Appendix 9.1 Peat Slide Risk Assessment

Contents

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Introduction

This Peat Slide Risk Assessment (PSRA) report provides an overview of peat slide mechanisms, desk study information relating to the site, and survey results to highlight any risk of peat slide within the Proposed Development area.

The Peat Slide Risk Assessment was led by Jenny Hazzard, Environmental Planning Director at ITPE. Jenny has a BSc in Geological Engineering and an MSc in Engineering Geology, and she is a Practitioner Member of IEMA. Jenny has 20 years of experience in environmental consultancy including EIA, geo-environmental assessment, ground investigations, and assessment of geology, hydrology and hydrogeology impacts. She has led on hydrology, hydrogeology and peat assessment work for several renewable energy and transmission & distribution projects across Scotland, including peat slide risk assessments and peat management plans for several proposed Scottish wind farm projects.

Field surveys were directed by Jenny and undertaken by members of the ITPE Environmental Planning team, with suitable experience of peat probing, geo-environmental and hydrological surveys.

Peat Failure Characteristics/Mechanisms

The Peat Landslide Hazard and Risk Assessments Best Practice Guide for Proposed Electricity Generation Developments, published by the then Scottish Executive (2006, updated by the Scottish Government April 2017) (hereafter referred to as the 'Best Practice Guide') 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^o to 15^o). 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, 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 simple 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, peat slides have a greater likelihood of occurrence where slope angles range from 5^o to 15^o. 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:** Boyland et al. (2008) 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 (note, the Proposed Development site is considered to generally fit the definition of an upland blanket bog site although recorded peat depths are generally shallower than the range noted).
  - Lowland Blanket Bog: similar to the upland version, however, they form around sea levels in areas of very high rainfall.
  - Raised Bog: generally, 3m -12 m thick, averaging 7 m, with growth occurring above the water table.

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.

- **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 hazard 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 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), 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 described as preparatory and triggering factors.

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.

Sources of Data

A desk study was undertaken to examine documentary information relating to the site. This included the following data sources:

- British Geological Survey, DiGMap and GeoIndex;
- 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;
- NatureScot Natural Spaces online database;
- Habitat and botanical survey data (refer to Chapter 8 and Figures 8.2 and 8.4);
- Historical mapping from the late 1800s to the mid-1900s, available from the National Library of Scotland; and
- Current aerial photography.

Baseline Conditions

Geography, Topography and Geomorphology

The Proposed Development lies approximately 8 km to the north of Lairg and 4 km to the east of Loch Shin and covers an area of approximately 79 hectares.

The site comprises mainly plantation forestry and scrub birch interspersed with areas of open moorland. Areas of potentially regenerating woodland are observed on the banks of Feith Osdail. The site is currently used primarily by the landholder for deer stalking.

The site lies within a gently sloping landscape, sloping down towards the south-west and ranging in elevation from approximately 155 m above ordnance datum (AOD) in the north-east site area to approximately 130 m AOD in the south-west. The landform across the site comprises a relatively uniform slope, steepening only along the banks of Feith Osdail which flows from the central part of the eastern site boundary, to its south-west corner.

Figure 1 shows the main geomorphological features of the site, including the position of slope breaks and particular concentrations of drainage features. Numerous small, man-made drainage features are present onsite, not clearly evident on aerial photography due to the forest cover.

Photographs of the Proposed Development site, with a focus on hydrological and geomorphological features, are presented in Chapter 9 and in Appendix 9.3.

No clear evidence of any historical slope failure could be discerned from aerial photography or site observations.

History

A review of historical map editions from the late 1800s to the mid-1900s identified the site as being open moorland with essentially no built development. A track traversed the site from north to south, however no other development has been identified.

Current aerial photography was consulted together with aerial photography at 5 m resolution, dated 2010, obtained from Emapsite, as part of the desk study review of site conditions. No material information was gained from this review that was not evident from mapping and site reconnaissance work. Historical aerial mapping was not reviewed given that sufficient information on site conditions, peat depth and distribution etc. was considered to be available from other sources.

During the design iteration process for the Proposed Development, information has been made available from the landowner (forestry manager). No reports of any peat slide incidents were noted.

Vegetation

Site observations and ecological surveys have identified that most of the site area is occupied by coniferous plantation woodland. The main exceptions are briefly described below, with further detail in Chapter 8:

- Areas of blanket bog are present in the west of the site, on the eastern boundary, and in forest rides/ firebreaks.
- Wet modified bog is present in the southern site area, mainly around the Feith Odsail watercourse and further south. Some marshy grassland is also present along the banks of Feith Osdail in the western part of the site.
- Areas of broadleaved and mixed plantation woodland are present in the north-west, west, and south-central parts of the site.

Rainfall

Rainfall data have been obtained from Nairn, approximately 85 km south-east of the Proposed Development. An average annual rainfall precipitation rate of 620 mm is indicated, based on averages collated between 1931 and 2019.

