Planning and Environmental Consultants



# Environmental Impact Assessment Report

## Briskalagh Renewable Energy Development, Co. Kilkenny

### Chapter 8 – Lands, Soils and Geology

# Table of Contents

# 8. LAND SOILS AND GEOLOGY

## 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 Project on the Land, Soils and Geology aspects of the receiving environment.

The Proposed Project is described in full in Chapter 4 of this EIAR.

The Site which includes the Proposed Wind Farm site and Proposed Grid Connection is located at Briskalagh and adjacent townlands, near Kilmanagh in Co. Kilkenny. The 'Proposed Project' encompasses the 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 significant effects that the construction, operation and decommissioning of the Proposed Project will have on the receiving environment. Where required, appropriate mitigation measures to avoid any identified significant effects to Land, Soils and Geology (i.e., natural resources) are recommended and the residual effects of the Proposed Project post-mitigation are assessed.

### 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, and our office is located in Dungarvan, County Waterford.

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 including wind farms and renewable energy projects.

This chapter of the EIAR was prepared by Michael Gill, Conor McGettigan and Jenny Law.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 22 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. In addition, he has substantial experience in geological characterisation, peatland morphology, and surface water drainage design and SUDs design and surface water/groundwater interactions. Michael has worked on the EIS/EIAR for Oweninny WF, Cloncreen WF, Croagh WF and over 100 other wind farm related projects across the country.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with 4 years' experience in the environmental sector in Ireland. Conor holds an M.Sc. in Applied Environmental Science (2020) and a B.Sc. in Geology (2016) from University College Dublin. Conor routinely prepares the land, soils and geology chapters of environmental impact assessment reports for wind farm development.

Jenny Law (BSc, MSc) is an environmental geoscientist holding a first honour's degree in applied environmental geosciences from the University College Cork in 2022. Jenny has assisted in the preparation of the land, soils and geology and hydrology chapters for various environmental impact assessment reports, hydrological impact assessments, Water Framework Directive Assessment reports

and Flood Risk Assessment reports for a variety of projects including wind farm developments and strategic housing developments.



## 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. Regard has also been taken of the requirements of the following legislation:

- Planning and Development Act, 2000 (as amended);
- Planning and Development Regulations, 2001 (as amended);
- S.I. No. 296/2018 European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018; and,
- The Heritage Act 1995, as amended.

## 8.1.4 Relevant Guidance

The Land, Soils and Geology chapter of this EIAR is carried out in accordance with the 'EIA Directive' as amended by Directive 2014/52/EU and having regard where relevant to 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 Assessment Methodology

## 8.2.1 Desk Study

A desk study was completed in advance of undertaking the walkover survey and site investigations. This involved collecting all relevant geological data for the Site and surrounding area. This included consultation with the following data sources:

- 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 18 (Geology of Kilkenny). Geological Survey of Ireland (GSI, 1997);
- 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 of the Site, including hydrological mapping and investigations of the Site, was undertaken by Conor McGettigan and Jenny Law of HES on the 28th September 2023 (refer to Section 8.1.2 above for qualifications and experience).

Geotechnical ground investigations (i.e. trial pitting and borehole drilling) were undertaken on the 18th, 19th December 2023, under the supervision of Michael Gill (refer to Section 8.1.2 above for qualifications and experience). Further trial pitting investigations (8 no.) were carried out at proposed borrow pit locations on 7th February 2024 under the supervision of Jenny Law (refer to Section 8.1.2 above for qualifications and experience). The combined geological dataset collected by HES has been used in the preparation of this EIAR Chapter.

The objectives of the intrusive site investigations included mapping the subsoil lithology for all proposed turbines and other key locations (i.e. internal access tracks) and assessing the underlying bedrock. This data was used to inform the final layout of the Site.

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

- HES completed initial walkover surveys at the Proposed Wind Farm site and inspection of the proposed infrastructure locations (including gouge augering and peat probing) on 28th September 2023;
- Excavation of 14 no. trials pits on 18th and 19th December 2023 under the supervision of HES. The trial pits were excavated at all proposed turbine locations and at other key locations (i.e. internal access roads) to investigate the underlying mineral soil lithology and subsoil/bedrock interface;
- Excavation of an additional 8 no. trial pits on 7th February 2024 at potential borrow pit locations;
- Drilling of 2 no. boreholes by Peterson Drilling Services Ltd under the supervision of HES on 19th December 2023, in order to understand the groundwater regime within the Site and the depth to bedrock;
- HES also completed a visual assessment of exposed soils, subsoils and bedrock and topographic changes along the Proposed Grid Connection underground cabling route;
- Logging of subsoil exposures across the Site where mineral soils were exposed; and,
- Mineral subsoils were logged according to BS: 5930.

## 8.2.3 Scoping and Consultation



The scope for this EIAR has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties. This consultation process is outlined in Section 2.5 of this EIAR. The Geological Survey of Ireland and Uisce Éireann were the only consultees to respond with respect to Land, Soils and Geology and their response was informative in nature with regard sources of online data for baseline assessment purposes. Their responses are summarised in Table 8-1.

*Table 8-1: Summary of Scoping Responses*

| Consultee | Description | Addressed in Section |
|---|---|---|
| Geological Survey of Ireland (GSI) | ***Geoheritage***<br>› Our records show that there are no CGSs in the vicinity of the proposed Renewable Energy Development site boundary.<br>***Groundwater***<br>› The Groundwater Data Viewer indicates aquifers classed as a 'Poor Aquifer - Bedrock which is Generally Unproductive except for Local Zones' a 'Regionally important gravel aquifer' and a 'Regionally Important Aquifer - Karstified (diffuse)' underlie the proposed Renewable Energy Development site boundary. The Groundwater Vulnerability map indicates the range of groundwater vulnerabilities within the area covered is variable. We would therefore recommend use of the Groundwater Viewer to identify areas of High to Extreme Vulnerability and 'Rock at or near surface' in your assessments, as any groundwater-surface water interactions that might occur would be greatest in these areas<br>› Our records show that there are groundwater drinking water abstractions with zones of contribution/source protection areas close to the Renewable Energy Development site boundary:<br>› Callan Public Water Supply Scheme (PWSS)<br>› Tullaroan Group Water Scheme<br>› BallyCallan Shale Region Group Water Scheme<br>› BallyCallan Limestone Region Group Water Scheme | › Geoheritage sites addressed in Section 8.3.6<br>› Information regarding groundwater, hydrogeology and groundwater drinking water abstractions are addressed in Chapter 9. |
| Uisce Éireann | › Having reviewed the documentation submitted there is no Uisce Éireann | N/A |

| Consultee | Description | Addressed in Section |
|---|---|---|
| | infrastructure in the area, therefore Uisce Éireann have no objection in principle. | |



### 8.2.4 Impact Assessment Methodology

Using information from the desk study and data from the site investigations, an assessment of the importance of the land, soil and geological environment within the Site 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.<br>Degree or extent of soil contamination is significant on a national or regional scale.<br>Volume of peat and/or soft organic soil underlying the site is significant on a national or regional scale. | Geological feature rare on a regional or national scale (NHA).<br>Large existing quarry or pit.<br>Proven economically extractable mineral resource |
| High | Attribute has a high quality, significance or value on a local scale.<br>Degree or extent of soil contamination is significant on a local scale.<br>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.<br>Large recent landfill site for mixed wastes.<br>Geological feature of high value on a local scale (County Geological Site).<br>Well drained and/or highly fertility soils.<br>Moderately sized existing quarry or pit<br>Marginally economic extractable mineral resource. |
| Medium | Attribute has a medium quality, significance or value on a local scale.<br>Degree or extent of soil contamination is moderate on a local scale.<br>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.<br>Small recent landfill site for mixed Wastes.<br>Moderately drained and/or moderate fertility soils. Small existing quarry or pit.<br>Sub-economic extractable mineral Resource. |
| Low | Attribute has a low quality, significance or value on a local scale.<br>Degree or extent of soil contamination is minor on a local | Large historical and/or recent site for construction and demolition wastes.<br>Small historical and/or recent landfill site for construction and demolition wastes. |

| Importance | Criteria | Typical Example |
|---|---|---|
| | scale.<br>Volume of peat and/or soft organic soil underlying site is small on a local scale. | Poorly drained and/or low fertility soils.<br>Uneconomically extractable mineral Resource. |



EPA, 2022 states that there are 7 no. steps in the preparation of the EIAR. The initial steps relate to screening, scoping, the consideration of alternatives and the description of the project. Step 5 relates to the description of the baseline environment which is presented in Section 8.3 for the land, soils and geological environment. Step 6 relates to the assessment of impacts and is presented in Section 8.6. The guideline criteria for the assessment of effects states that the purpose of an EIAR is to identify, describe and present an assessment of the likely significant effects. The likely effects are described with respect to their quality (positive, neutral or negative), significance (imperceptible to profound), extent (i.e. size of area or number of sites effected), context (is the effect unique or being increasingly experienced), probability (likely or unlikely), duration (momentary to permanent), frequency and reversibility. The descriptors used in this chapter are those set out in the EPA, 2022 glossary of effects 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.

*Table 8-3: Additional Impact Characteristics.*

| Impact Characteristic | Degree/ Nature | Description |
|---|---|---|
| Proximity | › Direct | An impact which occurs within the area of the Proposed Development, as a direct result of the Proposed Development. |
| | › Indirect | An impact which is caused by the interaction of effects, or by off-site developments. |
| Probability | Unlikely | The effect can reasonably be expected not to occur. |
| | Likely | The effect can be reasonably expected to occur. |

In order to provide an understanding of this descriptive system in terms of the geological/hydrological environment, elements of this system of description of effects are related to examples of potential likely significant effects on the geology and morphology of the existing environment, as listed in Table 8-4.

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

| Impact Characteristics | | Potential Hydrological Impacts |
|---|---|---|
| Quality | Significance | |
| Negative only | Profound | Widespread permanent impact on:<br>› The extent or morphology of a cSAC.<br>› Regionally important aquifers.<br>› Extents of floodplains.<br>Mitigation measures are unlikely to remove such impacts. |
| Positive or Negative | Significant | Local or widespread time-dependent impacts on:<br>› The extent or morphology of a cSAC / ecologically important area. |

| Impact Characteristics | | Potential Hydrological Impacts |
|---|---|---|
| Quality | Significance | |
| | | › A regionally important hydrogeological feature (or widespread effects to minor hydrogeological features).<br>› Extent of floodplains.<br>Widespread permanent impacts on the extent or morphology of an NHA/ecologically important area.<br>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:<br>› The extent or morphology of a cSAC / NHA / ecologically important area.<br>› A minor hydrogeological feature.<br>› Extent of floodplains.<br>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 Study Area

The study area for the land, soils and geological environment is limited to within the EIAR Site Boundary. There is no potential for the Proposed Project to effect the land, soils and geological environment outside of the Site.

