FEHILY TIMONEY

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GEOTECHNICAL & PEAT STABILITY ASSESSMENT REPORT

DERRYCLARE PEATLAND REHABILITATION

Prepared for: MKO Ltd

MKO

PLANNING & DEVELOPMENT SECTION
23 FEB 2023 0060
GALWAY COUNTY COUNCIL

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DRAFT GEOTECHNICAL & PEAT STABILITY ASSESSMENT REPORT
DERRYCLARE PEATLAND REHABILITATION

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Abstract: Fehily Timoney and Company (FT) were engaged by McCarthy Keville O'Sullivan (MKO) to undertake a geotechnical assessment of the proposed peatland rehabilitation site at Derryclare with respect to peat stability. As part of the geotechnical assessment of the proposed development, FT completed walkover surveys at the site. The findings of the geotechnical and peat stability assessment showed that the site has an acceptable margin of safety and is suitable for tree felling and resulting peatland rehabilitation.

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1. NON-TECHNICAL SUMMARY

Fehily Timoney and Company (FT) was engaged by McCarthy Keville O'Sullivan (MKO) Ltd (on behalf of Coillte) to undertake a geotechnical and peat stability assessment of the proposed peatland rehabilitation at Derryclare, located in northwest Co. Galway.

A walkover including intrusive peat depth probing, desk study, stability analysis and risk assessment was carried out to assess the susceptibility of the site to peat failure following the principles in Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (PLHRAG, Scottish Government, 2017).

The findings, which involved a stability analysis of approximately 73 locations, show that the site has an acceptable margin of safety, a low risk of peat failure and is suitable for the proposed rehabilitation works. The findings include recommendations and control measures for rehabilitation work in peat lands to ensure that all works adhere to an acceptable standard of safety.

The proposed rehabilitation works will involve felling of existing Coillte forestry within designated Restoration Harvest Blocks, removal of forestry drains and construction of new access roads to accommodate the felling works. The existing network of access roads will be used for the removal of felled trees off site.

In general, the sites' topography slopes down towards the east with elevations ranging from 20 to 180m AOD Slopes generally increase in steepness towards the west, where the site adjoins the upland areas of Bencorr (summit of 690m AOD) and Derryclare. Slopes flatten noticeably towards the east; however, the terrain is still punctuated by localised areas of elevated ground giving the site an overall undulating or hummocky appearance. The land use within the site comprises commercial forestry.

Slope inclinations across the Restoration Harvest Blocks and along the new and existing access roads range from 1 to 32 degrees. The variable and sometimes steep topography on site highlights the potential risk of peat instability. Ground conditions comprise a mantle of blanket peat overlying glacial till, which in turn overlies bedrock.

130 no. peat depth probes were taken across the site (86 no. completed by FT between November and December 2022 and 44 no. completed by RPS between July and August 2021). Peat depths recorded across the site ranged from 0.0 to 4.7m with an average depth of 1.1m. Approximately 63% of probe locations recorded peat depths of less than 1.0m and 86% of less than 2.0m. A number of localised readings were recorded where peat depths were between 2.0 and 4.7m. Base of peat was typically recorded as sand and gravel (till) or bedrock.

The purpose of the stability analysis was to determine the stability i.e. Factor of Safety (FoS), of the peat slopes. The FoS provides a direct measure of the degree of stability of a peat slope. A FoS of less than 1.0 indicates that a slope is unstable; a FoS of greater than 1.0 indicates a stable slope. An acceptable FoS for slopes is generally taken as a minimum of 1.3. The stability analysis for this project, which analysed the Restoration Harvest Blocks and access roads (new and existing), resulted in FoS above the minimum acceptable value of 1.3 for both the undrained and drained condition, indicating that the site has a satisfactory margin of safety.

The risk assessment uses the results of the stability analysis in combination with qualitative factors, which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability, to assess the risk of peat failure at the site. The results of the risk assessment are given in Appendix B.

In summary, the site has an acceptable margin of safety, is considered to be at low risk of peat failure and is suitable for the proposed rehabilitation works.

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2. INTRODUCTION

2.1 Fehily Timoney and Company

Fehily Timoney and Company (FT) is an Irish engineering, environmental science and planning consultancy with offices in Cork, Dublin and Carlow. The practice was established in 1990 and currently has about 90 members of staff, including engineers, scientists, planners and technical support staff. FT deliver projects in Ireland and internationally in our core competency areas of Waste Management, Environment and Energy, Civils Infrastructure, Planning and GIS and Data Management.

FT have been involved in over 100 wind farm developments in both Ireland and the UK at various stages of development i.e., preliminary feasibility, planning, design, construction, and operational stage and have established themselves as one of the leading engineering consultancies in peat stability assessment, geohazard mapping in peat land areas, investigation of peat failures and site assessment of peat.

This Report was written by Aaron Clarke (FT Principal Geologist, EurGeol, PGeo, MSc in Applied Geotechnics). Aaron is a Principal Geologist with Fehily Timoney and has over 18 years' experience within the geoscience field and over 10 years' experience within ground engineering.

2.2 Project Description

Fehily Timoney and Company (FT) were commissioned by MKO Ltd. (on behalf of Coillte) to undertake a geotechnical and peat stability assessment for a proposed peatland restoration at Derryclare, Co. Galway. The aim of the restoration project is to re-establish bogland habitat and native scrub woodland across 20 no. proposed Restoration Harvest Blocks (RHBs) over an area of approximately 350 hectares.

The rehabilitation works will comprise felling of existing Coillte forestry within the proposed RHBs, removal of forestry drains and construction of 1.58km of new access roads to accommodate the felling works. The existing network of access roads (total approximate length of 8.3km) will be used for the removal of felled trees off site.

2.3 Peatland Restoration

As part of this assessment, FT took into consideration the guidance set out in *Best practice in raised bogs restoration in Ireland (NPWS, 2017)*. The main restoration methods to be considered within this assessment are:

- Drain blocking; and
- Removal of trees/scrub.

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For drain blocking, the most common restoration measure undertaken on bogs in Ireland is blocking of manmade drains. The purpose of this measure is to raise the water table in the drain, and in adjacent areas in order to reduce run-off rates, carbon losses and the potential for subsidence.

Removal of forestry is a proven restoration measure, and has been used effectively by organisations such as Coillte at a number of bogs in Ireland. Removal of forestry is typically combined with other restoration measures such as drain blocking. When both are applied to a suitable area they can be effective in raising water levels in the peat and encouraging peatland development.

2.4 Peat Stability Assessment Methodology

FT undertook the assessment following the principles in *Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments (2nd edition, PLHRAG, 2017). The Peat Landslide Hazard and Risk Assessment Guide (PLHRAG)* is used in this report as it provides best practice methods to identify, mitigate and manage peat slide hazards and associated risks in respect of consent applications for electricity generation projects.

The aforementioned best practice guide was produced following peat failures in the Shetland Islands, Scotland in September 2003 but more pertinently following the peat failure in October 2003, during the construction of a wind farm at Derrybrien, County Galway, Ireland.

This peat stability assessment has been undertaken taking into account peat failures that have occurred on peatland sites (such as recent failures at Shass Mountain (2020), Co. Leitrim and Meenbog (2020), Co. Donegal). The lessons learned from both peat slide events have been incorporated into this assessment. The Meenbog failure occurred during the construction of a section of floating road on a wind farm on sidelong ground in an area of weak peat. It is important that the existing site drainage is maintained during felling operations to avoid a similar failure to that on Shass Mountain, which occurred following heavy rainfall, and this is referenced in the Risk Assessments for the proposed access roads.

A preliminary desk top study undertaken by FT to determine potential geohazards associated with the proposed rehabilitation works, prior to the site reconnaissance by engineering geologists/geotechnical engineers from FT. The extent and depth of ground investigation and peat stability analysis by FT have been undertaken in accordance with guidance within Eurocode 7 and PLHRAG (2nd Edition, 2017) to investigate peat slopes that have the potential to impact on the proposed development, as applicable. Sufficient peat depth data has been recorded during the site walkovers to enable the characterisation of the peat depth across the site as shown in Figure 2-1. The peat stability assessment is undertaken to identify peat slopes at risk from the proposed development, and to identify peat slopes that may pose a risk to the proposed development.

The geotechnical and peat stability assessment at the site included the following activities:

(1) Desk study, involving the review of publicly available soils and geology maps, records of historical peat failures, aerial photography.

(2) Site reconnaissance including shear strength and peat depth measurements were undertaken.

(3) Peat stability assessment of the peat slopes on site using a deterministic and qualitative approach.

(4) Peat contour depth plan – compiled based on the peat depth probes carried out across the site by FT (2022) and RPS (2021).

(5) Factor of safety plan – compiled for the short-term critical condition (undrained) for approximately 73 no. FoS points analysed within the proposed RHBs and along the proposed access roads on site (a total of 86 peat probe locations were visited during FT's site walkover, however 13 no. locations were recorded as having no peat).

(6) A buffer zone plan – identifies areas with an elevated or higher risk where mitigation/control measures will need to be implemented during the site's rehabilitation works to minimise the potential risks, as well as areas where rehabilitation works should be avoided.

(7) A peat stability risk register was compiled to assess the potential risks at the proposed RHBs and access track locations and determine adequate mitigation/control measures for each location to minimise the potential risks and ensure they are kept within an acceptable range, where necessary.

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Path: R:\Map Production\2022\P22-263\Workspace\P22-263_GIS_Fig_2_1_General Site Layout and Peat Probe Distribution _A3.mxd

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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Legend

- Restoration Harvest Blocks
- RPS Peat Probe Locations
- FT Peat Probe Locations
- Existing Access Roads
- New Access Roads

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TITLE:	General Site Layout and Peat Probe Distribution
PROJECT:	Derryclare Peatland Rehabilitation
FIGURE NO:	2-1
CLIENT:	MKO
SCALE: 1:20000	**REVISION:** 0
DATE: 09/02/2023	**PAGE SIZE:** A3

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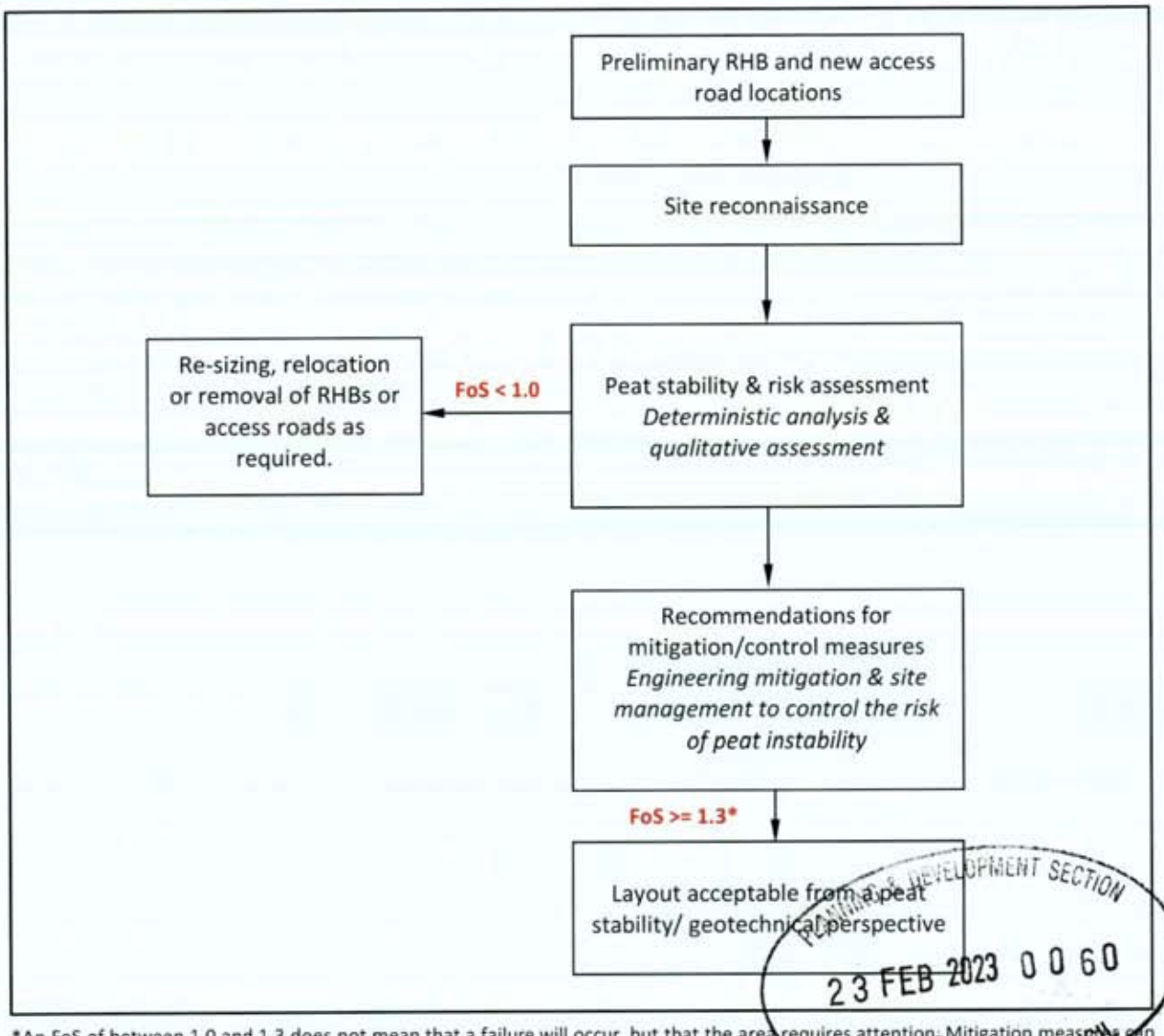
A flow diagram showing the general methodology for the peat stability assessment is shown in Figure 2-2. The methodology illustrates the optimisation of the site based on the findings from the site reconnaissance and stability analysis and subsequent feedback.

Figure 2-2: Methodology for Peat Stability Assessment



*An FoS of between 1.0 and 1.3 does not mean that a failure will occur, but that the area requires attention. Mitigation measures can be provided for areas with an FoS of between 1.0 and 1.3 to reduce the risk of failure.

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As for all construction projects, a detailed engineering construction design must be carried out by the appointed construction stage designer prior to any rehabilitation work commencing on site. This must take account of the consented project details and any conditions imposed by that consent. This must include a confirmatory peat stability assessment to account for any changes in the environment which may have occurred in the time leading up to the commencement of the rehabilitation works.

2.5 Peat Failure Definition

Peat failure in this report refers to a significant mass movement of a body of peat that would have an adverse impact on the proposed site and the surrounding environment. Peat failure excludes localised movement of peat that would occur below an access road, creep movement or erosion type events.

The potential for peat failure at this site is examined with respect to rehabilitation works, construction of access roads and associated activity.

2.6 Main Approaches to Assessing Peat Stability

The main approaches for assessing peat stability for peat restoration projects include the following:

(1) Geomorphological

(2) Qualitative (judgement)

(3) Index/Probabilistic (probability)

(4) Deterministic (factor of safety)

Approaches (1) to (3) listed above are considered subjective and do not provide a definitive indication of stability; in addition, a high level of judgement/experience is required which makes it difficult to relate the findings to real conditions. FT apply a more objective approach, the deterministic approach (as discussed in Section 2.6).

As part of FT's deterministic approach, a qualitative risk assessment is also carried out taking into account qualitative factors, which cannot necessarily be quantified, such as the presence of mechanically cut peat, quaking peat, bog pools, sub peat water flow, slope characteristics and numerous other factors. The qualitative factors used in the risk assessment are compiled based on FT's experience of assessments and construction in peat land sites and peat failures throughout Ireland and the UK. FT have been involved with in excess of 100 wind farm developments across Ireland and the UK at various stages of development, from preliminary feasibility stage through planning and from scheme development at tender design and detailed design stage, through to the construction and operational stages. This approach follows the guidelines for geotechnical risk management as given in Clayton (2001), as referenced in the best practice for Peat Landslide Hazard and Risk Assessment Guide (PLHRAG, 2017), and takes into account the approach of MacCulloch (2005).