Geological Conditions

BGS online mapping for the area shows that the bedrock geology underlying the site comprises mainly Morar Group Psammite (Altnaharra Psammite Formation), which is a low-grade metamorphic rock.

BGS mapping shows that bedrock across most of the site area Is overlain by peat. Till and morainic deposits, with no peat cover, are shown in the south of the site and across a central swathe from the north-west corner to the Feith Osdail watercourse. These deposits are anticipated to comprise poorly sorted sand, gravel, cobbles, boulders, silt and clay. Alluvial clays, silts, sands and gravels are indicated to be present on the banks of Feith Osdail.

Most of the site area is identified on the SNH Carbon and Peatlands Map (2016) as being within an area of Class 1 Peat, defined as “nationally important carbon-rich soils, deep peat and priority peatland habitat; areas likely to be of high conservation value.” The very southern area of the site is shown as Class 2 Peat, defined as “areas dominated by peat soil and peatland habitats”.

Peat depth surveys were undertaken to identify and characterise peat deposits that may be present around proposed turbines and associated infrastructure. The peat depth surveys identified peat depths across much of the site area were recorded as being less than 0.5 m, therefore defined as peaty soil. However, localised pockets of deeper peat were identified, with depths over 2 m recorded.

Peat across much of the site was observed to be disturbed and modified by the presence of tree roots and artificial drainage.

Surface Water

Feith Osdail is the only watercourse within the site, flowing westward from the centre of the eastern site boundary, downslope to the south-west corner of the site. Additional minor field drains and possible spring features were identified on the site during site reconnaissance and survey work. These all ultimately drain to Feith Osdail.

Feith Osdail flows directly into the River Tirry, approximately 140 m west of the site. The River Tirry flows southward into Loch Shin, some 4 km south of the site.

Feith Osdail and the River Tirry are classified by SEPA (2018) as having an overall status of Poor.

Hydrogeology

The groundwater body beneath the site is indicated by SEPA to comprise the Northern Highlands groundwater. This groundwater body was classified by SEPA in 2018 as having an overall status of Good.

The Hydrogeology Map of Scotland identifies the site as being underlain by a low productive aquifer in which flow is virtually all through fractures and other discontinuities.

Peat and peaty soils would be expected to contain perched groundwater but would also be expected to inhibit groundwater flow. Till and alluvial deposits, where present, are anticipated to be of variable permeability, depending on the proportion of clays and silts relative to coarser components (sand, gravel, cobbles and boulders).

No Private Water Supplies (PWS) have been identified within a 1 km radius of the site boundary.

Human Receptors

Human receptors that may be at risk from peat slide include construction staff during construction of the development, and the forestry workers accessing the site. Given the transient use of the site by these receptors, there is considered to be a low risk of direct harm from peat slide.

Ecology

No terrestrial protected species have been identified as likely to be impacted by peat slide within the study area. Therefore, these have not been considered further in this assessment.

Ecological resources associated with watercourses are considered as part of the identified surface water receptors noted in the Surface Water section above.

Archaeology

A number of heritage assets have been identified within the site boundary; however, none were assessed as being of any greater than low sensitivity. These are not considered highly sensitive to potential impact by localised peat slide and are not considered further in the assessment. The listed bridge immediately south-west of the site is considered as a built environment receptor (see below).

Infrastructure and Built Environment

There are existing forestry tracks across the site, some of which are proposed to be incorporated into the Proposed Development, which could potentially be impacted by peat slide and are considered in the assessment. The proposed turbines themselves also have the potential to be impacted by peat slide derived from other infrastructure locations which may be upslope. The turbines are considered as potential receptors, in the assessment of peat slide risk.

A public road, including a bridge over the Feith Osdail watercourse, is adjacent to the site on the west. A private road is adjacent to the site on the south. These are considered potential receptors, sensitive to potential impact by peat slide.

The nearest residential properties are over 1 km from any proposed turbines or other infrastructure, beyond the River Tirry. There is considered to be little or no risk to these properties from peat slide derived from the Proposed Development site.

Peat Depth Survey

Based on a desk study review of published geological mapping, it was anticipated that peat could be present across much of the Proposed Development site.

A peat depth survey was therefore undertaken in two phases, in line with Guidance on Developments on Peatland - Site Surveys (Scottish Natural Heritage, SEPA and The James Hutton Institute, 2017).

An initial 'Stage 1' peat survey was undertaken in 2015 as part of earlier work relating to a proposed development at the site. The surveys were undertaken by a team of suitably qualified and experienced surveyors, and provided a 100 m spaced grid, as per the above-noted guidance.

Following re-start of the project in 2020, including review and revision of the previously considered layout (refer to Chapter 2 of the EIA Report), a 'design chill' was agreed. This was considered to represent the best possible turbine and infrastructure layout to optimise yield whilst minimising environmental effects, including effects on geology, hydrogeology and peat but also taking account of other environmental constraints.

