Technical Appendix 8.3 Peat Landslide Hazard and Risk Assessment

Breezy Hill Energy Project

Breezy Hill Energy Limited

Prepared by:

SLR Consulting Limited

St. Vincent Place, Glasgow, G1 2EU

SLR Project No.: 413.VT2633.00001

19 March 2025

Revision: 1.0

Making Sustainability Happen

Revision Record

Revision	Date	Prepared By	Checked By	Authorised By
1.0	14 April 2025	B Narbett	D Nisbet	D Briggs

Basis of Report

This document has been prepared by SLR Consulting Limited (SLR) with reasonable skill, care and diligence, and taking account of the timescales and resources devoted to it by agreement with Breezy Hill Energy Ltd (the Client) as part or all of the services it has been appointed by the Client to carry out. It is subject to the terms and conditions of that appointment.

SLR shall not be liable for the use of or reliance on any information, advice, recommendations and opinions in this document for any purpose by any person other than the Client. Reliance may be granted to a third party only in the event that SLR and the third party have executed a reliance agreement or collateral warranty.

Information reported herein may be based on the interpretation of public domain data collected by SLR, and/or information supplied by the Client and/or its other advisors and associates. These data have been accepted in good faith as being accurate and valid.

The copyright and intellectual property in all drawings, reports, specifications, bills of quantities, calculations and other information set out in this report remain vested in SLR unless the terms of appointment state otherwise.

This document may contain information of a specialised and/or highly technical nature and the Client is advised to seek clarification on any elements which may be unclear to it.

Information, advice, recommendations and opinions in this document should only be relied upon in the context of the whole document and any documents referenced explicitly herein and should then only be used within the context of the appointment.

Table of Contents

Tables in Text

Annexes

1.0 Introduction

1.1 Background

SLR Consulting (Ltd) were commissioned by Brockwell Energy Ltd, on behalf of Breezy Hill Energy Limited (the 'Applicant') to undertake a Peat Landslide Hazard and Risk Assessment (PLHRA) for the proposed Breezy Hill Energy Project (the 'Proposed Development'), The Proposed Development is located approximately 13 km south-east of Ayr, 8.5 km south-west of Cumnock and 4.5 km north of Dalmellington, within the North Kyle Forest Estate (NKF) managed by Forestry and Land Scotland (FLS).

The Proposed Development is located adjacent to the North Kyle Energy Project. The Site falls within the East Ayrshire Council (EAC) administrative area, Site centre at British National Grid (BNG) coordinates 248092 612583, as shown on **Figure 8.3.1**.

The assessment has been undertaken in line with best practice guidance[1] issued by the Scottish Government for investigation, assessment, and reporting for wind farms in peat areas. Where relevant, reference is also made to guidance published by, NatureScot[2], the Scottish Environmental Protection Agency (SEPA)[3] and wind farm construction good practice guidance[4].

Although peat slides are naturally occurring, in the wake of high-profile peat slides arising during construction of Derrybrien Wind Farm in 2003 (and more recently at Meenbog in 2020) further consideration of the impact on peat instability of siting developments on peatlands is required.

Blanket bog is the most common peat habitat in the UK and is associated with thick peat deposits. Renewable energy developments, including wind farms, and transmission projects are commonly located on upland moorland terrain comprising blanket bog (though raised bogs, intermediate bogs and fens may also be impacted). Within these settings, peat instability can occur, particularly where thick peat deposits (> 1 m) are present.

Other anthropogenic factors may also increase the likelihood of peat instability events occurring, which are explored further within this report.

Peat instability is impacted by numerous factors, including but not limited to:

- Peat thickness;
- Gradient;
- Climate (and rainfall);
- Underlying geology; and
- Subsurface hydrology.

Other anthropogenic factors may also increase the likelihood of peat instability events occurring, which are explored further within this report.

[1] Energy Consents Unit Scottish Government., (April 2017) Peat Landslide Hazard and Risk Assessment: Best Practice Guide for Proposed Electricity Generation Developments, Second Edition.

[2] Mills, A.J. and Rushton, D. (2023) A risk-based approach to peatland restoration and peat instability. NatureScot Research Report 1259

[3] Scottish Government, SNH, SEPA., (2017) Peatland Survey. Guidance on Developments on Peatland, online version only.

[4] Scottish Renewables, SNH, SEPA, Forestry Commission Scotland, Historic Environment Scotland, Marine Scotland Science, AEECoW (2024), Good Practice During Wind Farm Construction, Fifth Edition.

1.2 Objectives

The PLHRA aims to assess the influence of peat on the proposed development, and the potential for instability. The objectives have been achieved by completion of the following:

- Geomorphological mapping of the site to identify the prevailing conditions.
- Reporting on evidence of any active, incipient or relict peat instability and the potential risk of future instability, describing the likely causes and contributary factors.
- Identification of potential mitigation and controls to be imposed on the contractors for the works to minimise the risk of peat instability occurring at the site.
- Peat probing to full depth at targeted locations across the site.
- Recommendation for further work or specific construction methodologies to suit the ground conditions at the site to mitigate any unacceptable risk of potential peat instability.

This report summarises the findings of the desk study and peat surveys and provides an assessment of the prevailing ground conditions at the site and how they relate to peat stability issues.

1.3 Development Description

The Proposed Development, detailed on **Figure 8.3.2** will have a maximum total capacity of 140 MW, comprised of the following:

- Up to 20 standalone, three bladed horizontal axis turbines up to 149.9 m tip height, each with a generating capacity of up to 5 MW each, totalling 100 MW generating capacity; and
- A 40 MW BESS will also be included as part of the Proposed Development.

In addition to the turbines and BESS, the Proposed Development will include the following long-term ancillary infrastructure:

- turbine foundations;
- crane hardstands;
- a site entrance;
- internal and private access road network;
- watercourse crossings;
- transformers and underground cables; and
- an on-site substation / switchgear building.

Temporary infrastructure required for construction will include:

- three construction compounds;
- a construction compound for exclusive use by the District Network Operator (DNO);
- crane assist pads;
- blade laydown supports;
- boom supports;
- laydown areas;
- a concrete batching plant; and

- potential excavations/borrow pit workings.

Full details of the Proposed Development are provided in **Chapter 2: Proposed Development**.

2.0 Peat Instability

2.1 Background Information on Peat

Peat is found in extensive areas in the upland and lowland regions of the UK and is defined as the partly decomposed plant remains that have accumulated *in situ*, rather than being deposited by sedimentation. When peat forming plants die, they do not decay completely as their remains become waterlogged due to regular rainfall. The effect of waterlogging is to exclude air and hence limit the degree of decomposition. Consequently, instead of decaying to carbon dioxide and water, the partially decomposed material is incorporated into the underlying material and the peat 'grows' *in situ*.

Lindsay (1995) defined two main types of peat bog, raised bog and blanket bog, which are prevalent on the west coast of Europe along the Atlantic seaboard. In Britain, the dominant peatland is blanket bog which occurs on the gentle slopes of upland plateaux, ridges and benches and is predominately supplied with water and nutrients via precipitation. Blanket peat is generally considered to be hydrologically disconnected from the underlying mineral layer.

The acrotelm is the fibrous surface to the peat bog, typically less than 0.5 m thick; which exists between the growing bog surface and the lowest position of the water table in dry summers. Below this are various stages of decomposition of the vegetation as it slowly becomes assimilated into the body of the peat.

There are two distinct layers within a peat bog, the upper acrotelm layer and the lower catotelm.

The degree of humification (decomposition) can be measured in the field via the von Post scale of humification (Von Post and Grunland, 1926) (Hobbs, 1986). The 'squeezing test' undertaken in the field provides humification values ranging from H1 (minimal decomposition) to H10 (highly decomposed).

The relative position of the water table within the peat controls the balance between accumulation and decomposition, and therefore its stability, hence artificial adjustment of the water table by drainage can have significant impacts.

2.2 Peat Shear Strength

In geotechnical terms, the shear strength of a soil is the maximum stress that a soil can sustain without experiencing failure. The physical characteristic of a soil impacts on the overall shear strength. For mineral soils such as clay or sands, such strength is variously given by an interparticle friction value and cohesion. Whether the mineral soil is predominately cohesive (clay) or non-cohesive (sand & gravels) governs which of the component strengths control the behaviour of the soil.

