of peat instability. The FoS at the proposed infrastructure locations (wind turbines, substation, met mast, construction compounds and peat and spoil storage areas) ranged from 4.2 to 43.09.

Table 8-9: Suummary Factor of Safety Results (drained condition)

Turbine No./Waypoint	Factor of Safety for Load Condition	
	Condition (1)	Condition (2)
T1	8.5	8.71
T2	7.32	4.2
T3	84.02	43.09
T4	10.45	7.75
T5	16.25	10.26
T6	19.72	17.45

Turbine No./Waypoint	Factor of Safety for Load Condition	
	Condition (1)	Condition (2)
T7	12.72	11.45
T8	6.22	4.77
Substation	23.68	7.64
Met Mast	10.57	5.39
Construction Compound	18.16	10.50
Borrow Pit 1	14.54	8.40
Borrow Pit 2	8.71	6.46
T1 Storage Area	n/a	8.71
T2 Storage Area	n/a	4.20
T3 Storage Area	n/a	43.09
T4 Storage Area	n/a	7.75
T6 Storage Area	n/a	17.45
T7 Storage Area	n/a	11.45
Enhancement Area 1	2.19	3.68
Enhancement Area 2	1.44	2.48
Enhancement Area 3	2.16	2.70

8.3.10.7 Risk Assessment

A peat stability risk assessment was carried out for the infrastructure elements at the Proposed Wind Farm. This approach adheres to best practice guidance for geotechnical/peat stability risk assessments as given in PLHRAG Guidance and MacCulloch (2005).

For each of the main infrastructure elements, a risk rating (product of probability and impact) is calculated. Where a location is rated 'Medium' or 'High', control measures are required to reduce the risk to at least a 'Low' risk rating. Where a subsection is rated 'Low' or 'Negligible', routine control measures are required. Please refer to the Geotechnical and Peat Stability Assessment Report (**Appendix 8-1**).

The results of the peat stability risk assessment for potential peat failure at the Proposed Wind Farm infrastructure is presented as a Geotechnical Risk Register in Appendix B of **Appendix 8-1**.

The risk rating for each infrastructure element of the Proposed Wind Farm is designated as Negligible or Low following some mitigation/control measures being implemented.

Details of the required infrastructure specific mitigation/control measures can be found in Appendix B of the Geotechnical and Peat Stability Assessment Report (**Appendix 8-1)** and the infrastructure specific control measures are briefly summarised below:

- Detailed ground investigation to confirm peat, mineral soil and bedrock condition and properties;
- Use of experienced geotechnical staff for confirmatory site investigation;
- Maintain hydrology of area as far as possible by maintaining the flow of water in existing drains to prevent the build-up of water pressures in the peat, leading to the peat becoming "buoyant"; and,
- Use of contractors with experience in working peat and trained operators to carry out the work.

8.3.10.8 Peat Stability Assessment Conclusions

In summary, the findings of the peat stability risk assessment showed that the Proposed Wind Farm has an acceptable margin of safety, is suitable for the Proposed Project and is considered to be of a low risk for peat failure provided appropriate control measures, such as implementing and maintaining an appropriate drainage system, are implemented.

The Proposed Grid Connection or TDR was not assessed for peat stability risk due to the lack of peat along the public road corrider and at the temporary works area associated with the TDR.

The findings include mitigation/control measures for construction work in peat lands, all of which will be implemented in full to ensure that all works adhere to an acceptable standard of safety.

8.4 Summary of Geology & Geotechnical Conditions

A detailed description of the geology of the Site is presented in this chapter.

Regional baseline geological data is available from the GSI through their online map viewer (www.gsi.ie). The bedrock across the Proposed Wind Farm is mapped as the Gull Island Formation (SILTSTONE and SANDSTONE). Subsoils are predominantly mapped as blanket peat and Namurian sandstone and shale tills.

The Proposed Wind Farm investigations and geotechnical assessments (including the Hen Harrier Enhancement lands) were extensive and consisted of 583 no. peat depth probes, 36 no. trial pits and 2 no. bedrock boreholes. The geological setting of the Proposed Wind Farm has been thoroughly examined and the geological/hydrogeological setting is fully understood.

Site investigations and geotechnical assessments are summarised as follows:

- The results of the factor of safety analysis showed all locations to have a low risk of peat instability;
- The risk rating for each infrastructure element at the Proposed Wind Farm is designated Negligible or Low following some mitigation/control measures being implemented;
- Peat depths recorded across the proposed Proposed Wind Farm ranged from 0.1 to 6.1m with an average depth of 0.7m, which is considered thin for blanket bog;
- Approximately 55% of recorded peat depth were less than 0.5m, 73% less than 1m and with 91% of less than 2.0m;

- The average peat depths recorded at the turbine locations varied from 0.25 to 1.6m (this is considered shallow peat, turbines have successfully been constructed in several metres of peat);
- With respect to the new proposed access roads, peat depths are typically less than 1.0m (average 0.55m) and therefore most roads will be constructed by excavate and replace method;
- At the 2 no. proposed borrow pit locations, peat depths are shallow (<0.5m);
- No evidence of past failures or any significant signs of peat instability were noted on site by FT at the time of the geotechnical walkover surveys;
- The geotechnical hand vane results indicate undrained shear strengths in the range 8 to 56kPa, with an average value of about 28kPa;
- The strengths recorded are typical of well drained peat as is present on the Proposed Wind Farm site;
- Mineral subsoils were typically described as firm to stiff, slightly sandy gravelly SILT/CLAY or SILT over silty sandy GRAVEL which is underlain by presumed bedrock or cobbles and boulders at some locations;
- Obstruction (refusal) on possible bedrock (presumed) was recorded in 17 of the 36 nos. trial pits (47%). The bedrock was typically described as weathered and presenting as angular gravel and cobbles of shale/siltstone;
- Obstruction on boulders was recorded at another 7 no. locations which indicates the top of bedrock is close underneath;
- Bedrock was presumed to be met at 4 no. turbine locations (T2, T3, T5 and T6) with depth ranging from 0.8m to 3m below ground level. Where bedrock was not presumed, refusal was typically on dense cobbles and boulders suggesting top bedrockrock is close;
- The investigations indicate that deep excavations will not be required due to the shallow depth of competent bedrock strata;
- Bedrock drilling encountered competent, strong SILTSTONE or SANDSTONE at shallow depths ranging from 2.6 to 3.9mbgl;
- No bedrock joints, fissures, fractures faults (groundwater bearing structures) were identified by the investigation drilling; and,
- The drilling demonstrates that the bedrock proposed for extraction at the 2 no. proposed borrow pits is strong, competent and fit for the purpose of rock extraction and follow on permanent storage of peat.