The Stage 1 survey had identified relatively shallow peat across the site, with the deepest peat located in the north-east site area, as well as along the western edge of the site, close to the A836. Stage 2 peat surveys were required to confirm and expand on Stage 1 findings, targeting the proposed infrastructure locations.

The Stage 2 peat depth probing exercise was undertaken by a suitably qualified team of ITPE surveyors, during the week of 20 July and on 3 August 2020. The pattern of peat probing in relation to proposed turbine locations and other infrastructure can be described as follows:

- Probe at each proposed turbine location plus every 10 m out to a minimum of 50 m from the turbine location to the north, south, east and west;
- Approximately five probes at each proposed turbine hardstanding area (generally around the centre and four outside corners);
- Nine probes at and around the proposed southern access point;
- Every 50 m along proposed new access tracks, plus approximately 10 m either side of each probe, perpendicular to the route of the track (except where proposed track alignments were amended following the peat depth survey, see below);

- Approximately a 30 m grid at the locations of the proposed substation and energy storage compound, temporary compound, and within the proposed borrow pit search areas; and
- A probe at the proposed met mast location, with several others in the close vicinity.

Following this Stage 2 survey work, some changes were made to the "design chill" layout, reducing the extent of infrastructure sited on areas of deeper peat. An area of track which would have crossed an area of peat with depths locally >1 m was removed from the design; another section of road was realigned to avoid deep peat. Other road alignments were slightly amended for design reasons unrelated to peat, but within areas where minimal peat depths had been recorded. Full details of the design iteration process are provided in Chapter 2 and Figures 2.3 to 2.7 of the EIA Report. An ongoing dialogue with SEPA was maintained to confirm suitability of the survey programme in response to design proposals.

In total, data has been obtained from 605 peat probe locations across the site area. **Figure 2** shows the peat survey locations, and **Annex 1** provides the full set of peat survey data (probe locations and recorded depths).

Peat samples were extracted using a hand auger at seven locations, and were subject to laboratory testing for moisture content, carbon content, and bulk density to help characterise the nature of the peat and/or peaty soil. Table 1 provides information on the location and depth of peat samples tested. The laboratory testing report is provided as **Annex 3.**

Table 1 – Locations of Peat Samples Collected for Laboratory Analysis

Location	Easting	Northing	Depth (cm below ground)	Notes
Turbine 1	258083	914757	65	Low carbon content, moderate/high moisture content. Likely peaty/organic soil rather than peat.
Turbine 2	257684	914717	20	Low carbon and moisture content. Likely peaty/organic soil rather than peat.
Turbine 3	257800	914382	55	Low carbon content, moderate/high moisture content. Likely peaty/organic soil rather than peat.
Turbine 4	258190	914303	40	Low carbon content, moderate/high moisture content. Likely peaty/organic soil rather than peat.
Borrow Pit Search Area (South)	257898	914414	60	Slightly low carbon content, moderate/high moisture content. Likely peaty/organic soil rather than peat.
South of T1	258078	914714	95	Low carbon content, moderate/high moisture content. Likely peaty/organic soil rather than peat.
Track west of T2	257578	914728	60	Low carbon content, moderate moisture content. Likely peaty/organic soil rather than peat.

As set out in Table 1, laboratory testing results from samples of peat taken during peat depth surveys identified moisture contents generally within or slightly below the typical values for peat of 85% to 95% for most of the samples. Carbon contents were recorded as being substantially below the typical value of 55% for peat in most samples. This suggests that materials across the site may be considered peaty or organo-mineral soils, rather than peat.

Survey Results

The general distribution of depth of penetration recorded during the peat survey is summarised in Table 2 and presented in **Figure 3**.

Table 2 – Distribution of Peat Depth Recorded at the Site

Peat Depth Interval (m)	Number of Occurrences	% of Probes
Nil	58	9.59
0.01 to 0.49	363	60.00
0.50 to 0.99	130	21.49

Peat Depth Interval (m)	Number of Occurrences	% of Probes
1.00 to 1.49	30	4.96
1.50 to 1.99	14	2.31
2.00 to 2.49	8	1.32
2.50 to 2.99	1	0.165
3.0 or more	1	0.165
Total	**605**	**100.0**

The Peat Landslide Hazard Best Practice Guidance (2017) uses the following Joint Nature Conservation Committee (JNCC) report 445 'Towards an Assessment of the State of the UK Peatlands' definition for classification of peat deposits:

- Peaty (or organo-mineral) soil: a soil with a surface organic layer less than 0.5 m deep;
- Peat: a soil with a surface organic layer greater than 0.5 m deep which has an organic matter content of more than 60 %;
- Deep Peat: a peat soil with a surface organic layer greater than 1.0 m deep.