In the case of peat soils, where the major constituent is organic, there is likely to be little or no mineral component, the geotechnical definition of shear strength therefore does not strictly apply. At present, there is no real alternative to defining shear strength of peat, therefore the geotechnical definition is usually adopted, in the knowledge that it should be used with caution.

As noted, the acrotelm or near surface peat comprises a tangle of fresh and slightly rotted roots and plant fibres. These roots and fibres impart a significant tensile strength capacity to the material which provides it with a significant load carrying capacity. The acrotelm is in effect, a fibre reinforced soil.

In the more decomposed catotelm, the tensile shear strength is reduced as the roots and fibres become increasingly rotted. However, the loss of strength is offset to a limited degree, by a gain in strength due to the overburden pressure. In geotechnical engineering there is an established relationship for recently deposited soils, between the shear strength of a sample and thickness of overburden above it.

Consequently, it is almost impossible to predict a shear strength profile in peat and attempts to measure the shear strength using normal geotechnical methods can be misleading (Evans & Warburton 2007[5]; Gosling and Keeton 2008[6], Winter et al 2005[7]). Typical values of shear strength from hand shear vanes would be in the range 10-60 kilopascal (kPa) although values of over 100 kPa have been recorded in peat elsewhere. The higher strengths are almost certainly influenced by the roots or other non-decomposed material. It is believed that the strength of peat should be quoted as a cohesion value as there are few, if any, discrete particles to give the material a significant frictional resistance. It should be noted that any quotation of shear strength for peat should be treated with extreme caution.

2.3 Peat Failure Characteristics/Mechanisms

This section reviews the nature of peat and how current and past activities can influence stability.

The PLHRA Best Practice Guide for Proposed Electricity Generation Developments, published by the then Scottish Executive (2006, updated by the Scottish Government April 20171[1]) determines peat landslide (instability) in two categories, 'peat slides' and 'bog bursts'. It is indicated that peat slides have a greater risk of occurrence in areas where peat depth is shallow (up to 2 m) and slope gradients are steep (5 to 15º). Bog bursts, however, are indicated to have a greater risk of occurrence in areas where peat depth is deep and slope gradients are shallow. As recorded in the Best Practice Guide[1], bog burst events have generally only been reported in Irish and Northern Irish peat bogs. They are uncommon in Scotland and therefore are not considered to attribute significant risk in relation to this assessment. It is noted that peat instability events (including bog bursts), although extremely uncommon, may occur outside the limits mentioned above.

Further to the definition above, a number of natural factors are considered to interact and create the potential for peat instability to occur. These natural factors would typically include:

- Slope Gradient: As noted in the Best Practice Guide[1], peat slides have a greater likelihood of occurrence where slope angles range from 5 to 15º. Deposits with shallower slope gradients are less susceptible to failure due to the reduced influence of gravity. Deposits with steeper slope gradients are less susceptible to failure due to the general lack of peat presence (although peaty debris slide may occur).
- Peat Depth: Boylan et al. (2008)[8] describes three common types of peat, controlled to an extent by rainfall and elevation:
    - Upland Blanket Bog: blanket bogs are typically about 3 m thick, however, they can be up to 5 m thick, generally thinning at higher elevations.
    - Lowland Blanket Bog: similar to the upland version, however, they form around sea level in areas of very high rainfall.
    - Raised Bog: generally, 3-12 m thick, averaging 7 m, with growth occurring above the water table.

[5] Evans, E. and Warburton, J (2007). Geomorphology of Upland Peat: Erosion, Form and Landscape Change. John Wiley & Sons.

[6] Gosling, D., and Keeton, P. (2008). Problems with Testing Peat for Stability Analysis.

Paper presented at Reinforced Water, Geological Society Conference.

[7] Winter, M.G., MacGregor, F. and Shackman, L. (2005) Scottish Road Network

Landslides Study, ISBN 0 7559 4649 9.

[8] Boylan, N., Jennings, P., Long, M. (2008). Peat Slope Failure in Ireland. Quarterly Journal of Engineering Geology and Hydrogeology.

Peat depth can give an indication of peat strength and the potential magnitude of a slide, where the generalisation can be made that the potential for peat instability increases with peat depth provided gradients exist to allow movement. However, when combined with other instability indicators, any depth of peat can fail. Factors that influence the potential include:

- Peat Strength: the shear strength of peat is an important aspect in assessing the risk of landslip in blanket peat areas, with areas of lower shear strength likely to be the cause of any peat slide. However, due to the influence of fibres within the deposits and of stratification with depth, reliable values of shear strength are difficult to near impossible to obtain, using common place in situ and laboratory soil strength tests. Where data is available, it can be used, with extreme caution, to assist in assessing likely risk.
- Relief: the combination of slope gradient and variation in elevation can result in confined and unconfined zones i.e., where undulating or hummocky terrain (confined) exists, the natural relief has the potential to mitigate the occurrence of a peat slide. However, convex sloping hillsides (unconfined) can increase the slide potential.
- Evident and/or Potential Areas of Instability: the presence of certain geomorphological characteristics may signify an increased risk of peat instability. However, peat instability events may occur in areas where no such geomorphological characteristics are present, if the general characteristics match those mentioned above.
- Vegetation Cover: the vegetation cover of an area of bog/mire gives an indication as to its hydrological setting and therefore physical characteristics, as noted in the Best Practice Guide[1] and detailed by Hobbs, 1986.
- Peat Stratification: the peat formation process causes peat to show natural anisotropic strength. The interface between the three distinct layers (indicating three hydroseral stages) within a peat mass is defined by hydrology. The three layers are:
    - Top Mat: living vegetation of herbaceous plants, grasses and mosses.
    - Acrotelm: decomposing peat which is saturated periodically and is of relatively high permeability; and
    - Catotelm: permanently saturated dense peat of relatively low permeability.

  Peat stratification is linked to peat depth (Dykes, 2006[9]), with thinner peat deposits having a thinner or no catotelm layer. A minimal or absent catotelm layer leads to peat mass having a higher shear strength, as the overlying top mat and acrotelm layers are more fibrous in nature compared to the underlying catotelm layer.
- Hydrology (Surface and Subsurface): surface (seeps and springs, wet flushes, watercourses, concentration of drainage networks etc.) and subsurface (pipe systems, underground channels etc.) drainage pathways can provide areas of peat with a water supply which may be absorbed by and potentially increase the mass of the peat. This can cause pooling/piping within the peat mass, or an increase in water at the base of the peat mass, each of which increases the susceptibility of the peat mass to failure.

The presence of a number of the above natural factors may create the potential for peat instability to occur, however, the actual instability is generally the result of a combination of further contributing factors. These factors have been grouped into two categories within the Best Practice Guide[1] described as preparatory and triggering factors.

[9] Dykes, A.P. and Kirk, K.J. (2006) Slope Instability and Mass Movements in Peat Deposits. In Martini, I.P., Martinez Cortizas, A. and Chesworth, W. (Eds.) Peatlands: Evolution and Records of Environmental and Climatic Changes. Elsevier, Amsterdam.

Preparatory factors, which affect the stability of peat slopes in the medium to long-term (tens to hundreds of years), are:

- increase in mass of the peat through peat formation.
- increase in mass of the peat through increase in water content.
- increase in mass of the peat through afforestation.
- reduction in shear strength from changes in the physical structure of the peat due to creep, weathering or vertical tension cracks of the material.
- loss of surface vegetation and associated tensile strength (e.g. deforestation).
- changes in the subsurface hydrology (water filled pools and/or pipes etc.); and
- afforestation reducing the water held in the peat body, increasing the potential for formation of desiccation cracks which can be exploited by rainfall on forest harvesting.

