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 effects of the proposed Ballivor wind farm development on the land, soil and geological environment. The proposed development site (the "proposed site") is a large area comprising 4 no. bog basins (Ballivor Bog, Carranstown Bog, Bracklin Bog, and Lisclogher Bog) situated between the towns of Raharney and Delvin, Co. Westmeath and Ballivor, Co. Meath.

The Ballivor wind farm development (the "Proposed Development") includes 26 no. wind turbines, associated access tracks and hardstands, an onsite 110 kV substation, met masts, temporary site compounds, borrow pits, drainage works, and all ancillary site and ground works. A full description of the Proposed Development is provided in Chapter 4: Description of Development.

This report provides a baseline assessment of the environmental setting of the Proposed Development, 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 Development will likely have. This report also considers any potential cumulative and in-combination effects on the land, soils and geological environment which may result from the Proposed Development. Where possible, appropriate mitigation measures to avoid any identified significant effects to land, soils and geology are recommended and the residual effects of the Proposed Development 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 and Conor McGettigan.

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 environmental impact assessments of wind farms and renewable projects in Ireland. In addition, he has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS / EIAR for Oweninny WF, Cloncreen WF, and Yellow River WF, and over 100 other wind farm related projects across the country.

Conor McGettigan (BSc, MSc) is an Environmental Scientist with 3 years experience in the environmental sector in Ireland. Conor holds an MSc in Applied Environmental Science and a BSc in Geology. Conor routinely prepares the land, soils and geology EIAR chapters and has worked om the EIAR for several wind farm developments on peatlands.

8.1.3 Scoping and Consultation

The scope for this assessment has been informed by consultation with statutory consultees, bodies with environmental responsibility and other interested parties as summarised in Section 2.6 of Chapter 2 of the EIAR. Consultation responses relating to the land, soils and geological environment were received from the Geological Survey of Ireland and the Health Services Executive. Details of these scoping responses and actions taken to address them are given in Section 2.6.2 of this EIAR.

8.1.4 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, 2000-2022 (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);
- S.I. No. 296/2018 European Union (Planning and Development) (Environmental Impact Assessment) Regulations 2018;
- European Communities (Environmental Impact Assessment) Regulations 1989 to 2017; and,
- S.I. No. 4/1995: The Heritage Act 1995, as amended.

8.1.5 Relevant Guidance

The land, soils and geology chapter of this EIAR was prepared 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;
- Environmental Protection Agency (2003): Advice Notes on Current Practice (in the Preparation of Environmental Impact Statements);
- Environmental Protection Agency (2002): Guidelines on the information to be contained in Environmental Impact Statements;
- 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;
- Wind Farm Development Guidelines for Planning Authorities (2006);
- Draft Revised Wind Energy Guidelines (2019);
- COFOR (2004) Forest Road Manual – Guidelines for the Design, Construction and Management of Forest Roads;
- Good Practice During Wind Farm Construction (Scottish Natural Heritage, 2010);
- PPG1 – General Guide to Prevention of Pollution (UK Guidance Note);
- Guidelines for Planning Authorities and An Bord Pleanála on carrying out Environmental Impact Assessment (DoHPLG, 2018).
- Guidance on the preparation of the EIA Report (Directive 2011/92/EU as amended 2014/52/EU) (European Union, 2017);

- Institute of Environmental Management and Assessment (IEMA) (2022): A New Perspective on Land and Soil in Environmental Impact Assessment; and
- Scottish Natural Heritage (SNH) report Research and Guidance on Restoration and Decommissioning of Onshore Wind Farms (SNH, 2013).

8.1.6 Limitations and Difficulties Encountered

No specific limitations or difficulties were encountered during the preparation of this Chapter.

8.2 Assessment Methodology

8.2.1 Desk Study

A desk study was completed by HES in late 2021 and early 2022 to collect all relevant geological data for the proposed site and the surrounding area. The desk study was completed to supplement site walkover surveys and site investigations. Desk study data has been checked and updated in February 2023. This study included consultation with the following data sources:

- Environmental Protection Agency soils and subsoils mapping (www.epa.ie);
- Geological Survey of Ireland – Geological databases (www.gsi.ie);
- Bedrock Geology 1:100,000 Scale Map Series, Sheet 13 - Geology of Meath (GSI, 2003);
- Geological Survey of Ireland – 1:25,000 Field Mapping Sheets;
- Bord na Móna peat depth and drainage databases;
- Bord na Móna Annual Reports: 1951 to 1970 and 1984 to 1987;
- Bord na Móna Lidar Data;
- Corine Land Cover and Land Cover Change Maps (www.land.copernicus.eu);
- Bord na Móna Rehabilitation Plans for each bog Appendix 6-6;
- Aerial Maps from 1973 to 2022; and,
- Integrated Pollution Control Licence (IPC) Derrygreenagh Bog Group (Ref: P0501-01) and associated Annual Environmental Reports (2008 to 2021).

8.2.2 Baseline Monitoring and Site Investigations

Geological mapping and a detailed walkover survey of the proposed site was undertaken by HES on 18th May 2020, 15th – 17th September 2020, 05th October 2020, 01st December 2020, 22nd March 2021, 01st April 2021, 20th September 2021 and 28th October 2021 and 19th January 2022.

Geotechnical ground investigations were undertaken by Fehily Timoney and Company (FTC) as part of the preparation of a Geotechnical and Peat Stability Assessment Report (FTC, 2023) (Appendix 8-1) and a Peat and Spoil Management Plan (FTC, 2023) (Appendix 4-2) for the proposed site. FT completed peat probing investigations at the proposed site during walkover surveys on 8th - 10th June and 22nd - 24th June 2021. Ground investigations in the form of trial pits and boreholes were carried out by FTC and Irish Drilling Ltd (IDL) on 17th – 21st August 2020, 1st-16th February 2021, 19th July 2021 and 5th-11th August 2021. In addition, Bord na Móna undertook trial pitting on the 18th – 19th March 2021.

The combined geological dataset collated by HES, MKO, FTC, IDL and Bord na Móna have been used in the preparation of this EIAR Chapter.

In summary, site investigations to address the land, soils and geology chapter of the EIAR included the following:

- A total of 457 no. peat probe depths/investigations points were carried out by HES, MKO and FTC in Ballivor Bog, Carranstown Bog, Bracklin Bog and Lisclogher Bog;

- Logging of subsoil exposures across the proposed site where mineral soils and peat profiles are exposed;
- Mineral subsoils and peat were logged according to BS: 5930 and Von Post Scale respectively;
- Ground investigations completed by FTC and IDL in the form of 78 no. trial pits, 16 no. boreholes, and 5 no. rotary coreholes;
- Completion of 24 no. trial pits excavated by Bord na Móna;
- A geotechnical and peat stability assessment report by FTC (FTC, 2023) (Appendix 8-1); and,
- A peat and spoil management plan by FTC (FTC, 2023) (Appendix 4-2).

8.2.3 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 geology of the existing environment within the proposed site and the surrounding area is assessed using the criteria set out in

Table 8-1 (NRA, 2008).

Table 8-1 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 (Natural Heritage Area). 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	Large historical and/or recent site for construction and demolition wastes.

Importance	Criteria	Typical Example
	scale. Degree or extent of soil contamination is minor on a local scale. Volume of peat and/or soft organic soil underlying site is small on a local scale.	Small historical and/or recent landfill site 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 likely significant effects require that likely effects are described with respect to their extent, magnitude, type (i.e., negative, positive or neutral) probability, duration, frequency, and reversibility. The descriptors used in this environmental impact assessment report 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 8-2.

In order to provide an understanding of this descriptive system in terms of the geological 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 8-3.

Table 8-2: Additional Impact Characteristics (EPA, 2022).

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	The effect can be reasonably expected to occur.
	Likely	The effect can reasonably be expected not to occur.

Table 8-3: 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 designated site (cSAC/SAC). › Regionally important aquifers. › Extents of floodplains. Mitigation measures are unlikely to remove such impacts.
Positive or Negative	Significant	Local or widespread time-dependent impacts on: › The extent or morphology of a cSAC / ecologically important area.

Impact Characteristics		Potential Geological and Hydrological Impacts
Quality	Significance	
		› 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.
Positive, Negative or Neutral	Not significant	An effect which causes noticeable changes in the character of the environment but without significant consequences.
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.

8.3 Existing Environment

8.3.1 Site Description

The Ballivor Wind Farm site (the "proposed site") comprises 4 no. Bord na Móna bogs which form part of the larger Derrygreenagh Bog Group situated between the towns of Kinnegad and Delvin, Co. Westmeath. The bogs comprising the proposed site include Ballivor Bog to the south, Carranstown and Bracklin Bogs towards the centre and Lisclogher Bog at the northern end of the proposed site. Lisclogher West Bog exists to the west of Lisclogher Bog and forms part of the Ballivor Sub-Group of bogs (a sub-group of the Derrygreenagh Group), however this bog does not form part of the proposed site. In addition, the western section of Bracklin Bog (Bracklin West) and the eastern section of Carranstown bog are omitted from the proposed site. The total area of the proposed site is 1,770ha (17.70km^2) and the area of each bog included within the proposed site is shown in Table 8-4.

The Meath-Westmeath county boundary runs through the centre of Lisclogher Bog, along the eastern boundary of Bracklin Bog and through the centre of both Carranstown and Ballivor Bogs. The proposed site is located approximately 3.7km west of the village of Raharney, 4.5km south of Delvin town, Co. Westmeath and 2.5km east of Ballivor village, Co. Meath. The total area of the proposed site is approximately 1,770ha (17.70km^2).

The south of the proposed site is dissected by the R156 which joins the villages of Ballivor in the east to Raharney in the west. Ballivor Bog lies to the south of this regional road with the other 4 no. bogs which comprise the Ballivor Bog Sub-Group lying to the north. A Bord na Móna works area lies in the northwest of Ballivor Bog, in the townland of Grange More and contains offices, storage sheds, roads and a peat loading area. The remainder of Ballivor Bog is located in the townlands of Robinstown and Clonycavan in the east and Riverdale, Clondalee More and Derryconor in the west. Ballivor Bog has a total area of 654ha and it was served by a Bord na Móna railway network which still extends from the loading area into the bog.

To the north of the R156, Carranstown Bog has an area of 305ha and lies in the townlands of Grangemore in the West and Carranstown Great, Carranstown Little and Killaconnigan in the east. The Bord na Móna railway links Carranstown Bog to Ballivor Bog to the south and Bracklin Bog to the north. Towards the centre of the proposed site, Bracklin Bog has an area of 755ha. Bracklin Bog lies in the townlands of Coolronan in the east, Craddanstown and Bracklin in the centre and Ballynaskeagh, Mucklin and Killagh in the west. A small bogland (~22ha) referred to as the Hill of Down lies to the east of Bracklin Bog in the townlands of Coolronan and Bracklin. Lisclogher Bog is located to the northeast of Bracklin Bog, approximately 4.3km southeast of the town of Delvin and has an area of 486ha. This bog is located in the townlands of Lisclogher Great, Coolronan, Bracklin, Cockstown and Clonleame.

Table 8-4: Proposed Site Area within the Ballivor Bog Sub-Group

Bog Name	Total Bog Area (ha)	Area included in Proposed Site (ha)
Ballivor Bog	643	635
Carranstown Bog	306	79
Bracklin Bog	768	619
Lisclogher	484	436

8.3.2 Topography

The current topography of the proposed site is relatively flat with an elevation range of between approximately 69 and 84mOD (metres above Ordnance Datum). Topography at the proposed site has been modified through the previous peat extraction activities and associated drainage works. The highest elevations are found at headlands and remnant peat banks which create elevated boundary berms, forming a basin effect within the former extraction areas of the bogs.

The Bord na Móna lidar map for Ballivor Bog (refer to Rehabilitation Plan included in Appendix 6-6) shows the current topography at Ballivor Bog. Currently the highest elevations at Ballivor Bog are found along its northern and southwestern margins where the topography ranges from ~75-79mOD. Ground elevations are lower in the interior of the bog, ranging from ~69-73mOD.

The Bord na Móna lidar map for Carranstown Bog (refer to Rehabilitation Plan included in Appendix 6-6) shows the current topography at Carranstown Bog. Currently the highest elevations at Carranstown Bog are found in the west, with maximum elevations ranging from ~73-78mOD. The topography slopes gently to the east.

The Bord na Móna lidar map for Bracklin Bog (refer to Rehabilitation Plan included in Appendix 6-6) shows the current topography at Bracklin Bog. Ground elevations are lower in the east of Bracklin Bog where the topography ranges between ~71-84mOD.

The Bord na Móna lidar map for Lisclogher Bog (refer to Rehabilitation Plan included in Appendix 6-6) shows the current topography at Lisclogher Bog. Currently the highest elevations at Lisclogher Bog are found along the headlands located at its northern, western and southern margins (~79mOD). The lowest topography is located towards the centre of the bog where elevations range from ~70-72mOD.

8.3.3 Landuse

8.3.3.1 Historical Land Change

Corine land cover maps (2018) show that the proposed site is located predominantly on "peat bogs" with some areas of "transitional woodland scrub", "agricultural pastures" and "broad leaved mixed forests" along its margins. The present day land cover surrounding the proposed site comprises primarily of agricultural lands with small areas of woodland and coniferous forestry. A scattered pattern of rural dwellings and farmhouses are located along the local road network which surrounds the proposed site. Corine (2018) map land cover in the wider area as predominantly "agricultural pastures" with some pockets of "non-irrigated arable land". The closest mapped urban centres are the villages of Ballivor to the east and Raharney to the west. Corine also map a "mineral extraction site" to the southwest of Ballivor Bog in the townland of Riverdale.

Historic Corine land cover maps (1990 – 2018) and Bord na Móna annual reports were consulted to investigate how land cover has changed historically at the proposed site and in the surrounding lands. The main historic land use changes at the proposed site have been associated with the peat production operations, with the main changes linked to the initial drainage of the bog and the removal of vegetation in advance of peat production. Drainage and peat production was initiated at different times across the 4 bogs and this is summarised in Table 8-5.

