Hill of Fare Wind Farm
Technical Appendix 10.1 - Peat Landslide Risk Assessment

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CONTROL SHEET

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1 INTRODUCTION

1.1 Terms of Reference

EnviroCentre Ltd has been commissioned by RES Ltd to carry out a Peat Landslide Risk Assessment (PLRA) for the proposed Hill of Fare Wind Farm ("the Proposed Development"). This report follows the Peat Instability Hazard Assessment carried out in April 2022 and forms Technical Appendix 10.1 of the Environmental Impact Assessment Report (EIAR) for the Proposed Development. This report should be read with reference to **Chapter 10: Hydrology, Geology and Hydrogeological Assessment** of the EIAR for the Proposed Development.

The purpose of this assessment is to assess the risk of a peat landslide occurring at the Proposed Development and identify suitable mitigation measures, where required to reduce the risk. This study was carried out in accordance with current Scottish Government guidance on peat landslide hazard and risk assessment for electricity generation developments (Scottish Government, 2017a), surveying peatland (Scottish Government, 2017b) and NatureScot/Scottish Natural Heritage (SNH) guidance on good practice during wind farm construction (SNH, 2015).

1.2 Scope of Report

The potential for the occurrence of a peat landslide at the Site was assessed using the following methodology:

- Desktop review of existing information including geology and soils maps, topographical data, aerial photography, published reports and technical guidance;
- Peat surveys including:
    - Initial peat depth survey across the Site on a 100 m grid (Phase 1);
    - Targeted peat depth surveys across the proposed infrastructure footprint (Phase 2). These are described in more detail in **Section 3.1.7**;
    - Geomorphological walk-over survey;
    - Peat sampling and analysis carried out at six locations across the Site;
- Testing of peat samples for Total Organic Carbon (TOC), density, moisture content and organic matter at an accredited laboratory;
- Hazard ranking of potential areas of peat instability using a qualitative risk assessment methodology and Geographic Information Systems (GIS);
- Production of a peat landslide risk zonation plan through the assessment of peat instability hazard and exposure;
- Summary of key findings; and
- Identification of suitable mitigation measures to reduce the risk of a peat landslide within the Site.

1.3 Report Usage

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1.4 About the Authors

Graeme Duff BSc (Hons) MSc CSci FGS

Graeme Duff has over 20 years' experience in environmental consultancy. Graeme is currently a Director within EnviroCentre. He has acted as Project Director for a wide range of environmental projects and has significant experience in co-ordinating a multi-disciplinary team to address a range of environmental licensing requirements. Graeme has a specialism in geo-environmental risk assessment and remedial design. Graeme is a Chartered Scientist (CSci) and a Fellow of the Geological Society (FGS).

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Martin is a Principal Consultant with EnviroCentre. He has over 12 years consultancy experience in geomorphology, coastal processes, hydrology, flood risk and EIA, within both the private and public sectors. Martin has geomorphology field survey experience in coastal, river and upland systems, and has undertaken EIA for a range of developments including coastal protection schemes, harbours, quarries, energy infrastructure and wind farms. He has undertaken hydraulic modelling in support of a range of projects including, coastal, river restoration and flood risk assessments. Martin has experience working in peatlands, including undertaking and co-ordinating peat surveys, designing and installing peatland monitoring programmes, preparing peat landslide risk assessments and peat management plans, and developing peatland restoration plans. He has extensive GIS experience including spatial and 3D data analysis. Martin is a Chartered Water & Environmental Manager (C.WEM), and an experienced project manager.

Jennifer Smith BSc (Hons) MSc MCIWEM

Jennifer Smith is an environmental consultant with EnviroCentre. She has gained over 4 years' experience of consultancy whilst working on a range of projects including peat surveys and assessments, hydrological assessments, flood risk, coastal assessments, surface water management and environmental monitoring. Jennifer has gained valuable skills in GIS, including spatial and 3D analysis techniques. Jennifer has designed and undertaken peat surveys and contributed to the assessment of peat landslide risk. She has gained significant field survey experience, allowing her to work independently and assist on various projects across the company. Jennifer is a non-chartered member of CIWEM.

2 ASSESSMENT METHODOLOGY

The assessment adopted a standard risk analysis methodology in line with the Scottish Government guidance, where ‘hazard’ is defined as the likelihood of a peat landslide occurring and ‘exposure’ is the effect and consequences that the event may have.

Peat Landslide Risk = Hazard x Exposure

A qualitative peat landslide hazard assessment has been undertaken using a multi-criteria approach in GIS, which is summarised in **Table 2-8**, **Table 2-9**, **Table 2-13** and **Table 2-14**. The risk bandings have been assigned based on a literature review, professional judgement, and experience. Key technical papers and published guidance are referenced throughout the following methodology subsections.

2.1 Pre-failure Indicators of Instability

The identification of features that are indicative of potential failure in the peat environment is discussed below. These pre-failure indicators have been defined through three GIS layers:

- *Pre-failure indicators relating to evidence of movement or tension*: Features included in the assessment were historical and recent failure scars and debris, features indicative of tension, features indicative of compression and evidence of peat creep.
- *Pre-failure indicators relating to hydrology*: Proximity to local drainage and connectivity between surface drainage and the peat/impervious interface are considered to be key characteristics that predispose sites to failure (Warburton, Holden & Mills, 2004) and shear strength tends to decrease as water content/pore water pressure increases (Lindsay & Bragg, 2004). Features included in the assessment were: concentration of surface drainage networks, including drainage ditches, surface watercourses, ponds and gullies. A 25 m buffer has been applied to watercourses. The remainder of the Site has been zoned according to the presence or absence of these hydrological pre-failure indicators.
- *Presence of clay*: A peat layer overlying an impervious or very low permeability clay or mineral base is also considered to be a key factor affecting stability (Warburton et al., 2004).

Table 2-1: Perceived Risk Factors: Movement-related Pre-failure Indicators

Movement Indicators	Perceived Risk Factor
Absent	0
Presence of features indicative of tension, compression or peat creep	1
Presence of historical or recent peat landslides	3

Table 2-2: Perceived Risk Factors: Hydrological-related Pre-failure Indicators

Hydrological Indicators	Perceived Risk Factor
Absent	0
Present	2

Table 2-3: Perceived Risk Factors: Presence of Clay

Presence of Clay	Perceived Risk Factor
Absent	0
Present	2

2.2 Land Management

There is evidence that land management practices can influence the stability of peat. Anthropogenic causes of failure include:

- Disturbance of the original peat mass by peat cutting, extraction or stockpiling;
- Pre-forestry ploughing, burning; and
- Cutting of boundary and drainage ditches (Yang & Dykes, 2006).

The influence of peat drainage is already considered within **Section 2.1**, however other practices are considered in **Table 2-4**, including peat cutting (influence on stability of face of the peat cutting) and the presence of forestry. This includes all potential effects of forestry on instability, including drainage and desiccation cracks between the forestry furrows and therefore these are not considered separately as pre-failure indicators where forestry is present. Low intensity activities include upland grazing, fallow land and land managed for environmental enhancements or protection.

Table 2-4: Perceived Risk Factors: Land Management

Land Management Practice	Perceived Risk Factor
Low intensity activities	0
Peat cutting	1
Forestry – standing or felled	2

2.3 Peat Depth

Peat depth is a key factor in peat stability. Typically, deeper peat is more humified and amorphous and is potentially weaker whereas shallow peat tends to have a more fibrous structure and higher shear strength. Peat landslides occur most frequently in peat masses ranging between 1 to 2 m in thickness, while bog bursts commonly occur in peat ranging between 1.5 to 6 m deep (Evans & Warburton, 2008).