Triggering factors, which can have an immediate effect on peat stability and act on susceptible slopes, include:

- intensive rainfall or snow melt causing development of high porewater pressures within the peat.
- alterations to drainage patterns generating high porewater pressures within the peat.
- peat extraction at the toe of the slope i.e. fluvial incision, cut slopes etc. reducing the support of the upslope material.
- peat loading commonly due to stockpiling or plant during construction (or natural causes i.e. landslide) causing an increase in shear stress.
- changes to the vegetation cover i.e. by stripping the surface cover or afforestation; and
- earthquakes or man-made rapid ground accelerations, such as blasting or mechanical vibrations, causing an increase in shear stress.

Evidence of the potential for peat instability within an area may be observed through the recording of the geomorphological conditions of the area. These existing geomorphological characteristics may indicate the presence of existing or historical failures or areas of future potential instability. The characteristics of particular interest include the presence of the following:

- historical failure scars and debris.
- tension cracking and tearing.
- compression ridges/thrusts or extrusion.
- peat creep.
- subsurface drainage (pools and/or piping).
- seeps and springs.
- cracking related to drying.
- concentration of surface drainage networks; and
- the presence of organic clays at the peat and bedrock interface.

2.4 Types of Failure

The result of peat instability is the down-slope mass movement of the peat material. There are several definitions of peat instability which are used to characterise the type of failure, briefly mentioned above but detailed below.

2.4.1 Bog Bursts (or Bog Flows)

Particularly fluid (amorphous) failures involving rupture of the peat blanket surface or margin due to subsurface creep or swelling, with liquefied basal material expelled through surface tears followed by settlement of the overlying peat mass, *in situ* (Hemingway and Sledge, 1941-46[10], Bowes, 1960[11]).

Accounts of bog bursts are generally associated with very wet climates or areas which have received storm rainfall events. Bog bursts can be associated with particularly wet peat landscapes; therefore, it is possible to identify broad regions of a higher susceptibility to these failures. The constraints used to identify the areas of higher susceptibility to bog burst failures are given below:

- peat thicknesses >1.5 m.
- shallow gradients, ranging from 2 - 10º (peat thicknesses associated with bog bursts are generally not observed on slopes steeper than 10º, where moisture content is reduced due to natural drainage.
- ground which is annually waterlogged to within the upper 1 m below ground level (the groundwater level may rise but rarely falls below this level (Crisp et al, 1964[12])).
- greater humification of the lower catotelm within the waterlogged ground; and
- lower surface tensile strength of the fibrous peat and vegetation.

The humified mass can be considered as analogous to a heavy liquid and the stability of this mass is maintained by the strength of the surface or acrotelm peat. Should the surface become weakened through erosion or desiccation or the construction of a surface drainage ditch for agricultural or forestry reasons or through turbary (peat cutting), failure is made more likely.

2.4.2 Peat Slides

Peat slides tend to be translational failures with a defined shear surface at or close to the interface with the substrate. The factors generally considered to influence susceptibility to peat slide failures are listed below:

- Peat depth up to 2 m;
- Slope gradients between 5 and 15 º;
- Natural or artificial drainage cut into the surrounding peat landscape;
- Greater humification of the lower catotelm within the waterlogged ground; and
- Lower surface tensile strength of the fibrous peat and vegetation.

---

[10] Hemingway, J.E. and Sledge, W.A. (1941-46) A Bog Burst near Danby in Cleveland.
Proceedings of the Leeds Philosophical and Literature Society, Science 4, pp276 – 288.
[11] Bowes, D.R. (1960) A bog burst in the Isle of Lewis. Scottish Geographical Magazine,
76, pp21-23
[12] Crisp, D.T., Dawes, M. & Welch, D. (1964), 'A Pennine Peat Slide', The Geographical Journal, Vol 130, No4, pp519-524.

It is noted that some of the factors causing instability are common to both bog bursts and peat slides. The peat – substrate interface is the primary zone of failure and is enhanced by elevated water content at this boundary and softening or weathering of the lower mineral surface. For this reason, any investigation or probing should try to distinguish the nature of the lower mineral substrate.

2.4.3 Bog Slides

A bog slide is a variation on a peat slide where part of the peat mass is subject to movement, usually on an internal layer of material, which may be more prone to movement, such as an interface between the acrotelmic and catotelmic layer.

2.4.4 Natural Instability

The stability of a peat mass is controlled by a complex interrelationship of factors. Key factors include sloping rock head, and proximity to water bodies. Rainfall often acts as a trigger after the slope has been conditioned to fail by natural processes.

It should also be remembered that peat bogs are growing environments and that there would come a time, on sloping ground, where the forces causing instability, the weight of the bog, can no longer be resisted by the internal strength of the peat and its interface with the underlying mineral surface. At this point, failure would occur.

The weight of the peat bog or any soils mantling steep hill slopes would be increased during periods of very heavy rain and it is common to see landslips occurring following extreme rain events. This may be a concern for future developments where one of the predicted effects of global warming is greater frequency of extreme weather, including intense storm events.

3.0 Desk Based Assessment

A desk-based review of the site and its condition has been conducted by the use of the following sources of information:

- British Geological Survey (BGS) mapping and data;
- Scottish Natural Heritage (SNH) Carbon and Peatland Map, 2016;
- Hydrogeological Map of Scotland, British Geological Survey, 1988;
- Soil Survey of Scotland Maps, James Hutton Institute;
- Habitat and botanical survey data (refer to Chapter 6: Ecology);
- Aerial photography;
- Ordnance Survey and topographic maps; and
- Historical mapping.

3.1 Baseline Conditions

3.1.1 Geological Setting

3.1.1.1 Superficial Geology

Published geological mapping from the British Geological Survey (BGS) at 1:50,000 scale indicates that the Site to be primarily underlain by peat deposits. Devensian till deposits are also mapped on-site, largely in the west and north-west of the Site. Alluvium deposits are present along the Water of Coyle in the centre of the Site. A small, localised area of glaciofluvial deposits comprising gravel, sand and silt is located in north-west of the Site (**Figure 8.3.3**).

3.1.1.2 Soils

The National Soil Map of Scotland shows the Site to be largely underlain by underlain by peaty gleys with dystrophic blanket peat. The south and centre of the Site there are areas of peaty gleyed podzols. Noncalcareous gleys are present in the low lying areas in the north-west of the Site.

Dystrophic blanket peat is an organic soil which is largely rain fed and mineral poor. Peaty gleys are described as wet soils with an organic (peaty) surface layer, often found in depressions and foothills with gentle slopes.

Published priority peatland mapping by NatureScot, Carbon and Peatland Map 2016, indicates that the Site primarily comprises Class 5 and Class 4 peatland. Mapping indicates the north-west of the Site comprises of Class 3 peatland and mineral soil. There is no Class 1 or Class 2 (priority) peatland located on-site.

Class 5 peatlands are defined as areas with no peatland habitats recorded but may include areas of bare soil, carbon-rich soils and deep peat. Class 4 peatlands defined as an area unlikely to be support peatland habitats or carbon-rich soils. Class 3 peatlands are defined as areas without dominant peatland vegetation cover with some areas of deep peat.

Phase 1 and phase 2 peat surveys were undertaken to gather site specific information of the presence and condition of peat soils and/or peat and is described further in **Section 4**.

3.1.1.3 Bedrock Geology

BGS GeoIndex Onshore Mapping identified that the Site is predominantly underlain by the Scottish Lower Coal Measures Formation and Scottish Middle Coal Measures Formation of the Scottish Coal Measures Groups. Olivine-Microgabbro and Analcime-Gabbro intrusions of the Midland Valley Carboniferous to Early Permian Alkaline Basic Sill Suite underlie the south-west and centre of the Site. Small, isolated areas of Ayrshire Basanitic and Foiditic Plugs and Vents are mapped in the east of the Site, as shown in **Figure 8.3.4**.

Four east to west trending inferred faults transect the centre of the Site. In the north of the Site there is a small north-west to south-east trending fault. There is no faulting mapped in the south of the Site.

3.1.1.4 Mining and Quarrying

A review of the Mining Remediation Authority (formerly Coal Authority) map shows that the Site is located within a Coal Mining Reporting Area, with the Site partly located within a Development High Risk Area. In their scoping response the Mining Remediation Authority (formerly Coal Authority) indicated that “there are two mine entries (adits) within the Site and areas of past surface mining activity” and that “building over the top of, or in close proximity to, mine entries should be avoided wherever possible.” The results of this risk assessment has been reviewed to inform the design of the Proposed Development. A Mining Stability Report Including Past Mining Risk Assessment prepared by JWH Ross is provided in Technical Appendix 8.8.