The risk assessment uses the results of the deterministic approach in combination with qualitative factors, which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability to assess the risk of instability on a peat land site.

2.7 Peat Stability Assessment – Deterministic Approach

The peat stability assessment is carried out across a wide area of peatland to determine the stability of peat slopes and to identify areas of peatland that are suitable for development; this allows the layout of infrastructure on a particular site to be optimised. The assessment provides a numerical value (factor of safety) of the stability of individual parcels of peatland. The findings of the assessment discriminate between areas of stable and unstable peat, and areas of marginal stability where restrictions may apply. This allows for the identification of the most suitable locations for access roads and infrastructure.

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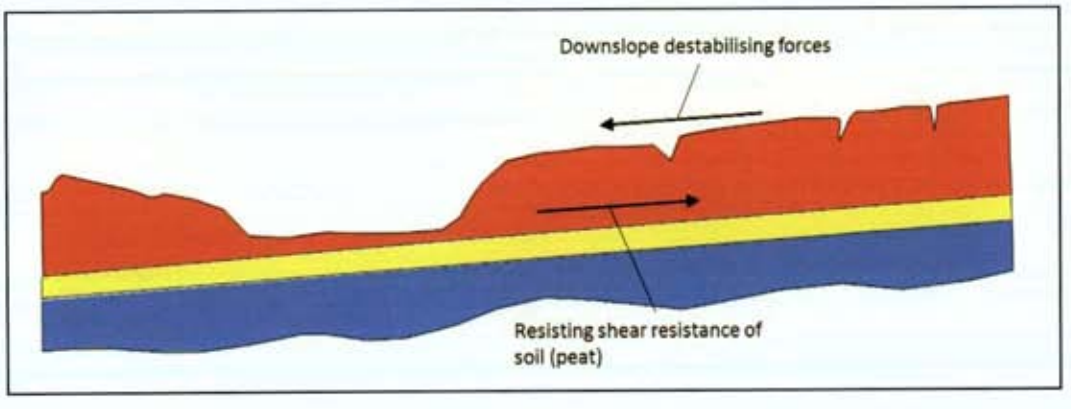
A deterministic assessment requires geotechnical information and site characteristics which are obtained from desk study and site walkover, e.g. properties of peat/soil/rock, slope geometry, depth of peat, underlying strata, groundwater, etc. An adverse combination of the factors listed above could potentially result in instability. Using the information above, a factor of safety is calculated for the stability of individual parcels of peatland on a site (as discussed in Section 6.).

The factor of safety is a measure of the stability of a particular slope. For any slope, the degree of stability depends on the balance of forces between the weight of the soil/peat working downslope (destabilising force) and the inherent strength of the peat/soil (shear resistance) to resist the downslope weight, see Figure 2-3.

Figure 2-3: Peat Slope Showing Balance of Forces to Maintain Stability



The factor of safety provides a direct measure of the degree of stability of a slope and is the ratio of the shear resistance over the downslope destabilising force. Provided the available shear resistance is greater than the downslope destabilising force then the factor of safety will be greater than 1.0 and the slope will remain stable. If the factor of safety is less than 1.0 the slope is unstable and liable to fail. The acceptable range for factor of safety is typically from 1.3 to 1.4.

2.8 Applicability of the Factor of Safety (Deterministic) Approach for Peat Slopes

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The factor of safety approach is a standard engineering approach in assessing slopes which is applied to many engineering materials, such as peat, soil, rock, etc.

The factor of safety approach is included in the Peat Landslide Hazard and Risk Assessments Best Practice Guide for Proposed Electricity Generation Developments (PLHRAG, 2017); see Section 5.3.1 of the guide. This guide provides best practice methods to identify, mitigate and manage peat slide hazards and associated risks in respect of consent applications for electricity generation projects.

Furthermore, the best practice guide notes that the results from the factor of safety approach 'has provided the most informative results' with respect to analysing peat stability (Section 5.3.1 of the guide).

The factor of safety approach in this report includes undrained (short-term stability) and drained (long-term stability) analyses. The undrained condition is the critical condition for the development. The purpose of the drained analysis is to identify the relative susceptibility of rainfall-induced failures at the site.

Notwithstanding the above, the stability analysis used by FT in this report also includes qualitative factors to determine the potential for peat stability i.e. the analysis used does not solely rely on the factor of safety approach.

The deterministic analysis is considered an acceptable engineering design approach. This concurs with the best practice guide referenced above.

2.9 Assessment of Intense Rainfall and Extreme Dry Events on the Peat Slope

The deterministic approach carried out by FT examines intense rainfall and extreme dry events. The deterministic approach includes and undrained (short-term stability) and drained (long-term stability) analysis to assess the factor of safety for the peat slopes against a peat failure.

The drained loading condition applies in the long-term. This condition examines the effect of the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes. For the drained analysis the level of the water table above the failure surface is required to calculate the factor of safety for the peat slope.

In order to represent varying water levels within the peat slopes, a sensitivity analysis is carried out which assesses varying water level in the peat slopes i.e. water levels ranging from 0 to 100% of the peat depth is conducted, where 0% equates to the peat been completely dry and 100% equates to the peat being fully saturated.

By carrying out such a sensitivity analysis with varying water level in the peat slopes, the effects of intense rainfall and extreme dry events are considered and analysed. The results of which are presented in Section 6. of this report.

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3. DESK STUDY

The main relevant sources of interest with respect to the site include:

- Geological plans and Geological Survey of Ireland database
- Ordnance survey plans
- Literature review of peat failures

The Geological Survey of Ireland online dataset viewer (GSI, 2022) for the site were used to verify the soil and bedrock conditions.

The Ordnance Survey plans were reviewed to determine if any notable features or areas of particular interest (from a geotechnical point of view) are present on the site.

The desk study also includes a review of both published literature and GSI online dataset viewer (GSI, 2022) on peat failures/landslides in the vicinity of the site.

3.1 Quaternary Geology

A review of the Geological Survey of Ireland online database and published documents from GSI was carried out.

GSI Quaternary Sediments mapping, presented in Figure 3-1, indicates the site is underlain by the following deposits:

- Alluvium Deposits (localised to one area along the western margins of the site)
- Blanket Peat (northernmost portion of the site)
- Till derived from metamorphic rocks (much of the southern portion of the site)
- Bedrock Outcrop or Subcrop (localised areas throughout the site and predominantly within the central/western portions of the site).

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3.2 Bedrock Geology

GSI 100K Bedrock mapping, presented in Figure 3-2, indicates the site is underlain by the following formations:

- Rhyolitic Intrusive rocks (Ordovician)
- Streamstown Schist Formation - Psammitic pelitic & semi-pelitic schists (Dalradian)
- Bennabeola Quartzite Formation - Pale quartzites and grits (Dalradian)
- Lakes Marble Formation - marbles, metavolcanics, schists and grits (Dalradian)
- Barnanoraun Schist Formation - aluminous schists and hornblendic rocks (Dalradian)

3.3 Structural Geology

The structural geology (Figure 3-2) across the site comprises a series of NNW-SSE trending faults showing both apparent dextral and sinistral displacement. These faults are laterally continuous over distances of between 0.5 and 5.0km. A solitary NE-SW trending normal fault is located to the south of the site. In addition to faulting, an

east-west trending anticlinal axis crosses the northernmost extent of the site. GSI mapped bedding dips range from 30 to 85° with dip direction typically towards the west.

3.4 Economic Geology

The GSI Active Quarries database indicates that the nearest quarry is Lissoughter Green Marble Quarry, located approximately 1.8km southeast of the site. The quarry produces Connemara Marble for ornamental dimension stone.

3.5 Karst

GSI Groundwater Karst Data indicates there are no mapped karst features within 20km of the site.

3.6 Geological Heritage

GSI Geological heritage mapping indicates there are no geological heritage sites within the site boundary. The closest geological heritage site is located approximately 180m to the south of the site and is described as *'A disused marble quarry site on the northeast shore of Derryclare Lough, in the Inagh Valley'* and is designated as a County Geological Site.

3.7 Topography

In general, the sites' topography slopes down towards the east. Elevations range from 180m AOD along the eastern slopes of Bencorr to 20m AOD along the shores of Lough Inagh and Derryclare Lough. Slopes generally increase in steepness towards the west, where the site adjoins the upland areas of Bencorr (summit of 690m AOD) and Derryclare (summit of 660m AOD), which form a series of corries and aretes. These aretes form steep sided east-west trending ridgelines, which abut against the sites' western boundary. Two eastward flowing streams flow from the corries and travel though the site before eventually draining into Lough Inagh. The terrain within the south-eastern and north-eastern extents of the site is considerably flatter. However, it is still punctuated by localised areas of elevated ground giving the site an overall undulating or hummocky appearance.

3.8 Landslide Susceptibility

The GSI Landslide Susceptibility mapping, presented in Figure 3-3, indicates the site lies within an area classified as having "low" to "high" susceptibility, which is expected given the variable terrain present. The areas mapped as having "moderately high" to "high" landslide susceptibility are typically found along the west of the site and are characterised by steep upland terrain. These areas generally correlate with mapped "bedrock outcrop or subcrop" (Figure 3-2). Structural dip and dip directions are favourable with respect to rock slope stability (i.e. bedding dips into the slope). In-situ peat probe measurements (discussed in detail in Section 5.) indicate peat depths across these areas are typically shallow (<1m depth). It is therefore considered that the risk of landslide is considered to be negligible and that the GSI Landslide Susceptibility Classification rating at these locations does not accurately reflect actual ground conditions encountered on site.

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3.9 Previous Failures

There are no recorded peat landslides within the site (GSI, 2022). The closest recorded landslide is located approximately 1.8km to the south of the site (ITM coordinates E 483007, N 747150) and is described as having an 'undefined' landslide mechanism. The failure occurred within an area of mapped Blanket Peat.

The site walkover identified a shallow (<1m deep) historic peat landslip at probe location POI008 (ITM coordinate E 482611, N 752382), which lies outside of the RHBs (immediately west of RHB GY27_HB0012) but is still within the overall Coillte site. This east-west trending failure is defined by an approximate 10m wide and 40m long concave depression on sloping ground (measured at 26°) with a well-defined failure lobe at its base. The toe of the failure terminates at a tree line comprising mature coniferous trees, suggesting the trees either:

1. prevented further movement; or
2. grew sometime after the failure event.

However, the trees at the toe are all growing vertically showing no signs of orientation change due to past ground movement suggesting they grew after the failure occurred. At the crown there is an approximate 1m deep backscarp (now vegetated). No signs of instability were observed either upslope, downslope or along strike of the failure. Peat depths measured at and around this location were all <1m deep. The topography to the west of the failure steeply climbs until at approximately 100m from the crown there is a near vertical cliff face exposing rocks from the Bennabeola Quartzite Formation (part of an east-west trending arête separating two corries). It is believed that surface water runoff from this upland area is the main contributor to this relatively small and isolated historic peat failure.

The peat stability assessment undertaken as part of this report and discussed in Section 6. indicates a FoS of <1 for both the drained and undrained condition at the location. However, the landslip is deemed to be a shallow (<1m) and isolated occurrence, which will have a negligible impact on the proposed rehabilitation works. Further to this, shallow peat depths (<0.4m) coupled with the occurrence of bedrock outcrop downslope of this failure indicate there is little possibility of this failure, if reactivated, having any negative impact downslope (i.e. within adjacent RHB GY27_HB0012). However, this area will require appropriate monitoring both during the proposed rehabilitation works and post works as detailed in Section 9.

3.10 Previous Investigations

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Between 28th July and 10th August 2021 a peat probing survey, comprising 44 no. probe locations was undertaken by RPS. The distribution of the peat probes are presented in Figure 2-1 and recorded depths ranging from 0.2 to 4.25m with a mean and median value of 1.2 and 0.9m respectively. Piezometers were installed at 29 of the 44 peat probe locations and water depths within the peat were recorded. Results from this monitoring programmes are presented in the Table 3-1, an indicate water level depths range from 0 to 0.8m with a mean depth of 0.31m. Based on these water depths the mean degree of saturation within the peat across these locations is estimated at 65%.

Table 3-1: RPS Peat Water Level Data

Location ID	Easting	Northing	Water Depth (m)	Date Monitored	Degree of Saturation (0% = Dry and 100% = fully saturated peat)
0	483210	753495	0.24	03/08/2021	93
1	483458	753128	0.1	03/08/2021	92
2	483884	753096	0.19	03/08/2021	79
3	483923	752753	0.34	03/08/2021	91
4	483604	752756	0.28	03/08/2021	93
5	483334	752835	0.47	03/08/2021	0

Location ID	Easting	Northing	Water Depth (m)	Date Monitored	Degree of Saturation (0% = Dry and 100% = fully saturated peat)
7	482915	752814	0.45	28/07/2021	10
13	483542	751363	DRY	03/08/2021	0
14	483968	751370	0	10/08/2021	100
16	482707	749383	0.8	28/07/2021	67
17	482460	749085	0.05	28/07/2021	99
18	482277	749311	0.06	28/07/2021	97
22	482465	749678	0.33	28/07/2021	74
23	482846	749973	0.31	28/07/2021	81
24	482950	749612	0.47	28/07/2021	62
25	483249	749889	0.56	28/07/2021	82
27	483533	750652	0.3	28/07/2021	60
28	484041	750250	0.15	28/07/2021	95
29	484063	749957	0.3	28/07/2021	14
30	483255	752421	0.2	10/08/2021	78
31	483471	752249	Not found	10/08/2021	-
33	483546	751814	0.56	03/08/2021	34
34	483910	752301	0.58	03/08/2021	60
35	483891	752114	0.48	03/08/2021	62
36	483908	751748	0.25	03/08/2021	83
37	483967	750620	0.24	03/08/2021	60
38	483803	750831	Not found	10/08/2021	-
39	484035	751151	0.11	10/08/2021	84
43	483186	750304	0.25	10/08/2021	86

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Sources: Esri, HERE, Garmin, iMetmap, Increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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Legend

- Existing Access Roads
- New Access Roads
- Restoration Harvest Blocks

Quaternary Sediments

- A, Alluvium
- BktPt, Blanket Peat
- Rck, Bedrock outcrop or subcrop
- TMp, Till derived from Metamorphic rocks
- Water

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TITLE: Quaternary Sediments			
PROJECT: Derryclare Peatland Rehabilitation			
FIGURE NO:	3-2		
CLIENT:	MKO		
SCALE:	1:20000	**REVISION:**	0
DATE:	09/02/2023	**PAGE SIZE:**	A3