Peat depth on the Proposed Development has been ranked according to **Table 2-5**. Organic soils of <0.5 m depth are not classified as peat and therefore given a zero risk and screened out of the assessment. The risk factor for deep peat, in excess of 2 m, has not been linearly increased as the majority of recorded peat landslides occur in peat depth of 1 -2 m (Evans & Warburton, 2008).

Table 2-5: Perceived Risk Factors: Peat Depth

Peat Depth (m)	Perceived Risk Factor	Description
< 0.5	0	Thinner bands of peat will have accumulated relatively slowly under a vegetation community dominated by vascular plant species. The roots of these species form a fibrous network within the peat which gives it a high degree of internal coherency.
0.5 - 1	1	These depths of peat will have accumulated relatively rapidly with a greater proportion of Sphagnum (bog-moss) in relation to the vascular taxa. This peat will therefore be less fibrous and more prone to failure due to its relatively amorphous structure.

Peat Depth (m)	Perceived Risk Factor	Description
> 1	3	The thicker the peat, the greater the accumulation rate with proportionally higher amounts of Sphagnum, relative to the abundance of vascular species. The peat is consequently less fibrous and more prone to slippage. In addition, deeper peats are more likely to include weak layers which may cause slip planes and this may be exacerbated further by the presence of semi-fluid pool peat lenses which may cause a high level of instability.

2.4 Slope

The majority of peat landslides occur on slopes of between 5-20° and slopes for bog bursts typically range between 2-8° (Evans & Warburton, 2008). The slope map described in **Section 3.1.1** has been classified according to the factors assigned in **Table 2-6**. The Scottish Government guidance suggests that over 95% of published peat failures are situated on slopes >2° unless triggered by a profound anthropogenic mechanism and therefore slopes <2° are given a zero ranking. The same risk factor is applied to all slopes >5° following the evidence that the majority of failures occur on slopes between 5-20°. It should be noted that the accumulation of significant peat depths is generally limited to slopes of <20° (Hobbs, 1986).

Table 2-6: Perceived Risk Factors: Slope

Slope (°)	Perceived Risk Factor
< 2	0
2-5	1
>5	3

2.5 Curvature

Published data on the mechanism of peat failure (Warburton et al., 2004) identifies the presence of a convex slope or a slope with a break of slope at its head (concentration of subsurface flow) as being a characteristic that may predispose a location to peat failure. Curvature across the Site has been assigned the rankings shown in **Table 2-7**. The ranking is weighted so that the risk increases as the degree of convex curvature increases, as this indicates a sharper break in slope.

Table 2-7: Perceived Risk Factors: Curvature

Curvature	Perceived Risk Factor
> -0.1 (straight and concave)	0
-0.1 to -0.3 (convex)	1
< -0.3 (highly convex)	2

2.6 Peat Instability Hazard

A weighting has been applied to each of the hazard layers described above to represent its perceived influence on peat stability and to standardise the scoring matrix (**Table 2-8**). The presence of relict slips, deeper peat (>1 m) and steeper slopes (>5°) are given a higher perceived risk factor value, reflected by the maximum score, as these have been identified as key factors influencing the stability of peat in the previous sections.

Table 2-8: Peat Instability Hazard Weightings

Pre-condition to Peat Instability	Perceived Risk Factor Range	Weighting	Maximum Score
Pre-failure Indicators – movement	0-3	2	6
Pre-failure Indicators – hydrology	0-2	2	4
Pre-failure Indicators – presence of clay	0-2	2	4
Land management	0-2	2	4
Peat depth	0-3	2	6
Peat slope	0-3	2	6
Curvature	0-2	2	4
	Maximum score		**34**

This scoring methodology has then been used to band the peat instability hazard across the Site in line with Scottish Government best practice guidance, as summarised in **Table 2-9**.

Table 2-9: Peat Instability Hazard

Scale (Perceived Hazard Range)	Hazard
5 (>24)	High
4 (19-23)	Medium High
3 (13-18)	Medium
2 (7-12)	Medium Low
1 (2-6)	Low

2.7 Exposure (Adverse Consequence)

An assessment of the effect and consequence of any peat landslide event is undertaken by assessing the potential exposure. Peat failure in the proposed Site could have the following key consequences:

- Risk of injury or death;
- Damage to wind farm infrastructure, including turbines, tracks and plant;
- Damage to local properties;
- Pollution of local watercourses and potential alteration of drainage patterns due to blockage;
- Pollution of water sources (watercourses and springs) used for Private Water Supplies;
- Damage to habitats (including aquatic habitats); and
- Risk of damage and/or blockage to local roads and transport links.

There is considerable uncertainty in defining the potential magnitude of impacts of a peat landslide as this will depend on the precise location of the slide, the volume of peat mobilised and the runout direction, distance and velocity.

The approach adopted to the assessment of exposure has been informed by review of published guidance (Scottish Government, 2017a), review of existing peat landslide risk assessments undertaken by other professionals working within Scotland, review of relevant literature as referenced within this report, along with the application of professional experience/judgement. The approach identifies downgradient receptors, considers the sensitivity of the likely receptor, the distance between the receptor and the area of potential peat instability, and the difference in elevation between the receptor and the area of potential peat instability.

A GIS-based methodology has been applied to analyse the topography and define the potential runout direction and extents of peat landslides across the Site, as well as the potential landslide runout path, connectivity between potential areas of peat instability and potential receptors. Sensitive receptors have been screened out where there is no identified runout pathway or connectivity potential with the areas of potential peat instability.

Details of the adopted assessment scales for receptor sensitivity, receptor proximity, and elevation difference between instability source and receptor, are presented in **Table 2-10**, **Table 2-11** and **Table 2-12** respectively.

Table 2-10: Exposure - Receptor Sensitivity

Perceived Sensitivity Scale	Sensitive Receptors
10	Residential property; Members of the public; Public drinking water; and Internationally designated sites (SPA / SAC etc.).
6	Public roads / transport links; Nationally designated sites (SSSI etc.); Private water supplies (PWS); and Commercial property.
4	Main watercourses (classified under WFD); Site infrastructure / construction.
2	Minor watercourses
1	Local habitat of limited ecological value; and Artificial drainage.

Table 2-11: Exposure – Receptor Proximity

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

Table 2-12: Exposure – Receptor Elevation Difference

Elevation Difference Scale	Difference in Elevation – Instability Source to Receptor
5	More than 250 m
4	100 m to 250 m
3	50 m to 100 m
2	10 m to 50 m
1	Less than 10 m

A total score for exposure has been calculated, as presented in **Table 2-13**, using the formula:

Exposure = A x (B + C)

Where A = Receptor Sensitivity Scale, B = Receptor Proximity Scale, and C = Receptor Elevation Difference Scale.

Table 2-13: Calculated Exposure

Scale (Calculated Range)	Exposure
5 (⩾ 46)	High
4 (31 – 45)	Medium High
3 (16 – 30)	Medium
2 (6 – 15)	Medium Low
1 (⩽5)	Low

2.8 Peat Landslide Risk

The peat instability hazard (**Table 2-9**) and exposure (**Table 2-13**) scores have been multiplied to produce a peat landslide risk ranking between 1 and 25, as shown in **Table 2-14**.