3.1.2 Hydrology & Climate

3.1.2.1 Hydrology

The Site is largely within the catchment of the Water of Coyle, with the Burnock Water catchment located in the north-east of the Site. These catchments are part of the wider surface water catchment of the River Ayr (ID: 10420) which lies to the north-west of the Site. The north-east of the Site is drained by the located within the Burnock Water catchment. In accordance with the SEPA Classification Hub the Water of Coyle and Burnock Water are classified as having ‘Poor’ overall status.

The catchment of the Water of Coyle drains the majority of the Site. The Water of Coyle (ID: 10423) rises in the south-east of the Site, flowing north-east, before flowing north-west through the centre of the Site.

3.1.2.2 Hydrogeology

The centre and south of the Site is underlain by Carboniferous to Permian intrusive igneous rocks of the Western Midland Valley Sills bedrock aquifer. The centre and north of the Site is underlain Scottish Coal Measures Group bedrock aquifer. The aquifers are defined as low and moderately productive respectively.

The SEPA Water Classification Hub shows the bedrock aquifers on-site to be within the Cumnock groundwater body (ID 150646). The groundwater body is noted to have an overall status and water quality of ‘Poor’ in 2023.

3.1.2.3 Rainfall

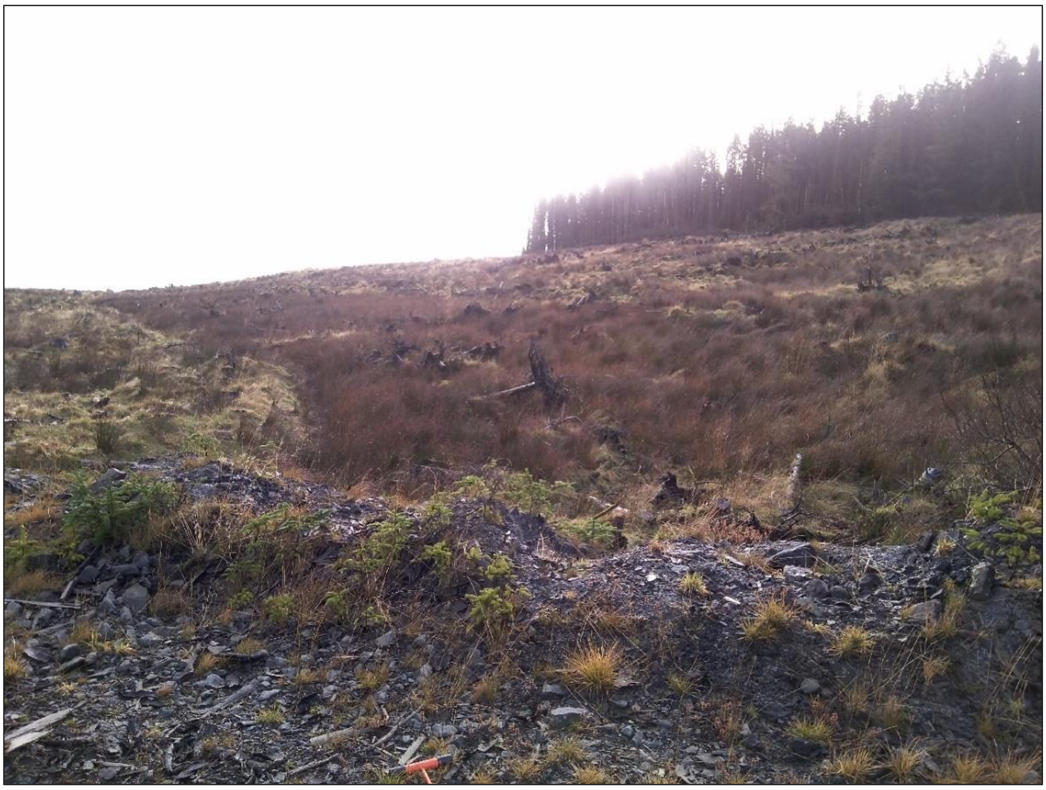
Periods of intense, heavy rainfall are often seen as triggers for instability events. The nearest Met Office weather station is approximately 15 km northwest of the Site, at Prestwick, Gannet. The average annual rainfall between 1991-2020 was 980.80 mm, which is 15.7% less than the UK national average, and 46% less than the west Scotland regional average.

Monthly rainfall averages at Prestwick, Gannet range from 54.58 mm in May to 106.42 mm in October.

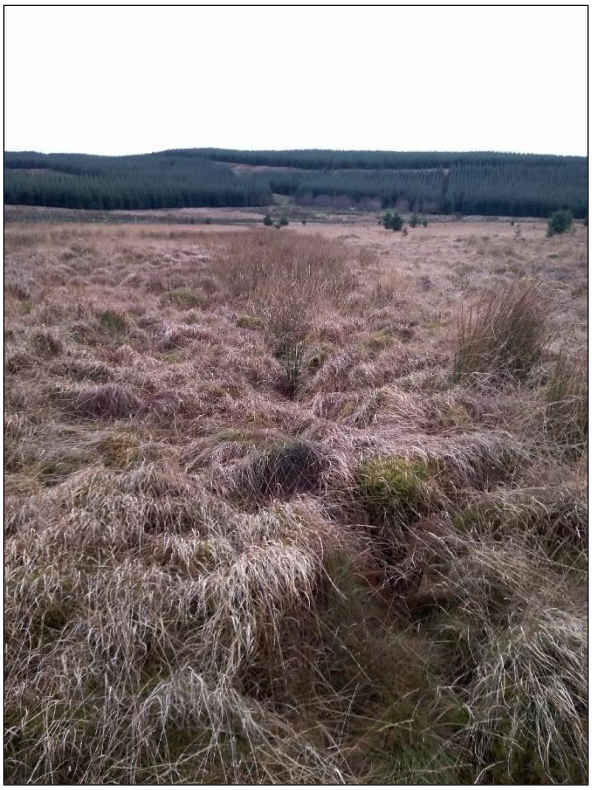
3.1.3 Land use and Topography

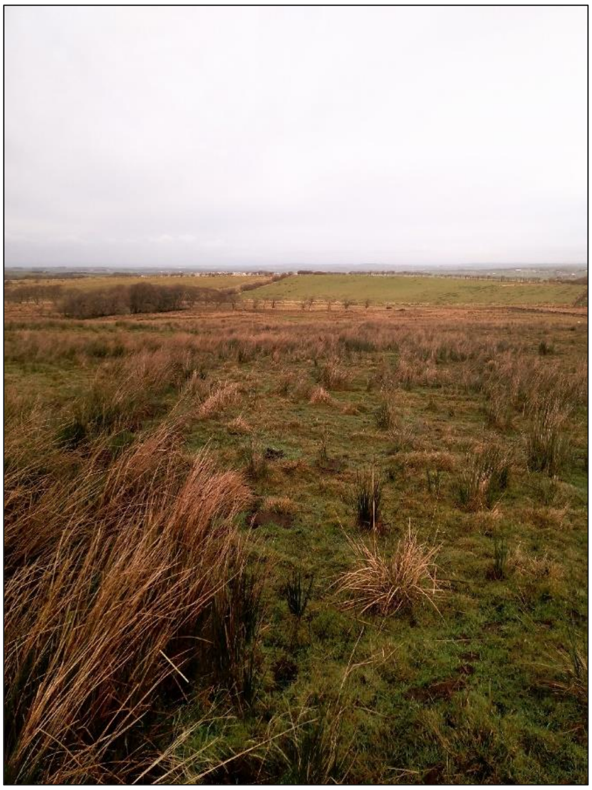
The Proposed Development is set primarily within commercial forestry **(Photograph 3-1)**, with small areas of open moorland **(Photograph 3-2)**. Historic land use onsite includes opencast mining, with artificial modified surface waterbodies present. The elevation on-site slopes from 420 m Above Ordnance Datum (AOD) in the south of the Site to 220 m AOD in the north-west. OS Terrain 5 Digital Terrain Model (DTM) data has been used, to create a slope plan for the Site, presented in **Figure 8.3.5**.