Table 8-5: First Drainage and First Production Years of the Bogs Comprising the Proposed Site

Bog Name	Bog Area (ha)	Site Preparation (removal of vegetation and drainage insertion)	First Production Year
Ballivor	643	1948 – 1953	1953
Carranstown	306	West: 1974 – 1987	West: Prior to 1988
Bracklin	768	Main Bog Area: 1952 – 1958	Main Bog Area: 1959
Lisclogher	484	1955 - 1959	1960

Recent aerial photographs (2020), site walkovers completed by HES between May 2020 and January 2022 and Bord na Móna's Land use maps (included in the Decommissioning and Rehabilitation Plans foreach bog, refer to Appendix 6-6) has verified the current land use across the proposed site. The current land use in each of the 4 no. bogs comprising the proposed site is described in detail in the following paragraphs.

Ballivor Landuse

Ballivor Bog has a total area of 643ha and had an approximate production area of 82ha which was in operation until Summer 2020. Following the cessation of peat extraction activities, the landuse/land cover in this former production area changed from peat production to areas of bare peat which are available for re-vegetation. The surface of Ballivor bog is currently drained by a series of northwest-southeast orientated drains spaced at approximately 15m intervals. The Bord na Móna current habitat map (refer to Appendix 6-6) shows the existing land cover at Ballivor. Much of the centre and northeast of the bog is characterized by areas of "bare peat". The lack of vegetation in these areas indicates that they were the

most recent areas of Ballivor Bog from which peat was being extracted, i.e. there has not been enough time for vegetation to colonise these areas post extraction. Meanwhile, areas in the northwest and southwest of Ballivor Bog contain a mosaic of "heath", "heath and scrub" and "pioneer open cutaway habitats". Ballivor Bog is fringed by "cutaway" and "cutover bog" in the northeast and remnant bog with some areas of "birch woodland" in the southwest. In terms of the Proposed Development, 6 no. turbines are mapped on bare peat in the recent production areas of the bog. Meanwhile, 6 no. turbines are mapped in areas of heath and open cutaway habitats. The proposed construction compound (and later to be one of the three public amenity access parking areas) in the north of the bog is located on made ground adjacent the existing Bord na Móna works area.

Carranstown Landuse

Carranstown Bog has a total area of 306ha and a production area of 178ha which was in operation until Summer 2020. Following the cessation of peat extraction activities, the landuse/land cover in this former production area changed from peat production to areas of bare peat which are available for re-vegetation. The bog currently consists of bare peat production fields with a series of northwest-southeast orientated drains. The Bord na Móna current habitat map for Carranstown Bog (refer to Appendix 6-6) shows that much of the bog comprises of "bare peat" fields. Meanwhile, to the east and west there are areas of "heath", "heath and scrub" and "woodland". Rehabilitation works have been completed on the eastern portion of the bog, outside the red line boundary, as part of the Peatland Climate Action Scheme(PCAS). In terms of the Proposed Development, the proposed construction compound and the proposed substation are located on "peat production related lands covered in heath" in the west of the bog. No turbines are proposed within Carranstown Bog. Meanwhile, 2 no. borrow pits are located in the centre of the bog are in an area of bare peat.

Bracklin Landuse

Bracklin Bog has a total area of 768ha and a production area of 118ha was in operation until Summer 2020. Recent production was concentrated in a small section in the west of the bog, referred to as Bracklin West, which is not included within the proposed site. The bog is drained by a series of northeast-southwest orientated drains. The Bord na Móna current habitat map for Bracklin (refer to Appendix 6-6) shows that much of the main bog area currently comprises of a mosaic of "heath", "scrub", "woodland" and "pioneer open cutaway habitats. Meanwhile, the south of Bracklin Bog contains some areas of "birch woodland" with areas of remnant high "bog" recorded along the northern margins of Bracklin Bog. In terms of the Proposed Development, 6 no. proposed turbines are located on cutaway bog with scrub and pioneer habitats towards the centre of Bracklin Bog. A proposed construction compound, located in the east of the bog is mapped in an area of cutaway peat with pioneer habitats. A proposed borrow pit is located on agricultural grasslands immediately to the south of Bracklin Bog. An amenity carpark is proposed in the Hill of Down bogland located immediately to the east of Bracklin Bog.

Lisclogher Landuse

Lisclogher Bog has a total area of 484ha and was not in production leading up to Summer 2020. Lisclogher is drained by a series of east-west orientated drains. The Bord na Móna Draft Rehabilitation Plan for Lisclogher Bog (refer to Appendix 6-6) states that the drainage system is beginning to break down with many drains becoming blocked and filling with water. The Bord na Móna current habitat map for Lisclogher shows that much of the bog is comprised of a mosaic of "pioneer open cutaway habitats", "scrub" and "heath" habitats. Some fingers of "bare peat" extend from the railway line to the east and west. In terms of the Proposed Development within Lisclogher Bog, 8 no. proposed turbines are located on cutaway bog with pioneer vegetation and areas of scrub.

8.3.4 Peat/Soils and Subsoils

The published soils map (www.epa.ie) for the area shows that cutover/cutaway peat is mapped almost exclusively over the proposed site. Soils in the surrounding lands are predominantly basic deep well drained mineral soils (BminDW) with smaller areas of basic deep poorly drained mineral soils (BminPD), poorly drained soils with a peaty topsoil (BminPDPT) and basic shallow well drained soils (BminSW). Mineral alluvium (AlluvMin) is mapped along local watercourses surrounding the proposed site. All wind farm infrastructures are mapped on cutover peat. The only exception is the proposed borrow pit (BP2) located to the south of Bracklin Bog which is mapped in an area of basic shallow well drained mineral soils (BminSW).

The published subsoils map (www.gsi.ie) shows cut over raised peat (Cut) underlies the proposed site. Other subsoil types mapped in the wider area include Glacial Tills derived from Limestone (TLs) and Gravels derived from Limestone (GLs). An area of Till derived from cherts (TCh) is mapped to the southeast of Lisclogher Bog. All of the proposed wind farm infrastructure is mapped on peat with the exception of the borrow pit (BP2) located to the south of Bracklin Bog which is mapped on gravels derived from limestone.

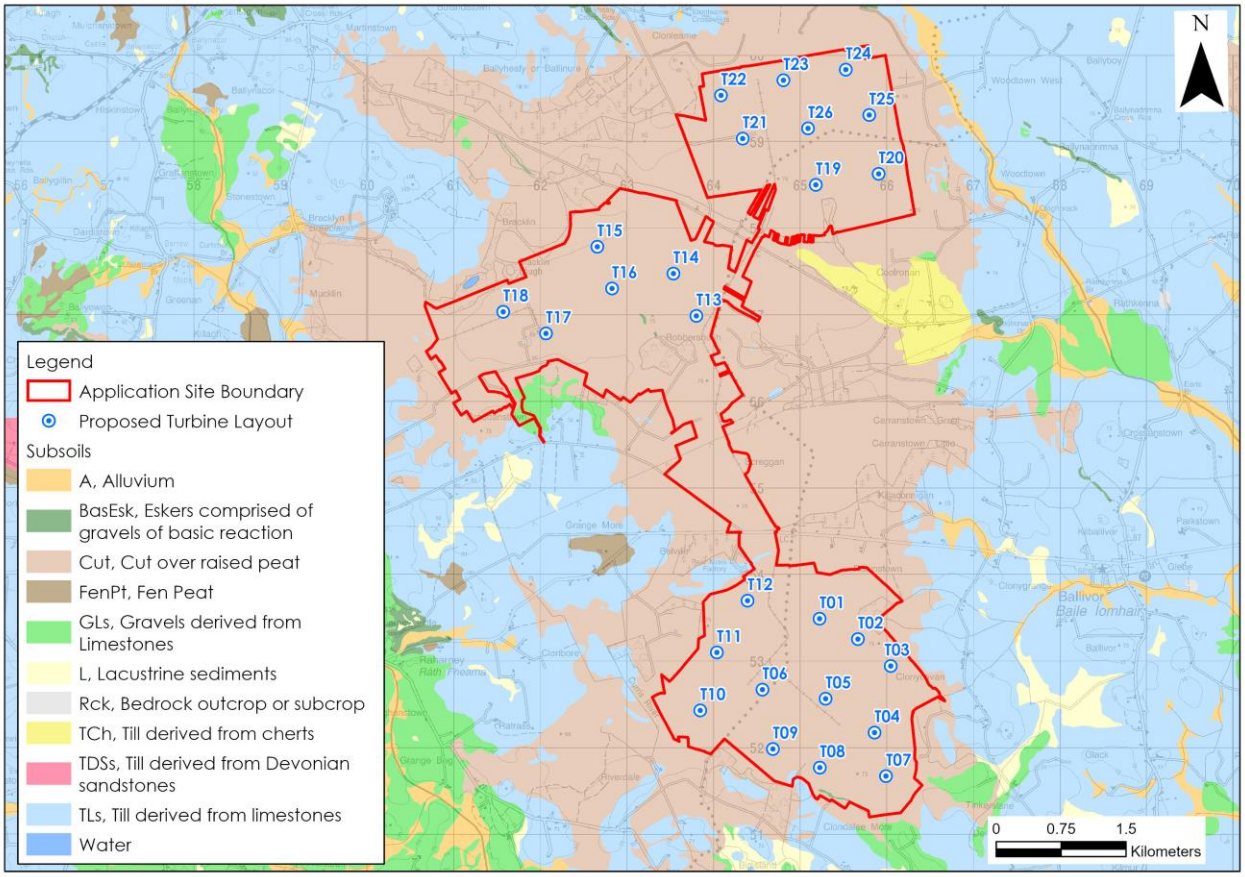
A summary of the soils and subsoils in each bog are included in Table 8-6. The local subsoil cover is illustrated on Figure 8-1.

Table 8-6: Summary of soils and subsoils within the bogs comprising the proposed site

Bog Name	Soils	Subsoils
Ballivor	This area of the proposed site is mapped exclusively as cutover peat with the exception of an area of made ground in the north of the bog, corresponding to the location of the Bord na Móna works depot. The peat is surrounded by basic deep well drained mineral soils with localised pockets of basic deep poorly drained mineral soils, basic shallow poorly drained mineral soils and lacustrine deposits. Mineral alluvium occurs along nearby watercourses.	Cutover peat at the proposed site surrounded by Till derived from limestones, Alluvium along streams/rivers. Some Gravels derived from limestones are located to the southeast and southwest but are remote from the proposed site.
Carranstown	This area of the proposed site is mapped exclusively as cutover peat. The peat is surrounded by deep well drained mineral soils with localised pockets of basic deep poorly drained mineral soils and poorly drained soils with a peaty topsoil. Mineral alluvium is found along nearby watercourses.	Cutover peat at the proposed site is surrounded by Tills derived from limestones and Alluvial deposits along streams/rivers.
Bracklin	Soils in this area of the proposed site are mapped almost exclusively as cutover peat with small areas of basic shallow well drained mineral soils located within the bog. The proposed borrow pit (BP2) to the south of Bracklin Bog is mapped on a mixture of peat and basic shallow well drained mineral soils.	Cutover peat at the proposed site surrounded by Tills derived from limestones, Alluvium along streams/rivers and some local limestone derived Gravels to the southwest. Some Till derived from chert is mapped to the east but remote from the bog boundary. BP2 is underlain by gravels derived from limestone.

Bog Name	Soils	Subsoils
Lisclogher	This area of the proposed site is overlain by cutover peat of Lisclogher Bog. The peat bog is surrounded by deep well drained mineral soils with localised pockets of basic deep poorly drained mineral soils, poorly drained soils with a peaty topsoil. An area of shallow well drained soils are mapped to the north and acid poorly drained soils to the southeast. Mineral alluvium occurs along nearby watercourses.	Cutover peat at the proposed site is surrounded by limestone derived Till to the north and east. Alluvium deposits along streams/rivers. Local Gravels to the north and Till derived from Cherts to the southeast.

Figure 8-1: Local subsoil map of the proposed site (www.gsi.ie)



The presence of subsoil peat on-site has been confirmed by peat probing investigations conducted by HES in September 2020 and March 2021. In order to investigate the peat and mineral subsoil lithology at the proposed site, a series of gouge core samples were taken at the proposed turbine locations and at points 100m north, south, east and west of the proposed turbine locations. These additional investigation locations (100m north, south, east and west) allowed for the wider peat depth and sub-peat geology to be understood, and also provided more spatial data should subsequent changes to turbine locations occur (through further iterations of the layout). Peat depth probing was also completed by FTC and MKO, and the entire dataset is used here. A total of 457 peat probes (HES, FTC and MKO) were completed across the proposed site at all key infrastructure locations and along proposed access tracks.

Peat depth intervals recorded across the proposed site are shown to a 0.5m interval on the histogram presented as Figure 8-2. Overall peat depths ranged from 0.4 to 5.7m with an average depth of 1.93m (n = 457, min = 0.4m, max = 5.7m, mean = 1.93m, σ = 0.96m (σ = standard deviation)). The peat depths across the proposed site are illustrated in Figure 8-3.

The subsoils encountered typically comprised of clay, sandy or gravelly mineral soils. Peat depth information for the individual bogs comprising the proposed site are summarised in Table 8-7. Peat depths at all site investigation points (HES, FTC and MKO) in Ballivor Bog ranged from 0.4 – 5.0m with an average depth of 1.95m. Further north the peat depths in Carranstown Bog ranged from 0.5 – 3.4m with an average depth of 1.55m. Peat depths ranged from 0.49 – 5.7m in Bracklin Bog with an average peat depth of 2.07m. Peat depths in Lisclogher Bog ranged from 0.53 – 5.5m with an average peat depth of 1.95m.

Shown on Table 8-8 below is a summary of the peat depth and mineral subsoil lithology at the proposed development locations as recorded during HES peat probing investigations. The average depth recorded during FTC/MKO site investigations is also included in Table 8-8.

According to HES site data, peat depths at the proposed turbine locations range from 0.7 - >5m with an average of 2.4m. According to FTC/MKO site data the average peat depth at the proposed turbine locations is 1.7m. HES site data indicated that 70% of the 26 no. proposed turbine locations have a peat depth of ≤3m, with only 2 no. locations recording peat depths in excess of 5m. These greatest peat depths were recorded at T1 in Ballivor Bog and T25 in Lisclogher Bog. The subsoils encountered at the proposed turbine locations generally comprise of gravelly mineral soils or gravelly clays.

Peat depths at the proposed substation located in Carranstown Bog range from 0.45 to 3.7m with an average peat depth of 2.57m. The subsoil encountered at the proposed substation location was generally described as a gravelly mineral soil. FTC/MKO site data indicates that the average peat depth across the borrow pits range from 0.7 to 1.3m, while the average peat depths at the construction compounds are recorded to range from 1.1 to 1.9m. The average peat depth at the proposed amenity carpark in Bracklin Bog is 1.4m while average peat depths at the proposed meteorological mast locations ranges from 1.65m in Ballivor Bog to 2.75m in Lisclogher Bog.