Table 2-14: Peat Landslide Risk Ranking

Risk Ranking		Proposed Actions
17-25	High	Avoid project development at these locations
11-16	Medium	Project should not proceed unless the hazard can be avoided or mitigated at these locations, without significant environmental effects, in order to reduce risk ranking to low or negligible.
5-10	Low	Project may proceed pending further post-consent investigation to refine assessment and/or mitigate any residual hazard through micro-siting or re-design at these locations.
1-4	Negligible	Project should proceed with monitoring and mitigation of peat land landslide hazards at these locations as appropriate.

2.9 Potential Effects of Development

Activities carried out during the construction, operation and decommissioning of the Project that have the potential to increase the risk of peat landslide or act as trigger factors are outlined in **Table 2-15**. It is the responsibility of the Development's on-site engineer in conjunction with the contractor to take consideration of the potential effects and the activities that may result in these during construction, operation and decommissioning. Detailed mitigation will be developed at the pre-construction stage of the Site.

Table 2-15: Potential Effects

Potential Effect	Activity	Development Phase
Flow alterations – focusing of drainage/ ponding generating high pore-water pressures along potential failure planes	Construction of turbines, tracks, cable trenches and other site infrastructure.	CO, OP, DE
Rapid ground accelerations – increased shear stress	Blasting or mechanical vibrations (e.g. piling).	CO
Unloading of peat mass	Cutting into peat slope e.g. for track and hardstanding construction.	CO
Loading of peat mass – increase in shear stress	Heavy plant, floating infrastructure and stockpiles.	CO, DE
Reduction in vegetation cover	Stripping of vegetation for construction elements.	CO, DE

CO: Construction, OP: Operation, DE: Decommissioning.

2.10 Data and Methodology Review

Analysis and review of all input datasets was undertaken, including of Ordnance Survey mapping, digital terrain model (DTM), and associated data, prior to being used for the assessment. Additionally, sense checks and quality checking via internal reviews was conducted at all stages of the assessment, using experience of similar peatland projects across Scotland.

2.11 Uncertainties and Limitations

During the phase 2 survey 244 locations were probed within the dense forestry area within the centre of the Site. GPS signal can be affected by tree coverage, therefore locations were probed as close to the required 10 m grid as possible.

Equipment used to determine peat depth may also pass through other soil types before reaching ‘refusal depth’, resulting in peat depth results incorporating all soil which probing rods pass through. This is a conservative approach to ensure peat depths are gauged, but is anticipated to provide an overestimate of peat depths in some locations. Peat samples were collected at six locations across the Site during the phase 2 peat survey. Samples analysed at the surface and base were comprised of peat only.

The inputs of slope and curvature were derived from a 5 m resolution digital terrain model (DTM). The outputs of slope and curvature are reflective of the quality of the DTM, and it is noted that features of less than 5 m scale are not likely to have been captured. Field surveys were undertaken to verify and capture details not picked up in the DTM, however due to dense vegetation cover it is possible that not all of these features were able to be identified.

As peat depths were used to create interpolated maps, it is possible that actual depths between probed points are different to those shown, as the depths between points on an interpolated map are calculated from the nearest neighbouring probed depths.

As outlined in **Section 2.7**, it is noted that there is considerable uncertainty in defining the potential magnitude of impacts of a peat landslide as this will depend on the precise location of the slide, the volume of peat mobilised and the runout direction, distance and velocity. The effect and consequence of any peat landslide event is determined by assessing the potential exposure, which is ranked by considering the likely effects. As this can be subjective there is uncertainty associated with the judgement calls made, however the internal review process applied at all stages of the assessment attempts to mitigate this uncertainty.

Uncertainties also surround some construction activities, and associated impacts. During any construction activity involving the movement of soils, increased loading upon soils or installation of drainage, account should be taken of the activity’s location and proximity to peat within construction method statements, whilst construction drainage should attempt to limit discharge into areas of peat landslide risk, and avoid concentration of flows where possible. The Site Engineer should monitor and consider this throughout the construction phase of works, and any implications it may have on the post-construction/operational phase.

The assessment does not take into account effects from the Site. The Site Engineer should consider these effects in the pre-construction phase and associated risks through visual inspection and on-going ground investigations throughout the construction phase.

3 SITE CONTEXT

The Site is situated on Hill of Fare, located approximately 6 km north of Banchory, Aberdeenshire. The Proposed Development consists of 16 turbines and associated infrastructure, access tracks (cut and floating), upgrades to existing access tracks, batching plant, six borrow pits, control building and substation, battery storage, temporary construction compound and enabling works compound (refer to **Chapter 2: Project Description** of EIAR).

3.1 Site Characteristics

3.1.1 Topography

The Site is located within areas of upland heather moorland and forestry (standing and felled) with nine distinct hill tops present on the Site.

The Site is characterised by upland plateaus and surrounding hillslopes. In the west of the Site, five distinct hill tops are present with associated flatter plateaus (Hill of Fare, Hill of Corfeidly, Tornamean, Craigrath and Blackyduds), the highest of which being Hill of Fare in the west of the Site (peak of 470 metres Above Ordnance Datum (mOAD)). The ground gradually slopes towards the Burn of Lythebauds in the north, and towards the Burn of Corrichie in the south. Relatively flatter upland moorlands are present in the centre of the Site, including the flat plateau of Brown Hill. The ground then slopes up to the steeper slopes of three remaining hilltops, Marquis's Hillock and Meikle Tap in the south of the Site and Greymore in the north. Relatively flatter heather moorlands are present in the east of the Site. Ground levels in the Site range between approximately 312 mAOD to 470 mAOD.

A surface slope map for the Site was produced from the OS Terrain 5 Digital Terrain Model (DTM) using terrain evaluation techniques in ESRI ArcGIS, as shown in **Drawing 375565-GIS003A, Appendix C**. The flatter plateaus in the centre, west and east of the Site are highlighted by areas where the slopes are <2°, whilst steeper slopes are shown to be associated with:

- Steep slopes of the nine hillslopes (Hill of Fare, Hill of Corfiedly, Tornamean, Blackyduds, Craigarth, Brown Hill, Marquis's Hillock, Meickle Tap and Greymore); and
- The valley sides of the Burn of Lythebauds, Burn of Corrichie and Landerberry Burn in the north-west, south and north-east of the Proposed Development.

The absence of slopes with gradients >2° is one of the defining criteria for the 'early exit' route from peat landslide risk assessment based on the Scottish Government guidance (Scottish Government, 2017a), however the early exit route is not applicable for the Site.

The curvature of slopes has also been identified from the DTM in the direction of the steepest slope, as shown in **Drawing 375565-GIS005A, Appendix C**. Values around zero are indicative of rectilinear slopes and are located on flatter plateaus on the top of the hillslopes or in flatter areas north-east and east of the Proposed Development. Areas of highly convex or concave areas are present in a proportion of this Site due to the relatively steep topography. The convex curvature is identified mainly in areas of steep slope mentioned above such as, valley slopes or breaks in slope on the steeper hillsides. In a few locations, minor inconsistencies may occur between the underlying topographic data and the curvature class, as a legacy of the data resolution and original processing during creation of the OS Terrain 5 ground model, however such instances are generally not considered to be significant.