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Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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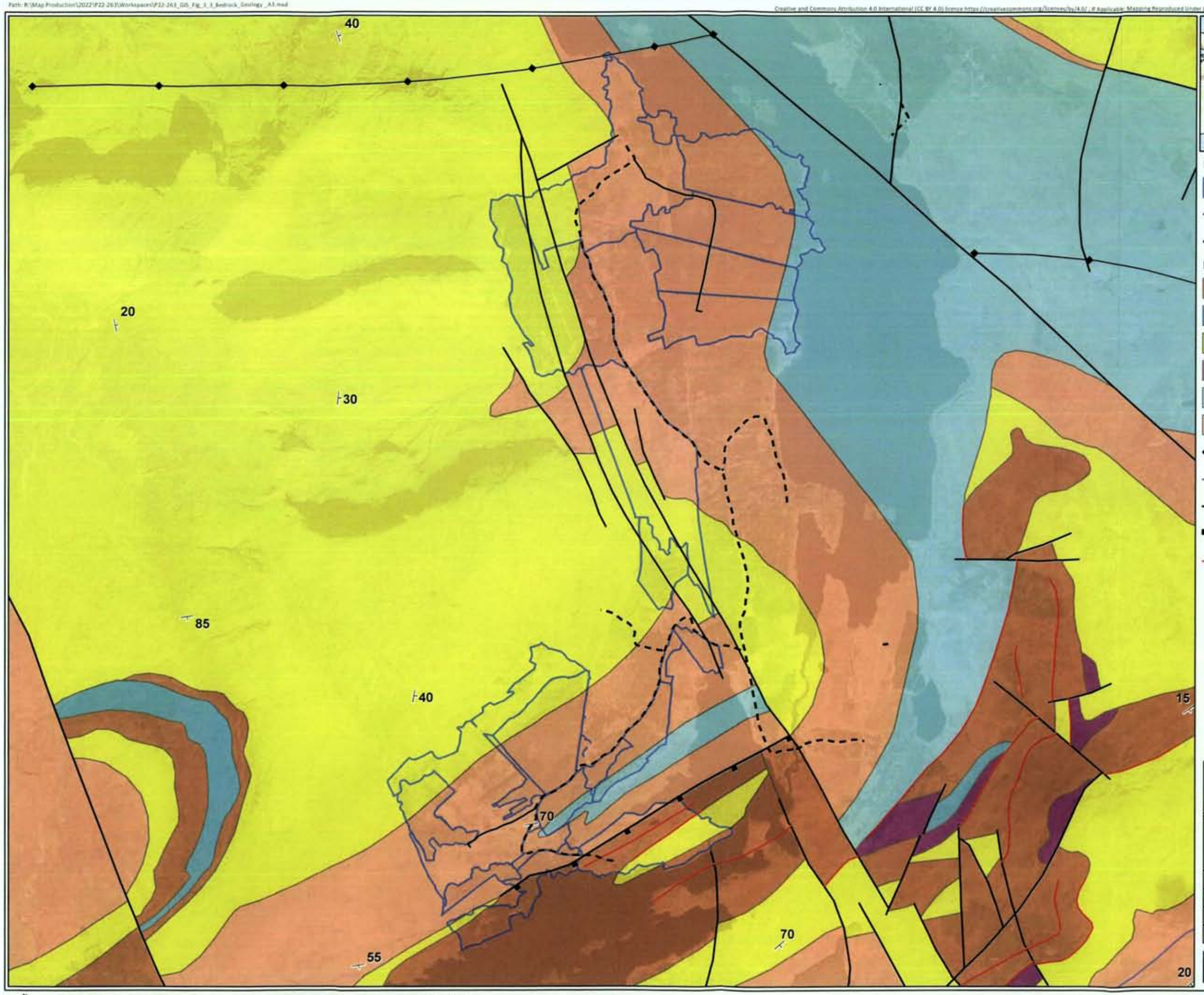

Legend

- Restoration Harvest Blocks
- New Access Roads
- Existing Access Roads

Bedrock Geology

- Barnanoraun Schist Formation
- Connemara Marble Formation
- Bennabeola Quartzite Formation
- Cleggan Boulder Bed Formation
- Lakes Marble Formation
- Streamstown Schist Formation
- Anticlinal Axis
- Dyke
- Fault
- Tectonic Slide, barbs on hanging-wall
- Thin stratigraphical unit, diagrammatic
- Strike and dip of bedding, way up unknown

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GALWAY COUNTY COUNCIL

TITLE: Bedrock Geology			
PROJECT: Derryclare Peatland Rehabilitation			
FIGURE NO:	3-3		
CLIENT:	MKO		
SCALE:	1:20000	**REVISION:**	0
DATE:	09/02/2023	**PAGE SIZE:**	A3

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Path: R:\Map Production\2022\P22-263\Workspace\P22-263_GIS_Fig_3_4_Landslide_Susceptibility_A3.mxd

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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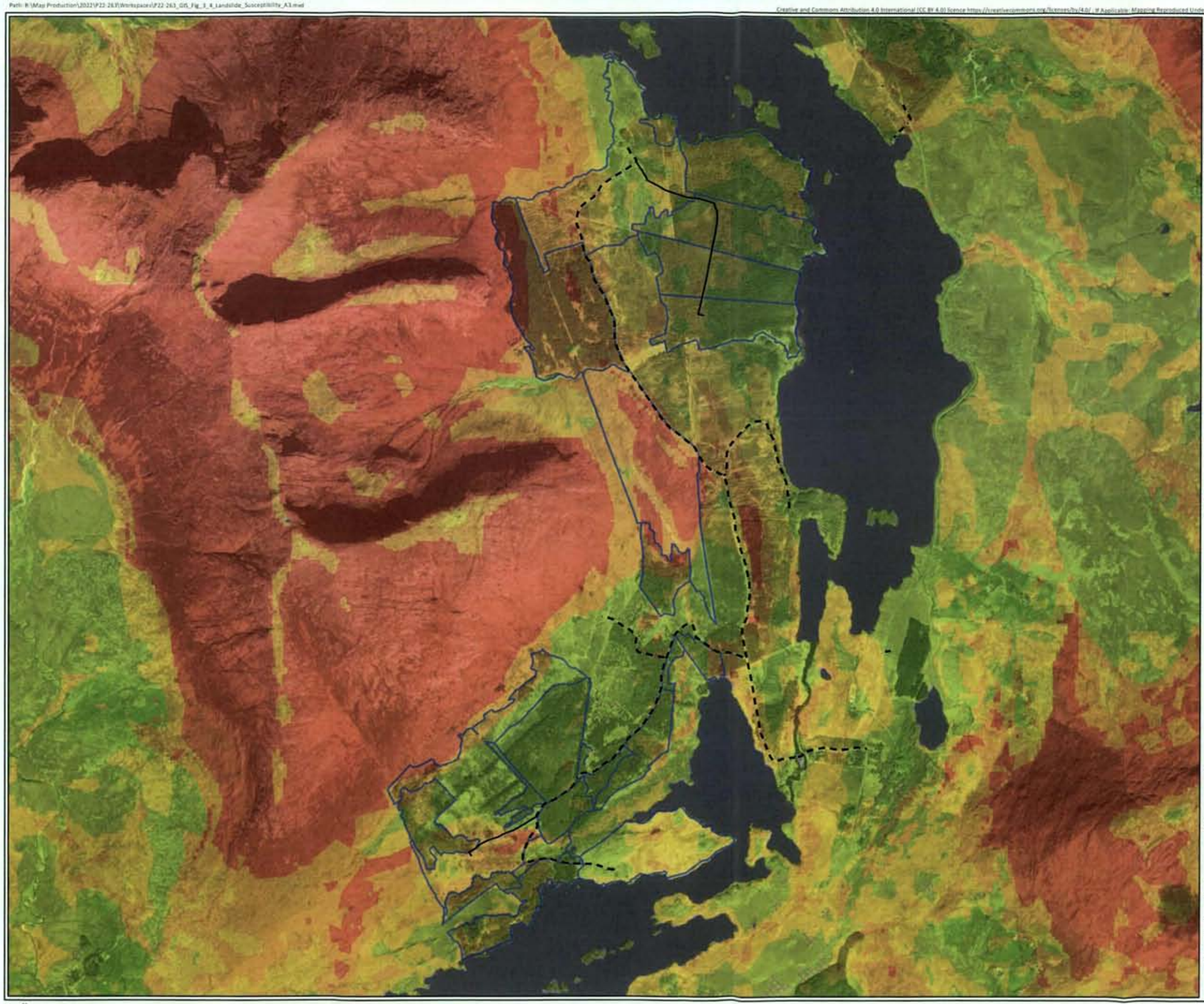

Legend

- Restoration Harvest Blocks
- Existing Access Roads
- New Access Roads

Landslide Susceptibility

Classification

- Low
- Low (inferred)
- Moderately Low
- Moderately Low (inferred)
- Moderately High
- Moderately High (inferred)
- High
- High (inferred)
- Made
- Water

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TITLE:	Landslide Susceptibility		
PROJECT:	Derryclare Peatland Rehabilitation		
FIGURE NO:	3-4		
CLIENT:	MKO		
SCALE:	1:20000	**REVISION:**	0
DATE:	09/02/2023	**PAGE SIZE:**	A3

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N W E S

0 0.5 1 2 Kilometers

4. FINDINGS OF SITE RECONNAISSANCE

4.1 Site Reconnaissance

As part of the assessment of potential peat failure at the proposed site, FT carried out a site reconnaissance in conjunction with the desk study review described in Section 3. This comprised walkover inspections of the site with recording of salient geomorphological features with respect to the proposed rehabilitation areas, which included peat depth and preliminary assessment of peat strength. General photographs of the site are presented in Appendix A.

The following salient geomorphological features were considered:

- Active, incipient or relict instability (where present) within the peat deposits
- Presence of shallow valley or drainage line
- Wet areas
- Any change in vegetation
- Peat depth (peat depth data was also collected by RPS in July and August 2021)
- Slope inclination and break in slope

The survey covered the proposed RHB and access track (new and existing) locations.

The method adopted for carrying out the site reconnaissance relied on experienced practitioners carrying out a visual assessment of the site supplemented with measurement of slope inclinations.

4.2 Findings of Site Reconnaissance

A site walkover was undertaken by FT over five days from the 14th to the 15th November and from the 6th to the 8th December 2022. Weather conditions during the site walkover were partly cloudy with occasional light showers and low temperatures ranging from 5 to 8° C. Site walkovers were also undertaken by RPS between 28th July and 10th August 2021.

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The main findings from the site walkover are as follows:

(1) The site is typically covered by a thin mantle of Blanket Peat, which is frequently punctuated by bedrock outcrops. Bedrock outcrops and glacial till deposits are more frequent along the western extent of the site, where the topography steepens and elevations increase as your approach the summit of Derryclare. A pair of incised river channels, which flow from two adjacent glacial corries on the eastern face of Derryclare, expose deposits of blanket peat overlying till, which in turn overlies the pale quartzite rocks and schists of the Bennabeola Quartzite Formation and Streamstown Schist Formation respectively.

(2) The sites' topography varies considerably. In general, the terrain can be described as having moderate to steep slopes displaying a hummocky terrain. These hummocks are believed to be indicative of shallow knolls of sub-cropping bedrock mantled by relatively thin deposits of peat over till. This is evidenced at several locations throughout the site where exposed outcrops display a morphology, which mimics the hummocky terrain of the adjacent peat covered landscape.

(3) Peat depths vary across the site depending on mainly topography. Deeper peat (>3m) is confined to the north (RHB GY27_HB0021, GY27_HB0009 and GY27_HB0010) and south (RHB GY27_HB0027 and

immediately south of GY27_HB0016) of the site and were recorded in areas of flatter terrain. Peat deposits upslope of these areas typically display depths of <1.5m. The distribution of peat depths across the site is presented as a heat map with peat probe depths in Figure 4-1. In general thinner peat deposits were encountered on slopes.

(4) The deepest peat deposit was encountered at peat probe location PP002 (ITM coordinates E 482320, N 749000), which is outside of the Coillte site boundary. This area is characterised by buoyant peat with gently undulating to flat terrain with frequent areas of standing water (no bog holes were observed). Vegetation typically comprises grass, rush and sphagnum. This flat area of deep peat is confined to the north, south and west by bedrock outcrops. The western boundary is cut by a south-west flowing stream, beyond which is hummocky peatland with frequent bedrock outcrops. The geology along the southern boundary is defined by a northeast-southwest striking conformable contact between The Streamstown Schist Formation and Bennabeola Quartzite Formation; a similarly trending fault is located to the north of this area and along strike of this conformably contact (Figure 3-2). It is possible that the presence of these geological boundaries have allowed for an increase in groundwater flow through spring lines, thereby influencing the development of this area of deeper peat.

(5) A total of approximately 130 no. (86 no. completed by FT and 44 no. completed by RPS) peat depth probes were carried out on site during the various site visits. Peat depths recorded across the site ranged from 0.0 to 4.7m with an average depth of 1.1m (Figure 4-1). Approximately 63% of probe locations recorded peat depths of less than 1.0m and 86% of less than 2.0m. A number of localised readings were recorded where peat depths were between 2.0 and 4.7m. Base of peat was typically recorded as sand and gravel (till) or bedrock. Importantly, peat depth varies considerably over relatively short distances and is believed to be a function of the underlying bedrock's hummocky morphology. In general, the peat probes were relatively dry when extracted from the ground, indicating a low saturation level.

(6) The land within the RHBs is predominantly forested, containing coniferous trees at different stages of maturity. Some of the RHBs have been felled but the stumps and root system remain intact.

(7) Forestry drainage channels were observed throughout the site and can be clearly seen on available online aerial photography. Where observed during the site walkover, these channels were typically dry. Natural drainage channels also proliferate the site; these are often narrower and deeper than the forestry drainage and, during the time of the site walkover, appear to be responsible for most of the surface water drainage.

(8) One historic peat failure was identified just outside of the site boundary and has been described earlier. No evidence of ongoing peat instability was noted in this area, or elsewhere on the site, during the site walkovers.

(9) The occurrence of buoyant peat was recorded at four peat probe locations (PP001, PP002, PP037 and PP043) where peat depths range from to 1.7 to 4.7m.

(10) Localised areas of ponded water were recorded. This is not unexpected given the ground conditions and the flat terrain present in localised areas across the site.

(11) With respect to the existing and proposed access roads, peat depths are typically less than 1.0m (average 1m) with localised deeper deposits of up to 3.0m recorded. All existing access roads, which are typically constructed sidelong to the site slopes, appear to be founded on either till or bedrock.

(12) Slope angles across the site range from 1 to 32 degrees with a mean and median value of 10 and 7.5 degrees respectively. The slope angle was obtained on site using a handheld Silva Clino Master, which has an accuracy of +/- 0.25 degrees. The slope angle quoted typically reflects the representative slope at each of the peat probe locations. The variable and sometimes steep topography/nature of the terrain on site highlights the potential risk of peat failure.

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World Imagery: Maxar, Maxar
Vector Topographic Map Esri, HERE, Garmin, FAO, NOAA, USGS,
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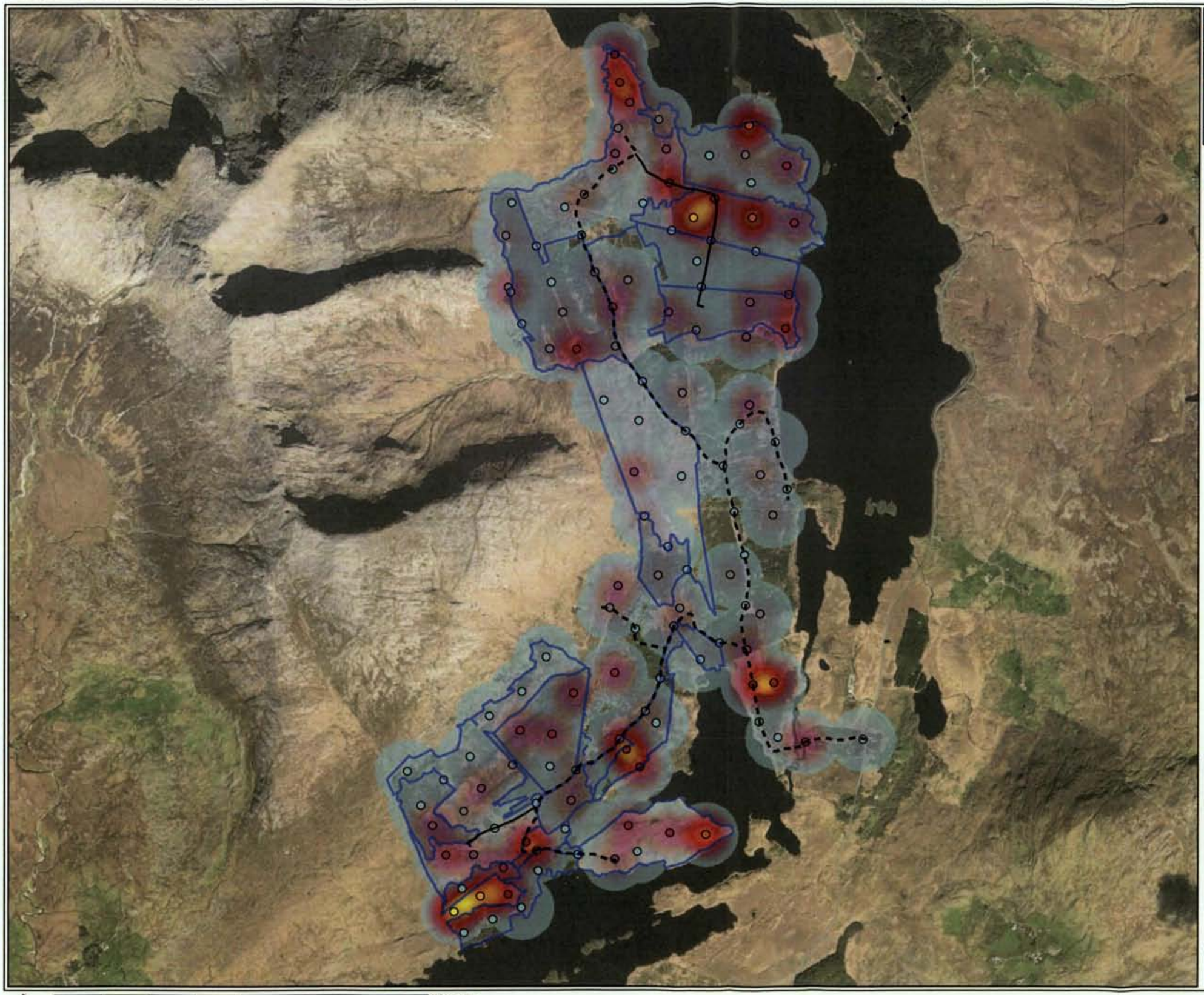