Applying these definitions indicates that the deposits underlying around 70% of the surveyed site area comprise peaty or organo-mineral soil. The above definition of peat applies to conditions recorded at around 21% of probes, with the remaining 9% of probes encountering deep peat.

Peat Contour Mapping

Figure 3 shows the interpreted peat depth, both as individual data points and as a contour plan based on interpolation of those peat sampling data points. The contouring has been undertaken using Natural Neighbour interpolation function within the Spatial Analyst Tools of ArcMap 10, which finds the closest subset of input samples to a query point and applies weights to them based on proportionate areas in order to interpolate a value.

Apart from peat depth at each survey point, no other inputs were defined by the user. Information from ESRI (the software provider) defines the Natural Neighbour function as such: "Interpolates a raster surface from points using a natural neighbour technique". As shown on **Figure 3**, interpolation has not been undertaken between probed areas, where no data is available. No assumptions have been made as to peat depth distribution outside the surveyed areas.

The peat contour mapping shows areas of peat with depth over 0.5 m, largely in the west and northeast site areas. The northwest, centre, and most of the southern site area exhibited peat depths less than 0.5 m (peaty soil), or no peat.

Peat Stability Hazard Scoring

Introduction

The Best Practice Guide defines the hazard scoring assessment as 'the likelihood of a peat landslide event occurring'. It states that there are a number of possible methods for hazard scoring and that an initial qualitative hazard scoring matrix methodology be employed using professional judgement based on qualitative scoring scales.

Methodology

The allocation of hazard score values for the various parameters which influence peat landslide occurrence (e.g. slope gradient, peat depth) is not defined in the Best Practice Guide and there is no published guide specifically relating to this issue. As such, it is left to the assessment teams to develop their own approach for categorising the hazard scoring for the site and the following sections outline the approach used for this specific site.

Firstly, it is important to note that the Proposed Development layout, including siting of turbines and other 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. This is described in detail in Chapter 2 and Figures 2.3 to 2.7.

Given that there is no evidence of current or historical peat instability at the site, and that the site design avoids areas of deep peat and steep slopes, it is considered appropriate to focus the assessment of peat slide risk on the proposed infrastructure locations, rather than the wider site where no disturbance or construction activity is proposed.

The potential for a peat slide to occur is controlled by a number of natural controlling factors. These are typically:

- Slope gradient;
- Peat depth;
- Peat strength;
- Relief;
- Evidence of historical failures/potential instability (e.g. tension cracks, creep, compression ridges);
- Vegetation cover; and
- Hydrology.

The Best Practice Guide relates peat landslide hazard, or likelihood, to a scale of 1 to 5, with 1 being negligible likelihood and 5 being almost certain. This scale relates to the final hazard potential for all the controlling factors under consideration. No guidance is provided on how the various factors should be combined to derive a final hazard scoring and the assessment team has derived a numerical scoring system as detailed in the following sections.

The most important of the above controlling factors are considered by the assessor to be peat depth and slope gradient as without both of these elements a risk of peat slide would be unlikely to exist. However, there are additional factors which can contribute to the potential for instability to occur, as set out above, and these have been considered in the evaluation of likelihood of peat slide (i.e. hazard scoring). This approach to the hazard, or likelihood, evaluation is described below and has resulted from a review of several case studies and assessments by experts in PSHRA for Scottish wind energy developments, and associated literature sources on peat slide mechanisms and reported contributing factors, as referenced in the sections below.

In total, eight factors have been considered in the hazard scoring process, in line with the controlling factors. Details of the scoring attributed for each factor set out in the subsequent paragraphs.

Peat strength has not been included as a factor in the hazard 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. 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 hazard scoring for peat depth.

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

Input Data Sets

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

- Slope angle: Terrain 5 DTM with a 5 m grid size;
- Peat depth: Site survey information for peat depth and site observations;
- 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;
- Geomorphology: Surveyor observations and aerial photography;
- Drainage: Surveyor observations, mapping and aerial photography;
- Forestry: Surveyor observations, mapping and aerial photography;
- Relief (convexity): Topographical mapping; and
- Land use: Surveyor observations, mapping and aerial photography.

The assessment focuses on the proposed infrastructure locations (turbines including hardstandings, tracks, substation compound, temporary construction compounds, laydown area, borrow pit search areas, and met masts).

Hazard Scoring and Ranking

There is no guidance available on how to combine the hazard scoring for each of the factors used in the assessment. The assessment team have used the methodology set out below, based on a review of case studies and assessments undertaken by a range of experts (in particular, a hazard scoring methodology adopted by east point geo on a number of assessments, including recently for the proposed Energy Isles Wind Farm in Shetland (east point geo, 2019), informed by various literature sources as referenced below.

For each of the eight factors noted above, a score 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 hazard score is the sum of the eight individual factor scores, with the maximum total hazard score therefore being 24.