8.5 Receptor Sensitivity and Importance

Based on the criteria set out in **Table 8-2** above, the soils and peat at the Proposed Wind Farm can be classed as being of low importance as the overlying peat and soil deposits are not designated in this area and are degraded in places as a result of the forestry and peat cutting operations and associated drainage.

The soils and subsoils along the Proposed Grid Connection are of low importance as the underground electrical cabling route is located predominantly along existing public roads and private access tracks, and no peat or soils deposits are designated along the Proposed Grid Connection. The bedrock geology underlying the Site can be classed as being of medium importance where the bedrock could be used on a sub-economic scale.

The land, peat, soils and bedrock geological formations underlying the Proposed Project are scoped in for impact assessment due to their proximal location to the Proposed Project and the potential effects that the Proposed Project may have on these receptors.

No geological heritage site or designated site will be scoped in for impact assessment due to their distant location from the Proposed Wind Farm and Proposed Grid Connection infrastructure.

There is no potential for the Proposed Project to effect the land, soils and geological environment outside of the Proposed Project. Therefore, there is no potential for effects to occur on any geological heritage site or designated site.

8.6 Characteristics of the Proposed Project

The Proposed Project will involve the removal of peat, soils, subsoils and bedrock in order for access roads, internal cabling network, hardstanding emplacement, turbine foundations, substation, peat and spoil management areas, grid connection cabling, crane hardstands, construction compounds, drainage works and met mast installation.

It is proposed that bedrock won from the on-site borrow pits (i.e. siltstone/sandstone) will be used to construct the sub-base layer of proposed upgraded and new access roads, hardstand areas and turbine base areas. Once installed the subbase layer will be overlain by a clean capping layer of high-grade limestone which will be sourced from local quarries. Please note that limestone is a sedimentary rock and is used country wide for public road construction. Limestone typically has a high strength/weight bearing capacity and is not prone to erosion.

The estimated quantity of available rock within the borrow pits is 180,000m^3. Conservative assumptions were made in estimating the quantity of rock available in the borrow pits.

Generally, the construction methodology for constructing any structure or platform foundation, such as a turbine base, hardstand or substation, involves removing all soft material is required to a depth where a suitable bearing material is encountered. Based on the site-investigation data it is expected gravity foundations may be constructed at all turbine locations. The maximum excavation depth at turbine locations is expected to be approximately 3m.

4.5km of existing access tracks will be utilised for the Proposed Project. Existing access tracks account for 45% of the overall proposed length of Wind Farm access roads (9.9km).

In addition, 5.4km of new access track will be constructed at the proposed Proposed Wind Farm. Due to the typically shallow nature of the peat along the route of the prospeod new roads, this will mainly be carried out using the excavate and replace technique. Crane hardstands, the substation platform, the met mast and the temporary construction compounds will all be constructed using the founded technique. The material excavated is required to be properly managed and stored and will be re-used in other elements of the Proposed Wind Farm infrastructure.

The quantities of peat and spoil requiring management at the Site have been calculated and are presented in **Table 8-10** below. The total estimated combined volume of peat and spoil to be managed following excavations during the construction phase of the Proposed Project is approximately 181,400m^3 (this includes a contingency factor of 10% to allow for increase in volume upon excavation). It should be noted that the aforementioned peat and spoil volume will be extracted and transported throughout the Site on a sequential basis, and that peat and spoil being transported will be separated by construction phase, which is discussed in Section 8.6.1 below.

It is proposed to manage overburden generated through construction activities locally within the Proposed Wind Farm, in the 6 no. designated peat/spoil storage areas, for landscaping at the proposed turbine locations and reinstatement of the 2 no. borrow pits.

The total capacity of the identified peat and spoil management areas, including the proposed landscaping and sidecasting is approx. 212,000m^3 (refer to **Table 8-11** below) and therefore, there is more than enough capacity to manage the total volume of peat and spoil requiring management for both the Proposed Wind Farm and Proposed Grid Connection.

The majority of material excavated along the Proposed Grid Connection underground cabling trench will be transported back to the Proposed Wind Farm for storage.

However, some excess spoil material generated during the cable route construction will be transported by permitted waste contractors to a suitable permitted/licensed site for disposal/recovery. This is dependent on the road makeup at locations along the Proposed Grid Connection underground cabling route. The main contractor will determine the appropriate location for management of arisings from the route. Whilst it is not yet confirmed which facility will be used, Clean (IRL) Refuse & Recyling Co. Limited in Creegh has been assessed as the receiving party for the purposes of the EIAR.

Further details are provided in the Peat and Spoil Management Plan for the works which is included in **Appendix 4-3.**

The Proposed Wind Farm also includes Hen Harrier Enhancement areas which are located outside the Site, however no excavations will occur in these areas.