Photograph 3-1 Commercial Forestry



Photograph 3-2 Open Moorland





3.1.4 Aerial Photography & Site History

3.1.4.1 Aerial Photography Interpretation

Given the extensive commercial forestry cover at the Site, aerial photography interpretation was limited, however it is possible to identify breaks in forestry, stream courses, drainage ditches, roads/tracks, mining disturbed land, and borrow pits from the photographs. The aerial photographs were used in conjunction with the site DTM data to identify geomorphological features. The site was further assessed during site visits when more detailed mapping was undertaken.

Interpretation of available aerial photographs was undertaken to assess and identify (where present) evidence of historic peat instability. The photographs were examined to highlight features of interest, where present, including:

- Possible extension and/or compression features;
- Areas of historic failure scars and debris;
- Evidence of soil/peat creep;
- Areas with apparent poor drainage;
- Areas with concentrations of surface drainage networks;
- Steeply incised stream cuttings within peat deposits; and
- Areas of peat extraction.

The aerial photography, DTM and data gathered on site have been used in conjunction to create a geomorphological interpretation of the site, presented in **Figure 8.3.6**. There was no evidence of peat instability identified on aerial imagery or at ground level.

3.1.4.2 Historical Mapping

Freely available historic OS mapping has been reviewed, there was no evidence of historic instability identified.

3.1.4.3 Local Knowledge

No anecdotal background from landowners, past site users or from construction works at the adjacent North Kyle Energy Project has been provided to suggest there has been a history of peat instability on the Site or locally.

3.2 Surface Water and Sensitive Receptors

The effects of peat failures are felt locally, both in the long and short term, but they can also have wider off-site implications.

A key part of the risk assessment process is to identify the potential scale of peat failure, should it occur, and identify the potential environmental effects as well as the receptors of such an event.

Peat failure associated with the Proposed Development could affect the following key receptors:

- The proposed development itself, including associated infrastructure;
- Property and infrastructure, for example roads or utilities;
- Land based ecological effects (damage to habitats e.g. GWDTE);
- On-site and downstream watercourses;
- Archaeological assets; and
- Visual amenity (scarring of the landscape).

4.0 Site Work

4.1 Peat Depth Survey

Technical Appendix 8.1 details the results of peat depth surveys undertaken at the Site, which are summarised in the following sections.

Peat depth surveys were carried out by MacArthur Green as follows:

- Phase 1 surveys were undertaken in July 2020 and May/June 2021, with additional surveys in September 2024 and March 2025, additionally survey data for the Polquhairn area of the Site (northwest) was originally gathered by MacArthur Green in 2013 – 2014.
- Phase 2 surveys were undertaken in December 2024, January 2025 and March 2025.

Additional walkovers were undertaken by SLR in December 2024 to assess the potential for peat instability.

A total of 3326 probe locations were collected across the various survey stages. Due to design iterations resulting in changes to the development boundary, 575 probes collected are now outside of the Proposed Development boundary.

A total of 2751 probes were collected within the Proposed Development site boundary and have been used to undertake the peat depth analysis.

4.1.1 Methodology

The surveys were carried out following best practice guidance for development on peatland[3].

The thickness of the peat/soils was assessed using a custom made, collapsible solid steel peat depth probe. This was pushed vertically into the peat/soil to refusal and the depth recorded using a handheld Global Positioning System instrument (GPS).

Alongside desk-based information, the 'feel' on refusal was used to interpret the underlying substrate. The following criteria was used in the field:

- Solid and abrupt refusal – Rock;
- Solid but less abrupt refusal with grinding or crunching sound – Granular (sands, gravel, weathered rock); and
- Gentle refusal – Cohesive (Clay/Silt).

Only peat or organo-mineral soil depths were recorded; where the sample point fell on mineral soil/rock the probe depth was recorded as zero.

4.1.2 Peat Depth Analysis

A summary of the peat depths encountered during probing is detailed in **Table 4-1** below and within **Figure 8.3.7** and **Figure 8.3.8**.

Table 4-1 Peat Depth Probing Summary

Peat Depth Interval (m)	Number of Occurrences	% of Probes
Nil	271	9.9
0.01 to 0.49	579	21.0
0.50 to 1.00	806	29.3

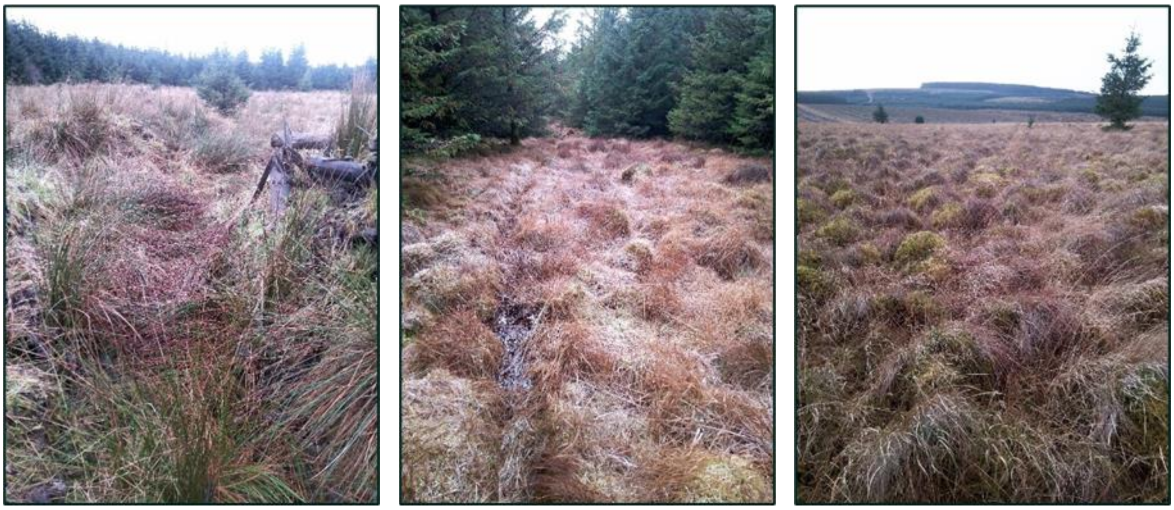
Peat Depth Interval (m)	Number of Occurrences	% of Probes
1.01 to 1.50	492	17.9
1.51 – 2.0	284	10.2
2.01 – 3.0	259	9.4
3.01 – 4.0	57	2.1
>4.01	6	0.2
Total	2751	100

The survey results show that 30.9 % of probes identifying thin soils (<0.5 m), with 60.2 % of probe locations identified thick peat (>1 m), to a maximum depth of 4.4 m.

The results show that deep peat (>1 m) is present across much of the Proposed Development, located primarily on shallow gradients.

The Proposed Development infrastructure has been through several design iterations, informed by multiple phases of peat probing. The development infrastructure has avoided areas of deep peat so far as practicable, whilst taking into consideration other technical and environmental constraints. General ground conditions of the Site area are shown in **Plate 5-2**.

Plate 5-2 –Site ground conditions



4.2 Peat Coring Survey

Peat and peat soils surrounding the Proposed Development have been subject to a number of pressures over the past century which include historical coal mining, grazing (deer and sheep) and commercial forestry which has contributed to significant degradation of peat habitats in areas of the Proposed Development. Peatland condition is detailed further in **Technical Appendix 6.1: National Vegetation Classification & Habitat**.

Six peat cores were undertaken by MacArthur Green using a peat auger and used to inform interpretations of the underlying peat. Peat samples were undertaken to depths of between 0.3 and 1.77 m bgl and the descriptions are detailed in Technical Appendix 8.1.

5.0 Peat Landslide Hazard and Risk Assessment

The Best Practice Guide[1] acknowledges that there is no universal agreed definition of hazard and risk that can be applied in the context of peat landslides.

The guidance describes the calculation of risk from the following formula:

Risk = Likelihood of a Peat Landslide x Adverse Consequence

The guidance provides examples of assessment methodology to be used. SLR Consulting have reviewed the guidance and the approach of other leading experts and has undertaken the assessment using the following methodology.