3.1.2 Land Use

The Site is predominantly upland moorland, managed for estate use, with vehicular tracks and grouse butts present. The Site is also accessed for recreation, with a series of footpaths present within the site. The Site is surrounded by dense plantation forestry, and associated access tracks. Forestry is present within the centre and north-east corner of the Site, and north of the access track in the east of the Site. A review of these areas during the May and August peat surveys showed many of these areas are now felled, with standing forest observed in the centre of the Site west of the access track and north of the access track in the east (**Photograph 3-1**). Within the Site itself vegetation out with the forestry areas is generally comprised of heather moorland and mossy areas.

Photograph 3-1: Taken on 26th May 2023 by EnviroCentre during Phase 2 Peat Survey

Photograph	Comment
	Dense coniferous forestry present within the centre of the Site, west of the access track.
	View looking south. Felled area present within the centre of the Site, east of the access track.

There is evidence that historic heather burning has taken place across the Site, with some areas now regenerating. There have also been other manmade alterations to the Site over time, particularly with the installation of a cable route aligned approximately north to south in the west of the Site. The Site drainage has also been modified over time, with a series of manmade ditches and grips identified in the west of the Site draining towards a gully and Burn of Lythebauds.

A review of historical mapping between 1843 and 1930 shows no history of forestry on the Site (National Library of Scotland, n.d.). There was evidence of rough pasture in 1888 and some marshy areas surrounding the Burn of Lythebauds in the north-east of the Site. Peat cutting has historically been undertaken on the Site, as further outlined in **Section 3.1.4**.

3.1.3 Hydrology

Peatland hydrology is dominated by surface water runoff and near-surface runoff due to high water tables and low hydraulic conductivity within the catotelm (more humified lower peat layers). The headwaters of two watercourses originate in the Site which drain in an easterly direction. The Burn of Lythenbauds is present in the north-west of the Site which confluences with the Gormack Burn approximately 400 m north of the Site. The Burn of Corrichie originates in the south-west of the Site and confluences with the Rae Burn approximately 1,600 m south of the Site.

To the north-west of the Site the headwaters of the Cluny Burn drain northwards towards Upper Tillenhilt. To the east of the Site the proposed access route runs adjacent to the Landerberry Burn. To the south-west of the Site there are a series of smaller drains and tributaries which confluence with the Blacklinn Burn, however these do not extend into the Site.

The Burn of Corrichie and Cluny Burn are classified as having a good status on the SEPA Water Framework Directive (SEPA,2020) and the Burn of Lythenbauds as having moderate status.

Within the Site there are a series of smaller hydrological features (small ponds or depressions) primarily within the west of the Site. A larger gully was identified in the west of the Site. During the site walkover a series of manmade ditches were observed, which are believed to have historically drained the areas to the south into the gully. Additionally, some manmade drainage channels/gullies were identified connecting to the Burn of Lythenbauds (target notes 35, 37 and 38), and some natural drainage areas were observed draining towards the Burn of Lythenbauds and Burn of Corrichie.

3.1.4 Geomorphology

The geomorphology of peatlands is closely linked to their hydrological functioning. For this assessment, the focus has been on geomorphological forms that are of relevance to peat stability. Aerial photography and Google Earth imagery of the Site were reviewed to identify the presence or absence of the following features:

- Existing land use and relevant management practices;
- Agricultural ditches / grips;
- Presence of springs, seeps or concentration of surface water;
- Evidence of historical or recent peat landslides;
- Evidence of peat cutting or ridges;
- Evidence of cracks, compression, collapse or peat creep; and
- Evidence of historical or recent peat erosion, for example bare peat, gullying, peat haggs.

A geomorphological walkover survey was carried out on 16th and 17th December 2021 of the west of the Site (Phase 1 Site boundary) to ground truth the features identified from the aerial photography, and to identify other features which are more difficult to identify from the aerial photography (for example the presence of peat pipes, peat cutting ridges). Weather conditions during the walkover consisted of dry, sunny intervals and cold conditions. A geomorphological map is provided in **Drawing 375565-GIS001A, Appendix C**. The associated target notes are in **Appendix A** of this report.

Limited peat erosion was observed at the Site, generally in two forms:

- Presence of a large gully in the west of the Site which was wide, shallow and vegetated with heather. Series of manmade ditches south of this gully which would have presumably drained the surrounding land into the gully. There were a few smaller gullies connected to the Burn of Lythenbauds (Target Notes 35, 37 and 38) some of which were vegetated or filled with shallow water; and

- Presence of two peat haggs where the gully or surface water network has extended so that isolated islands of peat are now present. This was only evident at two locations within the Site which corresponded with areas of deeper peat (target note 30 and 40).

There is evidence of historic peat cutting within the Site, notably in the form of a cut face / ridge in the western portion of the Site (target note 8 and 20). This cut face / ridge is jagged in orientation, consisting of straight edges and sharp turns, consistent with the typical pattern of historic intermittent manual peat cutting. The area to the west and south of the peat cut face corresponds with an area of shallow organic soil cover, where overlying peat cover is considered to have been historically extracted. Additionally, south of the Burn of Corrichie there is a small ridge which has the same jagged appearance in locations, and is also considered as evidence that peat cutting has taken place in this area (Target note 27). A small ridge is also present north of the peat cutting area shown in target note 9.

As noted in **Section 3.1.2**, a buried cable route transects the Site in the western portion, orientated approximately north to south. Peat present in the vicinity of the cable route will have been subject to disturbance during excavation of the cable trench.

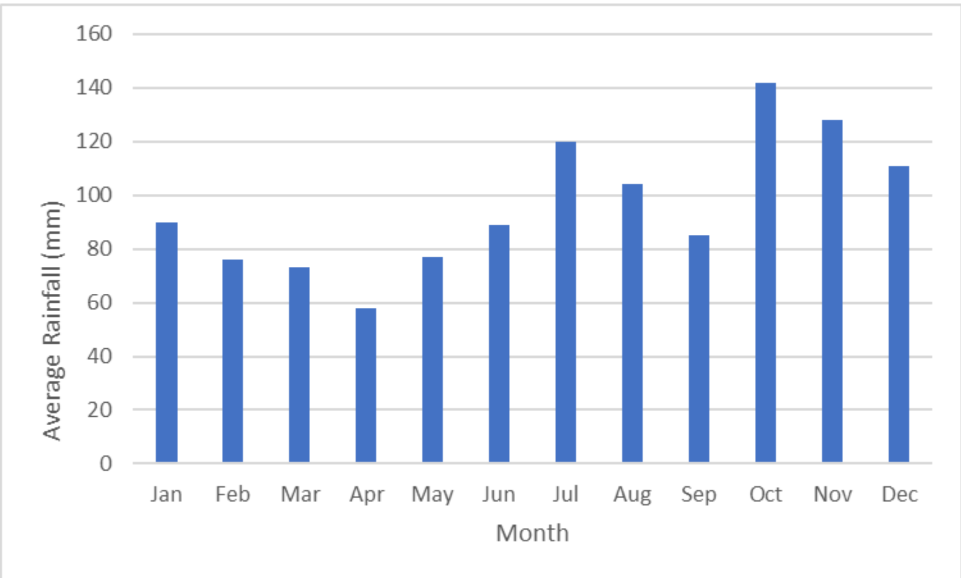
Throughout the Site there are several areas of historic burning or burning scars where heather has previously been burned. However, during the walkover survey it was observed that in large areas there is evidence of heather regeneration, and significant height of heather cover. As noted in **Section 3.1.2** areas of forestry are also present within the Site boundary some of which are now felled.