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). The Best Practice Guide details that peat slide hazard risk assessment 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 2º. 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 4**.

This slope, calculated in degrees, was identified at each proposed infrastructure element and scored as shown in Table 3.

Table 3 – Peat Stability Hazard Scoring (Slope)

Slope (degrees)	Slope Score	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

Slope (degrees)	Slope Score	Notes
		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.

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 Natural Neighbour interpolation function within the Spatial Analyst Tools of ArcMap 10.3 (see **Figure 3**).

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

The peat depth was identified at each proposed infrastructure element and scored as shown in Table 4.

Table 4 – Peat Stability Hazard Scoring (Peat Depth)

Peat Depth (m)	Depth Score	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

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. A smooth, relatively impermeable substrate surface 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. Conversely, granular substrate such as sand and gravel or permeable bedrock, can provide greater frictional strength, reducing the potential for failure to occur at the peat/substrate interface.

The nature of the substrate was inferred at each proposed infrastructure element, based on surveyor observations and BGS geological mapping, and scored as shown in Table 5.

Table 5 – Peat Stability Hazard Scoring (Substrate)

Substrate	Substrate Score	Notes
Permeable bedrock	0	Peat failure rarely associated with permeable bedrock
Impermeable bedrock/ granular till	1	Peat failures sometimes associated with bedrock or granular till substrate
Cohesive (clay) till	2	Peat failures often associated with cohesive till substrate
Cohesive (clay) till with iron pan	3	Peat failures often associated with cohesive till substrate, with impermeable iron pan providing a shear surface (Dykes and Warburton, 2007)

Geomorphology

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

The geomorphological conditions were noted at each proposed infrastructure element, based on surveyor observations, mapping and aerial photography, and scored as shown in Table 6.

Table 6 – Peat Stability Hazard Scoring (Geomorphology)

Geomorphology Description	Geomorphology Score	Notes
Gullied/dissected/hagged/eroded peat/bare peat/bare ground	1	Failures rarely recorded in peat fragmented by erosion
Existing peat slide	1	Failures typically stabilise after the event
Evidence of peat pipes/collapsed pipes, flushes, pools	2	Failures frequently associated with soil piping and areas of diffuse surface drainage such as flushes and pools
Intact planar peat	2	Failures frequently recorded in intact, planar peat
Emerging instability (tension cracks, compression ridges, bulging, quaking bog)	3	Failures likely to occur where evidence of emerging/ developing instability is observed
Adjacent/upslope (<50m) to existing instability	3	Failures frequently occur in close proximity to previous failure events

Drainage

The presence and geometry of natural and artificial drainage features can affect the stability of a peat mass, by creating lines of weakness. Where drainage features follow the slope direction, this effect is not likely to be as pronounced as drainage features being either oblique to or perpendicular to the slope direction.

The drainage conditions were noted at and in the vicinity (within ~100 m) of each proposed infrastructure element, based on surveyor observations, mapping and aerial photography (supplemented by habitat survey findings given the difficulty in identifying drainage details in dense forestry from aerial photography), and scored as shown in Table 7.

Table 7 – Peat Stability Hazard Scoring (Drainage)

Drainage Feature	Drainage Score	Notes
No artificial or natural drainage features	0	No impact on peat slide likelihood
Artificial drains or natural watercourses/drainage features aligned to slope direction	1	Peat slides are rarely associated with drainage features aligned to the slope direction
Artificial drains or natural watercourses/drainage features oblique to or across slope	3	Peat slides have been reported in areas with drainage features oblique to or perpendicular to the slope direction

Forestry

The presence of forestry can increase the mass loading and affect the potential for instability. The alignment of forestry rows, and the presence or otherwise of desiccation cracking are factors which can influence stability (Bragg & Lindsay, 2005).

Hazard scores relating to forestry are set out in Table 8.

Table 8 – Peat Stability Hazard Scoring (Forestry)

Forestry Description	Forestry Score	Notes
Not afforested	0	No impact on likelihood of peat slide
Deforested, ridge and furrows aligned to slope	2	Likely high-water table, lines of weakness may be present but aligned to slope direction
Deforested, ridge and furrows oblique to slope	3	Likely high-water table, lines of weakness may be present (cracks), oblique to or across slope and therefore more likely to result in instability
Mature forest, ridge and furrows aligned to slope	1	Forestry affects loading/mass, but rows aligned to slope direction are less likely to result in instability than rows oblique to or across slope

Forestry Description	Forestry Score	Notes
Mature forest, ridge and furrows oblique to slope	2	Forestry affects loading/mass and rows oblique to or across slope direction are more likely to result in instability

Relief (Convexity)

Several references have been made to peat instability initiating at convex and concave slopes. In particular, convex slopes may have thicker peat upslope, with the potential to buckle and fail, with thinner peat further down the slope providing limited support (Dykes & Warburton, 2007; Boylan & Long, 2011).