Table 8-10 Conservative Peat, Mineral Soil (Spoil) Excavation Volumes

Development Component	Peat Volume(m^3) (approx.)	Spoil Volume(m^3) (approx.)
8 no. Turbines and Hardstanding Areas (including foundations)	31,000	41,000
Access Roads	34,000	16,000
Construction Compound	1,300	700
Substation	2,000	6,800
Met Mast	150	450
Grid Connection	-	16,000
Borrow Pits 2 no.	11,000	21,000
Sub-Total	**79,450**	**101,950**
Total (m^3)	**181, 400m3 (Peat & Spoil Volume)**	

Table 8-11 Peat/Spoil Placement Reinstatement Areas

Development Component	Peat and Spoil Volume(m^3) (approx.)	Comment
Peat placement within clear felled areas around turbines	31,000	Up to 1m in height at 6 no. specific designated locations
Landscaping	16,000	It is estimated that approximately 2,000m^3 of peat will be required for landscaping and ballast backfill purposes at each of the 8 no. turbine locations

Development Component	Peat and Spoil Volume(m^3) (approx.)	Comment
Borrow Pits	165,000	Refer to Section 5.4 of the Peat & Spoil Management Plan
Total	**212,000**	-

8.6.1 Construction Phasing

The Proposed Project will be constructed in 4 phases, as detailed below. This will allow for the borrow pits to be developed and backfilled in stages. It should be noted that whilst the volumes below are broken into phases, in reality, the amounts extracted at any given time will be much lower than the amount generated over the entire phase. An outline of the Phasing is provided below.:

Phase 1:

Construction of site roads, Temporary Construction Compounds, Met Mast foundation and excavation of borrow pits (84,600m^3 of peat and spoil generated).

- All fill material will come from the on-site borrow pits
- All excavated material will be transferred to borrow pits once cells have been created

Phase 2:

Construction of hardstands and foundation bases for turbines T01, T02, T05 and T06 (45,400m^3 of peat and spoil generated).

- Fill material to be taken from both Borrow Pits.
- Excavated peat to be placed in clearfell storage areas around T01, T02 and T06 and any excess to be placed in the Borrow Pits
- All excavated spoil to be placed within the borrow bits

Phase 3:

Construction of hardstands and foundation bases for turbines T03, T04, T07 and T08 (26,600m^3 of peat and spoil generated).

- Fill material to be taken from BP1
- Excavated peat to be placed in clearfell storage areas around T03, T04 and T07 and any excess to be placed in the Borrow Pits
- All excavated spoil to be placed within the Borrow Pits

Phase 4:

Construction of on-site substation (8,800m^3 of peat and spoil generated).

- Fill material to be taken from borrow pits
- Excavated material to be transferred to Borrow Pits

The above phasing works are estimated to take 10-12 months in total.

8.7 Likely and Significant Effects on Land, Soils and Geology

8.7.1 Do Nothing Scenario

An alternative land-use option to the development of a renewable energy project at the Site would be to leave the Site as it is, with no changes made to existing land-use practices. In this 'Do Nothing' Scenario, the existing land use practices comprising of agricultural activities, turbary peat cutting and forestry would continue at the Proposed Wind Farm. Land drainage carried out in areas of the Proposed Wind Farm will continue to function and may be extended in some areas.

If the Proposed Project were not to proceed, the opportunity to capture part of Clare's valuable renewable energy resource would be lost, as would the opportunity to contribute to meeting Government and EU targets for the production and consumption of electricity from renewable resources and the reduction of greenhouse gas emissions. The opportunity to generate local employment, development contributions, rates and investment in the local area would also be lost. On the basis of the positive environmental effects arising from the Proposed Project, the do–nothing scenario was not the chosen option. The existing agricultural activities (grassland management), turbary, and forestry operations (felling and replanting) can and will continue in conjunction with the operation of the Proposed Wind Farm.

Furthermore, the opportunity to create habitat enhancement areas for Hen Harrier would be lost. Please see **Appendix 7-8** Hen Harrier Enhancement Plan for details.

8.7.2 Likely Signficant Effects and Mitigation Measures – Construction Phase

The likely impacts of the Proposed Project and mitigation measures that will be put in place to eliminate or reduce them are shown below.

8.7.2.1 Potential Effects on Land (Land-Take) and Land Use

The Proposed Wind Farm includes the construction of 8 no. turbines, associated hardstand areas, 2 no. temporary construction compound, an on-site 110kV substation, 2 no. borrow pits new access roads and upgrades to the existing road network. The footprint of the Proposed Wind Farm infrastructure is 15.55ha which accounts for only 4.1% of the Proposed Wind Farm site (375ha).

The Proposed Wind Farm construction works will result in local topographic changes with the removal of overburden at the proposed Proposed Wind Farm. There will be no effects on the lands adjoining the Proposed Wind Farm site or Hen Harrier Enhancement areas.

The Proposed Grid Connection will result in the excavation of a temporary narrow trench to accommodate the cabling. This trench will be reinstated once the cabling is emplaced with a comparable ground surface (tarmacadam or subsoil/topsoil). Therefore, no effects on land or landuse will occur along the majority of the Proposed Grid Connection underground cable route.

The TDR works will only require temporary loss of agricultural land and hedgerow/boundary removal during the construction phase.

Pathways: Excavation and infrastructure construction.

Receptors: Land (i.e. land upon which the Proposed Project will occur).

Pre-Mitigation Potential Effect: Negative, slight, direct, permanent, likely effect on land (land-take) within the Proposed Wind Farm. In the absence of mitigation measures, there will be no potential for significant effects on land at the Site.

Mitigation Measures / Impact Assessment: The Proposed Grid Connection is located predominantly along existing public roads. There will be no change in the land environment along the existing roads, whereby the roads will be reinstated with a comparable ground surface. The use of the existing road network reduces the area which will be altered or disturbed as a result of the works associated with the Proposed Grid Connection.

Following the construction phase areas of the proposed Proposed Wind Farm will be replaced by hardstand areas with a permanent development footprint of 15.55ha. This represents a change in landcover of ~4.1%.

The permanent loss of coniferous forestry (21ha), peatland (0.24ha) and species rich Wet Grassland (0.15ha) at the Proposed Wind Farm will not have a significant effect on land due to the small development footprint (4.1%). 56.3ha of conifer felling within the Hen Harrier Enhancement lands.

The loss of this land is minimal on a local and regional scale and therefore, the effects of land loss is negligible.

All felling operations will be completed in line with the Forest Service's published policy and will be subject of a Limited Felling Licence (LFL). The Forest Service policy requires replacement or replanting on a hectare for hectare basis for the footprint of the infrastructure developments. Therefore, while the loss of coniferous forestry (77.3ha) will be a permanent change to the land at these locations, all forestry lost will be replaced elsewhere within Ireland as per the Forest Service felling policy.