## 8.2.6 Limitations and Difficulties Encountered

No limitations or difficulties were encountered during the preparation of the Land, Soils and Geology Chapter of the EIAR.

# 8.3 Existing Environment

## 8.3.1 Site Description and Topography

### 8.3.1.1 Proposed Wind Farm

The Site is located within a rural, agricultural setting in northwest Co. Kilkenny, approximately 8.5km west of Kilkenny City. The settlement of Kilmanagh is located approximately 1.2km south of the nearest proposed turbine, and the settlement of Tullaroan is located approximately 2.7km north of the nearest proposed turbine. The Proposed Wind Farm site is situated in the townlands of Oldtown Hill, Oldtown, Reisk, Briskalagh and Ballycuddihy in the north, Coolnapisha towards the centre and the townlands of Kilmanagh and Knockenglass in the south. The Site has a total area of ~1,000 hectares.

The R695 regional road runs immediately south of the Site in an east-west orientation entering the settlement of Kilmanagh and then heading south from Kilmanagh towards Callan, passing within 1.3km of the nearest proposed turbine. Existing access is via farm entrances off the L5023 local road to the northwest, L5024 to the north, and L1009 to the south. The Site is traversed by a number of existing agricultural roads and tracks.

Landuse within the Site currently comprises a mix of pastoral agriculture and small-scale, private forestry. The surrounding landuse predominantly comprises pastoral agriculture and residential within Kilmanagh and Tullaroan.

The Proposed Wind Farm is situated within the valley of the Tullaroan Stream, that runs southwards. Elevations across the Proposed Wind Farm site generally range between 110mOD and 200mOD, with greatest elevations seen towards the north, in the area of the proposed borrow pit, and in the eastern portion of the Proposed Wind Farm site. Topography generally slopes towards the centre and the south of the Proposed Wind Farm site towards the Tullaroan Stream and the town of Kilmanagh.

### 8.3.1.2 Proposed Grid Connection

The Proposed Grid Connection includes the proposed onsite 38kV substation and associated control buildings in the townland of Oldtown within the Proposed Wind Farm site. The proposed onsite 38kV substation is located in agricultural lands and will be accessed via Proposed Wind Farm access roads.

The Proposed Grid Connection underground cabling route originates at the proposed onsite 38kV substation and connects to the existing 110kV Ballyragget substation. The Proposed Grid Connection underground cabling route is located primarily within the public road corridor, with ~260m located within a Site road to the west of the proposed substation, and a short off-road section through agricultural lands near Ballyragget substation.

The Proposed Grid Connection underground electrical cabling route will originate at the proposed onsite 38kV substation and run west for approximately 260m through the Proposed Wind Farm access Site road towards the L5023 local road. The Proposed Grid Connection underground cabling route continues underneath the local road network for approximately 12.3km before following the R694 north for 8.6km. The underground cabling route then follows the N77 national road north for ~1km before crossing the River Nore via directional drilling. On the eastern side of the River Nore, the proposed cable route then passes through several agricultural fields and tracks for approximately 660m. The proposed cable route then joins the R432 for the remainder of the route, a stretch of approximately 140m. From the R432 the cable route turns right into the existing 110kV Ballyragget Substation compound in the townland of Moatpark.

Much of the southern section of the Proposed Grid Connection underground cabling route is located at elevations in excess of 100mOD associated with the Slieve Ardagh Hills. Topography rises rapidly to the north of the Brittas cross roads and the greatest elevations are recorded in the townland of Picketstown where ground elevations stand at ~240mOD. Further to the north in the vicinity of Freshford and Ballyragget, ground elevations are relatively flat and range from 70 to 80mOD.



## 8.3.2 Land and Land Use

### 8.3.2.1 Proposed Wind Farm

Based on Corine (2018) mapping the Proposed Wind Farm site comprises of mainly agricultural pastures. An area of forest and semi natural areas can also be seen towards the southern portion of the Proposed Wind Farm site. T7 is located within this forested area within the boundaries of the Proposed Wind Farm site. Furthermore, heterogeneous agricultural areas are mapped towards the very southwestern area of the Proposed Wind Farm site.

Land cover at the Proposed Wind Farm site has been verified during site walkover surveys completed by HES, from the inspection of recent aerial imagery and from habitat mapping completed by ecologists as part of the baseline characterisation for Chapter 6.

The land cover at the location of the key Proposed Wind Farm infrastructure is detailed in Table 8-5.

*Table 8-5: Existing Land Cover at Proposed Wind Farm Infrastructure Locations*

| Proposed Wind Farm Key Infrastructure Element | Land Cover |
|---|---|
| T01, T02, T03, T05, T06, met mast, borrow pit, 1 no. temporary construction compounds and spoil management areas | Agricultural pastures |
| T07 and spoil management area | Coniferous forestry plantations |
| 1 no. temporary construction compound and spoil management areas | Heterogeneous agricultural areas (According to Corine 2018) – verified during site walkover survey to be agricultural pastures. |

### 8.3.2.2 Proposed Grid Connection

The proposed onsite 38kV substation and associated compound (including control buildings and temporary construction compound) are mapped by Corine (2018) to be located in agricultural pastures. This was verified during site walkover surveys completed by HES.

The Proposed Grid Connection underground cabling route is predominantly located in the carriageway of the existing public road network with the exception of ~260m along a Site road to the west of the proposed onsite 38kV substation and a short off-road section which passes through agricultural grasslands in the vicinity of the Ballyragget substation.

According to Corine land cover mapping (2018) (www.epa.ie), the majority of the lands surrounding the Proposed Grid Connection underground cabling route are comprised of agricultural lands. As the Proposed Grid Connection underground cabling route passes the townlands of Freshford and Ballyragget the land use is mapped as discontinuous urban fabric. Land use along the Proposed Grid Connection underground cabling route was verified during walkover surveys.

## 8.3.3 Soils and Subsoils

### 8.3.3.1 Proposed Wind Farm

The published Teagasc soils map (www.gsi.ie) shows that the north of the Proposed Wind Farm site is predominantly overlain by poorly drained acidic mineral soils (AminPD). There is some bedrock at the surface – non calcareous (RckNCa) at the north of the Proposed Wind Farm site also where the elevations are greatest. The areas that have bedrock at or near the surface are deemed to have well drained acidic mineral shallow soils (AminSW). Towards the south of the Proposed Wind Farm site, near the Tullaroan Stream, soils are mapped as well drained basic mineral soils (BminSW) and well drained acidic mineral soils (AminDW). Mineral alluvium is also mapped along the Tullaroan Stream.

The GSI subsoils map (www.gsi.ie) shows that the Proposed Wind Farm site is largely mapped to be underlain by till derived from Namurian shales and sandstones (TNSSs). The till is located on the sides of the valley of the Tullaroan Stream. In addition, an area of sand and gravels derived from Carboniferous limestone are mapped towards the centre and southern area of the Site, whilst alluvium subsoils are mapped along the Tullaroan Stream. The sands and gravels are mapped along a thin strip along the banks of the Tullaroan Stream.

The mapped subsoils in the surrounding lands are largely similar to those mapped within the Proposed Wind Farm site, dominated by till derived from Namurian sandstones and shales and areas of bedrock outcrop, with alluvium mapped along local watercourses.

A subsoil geology map for the Site is shown as Figure 8-1.

The soils and subsoils present at the Proposed Wind Farm site have been confirmed by site investigations comprising of trial pits and boreholes.

Initial walkover surveys and gouge coring/peat probing was completed by HES at the Proposed Wind Farm site on 28th September 2023. The proposed turbine locations were typically found to be overlain by brown clayey silty mineral soil. A peaty organic topsoil was only encountered at 1 no. proposed turbine location. Thin organic deposits (0.1-0.3m) were encountered in the conifer forestry plantation in the vicinity of T7, with gravelly subsoils encountered below the organic peaty topsoil.

Trial pit investigation were carried out at the Proposed Wind Farm site by HES in December 2023 and February 2024. The ground investigation comprised 14 no. trial pits carried out on 18th and 19th December 2023 at proposed infrastructure locations and an additional 8 no. trial pits on the 7th February 2024 were completed at potential borrow pit locations (refer to Figure 8-2 for trial pit locations).

The trial pits were carried out at the proposed turbine locations (excluding T7 due to dense forestry prohibiting access), the proposed borrow pit area and at various locations along Proposed Wind Farm access roads. The trial pit geological logs are attached as Appendix 8-1. Based on the site-specific data obtained from the trial pit investigations, the ground conditions at the Proposed Wind Farm site can be summarised as follows:

- TOPSOIL was encountered at all trial pit investigations. The thickness of the topsoil was found to range from 0.2 to 0.3m;
- The topsoil was typically underlain by glacial till. The till is noted to be comprised of sandy, gravelly or silty CLAY, frequently with low to medium cobble content, typically firm or stiff.
- More granular subsoil deposits comprising of clayey, gravelly, fine to coarse SAND were recorded beneath the topsoil at 6 no. trial pit locations (TP1, TP6, TP8, TP13, TP14, TP15. These shallow sands extended to a maximum depth 0.8mbgl (metres below ground level) and were underlain by more cohesive clay deposits;