Legend

- Restoration Harvest Blocks
- Existing Access Roads
- New Access Roads

All FTC RPS Peat Depths (m bgl)

Peat Depth

- 0 - 0.5
- 0.5 - 1
- 1 - 1.5
- 1.5 - 2
- 2 - 2.5
- 2.5 - 3
- 3 - 3.5
- 3.5 - 4
- 4 - 4.5
- 4.5 - 5

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TITLE:	Heat Map Showing Peat Depths		
PROJECT:	Derryclare Peatland Rehabilitation		
FIGURE NO:	4-1		
CLIENT:	MKO		
SCALE:	1:20,000	**REVISION:**	0
DATE:	09/02/2023	**PAGE SIZE:**	A3

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0 0.5 1 2 Kilometers

5. PEAT DEPTHS, STRENGTH & SLOPE AT RHB AND NEW ACCESS ROAD LOCATIONS

As part of the site walkover, peat depth, in-situ peat strength and slope angles were recorded at various locations across the site.

5.1 Peat Depth

Peat depth probes were carried out within the proposed RHBs and along access roads. The locations of the probes were predetermined at the desk study stage to complement the existing RPS peat probe survey undertaken in 2021 and to give a general coverage of the site.

5.2 Peat Strength

The strength testing was carried out in-situ using a Geonor H-60 Hand-Field Vane Tester. From FT's experience hand vanes give indicative results for in-situ strength of peat and would be considered best practice for the field assessment of peat strength.

5.3 Slope Angle

The slope angles at each of the main infrastructure locations were obtained using a combination of readings taken during the site reconnaissance by FT using handheld equipment, such as the Silva Clino Master and from contour survey plans for site.

The slope angle quoted typically reflects the general slope at each of the peat probe locations. It should be noted that slope angles derived from contour survey plans (such as for the RPS peat probe locations) would be considered approximate, as such surveys are dependent on the density of survey data and do not always reflect local variations in ground topography. Slope angles recorded during the site reconnaissance by FT using handheld equipment would generally be deemed more accurate and representative of local topography.

5.4 Summary of Findings

Based on the peat depths recorded across the site by FT and RPS, the peat varied in depth from 0.0 (no peat) to 4.7m with a mean and median depth of 1.1m and 0.8m respectively. All peat depth probes carried out on site have been utilised to produce a heat map illustrating peat depths across the RHBs (Figure 4-1).

A summary of the peat depths is given in Table 5-1. The data presented in Table 5-1 is used in the peat stability assessment of the site. RSP locations were excluded from the stability analyses as no slope angles were provided.

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Table 5-1: Peat Depth & Slope Angle at RHB, Access Roads and Points of Interest

Location	Easting	Northing	Peat Depth Range (mbgl)	Slope Angle Range (degrees)
Restoration Harvest Blocks (Coordinates represent approx. centre of RHB)				
GY27_3_09	482827	749973	0.1 to 2.0	3 to 10
GY27_HB0009	483856	753047	2.0 to 3.7	3 to 15
GY27_HB0010	483852	752726	0.4 to 4.3	2 to 4
GY27_HB0011	483800	752243	0.9 to 2.0	3
GY27_HB0012	482865	752344	0.0 to 2.5	2 to 28
GY27_HB0013	483493	750691	0.0 to 0.7	5 to 32
GY27_HB0014	482481	749694	0.1 to 2.0	2 to 20
GY27_HB0015	482161	749574	0.1 to 1.5	5 to 10
GY27_HB0016	482461	749191	0.1 to 1.7	2 to 12
GY27_HB0017	482701	749106	0.0 to 0.2	5 to 30
GY27_HB0018	483725	752502	0.2 to 0.4	3 to 8
GY27_HB0020	482900	749603	0.9 to 1.3	12
GY27_HB0021	483159	752945	0.2 to 3.3	3 to 8
GY27_HB0022	483382	751458	0.1 to 1.4	5 to 15
GY27_HB0023	482714	749676	0.0 to 0.9	3
GY27_HB0024	482819	749388	0.2 to 2.4	2 to 10
GY27_HB0027	483361	749396	0.4 to 4.0	2 to 7
GY27_HB0028	483366	749952	0.3 to 3.1	5 to 10
GY27_HB0029	483472	750413	0.0 to 0.7	15 to 16
GY27_HB0030	483121	749806	0.0 to 1.4	8
Access Roads (Coordinates represent approx. centre of Access Road)				
GY27R0025	483687	751453	0.0 to 2.8	1 to 24
GY27R0026	484034	751590	0.0 to 0.3	3 to 7
GY27R0027	483407	750208	0.0 to 1.4	5 to 16
GY27R0049	484363	749945	0.5 to 1.8	3
GY27R0052	483290	750552	0.0 to 0.8	13
GY27R0054	482692	749385	0.0 to 2.0	2 to 12
New Access Road (North)	483727	752817	0.2 to 3.0	3 to 4
New Access Road (South)	482567	749472	0.1 to 1.1	2 to 20
Points of Interest / Areas outside of Restoration Harvest Blocks				
PP001 – expansive area of deeper peat (not in block)	482609	749095	2.3	3
PP002 – expansive area of deeper peat (not in block)	482320	749000	4.7	2
POI008 – area of historic peat failure (not in block/site)	482611	752382	1.0	26

Note 1: The data presented in the table above is used in the peat stability assessment of the site.

In addition to probing, in-situ shear vane testing was carried out as part of the ground investigation. Strength testing was carried out at selected locations across the site to provide representative coverage of indicative peat strengths. The results of the vane testing with depth are presented in Figure 5-1.

The hand vane results indicate undrained shear strengths in the range 4 to 40kPa, with a mean and median value of 18 and 16kPa respectively. The strengths recorded would be typical of well drained peat as is generally present on site.

Peat strength at sites of known peat failures (assuming undrained loading failure) are generally very low, for example the undrained shear strength at the Derrybrien failure (AGEC, 2004) as derived from back-analysis, was estimated at 2.5kPa. The recorded undrained strength at Sheskin South is significantly greater than the lower bound values for Derrybrien indicating that there is no close correlation to the peat conditions at the Derrybrien site and that there is significantly less likelihood of failure on the Proposed Development site.

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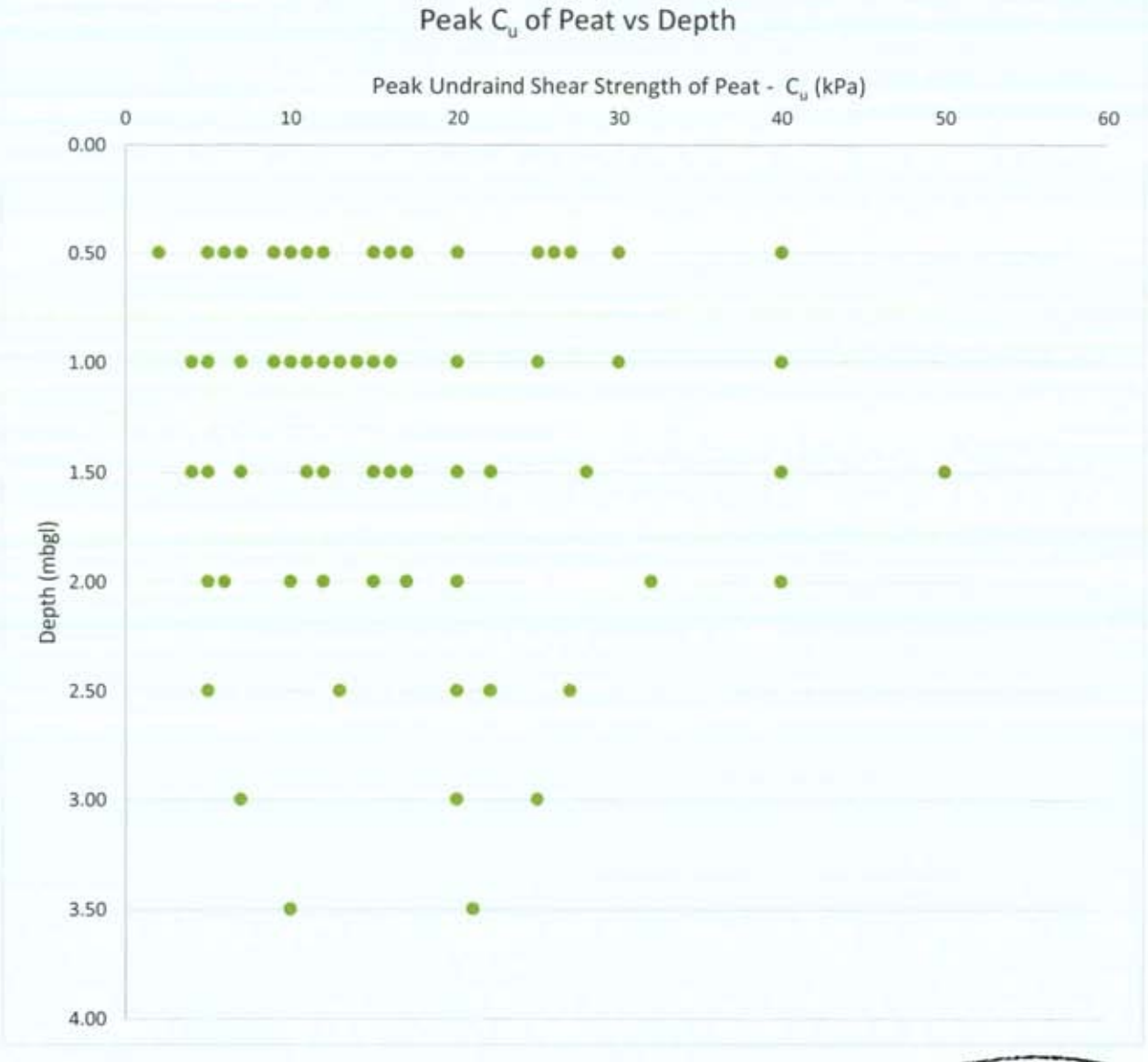
Figure 5-1: Peak Undrained Shear Strength (c_u) Profile for Peat with Depth



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6. PEAT STABILITY ASSESSMENT

The peat stability assessment includes an assessment of the stability of the natural peat slopes for individual parcels across the site including the RHBs and along the proposed access roads. The assessment also analyses the stability of the natural peat slopes with a surcharge loading of 10kPa, simulating the temporary load created by forestry machinery. On occasion, forestry machinery (such as harvesters) will exert ground pressures >10kPa on the underlying peat. However, the extensive root system from the existing and recently felled trees within the RHBs is anticipated to form a sufficient anchorage to support the temporary higher loadings produced by these plant. Additional measures to include the use of brash mattresses to support working platforms and haul roads shall also be used.

6.1 Methodology for Peat Stability Assessment

Stability of a peat slope is dependent on several factors working in combination. The main factors that influence peat stability are slope angle, shear strength of peat, depth of peat, pore water pressure and loading conditions.

An adverse combination of factors could potentially result in peat sliding. An adverse condition of one of the above-mentioned factors alone is unlikely to result in peat failure. The infinite slope model (Skempton and DeLory, 1957) is used to combine these factors to determine a factor of safety for peat sliding. This model is based on a translational slide, which is a reasonable representation of the dominant mode of movement for peat failures.

To assess the factor of safety for a peat slide, an undrained (short-term stability) and drained (long-term stability) analysis has been undertaken to determine the stability of the peat slopes on site.

1. The undrained loading condition applies in the short-term during construction and until construction induced pore water pressures dissipate.

2. The drained loading condition applies in the long-term. The condition examines the effect of the change in groundwater level as a result of rainfall on the existing stability of the natural peat slopes.

Undrained shear strength values (c_u) for peat are used for the total stress analysis. Based on the findings of the 2003 Derrybrien failure and other failures in peat, undrained loading during construction was found to be the critical failure mechanism.

A drained analysis requires effective cohesion (c') and effective friction angle (ø') values for the calculations. These values can be difficult to obtain because of disturbance experienced when sampling peat and the difficulties in interpreting test results due to the excessive strain induced within the peat. To determine suitable drained strength values a review of published information on peat was carried out. Table 6-1 shows a summary of the published information on peat together with drained strength values.

From Table 6-1 the values for c' ranged from 1.1 to 8.74kPa and ø' ranged from 21.6 to 43°. The average c' and ø' values are 4.5kPa and 30° respectively. Based on the above, it was considered to adopt a conservative approach and to use design values below the averages. For design the following general drained strength values have been used for the site:

$c' =$ 4kPa
$ø' =$ 25°

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Table 6-1: List of Effective Cohesion and Friction Angle Values for Peat

Reference	Cohesion, c' (kPa)	Friction Angle, ø' (degrees)	Testing Apparatus/ Comments
Hanrahan et al (1967)	5 to 7	36 to 43	From triaxial apparatus
Rowe and Mylleville (1996)	2.5	28	From simple shear apparatus
Landva (1980)	2 to 4	27.1 to 32.5	Mainly ring shear apparatus for normal stress greater than 13kPa
	5 to 6	-	At zero normal stress
Carling (1986)	6.5	0	-
Farrell and Hebib (1998)	0	38	From ring shear and shear box apparatus. Results are not considered representative.
	0.61	31	From direct simple shear (DSS) apparatus. Result considered too low therefore DSS not considered appropriate
Rowe, Maclean and Soderman (1984)	1.1	26	From simple shear apparatus
	3	27	From DSS apparatus
McGreever and Farrell (1988)	6	38	From triaxial apparatus using soil with 20% organic content
	6	31	From shear box apparatus using soil with 20% organic content
Hungr and Evans (1985)	3.3	-	Back-analysed from failure
Dykes and Kirk (2006)	3.2	30.4	Test within acrotelm
Dykes and Kirk (2006)	4	28.8	Test within catotelm
Warburton et al (2003)	5	23.9	Test in basal peat
Warburton et al (2003)	8.74	21.6	Test using fibrous peat
Hendry et al (2012)	0	31	Remoulded test specimen
Komatsu et al (2011)	8	34	Remoulded test specimen
Zwanenburg et al (2012)	2.3	32.3	From DSS apparatus
Den Haan & Grognet (2014)	-	37.4	From large DSS apparatus
O'Kelly & Zhang (2013)	0	28.9 to 30.3	Tests carried out on reconstituted, undisturbed and blended peat samples

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6.2 Analysis to Determine Factor of Safety (Deterministic Approach)

The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes using infinite slope analysis. The analysis was carried out at RHBs and along the proposed access roads.

The FoS provides a direct measure of the degree of stability of the slope. A FoS of less than 1.0 indicates that a slope is unstable, a FoS of greater than 1.0 indicates a stable slope.