During the site investigations HES also completed shear vane analysis at the proposed turbine locations to determine peat stability. In-situ shear vane readings were recorded using a Geonor H60 shear vane. The observed range of in-situ undrained shear strength at each turbine location is shown in Table 8-8. The in-situ shear strength ranged from 9 to 114kPA. A full assessment of peat stability was completed by FTC, with the results presented in Section 8.3.9 and the full report attached as Appendix 8-1 (FT, 2023).

Table 8-7: Summary peat depths across the proposed site (HES, FTC and MKO)

Bog Name	No. Peat Probes	Peat Depth Range (m)	Average Peat Depth (m)	Summary Subsoil Lithology
Ballivor	186	0.4 – 5.0	1.95	Clay or gravelly mineral soil
Carranstown	63	0.5 – 3.4	1.55	Clay or gravelly mineral soil
Bracklin	123	0.49 – 5.7	2.07	Sandy/gravelly mineral soil
Lisclogher	85	0.53 – 5.5	1.95	Sandy/gravelly mineral soil

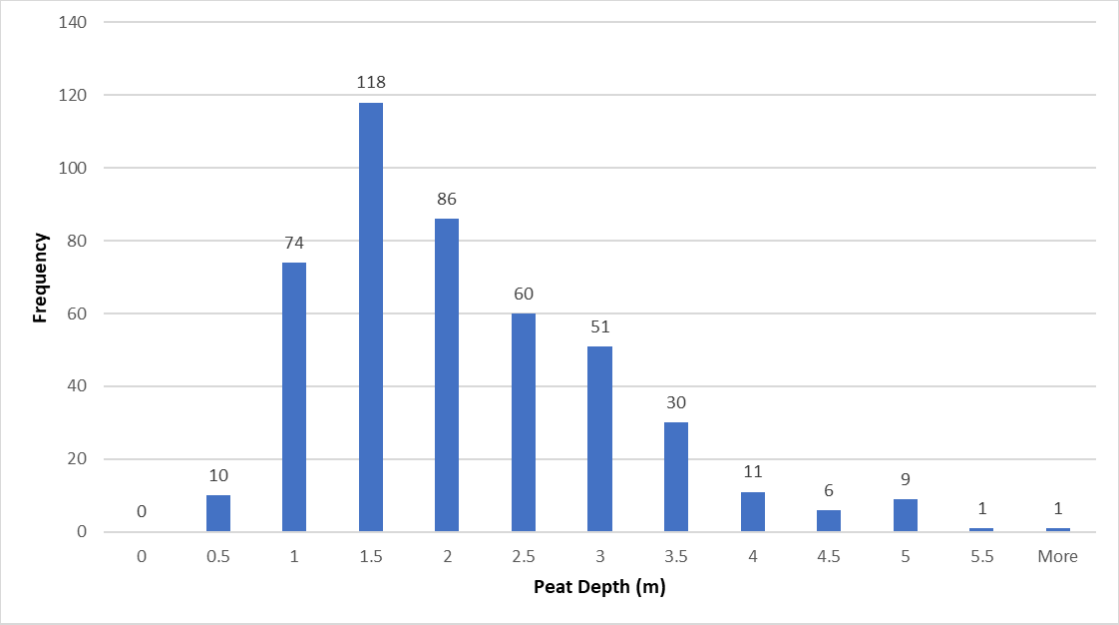


Figure 8-2: Peat depths at the proposed site (HES, FT and MKO peat probes)

Table 8-8: HES Peat Depths at Key Infrastructure Locations

Location	HES Peat Depth Range (*T Location & 100m spacings*) (m)	HES Peat Depth (m) at Turbine	FTC & MKO Average Peat Depth at Turbine	HES Shear Vane (kPa) Range	Summary of Underlying Mineral Subsoil Lithology
Ballivor Bog					
T1	1.8 - 5	5	1.5	18 - 65	Sandy gravelly base
T2	1.45-2.2	2	1.1	44 - 55	Gravelly/Sandy gravelly clay
T3	1.05 – 2.14	1.05	0.5	19 – 34	Gravelly base
T4	1.5 – 3.95	3.8	2.8	32 – 51	Gravelly clay

Location	HES Peat Depth Range (*T Location & 100m spacings*) (m)	HES Peat Depth (m) at Turbine	FTC & MKO Average Peat Depth at Turbine	HES Shear Vane (kPa) Range	Summary of Underlying Mineral Subsoil Lithology
T5	1 – 4.6	2.1	2.2	32 – 51	Gravelly base with cobbles
T6	1.35 – 2.1	1.4	1.1	9 – 59	Gravelly mineral soil
T7	3.3 - >5	3.43	3.9	44 – 62	Gravelly hard mineral soil
T8	1.45 - 2.2	1.45	1.5	41 – 51	Gravel base
T9	2.7 - >3	2.7	1.6	44 – 55	Sandy Gravel
T10	2.5 – 2.8	2.6	0.8	76 – 102	Gravel base
T11	2 - >5.5	3	1.1	74 – 114	Sandy Silt
T12	0.53-2.1	0.9	2.2	44	Gravelly mineral soil
Meteorological Mast			1.65	-	-
Temporary Construction Compound 3/Amenity Car park			1.45	-	-
Bracklin Bog					
T13	1.3 - >2.7	2.2	1.8	77 – 102	Sandy silt
T14	0.7 – 1.5	0.7	0.5	44	Gravelly clay
T15	0.8 – 3.7	0.8	2.6	20 – 45	Gravelly mineral soil
T16	3 – 4.6	>3.2	3.0	20 – 31	Sandy gravelly base
T17	1.25 - >4.5	2.84	0.8	-	Gravelly silty sand
T18	>3.1 – 4.3	4.2	0.9	32 – 47	Hard gravelly base
Amenity Car Park		-	1.4	-	-
Temporary Construction Compound 4		-	1.35	-	-
Borrow Pit		-	0.7	-	-
Lisclogher Bog					
T19	0.8 – 2.9	0.8	2.2	22	Gravelly clayey base
T20	0.8 – 2.9	0.8	1.8	25 – 58	Gravelly mineral soil
T21	2.6 - 4	4	0.9	30 – 45	Fine grained sand and sandy clay
T22	1.14 – 2.72	2.09	1.4	17 – 73	Gravelly mineral soil
T23	2.19 – 3.69	3.22	2.2	61 – 96	Sandy gravelly mineral soil
T24	2 – 3.65	2.17	1.8	34 – 53	Firm clay
T25	3 - >5	>5	2.1	24 – 36	Gravelly clay
T26	1.5 – 3.3	1.5	1.9	31 – 36	Gravelly clay
Meteorological Mast	-	-	2.75	-	-
Carranstown Bog					

Location	HES Peat Depth Range (*T Location & 100m spacings*) (m)	HES Peat Depth (m) at Turbine	FTC & MKO Average Peat Depth at Turbine	HES Shear Vane (kPa) Range	Summary of Underlying Mineral Subsoil Lithology
Substation	0.45 – 3.5 Average: 2.57 (5 no. measurements)		1.5	-	Gravelly mineral soil
Borrow Pit 1a			1.2	-	-
Borrow Pit 1b			1.4		
Amenity Car park			-	-	-
Construction Compound 1			1.9	-	-
Construction Compound 2			1.1	-	-

A total of 102 no. trial pits have been completed across the proposed site, at each of the 26 no. proposed turbine locations and other key infrastructure locations. Trial pit depths extended to a maximum of 6mbgl (metres below ground level). Peat was encountered in all trial pits (with the exception of those completed at the proposed location of the borrow pit to the south of Bracklin Bog) with depths ranging from 0.1 to 4.9mbgl. Ground conditions generally consisted of peat overlying glacial tills comprising of slightly sandy gravelly silt/clay and/or silty sands and gravels with some cobbles and boulders. Trial pit logs are included in Appendix F of Appendix 8-1.

A total of 16 no. cable percussion boreholes (BHs) and 5 no. rotary coreholes (RCs) were also completed at key infrastructure locations. BH/RC depths ranged from 1.70 to 11mbgl. Ground conditions generally comprised of peat overlying glacial till overlying possible bedrock. Summary data for the boreholes completed at the proposed borrow pits and substation are presented in Table 8-9 below.

All site investigation locations (TPs, BHs, and RCs) are shown on Figure 8-4, Figure 8-5, and Figure 8-6. The site investigation report containing these data is included as an Appendix to the Peat Stability Assessment Report attached as Appendix 8-1.

Table 8-9: Borrow Pit and Substation Site Investigation Summary Data

Location	Location ID	Ground level (mOD)	TP/BH/RC depth (mbgl)	Summary of Mineral Subsoil Lithology
BP-2	FBP-W03	82.35	11.0	0-1.5 - no recovery 1.5-11.0 - Brown slightly gravelly silty fine and medium SAND with cobbles.
	FBP-W03	85.88	11.0	0-1.5 - no recovery 1.5-11.0 – Brownish grey slightly fine to coarse SAND with cobbles.
Carranstown Borrow Pits (BP-1a and BP-1b)	BPA-BH1	78.02	5.10	0-2.6 – Very soft blackish brown PEAT 2.6-4.0 – Medium dense greyish brown sandy very silty GRAVEL with cobbles 4.0-5.0 – Dense greenish grey very silty GRAVEL with cobbles 5.0-5.1 – Obstruction – Possible rock

Location	Location ID	Ground level (mOD)	TP/BH/RC depth (mbgl)	Summary of Mineral Subsoil Lithology
	BPA-BH2	78.72	6.0	0-0.4 – PEAT 0.4–3.5 – Firm dark grey slightly sandy gravelly SILT with cobbles 3.5-6.0 – Medium dense silty very gravelly coarse SAND 6.0 – Obstruction – Possible rock
	BPA-BH3	76.34	1.70	0-0.5 – Very soft brown PEAT 0.5-1.6 – Medium dense grey slightly sandy very silty GRAVEL with cobbles and boulders 1.6-1.7 - Obstruction
	BPA-BH3a	76.63	4.50	0-0.6 – Very soft brown PEAT 0.6-2.5 – Firm greyish brown slightly sandy slightly gravelly SILY with cobbles and boulders 2.5-4.4 – Medium dense dark grey very sandy very silty medium GRAVEL 4.4-4.5 – Obstruction – possible rock
	CMP-W05	76.84	11.0	0-1.5 - no recovery 1.5-11.0 – Greyish Brown limestone GRAVEL.
Substation	BH5	77.06	7.20	0-3.0 Very soft brown fibrous PEAT 3.0-5.6 – Firm greyish green slightly sandy gravelly SILT with cobbles 5.6-7.0 – Stiff grey slightly sandy slightly gravelly CLAY with cobbles 7.0-7.3 – Obstruction - Possible rock

Figure 8-3: Recorded peat depths across the proposed site (HES, FT and MKO peat probe data)

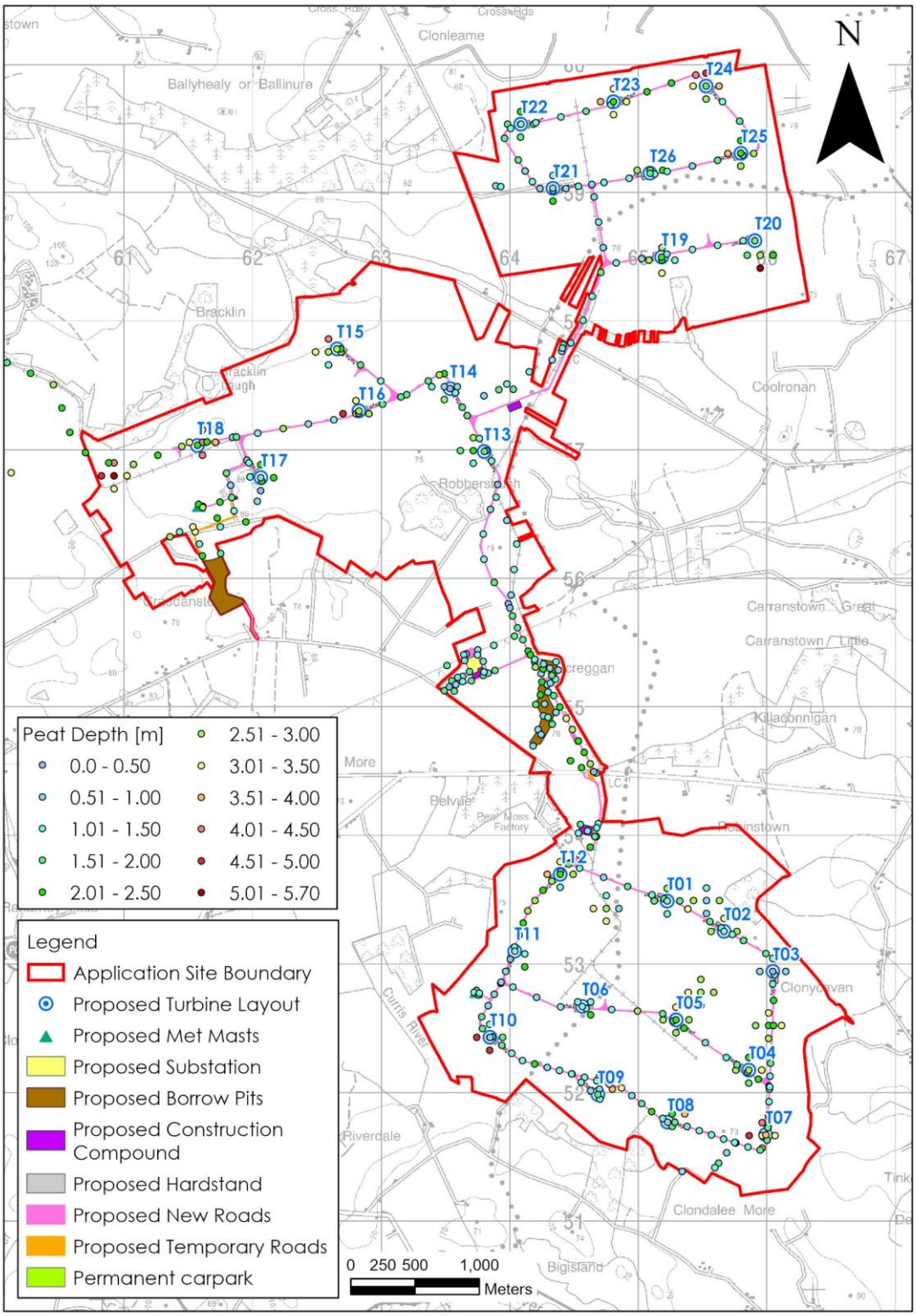


Figure 8-4: Site Investigation Locations (Trial Pits and Boreholes) in Bracklin and Lisclogher bogs