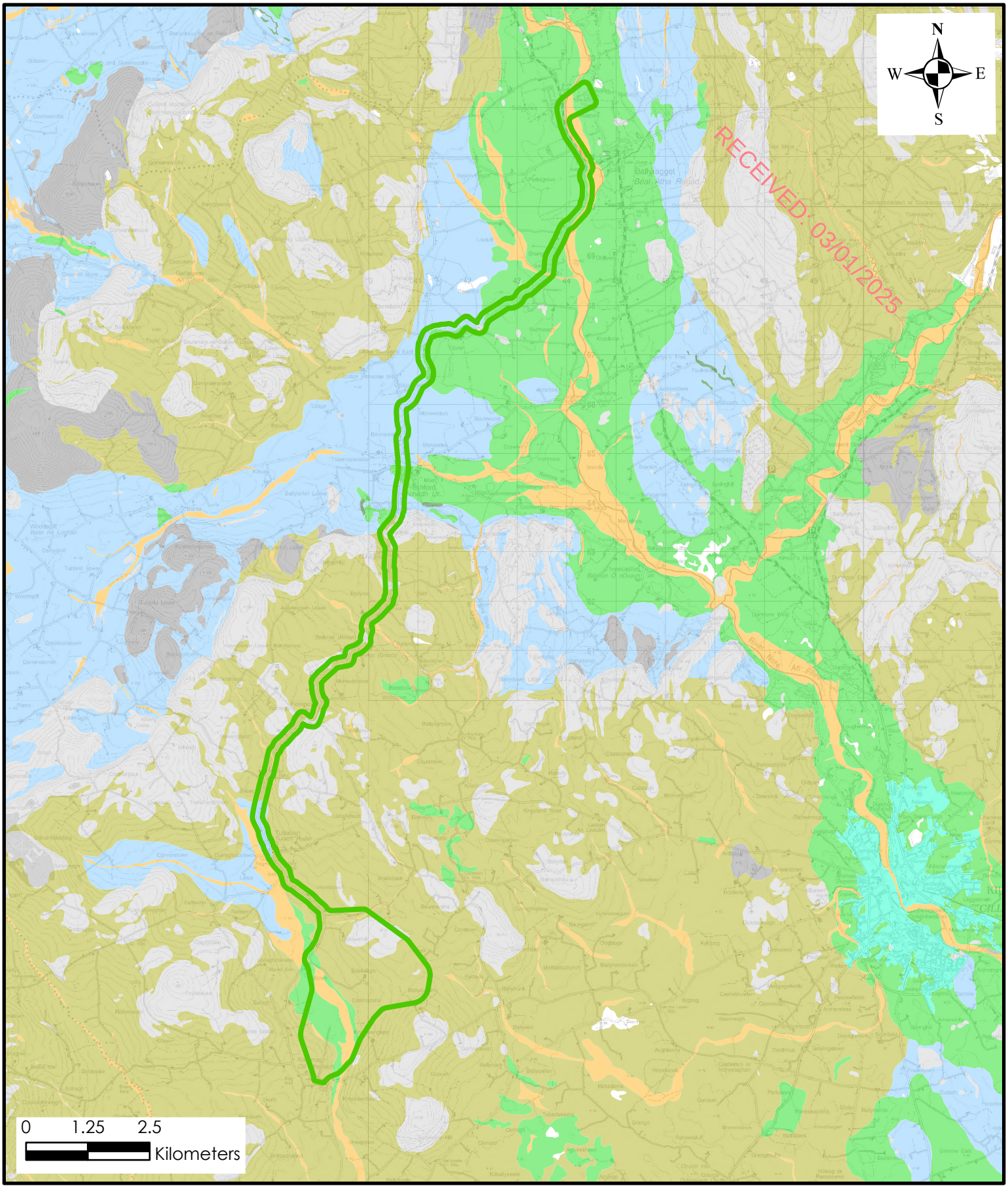
- Deeper wet SANDs and GRAVELs were encountered at a depth of 1.2m at TP14 adjacent to the proposed crossing of the Tullaroan Stream. These granular water-bearing deposits extended to the base of the trial pit excavation (3mbgl);
- Loose, angular, weathered – SILTSTONE bedrock ("Slig") was encountered at 7 no. trial pit locations at depths of 0.4 to 3.3mbgl. The depth to weathered rock was shallowest (0.4-1mbgl) in the north of the Proposed Wind Farm site at the location of the proposed borrow pit.; and,
- Competent bedrock was encountered at 2 no. trial pit locations (BP1-TP3 and BP2-TP3) at depths of 2.46mbgl and 3.5mbgl respectively.



Particle Size Distribution (PSD) analysis was completed at 7 no. trial pit locations. The samples were described in the logs as being gravelly CLAY. Based on the PSD analysis the percentage components of SAND and GRAVEL ranged from 17.9% to 29.4% and 23.8% to 50.4% respectively. The PSD analysis reports are attached as Appendix 8-3. The results of the PSD analysis are also presented in Figure 8-3.

2 no. monitoring wells were drilled by Peterson Drilling Services Ltd on 18th and 19th December 2023 towards the south of the Proposed Wind Farm Site, in the valley of the Tullaroan Stream. These wells were drilled to facilitate the monitoring of groundwater levels (refer to Chapter 9). The location of the monitoring wells are shown on Figure 8-2. The drilling geological logs are attached as Appendix 8-2.

The drilling investigation locations revealed the occurrence of thick deposits of SANDs and GRAVELs along the banks of the Tullaroan Stream. At these locations the granular subsoils were between 13.4 and 18.7m thick. Glacial till deposits were encountered on the valley sides.




Legend

- EIAR Site Boundary

Subsoils

- A, Alluvium
- BasEsk, Eskers comprised of gravels of basic reaction
- GLs, Gravels derived from Limestones
- KaRck, Kartsified bedrock outcrop or subcrop
- Rck, Bedrock outcrop or subcrop
- TLs, Till derived from limestones
- TNSSs, Till derived from Namurian sandstones and shales
- Urban

Client: Briskalagh Ltd.

Job: Briskalagh Renewable Energy Development, Co. Kilkenny

Title: Subsoils Map

Figure No: 8-1

Drawing No: P1657-0-0824-A4-801-00A

Scale: 1:100,000

Drawn By: GA

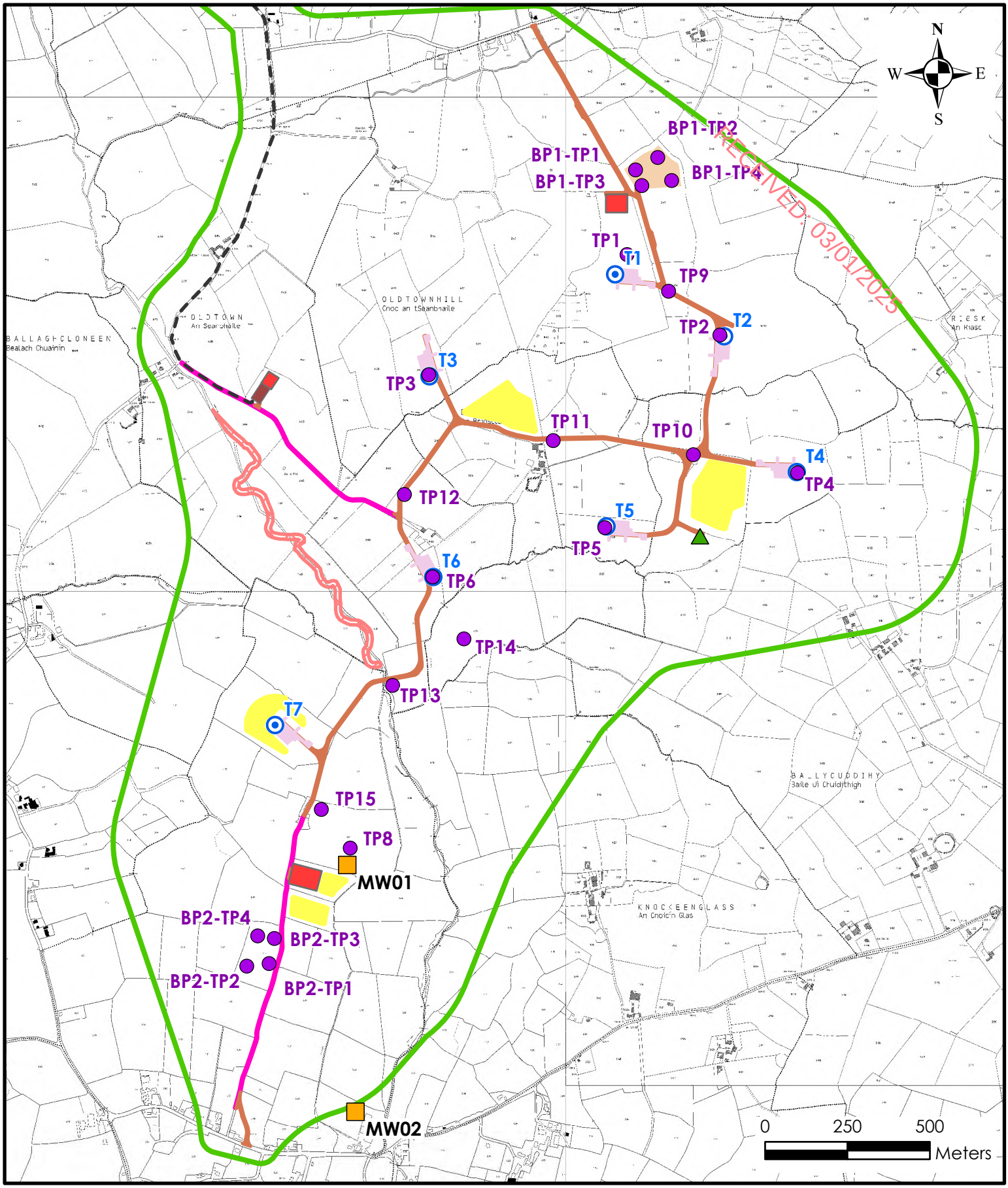
Sheet Size: A4

Project No: P1657-0

Date: 27/08/2024

Checked By: MG

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie




Legend

- EIAR Site Boundary
- Proposed Turbine Locations
- Proposed Hardstands
- Proposed Met Mast
- Existing Roads for Upgrade
- Proposed New Roads
- Proposed Temporary Construction Compound
- Spoil Management Areas
- Proposed Borrow Pit
- Proposed Onsite Substation
- Proposed Underground Cabling Route
- Riparian Planting Buffer
- Monitoring Well Locations
- Trial Pit Locations

Client: Briskalagh Ltd.