The relief, specifically the identification of slopes being planar, convex or concave, was noted at each proposed infrastructure element, based on topographical mapping, and scored as shown in Table 9.

Table 9 – Peat Stability Hazard Scoring (Relief)

Relief/Profile	Relief Score	Notes
Planar slope	0	No impact on likelihood of peat slide
Concave slope	2	Peat slides occasionally reported associated with concave slopes
Convex slope	3	Peat slides often reported associated with convex slopes

Land Use

Land uses such as moor burning, quarrying, and peat cutting, can impact on the stability of the peat mass.

The nature of the land use was noted at each proposed infrastructure element, based on surveyor observations, mapping and aerial photography, and scored as shown in Table 10.

Table 10 – Peat Stability Hazard Scoring (Land Use)

Land Use Feature	Land Use Score	Notes
Evidence of burning	1	Burning activities may theoretically create desiccation cracking and allow water to flow to the base of the peat, creating a failure surface (limited evidence in practice)
Quarrying adjacent to location	2	Failures have been reported adjacent to quarrying activity, although typically bog bursts or flows rather than peat slides in blanket bog areas
Peat cutting	3	Peat failures have often been reported associated with peat cutting
Any land use other than noted above	0	No impact on likelihood of peat slide

Peat Slide Hazard Scoring Summary

The scores assigned for each of the above eight factors were summed to give a total hazard score associated with each proposed infrastructure element.

Hazard (likelihood) category rankings have then been assigned based on the total hazard scores. The hazard rankings reflect the qualitative likelihood of failure, from very low to very high, taking into account the combination of all factors described above. The maximum hazard score, if all element scores are three, is 24. Where the hazard score is less than 12, i.e. less than half the maximum, the likelihood of failure is considered to be very low or low.

Table 11 sets out the hazard category ranking system employed in this assessment.

Table 11 – Hazard Ranking

Total Hazard Score	Hazard Ranking	Hazard (Likelihood) Description	Notes
6 or less	1	Very Low	Low scores for peat depth, slope angle, and other factors
7 to 11	2	Low	Generally low scores for peat depth and slope angle, potentially some moderate or occasional high scores for certain factors
12 to 16	3	Moderate	Moderate to high scores for peat depth and slope angle, some elevated scores for other factors
17 to 21	4	High	High scores for peat depth, slope angle, and several other factors
>21	5	Very High	High scores for most or all factors

Detailed hazard scoring, showing the scores given to each infrastructure element for each of the above factors, is set out in **Annex 2**. Table 12 below presents a summary of the Hazard Ranking for each proposed infrastructure element at the site, using the methodology described above.

The access track sections noted below are labelled on **Figures 3 and 4**.

Table 12 – Hazard Scoring Summary

Infrastructure Element	Total Hazard Score	Hazard Ranking	Hazard (Likelihood) Description
Turbines (including hardstandings)			
T1	6	1	Very Low
T2	8	2	Low
T3	11	2	Low

Infrastructure Element	Total Hazard Score	Hazard Ranking	Hazard (Likelihood) Description
T4	5	1	Very Low
Other Infrastructure			
Entrance Compound South	7	2	Low
Entrance Compound North	11	2	Low
Temporary Construction Compound	6	1	Very Low
Energy Storage Compound	6	1	Very Low
Borrow Pit Search Area (North-west)	12	3	Moderate
Borrow Pit Search Area (Central)	11	2	Low
Borrow Pit Search Area (South)	9	2	Low
New Access Track Sections			
Track – 1	7	2	Low
Track – 2	8	2	Low
Track – 3	5	1	Very Low
Track – 4	6	1	Very Low
Track – 5	6	1	Very Low
Track – 6	7	2	Low
Track – 7	5	1	Very Low
Track – 8	7	2	Low
Track – 9	9	2	Low
Track – 10	7	2	Low
Track – 11	9	2	Low

As can be seen from Table 12, all infrastructure elements except the north-west borrow pit search area have been assigned hazard rankings of low or very low. This accords with a site which has no evidence of historical failures.

Peat Slide Hazard Risk Assessment

Methodology

The level of risk allocated to a particular area relates to the presence of peat, the likelihood of failure occurring (the hazard) and the consequences of such a failure (the exposure). Risk assessment should be based on consideration of the hazard (discussed above) and exposure (consequence of peat failure):

Hazard x Exposure = Risk

Consequences of Peat Failure (Exposure)

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.

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 100 m – 200 m and those entering watercourses, many miles, as was the case of the Derrybrien failure in Co. Galway, Ireland in 2003 (Bragg & Lindsay 2005).

Peat failure associated with the Proposed Development could affect the following key receptors, which are considered in the assessment:

- The Proposed Development itself including associated infrastructure;
- The adjacent private and public roads and listed bridge; and
- Onsite and downstream watercourses.