3.1.5 Rainfall

Rainfall information was provided by SEPA for the rain gauge at Mongour (ID: 115234) which is located approximately 13.5 km to the south-east of the Site at an elevation of approximately 320 mAOD. **Table 3-1** shows the monthly average rainfall at this location for the period February 2010 to August 2023. The annual average rainfall over this period at Mongour is recorded as 1,153 mm.

Table 3-1: Summary of Monthly Rainfall Information from Mongour Lodge Rain Gauge (mm)

J	F	M	A	M	J	J	A	S	O	N	D	Ann. Ave.
90	76	73	58	77	89	120	104	85	142	128	111	***1153***



Peat exhibits highly erratic strength properties and these appear to be linked to water content; shear strength decreases as water content/pore water pressure increases (Lindsay & Bragg, 2004). However, the exact mechanism of failure is not always known. While many reported peat failures have been associated with heavy or prolonged rainfall, it should be noted that prolonged periods of heavy rainfall are not necessarily related to instability. Some recorded peat mass movements have occurred following a dry period proceeded by intense, but not prolonged, rainfall.

Both the distribution and intensity of precipitation have a complex influence on the mass movement of peat (Wilson & Hegarty, 1993) and rainfall has therefore been considered to be a constant at the Site for the risk assessment.

3.1.6 Geology

3.1.6.1 Bedrock Geology

BGS mapping (BGS, n.d.) shows that the bedrock geology underlying the majority of the Site is Hill of Fare Intrusion Leucogranite (**Drawing 375565-GIS006A, Appendix C**). Within the centre and west of the Site there are small areas underlain by Hill of Fare Microgranite.

3.1.6.2 Superficial Deposits

BGS mapping (BGS, n.d.) shows that peat deposits are present across the majority of the west of the Site with smaller areas in the centre (**Drawing 375565-GIS007A, Appendix C**). Banchory Till Formation deposits are present around the Burn of Corrichie in the south of the Site and Landerberry Burn in the north-east. There are large areas in the east, west and centre of the Site, surrounding Burn of Lythebauds and at the base of the hillslopes where there are no records of superficial deposits.

The carbon and Peatland map identifies 5 classes of soil are present across the Site (SNH, 2016) (**Drawing 375565-GIS016, Appendix C**). Surrounding the Burn of Corrichie and Burn of Lythebauds class 0 soil is present which indicates the presence of mineral based soils. Within the west of the Site on the slopes of Hill of Fare, class 1 soil is present which is comprised of peat soil and peatland vegetation. In the west, north-west, south west and north-east of the Site there are small patches of class 3 soil which indicates the presence of predominantly peaty soil with some peat soil, and peatland vegetation with some heath. Within the majority of the centre and east of the Site along the proposed access track, class 4 soil is present. This is comprised of predominantly mineral soil with some peat soil and heathland vegetation. Within the remainder of the west of the Site, around Landerberry Burn and small patches within the forestry in the south of the Site class 5 soil is present which is comprised of peat soils with no peatland vegetation.

Samples were obtained at six locations across the Site to base. Clay was not encountered at the base of any location during sampling (refer to **Appendix B**) and therefore for the purposes of this report it is considered that clay is not present in the Site.

3.1.7 Peat Characteristics

3.1.7.1 Peat Depth

The following peat depth surveys have been undertaken at the Site, with a total of 2,822 locations probed:

- *15th- 17th December 2021 and 19th - 20th January*: Initial investigative peat depth survey undertaken across the Phase 1 Peat Mapping Area on a 100 m grid. A total of 538 locations were probed;

- *9th-25th May 2023*: Targeted Phase 2 peat survey was undertaken in line with the Proposed Development layout (04542-RES-LAY-DR-PE-001). Peat depths were recorded at 50 m intervals and 10 m offset along the proposed track, at the centre of each turbine with four points at 10 m and 20 m buffers and all other infrastructure probed on a 10 m grid. A total of 2,068 locations were probed. Six peat samples were also collected across the Site using a Russian Corer; and
- *29th -30th August 2023:* Additional surveying of the Proposed Development layout in response to the layout changes at the Site ((as per Infrastructure Layout Rev 3.0). - "Design Freeze Layout"). Peat depths were recorded at the same spacing as the targeted phase 2 survey. A total of 216 additional locations were probed.

During each survey a high-accuracy handheld Trimble GPS device was used to navigate to the probe locations. At each location probed depths were obtained by manual insertion of a metal probe to a refusal depth (maximum depth of 5 m). At each probed location vegetation type and drainage characteristics were also noted.

An Unexploded Ordnance (UXO) Risk Assessment was carried out at the Site in March 2022 by 1st Line Defence (Refer to **Chapter 14: Aviation and Other issues**). This assessed the Site as having a precautionary medium risk of UXO. For the phase 1 peat survey a 100 m grid was applied for peat probing therefore UXO support was not deemed necessary, however for the phase 2 surveys UXO engineers were present due to the denser grid (10 m). A non-intrusive UXO survey was undertaken by 1st Line Defence engineers which involved scanning the ground with a handheld magnetometer prior to probing or sampling. No anomalies were detected during the surveys, therefore no restrictions were placed on probing or sampling within the Site.

The peat depth data from the Site surveys is summarised in **Table 3-2**, and the interpolated peat depths across the Site and proposed access track are plotted in **Drawing 375565-GIS011A, Appendix C.** Organic soils of less than 0.5 m depth are not classified as peat in current guidance and therefore have been screened out of the hazard assessment. Soils of less than 0.5 m depth, which will comprise a mix of organic and mineral soils as outlined in **Section 3.1.6.2**, accounted for 74.7 % of the probed locations. Areas of deep peat (>1m) were recorded at 8 % of the probed locations. Surveyed peat depth ranged from 0.5 m to 5.0 m across the Site.

Table 3-2: Peat Depth at Probing Locations

Peat Depth Range (m)	Peat Depth Categorisation	Number of Locations	% of Locations
< 0.5	Soils not classified as peat	2108	74.7
0.5 – 1.00	Shallow	473	16.8
1.01 – 1.50	Deep	117	4.1
1.51 – 2.00		73	2.6
2.01 – 3.00		39	1.3
3.01 – 4.00	Very deep	10	0.4
4.01 – 5.00		2	0.1
> 5.00		0	0
Total		**2822**	**100**

The proposed infrastructure layout has been designed to avoid areas of deep peat wherever possible. The majority of the access track passes through soils or shallow peat with a four sections of track traversing pockets of deeper peat (between Turbines 2 and 3, 6 and 7, 6 and 8, and to Turbine 11). It should be noted that all of these track sections are proposed to be floating track, with the exception of a small isolated pocket of peat on track to Turbine 11.

Of the 16 proposed turbines and associated infrastructure (hardstanding):

- Turbines 10, 13, 14 and 16 are located in areas of soils;
- Turbines 2, 4, 5, 9, 12 and 15 are located in areas or soils and shallow peat (<1 m);
- Turbines 1, 3, 6, 8 and 11 are located in areas of soils or shallow peat (average <1 m) but also contains some areas of deeper peat (1-1.9 m); and
- Turbine 7 is located in areas of soils or shallow peat but also contains areas of deeper peat (1-2.5 m).

Of the remaining infrastructure:

- Batching Plant, Temporary Enabling Works Compound and Control Building and Substation are located within areas of soils;
- Six Borrow Pits and Temporary Construction Compound are located within areas of soils or shallow peat (average depth <1.0 m); and
- Battery Storage is located within areas of soils, shallow and deep peat (maximum of 1.2 m recorded).