Job: Briskalagh Renewable Energy Development, Co. Kilkenny

Title: Site Investigation Locations - trial pits and boreholes

Figure No: 8-2

Drawing No: P1657-0-1024-A4-802-00A

Scale: 1:15,000

Drawn By: GA

Sheet Size: A4

Project No: P1657-0

Date: 01/10/2024

Checked By: MG

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

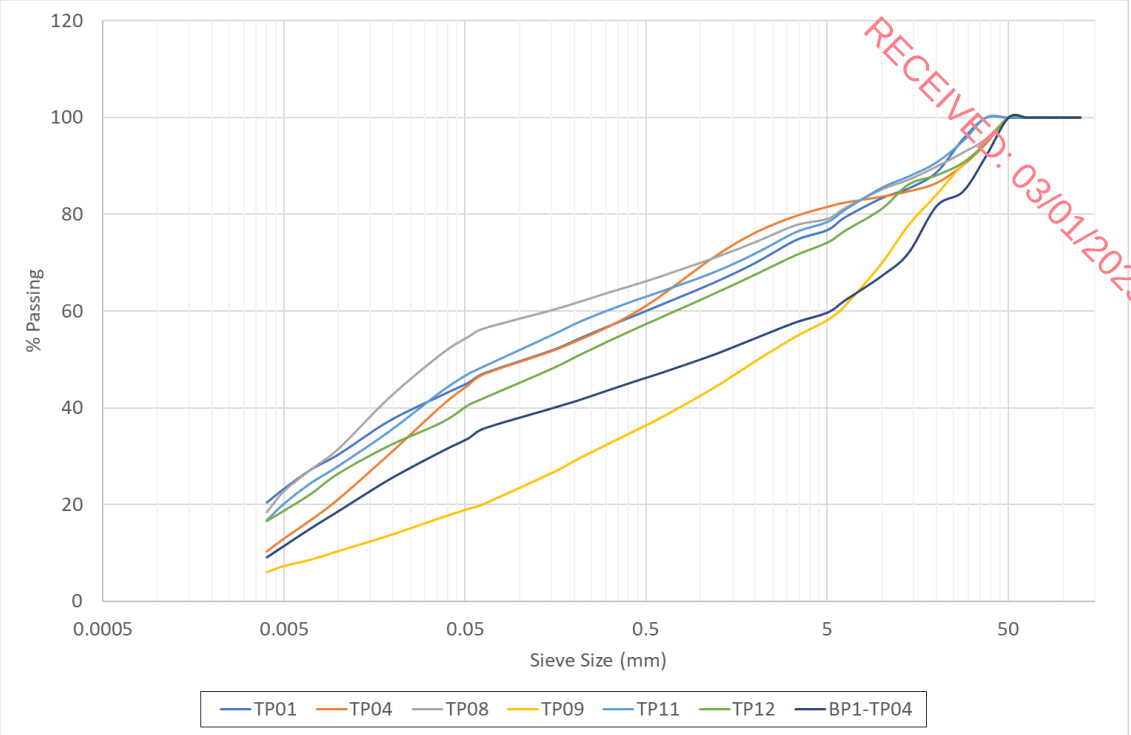





*Figure 8-3: PSD Analysis of Subsoils*

### 8.3.3.2 Proposed Grid Connection

According to the Teagasc soil mapping (www.gsi.ie), the proposed onsite 38kV substation and associated compound are overlain by mainly acidic poorly drained mineral soils (AminPD). The southern portion of the Proposed Grid Connection underground cabling route is largely overlain by acidic mineral soils that are poorly drained (AminPD), well drained acidic mineral shallow soils (AminSW) and well drained acidic mineral soils (AminDW). Meanwhile, ~700m of the Proposed Grid Connection underground cabling route to the west of the proposed onsite 38kV substation is overlain by mainly basic shallow well drained mineral soils (BminSW) and ~1.15km of the route in the townlands of Tullaroan and Brittas is overlain by basic deep well drained mineral soils (BminDW). The northern section of the Proposed Grid Connection underground cabling route is overlain by deep well drained mineral (mainly basic) soils (BminDW), mineral poorly drained (mainly basic) soils (BminPD) and well drained basic mineral soils (BminSW). Mineral alluvium is also mapped along several watercourses in the vicinity of the Proposed Grid Connection underground cabling route.

In terms of subsoils, the GSI (www.gsi.ie) map shows that the location of the proposed onsite 38kV substation and associated compound and the majority of the southern portion of the Proposed Grid Connection underground cabling route are underlain by till derived from Namurian sandstones and shales and bedrock outcrop or subcrop. Meanwhile, the Proposed Grid Connection underground cabling route to the west of the proposed substation is mapped by the GSI to be underlain by gravels derived from limestones. Other GSI mapped subsoils along the Proposed Grid Connection underground cabling route include till derived from limestones in the townlands of Tullaroan and Brittas. Meanwhile, the norther section of the Proposed Grid Connection underground cabling route is mapped to be underlain by tills derived from limestones near Freshford and gravels derived from limestones further to the north.

Subsoils along the Proposed Grid Connection are shown in Figure 8-1.

The soils and subsoils along the Proposed Grid Connection underground cabling route were verified during visual assessment of exposed soils and subsoils completed during surveys of the route.

## 8.3.4 Bedrock Geology

### 8.3.4.1 Proposed Wind Farm

Based on the GSI Bedrock Geology 100k, the Proposed Wind Farm site is underlain by the Killeshin Siltstone Formation.

The Killeshin Siltstone Formation is comprised of muddy siltstone and silty mudstone. The GSI provide the following lithological description of the Killeshin Siltstone Formation:

*"The formation is composed mainly of grey argillaceous siltstones or silty mudstones, with lesser amounts of sandstone and shale. The siltstones are poorly bedded with an irregular conchoidal fracture. Black shales occur infrequently".*

Towards the south of the Proposed Wind Farm site, a thin stratigraphical unit called the Carlow Flagstone Member of the Killeshin Siltstone Formation is mapped across the Site, from east – west. The Carlow Flagstone Member is described as a fine, grey, flaggy sandstone.

There are no mapped faults or folds within or in the immediate vicinity of the Proposed Wind Farm site.

The GSI map the presence of bedrock outcrop towards the north of the Proposed Wind Farm site, in the area of the proposed borrow pit.

A bedrock geology map for the Proposed Wind Farm site is included below as Figure 8-4.

A total of 7 of the 22 no trial pit excavations encountered weak weathered grey SILTSTONE bedrock at depths ranging from 0.4 to 3.3m. The 2 no. boreholes drilled in the valley of the Tullaroan Stream encountered thicker overburden deposits with rock encountered at 18.7 and 13.4mbgl at MW01 and MW02 respectively. Competent bedrock was encountered in MW01 and was described as medium strong to strong, shaley black SILTSTONE. The bedrock encountered during the site investigations corresponds with the bedrock mapped and described by the GSI.

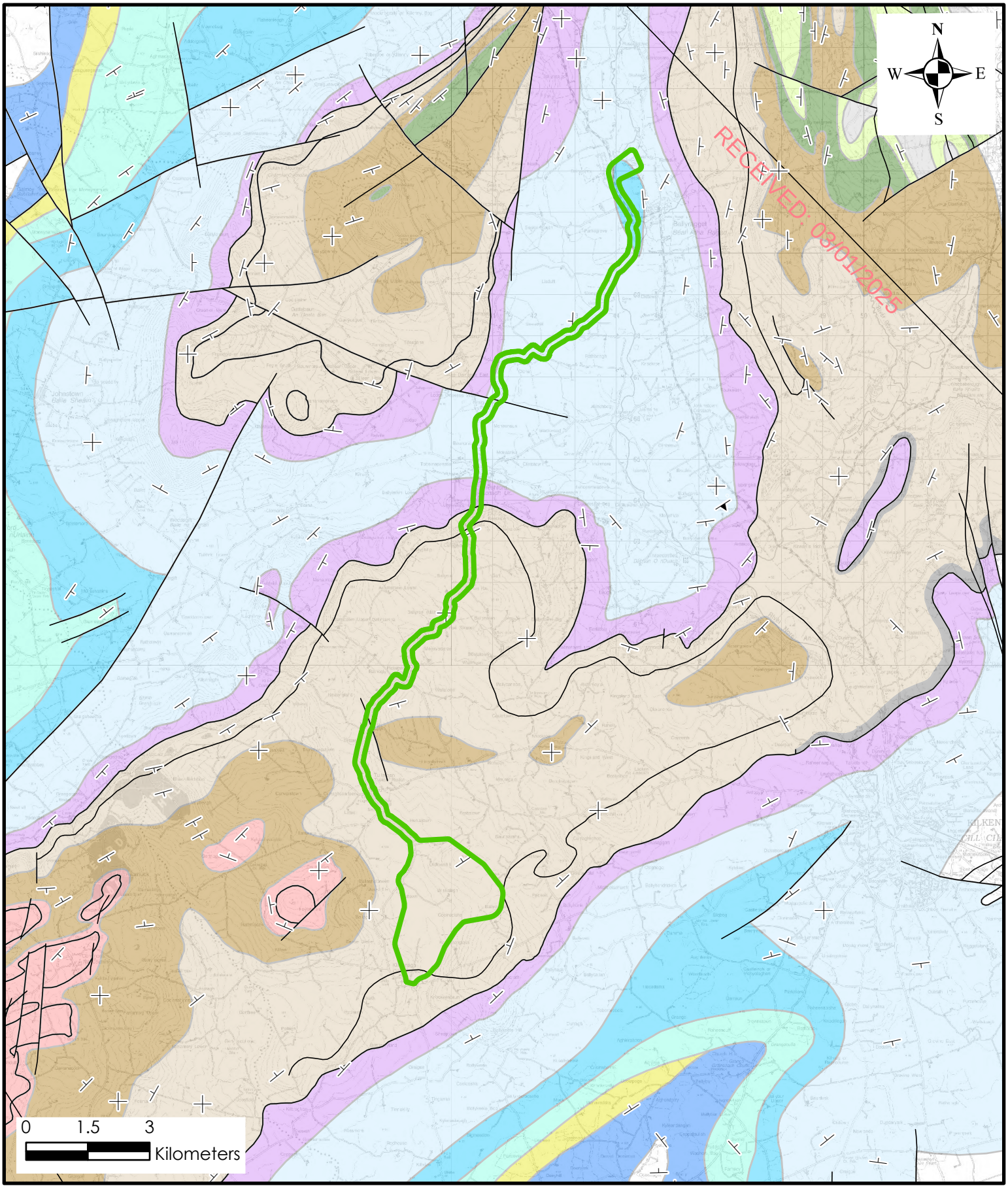
### 8.3.4.2 Proposed Grid Connection

The proposed onsite 38kV substation and associated compound and the southern section of the Proposed Grid Connection underground cabling route are mapped to overlie the Killeshin Formation. As the Proposed Grid Connection underground cabling route approaches Freshford, it traverses over the thin stratigraphical unit of the Carlow Flagstone Member within the Killeshin Formation, and further to the north it is mapped to be underlain by the Clogrenan Formation. The contact boundary between the younger, Namurian Killeshin Formation and the older, Dinantian, Clogrenan Formation is mapped as an unconformity by the GSI. The Clogrenan Formation consists of Cherty, muddy, calcarenitic limestone. Further north, the majority of the northern section of the Proposed Grid Connection underground cabling route is underlain by the Ballyadams Formation, comprising crinoidal wackestone/packstone limestone. In the area of Ballyragget, the Proposed Grid Connection underground cabling route is also mapped to overlie the Durrow Formation which consists of Shaly fossiliferous and oolitic limestone.