The acceptable safe range for FoS typically ranges from 1.3 to 1.4. The previous code of practice for earthworks BS 6031:1981 (BSI, 1981), provided advice on design of earthworks slopes. It stated that for a first-time failure with a good standard of site investigation the design FoS should be greater than 1.3.

As a general guide the FoS limits for peat slopes in this report are summarised in Table 6-2.

Table 6-2: Factor of Safety Limits for Slopes

Factor of Safety (FoS)	Degree of Stability
Less than 1.0	Unstable (red)
Between 1.0 and 1.3	Marginally stable (yellow)
1.3 or greater	Acceptable (green)

Eurocode 7 (EC7) (IS EN 1997-1:2005) now serves as the reference document and the basis for design geotechnical engineering works. The design philosophy used in EC7 applies partial factors to soil parameters, actions and resistances. Unlike the traditional approach, EC7 does not provide a direct measure of stability, since global Factors of Safety are not used.

As such, and in order to provide a direct measure of the level of safety on a site, EC7 partial factors have not been used in this stability assessment. The results are given in terms of FoS.

Lower bound undrained shear strength (c_u) values for the peat of 4kPa (for slopes <6°) and 10kPa (for slopes >6°) were selected for the assessment and were based on the c_u values recorded on site. It should be noted that these c_u values are considered a conservative value for the analysis and are not representative of all peat present across the site. In reality the peat generally has a higher undrained strength.

The formula used to determine the factor of safety for the undrained condition in the peat (Bromhead, 1986) is as follows:

$$F = \frac{c_u}{\gamma z \sin\alpha \cos\alpha}$$

Where:

F = Factor of Safety
c_u = Undrained strength
γ = Bulk unit weight of material

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z = Depth to failure plane assumed as depth of peat

α = Slope angle

The formula used to determine the factor of safety for the drained condition in the peat (Bromhead, 1986) is as follows:

$$F = \frac{c' + (\gamma z - \gamma_w h_w)\cos^2 \alpha \tan \phi'}{\gamma z \sin \alpha \cos \alpha}$$

Where:

F = Factor of Safety

c' = Effective cohesion

γ = Bulk unit weight of material (Peat)

z = Depth to failure plane assumed as depth of peat

γ_w = Unit weight of water

h_w = Height of water table above failure plane

α = Slope angle

ϕ' = Effective friction angle

For the drained analysis the level of the water table above the failure surface is required to calculate the factor of safety for the slope. Since the water level in blanket peat can be variable and can be recharged by rainfall, it is not feasible to establish its precise location throughout the site. Therefore, a sensitivity analysis using water level ranging between 0% and 100% of the peat depth was conducted, where 0% equates to the peat being completely dry and 100% equates to the peat been fully saturated.

The following general assumptions were used in the analysis of peat slopes at each location:

(1) Peat depths are based on the maximum peat depth recorded at each location from the walkover surveys.

(2) The slope angles used in the peat stability assessment were obtained during the site reconnaissance by FT using handheld equipment. Slope angles were not recorded for the 44 no. RPS peat probe locations. As a result they will not be included in the stability analysis.

(3) Slope angle at base of sliding assumed to be parallel to ground surface.

(4) A lower bound undrained shear strength, c_u for the peat of 4kPa and 10kPa, depending on the location, was selected for the assessment. The value of 10kPa was used in areas with steeper slopes (>6°). The lowest recorded value on the site during the site walkover was 4kPa. It should be noted that a c_u of 4/10kPa for the peat is considered a conservative value for the analysis and is not representative of all peat present across the site. In reality, the majority of the peat has a significantly higher undrained strength as a result of the extensive drainage (both natural and artificial) present within Sitka forestry across the site.

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For the stability analysis two load conditions were examined, namely

Condition (1): no surcharge loading;

Condition (2): surcharge of 10 kPa, to represent temporary loading from site traffic and forestry machinery is assumed as a worst case.

6.3 Results of Analysis

6.3.1 Undrained Analysis for the Peat

The results of the undrained analysis for the natural peat slopes at all locations analysed are presented in Appendix C and the results of the undrained analysis for the most critical load case (load condition 2) are shown on Figure 6-1. The undrained analysis for load condition 2 is considered the most critical load case as most peat failures occur in the short term upon loading of the peat surface. The results from the RHBs and along access roads, are summarised in Table 6-3.

The calculated FoS for load condition 1 is in excess of 1.30 for each of the peat probe locations (73 no. locations) analysed with a range of FoS of 1.78 to 58.48, indicating a low risk of peat instability.

The calculated FoS for load condition 2 is in excess of 1.30 for each of the peat probe locations (72 no. locations), with the exception of peat probe location POI008, which gave a undrained FOS of 0.89. POI008 represents an isolated historic peat failure, which is located outside of the RHB and shows no sign of recent instability. The remaining locations were analysed with a range of FoS of 1.40 to 8.02, again indicating a low risk of peat instability with respect to the RHBs and access roads.

Table 6-3: Factor of Safety Results (Undrained Condition)

Location ID	Easting [Note 1]	Northing [Note 1]	Minimum Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
Restoration Harvest Block (RHB)				
GY27_3_09	482827	749973	3.65	2.25
GY27_HB0009	483856	753047	2.60	2.05
GY27_HB0010	483852	752726	2.55	1.91
GY27_HB0011	483800	752243	3.06	2.19
GY27_HB0012	482865	752344	1.97	1.40
GY27_HB0013	483493	750691	3.63	1.49
GY27_HB0014	482481	749694	9.07	2.83
GY27_HB0015	482161	749574	3.90	2.34
GY27_HB0016	482461	749191	6.75	4.25
GY27_HB0017	482701	749106	14.40	2.40
GY27_HB0018	483725	752502	18.14	5.18
GY27_HB0020	482900	749603	5.46	2.59
GY27_HB0021	483159	752945	1.92	1.44

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Location ID	Easting [Note 1]	Northing [Note 1]	Minimum Factor of Safety for Load Condition	
			Condition (1)	Condition (2)
GY27_HB0022	483382	751458	3.29	1.92
GY27_HB0023	482714	749676	8.06	3.82
GY27_HB0024	482819	749388	5.73	3.82
GY27_HB0027	483361	749396	2.87	2.29
GY27_HB0028	483366	749952	2.66	1.83
GY27_HB0029	483472	750413	5.39	2.22
GY27_HB0030	483121	749806	5.18	3.02
Existing Access Roads				
GY27R0025	483687	751453	4.86	2.00
GY27R0026	484034	751590	30.61	6.12
GY27R0027	483407	750208	5.18	2.22
GY27R0049	484363	749945	4.25	2.73
GY27R0052	483290	750552	No Peat	
GY27R0054	482692	749385	5.46	2.59
Proposed Access Roads				
Access Road (South)	483727	752817	10.43	2.83
Access Road (North)	482567	749472	1.92	1.44
Peat Probe Locations Outside of RHBs				
POI008 [Note 2]	482611	752382	1.78	0.89
PP001	482609	749095	3.33	2.32
PP002	482320	749000	2.44	2.01

Note 1 – for RHBs and Roads the ITM coordinate represent the approx. centre of the feature
Note 2 – this peat failure is deemed to be a shallow (<1m) and isolated occurrence, which will have a negligible impact on the proposed rehabilitation works. It will therefore be discounted from any further assessment.

Path: R:\Map Production\2022\P22-263\Workspace\P22-263_GIS_Fig_6_1_Factor of Safety Plan – Short Term Condition_Undrained_A3.mxd

Sources: Esri, HERE, Garmin, InterMap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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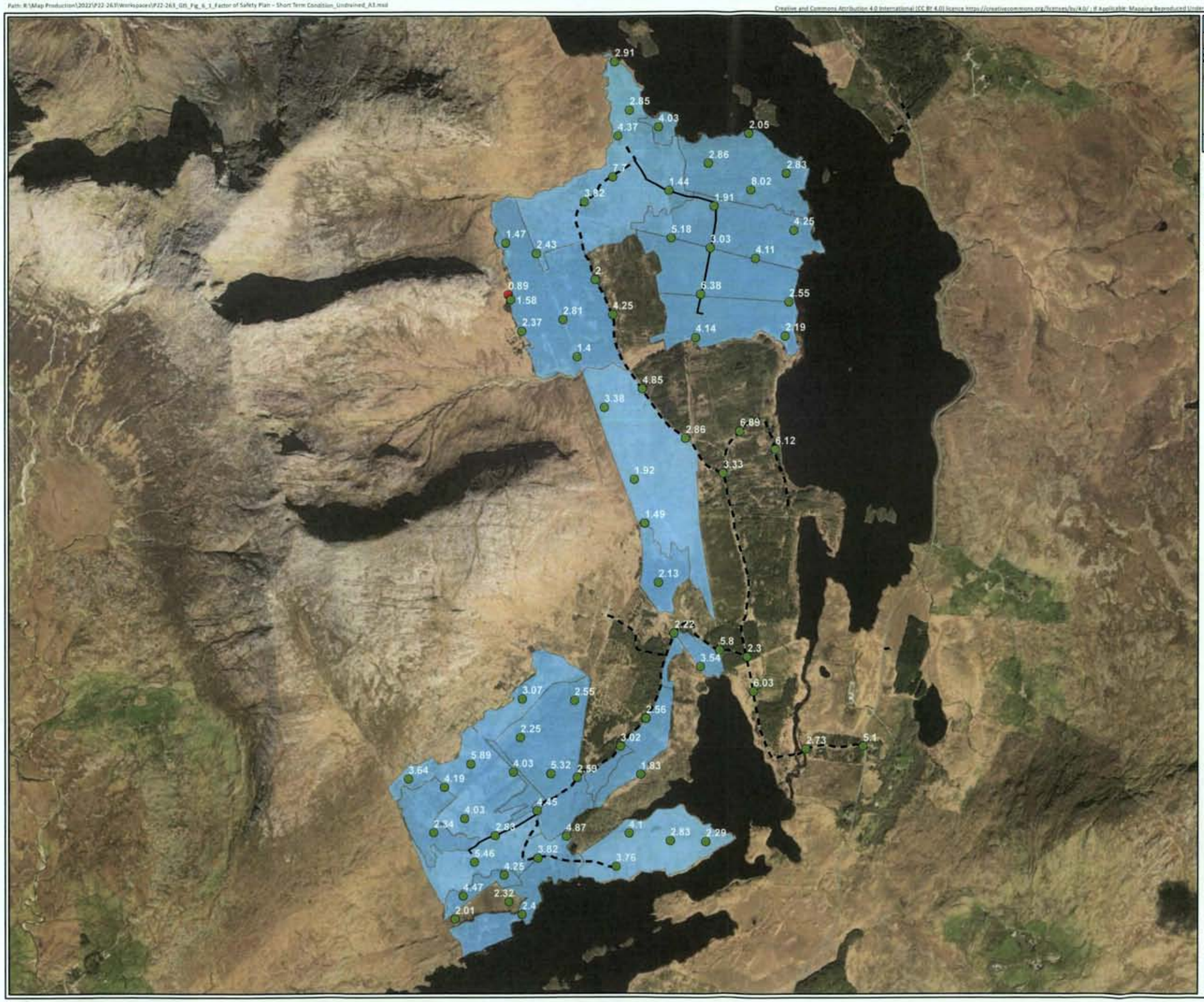

Legend

- Restoration Harvest Blocks
- Existing Access Roads
- New Access Roads

FOS (Undrained Condition)

- <1
- 1 - 1.3
- > 1.3

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TITLE:	Factor of Safety Plan – Short Term Condition (Undrained)		
PROJECT:	Derryclare Peatland Rehabilitation		
FIGURE NO:	6-1		
CLIENT:	MKO		
SCALE:	1:20000	**REVISION:**	0
DATE:	09/02/2023	**PAGE SIZE:**	A3

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6.3.2 Drained Analysis for the Peat

The results of the drained analysis for the peat are presented in Appendix C. The results from the RHBs and along access roads, are summarised in Table 6-4. As stated previously, the drained loading condition examines the effect of in particular, rainfall on the existing stability of the natural peat slopes and represents the post rehabilitation phase of the development.

Out of the 73 no. analysed peat probe locations, 69 no. gave a calculated FoS for load condition 1 in excess of 1.30 (FoS range of 1.45 to 46.07). Three peat probe locations gave a FoS of between 1 and 1.3 and one peat probe location gave a FoS of <1. In general, results from this analysis indicate the site has a low risk of peat instability. However, further consideration has to be given to the following RHBs with respect to isolated low (<1.3) FoS values:

- GY27_HB0009
- GY27_HB0012
- GY27_HB0028

The calculated FoS for load condition 2 is in excess of 1.30 for each of the locations (70 no. locations), with the exception of three peat probe locations, which give a drained FoS ranging from 0.99 to 1.16. The remaining locations were analysed with a range of FoS of 1.96 to 13.79, indicating a low risk of peat instability. However, further consideration has to be given to the following RHBs with respect to isolated low (<1.3) FoS values:

- GY27_HB0012
- GY27_HB0013

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Table 6-4: Factor of Safety Results (Drained Conditions)

Location ID	Easting [Note 1]	Northing [Note 1]	Minimum Factor of Safety for Load Condition (Assuming 100% Water)	
			Condition (1)	Condition (2)
Restoration Harvest Block (RHB)				
GY27_3_09	482827	749973	1.46	1.92
GY27_HB0009	483856	753047	1.04	1.76
GY27_HB0010	483852	752726	2.55	4.14
GY27_HB0011	483800	752243	3.06	4.73
GY27_HB0012	482865	752344	0.79	1.15
GY27_HB0013	483493	750691	1.45	1.16
GY27_HB0014	482481	749694	3.63	2.30
GY27_HB0015	482161	749574	1.56	1.99
GY27_HB0016	482461	749191	6.75	3.78
GY27_HB0017	482701	749106	5.76	1.92
GY27_HB0018	483725	752502	7.26	4.44
GY27_HB0020	482900	749603	2.19	2.19
GY27_HB0021	483159	752945	1.67	2.45
GY27_HB0022	483382	751458	3.29	2.85

Location ID	Easting [Note 1]	Northing [Note 1]	Minimum Factor of Safety for Load Condition (Assuming 100% Water)	
			Condition (1)	Condition (2)
GY27_HB0023	482714	749676	8.50	8.71
GY27_HB0024	482819	749388	5.73	4.15
GY27_HB0027	483361	749396	2.76	3.23
GY27_HB0028	483366	749952	1.06	1.56
GY27_HB0029	483472	750413	2.16	1.84
GY27_HB0030	483121	749806	2.07	2.59
Existing Access Roads				
GY27R0025	483687	751453	1.94	1.64
GY27R0026	484034	751590	16.53	5.92
GY27R0027	483407	750208	2.07	1.84
GY27R0049	484363	749945	4.25	5.91
GY27R0052	483290	750552	No Peat	
GY27R0054	482692	749385	2.19	2.19
Proposed Access Roads				
Access Road (South)	483727	752817	10.43	2.30
Access Road (North)	482567	749472	1.92	3.10
Peat Probe Locations Outside of RHBs				
POI008 [Note 2]	482611	752382	1.02	0.99
PP001	482609	749095	3.33	5.02
PP002	482320	749000	2.44	4.35

Note 1 – for RHBs and Roads the ITM coordinate represent the approx. centre of the feature
Note 2 – this peat failure is deemed to be a shallow (<1m) and isolated occurrence, which will have a negligible impact on the proposed rehabilitation works. It will therefore be discounted from any further assessment.

Based on the findings from the initial drained analysis (assuming water level at 100%) a sensitivity analysis was undertaken to assess varying degrees of saturation within the peat slopes. The analysis was undertaken using water levels ranging from 0 to 100% (at 25% intervals). The results from this analysis are presented in Appendix C.

Existing water monitoring data captured by RPS in 2021, coupled with field observations made during FT's 2022 site walkovers, indicate groundwater depths, particularly on sloping ground (>6°) are deeper than assumed in the initial analysis. To reflect actual site conditions, a water level of 50% within the peat was chosen. This is still deemed to be a conservative estimate.