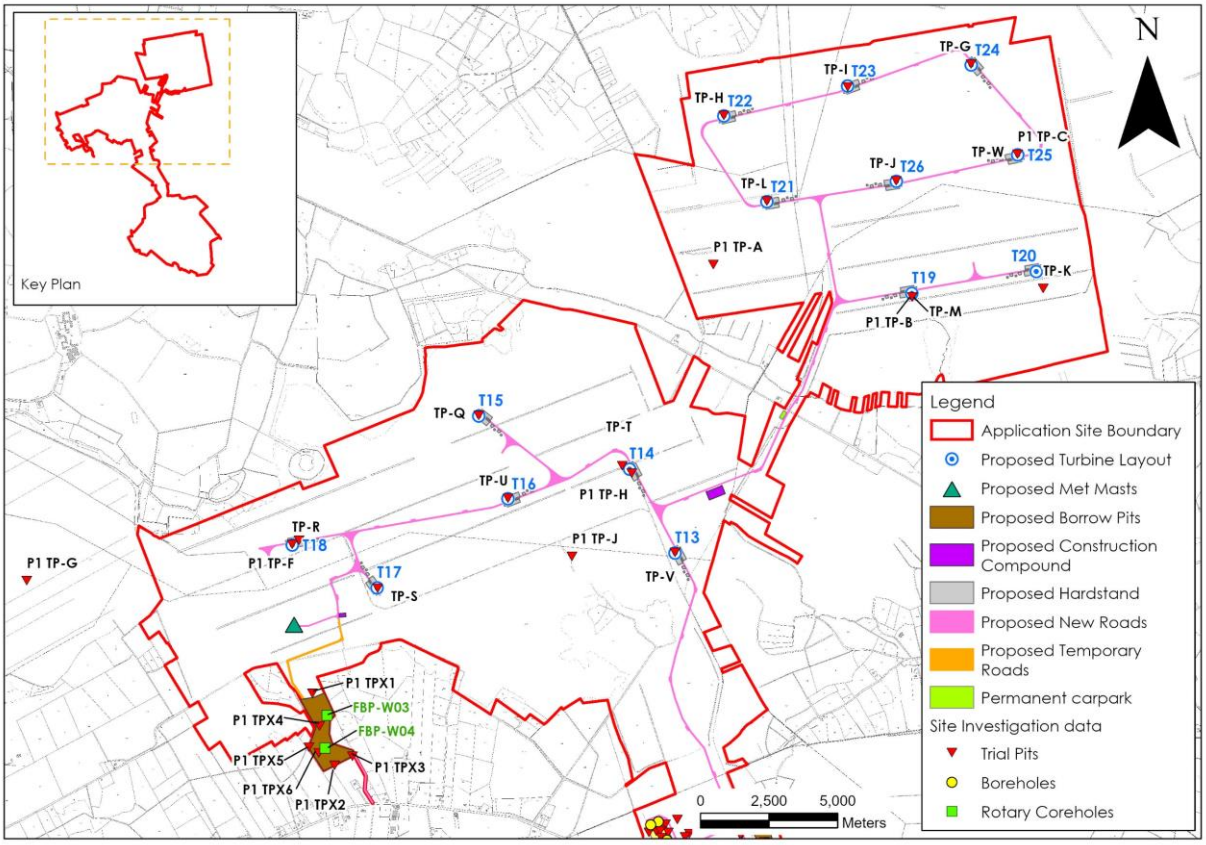


Figure 8-5: Site investigation Locations (Trial Pits and Boreholes) in Ballivor bog

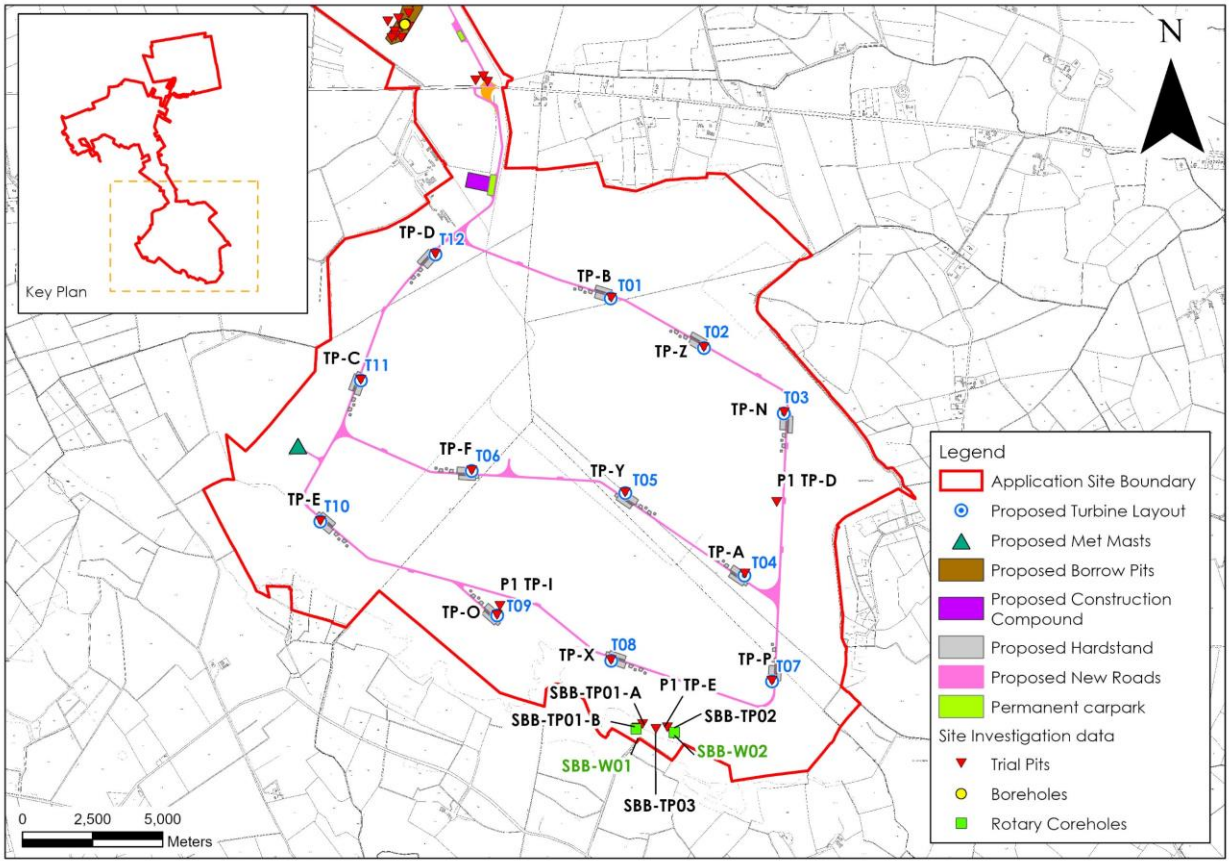
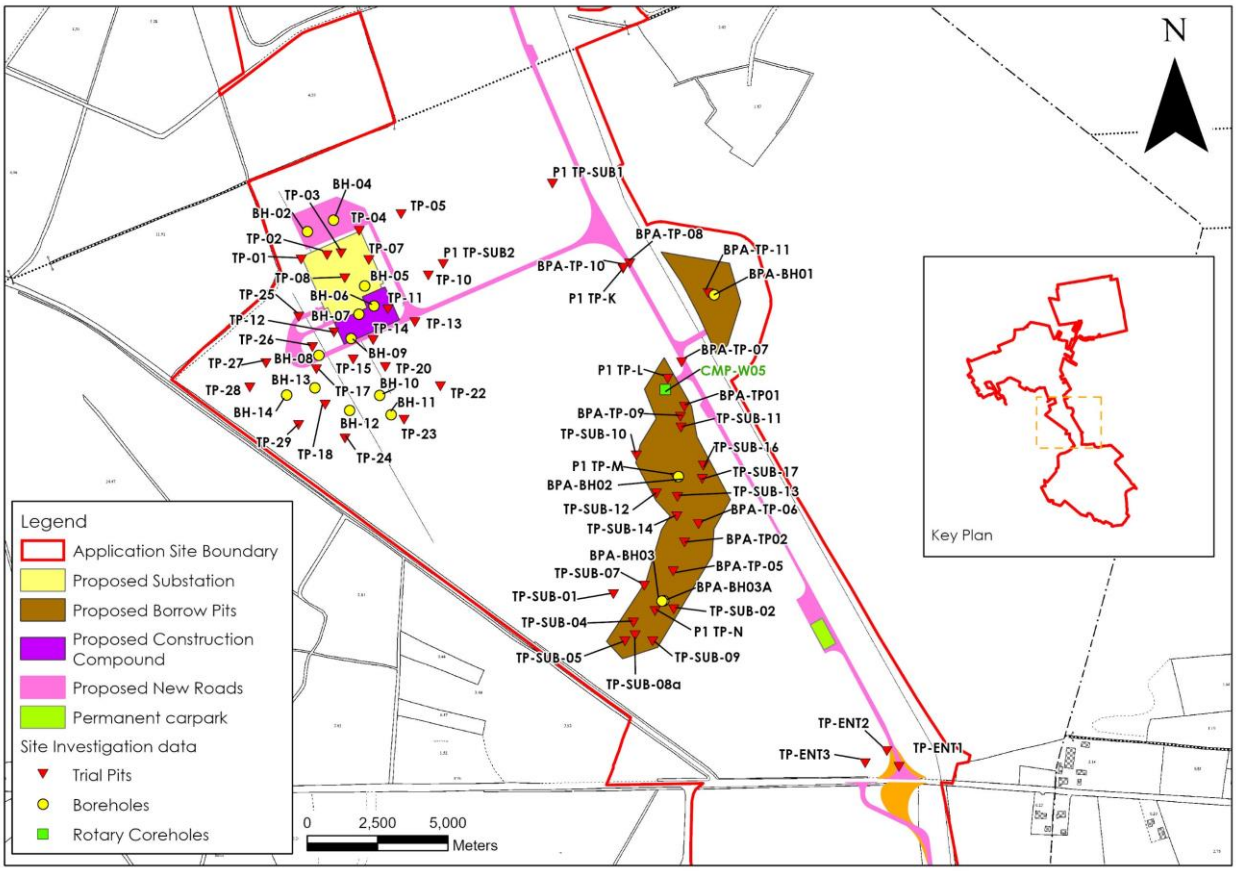


Figure 8-6: Site investigation Locations (Trial Pits and Boreholes) in Carranstown bog



8.3.5 Bedrock Geology

The GSI online maps (www.gsi.ie) show that the bedrock underlying the proposed site to be Dinantian Pure Unbedded Limestones (DPUL) of the Waulsortian Limestone Formation, Dinantian Upper Impure Limestones (DUIL) of the Tober Colleen Formation and the Lucan Formation and Dinantian Lower Impure Limestones (DLIL) of the Ballysteen Formation.

The Waulsortian Limestone Formation is mapped below the vast majority of Ballivor Bog, all of Carranstown Bog, the southern section of Bracklin Bog and the east of Lisclogher Bog. The Waulsortian Limestone Formation comprises massive, unbedded lime mudstones and are dominantly pale grey in colour. The Tober Colleen Formation is mapped to underly the central area of Bracklin Bog and an area towards the centre of Lisclogher Bog. The Tober Colleen Formation is described by the GSI as "dark-grey, calcareous, commonly bioturbated mudstones and subordinate thin micritic limestones". The Lucan Formation is mapped to underlay an area to the southwest of Ballivor Bog, and an area in the west of Lisclogher Bog. The Lucan Formation is noted to comprise of dark limestones and shales. The Ballysteen Formation underlies the western portion of Bracklin Bog and is comprised of "*irregularly bedded and nodular bedded argillaceous bioclastic limestones, interbedded with fossiliferous calcareous shales*".

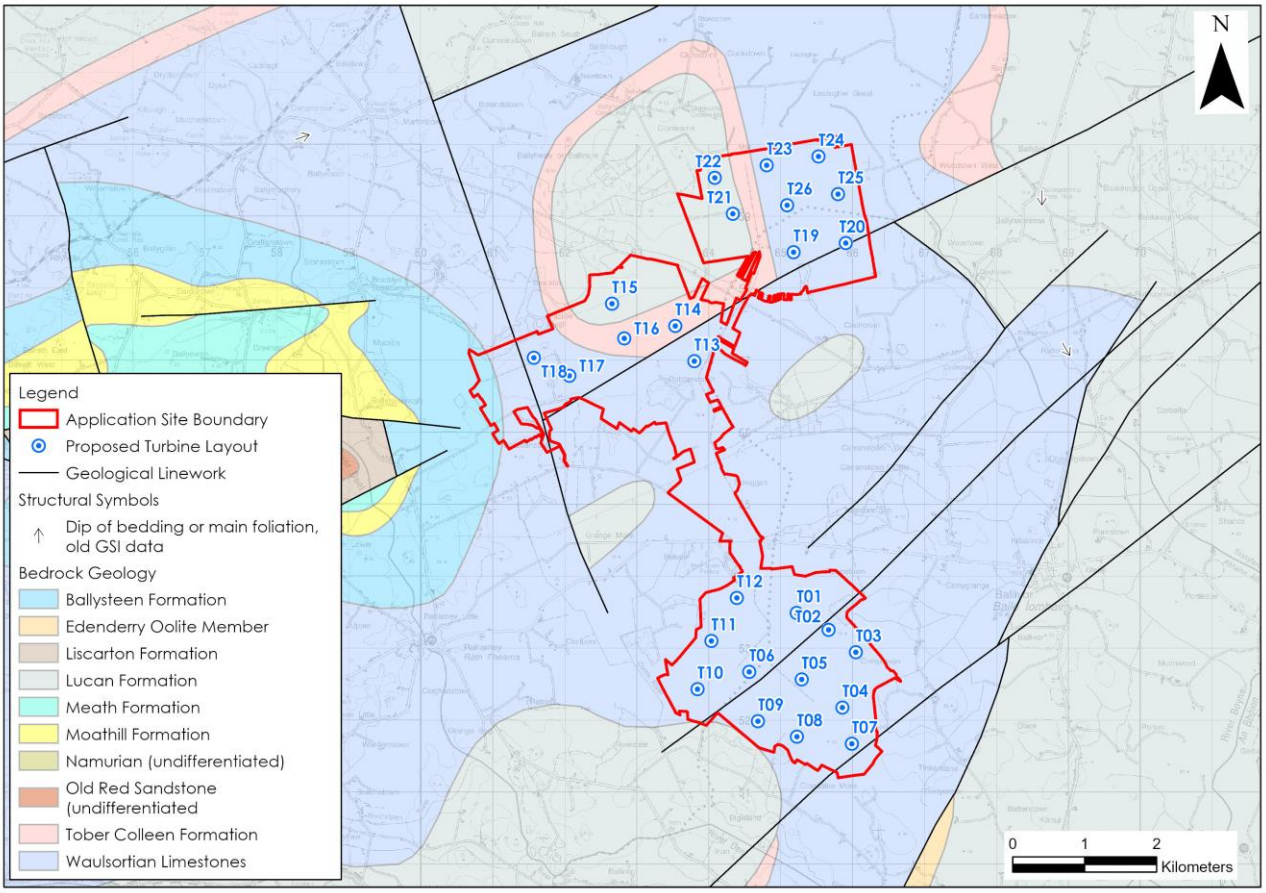
In terms of key wind farm infrastructures 21 no. proposed turbine locations, the proposed substation location, 4 no. proposed construction compounds and 3 no. borrow pits are mapped as being underlain by Waulsortian Limestone. Meanwhile, T14 and T16, located towards the centre of Bracklin Bog, are mapped as being underlain by the Tober Colleen Formation. And T15, T21 and T22 located towards the north of Bracklin Bog and the west of Lisclogher Bog are mapped as being underlain by the Lucan Formation.