The Proposed Grid Connection underground cabling route is mapped to traverse over 2 no. faults. The GSI map a small northwest to southeast trending fault to be located ~150m north of Brittas Cross Roads. A larger west/northwest to east/southeast orientated fault is mapped ~1.7km north of Freshford town.

There are several small pockets of bedrock outcrop mapped along the Proposed Grid Connection underground cabling route by the GSI. These areas of mapped bedrock outcrop are located to the south of Freshford and further north in the townlands of Clone and Grange.

A bedrock geology map for the Proposed Grid Connection is attached as Figure 8-4.




Legend

- EIAR Site Boundary

Bedrock

- Aghmacart Formation
- Ballyadams Formation
- Bregaun Flagstone Formation
- Clay Gall Sandstone Formation
- Clogrenan Formation
- Coolbaun Formation
- Crosspatrick Formation
- Durrow Formation
- Killeshin Siltstone Formation
- Lickfinn Coal Formation
- Luggacurren Shale Formation
- Moyadd Coal Formation
- Waulsortian Limestones
- Geological Linework

Structural Symbols

- Horizontal Bedding
- Strike and dip of bedding, way up unknown
- Strike and dip of first foliation

Client: Briskalagh Ltd.

Job: Briskalagh Renewable Energy Development, Co. Kilkenny

Title: Bedrock Geology Map

Figure No: 8-4

Drawing No: P1657-0-0824-A4-804-00A

Scale: 1:120,000

Drawn By: GA

Sheet Size: A4

Project No: P1657-0

Date: 27/08/2024

Checked By: MG

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

## 8.3.5 Geological Resource Importance

### 8.3.5.1 Proposed Wind Farm

The GSI Online Database accessed via the Public Data Viewer (www.gsi.ie) does not record the presence of any active quarries or sand and gravel pits within the Proposed Wind Farm site. Holdensrath Quarry is an active limestone quarry mapped ~6.5km northeast of the Proposed Wind Farm site.

Furthermore, the GSI do not record the presence of any historic quarries or pits within the Proposed Wind Farm site. The closest mapped historic quarry/pits are situated to the southeast of the Proposed Wind Farm site. These include historic quarries in townland of Ballycuddihy, ~1km away where several small quarries in broken shales with gritty beds were present. Historic quarries and pits are also recorded in the townland of Knockeenbaun, ~1.5km away where limestone with shale was quarried and in the townland of Gorteenteen, ~2.7km away where a disused quarry in limestone with some dolomite is located. No evidence of historic extraction activities was recorded during the site walkover surveys.

The GSI do not record any mineral localities within the Proposed Wind Farm site. However, the historic quarry/pits outlined above in the townlands of Knockeenbaun, Gorteenteen and Ballycuddihy are also noted as mineral localities by the GSI.

The GSI online Aggregate Potential Mapping Database (www.gsi.ie) shows that the crushed rock aggregate potential of the Proposed Wind Farm site ranges from 'Very Low' to 'Moderate'. Much of the Proposed Wind Farm site is noted as being of 'Very Low' to 'Low' potential. Areas of 'Moderate' potential are found in the north where the depth to rock is shallowest. The bedrock at the Proposed Wind Farm site could be used on a "sub-economic" local scale for construction purposes. However, no borrow pits were encountered during walkover surveys. The bedrock has not previously been extracted due to the coverage of till.

The Proposed Wind Farm site is generally not located within an area mapped for granular aggregate potential (i.e., potential for gravel reserves). The areas along the valley of the Tullaroan Stream within the Proposed Wind Farm site is mapped as having 'Very Low' to 'Moderate' potential. The subsoil deposits at the Proposed Wind Farm site can be considered to be of 'Low' importance.

### 8.3.5.2 Proposed Grid Connection

There are no active quarries or active sand and gravel pits mapped along the Proposed Grid Connection underground cabling route or in the vicinity of the proposed onsite 38kV substation (www.gsi.ie).

The GSI online Aggregate Potential Mapping Database (www.gsi.ie) shows that the crushed rock aggregate potential along the Proposed Grid Connection underground cabling route ranges from 'Low' to 'Very High'. The greatest potential is found in the north of the route along the R694. The crushed rock aggregate potential is 'Low' at the location of the proposed onsite 38kV substation.

The majority of the southern portion of the Proposed Grid Connection underground cabling route is not mapped in an area for granular aggregate potential. However, as the Proposed Grid Connection underground cable route travels north, sections of the route, towards Freshford and Ballyraggett have 'High' and 'Very High' potential for gravel reserves respectively. The proposed onsite 38kV substation is not mapped in an area of granular aggregate potential.

## 8.3.6 Geological Heritage Sites

### 8.3.6.1 Proposed Wind Farm

There are no recorded geological heritage sites within the Proposed Wind Farm site (www.gsi.ie).

The closest geological heritage site is Ballykeefe Quarry County Geological Site (CGS) (Site Code: KK008). This CGS is located ~1.85km to the southeast of the Proposed Wind Farm site. Ballykeefe Quarry is a disused quarry used as an amphitheatre and rock climbing venue which has exposed faces of fossiliferous limestone with localised karst weathering features (Kilkenny – County Geological Site Report).

There are no other geological heritage sites within 5km of the Proposed Wind Farm site.

A map of local geological heritage sites is shown below as Figure 8-5.

### 8.3.6.2 Proposed Grid Connection

There are no geological heritage sites mapped along the Proposed Grid Connection underground cabling route. Geological Heritage Sites within 5km of the Proposed Grid Connection underground cabling route are described below.

The Ballyraggett Quarry CGS (Site Code: KK009) is located ~2km east of the Proposed Grid Connection underground cabling route and ~2.2km southeast of Ballyraggett town. The Ballyraggett Quarry CGS is described as a working quarry with exposed faces of limestone overlain by thick glacial deposits (Kilkenny – County Geological Site Report). This CGS may be recommended for Geological NHA.

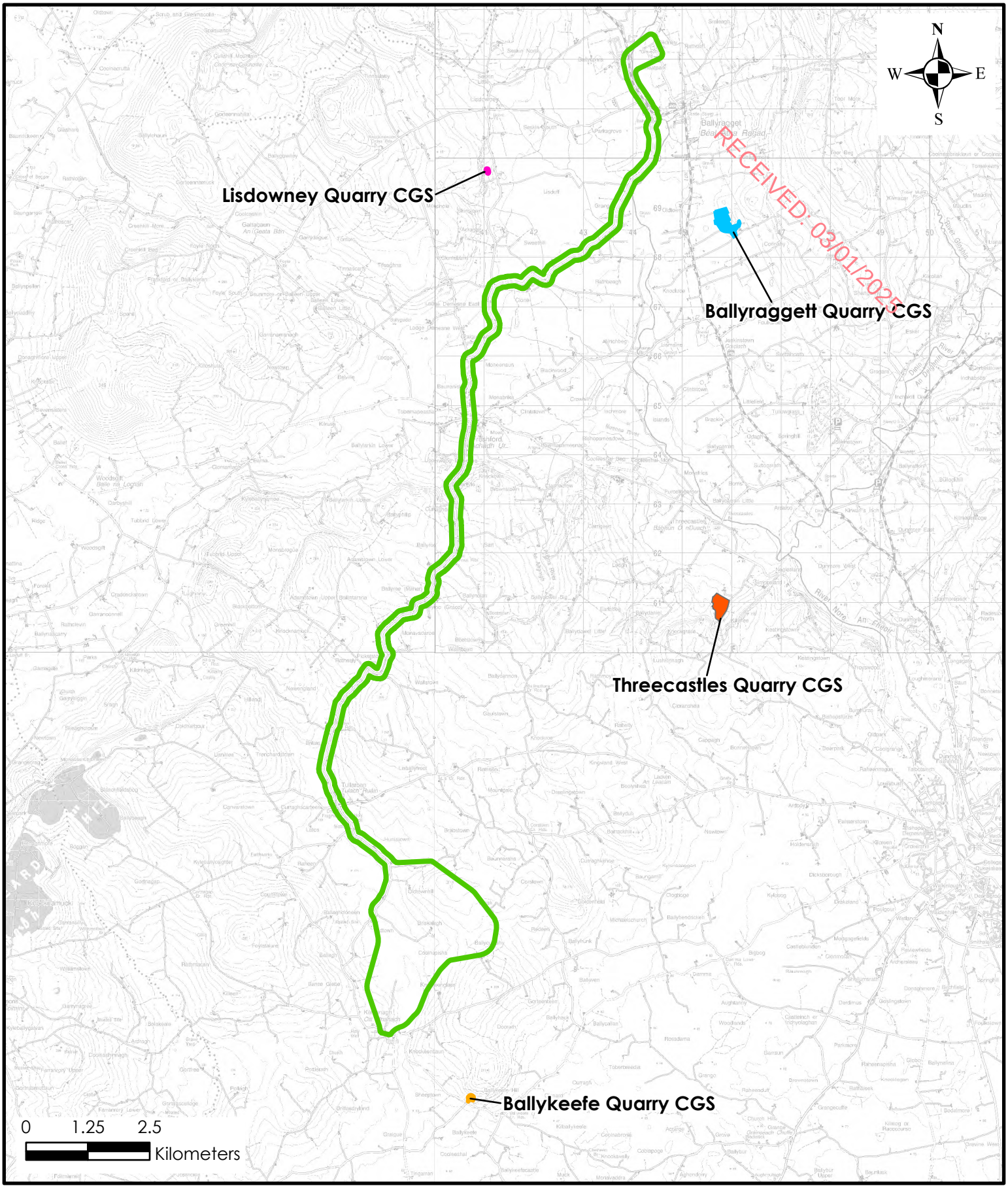
The Lisdowney Quarry CGS (Site Code: KK004) is located ~2.75km west of the Proposed Grid Connection underground cabling route and ~4km southwest of Ballyraggett town. The Lisdowney Quarry is a disused historical limestone quarry with natural exposures of rock along a ridge, showing important Lower Carboniferous crinoid fauna. (Kilkenny – County Geological Site Report). This CGS may be recommended for Geological NHA.