At each probed location vegetation type and drainage categories were observed, the results of which are detailed in **Drawings 375565-GIS008A and 365565-GIS009A, Appendix C**. In summary the dominant vegetation type across the Site is heather. Areas of felled trees are present at the eastern entrance to the Site and within the centre of the Site east of the access track. On the right of the access track in the centre of the Site forestry plantation is present mainly with moss or grass on the ground surface. An existing access track is present within the Site originating at the eastern boundary. The centre of the track in the centre and west of the Site was probed during the phase 2 surveys and probing was offset from the access track in the east of the Site during the Phase 1 Survey. This identified the dominant vegetation type alongside the access track in the east is heather with some isolated patches of bog/moss, grass and bracken. Some isolated patches of moss and grass were identified across the Site, with the majority surrounding the Burn of Lythebauds and Burn of Corrichie.

The majority of the Site is noted to be dry or drained. Wetter areas are present around the watercourses, where bog/moss was present and in the southern forestry areas within the centre of the Site where moss was noted to be present.

3.1.8 Physical Characteristics

Peat samples for laboratory testing were obtained using a Russian corer from six locations across the Site. At least two samples were taken at each location, one from the more fibrous upper peat layer (<0.5 m depth) and at least one from the more decomposed lower layers (>0.5 m depth). The peat sampling locations were chosen to provide a representative coverage of the peat characteristics of the Site, taking into proposed infrastructure layout and various peat depths. The sample locations are shown in **Drawing 375565-GIS11A, Appendix C**.

At each location in-situ shear vane testing was carried out at the top (surface layer - 0.1 m), middle and base depth. Stratigraphic logging using the Von Post Classification was also undertaken every 0.5 m depth increment to 1.0 m at all sample locations (0m to 0.5 m and 0.5 m to 1.0 m), with one classification in deeper peat where present. Samples were then analysed by an accredited laboratory for moisture content, organic matter, bulk density and Total Organic Content (TOC), A summary of the physical characteristics from both the field and laboratory results is provided in **Appendix C**.

The results of the Von Post classification suggest that peat at the Site is generally moderately highly or very highly decomposed, even within the first 0.5 m depth in five out of the six locations. This could affect the suitability of the peat for re-use at the Site and is discussed further in the Peat Management

Plan (**Technical Appendix 10.2, Volume 4 of the EIAR**). It was noted that degree of humification was noted to be lower at Sample F in the south-west of the Proposed Development with slightly decomposed peat recorded.

Peat soils generally have very high moisture contents typically in the range of 600-1800 % in comparison to the mass of dry material of the same volume (Hobbs, 1986). Samples taken within the west of the Site (Samples D and E) and the centre of the Site (Sample C) fall within the range. Moisture content typically decreased with depth, with an average of 651 % in the first 0.5 m depth of peat and 560 % at depths >0.5 m.

The measured shear strength ranged from 8 kPa to 26 kPa (average 16 kPa) in the top 0.1 m of peat and generally increased with depth ranging from 4 to 30 kPa (average 18 kPa). Sheer strength can be expected to decrease with depth as humification increases (Lindsay & Bragg, 2004). This assumption was not met in the majority of samples however it was noted humification results were recorded as similar at different depths in the majority of samples. Shear strength is not included as an explicit criterion within the qualitative peat landslide risk assessment described in **Section 2**. Higher shear strength at the base of the samples suggests ground is more stable and less at risk of instability and slippage at the base. These samples were typically acquired in flatter areas of shallower peat (maximum 1.5 m). In section 2 flatter slopes are considered to have a lower risk of failure. The sample collected within the centre of the Site was found to have shear strength increasing with depth. The sample acquired here was at the deepest depth (2.1 m) and humification was noted to increase with depth.

The Total Organic Content of the peat ranged between 23.6 % and 48.1 % in the first 0.5m depth of peat and 42.6 % to 70.7 % at deeper peat layers, with an overall average of 46%. The dry bulk density ranged from 0.08 g/cm^3 to 0.22 g/cm^3, with an overall average of 0.15 g/cm^3 and bulk density ranged from 0.98 g/cm^3 to 1.05 g/cm^3 with an overall average of 0.99 g/cm^3.

4 PEAT LANDSLIDE RISK ASSESSMENT

4.1 Peat Instability Hazard

A peat instability hazard map for the Site was produced, in line with the aforementioned methodology, and is shown in **Drawing 375565-GIS012A, Appendix C**. Any blank areas within the Site extent represent areas where the probed depth is less than 0.5 m, and as such peat is not considered to be present, and therefore these areas have been screened out of the assessment. The outputs of the peat surveys and peat instability hazard assessment have informed iterative layout design development. The following proposed infrastructure lies within areas where peat is not considered to be present: batching plant, temporary enabling works compound, control building and substation, Turbines 10, 13, 14, 16 and sections of proposed access track.

The key findings from the hazard maps are:

- The battery storage, control building and substation and one borrow pit within the centre of the Site lies within area of standing or felled forestry. Turbines 3-5 and 9 with associated infrastructure and tracks lies within the area of historical peat cutting, where peat has been removed historically, however no infrastructure is proposed on the remaining peat cut face;
- The vast majority of infrastructure avoids areas near watercourses or hydrology features (gullies, grips, drainage ditches), with the exception of a small section of the track between Turbines 6 and 7 and Turbines 6 and 8 that traverses an area of manmade drainage/gully;
- While much of the proposed infrastructure in the west and centre of the Site lies within areas of peat, the layout of turbine locations, infrastructure and access tracks has been iteratively developed so as to avoid areas of deep peat wherever practicable;
- The majority of the infrastructure has been sited in areas of relatively shallow slope (<5°). A number of sections of access track do however traverse slopes >5°, and the proposed locations of turbines 5, 8, 11,12,13,14 are also on slopes >5°. Turbine 1 is located immediately adjacent to slopes >5°; and
- Of the proposed infrastructure sited within peat (six borrow pit areas, a temporary construction compound, battery storage, Turbines 1 - 9, 11, 12 and 15, and proposed access track) the vast majority lies within areas of low or medium-low peat instability hazard. A small section of proposed access track between turbine 6 and 8, and 6 and 7, lies within an area of medium to medium-high peat instability hazard. This section of track is proposed to be floating track.

4.2 Exposure

Exposure has been assessed using the aforementioned methodology in **Section 2.7**. **Drawing 375565-GIS017, Appendix C,** outlines the potential landslide runout pathways and sensitive receptors. The majority of the peat masses have been assessed as having medium exposure, affecting infrastructure or watercourses classed on the Water Framework Directive (WFD) (Burn of Corrichie, Burn of Lythebauds and Cluny Burn). A small area on the southern and western boundary is assessed as having a medium-low exposure, affecting non-designated watercourses. A small area in the southwest of the Site is assessed as having medium-high exposure, as it has the potential to affect the Strath PWS (spring) downslope in Cormoir Wood. An exposure map is provided in **Drawing 375565-GIS013, Appendix C**.