The proposed site is crosscut by several northeast – southwest orientated faults. 2 no. faults of this orientation are mapped to underlie Ballivor Bog with a third mapped in the southeast of Carranstown Bog. A large fault of similar orientation is also mapped to cut across Lisclogher Bog and Bracklin Bog. This fault is in turn crosscut by a later north/northwest to south/southeast orientated fault which underlies the west of Bracklin Bog.

The GSI do not map any bedrock outcrop within the proposed site or in the surrounding lands.

No bedrock was encountered in any of the 102 no. trial pits completed at the proposed site which extended to a maximum depth of 4.9mbgl. The 16 no. cable percussion boreholes and 5 no. rotary coreholes extended to depths ranging from 1.7 to 11mbgl and were terminated due to obstruction (possibly due to bedrock or large boulders in the underlying glacial till). Depth to bedrock at the proposed site is expected to be in excess of 11m. A bedrock geology map of the area is attached as Figure 8-7.

Figure 8-7: Bedrock Geology Map (www.gsi.ie)



8.3.6 Soil Contamination

According to the EPA online mapping (www.epa.ie), there are no licenced waste facilities or dump sites in the proposed site or its immediate environs. The closest EPA mapped waste locality is Annaskinnan Landfill located approximately 5.6km southwest of the proposed site.

The EPA map several Industrial Emissions Licensing (IEL) facilities and IPC facilities in the area of the proposed site. An IPC Licence (P0506-01) was granted to Bord na Móna Energy Ltd on 28/04/2000 for the extraction of peat at the Ballivor Bog Group. Since 2000 all best practice procedures which were implemented to prevent the occurrence of spills and leakages were upgraded to comply with the IPC licence requirements. Condition 7 referred to Waste Management whereby all hazardous waste materials (oils, oil filters, batteries etc) were required to be disposed of by licenced waste contractors. According to the available AER reports, no significant fuel spills or wastewater discharges have occurred at the proposed site prior to or since 2000.

An IEL licence (P0984) also exists at Clondrisse Pig Farm located ~600m north of Bracklin Bog.

The GSI do not map the presence of any historic quarries or pits within the proposed site. Several historic quarries dating from the 1830s are mapped along the R156 to the east of the proposed site and in the lands surrounding the village of Ballivor. The GSI also record a quarry dating from the early to mid-20th century to the west of the existing Bord na Móna depot situated to the north of Ballivor Bog. Historic gravel pits are also recorded in the lands to the southeast of Ballivor Bog, southwest of Bracklin Bog and to the southeast of Lisclogher Bog.

During the site walkovers, no large areas of particular contamination concern were identified within the proposed site. Some minor fly-tipping (of domestic and construction and demolition (C&D) waste) was noted along the edge of access tracks, but these were very localised.

8.3.7 Economic Geology

The GSI Online Minerals Database accessed via the Public Data Viewer (www.gsi.ie) shows a small number of historic quarries and pits in the lands surrounding the proposed site. The GSI does not record the presence of any active quarries or pits in the proposed site or in the surrounding lands. The closest mapped active quarry is located approximately 10km east of the proposed site near the village of Rathmoylan. The closest GSI mapped active sand and gravel pit is located approximately 8km south of the proposed site near Clonard.

The GSI also record the presence of 1 no. mineral locality within the proposed site. This is located in Lisclogher Bog with the key mineral identified being marl. In the townland of Riverdale to the southwest of Ballivor Bog the GSI note the occurrence of sand and gravel deposits describing the site as an active pit with high quality sand.

The GSI online Aggregate Potential Mapping Database (www.gsi.ie) shows that the crushed rock aggregate potential of the proposed site ranges from Low to Very High. The areas of very high potential are located in the centre and northeast of Carranstown Bog and the south and west of the main Bracklin Bog area. The limestone bedrock underlying the proposed site could be classified as “Medium” importance. The bedrock could be used on a “sub-economic” local scale for construction purposes. The bedrock has not been used in the past at the proposed site for this purpose, likely because of the covering of peat and glacial till overburden in the area.

The majority of the proposed site is not located within an area mapped for granular aggregate potential (i.e., potential for gravel reserves). Some small areas in the interior of Bracklin Bog are mapped as having "Low” granular aggregate potential. Meanwhile the location of the proposed borrow pit (BP2) to the south of Brackin Bog is mapped as having “High” potential. The overlying peat deposits at the proposed site could be classified as “Low” importance as the peat is not designated in this area and is significantly

degraded in most places at the proposed site as a result of industrial peat production/extraction and drainage. Refer to

Table 8-1 for definition of these criteria.

Table 8-10: Summary of Bedrock Geology and Geological Resources

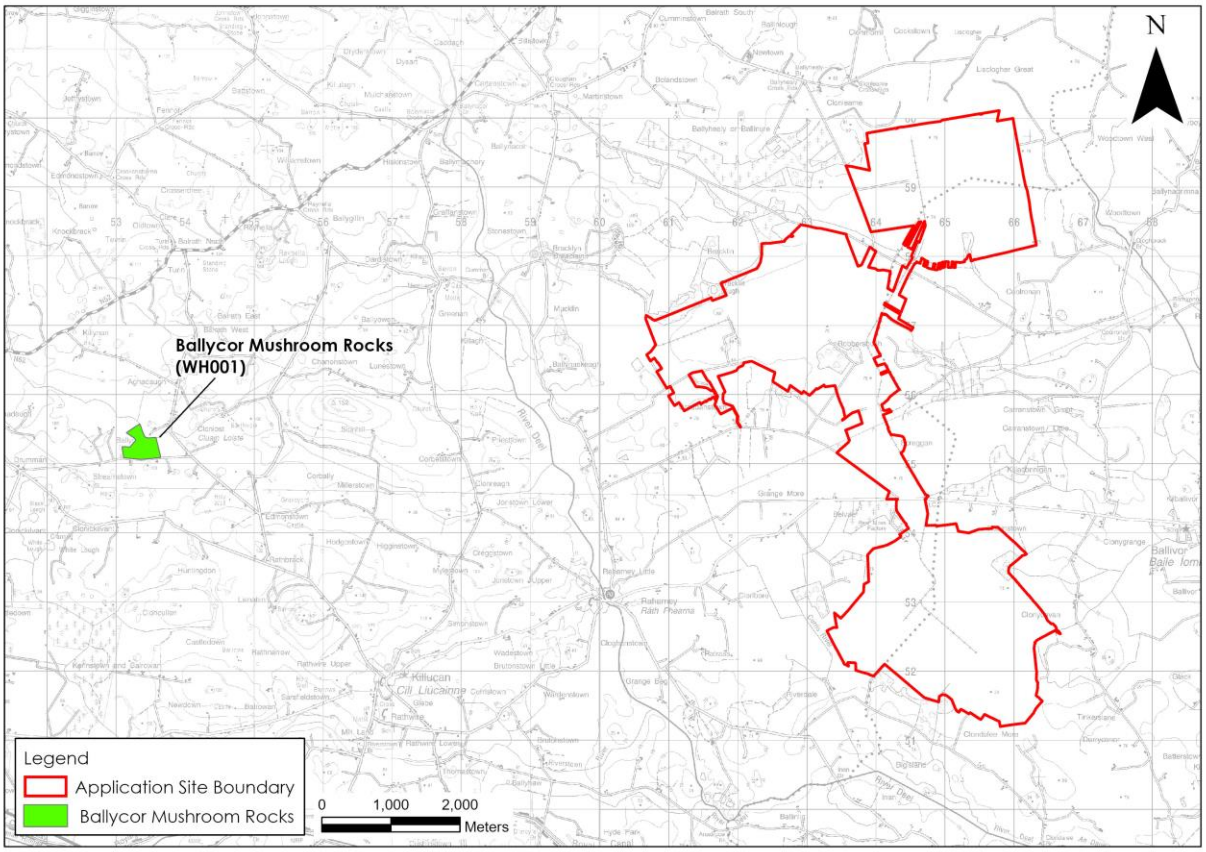
Bog Name	Bedrock Geology	Bedrock Geological Resource Potential (Crushed Rock)
Ballivor	Calcareous, with bog mainly underlain by Waulsortian Limestone. Faulting in the area has a NW-SE orientation.	Low to Medium
Carranstown	Calcareous, with bog mainly underlain by Waulsortian Limestone. Faulting in the area has a NE-SW orientation	Generally Low to Medium Area in the north is of Very High Potential
Bracklin	Calcareous, with bog underlain by Waulsortian Limestone to south, and Tober Colleen Formation and Lucan Formation to north. Faulting in the area has NW-SE and NE-SW orientations	Generally Low to Medium Areas in the south have Very High Potential
Lisclogher	Calcareous, with bog underlain by Waulsortian Limestone to east, and Tober Colleen Formation and Lucan Formation to west. Faulting in the area has a NE-SW orientation	Low to Medium

8.3.8 Geological Heritage Sites

There are no geological heritage sites at or near the proposed site (www.gsi.ie). The closest geological heritage site, the Ballycor Mushroom Rocks (Site Code: WH001), is located approximately 7.3km west of the proposed site.

A map of local geological heritage sites is attached as Figure 8-8.

Figure 8-8: Geological Heritage Sites



8.3.9 Peat Stability Assessment

8.3.9.1 Introduction

Fehily Timoney and Company (FTC) was engaged to undertake a geotechnical and peat stability assessment of the proposed site. A Geotechnical and Peat Stability Assessment Report (FT, November 2023) is attached in Appendix 8-1.

Hydrological, hydrogeological and ecological factors were also assessed in the Geotechnical and Peat Stability Assessment Report, and interaction between FTC, HES and MKO were undertaken throughout the iterative design process. The assessment was done in accordance with 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 at the proposed site, prior to the site reconnaissance by engineering geologists/geotechnical engineers from FTC.

8.3.9.2 Hydrological Considerations

The hydrological factors with regard 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 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 the above Pre-conditions at the proposed site was a key part of the hydrological constraints assessment carried out in conjunction with project design team.

8.3.9.3 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). 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. The slope angle on the proposed site are lower than those at Meenbog, and no significant areas of sidelong ground are present. 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.

The proposed site is on cutover raised bog. Many of the conditions noted above do not occur at the proposed site.

8.3.9.4 Peat Stability Desk Study and Investigations

The GSI do not record the occurrence of any historic landslides within the proposed site or in the surrounding lands. The closest recorded landslide event (1999) is mapped at Girley Bog, Chamberlainstown, approximately 12km northeast of Lisclogher Bog.

The GSI Landslide Susceptibility Map (www.gsi.ie) classifies the probability of a landslide occurring at the proposed site as Low. This is due to the proposed sites relatively flat topography (refer to Section 8.3.2).

A Geotechnical and Peat Stability Assessment Report (FTC, 2023) is attached in Appendix 8-1. Summary data and conclusions from that report are provided below.

FTC completed an analysis of peat sliding at all the main infrastructure locations (proposed turbine, meteorological masts, borrow pits, substation and temporary construction compound locations) across the proposed site as for both the undrained and drained conditions. The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes. The minimum required Factor of Safety (FoS) is 1.3 based on BS6031:1981: Code of Practice for Earthworks (BSI, 2009). The assigned probability of instability associated with a given FoS value is described in Table 8-11.

Table 8-11: Probability Scale for Factor of Safety for Peat

Scale	Factor of Safety	Probability
1	1.30 or greater	Negligible/None
2	1.29 to 1.20	Unlikely
3	1.19 to 1.11	Likely
4	1.01 to 1.10	Probable
5	<1.0	Very Likely

8.3.9.5 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 (FTC, 2023).

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 (short-term stability) and drained (long-term stability) analysis has been undertaken to determine the stability of the peat slopes on site (FTC, 2023).

- 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 (FTC, 2023) is attached in Appendix 8-1.

Undrained Analysis

The results of the undrained analysis for the peat at the proposed infrastructure locations are presented in Table 8-12. The analysis was undertaken for 2 no. conditions: Condition 1 with no surcharge loading and Condition 2 with a surcharge loading of 10kPa, equivalent to 1m of stockpiled peat. As outlined above the undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.

The calculated FoS for Condition 1 is in excess of 1.30 for all of the key infrastructure locations. The calculated FoS for Condition 1 was found to range from 2.61 to 57.34, indicating a low risk of peat instability.

The calculated FoS for Condition 2 is in excess of 1.30 for all key infrastructure locations. The calculated FoS for Condition 2 was found to range from 2.13 to 16.38, indicating a low risk of peat instability.