Given the undulating nature of the local topography resulting from the quaternary deposits, any change in topography is likely to be minimal in the overall landscape.

Post-Mitigation Residual Effect: The residual effect will be a negative, direct, slight, likely, permanent effect on land and landuse.

Significance of Effects: For the reasons outlined above (small development footprint), no significant effects on land (land-take) will occur.

8.7.2.2 Potential Effects from Peat and Spoil Excavation

The peat, the cohesive soils and the granular soils and subsoils at the Site can be classified as of "Low" importance. The effect is the disturbance and relocation of 181,400m^3 of material, as outlined in Section 8.6 and broken down into phased sequential volumes in Section 8.6.1 above.

Excavation of peat and mineral soil/subsoil will be required for the installation of foundations for the access roads, turbine hardstands and foundations, met mast, cable trenching, and on-site substation within the proposed Proposed Wind Farm. Soils and subsoil will also require excavation at the designated peat and spoil management areas.

The excavation of soils will also be required along the Proposed Grid Connection underground electrical cabling route. Estimated volumes of peat and spoil to be relocated are summarised above in **Table 8-10** above.

There will be no loss of peat or spoil from the proposed Proposed Wind Farm, as it will be accommodated within the proposed 6 no. designated peat/spoil storage areas at turbine locations as well as reinstating the 2 no. proposed borrow pits.

Spoil will also be used for landscaping at the proposed turbine locations and in linear berms along access roads where appropriate.

Excavated subsoils along the Proposed Grid Connection will be removed from the underground electrical cabling trench and will be transported to the peat and spoil storage area at the Proposed Wind Farm or transported to a local licenced facility as appropriate.

Pathway: Extraction/excavation.

Receptor: Soil, subsoil and bedrock within the proposed Proposed Wind Farm and along the Proposed Grid Connection.

Pre-Mitigation Potential Effect: Negative, slight/moderate, direct, likely, permanent effect on soils and subsoils due to relocation within the Site. In the absence of mitigation measures, there will be no potential for significant effects on soils and subsoils at the Site.

Proposed Mitigation Measures by Design:

All work will be in accordance with the Peat and Spoil Management Plan detailed in Section 4.3.1.9 of Chapter 4. The site layout design has been iteratively developed using comprehensive site-specific site investigation dataset, which includes peat probes, gouge cores, trial pits and boreholes.

Proposed Wind Farm

- Placement of turbines and associated infrastructure in areas with suitable ground conditions where appropriate (based on detailed site investigation data – the areas of deeper peat have been avoided by the Proposed Wind Farm infrastructure);
- The peat/soils and subsoils which will be removed during the construction of turbine hardstands will be localised to the turbine locations. The peat/soil/subsoil will be placed/spread locally alongside the excavations or stored within the 6 no. designated peat and spoil storage areas;
- Excavated peat/soils/subsoils will be excavated and stored separately to topsoil; this will prevent mixing of materials and facilitate reuse afterwards;
- At the identified peat and spoil management areas, the vegetative topsoil layer will be removed to allow for spoil to be placed and upon reaching the recommended height, the vegetative topsoil layer will be reinstated;
- The peat placed within the peat and spoil management areas will be restricted to a maximum height of 1m. Weak/liquified peat will be stored in the borrow pits and not at the 6 no. peat and spoil management areas;
- The placement of excavated peat will be avoided without first establishing the adequacy of the ground to support the load. The placement of peat and spoil within the peat and spoil management areas will require the use of long reach excavators, low ground pressure machinery and possibly bog mats in particular for drainage works;
- It will be ensured that the surface of the placed peat will be shaped to allow efficient run-off of surface water. Shaping of the surface of the peat will be carried out as placement of peat within the peat and spoil management area progresses. This will reduce the likelihood of debris run-off and reduce the risk of instability of the placed peat;
- Finished/shaped side slopes in the placed peat will be not greater than 1 (v): 4 (h). This slope inclination will be reviewed during construction, as appropriate;
- Where available, the acrotelm will be placed on the finished surface with the vegetation part of the sod facing the right way up to encourage growth of plants and vegetation at the surface of the placed peat and spoil within the peat and spoil management areas;
- Movement monitoring instrumentation will be placed around the areas where peat has been placed. The locations where monitoring is required will be identified by the Project Geotechnical Engineer on site;

- Supervision by the Project Geotechnical Engineer will be carried out for the works;
- An interceptor drain will be installed upslope of the designated peat and spoil management areas to divert any surface water away from these areas. This will help ensure stability of the placed peat and reduce the likelihood of debris run-off. (interceptor drains will not be required at all areas as the existing drainage network can function as interceptor drains – silt fences will be installed upgradient of the peat and spoil management areas in these locations); and,
- A check of peat stability in each area was also undertaken, allowing for the additional loading from 1m of stored peat, and these results are included in the Geotechnical and Peat Stability Assessment Report (FT, February 2026).

Proposed Grid Connection:

- Any overburden excavated from the cable trench will be transported to the peat and spoil management areas at the proposed Proposed Wind Farm; and,
- Some excess spoil material or pavements materials containing tar generated during the cable route construction will be transported by permitted waste contractors to a suitable permitted/licensed site for disposal/recovery.

- **Post Mitigation Residual Effect:** With the implementation of the prescribed mitigation measures the residual effect will be negative, slight to moderate, direct, likely, permanent effect on soils and subsoils due to disturbance and relocation within the Site.

Significance of Effects: For the reasons outlined above, no significant effects on soils, subsoils or bedrock will occur.

8.7.2.3 Potential Effects from the Contamination of Soil/Subsoil by Leakages and Spillages

Plant and machinery will be run on oils and fuels. Oils will also be present in the substation and turbines. Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to land, soils and associated ecosystems. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, and is persistent in the environment.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Pre-Mitigation Potential Effect: Negative, direct, slight, short term, unlikely effect on peat, subsoil and bedrock. In the absence of mitigation measures, there will be no potential for significant effects on soils, subsoils and bedrock at the Site.