The FoS was recalculated using the 50% water level for locations that initially returned a drained FoS of <1.3. The results of this analysis are summarised in Table 6-5 and show drained FoS values >1.3, with the exception of POI008 (FoS = 1.22).

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Table 6-5: Comparison of Factor of Safety Results at 100% and 50% Water Levels within the Peat

Location ID	Factor of Safety for Load Condition (Assuming 100% Water)		Factor of Safety for Load Condition (Assuming 50% Water)	
	Condition (1)	Condition (2)	Condition (1)	Condition (2)
GY27_HB0009	1.04	1.76	3.26	3.51
GY27_HB0012	0.79	1.15	1.88	1.32
GY27_HB0013	1.45	1.16	1.93	1.36
GY27_HB0028	1.06	1.56	2.39	2.47
POI008 Note 1	1.02	0.99	1.49	1.22

Note 1 – this peat failure is deemed to be a shallow (<1m) and isolated occurrence, which will have a negligible impact on the proposed rehabilitation works. It will therefore be discounted from any further assessment.

The areas with FoS values <1.3 at 100% water level (Table 6-5) will be subject to appropriate monitoring (both during and post works) as detailed in Section 9. In addition to monitoring, the appointed forestry contractor shall ensure that the natural site drainage is maintained during the rehabilitation works, thereby reducing the likelyhood of water levels within the peat of rising to 100%.

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Path: R:\Map Production\2022\P22-263\Workspaces\P22-263_GIS_Fig_6_2_Factor of Safety Plan - - Long Term Condition Drained_A3.mxd

Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community
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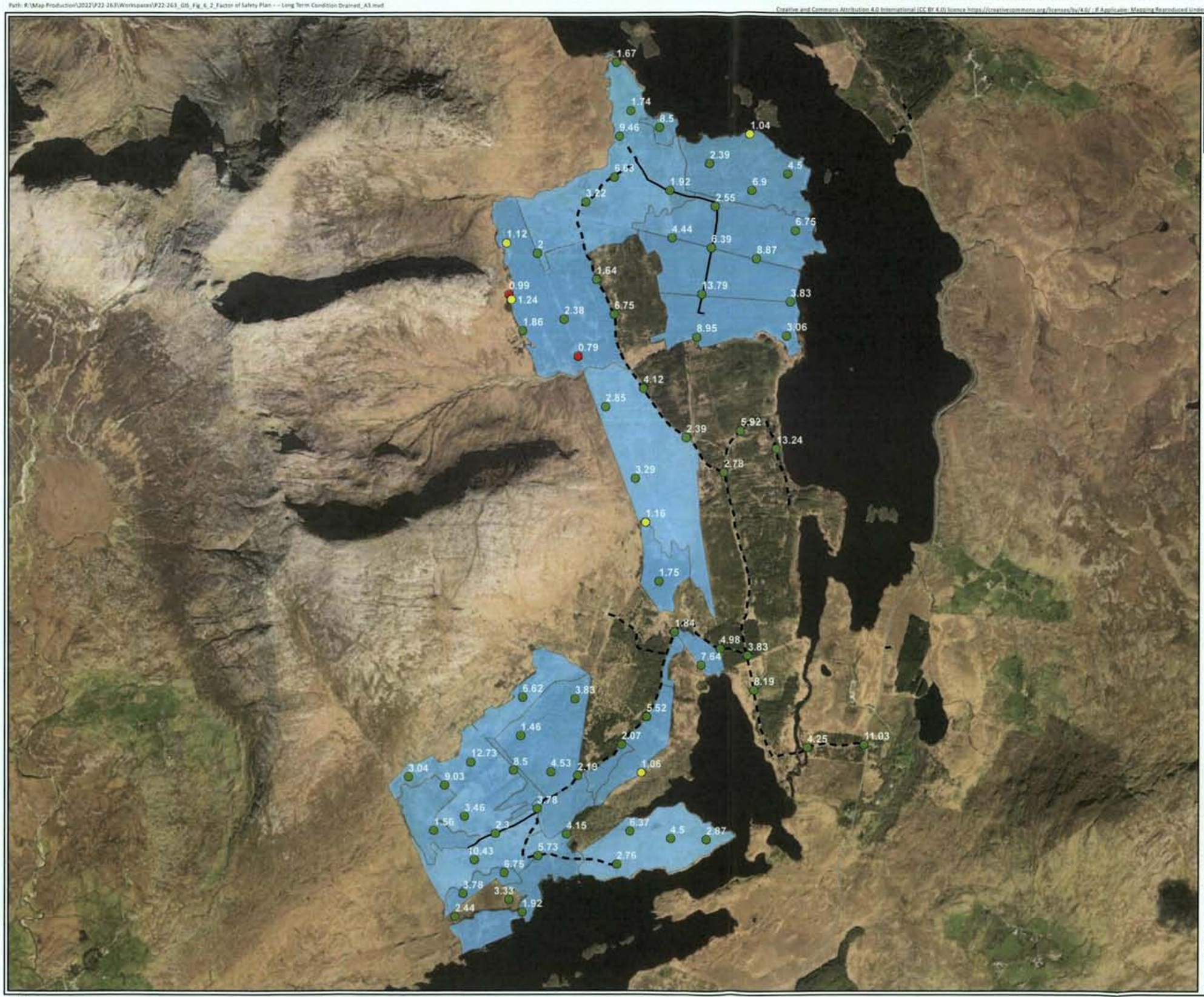

Legend

- Restoration Harvest Blocks
- Existing Access Roads
- New Access Roads

FOS (Drained Condition)

- <1
- 1 - 1.3
- > 1.3

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TITLE:	Factor of Safety Plan – Long Term Condition (Drained)		
PROJECT:	Derryclare Peatland Rehabilitation		
FIGURE NO:	6-2		
CLIENT:	MKO		
SCALE:	1:20000	**REVISION:**	0
DATE:	09/02/2023	**PAGE SIZE:**	A3

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7. PEAT STABILITY RISK ASSESSMENT

A peat stability risk assessment was carried out for the RHBs and along the access roads. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRA (2017) and MacCulloch (2005).

The risk assessment uses the results of the stability analysis (deterministic approach) in combination with qualitative factors, which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability, to assess the risk for each infrastructure element.

For each of the RHBs and access roads, a risk rating (product of probability and impact) is calculated and rated as shown in Table 7-1. Where a subsection is rated 'Medium' or 'High', control measures are required to reduce the risk to at least a 'Low' risk rating. Where a subsection is rated 'Low' or 'Negligible', only routine control measures are required.

Table 7-1: Risk Rating Legend

17 to 25	High: avoid works in area or significant control measures required
11 to 16	Medium: notable control measures required
5 to 10	Low: only routine control measures required
1 to 4	Negligible: none or only routine control measures required

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A full methodology for the peat stability risk assessment is given in Appendix D.

7.1 Summary of Risk Assessment Results

The results of the peat stability risk assessment for potential peat failure at the main infrastructure elements is presented as a Geotechnical Risk Register in Appendix B and summarised in Table 7-2. The risk rating for each area (RHBs, Existing Access Roads and Proposed Access Roads) is designated Low to Medium following some general mitigation/control measures being implemented.

Details of the required mitigation/control measures can be found in the Geotechnical Risk Register for each infrastructure element (Appendix B) and are summarised below:

- Ensure appropriate supervision of the site is undertaken by the appointed contractor using experienced personnel.
- Use of experienced contractors, trained operators and appropriate plant to carry out the work.
- Use of experienced geotechnical staff for supervision of rehabilitation works for risk ratings of >11 (Medium to High risk)
- Maintain hydrology of area as far as possible by ensuring the site's natural drainage is preserved during the proposed rehabilitation works. This will help prevent the build-up of water pressures in the peat, leading to the peat becoming "buoyant".
- Stabilise wet peat using stacked branches or trunks laid across/perpendicular to temporary haulage routes (not applicable to existing/new access roads).
- Post works monitoring of the site be undertaken by experienced geotechnical staff over a period of no less than 12 months (where risk rating is >11 (Medium to High risk) after post control measures are prescribed).

Table 7-2: Summary of Peat Stability Risk Register

Location ID	Pre-Control Measure Implementation Risk Rating	Pre-Control Measure Implementation Risk Rating Category	Notable Control Measures Required	Post-General Control Measure Implementation Risk Rating	Post-General Control Measure Implementation Risk Rating Category
Restoration Harvest Block (RHB)					
GY27_3_09	Low	5-10	No	Low	5-10
GY27_HB0009	High	17-25	Yes	Low	5-10
GY27_HB0010	High	17-25	Yes	Low	5-10
GY27_HB0011	Low	5-10	No	Low	5-10
GY27_HB0012	High	17-25	Yes	Low	5-10
GY27_HB0013	Medium	11-16	No	Low	5-10
GY27_HB0014	Low	5-10	No	Low	5-10
GY27_HB0015	Low	5-10	No	Low	5-10
GY27_HB0016	Low	5-10	No	Low	5-10
GY27_HB0017	Low	5-10	No	Low	5-10
GY27_HB0018	Low	5-10	No	Low	5-10
GY27_HB0020	Low	5-10	No	Low	5-10
GY27_HB0021	Medium	11-16	No	Low	5-10
GY27_HB0022	Low	5-10	No	Low	5-10
GY27_HB0023	Low	5-10	No	Low	5-10
GY27_HB0024	Low	5-10	No	Low	5-10
GY27_HB0027	Medium	11-16	No	Low	5-10
GY27_HB0028	Medium	11-16	No	Low	5-10
GY27_HB0029	Low	5-10	No	Low	5-10
GY27_HB0030	Low	5-10	No	Low	5-10
Existing Access Roads					
GY27R0025	Low	5-10	No	Low	5-10
GY27R0026	Low	5-10	No	Low	5-10
GY27R0027	Low	5-10	No	Low	5-10
GY27R0049	Low	5-10	No	Low	5-10
GY27R0052	Low	5-10	No	Low	5-10
GY27R0054	Low	5-10	No	Low	5-10
New Access Roads					
Access Road (South)	Low	5-10	No	Low	5-10
Access Road (North)	High	11-16	No	Low	5-10

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8. FOUNDING DETAILS FOR ACCESS ROADS

8.1 Access Roads

It is recommended that access roads on site are constructed as excavate and replace (founded) type construction, which, given the ground conditions and type of terrain present, is deemed the most appropriate construction approach.

The total length of new access roads to be constructed on site is 1.58km (Figure 2-1)

It is anticipated that peat spoil resulting from the construction of the proposed access roads can be re-used in the blocking of forestry drainage as part of the re-wetting works.

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9. WORKS MONITORING AND POST WORKS MONITORING

9.1 Works Supervision and Monitoring

Works supervision can be classed into two divisions which require different levels of experience with respect to the supervisor and shall be based on the post control risk rating presented in Appendix B.

Where the post control risk rating is ≤ 10 (Negligible to Low) the works shall be supervised full-time by personnel with a minimum of 10 years' experience working within the forestry industry to include relevant experience in peatland rehabilitation.

Where the post control risk rating is ≥ 10 (Medium to High) the works shall be supervised full-time by a suitably qualified geotechnical engineer/ engineering geologist with no less than 10 years' relevant experience.

9.2 Movement Monitoring Posts

To monitor possible peat movements in areas where the pre-control measure risk rating (Appendix B) is ≥ 10 (Medium to High), it is proposed to install sighting posts upslope and downslope of the rehabilitation works areas and access roads. Details of sighting posts are given below.

1. A line of sighting posts shall comprise:
    a. A line of wooden stakes (typically 1 to 1.5m long) placed vertically into the peat to form a straight line.
    b. The sighting line shall comprise 6 nos. posts at (say) 5m centres that is a line some 25m long.
    c. A string line shall be attached to the first and last posts and all intervening posts shall be adjusted so they are just touching the string line.
2. Lines of sighting posts shall be placed across the existing slope about 5m away from the area to be worked. It is recommended that the posts are located along the road at 10m intervals in areas of deep peat (say greater than 1m). Where there are relatively steeper slopes or softer ground a sighting line shall be placed down the slope, or at any location where monitoring would be deemed useful.
3. Each line of sighting posts shall be uniquely referenced with each post in the line given a reference. The post reference shall be marked on each post (e.g. reference 1-1, 1-2, 1-3, 1-4, 1-5, and 1-6 for posts in line 1).
4. The sighting lines shall be monitored at the beginning of each working day, and during the day were considered appropriate (e.g. when working activity is concentrated at a specific location).
5. Monitoring of the posts shall comprise sighting along the line and recording any relative movement of posts from the string line.
6. Where increased movements are recorded the frequency of monitoring shall be increased.

A monitoring record shall be kept of the date, time and relative movement of each post, if any. This record shall be updated and stored as a spreadsheet.

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9.3 Post Works Monitoring

Where the pre-control risk rating (Appendix B) is ≥ 10 (Medium to High) the affected area shall be monitored on a monthly basis for no less than 12 months. Monitoring shall be undertaken by a suitably qualified geotechnical engineer/ engineering geologist with no less than 10 years' relevant experience. The need for monitoring beyond the 12 month period shall be determined based on findings from the initial monitoring period.

As part of the post works monitoring the following factors shall be considered:

- Weather at time of visit
- Evidence of sub peat water flow
- Evidence of surface water flow
- Evidence of historic and recent failures/slips
- Type of vegetation
- General slope characteristics
- Evidence of buoyant peat
- Evidence of bog pools

Photos shall also be taken at set locations and orientations during each visit for comparison purposes.

10. SUMMARY AND RECOMMENDATIONS

10.1 Summary

FT was engaged by MKO to undertake a geotechnical and peat stability assessment of the proposed peatland rehabilitation site at Derryclare, Co. Galway.

The findings of the peat assessment showed that the proposed RHB and new and existing access roads, generally have a low risk of peat failure and are suitable for the proposed rehabilitation works. The findings include recommendations and control measures for rehabilitation work in peat lands, all of which will be implemented in full to ensure that all works adhere to an acceptable standard of safety.

The site is typically covered by a thin mantle of Blanket Peat, which is frequently punctuated by bedrock outcropping. Bedrock outcrops and glacial till deposits are more frequent along the western extent of the site, where the topography steepens. The sites' topography varies considerably. In general, the terrain can be described as having moderate to steep slopes displaying a hummocky terrain. The land within the RHBs is predominantly forested, containing coniferous trees at different stages of maturity. Some of the RHBs have been felled but the stumps and root system remain intact.

Peat thicknesses recorded during the site walkovers from 130 probes ranged from 0.0 to 4.7m with an average depth of 1.1m. 63% of the probes recorded peat depths of less than 1.0m, with 86% of peat depth probes recorded peat depths of less than 2.0m. The deepest peat deposits of

Slope inclinations at the main infrastructure locations range from 1 to 32 degrees with a mean value of 10 degrees.

An analysis of peat sliding was carried out at each of the FT peat probe locations within the RHBs for both the undrained and drained conditions. The purpose of the analysis was to determine the Factor of Safety (FoS) of the peat slopes.

An undrained analysis was carried out, which applies in the short-term during the rehabilitation works. For the undrained condition, the calculated FoS for load conditions 1 and 2 for the locations analysed, showed that all locations within the RHBs and along the new and existing access roads returned a FoS >1.3, indicating a low risk of peat failure.

A drained analysis was also carried out, which examined the effect of in particular, rainfall on the existing stability of the natural peat slopes on site. For the drained condition (at 100% water level within the peat), the calculated FoS for load conditions (1) & (2) for the locations analysed, showed that locations within the RHBs and along the new and existing access roads typically returned FoS values >1.3. However, the analyses returned FoS values of >1.3 at six locations with the RHBs . When analysed using a 50% water level (thought to be more typical of observed site conditions), the returned FoS values all six where >1.3., indicating a low risk of peat failure. Notwithstanding this, the areas with FoS values <1.3 at (100% water level) will be subject to appropriate monitoring (both during and post works) as detailed in Section 9. In addition to monitoring, the appointed constractor shall ensure that the natural site drainage is maintained during the rehabilitation works, thereby reducing the likelyhood of water levels within the peat of rising to 100%.