## 8.3.7 Soil Contamination

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

According to the EPA online mapping (http://gis.epa.ie/Envision), there are no licenced waste facilities or dump sites in the vicinity of the Proposed Wind Farm site. The closest mapped Industrial Emissions Licensed (IEL) facility is E. Smithwick & Sons Ltd (P0448), this licence has been surrendered and is located in Kilkenny city 10.5km to the east. With regards to the Proposed Grid Connection underground cabling route an IEL facility (Tirlan Ltd – P0359) is located ~700m west of the existing 100kV Ballyragget substation. There are no IPC or IEL facilities mapped along the route.

There are no historic mines at or in the immediate vicinity of the Site that could potentially have contaminated tailings. There are a couple mines to the southeast of the Proposed Wind Farm site, however not in the direct vicinity of the Proposed Wind Farm site. No contaminated tailing were recorded during walkover surveys of the Site.




Legend

- EIAR Site Boundary

Geological Heritage Sites

- Ballykeefe Quarry
- Ballyraggett Quarry
- Lisdowney Quarry
- Threecastles Quarry

Client: Briskalagh Ltd.

Job: Briskalagh Renewable Energy Development, Co. Kilkenny

Title: Geological Heritage Sites

Figure No: 8-5

Drawing No: P1657-0-0824-A4-805-00A

Scale: 1:120,000

Drawn By: GA

Sheet Size: A4

Project No: P1657-0

Date: 27/08/2024

Checked By: MG

HYDRO ENVIRONMENTAL SERVICES
22 Lower Main St
Dungarvan
Co.Waterford
Ireland
tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

### 8.3.8 Geohazards

#### 8.3.8.1 Slope Stability

##### 8.3.8.1.1 *Proposed Wind Farm*

The GSI Landslide database (www.gsi.ie) does not record any historic landslides in the vicinity of the Proposed Wind Farm 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 probability of a landslide occurring at the Proposed Wind Farm site is mapped as being 'Low'.

The site investigation data indicates that peat soils/subsoils are absent across the majority of the Proposed Wind Farm site. The peaty organic topsoil encountered in the coniferous forestry in the vicinity of T7 is very thin (0.1 to 0.3m) and does not present a risk in terms of peat stability.

##### 8.3.8.1.2 *Proposed Grid Connection*

The GSI Landslide database (www.gsi.ie) does not record any historic landslides in the vicinity of the proposed onsite 38kV substation or along the Proposed Grid Connection underground cabling route. These areas are typically mapped as 'Low' on the GSI's landslide susceptibility classification. There are only very small areas of 'Moderate' to 'High' potential mapped along the Proposed Grid Connection underground cabling route. However, walkover surveys and inspections identified no stability issues along the route.

## 8.4 Receptor Sensitivity and Importance

Based on the criteria set out in **Table 8-2** above, the soils and subsoils at the Proposed Wind Farm site can be classed as being of low importance as the soils in this area are not designated.

The bedrock geology underlying the Proposed Wind Farm site can be classed as being of medium importance where the bedrock could be used on a sub-economic scale.

The land, soils and bedrock geological formations underlying the Proposed Wind Farm site and the Proposed Grid Connection underground cabling route will be included in the impact assessment due to their proximal location to the Proposed Project and the potential direct effects that the Proposed Project may have on these receptors.

All geological heritage sites have been screened out of the impact assessment due to their distant location from the Site. There is no potential for effects to occur on these geological heritage sites.

## 8.5 Characteristics of the Proposed Project



The Proposed Project is defined in full in Chapter 4.

The Proposed Project will involve the removal of soils, subsoils and bedrock in order for access roads, internal cabling network, hardstanding emplacement, turbine foundations, substation, grid connection cabling, crane hardstands, construction compounds, drainage works and met mast installation. Rock for construction purposes will be sourced from the proposed onsite borrow pit, from cuttings during the construction phase and from local licenced quarries.

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. Rock breaking may be required at some of the turbines and hard-standing locations to create the reduced foundation level and the levelling required for construction. The material excavated is required to be properly managed and stored and should be re-used in other elements of the Proposed Wind Farm infrastructure. The turbine foundations will either be gravity design or piled foundation depending on more detailed site investigations.

The quantities of spoil requiring management at the Site has been calculated and are presented in Table 8-6 below. The total estimated volume of spoil to be managed following excavations during the construction phase of the Proposed Project is approximately 65,370m$^3$ (this includes a contingency factor of 10% to allow for increase in volume upon excavation). It is proposed to manage overburden generated through construction activities locally within the Site, through the backfilling of the proposed borrow pit void in the first instance, and following that within identified spoil management areas and in linear berms along access roads and turbine hardstands where appropriate. The total capacity of the identified spoil management areas, including the backfilling of the borrow pit, within the Site is approx. 70,000m$^3$ and therefore, in conjunction with roadside berms, there is more than enough capacity to manage the total volume of spoil requiring management for both the Proposed Wind Farm and the Proposed Grid Connection.

The majority of material excavated along the Proposed Grid Connection underground cabling trench will be reinstated back into the trench. 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.

In order to facilitate the construction of the Proposed Project, all crushed stone, hardcore materials and ready mix concrete will be sourced from the proposed onsite borrow pit and from cut earthworks. Any aggregate material which requires a specific grade or quality may be sourced from a suitable licenced quarry.

*Table 8-6 Spoil and Stone Volumes*

| Development Component | Spoil Volume(m3) (approx.) | Crushed Stone Requirement (m3) (approx.) |
|---|---|---|
| Proposed Wind Farm | | |
| **7 no. Turbines and Hardstanding Areas (including foundations)** | 33,850 | 31,190 |
| **Access Roads (including met mast and hardstand)** | 12,490 | 16,660 |
| **Temporary Construction Compounds** | 2,770 | 3,690 |
| **Total** | 49,110 | 51,540 |
| Proposed Grid Connection | | |
| **Onsite Substation (including temporary construction compound)** | 1,330 | 1,660 |
| **Cabling Trench** | 13,830 | 6,230 |
| **Total** | **14,160** | **7,475** |
| **Total** | **64,270** | **59,430** |
| **Total (including 10% contingency)** | **70,700** | **64,370** |

# 8.6 Likely Significant Effects and Associated Mitigation Measures

## 8.6.1 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 and forestry would continue at the Proposed Wind Farm site. Forestry will be felled as forestry compartments reach maturity. Re-planting of these areas with coniferous plantation is likely to occur. Land drainage carried out in areas of the Site 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 Kilkenny'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) and forestry operations (felling and replanting) can and will continue in conjunction with the Proposed Project use of the Site.

Furthermore, the opportunity to new create a riparian buffer zone comprising native species adjacent the Tullaroan stream within the Proposed Wind Farm site, increase the ecological condition of over 3.5km of existing hedgerow and to plant approximately 270m of new native hedgerow. Please see Appendix 6-4 Biodiversity Management and Enhancement Plan for details.

## 8.6.2 Construction Phase - Likely Significant Effects and Mitigation Measures

The likely effects of the Proposed Project and mitigation measures that will be put in place during the construction phase to eliminate or reduce them are outlined below. The assessment considers the Proposed Project as a whole i.e. both the Proposed Wind Farm and the Proposed Grid Connection. Where this is required to be assessed separately, this is noted in the text.

### 8.6.2.1 Effects on Land and Land use

The Proposed Project includes the construction of 7 no. turbines, associated hardstand areas, 3 no. temporary construction compounds, an onsite substation, new access roads and upgrades to existing roads. The Proposed Project has a total development footprint of 87,415m$^2$ (85,980m$^2$ associated with the Proposed Wind Farm and 1,435m$^2$ associated with the proposed onsite substation).

In addition, a total of 4.3ha of forestry (comprising both 3.57ha conifer plantation (WD4) and 0.73ha mixed broadleaved/conifer plantation (WD2)) will be permanently felled to accommodate Turbine 7 and its associated infrastructure. The permanent footprint of the Proposed Project will result in the permanent loss of both agricultural land and forestry plantations, which will be replaced by turbine foundations, hardstand areas, access roads and other related infrastructure. The Proposed Project construction works will also result in local topographic changes with the removal of overburden and bedrock.

No effects on land or landuse will occur along the Proposed Grid Connection underground cable route as works will predominantly occur within the carriageway of the existing public road network. The works will result in the excavation of a narrow trench to accommodate the cabling. This trench will be reinstated once the cabling is emplaced with a comparable ground surface. The off-road section of the

proposed route will also be reinstated and works will be completed over a very short time period in these agricultural lands.

There will be no effects on the land or landuse adjoining the Site.

**Pathway**: Construction Land take.

**Receptor**: Land and Landuse (i.e. the land upon which the Proposed Project will occur).

**Potential Pre-mitigation Effect**: Negative, moderate, direct, likely, long term effect on land and landuse at the Proposed Wind Farm site.

Negative, slight, direct, likely, long term effect on land and landuse along the Proposed Grid Connection underground cabling route.

**Impact Assessment / Mitigation Measures**:

- The loss of ~8.7ha agricultural and forestry land resulting from the Proposed Project on a local or regional scale is minimal and therefore the effects of actual agricultural land loss is imperceptible.
- This loss of land represents ~0.87% of the EIAR Site Boundary (~1,000ha).
- No mitigation is proposed with regard agricultural loss of land as it is an accepted part of the Proposed Project.
- The total amount of forestry to be felled (4.3ha) accounts for only approximately 16% of the existing woodland habitat (conifer forestry and broadleaf) coverage at the Proposed Wind Farm site which is approximately 29ha. Furthermore, in line with the Forest Service's published policies for wind farm development, the land cleared of forestry will be replanted at an alternative site.

**Residual Effect Assessment:** Due to the small footprint of the Proposed Project on a local scale the residual effect is considered negative, direct, slight to moderate, likely, long term on land and landuse.

**Significance of Effects:** For the reasons outlined above, no significant effects on land or landuse will occur at the Site.