Proposed Mitigation Measures:

- On site re-fuelling at a designated bunded area with the construction compound will be undertaken using a fuel truck with spill kits on the ready for accidental leakages or spillages;
- On site re-fuelling will be undertaken by suitably trained personnel only;
- 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 construction and fitted with a storm drainage system and an appropriate oil interceptor;

- The electrical substation will be bunded appropriately to the volume of oils likely to be stored, and to prevent leakage of any associated chemicals and to groundwater or surface water. The bunded area will be fitted with a storm drainage system and an appropriate oil interceptor;
- The plant used during construction will be regularly inspected for leaks and fitness for purpose;
- All waste tar material arising from the chipping and resurfacing of the temporary construction access road will be removed off-site and taken to licenced waste facility; and,
- An emergency plan for the construction phase to deal with accidental spillages is contained within the Construction and Environmental Management Plan (Appendix 4-5 of this EIAR). Spill kits will be available to deal with and accidental spillage in and outside the re-fuelling area.

Post Mitigation Residual Effect: The use and storage of hydrocarbons and small volumes of chemicals is a standard risk associated with all construction sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect will be a negative, imperceptible, direct, short-term, unlikely effect on peat and subsoils and bedrock.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock will occur.

8.7.2.4 Potential Effects from the Erosion of Exposed Subsoils and Peat During Tree Felling and Construction Works

Peat and spoil removed from turbine locations and access roads and all elements of the Proposed Project listed in **Table 8-10**, will be used for landscaping, cast aside alongside designated access roads, placed in 6 no. dedicates peat/spoil storage areas and used to reinstate the 2 no. proposed borrow pits.

Erosion of peat/subsoil can have the effect of reducing the overall volume of peat/subsoil at the Site, with the potential for some eroded subsoils to reach watercourses, leading to water quality issues such as high turbidity. Erosion of soils/subsoils may occur at any works area where excavation is ongoing, i.e. turbine foundations, access roads and felling areas within the Site. The main impacts associated with this aspect is to the water environment, and therefore this aspect is further assessed in detail in Chapter 9.

During felling operations there is a high likelihood of erosion due to the distance of soils and subsoils associated with vehicle and plant movements. This also has associated potential effects on the water environment; and therefore this aspect is assessed in further detail in Chapter 9 Water.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Pre-Mitigation Potential Effect: Negative, direct, slight, short term, unlikely effect on peat, subsoil and bedrock. In the absence of mitigation measures, there will be no potential for significant effects on soils and subsoils at the Site.

Mitigation:

All excavated material will be completed in accordance with the Peat and Spoil Management Plan presented as **Appendix 4-3**. Material will be moved over the least possible distance.

Any excess peat will be moved to peat storage areas or will be temporarily surrounded by earthen berms to prevent erosion. This will prevent erosion of soil. Silt fences will be installed around

temporary stockpiles to limit movement of entrained sediment in surface water runoff. The use of earthen berms and silt fencing around earthworks and spoil mounds will prevent egress of water from the works.

In order to minimize erosion of mineral subsoils stripping of peat will not take place during extremely wet periods[3] (to prevent increased silt rich runoff). Temporary drainage systems (as outlined in Section 9.5.2.2 of the Chapter 9) will be implemented to limit runoff impacts during the construction phase.

All proposed felling works will be completed in accordance with the best practice Forest Service regulation, policies and strategic guidance documents as well as Coillte and DAFM guidance documents to ensure that felling results in minimal potential negative effects on the local soil and subsoil environment.

In addition, the following mitigation measures will be implemented during felling operations:

- Before any works are completed silt fences will be installed to limit the movement of entrained sediment in surface water runoff;
- The harvester and the forwarder are designed specifically for the forest environment and are low ground pressure machines;
- All machinery will be operated by suitably qualified personnel;
- These machines will traverse the Proposed Wind Farm along specified off-road routes (referred to as racks);
- Brash mats will be placed on the racks to support the vehicles on soft ground, reducing mineral soil disturbance and erosion and avoiding the formation of rutted areas, in which surface water ponding can occur;
- As felling progresses, the harvester will collect brash produced by the felling and place it in front of the machine before it advances forward along the rack;
- The condition of the racks will be continually monitored and fresh brash will be applied when the brash mat becomes heavily used and worn, ensuring that the mat remains effective throughout the operational phase; and,
- The location of racks will be chosen to avoid wet and potentially sensitive areas.

Post Mitigation Residual Effect: Peat soils and spoil can be eroded by vehicle movements, wind action and by water movement. To prevent this, all excavation works will be completed in accordance with the detailed Peat and Spoil Management Plan, material will be moved the least possible distance, and reseeding and planting will be completed to bind landscaped peat and spoil together. Following implementation of these measures the residual effect will be a negative, slight, direct, short-term, likely effect on peat and subsoils by erosion and wind action.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock are wil occur.

8.7.2.5 Potential Effects from Peat Instability and Failure

Peat instability and failure are risks at the Proposed Proposed Wind Farm during the construction phase and are assessed herein. Peat instability is not considered to be a risk along the Proposed Grid Connection due to the nature of the proposed works and the limited extent of peat along the route. No peat is present along the Proposed Grid Connection cable route (i.e. public roads).

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[3] >10 mm/hr (i.e. high intensity local rainfall events);
>25 mm in a 24-hour period (heavy frontal rainfall lasting most of the day); or,
>half monthly average rainfall in any 7 days.

A Geotechnical and Peat Stability Risk Assessment was carried out for the main infrastructure elements at the Proposed Proposed Wind Farm. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRAG (2017) and MacCulloch (2005).

Peat instability or failure refers to a significant mass movement of a body of peat that would have a significant effect on the proposed Proposed Wind Farm and the surrounding environment. Peat failure excludes localised movement of peat that could occur below an access road, creep movement or erosion type events. The consequence of peat failure at the study area may result in:

- Death or injury to site personnel;
- Damage to machinery;
- Damage or loss of access tracks;
- Drainage disrupted;
- Site works damaged or unstable;
- Contamination of watercourses, water supplies by particulates;
- Degradation of the environment.