The peat stability risk assessment at the RHB locations and along the new and existing access roads identified a number of mitigation/control measures to reduce the potential risk of peat failure. See Appendix B for details of the required mitigation/control measures for each area.

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In summary, the findings of the peat assessment showed that the site has an acceptable margin of safety, is suitable for the proposed peatland rehabilitation works and is considered to be at **low** risk of peat failure provided appropriate mitigation measures, such as maintaining the existing natural drainage network is implemented. The findings include recommendations and mitigation/control measures for rehabilitation work in peat lands, all of which will be implemented in full to ensure that all works adhere to an acceptable standard of safety.

10.2 Recommendations

The following recommendations are given, all of which will be implemented in full.

Notwithstanding that the site has a predominantly low risk of peat failure a number of mitigation/control measures are prescribed to ensure that all works adhere to an acceptable standard of safety for work in peatlands. Mitigation/control measures identified for each of the infrastructure elements in the risk assessment will be implemented throughout the rehabilitation works (Appendix B).

Where existing access roads are founded on sidelong ground the upslope road drainage is often blocked causing localised areas of standing water within the drainage channels. It is recommended that the existing road drainage network be adequately updated/maintained to avoid unwanted accumulations of water adjacent to the access roads.

Ongoing post works monitoring shall be undertaken by an experienced geotechnical engineer/ engineering geologist over an initial 12 month period with further monitoring requirements to be reviewed and implemented at the end of this period if deemed necessary.

Some areas of the site were extensively forested with heavy undergrowth (including fallen trees) present during the time of the site walkover. An additional site reconnaissance should be undertaken post felling activities to identify potential signs of instability that may have been covered by vegetation during the initial site walkover.

In addition to the above recommendations, remediation measures as set out in *The Drainage of Peatlands: impacts and rewetting techniques, 2012* should be considered with respect to tree removal and the backfilling of forestry drainage.

To minimise the risk of rehabilitation and construction activity causing potential peat instability the Construction Method Statements (CMSs) for the project will implement in full, but not be limited to, the recommendations above. This will ensure that best practice guidance regarding the management of peat stability will be inherent in the construction phase.

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APPENDIX A

Photos from Site Walkover

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General Photos from Restoration Harvest Block GY27_3_09

PP018 (view W)

PP078 (view W)

ION
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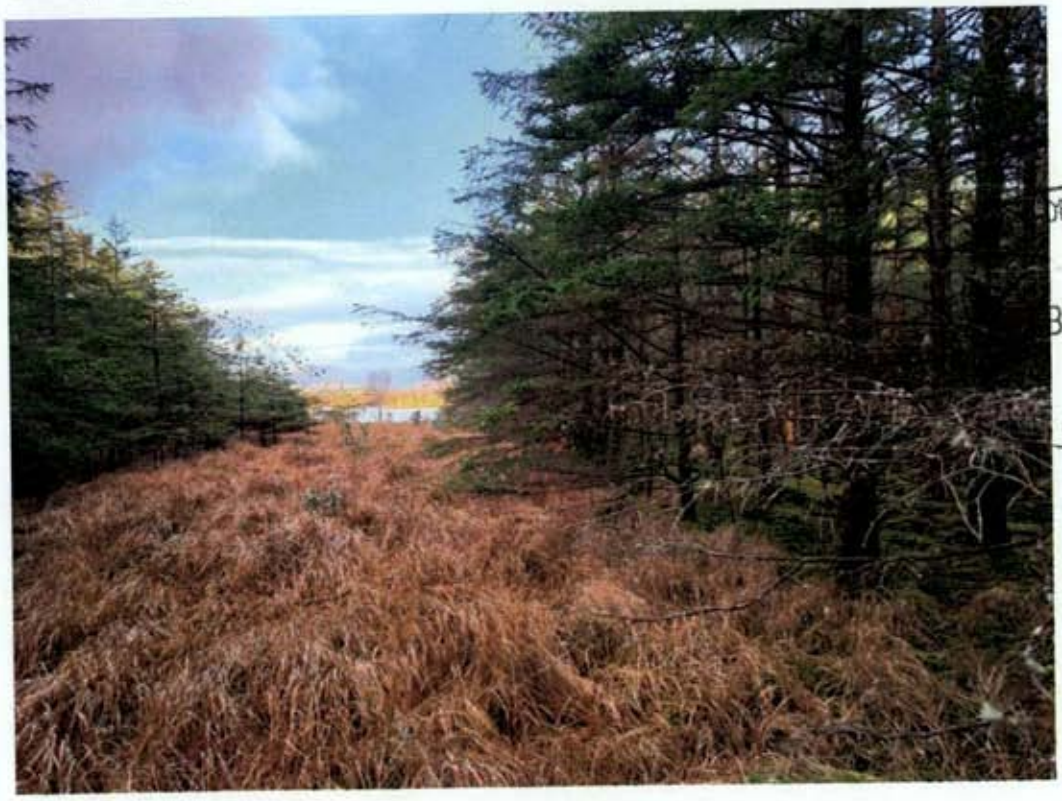
COUNCIL

General Photos from Restoration Harvest Block GY27_HB0009

PP042 (view S)

PP049 (view N)



DEVELOPMENT SECTION
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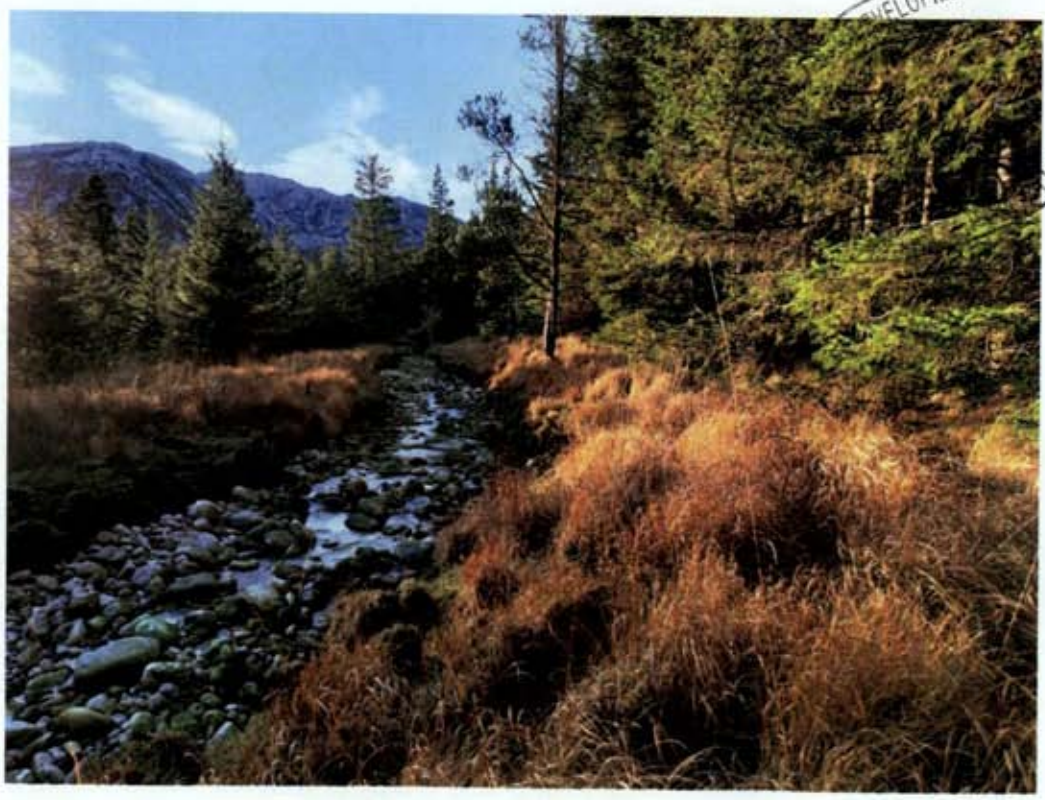
COUNTY COUNCIL

General Photos from Restoration Harvest Block GY27_HB0011

PP041 (view West)

PP047 (view W)



VELOPMENT SECTION
60
COUNCIL

General Photos from Restoration Harvest Block GY27_HB0012

PP031 (view S)

NT SECTION
23 FEB 2023 00 60
GALWAY COUNTY COUNCIL

PP033 (view W)

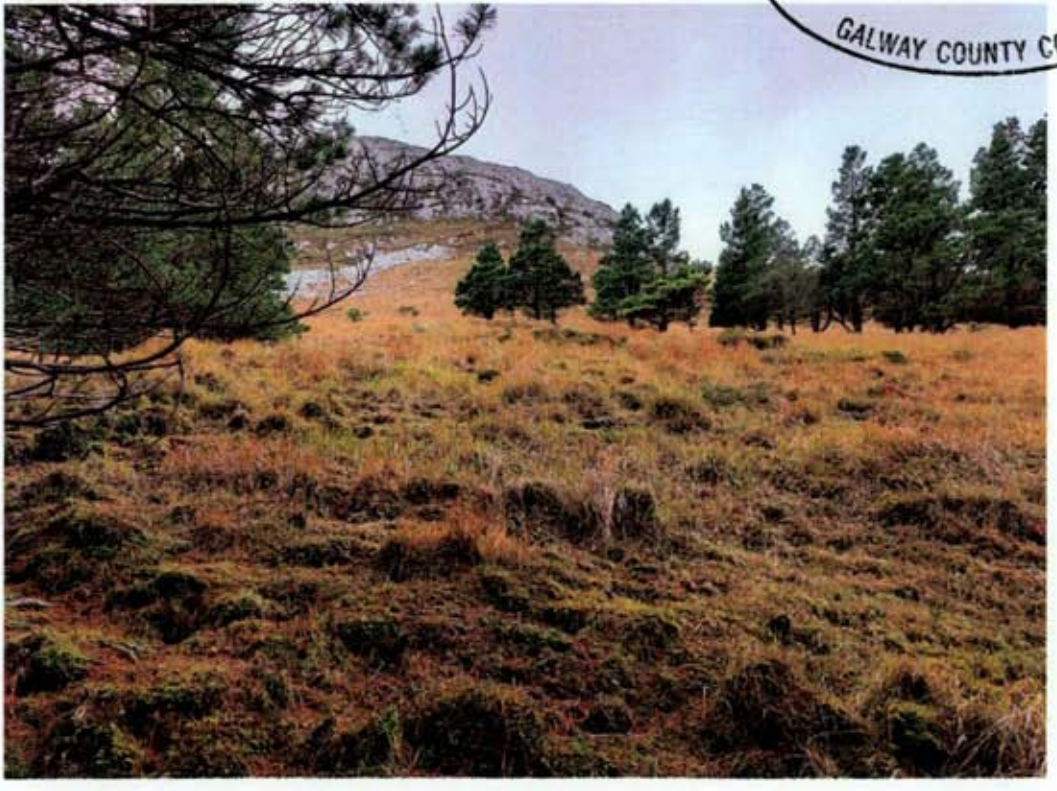


Photo of POI008 Historic Peat Landslip – view W towards backscarp face.

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General Photos from Restoration Harvest Block GY27_HB0013

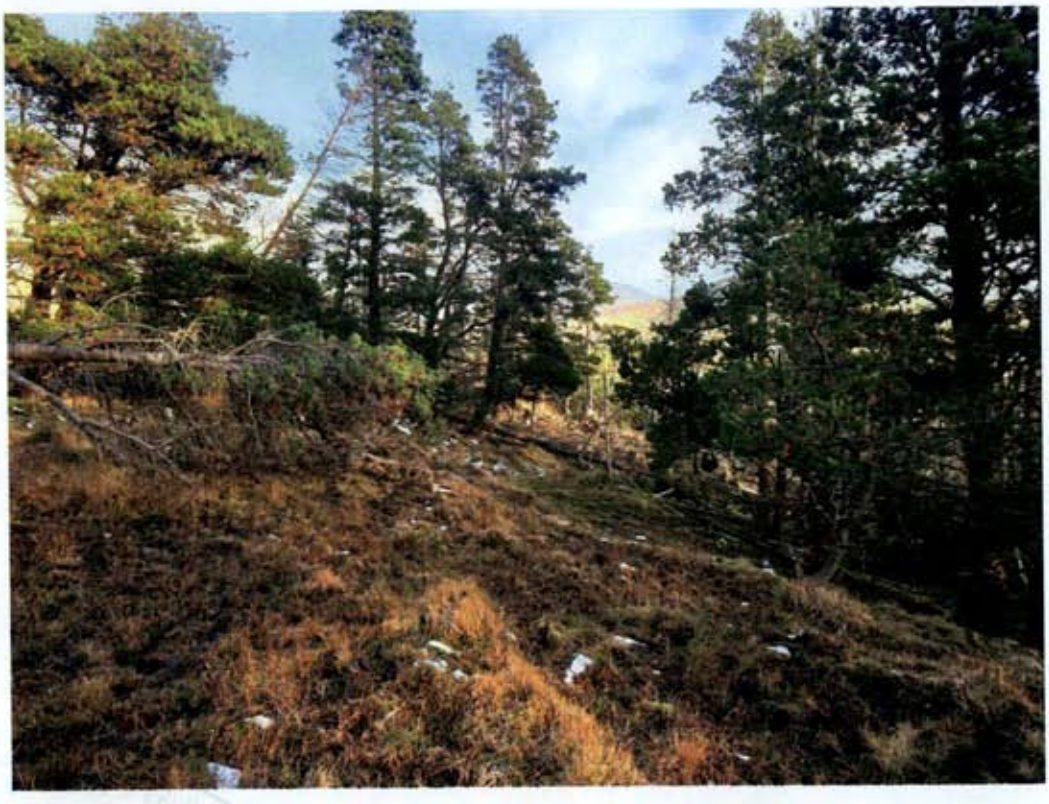
PP024 (view N)

PP025 (view W)

PLANNING & DEVELOPMENT SECTION
2023 0060
OUNTY COUNCIL

General Photos from Restoration Harvest Block GY27_HB0014

PP014 (view E)



PP075 (view E)

T SECTION
23 0060
COUNTY COUNCIL

General Photos from Restoration Harvest Block GY27_HB0015

PP011 (view S)

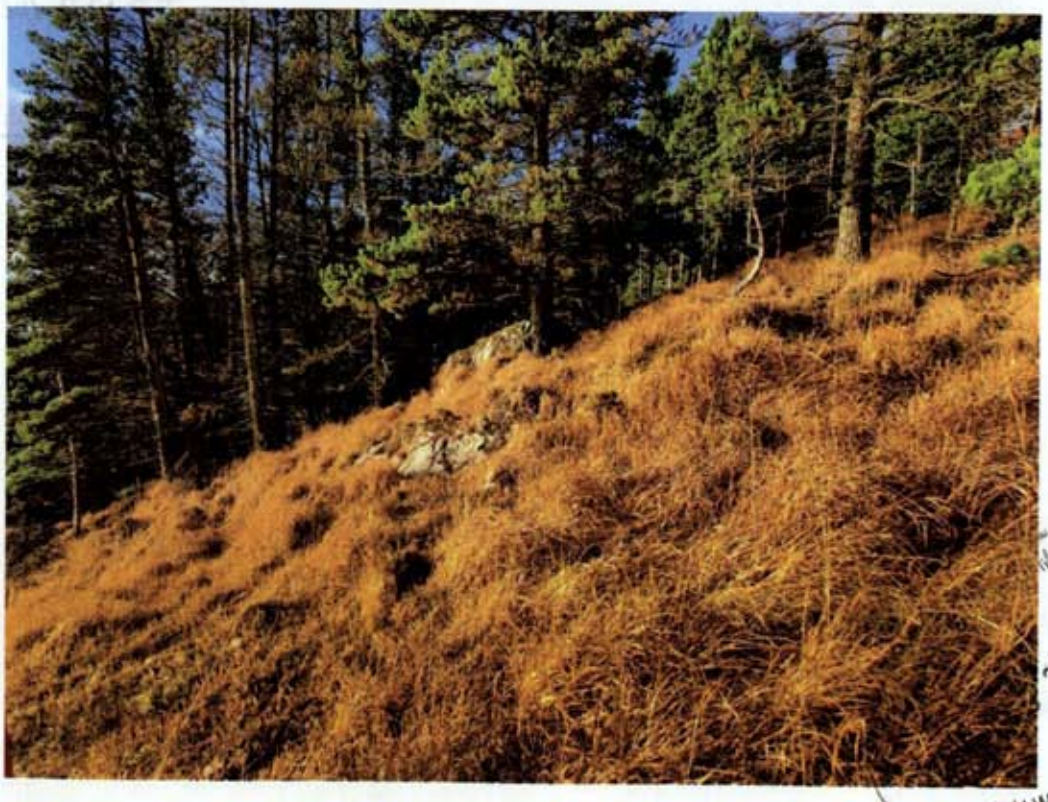
PP012 (view W)