Table 8-12: Factor of Safety Results (undrained condition)

Turbine No.	Easting	Northing	Factor of Safety for Load Condition[1]	
			Condition (1)	Condition (2)
T1	665162	753511	9.76	6.85
T2	665604	753275	8.75	5.57
T3	665983	752965	26.98	12.40
T4	665796	752196	5.47	4.03
T5	665231	752587	4.68	3.89
T6	664502	752692	7.29	4.94
T7	665928	751694	2.61	2.13
T8	665164	751792	6.04	4.78
T9	664623	752007	7.91	5.88
T10	663783	752452	11.19	7.52
T11	663976	753121	13.92	7.29

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

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

Turbine No.	Easting	Northing	Factor of Safety for Load Condition[1]	
			Condition (1)	Condition (2)
T12	664329	753719	6.55	5.10
T13	663739	757007	8.19	6.04
T14	663474	757496	12.76	6.96
T15	662595	757805	5.89	4.25
T16	662765	757323	5.59	4.50
T17	662002	756804	12.77	6.05
T18	661508	757054	2.61	2.13
T19	665118	758520	4.11	3.03
T20	665844	758647	11.47	7.65
T21	664274	759054	17.01	8.06
T22	664023	759553	16.38	9.56
T23	664744	759727	7.40	5.59
T24	665464	759850	457	3.52
T25	665735	759326	5.96	4.73
T26	665028	759172	9.97	6.95
Meteorological Mast 1	661518	756595	7.65	5.10
Meteorological Mast 2	663677	752816	11.47	7.65
Borrow Pit BP1a and BP-1b (Carranstown)	664226	755100	7.66	4.60
Borrow Pit BP-2 (South of Bracklin Bog)	661667	755996	16.42	6.76
Substation	663587	755382	12.07	7.91
Construction Compound 1	663854	757488	8.50	5.47
Construction Compound 2	663517	755194	12.07	7.91
Construction Compound 3/Amenity Car Park	664542	754056	12.74	8.19
Construction Compound 4	661791	756641	11.47	7.65

Drained Analysis

Drained analysis results are presented in Table 8-13. Similar to the undrained analysis, the drained analysis was done for 2 no. conditions: Condition 1 with no surcharge loading and Condition 2 with a surcharge of 10kPa, equivalent to 1m of stockpiled peat. 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 Condition 1 was in excess of 1.30 at all key infrastructure locations. The FoS ranged from 1.31 to 28.67, indicating a low risk of peat instability.

The calculated FoS for Condition 2 was in excess of 1.30 at all key infrastructure locations. The FoS ranged from 2.30 to 17.73, indicating a low risk of peat instability.

Table 8-13: Factor of Safety Results (drained condition)

Turbine No.	Easting	Northing	Factor of Safety for Load Condition[2]	
			Condition (1)	Condition (2)
T1	665162	753511	4.88	7.41
T2	665604	753275	4.37	6.02
T3	665983	752965	13.49	13.42
T4	665796	752196	2.73	4.36
T5	665231	752587	2.34	4.21
T6	664502	752692	3.64	5.34
T7	665928	751694	1.31	2.30
T8	665164	751792	3.02	5.17
T9	664623	752007	3.95	6.36
T10	663783	752452	5.59	8.14
T11	663976	753121	6.96	7.88
T12	664329	753719	3.28	5.52
T13	663739	757007	4.10	6.53
T14	663474	757496	6.38	7.52
T15	662595	757805	2.94	4.60
T16	662765	757323	2.80	4.87

[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.

Turbine No.	Easting	Northing	Factor of Safety for Load Condition[2]	
			Condition (1)	Condition (2)
T17	662002	756804	6.39	6.54
T18	661508	757054	1.31	2.30
T19	665118	758520	2.05	3.27
T20	665844	758647	5.73	8.27
T21	664274	759054	8.50	8.71
T22	664023	759553	8.19	10.34
T23	664744	759727	3.70	6.05
T24	665464	759850	2.28	3.80
T25	665735	759326	2.98	5.12
T26	665028	759172	4.99	5.72
Meteorological Mast 1	661518	756595	3.82	6.21
Meteorological Mast 2	663677	752816	5.73	8.27
Borrow Pit BP1a and BP-1b (Carranstown)	664226	755100	3.83	4.97
Borrow Pit BP-2 (South of Bracklin Bog)	661667	755996	8.21	7.30
Substation	663587	755382	6.04	8.56
Construction Compound 1	663854	757488	4.25	5.91
Construction Compound 2	663517	755194	6.04	8.56
Construction Compound 3	664542	754056	6.37	8.86
Construction Compound 4	661791	756641	5.73	8.27

The findings of the peat stability assessment showed that the proposed site has an acceptable margin of safety and is suitable for the Proposed Development. The findings include recommendations and control measures (Appendix 8-1) for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

An analysis of peat stability was carried out at the 26 no. turbine locations, substation compound, 4 no. construction compounds and 2 no. meteorological masts for both the undrained and drained conditions. The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes.

An undrained analysis was carried out, which applies in the short-term during construction. For the undrained condition, the calculated FoS for load conditions (1) & (2)[3] for the locations analysed, show that all locations generally have an acceptable FoS of greater than 1.3, indicating a low risk of peat failure. The undrained analysis would be considered the most critical condition for the peat slopes.

In summary, the findings of the peat assessment showed that the proposed site has an acceptable margin of safety, is suitable for the Proposed Development and is considered to be at low risk of peat failure. The findings include a series of control (mitigation) measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety. These are included below at Section 8.5.2.6.

8.4 Characteristics of the Proposed Development

The Proposed Development consists of 26 no. wind turbines and associated infrastructure including hardstands, 2 no. meteorological masts, 4 no. temporary construction compounds, 2 no. borrow pits, a 110kV substation, 3 no. permanent amenity carparks as well as access roads and all associated development and drainage works. Please refer to Chapter 4 for a full description of the Proposed Development.

FTC have prepared a Peat and Spoil Management Plan (2023) which describes how peat and spoil, which will be excavated from infrastructure locations, will be handled and placed/reinstated onsite. The Peat and Spoil Management Plan is attached as Appendix 4-2. The main characteristics of the Proposed Development that could effect the local soils and geological environment are described below:

- Opening of the 3 no. borrow pits, which will involve the stripping of ~98,400m^3 of peat and ~53,880m^3 of spoil (non-peat) (FTC, 2023). Rock extraction and subsequent processing of suitable rock to create aggregate for use on site in access tracks and hardstand construction.
- The establishment of the 4 no. temporary construction compounds will be constructed using the founded technique, with the platforms founded on material underlying the peat deposits. All compounds are mapped on peat and it is estimated that construction will require the removal of ~20,000m^3 of peat and 8,000m^3 of non-peat materials (FTC, 2023). The construction compounds will involve the use of Class 6 crushed stone and general fill materials and may include up to 1,000mm of granular stone fill with possibly a layer of geotextile. Welfare facilities will be provided at the site compounds. Wastewater effluent will be collected in a wastewater holding tank and periodically emptied by a licensed contractor.
- Construction of the on-site substation will be completed using a founded technique. The substation construction will require the excavation of ~50,000m^3 of peat and 5,500m^3 of non-peat (spoil) material (FTC, 2023). The substation will be founded on glacial till as the peat and lacustrine deposits would not provide a suitable founding stratum. The substation platform will be constructed with Class 1/6F material and may include granular stone fill with possibly a layer of geotextile. Welfare facilities will be provided at the substation. Wastewater effluent will be collected in an underground concrete holding tank and periodically emptied by a licensed contractor for the operational phase of the Proposed Development.
- The upgrade of existing access roads and the construction of new roads will require the removal of ~2,600m^3 of peat and 5,100m^3 of non-peat material (FTC, 2023). Due

[3] *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.*

to the peat depth at the proposed site access roads will generally be constructed using the floated technique. The methodology includes the placement of a geotextile membrane on both sides of the existing access track. Benching of the existing road and placement of granular fill. Overlay existing road with granular fill and new access road to be finished with a layer of capping. No peat extraction will be required in the upgrade of existing floated access roads and/or construction of new floating roads. The upgrade and construction of these tracks will require the use of Class 6 crushed stone and general fill.

- Construction of the turbine hardstands and 26 no. turbines will require the removal of approximately 376,900m^3 of peat and 95,000m^3 of spoil (FTC, 2023). The construction will also involve the use of aggregate, sourced from the onsite borrow pits.
- All turbines and their associated hardstands are likely to require a piled foundation as a result of the depth of peat present at these locations.
- The construction of the 2 no. met masts is estimated to require the excavation of approximately 3,500m^3 of peat and 750m^3 of spoil (FTC, 2023). The met mast foundation will likely comprise gravity type foundation, with the foundation to be founded on a competent stratum below the peat.
- The construction of the underground grid cable trench to connect the turbines with the proposed substation will require the excavation of ~12,500m^3 of peat (FTC, 2023). This trench will be shallow and kept at a uniform depth (refer to Chapter 4).
- Peat generated by construction will be reused or reinstated and will be available to be used for landscaping on edges of constructed infrastructure. As part of the CEMP, it is proposed to place excavated peat in the 3 no. borrow pits.

Summary volumes of material to be excavated are provided in **Table 8-14**.

Table 8-14: Estimated Peat, Mineral Soil and Bedrock Excavation Volumes (FTC, 2023)

Infrastructure Element (1)	Dimensions	Peat Volume (m^3) (2)	Spoil (non-peat) Volume (m^3) (2)	Comments
26 no. Turbines and Hardstands	26m diameter excavation footprint for turbine foundation with 34 x 80 m hardstand area	376,900	95,000	
Access Roads	Assumed 5m running surface with 6m wide development footprint	2,600	5,100	Excludes proposed floating sections of access road where no excavation of peat will take place
2 no. Meteorological Masts	10 x 10m foundation footprint and 30 x 30m hardstanding area	3,500	504	
4 no. Temporary Construction Compounds	Hardstanding areas will vary	20,000	8,000	

Infrastructure Element (1)	Dimensions	Peat Volume (m^3) (2)	Spoil (non-peat) Volume (m^3) (2)	Comments
Substation		50,000	5,500	
3 no. Borrow Pits		98,400	53,880	Peat and spoil generated from BP2 will be backfilled upon completion
Cable route and grid connection		12,500	-	
Sub-total		564,000 m^3	168,000 m^3	
Total Peat and Spoil Volume		732,000m^3		

Note (1) The location of the infrastructure elements on-site are shown on Planning Drawings.
Note (2) A factor of 20% (bulking factor of 15% and contingency factor of 5%) has been applied to the excavated peat & spoil volumes to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the proposed site.

Table 8-15: Summary of Peat and Spoil Placement/Reinstatement Areas at the Proposed Site (FTC, 2023)

Location	Peat & Spoil Volume (m^3)	Comment
Borrow Pits	290,000	Peat and spoil generated from BP2 will be backfilled into pit upon completion.
Peat placement alongside designated roads	405,000	1.3m in height and approx. 10m wide corridor on both sides of proposed infrastructure elements on site. For example, 10m wide corridor on both sides of proposed access roads, see Section 7.4 of the Peat and Spoil Management Plan report for further details. The placement of peat alongside infrastructure elements also includes around hardstanding areas, either side of cable trenches, etc.
Landscaping	52,000	It is estimated that approximately 2,000m^3 of peat will be required for landscaping purposes at each of the 26 no. turbine locations
Total	747,000m^3	

Table 8-16: Summary of Proposed Infrastructure construction methods (FTC, 2023)

Location	Foundation/Construction Method
Excavations for 26 no. wind turbines, hardstanding and infrastructure locations	All 26 no. turbine foundations are likely to be piled foundations. Should gravity foundations be employed that volume of peat and spoil will decrease from that described in Table 8-14. Similarly crane hardstands, construction compounds, meteorological mast foundations and the substation foundation will require excavation through peat and spoil to competent overburden. All material arising from excavations will be transported immediately to designated peat storage areas (borrow pits or storage areas alongside

Location	Foundation/Construction Method
	access roads (refer to Peat and Spoil Management Plan attached as Appendix 4-2 for the full proposed methodology). All excavations will be adequately supported or battered to a safe inclination. Excavation will be kept free from water at all times.
Access roads	The upgrade of existing roads will be completed by road construction types A and B with new excavated roads in shallow peat constructed with type C and new floating roads over deep peat (>1m) constructed with type D. Floating roads (Type D) will be the dominant road construction type used at the proposed site. The proposed road construction types are proposed to cater for the ground conditions and type of terrain present at the proposed site. Please refer to the Peat and Spoil Management Plan attached as Appendix 4-2 for a full description of road construction types A to D.
Borrow Pits	Borrow pits will be developed in a way in which the excavated peat and spoil can be safely stored, with cells in the borrow pits to be designated for the placement of excavated material. Borrow pits will be developed with stable inclinations and exposed slopes will be left with irregular faces to promote re-vegetation. Where possible segments of granular material will be left in places to help retain placed peat and spoil. Where this is not possible buttresses of permeable fill may be constructed to provide sufficient stability to the placed peat. Infilling of peat should commence at the back of the borrow pit and progress towards the pit entrance. All works associated with the movement of materials at the borrow pits should be supervised by a geotechnical engineer. A full description of the methodology associated with the construction and infilling of the borrow pits is included in Chapter 4.
Excavation for Underground Cables	Underground cabling will be required to connect the turbines to the proposed substation located in the townland of Grange More and then to the national grid. The trenches will be 900mm wide and 1200mm deep, with the cable trench likely to encounter peat across the proposed site. It is proposed to excavate the trenches at uniform depths, with all excavations adequately supported or battered to a safe inclination. Excavation will be kept free from water at all times and suitable excavated material will be reinstated into the trench. Material deemed unsuitable for reinstatement will be used locally for landscaping.

8.5 Likely Significant Effects and Associated Mitigation Measures

8.5.1 Do Nothing Scenario

If the Proposed Development were not to proceed, the proposed site would continue to be managed under the requirements of the relevant IPC licence and therefore the ongoing site management and environmental monitoring, peat stockpile removal (due to be completed by 2024), and wind measurement would continue. In addition, if the Proposed Development were not to proceed, the implementation of peatland rehabilitation plans as required under IPC License would occur. Likewise, the PCAS scheme in adjacent Bogs (where selected) would continue to be implemented. Other existing land use practices including local small scale turbary activities would continue along the margins of the proposed site. These land uses and activities will also continue if the Proposed Development does proceed.