However, the findings of the peat stability risk assessment (FT, 2026), which involved analysis of 227 no. locations, showed that all Proposed Wind Farm infrastructure elements are located in areas of negligible to low risk as discussed in Section 8.3.10 above.

Notwithstanding the above, the management of peat stability and appropriate construction practices will be inherent in the construction phase of the Proposed Wind Farm to ensure peat failures do not occur on site.

Pathway: Vehicle movement and excavations.

Receptor: Peat subsoils.

Pre-Mitigation Potential Effect: Direct, negative, slight, unlikely effect on peat and subsoils. The findings of the GPSRA (FT, February 2026) showed that the Proposed Wind Farm has an acceptable margin of safety, is suitable for the Proposed Project and is considered to be at negligible to low risk of peat failure. In the absence of mitigation measures, there will be no potential for significant effects on peat and subsoils at the Proposed Wind Farm. However mitigation measures discussed below will be implemented for best practice adherence.

Mitigation Measures:

Based on the recommendations and control measures given in the FT Geotechnical and Peat Stability Assessment (**Appendix 8-1**) 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 negligible/none risk of peat instability/failure at the proposed Proposed Wind Farm (i.e. all elements of the Proposed Wind Farm infrastructure and peat/spoil storage locations as listed in **Table 8-8** and **Table 8-9**).

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.

The following measures incorporated into the construction phase of the project will be implemented in full and assist in the management of the risks for this site.

- Appointment of experienced and competent contractors;
- The site will be supervised by experienced and qualified personnel;
- 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);

- Prevent undercutting of slopes and unsupported excavations;
- Maintain a managed robust drainage system;
- Prevent placement of loads/overburden on marginal ground;
- Set up, maintain and report findings from monitoring systems;
- Ensure construction method statements are followed or where agreed modified/ developed; and,
- Revise and amend the Geotechnical Risk Register as construction progresses.

Please refer to **Appendix 8-1** for proposed turbine specific and road section mitigation measures.

Post Mitigaion Residual Effect: A detailed Geotechnical and Peat Stability Assessment has been completed for the development proposal. The findings of that assessment have demonstrated that there is a negligible to low risk of peat failure, at the Proposed Wind Farm. With the implementation of the control measures outlined above the residual effect is a negative, imperceptible, direct, unlikely, permanent effect on peat and subsoils.

Significance of Effects: For the reasons outlined above, no significant effects on peat and subsoils will occur.

8.7.2.6 Potential Effects from Turbine Delivery Route Works

Minor earthworks are required for turbine delivery. These include for temporary widening of existing roads and junctions. These TDR works are described in Section 4.2.10.4 of the EIAR.

Pathway: Extraction/excavation/landscaping.

Receptor: Soil and subsoil

Pre-Mitigation Potential Effect: Negative, imperceptable, direct, likely, temporary effect on land, peat and subsoil. No potential for signficant effects.

Proposed Mitigation Measures:

- All works are minor and localised and cover very small areas;
- These works are distributed over a wide area; and,
- All works are temporary in nature.

Post Mitigation Residual Effect: The TDR related earthworks are minor in nature and will be temporary in duration. They are also separated from each other by considerable distances. Residual effects will be negative, imperceptable, direct, likely, temporary effects on soils and subsoil.

Significance of Effects: For the reasons outlined above, no significant effects on soils or subsoils will occur.

8.7.2.7 Potential Effects from the Proposed Hen Harrier Enhancement Plan

Enhancement works are proposed over a total of ~123.7ha near the Proposed Wind Farm.

The identified area of existing forestry will be permanently removed. The timber, brash and stumps will be collected and removed off-site. The area will be allowed to revert to peatland habitat. This process will be aided by drain blocking.

Pre-mature felling of forestry will be undertaken before the first breeding season of the construction phase of the project programme. This will allow time (i.e. min. three growing seasons) for the clear-

felled site to revegetate in advance of the operational phase. Thereby ensuring replacement habitat will be available should the predicted displacement effect occur.

Some of these proposals will disturb local peat, soil and subsoil deposits and increase the likelihood of erosion of peat and subsoils. However, due to the largely non-invasive nature of the works the potential for effects on the soils and geological environment are limited. The works will have a positive effect on the land environment.

Pathway: Vehicle movement, restoration works, surface water and wind action.

Receptor: Land, peat/soil and subsoil.

Pre-Mitigation Potential Effect: Negative, direct, slight, likely effect on peat and subsoils due to temporary disturbance associated with proposed restoration works. Positive, slight, direct, permanent effect on the land at the Hen Harrier Enhancement lands. In the absence of mitigation measures, there will be no potential for significant effects on land, peat, soils and subsoils at the Hen Harrier Enhancement lands.

Proposed Mitigation Measures:

All proposed habitat management and enhancement works will be in accordance with the best practice Forest Service regulation, policies and strategic guidance documents as well as Coillte, DAFM and NatureScot guidance documents to ensure minimal potential negative effects on the local peat, soil and subsoil environment.

Given the nature of the restoration measures the following mitigation measures are proposed:

- Before any works are completed silt fences will be installed to limit the movement of entrained sediment in surface water runoff;
- Proposed off-road routes will be walked in advance of any machinery;
- All machinery operators will be experienced and suitably trained;
- The proposed enhancement lands will be walked before a machine goes off-road in order to prevent any damage to sensitive habitats;
- Bog mats will be used where the excavator is required to travel over wet ground; and,
- A low ground pressure excavator with wide tracks (1.9m or greater) will be used to reduce compaction of the peat and subsoils.

Post-Mitigation Residual Effect: With the implementation of mitigation measures outlined above the residual effect will be a negative, direct, imperceptible, likely effect on peat and subsoils. There will be a slight, positive, permanent effect on land within the proposed enhancement area.

Significance of Effects: For the reasons outlined above, and with the implementation of the listed mitigation measures, no significant effects on land, peat and subsoils.