### 8.6.2.2 Soil, Subsoil and Bedrock Excavation

Excavation of mineral soil/subsoil and bedrock will be required for the installation of foundations for the access roads, turbine hardstands and foundations, for biodiversity enhancement, and cable trenching within the Proposed Wind Farm site, and for the Proposed Grid Connection on-site substation and underground electrical cabling route. Estimated volumes of subsoils and bedrock to be relocated are summarised above in Table 8-6. It is noted that earthworks of this type, scale and magnitude have been granted permission and successfully completed at similar sites around the country.

However, there will be no loss of spoil from the Proposed Wind Farm site, as it will be relocated and stored within the proposed onsite borrow pit, in the designated spoil management areas or in linear berms along access roads and turbine hardstands where appropriate. Excavated spoil material can also be reused as fill material while the excavated rock will be used to facilitate the construction of the Proposed Project.

Excavation of subsoils will also be required along the Proposed Grid Connection underground cabling route. These deposits will be removed from the underground electrical cabling trench and will be transported to the spoil management areas within the Proposed Wind Farm site or to a local licenced facility..

**Pathway:** Extraction/excavation.

**Receptor: Soil, s**ubsoil and bedrock.

**Pre-Mitigation Potential Effect:** Negative, slight/moderate, direct, likely, permanent effect on subsoil and bedrock due to relocation within the Site.

**Proposed Mitigation Measures by Design:**

**Proposed Wind Farm site**

- Placement of turbines and associated infrastructure in areas with suitable ground conditions (based on detailed site investigation data);
- The soils and subsoil which will be removed during the construction of turbine hardstands will be localised to the turbine locations. The soil/subsoil will be placed/spread locally alongside the excavations or stored within the borrow pit and/or spoil management areas;
- Excavated soils/subsoils shall be excavated and stored separately to topsoil; this will prevent mixing of materials and facilitate reuse afterwards;
- At the identified spoil management area, 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 identified spoil management areas will be developed in a phased approach, with the topsoil removed and temporarily stockpiled within the defined area while the spoil is being placed. The stockpiled topsoil will then be reinstated over the placed spoil, and the exercise will continue within the same spoil management area until the area is full;
- The placement of spoil will be restricted to a maximum height of 1.0m, subject to confirmation by the Geotechnical Engineer;
- Where practical, the surface of the placed spoil is shaped to allow efficient run-off of surface water. Where possible, shaping of the surface of the spoil will be carried out as placement of spoil within the area progresses. This will reduce the likelihood of debris run-off and ensure stability of the placed spoil;
- Finished/shaped side slopes of the placed spoil will be not greater than 1 (v): 3 (h) in the dedicated spoil management zones and not greater than 1 (v): 1 (h) alongside access tracks;
- Inspections of the spoil management areas will be made by a Geotechnical Engineer through regular monitoring of the works. The appointed contractor will review work practices at spoil management areas when periods of heavy rainfall are expected so as to prevent excessive dirty water runoff from being generated;
- An interceptor drain will be installed upslope of the identified spoil management areas to divert any surface water away from these areas;
- Silt fences and double silt-fences will be emplaced down-gradient of spoil management areas and will remain in place throughout the entire construction phase, or until reseeding has been established to a sufficient level;
- The surface of the deposited spoil will be profiled to a gradient to be agreed with the Geotechnical Engineer and vegetated or allowed to vegetate naturally as indicated by the Project Ecologist;
- All the above-mentioned general guidelines and requirements will be confirmed by the Geotechnical Engineer prior to construction;
- The material will be backfilled into the spoil management areas and will be spread evenly across the area;
- It will be compacted to reduce air voids and reduce the migration paths for infiltration by precipitation. This will reduce the amount of potentially silt laden surface water run-off from these spoil management areas. Excavated soils/subsoils shall be excavated and stored separately to topsoil; this will prevent mixing of materials and facilitate reuse afterwards; and,

- All materials which require management will be stockpiled at low angles (< 5-10°) to ensure their stability and secured using silt fencing where necessary. This will help to mitigate erosion and unnecessary additions of suspended solids to the drainage system;
- Spoil management will take place within a minimal distance of each turbine to avoid excessive transport of materials within the Site.

Proposed Grid Connection underground cabling route:

- Soils and subsoils excavated along the Proposed Grid Connection underground cabling route will be temporarily stored in covered stockpiles along the edge of the road carriageway;
- Once the emplacement of the cable has been completed, the stored soils and subsoils will be reinstated, with the minimal amount of compaction required to level the top surface;
- The tarmacadam surface along the road sections of the route will be replaced with the same design standard as the surrounding carriageway;

**Residual Effect Assessment:** The cohesive and granular soils and subsoils at the Site can be classified as of "Low" importance and the bedrock of "Low - Medium" importance. The effect is the disturbance and relocation of 70,093m3 of material. All work will be in accordance with the 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 boreholes and trial pits. The residual effect will be negative, slight to moderate, direct, likely, permanent effect on soil, subsoils and bedrock 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.

### 8.6.2.3 Contamination of Soil by Leakages and Spillages

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a pollution risk at the Site. The accumulation of small spills of fuels and lubricants during routine plant use can also be a significant pollution risk. Hydrocarbon has a high toxicity to humans, and all flora and fauna, including fish, and is persistent in the environment. Large spills or leaks have the potential to result in significant effects (i.e. contamination of soils, subsoils and pollution of the underlying aquifer) on the geological and water environment, depending on where a spill may occur, *i.e* Proposed Wind Farm site and Proposed Grid Connection. Additionally, waste tar, removed from the road hardstanding along the Proposed Grid Connection underground cabling route has the potential to affect soil/subsoil geochemistry.

**Pathway:** Subsoil and underlying bedrock pore space.

**Receptor:** Soils, Subsoil and bedrock.

**Pre-Mitigation Potential Effect:** Negative, slight, direct, short-term, unlikely effect on soils, subsoils and bedrock.

**Proposed Mitigation Measures:**

- Minimal refuelling or maintenance of construction vehicles or plant will take place on site. Where possible, off-site refuelling will occur at a controlled fuelling station;
- On-site re-fuelling will be undertaken using a a refuelling truck with spill kits kept onboard;
- Only designated trained operatives will be authorised to refuel plant on-site;
- Taps, nozzles or valves associated with refuelling equipment will be fitted with a lock system;

- All fuel storage areas will be bunded appropriately for the duration of the construction phase. All bunded areas will be fitted with a storm drainage system and an appropriate oil interceptor. Ancillary equipment such as hoses, pipes will be contained within the bunded area;
- Fuel and oil stores including tanks and drums will be regularly inspected for leaks and signs of damage;
- The on-site substation will be bunded appropriately to the volume of oils likely to be stored and to prevent leakage of any associated chemicals 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 works on hard top roads will be removed off-site and taken to licenced waste facility; and,
- An emergency response plan for the construction phase to deal with accidental spillages is contained within the Construction and Environmental Management Plan (which is contained in Appendix 4.3).

**Residual Effect Assessment:** 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 - Negative, imperceptible, direct, short-term, low unlikely effect on soils, subsoils and bedrock.

**Significance of Effects:** For the reasons outlined above, and with the implementation of the listed mitigation, no significant effects on soils, subsoils and bedrock will occur.

#### 8.6.2.4 Erosion of Exposed Subsoils During Construction of Infrastructure

Erosion of soil/subsoil by the pathways listed below, can have the effect of reducing the overall volume of soil/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.

**Pathway:** Vehicle movement, surface water and wind action.

**Receptor:** Soils and subsoils.

**Pre-Mitigation Potential Effect:** Negative, slight, direct, short-term, likely effect on soils and subsoils by erosion and wind action.

**Proposed Mitigation Measures:**

- Soil/subsoil removed from the turbine locations and associated access roads will be used for landscaping, or placed/spread locally alongside the excavation.
- Temporary drainage systems will be required to limit runoff impacts during the construction phase.
- In forestry areas (near T7) brash mats will be used to support vehicles on soft ground, reducing soil erosion and avoiding the formation of rutted areas, in which surface water ponding can occur. Brash mat renewal will take place when they become heavily used and worn. Provision will be made for brash mats along all off-road routes, to protect the soil from compaction and rutting.

- Soils/subsoils removed from the Proposed Grid Connection groundworks will be removed and either used for Proposed Wind Farm site borrow pit reinstatement/spoil management areas or taken to an appropriately licenced facility.



**Residual Effect Assessment:** Following implementation of these measures the residual effects will be - Negative, slight, direct, short-term, likely effect on subsoils by erosion and wind action.

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

### 8.6.2.5 Erosion of Exposed Soils/Subsoils During Tree Felling

Tree felling is a component of the proposed works at the Proposed Wind Farm site, with ~4.3ha of felling proposed around T7.

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 Hydrology & Hydrogeology.

**Pathway:** Vehicle movement, surface water and wind action.

**Receptor:** Soils, subsoil and weathered bedrock.

**Pre-Mitigation Potential Effect:** Negative, slight, direct, permanent, likely effect on soils, subsoils and weathered bedrock due to felling operations.

**Proposed Mitigation Measures:**

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 Site 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.

**Residual Effect Assessment:** The proposed felling works will result in the disturbance and erosion of soil and subsoil within the Proposed Wind Farm site. However, given the minimal footprint of the proposed felling areas combined with the mitigation measures above, the residual effect is - negative, imperceptible, direct, permanent, unlikely effect on soils, subsoils and weathered bedrock.

**Significance of Effects:** For the reasons outlined above, and with the implementation of the proposed mitigation measures, no significant effects on soils, subsoils or bedrock will occur.



### 8.6.2.6 Potential Effects on Geological Heritage Sites

The works proposed as part of the Proposed Project are remote from any geological heritage site (refer to Section 8.3.6.

There are no geological heritage sites mapped in the vicinity of the Proposed Wind Farm or along the Proposed Grid Connection underground cabling route.

Potential effects on other designated sites including Special Areas of Conservation (SACs) and Special Protected Areas (SPAs) are assessed in Chapter 9.

**Pathway:** There is no pathway for effects between the Geological Heritage Sites and the Proposed Wind Farm site and Proposed Grid Connection underground cabling route.

**Receptor:** Geological Heritage Sites.

**Pre-Mitigation Potential Effect**: No potential for effects.

**Residual Effects**: There will be no residual effects on geological heritage sites as a result of the Proposed Project.

**Significance of effects**: No effects

### 8.6.2.7 Ground Instability and Failure

Ground instability or failure refers to a significant mass movement of a body of ground that would have an adverse impact on the environment as a result of the Proposed Project.