Bord na Móna's Decommissioning and Rehabilitation Plans for the proposed site will continue to be implemented in accordance with the IPC licence requirements, to environmentally stabilise the proposed site through encouragement of re-vegetation of bare peat areas, with targeted active management being used to enhance re-vegetation and the creation of small wetland areas (if required).

In addition to the standard rehabilitation required by the IPC licence, enhanced rehabilitation measures will be implemented in certain areas of the Ballivor Bog Group (Carranstown East and Bracklin West). The enhanced decommissioning, rehabilitation and restoration measures, referred to as the Peatlands Climate Action Scheme (PCAS), are designed both to exceed/meet the standard requirements as defined by the IPC licence and to enhance ecosystem services by optimising climate action benefits. We note that work associated with PCAS has already begun in Carranstown East. The enhanced restoration, which will include more intensive drain blocking and ground re-profiling.

If the Proposed Development were not to proceed, the cumulative effect of the Do Nothing Scenario and the implementation of the Decommissioning and Rehabilitation Plans (including the PCAS Scheme) for the Ballivor Bog Group would result in a Moderate, Positive, Direct, Long-Term effect on Land and Soils/land.

8.5.2 Construction Phase - Likely Significant Effects and Mitigation Measures

The likely significant effects of the Proposed Development for the construction phase and mitigation measures that will be put in place to eliminate or reduce them are shown in this section. It should be noted that the main potential effects on the soils and geology environment will occur during the construction stage.

8.5.2.1 Effects on Soils/Land

The construction of the Proposed Development, with a total development footprint of 32.4ha, will result in the loss of approximately 26.59ha of peat bogs and 5.81ha of agricultural land (associated with the proposed borrow pit (BP2) to the south of Bracklin Bog). There will be no effects on the lands adjoining the proposed site.

Pathway: Excavation/hardstand construction

Receptor: Soils/land

Potential Pre-mitigation Effect: Negative, slight, direct, likely, permanent effect on land and soils/land.

Mitigation Measures/Impact Assessment:

The loss of peat bog land within the proposed site (1,770ha) and within the wider Ballivor Bog Group (2,419ha) is minimal (~1.8% loss within proposed site and ~1.3% loss across the Ballivor Bog Group). Therefore the effects of actual peat bog land loss in the area is negligible.

The loss of agricultural land associated with the proposed borrow pit (BP2) is minimal given the agricultural nature of the lands surrounding the proposed site and the wider area in Co. Meath and Co. Westmeath.

As a result of the small development footprint no mitigation measures are required.

Residual Effect: Since peat extraction activities formerly ceased at the proposed site in the summer of 2020, land cover at the proposed site, the former peat production fields are now available for re-vegetation and natural colonisation. Over time the proposed site would develop into a mosaic of open cutaway, heath and scrub habitats. Areas of the proposed site which are proposed for development will not be able to naturally re-vegetate and the peat bog will be replaced by hardstand areas (roads, turbine hardstands, turbine bases etc). However, due to the relatively small footprint of the proposed infrastructure on a site scale and even more so on a local scale the residual effect is considered Negative, direct, slight, likely, permanent effect on land and soils/land.

Significance of Effects: For the reasons detailed above (*i.e.* small development footprint), no significant effects on land or soils/land will occur.

8.5.2.2 Peat and Subsoil Excavation

Excavation and removal of peat and subsoil will be required for the following construction works:

- Opening of the 3 no. borrow pits will require the stripping of ~98,400m^3 of peat and ~53,880m^3 of spoil (non-peat);
- Construction of the 4 no. construction compounds will require the removal of ~20,000m^3 of peat and 8,000m^3 of non-peat materials;
- Construction of the on-site substation will be completed using a founded technique requiring the excavation of ~50,000m^3 of peat and 5,500m^3 of non-peat (spoil) material;
- The upgrade of existing access roads and the installation of new roads (predominantly floated) will require the removal of ~2,600m^3 of peat and 5,100m^3 of spoil;
- Construction of the 2 no. meteorological masts will require the excavation of ~3,500m^3 of peat and 750m^3 of spoil;
- Construction of the turbine hardstands and gravity bases and/or bases on a piled formation will require the removal of ~376,900m^3 of peat and 95,000m^3 of spoil; and,
- The development of the shallow underground grid cable trench will involve the removal ~12,500m^3 of peat (although much of this material can be reinstated back into the trench).

The above works will result in a permanent removal and relocation of in-situ peat and subsoil at most excavation locations (material excavated for the construction of the underground cable trench can be reinstated back into the trench if deemed suitable). In total it is estimated that 732,000m^3 of material (550,400m^3 of peat and 180,730m^3 of non-peat subsoils) will be excavated during the construction phase of the Proposed Development. There is no loss of peat or subsoil, as it will be relocated within the proposed site.

Minor haul route works will have a minimal impact on soils and subsoils.

Pathway: Extraction/excavation.

Receptor: Peat and subsoil.

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

Proposed Mitigation Measures by Design:

- Placement of turbines and associated infrastructure in areas with shallower peat where constraints allow;
- Use of floating roads, where appropriate, to reduce peat excavation volumes;
- The peat and subsoil which will be removed during the construction phase will be localised to the wind farm infrastructure turbine location, substation and temporary compounds and access roads;
- The Proposed Development has been designed to avoid sensitive habitats within the application area;
- A minimal volume of peat and subsoil will be removed to allow for infrastructural work to take place in comparison to the total volume present on the site due to optimisation of the layout by mitigation by design;
- In general, excavated peat will be moved short distances from the point of excavation and used locally for landscaping;
- Excavated peat that is not used locally for landscaping will be stored in the 3 no. borrow pits; and
- Construction of settlement ponds will be volume neutral, and all excess material will be used locally to form pond bunds and surrounding landscaping.

Residual Effect Assessment: The granular soil at the proposed site can be classified as of "Medium" importance and the peat deposits at the proposed site can be classified as of "Low" importance as the raised bog is already degraded by historical harvesting and drainage. The overall proposed site area is extensive (1,770ha) while the Proposed Development footprint (32.4ha) is approximately 1.8% of the overall proposed site area. The effect is the disturbance and relocation of c 732,000m^3 of soil and subsoil during construction. The design measures incorporated into the project as described above. in particular the avoidance of deeper peat areas such as bog remnants and areas on the boundary of the proposed site, the small development footprint, combined with the 'Medium' and 'low' importance of the deposits means that the residual effect is considered - Negative, slight, direct, likely, permanent effect on peat and subsoils due to disturbance and relocation within the proposed site.

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

8.5.2.3 Excavation of Proposed Borrow Pits

The excavation of ~98,400m^3 of peat and ~53,880m^3 of spoil (non-peat) will be completed at 3 no. proposed borrow pit locations. Once the overlying peat has been removed granular material will be excavated from the borrow pits to facilitate the construction of the Proposed Development.

Pathway: Extraction/excavation.

Receptor: Peat and subsoil.

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

Proposed Mitigation Measures by Design:

The Peat and Spoil Management Plan (FTC, 2023) attached as Appendix 4-2 sets out the guidelines for the construction and reinstatement of the on-site borrow pits. Upon the removal of the required volumes of granular material (for the construction of the infrastructure elements at the wind farm) from the borrow pits it is proposed to reinstate the pits using excavated peat and spoil. The borrow pits are designed and

will be constructed in a way which will allow the excavated peat and spoil to be placed safely, with areas within the borrow pits designated for the storage of excavated peat. Other mitigation measures included in the design of the borrow pits are as follows:

- Borrow pits will be developed with stable ground inclinations;
- Exposed slopes will be left with irregular faces to promote re-vegetation;
- Where possible segments of granular material will be left in places to help retain placed peat and spoil. Where this is not possible buttresses of permeable fill may be constructed to provide sufficient stability to the placed peat; and,
- Infilling of peat should commence at the back of the borrow pit and progress towards the pit entrance.

Residual Effect Assessment: The granular soil at the proposed site can be classified as of "Medium" importance and the peat deposits at the proposed site can be classified as of "Low" importance as the raised bog is already degraded by historical harvesting and drainage. The overall proposed site area is extensive (1,770ha) while the proposed development footprint of the borrow pits (16.32ha) is approximately 0.6% of the overall proposed site area. The effect is the of c 98,4000m^3 of peat and ~53,880m^3 of spoil during construction and the relocation of sand/gravel to be used for the construction of the Proposed Development. The design measures as described above in particular the avoidance of deeper peat areas combined with the 'Medium' and 'low' importance of the deposits means that the residual effect is considered - Negative, slight, direct, likely, permanent effect on peat and subsoils due to disturbance and relocation within the proposed site.

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

8.5.2.4 Contamination of Soil by Leakages and Spillages and Resulting Alteration of Peat/Soil Geochemistry

Accidental spillage during refuelling of construction plant with petroleum hydrocarbons is a pollution risk. 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 peat, subsoils and pollution of the underlying aquifer) on the geological and water environment.

Pathway: Peat and subsoil and underlying bedrock pore space and faults in the underlying bedrock.

Receptor: Peat and subsoil, bedrock.

Pre-Mitigation Potential Effect: Negative, slight, direct, short-term, likely effect on peat, subsoils and bedrock.

Proposed Mitigation Measures:

- On-site re-fuelling will be undertaken using a double skinned bowser with spill kits kept on site for accidental leakages or spillages;
- 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;
- Fuels volumes stored on-site will be minimised. All 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 plant used during construction will be regularly inspected for leaks and fitness for purpose; and
- An emergency response plan for the construction phase to deal with accidental spillages will be contained within the Construction 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 is considered to be - Negative, imperceptible, direct, short-term, unlikely effect on peat and subsoils and bedrock.

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

8.5.2.5 Erosion of Exposed Subsoils and Peat During Construction of Infrastructure

There is a high likelihood of erosion of peat and spoil during its excavation and during final landscaping works increasing silt levels in water runoff from the works area. The impact source is also associated potential effects on the water environment, and therefore this aspect is further assessed in detail in Chapter 9.

The erosion of peat and spoil during construction will not have a significant effect due to the small development footprint in comparison to the total site area and due to the small volumes of material to be excavated in comparison to the total volumes of peat and spoil present at the proposed site.

Pathway: Vehicle movement, surface water and wind action.

Receptor: Peat and subsoil.

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

Proposed Mitigation Measures:

- All works will be completed in accordance with the Peat and Spoil Management Plan (FTC, 2023)
- All excavated peat and spoil shall be transported immediately on excavation to designated peat storage areas along the access roads and will be used on site for landscaping close to the extraction area;
- Where peat/spoil is not used to landscaping it will be transported immediately to one of the proposed borrow pits;
- Peat and spoil will not be transported significant distances upon excavation;
- Upon excavation, the upper vegetative layer (where still present) will be stored with the vegetation part of the sod facing the right way up to keep the plants and vegetation alive to aid construction reinstatement of disturbed ground;
- Re-seeding and spreading/planting will also be carried out in areas where ground will be disturbed; and,
- A full Peat and Spoil Management Plan for the development is shown as Appendix 4-2.

Residual Effect Assessment: Peat soils and spoil can be eroded by vehicle movements, wind action and by water movement. To minimise this, all excavation works will be completed in accordance with a 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 is considered - Negative, slight, direct, short-term, likely effect on peat and subsoils by erosion and wind action.

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

8.5.2.6 Peat Instability and Failure

Peat instability or failure refers to a significant mass movement of a body of peat that would have an adverse effect on the proposed site and the surrounding environment. The potential significant effects of peat failure are likely to be:

- Death or injury to site personnel;
- Damage to machinery;
- Damage or loss of infrastructure;
- Drainage disruption by blockage of drainage pathway by relocated peat and spoil;
- Site works damaged or become unstable;
- Contamination of watercourses, water supplies by particulates/silt; and,
- Degradation of the peat environment by relocation of peat and spoil.

Pathway: Vehicle movement and excavations.

Receptor: Peat and subsoils.

Pre-Mitigation Potential Effect: Negative, significant, direct, unlikely, permanent effect on peat and subsoils. The findings of the peat stability assessment showed that the proposed site has an acceptable margin of safety, is suitable for the Proposed Development and is considered to be at low risk of peat failure. The findings include recommendations and control measures for construction work in peatlands to ensure that all works adhere to an acceptable standard of safety.

Proposed Mitigation Measures:

The following mitigation measures will be adhered to during the construction phase to minimise the risks of peat instability and failure:

- 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 localised 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 (as detailed in the Geotechnical and Peat Stability Assessment);
- Ensure construction method statements are finalised and implemented prior to the commencement of construction (these construction method statements will aligm with the mitigation measures outlined in this EIAR and the CEMP); and,
- Revise and amend the Construction Risk Register as construction progresses to ensure that risks are managed and controlled for the duration of construction.

Please refer to Chapter 4 for proposed turbine specific and road section design proposals.

Residual Effect Assessment: A detailed Geotechnical and Peat Stability Assessment (FTC, 2023) (**Appendix 8-1**) has been completed for the Proposed Development. The findings of that assessment have demonstrated that there is a low risk of peat failure (at the proposed site) as a result of the Proposed Development once the recommended mitigation measures are implemented. Considering the mitigation

measures the residual effect is considered - Negative, imperceptible, direct, unlikely, permanent effect on peat and subsoils.

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

8.5.2.7 Piling Works

Due to the depth of peat at the proposed site turbines and infrastructure locations will require piled foundations. For the piled turbine foundations, a piling type and configuration could be up to 50 no. 300mm square concrete driven piles. A similar type pile and configuration was used for the turbine foundations on the Mount Lucas wind farm (Offaly Co. Co. Planning Ref: 11232). A similar piling system and array may be used under other infrastructure components (e.g. substation), but with a reduced pile frequency/spacing. An alternative pile configuration could be up to 20 no. 900 to 1200mm cylindrical bored piles below turbine bases. Proposed foundation and pile configurations are detailed in Section 4.3, Chapter 4.

The potential effects associated with the driving of piles relate to peat/subsoil compaction and displacement in the area of the proposed works.

Pathway: piling works.

Receptor: peat/soils and subsoils.

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

Proposed Mitigation Measures:

Other than surface level and minor excavation works, any driven piles will not produce significant volumes of spoil, these will displace soil/subsoil within the ground.

The bored pile option could produce between 230 to 410m^3 of spoil material per turbine base. Excess spoil will be removed for permanent storage in the on-site borrow pits. Bored pile spoil volumes only amount to between ~1 to 1.5% of the overall peat and spoil volumes for the Proposed Development.