8.7.3 Assessment of Health Effects

Potential health effects arise mainly through the potential for soil and ground contamination. Based on the authors experience and professional judgement, wind farms are not a significant source of contamination so the potential for effects during the operational phase are negligible. Hydrocarbons will be used onsite during construction, operational and decomissioning phases, however the volumes will be small in the context of the scale of the Proposed Project and the sensitivity of the surrounding environment to a pollution event and will be handled and stored in accordance with best practice mitigation measures as described in detail in Section 8.7.2.3 above. The potential residual impacts associated with soil or ground contamination and subsequent health effects are imperceptible. Health effects relating to incidences of landslide/peat movement are not anticipated as the risk of peat slide has been assessed as negligible/none.

8.7.4 Likely Significant Effects and Mitigation Measures – Operational Phase

Very few potential direct impacts are envisaged during the operational phase of the Proposed Project. These may include:

- Maintenance of site roads;
- Some construction vehicles or plant will be necessary for maintenance of turbines which could result in minor accidental leaks or spills of fuel/oil; and,
- The transformer in the substation and transformers in each turbine are oil cooled. There is potential for spills / leaks of oils from this equipment resulting in contamination of soils and groundwater.

8.7.4.1 Potential Effects from Site Road Maintenance

In relation to indirect impacts a small amount of granular material will be required to maintain access tracks/site roads during operation which will place intermittent minor demand on local quarries. Please note the on-site borrow pit will have been reinstated with excavated peat and spoil following the construction stage and will not be available to source aggregate during the operational phase.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Bedrock.

Pre-Mitigation Potential Effect: Negative, indirect, imperceptible, short term, likely impact bedrock. In the absence of mitigation measures, there will be no potential for significant effects on at the Proposed Wind Farm.

Proposed Mitigation Measures:

- Use of aggregate from authorised quarries for use in road and hardstand maintenance.

Post Mitigation Residual Effect: The use aggregate for site road maintenance will be minor and infrequent, and all material will be imprted to the site from local authorised quarries. The residual effect will be a negative, imperceptible, indirect, short-term, unlikely effect on bedrock.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils or geology will occur.

8.7.4.2 Potential Effects from Site Vehicle/Plant Use

Plant and site vehicles used in site maintenance will be run on fuels and use hydraulic oils. Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a significant pollution risk to land, soils and associated ecosystems. The accumulation of small spills of fuels and lubricants during routine plant use can also be a pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, and is persistent in the environment.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Pre-Mitigation Potential Effect: Negative, direct, slight, short term, unlikely effect on peat, subsoil and bedrock. In the absence of mitigation measures, there will be no potential for significant effects on peat, subsoils and bedrock at the Proposed Wind Farm.

Proposed Mitigation Measures:

- Vehicles used during the operational phase will be refulled off site before entering the site;
- No fuels will be stored on-site during the operational phase;
- Spill kits will be available in all site vehicles to deal with and accidental spillage and breakdowns; and,
- An emergency plan for the operational phase to deal with accidental spillages and breakdowns will be contained in the Environmental Management Plan for the wind farm operational phase.

Post Mitigaion Residual Effect: The use of hydrocarbons in plant and vehiles is a standard risk associated with all operational wind farms. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect will be a– negative, imperceptible, direct, short-term, unlikely effect on peat and subsoils and bedrock.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock will occur.

8.7.4.3 Potential Effects from the Use of Oils in Turbine Transformers

- The transformer in the substation and transformers in each turbine are oil cooled. There is potential for spills / leaks of oils from this equipment resulting in contamination of soils and groundwater. Hydrocarbon has a high toxicity to humans, and all flora and fauna, and is persistent in the environment.

Pathway: Peat, subsoil and bedrock pore space.

Receptor: Peat, subsoil and bedrock.

Pre-Mitigation Effect: Negative, direct, slight, short term, unlikely effect on peat, subsoil and bedrock. In the absence of mitigation measures, there will be no potential for significant effects on peat, subsoils and bedrock at the Proposed Wind Farm.

Proposed Mitigation Measures:

- All transformers and substation areas will be bunded to 110% of the volume of oil used in each transformer/substation; and,
- An emergency plan for the operational phase to deal with accidental spillages will be contained in the Environmental Management Plan for the wind farm operational phase.

Post Mitigaion Residual Effect: The use of hydrocarbons in transformers and substations is a standard risk associated with all operational wind farms. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and will break the pathway between the potential source and the receptor. The residual effect will be a negative, imperceptible, direct, short-term, unlikely effect on peat and subsoils and bedrock.

Significance of Effects: For the reasons outlined above, no significant effects on land, soils, subsoils or bedrock will occur.

8.7.5 Likely Significant Effects and Mitigation Measures – Decommissioning Phase

The potential impacts associated with decommissioning of the Proposed Project will be similar to those associated with construction but at a reduced magnitude due to the reduced scale of the works. Please refer to Section 8.7.2 above.

During decommissioning, it will be possible to reverse or at least reduce some of the potential impacts caused during construction by rehabilitating construction areas such as turbine bases, hard standing areas, and the substation. This will be done by covering hard surfaces with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation. Other impacts such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude as the extent of the works will be less. However, as noted in the Scottish Natural Heritage report (SNH) *Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms* (SNH, 2013) reinstatement proposals for a wind farm are made approximately 30 years in advance, so within the lifespan of the wind farm, technological advances and preferred approaches to reinstatement are likely to change. According to the SNH guidance, it is therefore:

> *"best practice not to limit options too far in advance of actual decommissioning but to maintain informed flexibility until close to the end-of-life of the wind farm".*

Mitigation measures applied during decommissioning activities will be similar to those applied during construction where relevant. Some of the impacts will be avoided by leaving elements of the Proposed Project in place, including the bases which will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Mitigation measures to avoid contamination by accidental fuel leakage and compaction of soil by on-site plant will be implemented as per the construction phase mitigation measures.

No significant effects on the land, soils and geology environment are envisaged during the decommissioning phase of the Proposed Project.

8.7.6 Risk of Major Accidents and Disasters

None, as indicated above the risk of a landslide/peat instability at the proposed Proposed Wind Farm site is determined to be negligible/none.

8.7.7 Post Construction Monitoring

None required as no significant effects are anticipated.