The following approach to analysis of the consequence, or exposure, has been based on a review of PSHRA reports undertaken by a range of professionals for different sites across Scotland, together with reference to the guidance and literature noted above, and professional experience. The analysis 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.

In this assessment, the proposed infrastructure elements are considered to be the potential sources areas of instability. The exposure assessment involves identification of sensitive receptors in the down-gradient direction from each proposed infrastructure element (source area), and assigning scores for sensitivity of receptor, proximity, and relative elevation. The rationale for assigning each of these scores is set out in Tables 13 to 15 below.

Table 13 – Exposure Scoring (Receptor Sensitivity)

Receptor Type	Sensitivity Score
Minor private roads/tracks, including Proposed Development tracks	1
Local drainage systems/artificial drains, rural land	2
Watercourses, local roads and services, individual dwellings and business properties	3

Receptor Type	Sensitivity Score
High-sensitivity watercourses (e.g. national or international designations), major infrastructure (major roads, motorways, pipelines), proposed turbines, small settlements (up to ~ 10 residents)	4
Communities (more than approximately 10 residents)	5

Table 14 – Exposure Scoring (Proximity)

Proximity of Receptor to Source	Proximity Score
More than 1 km	1
100 m to 1 km	2
50 m to 100 m	3
10 m to 50 m	4
Less than 10 m	5

Table 15: Exposure Scoring (Relative Elevation)

Relative Elevation of Source above Receptor	Sensitivity Score
Less than 10 m	1
10 m to 50 m	2
50 m to 100 m	3
100 m to 150 m	4
More than 150 m	5

A total exposure score has been determined for each proposed infrastructure location, by multiplying the three component scores together and taking the cube root of the result. This is considered to provide an appropriate reflection of the overall consequence, or exposure, taking account of receptor sensitivity, proximity, and relative elevation as contributing considerations.

Where more than one receptor was identified down-gradient from a given proposed source area, the process has been repeated for each receptor, and the highest total exposure score has been used in the assessment related to that particular source (proposed infrastructure element).

Table 16 gives a qualitative description of the exposure (impact) associated with the scores determined by the above method.

Table 16 – Peat Slide Exposure Categories

Score	Consequence	Exposure (Impact)
1	Minor restoration of works.	Low
2	Blockage of site access roads or local drainage systems.	Low – Medium
3	Damage to rural lands and localised pollution to watercourses.	Medium
4	Blockage of public roads, short to medium term pollution incident.	Medium – High
5	Loss of life, major damage to property, public roads and major pollution incident to watercourses.	High

Table 17 below provides a summary of the exposure assessment at each of the proposed infrastructure elements.

Table 17 – Peat Slide Exposure Scores

Infrastructure Element	Receptor	Sensitivity Score	Proximity Score	Elevation Score	Total Exposure Score
Turbines (including hardstandings)					
T1	Watercourse	3	2	2	2.29
T2	Road/watercourse	3	2	2	2.29
T3	Watercourse	3	2	1	1.82
T4	Watercourse	3	2	1	1.82
Other Infrastructure					
Entrance Compound South	Watercourse	3	4	1	2.29
Entrance Compound North	Watercourse	3	2	1	1.82

Infrastructure Element	Receptor	Sensitivity Score	Proximity Score	Elevation Score	Total Exposure Score
Temporary Construction Compound	Watercourse	3	3	1	2.08
Energy Storage Compound	Watercourse	3	3	1	2.08
Borrow Pit Search Area (North-west)	Watercourse	3	2	1	1.82
Borrow Pit Search Area (Central)	Proposed turbine	4	3	1	2.29
Borrow Pit Search Area (South)	Watercourse	3	3	1	2.08
New Access Track Sections					
Track – 1	Watercourse	3	5	1	2.46
Track – 2	Watercourse	3	5	1	2.46
Track – 3	Watercourse	3	3	1	2.08
Track – 4	Watercourse	3	2	1	1.82
Track – 5	Watercourse	3	5	1	2.46
Track – 6	Watercourse	3	2	2	2.29
Track – 7	Watercourse	3	2	2	2.29
Track – 8	Watercourse	3	2	1	1.82
Track – 9	Watercourse	3	2	1	1.82
Track – 10	Watercourse	3	2	1	1.82
Track – 11	Watercourse	3	2	1	1.82

As shown in the summary table above, the total exposure scores range from 1.82 to 2.46, reflecting the presence of sensitive receptors, tempered by the distance between receptors and source areas and/or the relatively gentle topography.

Peat Slide Hazard Risk Scoring

Following the identification of the above hazards and exposure, it is possible to categorise each proposed infrastructure element (i.e. each potential source location) with a risk score, by multiplying the likelihood of failure (Hazard Ranking) by its potential impact (exposure score). The matrix suggested by the Best Practice Guidance to determine the risk category is presented in Table 18 below.