A significant amount of site investigation data has been acquired across the Proposed Wind Farm site. No significant peat deposits are present at the Proposed Wind Farm site with only a thin layer (0.1 - 0.3m) of peaty organic topsoil encountered in the vicinity of T7. Subsoils are described as glacial tills comprising of gravelly clay and granular subsoils comprised of sands and gravels.

The subsoils range in depth between 0.4 and 18.7m across the Proposed Wind Farm site, with the thickest subsoils in the valley of the Tullaroan Stream.

An iterative design process involving multiple stages of ground investigations, followed by turbine and infrastructure design has been completed to ensure the areas with optimum ground conditions have been selected.

**Mechanism**: Vehicle movement and excavations.

**Receptor**: Soils, subsoils and weathered bedrock.

**Pre-Mitigation Potential Effect:** Negative, slight, direct, very unlikely permanent effect on soils, subsoils and weathered bedrock.

**Impact Assessment:**

The findings of the comprehensive site investigation indicate good ground conditions, and all proposed turbines can be founded on subsoils or bedrock. The Proposed Wind Farm layout optimisation and design process was iterative, and through this iterative process the areas with optimum ground conditions have been selected.

Due to the nature of the Proposed Grid Connection underground cabling route there will be no effect on ground stability. The formation of the underground cabling trench will be within the underlying competent subsoil.

**Mitigation Measures:**

The following measures which will be implemented during the construction phase of the Proposed Project will assist in the management of the geotechnical risks for this site.

- Appointment of experienced and competent contractors;
- The site will be supervised by experienced and qualified engineering/geotechnical personnel;
- Allocate sufficient time for the project;
- Prevent undercutting of slopes and unsupported excavations;
- Maintain a managed suitable drainage system;
- Ensure construction method statements are followed or where agreed modified/ developed; and,
- Revise and amend the Geotechnical Risk Register as construction progresses.

**Residual Effects Assessment:** The residual effect is no effects on subsoil/weathered bedrock and ground.

**Significance of Effects:** For the reasons outlined above, and with the application of the mitigation measures outlined above, no significant effects on land, soils, subsoils or bedrock will occur.

### 8.6.2.8 Piling Works

Piling foundations may be required at T7 (as no trial pit data is available at that location due to existing tree cover). The requirement for piling at T7 will be determined during post-consent ground investigations. Based on the available site investigation data piling works are not envisaged at the other proposed turbine locations, however, taking a precautionary approach an assessment of piling at all proposed turbines has been included below.

**Pathway:** Piling works.

**Receptor:** Soils and subsoils.

**Pre-Mitigation Potential Effect:** Negative, slight, direct, permanent, unlikely effect on subsoils by piling works.

**Proposed Mitigation Measures:**

Piles have a very small footprint and will result in the displacement of small volumes of spoil. The small spoil volumes can be easily managed at the Site with excess spoil being removed for permanent storage in the on-site borrow pit or within the spoil management areas. Spoil volumes generated by any potential piling works will only amount to a very small percentage of the overall spoil volumes for the Proposed Project.

No mitigation measures are proposed or required for soils and geology environment. Proposed mitigation to protect the water environment are outlined in Chapter 9.

**Residual Effect Assessment:** The residual effects are considered - negative, direct, imperceptible, permanent, unlikely effect on subsoils by piling works.

**Significance of Effects** For the reasons detailed above, and with the implementation of the proposed mitigation measures, no significant effects on subsoils will occur.

#### 8.6.2.9 TDR Works

Turbine Delivery Route (TDR) works such as road widening are sometimes required along proposed turbine transport routes to accommodate the large turbine components and associated vehicles seeking to access wind farm sites. The proposed transport route for the Proposed Project has been the subject of a route assessment to determine if any works are required along its length. Full details of the assessment are included as part of the traffic impact assessment set out in Section 15.1 of this EIAR.

The turbine delivery vehicles have been modelled in the swept path assessments of identified pinch points along the proposed turbine delivery route, as detailed in Chapter 15: Material Assets of this EIAR.

**Pathway:** No significant works proposed.

**Receptor:** Soils and subsoils.

**Pre-Mitigation Potential Effect**: No potential for effects.

**Residual Effects**: There will be no residual effects on soils and subsoils as a result of works along the TDR.

**Significance of effects**: No effects.

### 8.6.3 Operational Phase - Likely Significant Effects and Mitigation Measures

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

- Some construction vehicles or plant may 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 or during the maintenance of this equipment of soils and groundwater.

In relation to indirect impacts a small amount of granular material may be required to maintain access tracks during operation which will place intermittent minor demand on local quarries.

None of these potential impacts will be significant, as they are of such small scale and also of an intermittent nature.

Mitigation measures for land, soils and geology during the operational phase include the use of aggregate from authorised quarries for use in road and hardstand maintenance. Oil used in transformers (at the onsite substation and within each turbine) and storage of oils in tanks at the substation could leak during the operational phase and impact on ground and subsoils and groundwater or surface water quality. The base of the substation transformer will bunded and capable of holding 110% of the stored oil volume. Turbine transformers are fully bunded within the enclosed turbines, so any leaks would be contained within the turbine and there is no potential pathway to receptors associated with the Land, Soils and Geological environment. These mitigation measures are considered sufficient to eliminate potential risks to ground/soils and subsoils, and groundwater and surface water quality.

## 8.6.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures



The potential effects associated with decommissioning of the Proposed Project will be similar to those associated with construction but of reduced magnitude.

The proposed wind turbines are expected to have a lifespan of approximately 35 years. Following the end of their useful life, the equipment may be replaced with a new technology, subject to planning permission being obtained, or the Proposed Wind Farm will be decommissioned fully.

Upon decommissioning of the Proposed Wind Farm, the wind turbines and the meteorological mast would be disassembled. All above ground turbine and mast components would be separated and removed off-site for recycling. Turbine and mast foundations would remain underground and would be covered with earth and allowed to revegetate. Leaving the foundations in-situ is considered a more environmentally prudent option, as to remove that volume of reinforced concrete from the ground could result in significant temporary environment nuisances such as noise, dust and/or vibration. Site roadways will be used during the operational phase by farm machinery and will provide a useful means of extracting the commercial forestry crop which exists on at the Site and therefore will be retained post decommissioning to facilitate these activities.

The underground electrical cabling connecting the turbines to the on-site substation will be removed from the cable ducts. The cabling will be pulled from the cable ducts using a mechanical winch which will extract the cable and re-roll it on to a cable drum. This will be undertaken at the original cable jointing pits which will be excavated using a mechanical excavator and will be fully re-instated once the cables are removed. The cable ducting will be left in-situ as it is considered the most environmentally prudent option, avoiding unnecessary excavation and soil disturbance. The cable materials will be transferred to a suitable recycling or recovery facility.

The Proposed Grid Connection infrastructure, onsite 38kV electricity substation and associated underground cabling connection to Ballyragget substation, will remain in place as it will be part of the Electricity Grid under the ownership and control of the ESBN.

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 foundations, hard standing areas. This will be done by covering with subsoil or vegetation to encourage vegetation growth and reduce run-off and sedimentation. Other impacts such as possible soil contamination by fuel leaks will remain but will be of reduced magnitude. 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 phase as shown in Section 8.6.2 above.

Some of the impacts will be avoided by leaving elements of the Proposed Project in place where appropriate. The turbine foundations will be rehabilitated by covering with local topsoil in order to regenerate vegetation, which will reduce runoff and sedimentation effects. Internal roads will remain as access roads for farmers and forestry operations. Mitigation measures to avoid contamination by accidental fuel leakage and erosion of soil by on-site plant will be implemented as per the construction phase mitigation measures.

No significant effects on the land, soils and geological environment will occur during the decommissioning phase of the Proposed Project.



## 8.6.5 Assessment of Human Health Effects

Potential human health effects arise mainly through the potential for soil and ground contamination. A wind farm/grid connection route is not a recognized source of pollution and so the potential for effects during the operational phase are negligible. Hydrocarbons will be used onsite during construction however the volumes will be small in the context of the scale of the Proposed Project and will be handled and stored in accordance with best practice mitigation measures. The potential residual effects associated with soil or ground contamination and subsequent health effects are negligible.

## 8.6.6 Risk of Major Accidents and Disasters

Due to the nature of the Site, i.e. sloping terrain, with an absence of peat, there is a low risk of a landslide occurring.

Refer to Chapter 16: Major Accidents and Natural Disasters for a full assessment.

## 8.6.7 Cumulative Effects

The potential for impact between the Proposed Project, and other relevant developments has been carried out with the purpose of identifying what influence the Proposed Project (Proposed Wind Farm and Proposed Grid Connection underground cabling route combined) will have on the surrounding environment when considered cumulatively and in combination with relevant existing permitted or proposed projects and plans in the vicinity of the Site, as set out in Chapter 2 of this EIAR. Please see Section 2.8 of Chapter 2 for cumulative assessment methodology.

The proposed planning applications within the dataset have been analysed, with particular emphasis on the larger projects listed. Following this analyses, there will be no cumulative effects on the land, soils and geology environment as a result of the Proposed Project.

Due to the localised nature of the proposed construction works which will be kept within the Site boundary, there is no potential for significant cumulative effects in-combination with other local developments on the land, soils and geology environment as all effects are direct within the Site. Other projects outside the Site do not have the potential to reduce or increase the magnitude of effects of the Proposed Project on Land, Soils and Geology.

The only way the Proposed Project can have cumulative 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. The construction of the Proposed Grid Connection works will only require relatively localised excavation works within the Site boundary and therefore will not contribute to any significant cumulative effects.

The construction of the Proposed Grid Connection underground cabling route will only require relatively localised excavation works within the site boundary and therefore will not contribute to any significant cumulative effects. Following a review of other planning applications it is revealed that there is an overlap of ~300m along the N77 with the grid connection for the Farranrory Wind Farm. However, the timing of works will be coordinated to ensure that there is concurrent works, and therefore no cumulative effect.

Also, in the vicinity of Ballyragget substation there is a permitted application for the construction of battery energy storage systems. A hydrological and hydrogeological assessment report and drainage strategy was submitted along with the Environmental Report for the Power Reserve Project at

Ballyragget. This report detailed mitigation measures for the protection of the geological and hydrological/ hydrogeological environment through all phases of that development.

As such, the works along the Proposed Grid Connection are minor and transient, similar to roadworks being completed across the country and have no potential for significant cumulative effects on the land soils and geology environment.



### 8.6.8 Post Construction Monitoring

None required.