8.7.8 Potential Cumulative Impacts

Due to the localised nature of the proposed construction works which will be kept within the Site there is no potential for cumulative effects in-combination with other local developments on the land, soils and geology environment. The only way the Proposed Project can have in combination effects with other off-site projects and plans is via the drainage and off-site surface water network, and this hydrological pathway is assessed in Chapter 9: Hydrology and Hydrogeology.

Tree felling has a negligible effects on land, soils and geology as no significant excavations are required during tree felling and therefore the surrounding commercial forestry will not contribute to cumulative effects associated with wind farm or cable route construction.

Given there are no off-site effects associated with the Proposed Project, no cumulative impacts between the Proposed Project (Proposed Wind Farm and Proposed Grid Connection including TDR works and Hen Harrier Enhancement Lands), and other existing, permitted or proposed projects, listed in Section 2.7 of this EIAR, on land soils and geology will occur as there can be no interaction due to distance and separation.

8.7.9 Summary Conclusion

Peat depths recorded across the proposed Site ranged from 0.1 to 6.1m with an average depth of 0.7m, which is considered shallow for blanket bog. Approximately 55% of recorded peat depth were less than 0.5m, 73% less than 1m and with 91% of less than 2.0m.

No evidence of past failures or any significant signs of peat instability were noted on site at the time of the geotechnical walkover surveys. A Geotechnical and Peat Stability Assessment undertaken for the Site shows that there is a low risk of peat instability/failure at the Proposed Wind Farm site.

Mineral subsoils were typically described as firm to stiff, slightly sandy gravelly SILT/CLAY or SILT over silty sandy GRAVEL which is underlain by presumed bedrock or cobbles and boulders at some locations. Obstruction (refusal) on bedrock (presumed) was recorded in 17 of the 36 no. trial pits (47%). The bedrock was typically described as weathered and presenting as angular gravel and cobbles of shale/siltstone. The depth to bedrock at the 17 no. locations ranged between 0.3m and 4.1m with an average of 1.6m. Trial pits that encountered bedrock were distribured throughout the Site indicating relatively shallow bedrock across the overall Proposed Wind Farm site.

Excavation of peat, subsoil and bedrock will be required for site levelling and for the installation of Prorposed Wind Farm infrastructure. This will result in a permanent removal of peat, subsoil and possibly bedrock at most excavation locations. Excavated peat will be utilized to re-instate the borrow pit locations (2 no.), placed in dedicated peat storage areas and will also be used for reinstatement and landscaping works around the Site.

The handling and management of peat will be undertaken in accordance with the Peat & Spoil Management Plan (Appendix 4-3). Storage and handling of hydrocarbons/chemicals will be carried out using best practice methods. Measures to prevent peat and subsoil erosion during excavation, reinstatement, and permanent placement in borrow pit will be undertaken also using best practice methods.

No significant effects on the land, soil, and geology of the Proposed Project site will occur during construction, operation, or during decommissioning phases. There will be no potential to effect local designated sites or geological heritage sites due to separation distances between the Site.

The assessment also concludes that there will be no cumulative effects on land, soil and geology environment as a result of the Proposed Project.

EIA CLASSIFICATION SUMMARY

Please see the below table for a summary of all identified impacts for the Proposed Project relating to Land Soils and Geology.

Proposed Wind Farm

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
Construction Phase				
Land and Land-Use	Permanent, Slight, Negative	Section 8.7.2.1	Permanent, Slight, Negative	Not Significant
Peat and Subsoil Excavation	Permanent, Slight/Moderate, Negative	Section 8.7.2.2	Permanent, Slight/Moderate, Negative	Not Significant
Contamination, Leakages and Spillages	Short-Term, Slight, Negative	Section 8.7.2.3	Short-Term, Imperceptible, Negative	Not Significant
Erosion of Exposed Subsoils and Peat	Short-Term, Slight, Negative	Section 8.5.2.4	Short-Term, Slight, Negative	Not Significant
Peat Instability and Failure	Permanent, Imperceptible, Negative	Section 8.7.2.5	Permanent, Imperceptible, Negative	Not Significant
TDR Works	Temporary, Imperceptible, Negative	Section 8.7.2.6 – None Proposed	Temporary, Imperceptible, Negative	Not Significant
Hen Harrier Enhancement Plan – Peat and Subsoils	Permanent, Slight, Negative	Section 8.7.2.7	Permanent, Imperceptible, Negative	Not Significant
Hen Harrier Enhancement Plan – Land	Permanent, Slight, Positive	Section 8.7.2.7	Permanent, Slight, Positive	Not Significant
Operational Phase				
Site Road Maintenance	Short-Term, Imperceptible, Negative	Section 8.7.4.1	Short-Term, Imperceptible, Negative	Not Significant

Site Vehicle / Plant Use	Short-Term, Slight, Negative	Section 8.7.4.2	Short-Term, Imperceptible, Negative	Not Significant
Use of Oils in Turbine Transformers	Short-Term, Slight, Negative	Section 8.7.4.3	Short-Term, Imperceptible, Negative	Not Significant
Decommissioning Phase				
Land Soils and Geology	The potential impacts associated with decommissioning of the Proposed Project will be similar to those associated with construction but of reduced magnitude.	N/A	N/A	Not Significant

Proposed Grid Connection

Topic	Pre-Mitigation Effect	Mitigation Section Reference	Residual Effect	Significance
Construction Phase				
Land and Land-Use	No Effect	Section 8.5.2.1 – None Required	No Effect	Not Significant
Peat and Subsoil Excavation	Permanent, Slight/Moderate, Negative	Section 8.7.2.2	Permanent, Slight/Moderate, Negative	Not Significant
Contamination, Leakages and Spillages	N/A	N/A	N/A	N/A
Erosion of Exposed Subsoils and Peat	Short-Term, Slight, Negative	Section 8.7.2.4	Short-Term, Slight, Negative	Not Significant
Peat Instability and Failure	N/A	N/A	N/A	N/A
Operational Phase				

Land Soils and Geology	No Effect	N/A	No Effect	No Effect
Decommissioning Phase				
Land Soils and Geology	The Proposed Grid Connection cabling will be left and therefore no effects are anticipated	N/A	N/A	No Effect

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