Firstly, it is important to note that the Proposed Development layout, including siting of infrastructure, resulted from an iterative process which took into account the findings from peat survey work. Deeper peat was avoided wherever possible, in order to minimise the requirement to disturb and/or excavate peat, and to minimise peat slide risk associated with construction across and within peat.

The first phase of assessment is to identify the susceptibility or likelihood of a peat landslide occurring based on existing conditions and parameters that influence peat landslide occurrence (prior to influence of construction).

Once areas of increased likelihood of a peat slide occurring have been identified, an assessment of adverse consequence (impact) and risk assessment would be undertaken on these areas, assessing the impact of a potential peat slide on identified receptors. For this further assessment, impact coefficient scores are determined, combined with an assessment of the vulnerability of receptors to establish a final risk score.

5.1 Likelihood Assessment

The susceptibility or likelihood of a peat slide occurring is controlled by a number of natural controlling and trigger factors. These are typically:

- Slope gradient;
- Peat depth;
- Peat strength;
- Nature of the substrate beneath peat deposits;
- Relief;
- Evidence of historical failures/potential instability (e.g. tension cracks, creep, compression ridges);
- Vegetation cover;
- Land use; and
- Hydrology.

The most important of the above controlling factors are considered by the assessor to be peat depth, slope gradient, underlying substrate and evidence of potential instability (which is controlled by the former). Without peat and slope, the risk of a peat slide would be unlikely to exist.

Key parameters influencing peat stability have been scored and provided a coefficient value.

The Best Practice Guide[1] relates the likelihood of a peat landslide to a scale of 1 to 5, with 1 being negligible (very low likelihood) and 5 being almost certain (very high likelihood). This scale relates to the likelihood of instability for all the controlling factors under consideration.

It is important to note that this study only focuses on peat soils and the criteria used is specifically tailored to the key factors affecting peat stability. As such it does not account for the stability of other mineral soils or rock.

Peat strength has not been included as a factor in the likelihood scoring process. Site-specific peat strength data was not collated for the site given the difficulty in obtaining reliable values of shear strength using common place in situ and laboratory soil strength tests (as described in Section 2.2). The shear strength is also linked to peat depth as strength is considered to decrease with thickness. As such this parameter is considered to be factored into the risk scoring for peat depth.

5.1.1 Input Data

The input data sets used for the analysis were as follows:

- Slope gradient: Terrain 5 DTM with a 5 m grid size;
- Peat depth: Site survey information for peat depth and site observations;
- Nature of substrate: Surveyor observations of substrate “feel” at the refusal point during probing, together with BGS geological mapping and surveyor observations of exposed substrate at the site;
- Emerging Instability: Where there is local evidence of instability or factors which may increase the likelihood of a slide event occurring e.g. soil creep, slumping, possible extension/compression features, poor drainage etc.

The assessment firstly considers the likelihood of instability occurring, based on a series of input factors. These factors were attributed coefficient scores based on their influence on peat stability.

There is no guidance available on how to combine the likelihood scoring for each of the factors used in the assessment. The assessment team have used the methodology set out below.

For each of the factors noted, a score/coefficient of zero to three has been assigned. A zero score reflects no contribution to peat slide likelihood, with a score of three indicating a high peat slide likelihood associated with that particular factor.

The total likelihood ranking is the product of the four individual factor scores.

5.1.1.1 Slope Angle

The limiting factor governing the formation of thick peat deposits is topography. In the case of blanket peat, it tends to be deepest in closed depressions, and typically thin as the slope angle increases (Boylan et al. 2008[13]). The Best Practice Guide1 details that a PLHRA is not needed for blanket bog sites with slopes less than 2° and as such, a score of zero has been assigned for slopes less than 2°. For slopes greater than 2°, scores have been assigned based on the type and nature of peat slides reported for different slope conditions.

A slope angle GIS layer was generated from the DTM at a 5 m cell resolution. The source DTM is also at a 5 m resolution. The slope angle details are illustrated in **Figure 8.3.5**.

This slope, calculated in degrees, was identified at each probe location and scored as shown in **Table 5-1**.

Table 5-1 Coefficient for Slope

Slope (˚)	Slope Coefficient	Notes
2.0 or less	0	Failure unlikely due to flat ground.
2.1 – 5.0	2	Failure in blanket bog areas would typically occur as peat slides and peaty debris slides, due to low slope angle.
5.1 – 15.0	3	Failure in blanket bog areas would typically occur as peat slides, bog slides or peaty-debris slides. This is the key slope range for reported peat failures.
15.1 – 20.0	2	Failure would typically occur as peaty debris slides due to low thickness of peat on steeper slopes.
>20.0	1	Failure would typically occur as peaty debris slides due to low thickness of peat on steeper slopes.

5.1.1.2 Peat Depth

Peat thickness is seen as one of the key factors associated with peat stability. Typically, the deeper the peat the more humified, and therefore potentially weaker and unstable it is. Peat depth surveys have been completed on the site and these data were then interpolated using the Spline interpolation function within the Spatial Analyst Tools of ArcPro (see **Figure 8.3.7** and **Figure 8.3.8**).

The highest hazard scores have been assigned to peat depth ranges most frequently associated with peat slides on upland sites (Evans and Warburton, 2007[10]).

The peat depth was identified at each probe location and scored as shown in **Table 5-2**.

Table 5-2 Coefficient for Peat Depth

Peat Depth (m)	Depth Coefficient	Notes
Nil	0	No peat/organic soil therefore no potential for peat slide
<0.5	1	Peaty/organic soil rather than peat, therefore failures would be peaty-debris slides
0.5 – 1.5	3	Sufficient peat thickness for peaty debris or peat slide
>1.5	2	Sufficient peat thickness for peat slide however less often recorded at this thickness, due to thicker peat generally occurring in areas of shallow gradients

5.1.1.3 Substrate

The nature of the substrate beneath peat deposits can have a bearing on the likelihood of instability arising, with failure often occurring at the interface between the base of the peat mass and the top of the substrate.

Where granular soils (sand/gravel derived from glacial till) or weathered rock form the substrate, the effective strength of the interface can be considered to be good, with comparatively high friction values. Under these conditions, failure is likely to occur in a zone within the peat, just above the interface. Further factors are necessary to cause a failure of this nature (increased pore pressures within the peat) and occurrence of such events is rare.

Where cohesive soils (clay) form the interface, there is likely to be a significant zone of softening in the clay (due to saturation at low normal stresses, poor or non-existent vertical drainage and the effect of organic acids), resulting in either very low undrained shear strength of low effective shear stress parameters. The result is that potential shearing could occur either in the peat, or in the interface or in the clay; all three possibilities have been documented in peat slides.

A rock substrate provides a high strength stratum, however, the rock surface can be smooth, with a relatively impermeable surface which can result in a 'slippery' interface, accumulation of groundwater and/or low shear strength at the interface, resulting in a higher susceptibility for the overlying peat mass to fail.

The nature of the substrate was inferred at each probe location, based on surveyor observations and BGS geological mapping, and scored as shown in **Table 5-3**.

Table 5-3 Coefficient for Slope

Substrate	Substrate Coefficient	Notes
Granular – Sands/Gravels/Weathered rock	1	Peat failures sometimes associated with bedrock or granular till substrate
Cohesive (clay)	2	Peat failures often associated with cohesive till substrate
Rock (smooth interface)	2	Peat failures often associated with impermeable 'smooth' bedrock surface.
Not proven	3	If the overall thickness of the peat had not been proven, the risk associated with the significant thickness and the unknown substrate would be given a high rating to accommodate unknown factors.

5.1.1.4 Evidence of Existing or Emerging Instability

Geomorphological considerations such as peat erosion, hagging, peat pipes, pools, and evidence of existing instability, can contribute to the potential for instability to arise.

Where evidence of existing or emerging instability was identified by surveyor observations or through mapping and aerial photography a coefficient score has been assigned, as shown in **Table 5-4**.