4.3 Peat Landslide Risk

The peat instability hazard and exposure scores have been multiplied to produce a peat landslide risk ranking between 1 and 25, as described in **Table 2-14**. The vast majority of the proposed infrastructure falls within either negligible or low zones. Both the negligible or low zones are considered acceptable for development, assuming that suitable mitigation, monitoring and contingency measures are put in place as described in the section below. Small, isolated sections of the proposed floating track between Turbine 6 and 7 falls within a medium zone. A review of the pattern of the medium risk in this area shows that it influenced by the curvature input layer for the Peat Instability Hazard (**Drawing 375565-GIS05A, Appendix C**). As mentioned in **Section 2.11** curvature outputs are derived from a 5 m resolution DTM and therefore the output is reflective of the DTM quality. It is considered that this risk may be overestimated and could be refined and/or managed on Site during construction with on-site ground investigations and mitigation measures detailed below (**Section 5**).

The peat landslide risk zonation for the Site is shown in **Drawing 375565-GIS015, Appendix C.**

5 MITIGATION AND GOOD PRACTICE

This section outlines the mitigation, monitoring and contingency plans that will be implemented to reduce the risk of a peat landslide at the Site.

The proposed layout avoids excavation in very deep peat. Areas of deep peat have been avoided where possible through the iterative site layout design process, and through the use of floating tracks within the Site. The layout has also been designed to avoid proximity to watercourses, and areas of higher peat instability hazard.

The following mitigation and good practice measures will be carried out during the construction phase:

- Small areas of medium risk are present underlying sections of track between turbine 6 and turbine 7. These tracks are proposed to be floating tracks. It is recommended that on-site ground investigation be carried out prior to construction of the floating tracks, and where any residual instability risk is detected the floating tracks could be microsited to the west (areas with a lower Peat landslide risk rating);
- Suitable construction techniques will be adopted by experienced and competent contractors during construction of the development in accordance with current guidance (Scottish Executive, 2006; SNH & FCE, 2010; SNH, 2015). Staff will be made aware of peat instability indicators and emergency procedures;
- A Geotechnical Risk Register (GRR) will be used during the construction and decommissioning phases under the supervision of an on-site geotechnical engineer. The GRR will be informed by on-going ground investigations and will be updated throughout the construction phases;
- Additional slope stability calculations will be undertaken as required during detailed design to ensure that the peat landslide risk ranking remains at an acceptable level;
- During the construction of the Proposed Development, all reasonable measures will be taken to avoid or minimise excavations and minimise disturbance to peat and peatland habitats;
- Ground disturbance areas around excavations within peat will be kept to a minimum and will be clearly defined on Site. Access to working areas during construction will be restricted to specified routes, comprising constructed tracks. Vegetation will be re-established as soon as possible;
- Infrastructure will be micro-sited to avoid areas of higher risk in the detailed pre-construction design, as identified by the on-site geotechnical engineer;
- Excavations will be designed by the geotechnical engineer based on information from local ground investigation during the construction phase. Undercutting of peat slopes will be minimised. Suitable retaining structures will be designed by the geotechnical engineer and put in place;
- Suitable and robust Sustainable Drainage Systems (SuDS) will be installed in advance of construction activities to avoid concentration of flows onto slopes or excavations or the drying of peat. This will be regularly inspected and maintained to ensure optimal performance. Sediment control measures will be incorporated into all Site temporary and permanent SuDS. The SuDS will be designed to ensure that build-up of surface water (leading to additional loading) in areas of higher peat landslide risk is avoided;
- Track construction will include the maintenance of existing drainage paths with suitable cross drains installed where necessary to prevent the accumulation of surface water;
- Floating tracks will be constructed in areas underlying by deeper peat to minimise excavation of peat;
- Excavated peat will be re-used as soon as is practicable and its storage will avoid areas of higher risk and deeper peat, as identified in the GRR;

- Peat working will be restricted during and immediately after heavy and prolonged rainfall events; and
- Excavated material or other forms of loadings will be avoided in areas of marginally-stable ground and breaks in slopes (to be identified by geotechnical engineer).

Contingency/emergency planning for peat landslide events will be undertaken at an early stage during construction planning and incorporated into the Construction Environmental Management Plan (CEMP). It will address the following:

- Monitoring for movement and changes in the stability of the peat mass;
- Investigation of local ground conditions;
- Consideration of the potential size of a peat landslide;
- Steps to be taken on detection of an incipient peat landslide or of the event occurring;
- Communication mechanisms in the event of a peat landslide; and
- Remedial works.

While the Proposed Development is operational the GRR will be maintained and routinely updated. Where maintenance works are required, for example of on-site tracks, the relevant mitigation measures and best practice working methods as outlined for the construction phase will be employed. Contingency measures and emergency procedures should be in place throughout the lifetime of the wind farm.

During the decommissioning phase appropriate mitigation, environmental management and monitoring measures will be adopted as during the construction phase, subject to advances in approach and changes in legislation.

During the pre-construction phase of the Proposed Development, detailed assessment will be conducted by the Site Engineer and contractor, considering the potential implications of peat landslide risk, in consultation with the Environmental Clerk or Works (EnvCoW), particularly around areas of peat on slopes. Suitable specific mitigation will also be developed during the pre-construction phase by the appointed contractor and the Site Engineer.

6 CONCLUSIONS AND RECOMMENDATIONS

A total of 2822 locations were probed, with 74.7% identifying soils and 25.3% peat. Where peat has been identified it is distributed throughout the centre and west of the Site, with deeper deposits predominantly located within the elevated, flatter areas on the top of the hilltops and plateaus, with depth ranging from 0.5 m to 5.0 m. Banchory Till Formation Deposits are present around the Burn of Corrichie in the south and Landerberry Burn in the north-east.

The proposed infrastructure layout has been designed to avoid areas of deep peat wherever possible. The majority of the access track passes through organic soils or shallow peat with four sections of track traversing pockets of deeper peat. It should be noted that most of these track sections are proposed to be floating tracks. Of the 16 proposed turbines:

- Turbines 10, 13, 14 and 16 are located in areas of soils;
- Turbines 2, 4, 5, 9, 12 and 15 are located in areas of soils and shallow peat (<1 m);
- Turbines 1, 3, 6, 8 and 11 are located in areas of soils or shallow peat (average <1 m) but also contains some areas of deeper peat (1-1.9 m); and
- Turbine 7 is located in areas of soils or shallow peat but also contains areas of deeper peat (1-2.5 m).

Of the remaining infrastructure the majority is located in areas of soils or shallow peat with small sections of the battery storage located within areas of deep peat (maximum of 1.2 m recorded).

A qualitative peat landslide risk assessment has been undertaken using a multi-criteria approach in GIS. The vast majority of the proposed infrastructure layout falls within either low or medium-low hazard of peat landslide risk. Short section of access track between Turbine 6 and 7 and 6 and 8 lie within an area of medium to medium-high hazard.

The majority of the Site is assessed as having medium exposure affecting infrastructure or watercourses designated on the WFD. Small section in the south and west are assessed as having medium-low exposure, affecting a non-designated watercourse and a small section in the south is designated as having medium-high exposure as it has the potential to affect a downslope PWS.

The vast majority of the proposed infrastructure is underlain by negligible and low peat landslide risk zones. Small, isolated sections of the proposed floating track between Turbine 6 and 7 falls within a medium risk zone. It is however considered these results are influenced by the quality of the DTM, and associated curvature outputs. It is considered that as a result this risk may be overestimated, and due to the small areas, the assessment could be refined with on-site ground investigations and / or the risk managed on site with micro-siting and appropriate mitigation measures.