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 effects of piling works on soils and geology have been assessed. Driven pile install works would only result in small volumes of spoil, and minimal displacement of in-situ peat and subsoils. This small displacement would not alter ground levels, nor change the local geological environment in any significant way. For the bored pile options spoil will be removed for permanent storage in the on-site borrow pits. As such the residual effects are considered - negative, direct, imperceptible, permanent, unlikely effect on peat and 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 peat, soils/subsoils and bedrock will occur.

8.5.2.8 Proposed Substation

As presented in **Table 8-14** above the estimated volume of peat and spoil to be excavated at the proposed substation is 55,000m^3 (50,000m^3 of peat and 5,500m^3 of spoil). The exact location of the substation has been selected based on detailed geotechnical investigations and peat stability risk assessments. Material excavated at the substation location will be used for landscaping and the remainder will be permanently stored in low linear sections.

Pathway: Extraction/excavation of peat and soil/subsoils (spoil).

Receptor: Peat and underlying subsoil.

Pre-Mitigation Potential Effect: Negative, slight/moderate, direct, permanent, likely effect on peat and subsoil.

Proposed Mitigation Measures:

Mitigation measures in respect of peat and subsoil excavation are detailed in Section 8.5.2.2.

Mitigation measures in respect of proposed piling works are detailed at Section 8.5.2.7 where the residual effect of all piling works is also assessed.

Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section 8.5.2.4 above and measures dealing with soil erosion are dealt with in Section 8.5.2.5.

Residual Effect Assessment: The granular subsoil at the substation site can be classified as of "Medium" importance and the overlying peat deposits can be classified as of "Low" importance as the raised bog is already degraded by historical harvesting and drainage. The overall area of the proposed site is extensive (~1,770ha) while the proposed substation development footprint is small (~1.76aha), or ~0.09% of the overall area. The effect is the disturbance and relocation of c 55,500m^3 (note this is already included in the 716,130m^3 assessed in Section 8.5.2.2) of peat and spoil during the construction of the substation and the residual effect of this is considered - Negative, slight, direct, permanent likely effect on peat and subsoils due to disturbance and relocation within the proposed site.

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

8.5.2.9 Proposed Amenity Links

Approximately 28 km of internal roads will be provided as part of the construction of the Proposed Development. This internal road network will link all infrastructure together and will be re-purposed following construction to form the amenity pathways, in addition to being used for maintenance access during the operational phase and will have a gravel/crushed stone finish surface. In addition, approximately 3.3 km of additional dedicated amenity pathways are proposed to provide access points, links and a variety of shorter walking loops within the proposed site along internal road network.

The proposed construction methodology for the amenity pathways is by floated road construction, with no requirement for additional excavation or spoil generation. Pathways will be created on the existing ground surface by adding crushed stone.

Pathway: Extraction/excavation of peat and soil/subsoils (spoil).

Receptor: Peat and underlying subsoil.

Pre-Mitigation Potential Effect: Negative, slight, direct, likely, permanent effect on peat and subsoil.

Proposed Mitigation Measures:

Mitigation measures in respect of peat and subsoil excavation are outlined at Section 8.5.2.2.

Mitigation measures to prevent soil / subsoil contamination (leaks / spills) are dealt with in Section 8.5.2.4 above and measures dealing with soil erosion are dealt with in Section 8.5.2.5. The residual effects of soil / subsoil contamination from leaks / spills is assessed in Section 8.5.2.4, and the residual effects of soil erosion are assessed in Section 8.5.2.5.

Residual Effect Assessment: It is proposed to place amenity pathways on top of the existing ground. Ground disturbance and peat and/or spoil relocation during these works will be minimal. As such the residual effects of these works are considered - Negative, imperceptible, direct, likely, permanent effect on peat and subsoils by covering with 3m wide pathway.

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

8.5.3 Operational Phase - Likely Significant Effects and Mitigation Measures

Very few potential direct and indirect effects are envisaged during the operational phase of the Proposed Development. These will likely 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;
- 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; and
- 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.

8.5.3.1 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: Peat, subsoil and bedrock.

Potential Pre-Mitigation Effect: Negative, indirect, imperceptible, short term, likely effect on peat, subsoil and bedrock.

Proposed Mitigation Measures:

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

Residual Effect: The use of aggregate for site road maintenance will be minor and infrequent, and all material will be imported to the proposed site from local authorised quarries. The residual effect is considered to be - Negative, imperceptible, indirect, short-term, unlikely effect on peat, subsoil and bedrock.

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

8.5.3.2 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.

Potential Pre-Mitigation Effect: Negative, direct, slight, short term, unlikely effect on peat, subsoil and bedrock.

Proposed Mitigation Measures:

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

Residual Effect: The use of hydrocarbons in plant and vehicles is a standard risk associated with all operational wind farm 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 is considered to be - Negative, imperceptible, direct, short-term, unlikely effect on peat and subsoils and bedrock.

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

8.5.3.3 Use of Oils in Substation and 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.

Potential Pre-Mitigation Effect: Negative, direct, slight, short term, unlikely effect on peat, subsoil and bedrock.

Proposed Mitigation Measures:

- The electrical control building (at the 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;
- All transformer areas at the turbines will be bunded to 110% of the volume of oil used in each transformer;
- An emergency plan for the operational phase to deal with accidental spillages will be contained in the Environmental Management Plan.

Residual Effect: The use of hydrocarbons in transformers and substations is a common risk associated with operational wind farm sites. Proven and effective measures to mitigate the risk of spills and leaks have been proposed above and minimise potential effects on the local environment. The residual effect

is considered to be - Negative, imperceptible, direct, short-term, unlikely effect on peat and subsoils and bedrock.

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

8.5.4 Decommissioning Phase - Likely Significant Effects and Mitigation Measures

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

During decommissioning, it may be possible to reverse or at least reduce some of the potential effects caused during construction by rehabilitating construction areas such as turbine bases and hard standing areas. This will be done by covering with peatland vegetation/scraw or poorly humified peat to encourage vegetation growth and reduce run-off and sedimentation. Other effects such as possible soil compaction and contamination by fuel leaks will remain but will be of reduced magnitude. However, as noted in the Scottish Natural Heritage (SNH) report 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 effects will be avoided by leaving elements of the Proposed Development in place where appropriate. The turbine bases will be rehabilitated by covering with local topsoil/peat in order to regenerate vegetation which will reduce runoff and sedimentation effects. Internal roads will remain as amenity pathways. The underground grid cable will be left in-situ with the ends cut and tied to avoid excavation of the trench.

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 soils and geology environment are envisaged during the decommissioning stage of the Proposed Development.

8.5.5 Risk of Major Accidents and Disasters

Due to the nature of the proposed site, i.e. cutover raised bog, with residual peat deposits occurring in basins, and with relatively flat ground conditions, the risk of a landslide occurring at the proposed site is low. To confirm this, a comprehensive Peat Stability Risk Assessment has been undertaken for the proposed site (FT, 2023), and it concludes that with the implementation of the proposed control (mitigation measures), the risk is determined to be negligible/none.

8.5.6 Assessment of Health Effects

Potential health effects arise mainly through the potential for soil and ground contamination. The Proposed Development is not a recognized source of pollution (e.g. it's not a waste management site, or a chemical plant), 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 Development 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 imperceptible.

8.5.7 Potential Cumulative Effects

Due to the localised nature of the proposed construction works which will be kept within the Proposed Development red line site boundary, there is no potential for significant cumulative effects with other local developments on the land, soils and geology environment. The only pathway that the Proposed Development can have cumulative effects with other off site projects or developments is via the drainage and surface water network. This hydrological pathway is assessed in Chapter 9.

The Decommissioning and Rehabilitation Plans for each of the bogs comprising the proposed site will be implemented in order to meet the requirements of Condition 10.2 of the IPC licence No. P0501. These cutaway bog Decommissioning and Rehabilitation plans, attached as Appendix 6-6, will be subject to consultation as well as input from the EPA prior to their implementation across the proposed site. Given the overlap of these proposals and the proposed site, the Proposed Development has the potential to interact with the Decommissioning and Rehabilitation Plans and the cumulative effects are assessed below.

8.5.7.1 Cumulative Effect with Decommissioning and Rehabilitation Plans for the Ballivor Bog Group

The objective of the Decommissioning and Rehabilitation Plans is to stabilise and rehabilitate the peat bog within the proposed site. The plans use bespoke interventions designed to firstly stabilise the environment and secondly to rehabilitate the proposed site as much as possible by placing the existing peatland environments on a path towards naturally functioning peatlands. In addition PCAS will be implemented in certain areas of the bog group (Carranstown East and Bracklin West) and will optimise climate benefits. The proposed Decommissioning and Rehabilitation plans at the proposed site will be undertaken using best practice peatland restoration methods.

Much of the work associated with the decommissioning and rehabilitation plans will occur during the initial stages of the plan. Once drain blocking and other measures have been implemented the operational activities will comprise non-intrusive ecological and hydrological monitoring and may also include minimal maintenance and repair works.

The decommissioning and rehabilitation plans for the bogs will coincide with the construction of the Proposed Development if this application is permitted.

The proposed rehabilitation plans for the Ballivor Bog Group aim to rehabilitate the existing degraded bog at the proposed site.

The Proposed Development has a total development footprint of 32.4ha. Therefore, the Proposed Development will result in the loss of approximately 32.4ha of cutover peat bog which will have a negative effect on land as peat bogs will be replaced by access roads, turbine bases, hardstands etc.

The proposed decommissioning and rehabilitation plans aim to stabilise and rehabilitate the peat bog within all bogs comprising the Ballivor Bog Group including the area of the proposed site. These plans will have a positive effect on land at the proposed site as the degraded bogs, which currently largely comprise of bare peat fields, will be replaced by an array of scrub, woodlands, wetland and peatland habitats.

Pathway: Excavation/hardstand construction and rewetting measures, natural colonisation and targeted revegetation.

Receptor: Soils/land

Potential Pre-mitigation Effect: Moderate, positive, direct, likely, long-term effect on land and soils/land.

Mitigation Measures/Impact Assessment:

The loss of peat bog land within the proposed site is minimal (~1.8% loss) as a result of the Proposed Development. On a wider scale, the decommissioning and rehabilitation plans will be implemented across the entire Ballivor Bog Group which has a total area of 2,419ha. Therefore, within the wider Ballivor Bog Group, the Proposed Development will result in a loss of 2% of land. If the Proposed Development were to proceed this land will no longer be available for rehabilitation.

However, due to the small footprint of the Proposed Development, both in terms of the proposed site and the wider Ballivor Bog Group, the effects of actual peat bog land loss associated with the Proposed Development is negligible.

The decommissioning and rehabilitation plans for the bogs will be updated to incorporate the Proposed Development infrastructure. No additional mitigation measures are required.

Residual Cumulative Effect: The Proposed Development and the Decommissioning and Rehabilitation Plans for the Ballivor have the potential to change landcover at the proposed site. The Proposed Development will negatively affect soils/land whilst the Decommissioning and Rehabilitation Plans will have a positive effect on soils/land. Given the small footprint of the Proposed Development, the residual cumulative effect is considered to be Positive, direct, moderate, likely, long-term effect on soils/land.

Significance of Effects: For the reasons detailed above (*i.e.* small development footprint), no significant effects on land or soils/land will occur.

8.5.8 Conclusion

This chapter assesses the likely significant effects that the Proposed Development may have on land, soils and geology and sets out the mitigation measures proposed to avoid, reduce or offset any potential significant effects that are identified.

The proposed site consists predominantly of cutover bog comprising of bare peat fields separated by field drains. The existing topography of the proposed site is relatively flat, ranging from approximately 69 to 84mOD. As a result of historic peat extraction activities and associated drainage works the land and topography of the proposed site has been significantly modified. Peat extraction activities ceased at the proposed site in the summer of 2020 and the former peat production areas are not available for revegetation,

Based on the peat depth information for the proposed site, the peat varied in depth from 0.4 to 5.7m with an average of 1.93m. The peat thickness at proposed turbine locations ranges from 0.7 to >5m with an average of 2.4m. Site data indicates that 70% of the proposed turbine locations have a peat depth ≤3m, with only 2 no. proposed turbine locations having a peat depth in excess of 5m. The deeper peat areas have generally been avoided in the Proposed Development layout. The peat deposits at the proposed site are underlain by glacial tills comprising of clay, silts, sands and occasional gravels. The glacial till deposits are underlain by limestone bedrock.

The Proposed Development will typically involve removal of peat and subsoils (spoil) for access roads, internal road network, internal cable network, hardstanding emplacement, turbine foundations, substation, crane hardstands, compounds and met mast foundations.

Estimated volumes of peat and spoil to be excavated are in the region of 732,000m^3. Excavated peat and spoil will also be used for reinstatement and landscaping works as close to the extraction point as possible

or stored within the proposed onsite borrow pits. The handling and storage of peat and spoil will be done in accordance with the Peat and Spoil Management Plan which is included as Appendix 4-2 to the EIAR.

Storage and handling of hydrocarbons/chemicals will be carried out using best practice methods. Measures to prevent peat and subsoil erosion during excavation and reinstatement will be undertaken to prevent water quality impacts.

A Geotechnical and Peat Stability Assessment was undertaken for the proposed site (Appendix 8-1) and it demonstrates an acceptable margin of safety, that the proposed site is suitable for the Proposed Development and is considered to be at low risk of peat failure. A number of control measures are given in the peat stability assessment to manage all risks associated with peat instability.

The Proposed Development has a very small development footprint when compared to the overall area of the proposed site and the wider Ballivor Bog Group. Therefore no significant effects on land will occur during the construction, operation or decommissioning phases of the Proposed Development.

The peat bog at the proposed site is already degraded by the historical harvesting and drainage. For this reason, and with the implementation of the mitigation measures detailed in this EIAR and the best practice measures detailed in the Peat and Spoil Management Plan, no significant effects on peat and soils will occur during the construction, operation or decommissioning phases of the Proposed Development.

With the implementation of the mitigation measures outlined in this EIAR, no significant effects on the underlying limestone bedrock geology will occur during the construction, operation, or decommissioning phases of the Proposed Development.

An assessment of potential cumulative effects associated with the Proposed Development and other developments on land, soils and geology has been completed. The Land, Soils and Geology Assessment confirms there will be no significant cumulative effects on land, soil and geology as a result of the Proposed Development. The assessment found that the cumulative effect with the bogs rehabilitation plans will result in an overall positive effect on the local land, soils and geological environment due to the small footprint of the development.