Table 18 – Peat Slide Risk Categories

Peat Slide Hazard Risk Scoring		**Action Suggested**
1 – 3.99	Negligible	Project should proceed with monitoring and mitigation of peat landslide hazards at these locations as appropriate
4 – 7.99	Low	Project may proceed pending further investigation to refine assessment and mitigate hazard through relocation or re-design at these locations
8 – 14.99	Medium	Project 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
15.00 or more	High	Avoid project development at these locations

Table 19 below presents a summary of the assessment of peat slide risk based on the methodology set out above.

Table 19 – Peat Slide Risk

Infrastructure Element	**Hazard Ranking**	**Exposure Score**	**Risk Score**	**Risk Category**
Turbines (including hardstandings)				
T1	1	2.29	2.29	Negligible
T2	2	2.29	4.58	Low
T3	2	1.82	3.63	Negligible
T4	1	1.82	1.82	Negligible
Other Infrastructure				
Entrance Compound South	2	2.29	4.58	Low

Infrastructure Element	Hazard Ranking	Exposure Score	Risk Score	Risk Category
Entrance Compound North	2	1.82	3.63	Negligible
Temporary Construction Compound	1	2.08	2.08	Negligible
Energy Storage Compound	1	2.08	2.08	Negligible
Borrow Pit Search Area (North-west)	3	1.82	5.45	Low
Borrow Pit Search Area (Central)	2	2.29	4.58	Low
Borrow Pit Search Area (South)	2	2.08	4.16	Low
New Access Track Sections				
Track – 1	2	2.46	4.93	Low
Track – 2	2	2.46	4.93	Low
Track – 3	1	2.08	2.08	Negligible
Track – 4	1	1.82	1.82	Negligible
Track – 5	1	2.46	2.46	Negligible
Track – 6	2	2.29	4.58	Low
Track – 7	1	2.29	2.29	Negligible
Track – 8	2	1.82	3.63	Low
Track – 9	2	1.82	3.63	Low
Track – 10	2	1.82	3.63	Low
Track – 11	2	1.82	3.63	Low

The summary presented in Table 19 indicates that the risk of peat slide at all proposed infrastructure elements is negligible or low.

Proposed Development Design and Mitigation

Detailed Design and Site Investigation

A detailed site investigation would be required to assist detailed design. Intrusive ground investigations would be completed 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.

Turbines and Hardstandings

This peat slide hazard risk assessment has identified that all turbines are at negligible or low risk locations. However, 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 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.

Access Tracks

Areas of deep peat have been avoided with respect to access track routing. However, the following mitigation measures would be employed to ensure suitable construction of tracks and minimising risk of instability:

- Road alignments would be micro-sited to further reduce risk where possible and appropriate, based on detailed site investigation findings;
- Roads would be constructed to take the required vehicular loadings, having due regard to overall site stability;
- Machinery and vehicles used in track construction would be operated from the already constructed sections of the road as it progresses;
- Conservative design parameters would be used, taking account of potential impacts of localised deforesting and re-planting;
- Good quality rock would be used to construct roads where applicable;
- Ground movement and water level monitoring would be carried out at all times;
- All machinery and construction methods onsite would be selected with a view to minimising impact on the surrounding habitat; and

- All roads would have sufficiently sized culverts, permeable fill or cross drains at the location of each water crossing, flush or other hydrological feature in order to allow the natural flow of water across the site and prevent ponding and the generation of pore pressures which may initiate instability.

Peat Storage

The principles of temporary peat storage are discussed in Appendix 9.2 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.

Drainage Areas

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

Any construction activity relating to, or undertaken in the vicinity of watercourses would be carried out in general accordance with relevant SEPA Pollution Prevention Guidelines, The Water Framework Directive (WFD), The Water Environment and Water Services (Scotland) Act 2003 (WEWS) and the Controlled Activities Regulations (CAR) 2011 (as amended).

Borrow Pits

Pre-construction site investigation works would be undertaken to further assess the borrow pit search areas and to identify the specific excavation locations and extents within the search areas. This would be based on peat depth and distribution, with 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.

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.

On a similar note, 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.

Conclusion

Based on an extensive peat survey programme, the Proposed Development is characterised as a blanket bog site with generally shallow peat depths across the site. The Proposed Development layout, including turbines and associated infrastructure, has been designed to avoid localised areas of deep peat and areas where peat landslide may occur. Further detailed design would be informed by detailed ground investigations to be undertaken prior to commencement of any works onsite.

The peat slide risk assessment has identified that all proposed infrastructure elements represent a negligible or low peat slide risk.

Mitigation measures are detailed herein which would assist in reduction of any potential risks associated with construction activities causing ground instability, including undertaking detailed intrusive ground investigations to clarify risks and allow stipulation of specific geotechnical mitigation measures and/or micro-siting as required.

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Annex 1 – Record of Peat Depths

Annex 2 – Hazard Scores

Annex 3 – Laboratory Results