The peat landslide risk with negligible and low zones is considered manageable through the implementation of good practice and mitigation measures. These include the use of a geotechnical risk register during the construction and decommissioning phases, supervision by an on-site geotechnical engineer, micro-siting of infrastructure as required based on in-situ ground conditions, storage of excavated material in areas of lower risk, installation of appropriate drainage and monitoring of groundwater levels at key locations.

Further detailed ground investigations should be undertaken prior to construction of the Proposed Development to inform detailed design and optimise micro-siting of infrastructure. Slope stability calculations should be undertaken as required during detailed design to ensure that the peat landslide hazard remains at an acceptable level. Ongoing consideration should be given to peat landslide risk throughout the lifetime of the project. Contingency measures for peat landslide events will be incorporated in the Proposed Development's CEMP.

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APPENDICES

A TARGET NOTES

Target Note	X	Y	Photograph	Comment
1	367193.3	801786.4		Undulations on ground leading from small bog area
2	367258.1	801816.9		Historic burned area with shorter heather

Target Note	X	Y	Photograph	Comment
3	367008.7	801984.7		Small ditch which is dry and vegetated with heather
4	367242.3	802063.2		Historic burned area with short heather and grass
5	367381.4	801918.1		Historic burned area

Target Note	X	Y	Photograph	Comment
6	367548.5	801853.9		Depressions and ditch. Ditch was vegetated and dry
7	367113.9	802107		Historic burned area
8	367461.8	802031.8		Edge of historic peat cutting showing cut face to left of picture

Target Note	X	Y	Photograph	Comment
9	367475.7	802129.1		Ridge. Pools and drains present in area
10	366931.5	802380.7		Vegetated mound (covered wall/boundary) and series of smaller ditches. Ditches are vegetated and dry.
11	367004.5	802298.5		Historic burned area

Target Note	X	Y	Photograph	Comment
12	367099	802311.2		Historic burned area
13	367412.2	802271.4	See TN14	Historic burned area
14	367350.8	802384.6		Gully natural drainage feature

Target Note	X	Y	Photograph	Comment
15	367588.1	802406.2		Drained area with manmade rectilinear ditches
16	367063.4	802513.1		Historic burned area with short heather
17	367029.3	802688.5		Historic burned area

Target Note	X	Y	Photograph	Comment
18	367060.5	802828.7		Historic burned area
19	366989.1	802945.4		Historic burned area
20	367252.8	802934.6		Area of historic peat cutting, cut face to left of picture

Target Note	X	Y	Photograph	Comment
21	367453.1	802848.5		Ditch vegetated with heather
22	367419.5	802792.2		Ditch
23	367737	802660.2		Gully

Target Note	X	Y	Photograph	Comment
24	367970	802730.7		Historic burned area
25	368302.9	802583.2		Historic burned area with regenerated heather
26	368233.9	802125.9		Natural drainage area with a wet flush

Target Note	X	Y	Photograph	Comment
27	367997.4	801986.2		Cut face on edge of peat cutting
28	368002	801951		Low lying area with marshy vegetation draining to burn
29	368263	801984.5		Area of short regenerated heather

Target Note	X	Y	Photograph	Comment
30	367939.4	801859.7		Peat hag (visible in distance)
31	367693.3	801807		Historic burned area
32	368168.1	803591.3		Historic burned area with regenerated heather

Target Note	X	Y	Photograph	Comment
33	368426.8	803739.2		Natural drainage into Burn of Lythenbauds
34	368727.6	803818.8		Regenerated burned area
35	368601.7	803591.3		Gully

Target Note	X	Y	Photograph	Comment
36	368028.9	803311.3		Historic burned area
37	368219.1	803329.3		Gully
38	368655.7	803453.2		Standing water within gully feature

Target Note	X	Y	Photograph	Comment
39	368765.3	803438.5		Historic burned area
40	368822.7	803457.7		Peat Hag (visible in distance)
41	368697	802930.9		Historic burned Area

Target Note	X	Y	Photograph	Comment
42	369243.4	803135.7		Area of regenerated heather
43	369227.9	803062		Historic burned area
44	370129	803455		Historic burned area

B PEAT CHARACTERISTICS

Field Results/Summary

Sample ID	Sample Depth (m)	Von Post Classification*		Photograph	Notes
		Humification	Moisture		
A	0-0.5	H6	B1		At 0.2m a band of gravel/fine course sand was vsible
	0.5-1.0	H8	B2		Plant remains visble and tree branch presnt at 0.9m

Sample ID	Sample Depth (m)	Von Post Classification*		Photograph	Notes
		Humification	Moisture		
B	0-0.5	H8	B2		Sample was noted to be sticky. Tree roots were vsible at 0.3m
	0.5-1.0	H8	B3		Sample was noted to be sticky.
C	0-0.5	H6	B2		

Sample ID	Sample Depth (m)	Von Post Classification*		Photograph	Notes
		Humification	Moisture		
	0.5-1.0	H4	B3		Tree debris visible at 0.5-0.6m
	1.5-2.0	H8	B3		Tree branch visible at 1.8m
D	0-0.5	H8	B4		Roots and organic matter visible

Sample ID	Sample Depth (m)	Von Post Classification*		Photograph	Notes
		Humification	Moisture		
	0.5-1.0	H8	B3		
	1.0-1.5	H8	B3		Tree branch visible at 1.0m
E	0-0.5	H6	B2		

Sample ID	Sample Depth (m)	Von Post Classification*		Photograph	Notes
		Humification	Moisture		
	0.5-1.0	H7	B3		
	1.0-1.5	H7	B2		
F	0-0.5	H4	B4		

Sample ID	Sample Depth (m)	Von Post Classification*		Photograph	Notes
		Humification	Moisture		
	0.5-1.0	H4	B4		

*Von Post Classification –humification increases on scale H1 – H10, moisture content increases on scale B1-B5.

<u>Sheer Vane Results</u>

Sample ID	Location and Depth (m)	Sheer Strength (kPa)
A	Top- 0.1	8
	Middle -0.65	17
	Bottom -1.1	13
B	Top- 0.1	26
	Middle -0.5	16
	Bottom -1.0	26
C	Top- 0.1	12
	Middle -1.0	9
	Bottom -2.0	4
D	Top- 0.1	10
	Middle -0.75	12
	Bottom -1.5	15
E	Top- 0.1	24
	Middle -0.7	26
	Bottom -1.4	30

Sample ID	Location and Depth (m)	Sheer Strength (kPa)
F	Top- 0.1	16
	Middle -0.5	9
	Bottom -1.0	22

Laboratory Results

Sample ID	Sample Depth (m)	Bulk Density (g/cm³)	Dry Bulk Density (g/cm³)	Moisture Content (%)	Total Organic Carbon Content (%)	Organic Matter Content (%)
A	0-0.5	1.05	0.3	246	23.6	45.5
	0.5-1.0	0.98	0.21	370	70.7	80.4
B	0-0.5	0.98	0.14	590	46.9	95.4
	0.5-1.0	0.98	0.15	554	46.4	96.6
C	0-0.5	0.98	0.13	629	47.8	97.8
	1.5-2.0	1.01	0.16	547	50.1	92.1
D	0-0.5	1.01	0.10	904	48.1	97.2
	1.0-1.5	1.01	0.12	719	47.4	93.1
E	0-0.5	1.02	0.08	1119	47.6	98.7
	1.0-1.5	0.99	0.11	799	44.6	97.7
F	0-0.5	0.95	0.18	421	33.9	91.6
	0.5-1.0	1.02	0.22	371	42.6	91.4

C DRAWINGS