Table 5-4 Coefficient for Existing or Emerging Instability

Evidence of Existing/Emerging Instability	Existing or Emerging Instability Coefficient	Notes
Yes	2	Failures likely to occur where evidence of emerging/ developing instability is observed (peat pipes/collapsed pipes, areas of diffuse surface drainage such as flushes and pools, tension cracks, compression ridges, bulging, quaking bog) or in areas in close proximity to previous failure events.
No	1	No impact on likelihood of peat slide

5.1.2 Likelihood Rating

The coefficient scores assigned for each of the above factors were multiplied to give a likelihood rating. Identification of the likelihood of a peat landslide occurring is the first step of the assessment, allowing areas of potential concern to be identified. **Table 5-5** sets out the ranking system employed in this assessment.

Table 5-5 Coefficient for Slope

Likelihood Rating Coefficient	Likelihood of Instability	Action
1 - 5	Negligible	No mitigation required, good construction practices should be followed.
>5 - 15	Low	Further investigation to refine assessment and mitigate hazard through relocation or re-design at these locations.
>15 - 30	Medium	Should not proceed unless risk can be avoided or mitigated at these locations, without significant environmental impact, in order to reduce likelihood score to low or negligible.
>30 - 36	High	Avoid project development at these locations
>36 - 54	Very High	Area should be avoided due to very high level of risk and almost certain likelihood of a peat slide occurring.

The assessment of all probe locations is included in **Annex B**. The results show that of the 2751 probe locations within the extent of the Site, the following likelihood ratings were identified:

- No likelihood at 612 locations,
- Negligible likelihood at 942 locations,
- Low likelihood at 1197 locations; and
- No medium, high or very high likelihood locations.

Figure 8.3.9 provides the interpreted likelihood of peat stability based on the rating calculated from the above factors. A summary of the likelihood of peat instability at infrastructure locations is shown in **Table 5-6** below.

Table 5-6 Distribution of Peat Depth and Instability Recorded at the Site

Infrastructure Element		Instability Rating	Average Peat Depth (m)	Average Slope (˚)	Suitability of Location
Turbines and Hardstanding					
T1	Perm Hardstand and turbine	Low	0.72	6.1	Suitable
	Temp Hardstand	Low	0.81	5.7	Suitable
T2	Perm Hardstand and Turbine	Negligible	0.50	1.3	Suitable
	Temp Hardstand	Negligible	0.69	1.3	Suitable
T3	Perm Hardstand and Turbine	Negligible	0.88	2.5	Suitable
	Temp Hardstand	Negligible- Low	0.83	2.7	Suitable

Infrastructure Element		Instability Rating	Average Peat Depth (m)	Average Slope (˚)	Suitability of Location
T4	Perm Hardstand and Turbine	Low- Negligible	0.93	3.2	Suitable
	Temp Hardstand	Negligible	0.66	1.8	Suitable
T5	Perm Hardstand and Turbine	Negligible	0.30	4.8	Suitable
	Temporary Hardstand	Negligible	0.30	4.6	Suitable
T6	Perm Hardstand and Turbine	Low	0.60	3.9	Suitable
	Temp Hardstand	Negligible- Low	0.54	4.2	Suitable
T7	Perm Hardstand and Turbine	Low	0.84	7.7	Suitable
	Temp Hardstand	Negligible	0.28	6.7	Suitable
T8	Perm Hardstand and Turbine	Low	0.82	3.9	Suitable
	Temp Hardstand	Low	0.76	5.6	Suitable
T9	Perm Hardstand and Turbine	Negligible- Low	0.69	1.9	Suitable
	Temp Hardstand	Negligible- Low	0.61	4.0	Suitable
T10	Perm Hardstand and Turbine	Negligible- Low	0.65	2.7	Suitable
	Temp Hardstand	Negligible	0.56	1.7	Suitable
T11	Perm Hardstand and Turbine	Low	0.66	5.0	Suitable
	Temp Hardstand	Negligible- Low	0.65	4.1	Suitable
T12	Perm Hardstand and Turbine	Low	0.92	3.4	Suitable
	Temp Hardstand	Negligible- Low	1.00	4.8	Suitable
T13	Perm Hardstand and Turbine	Low	0.56	6.3	Suitable
	Temp Hardstand	Negligible- Low	0.51	5.3	Suitable
T14	Perm Hardstand and Turbine	Negligible- Low	1.46	4.8	Suitable
	Temp Hardstand	Negligible- Low	1.60	4.3	Suitable
T15	Perm Hardstand and Turbine	Low	1.25	3.3	Suitable
	Temp Hardstand	Negligible- Low	1.38	3.4	Suitable
T16	Perm Hardstand and Turbine	Negligible- Low	1.53	3.1	Suitable
	Temp Hardstand	Negligible- Low	1.97	3.3	Suitable

Infrastructure Element		Instability Rating	Average Peat Depth (m)	Average Slope (˚)	Suitability of Location
T17	Perm Hardstand and Turbine	Low	1.19	4.2	Suitable
	Temp Hardstand	Negligible-Low	1.48	4.5	Suitable
T18	Perm Hardstand and Turbine	Negligible- Low	0.45	4.2	Suitable
	Temp Hardstand	Low	0.53	5.0	Suitable
T19	Perm Hardstand and Turbine	Low	0.67	5.0	Suitable
	Temp Hardstand	Low	0.65	4.2	Suitable
T20	Perm Hardstand and Turbine	Low	0.81	6.2	Suitable
	Temp Hardstand	Low	0.85	4.6	Suitable
Other Infrastructure					
Substation Compound		Negligible- Low	0.43	3.5	Suitable
SPEN		Low	0.87	3.3	Suitable
BESS		Negligible- Low	0.91	3.0	Suitable
Borrow Pit 01		Low	0.65	13.1	Suitable
Borrow Pit 02		Low	0.66	5.1	Suitable
Borrow Pit 03		Negligible	0.23	7.8	Suitable
Track (All)		None-Low	0.87	4.8	Suitable

As can be seen from **Table 5-6**, all infrastructure elements have been assigned likelihood rankings of negligible or low. The generally negligible and low rankings accord with Proposed Development being sited outwith areas of deep peat identified on site, and with no evidence of historical failures where peat is present.

5.2 Results

The likelihood assessment has determined that the site lies within an area of negligible to low likelihood of a peat landslide occurring (**Figure 8.3.9**).

5.3 Impact Assessment

In line with best practice guidance[1], where areas with medium or higher likelihood of instability are identified, further assessment should be undertaken to identify the overall risk, by considering the impact (adverse consequence) should a peat landslide occur.

Given that no medium risk locations have been identified, there is no requirement to undertake an impact assessment. For completeness, we have included the assessment methodology that would have been undertaken had an impact assessment been required.

The assessment would follow the methodology outlined below, and considers the sensitivity of the receptor, the distance between the potential source of instability and the receptor, and the relative elevation of the source compared to the receptor. This is considered to be a more realistic and suitable analysis than considering distance alone, given that a receptor which is close to a source area but is up-gradient from it, would not be affected by run-out from the resultant failure.

The impact rating is derived by multiplying the receptor sensitivity coefficient by the receptor proximity coefficient and the relative elevation coefficient. The following sections detail the methodology for assigning coefficient scores.

For example, a highly sensitive watercourse (6) at 250 m from the source of potential peat slide (2) at a relative elevation of <10 m (1) would be scored an impact rating of 12 (low), as detailed in **Table 5-10**.

5.3.1 Receptor Sensitivity Ranking

Should a peat landslide occur, nearby structures or features may be impacted. Generally, only features down-gradient should be considered, therefore a review of topography and geomorphological features need to be identified prior to identifying receptors. However, it should be noted that instability occurring on steep slopes do risk the back scarp of instability migrating up-slope, affecting areas not previously considered to be at risk. The receptors detailed in **Table 5-7** have been ranked according to their size and sensitivity with corresponding coefficients assigned.

Table 5-7 Coefficient for Receptor Sensitivity

Receptor	Receptor Sensitivity Coefficient
Minor infrastructure e.g. private roads/tracks, including Proposed Development track	1
Watercourses, private water supplies, GWDTE and critical infrastructure (roads/ services, individual dwellings and business properties)	3
High-sensitivity watercourses (e.g. national/international designations)	6
Communities (over approximately 10 dwellings)	8

5.3.2 Receptor Proximity Ranking

The proximity of a receptor should be considered to assess the likely level of disruption should a peat landslide occur. Predicting the size of a failure and the distance it may travel is very difficult. The high moisture content of peat makes it especially mobile once it fails and the structure of the peat breaks down. If a peat slide enters a watercourse this can mobilise the slide further and have impacts many kilometres beyond the bounds of the site. In many instances, minor slumps are localised and have little or no impact. Other failures may travel at 100 – 200 m and those entering watercourses, many miles, as was the case of the Derrybrien failure in Co. Galway, Ireland in 2003 (Lindsay & Bragg 2005[5]).

The distance from the source and the relative elevation of the receptor have been assigned coefficients as detailed in **Table 5-8** and **Table 5-9**.

Table 5-8 Coefficient for Receptor Proximity

Distance from Coefficient Feature	Distance Coefficient
More than 1 km	1
100 m to 1 km	2
10 m to 100 m	3
Less than 10 m	4

Table 5-9 Coefficient for Relative Elevation

Relative Elevation of Receptor	Relative Elevation Coefficient
Less than 10 m	1
10 m to 50 m	2
50 m to 100 m	3
More than 100m	4

The results of the likelihood and impact assessment have been normalised into a numerical score, detailed in **Table 5-10**. The overall risk ranking (detailed in **Table 5-11**) is determined from the product of the likelihood rating coefficient (normalised) and the Impact rating coefficient (normalised).

Where a risk ranking is greater than negligible, qualitative assessment has been undertaken to determine if the ranking can be revised to an acceptable level through appropriate mitigation or re-design.

Table 5-10 Rating Normalisation

Likelihood		Impact	
Normalised Scale	Current Scale	Normalised Scale	Normalised Scale
Negligible (≤5)	1	Very Low (<10)	1
Low (>5 – 15)	2	Low (11 – 20)	2
Medium (>15 – 30)	3	Moderate (21 – 30)	3
High (>30 – 36)	4	High (31 – 50)	4
Very High (>36)	5	Extremely High (>51)	5

Table 5-11 Risk Ranking

Risk Ranking	Risk Ranking Level	Action
1-4	Negligible	No mitigation required, good construction practices should be followed.
5-10	Low	Further investigation to refine assessment and mitigate hazard through relocation or re-design at these locations.
11-16	Medium	Should not proceed unless risk can be avoided or mitigated at these locations, without significant environmental impact, in order to reduce risk score to low or negligible.
17-25	High	Avoid project development at these locations

5.4 Assessment of Increased Likelihood Locations

Where the likelihood assessment identified areas of negligible and low likelihood of instability, no specific mitigation measures are considered necessary. However, best practice construction methodology should be adopted with ongoing monitoring of ground conditions.

A qualitative assessment of increased likelihood locations would be undertaken for locations identifying medium likelihood or higher.

6.0 Proposed Development Design and Mitigation

A detailed site investigation would be required to assist detailed design, comprising intrusive ground investigations at infrastructure locations prior to construction commencing, to ascertain depth to bedrock and suitable founding conditions.

A detailed stability analysis can then be completed at all infrastructure locations using the increased confidence in the shear strength/peat depth data and site-specific topographical survey data, to provide added robustness to the stability assessment.

6.1 Turbines and Hardstandings

Design

This PLHRA has identified that all turbines and hardstandings are at low or negligible likelihood of a peat slide occurring.

Mitigation

The infrastructure would not be constructed on peat, rather peat would be excavated to allow founding onto a suitable stratum i.e. bedrock.

It is anticipated that extraction of rock will be required in at least some areas to create suitable levels for founding turbines and hardstandings.

Prior to construction, a specific construction method statement would be produced which would draw on the findings of intrusive investigations. The method statement would detail the exact construction methodology to be used, in line with the Peat Management Plan and taking into account:

- Opportunities for micro-siting turbines and hardstandings to further minimise risk where possible;
- A geotechnical analysis for each turbine base;
- The method of excavation and the location for placing and storing excavated material to ensure that these operations do not give rise to slope or site instability;
- Methodology for storing and watering surface vegetated turves, for re-sodding bare areas;
- Details of how excavated spoil would be stored;
- Avoidance of construction (if possible) on wet areas, flushes and easily eroded soils;
- Adequate drainage design to cater for expected heavy rainfall events; and
- Monitoring of ground movement and water levels.

The Construction Method Statement would also detail how pumped water from excavated bases would be controlled and monitored to ensure it is appropriately managed and if directed into or conveyed to existing drains/watercourses, to ensure that all have adequate treatment beforehand and capacity to deal with the volumes of water encountered.

6.2 Access Tracks

6.2.1 Design

Areas of deep peat have been largely avoided with respect to access track routing so far as practicable, with existing tracks adopted where appropriate. Where avoidance of deep peat hasn't been possible, floated track construction has been proposed on peat, where the cross slope and longitudinal slope is less than 5 %, and the length of track is appropriate.

6.2.2 Peat Storage

The principles of temporary peat storage are discussed in the Outline Peat Management Plan. Detailed requirements for any appropriate mitigation measures would be set out in the Construction Environmental Management Plan (CEMP).

Best practice measures for temporary and permanent peat storage during construction would be followed, in accordance with guidance including Developments on Peatland: Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste (Scottish Renewables and SEPA, 2012). This includes:

- selecting suitable temporary storage areas with relatively low ecological value, and low stability risk i.e. not at the crest of a slope or in areas identified as being at higher risk of instability;
- reuse of temporarily stored peat as soon as possible after excavation;
- dressing and reinstating peat used for road verges and infrastructure batters (as part of site landscaping works) as soon as practicable after construction; and
- suitably limiting the angle of reinstated slopes to reduce run-off and erosion

6.2.3 Drainage areas

Design and construction of a suitable drainage system for the proposed Development would follow Sustainable Drainage Systems (SuDS) principles and would ensure natural drainage without significant alteration of the hydrological regime of the site area.

Any construction activity relating to, or undertaken in the vicinity of watercourses would be carried out in general accordance with relevant guidelines and legislation.

6.2.4 Borrow Pit

Pre-construction site investigation works would be undertaken to further assess the borrow pit search area and to identify the specific excavation locations and extents within the search area. This would be based on peat depth and distribution, with any deep peat avoided, and suitability of rock for excavation. These further investigations would also establish the method of extraction, determining whether any blasting is required. If blasting is required, further analysis of potential impacts on peat stability in the vicinity would be undertaken and appropriate mitigation stipulated.

6.3 Monitoring and Management

A line of surveyed and levelled pegs and visual monitoring is an acceptable method of monitoring movement adjacent to roads, excavations and stockpile areas.

Thus, as construction activities commence, the appearance of the area and surrounding land would be monitored visually by installing a line of levelled pegs adjacent to the activity location. Specifically, the following signs would be looked for:

- An increased rate of sinking or tilting;
- The rising of adjacent peat/peaty soils;
- Cracking and lateral movement of the soil surface; and
- A rise in water levels.

The Principal Contractor would ensure that suitably qualified and experienced construction staff are engaged on the project, including a senior geotechnical engineer with extensive practical knowledge and experience of similar conditions to those at the site. The senior geotechnical engineer would have responsibility for maintaining and actively monitoring a geotechnical risk register for the construction works.

Additionally, all staff would undergo a site induction and suitable training relating to construction on peatland sites. This would raise awareness of ground instability indicators, best practice construction techniques, mitigation and emergency procedures. All staff should be responsible for observational monitoring and reporting.

7.0 Conclusion

Based on the findings to date, there is a negligible to low likelihood of a peat landslide occurring at the site. Where peat is present, it is situated on a shallow gradient, with negligible to low likelihood of a peat slide occurring. The landscape is heavily modified, comprising drained commercial forestry.

Construction of the proposed Breezy Hill Energy Project is not likely to increase the likelihood of a peat landslide occurring.

Although the impacts on peat and the likelihood of peat instability are considered negligible to low, excavations within peat should be monitored by a suitably qualified geotechnical engineer.

Annex A Figures

Annex B Peat Slide Likelihood Data

Making Sustainability Happen