DEVELOPMENT SECTION
FEB 2023 0060
COUNTY COUNCIL

General Photos from Restoration Harvest Block GY27_HB0017

PP003 (view W)

PP005 (view W)



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2023 0060
GALWAY COUNTY COUNCIL

General Photos from Restoration Harvest Block GY27_HB0018

PP040 (view N)

PP041 (view N)

PLANNING & DEVELOPMENT SECTION
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General Photos from Restoration Harvest Block GY27_HB0020

PP019 (view S)

PP016 (view N)

PLANNING & DEVELOPMENT SECTION
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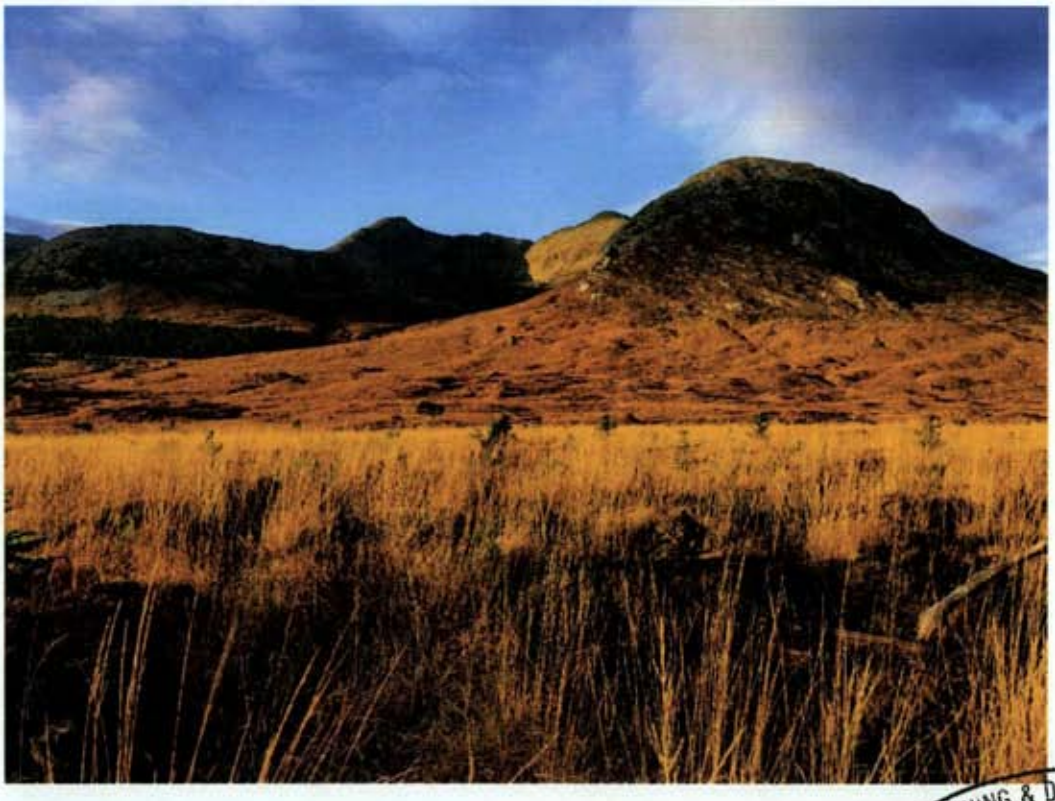
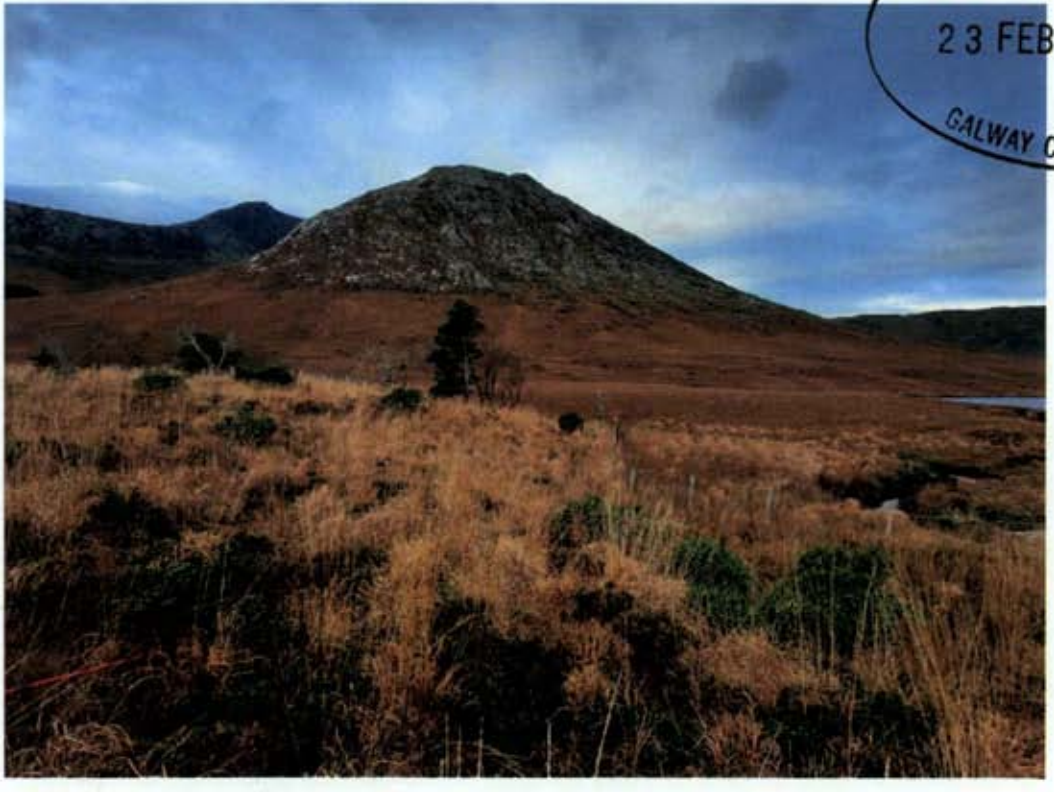
General Photos from Restoration Harvest Block GY27_HB0021

PP082 (view W)



PP083 (view W)



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General Photos from Restoration Harvest Block GY27_HB0022

PP076 (view N)

PP077 (view N)

SECTION
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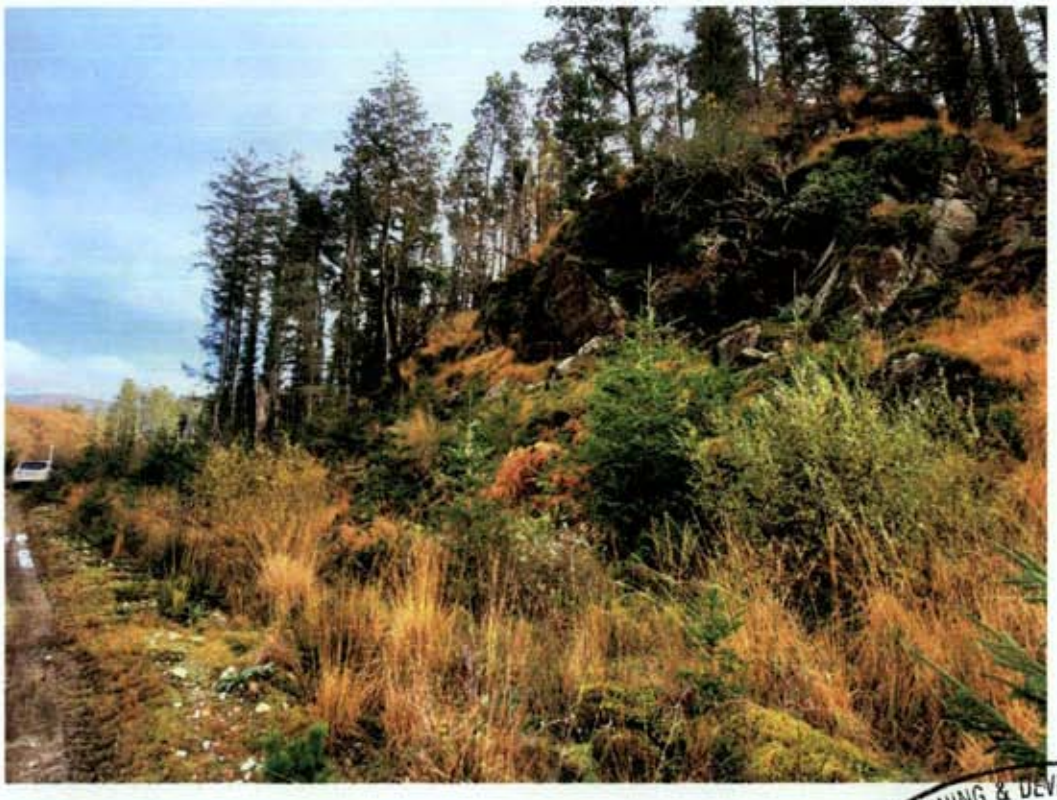
General Photos from Restoration Harvest Block GY27_HB0024

PP006 (view NE)



PP074 (view E)

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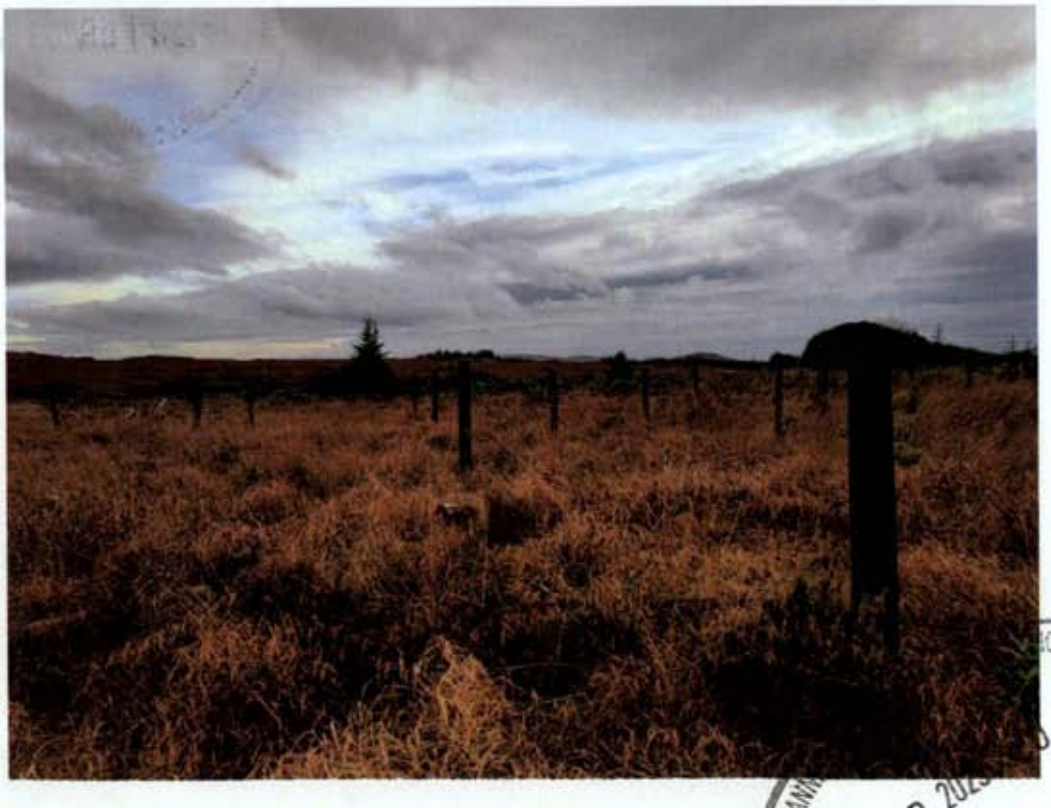
General Photos from Restoration Harvest Block GY27_HB0027

PP073 (view E)

PP085 (view E)



23 FEB 202
GALWAY COUNTY

General Photos from Restoration Harvest Block GY27_HB0028

PP067 (view E)

PP067 (view S)

PLANNING & DEVELOPMENT SECTION
2023 0060
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General Photos from Existing Access Road GY27R0025

PP055 (view N)

PP061 (view W)

SECTION
0060
COUNTY COUNCIL

General Photos from Existing Access Road GY27R0026

PP063 (view E)

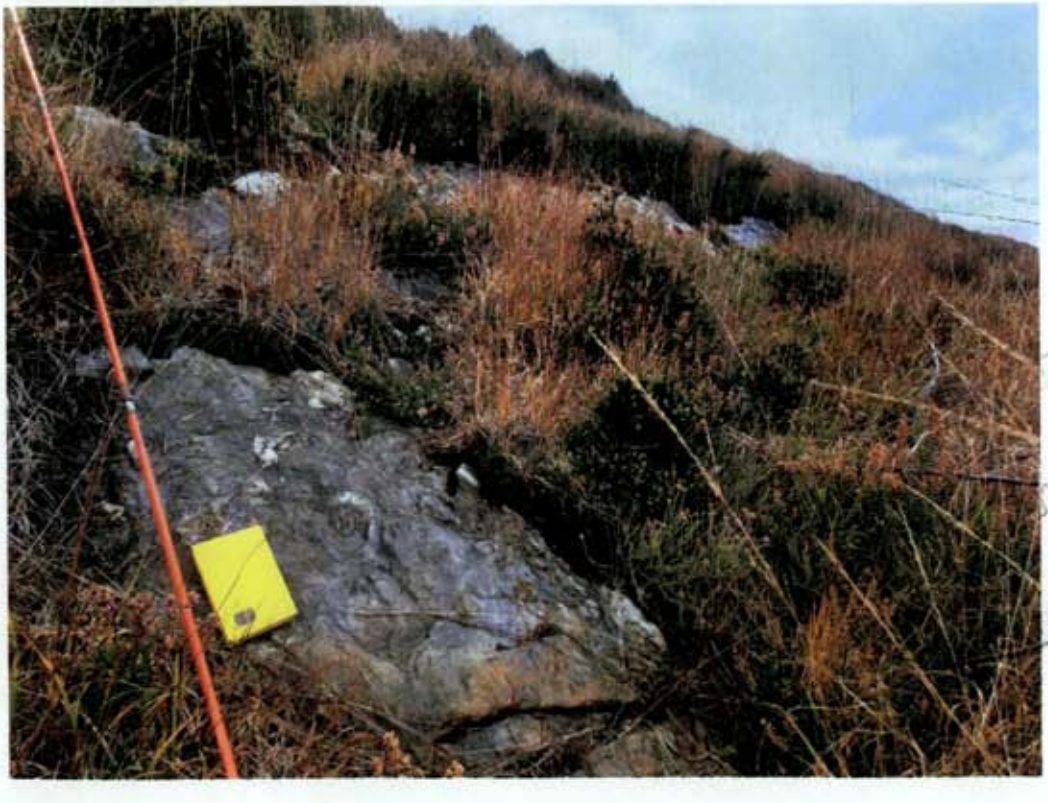
DEVELOPMENT SECTION
23 FEB 2023 0060
GALWAY COUNTY COUNCIL

PP063 (view W)

General Photos from Existing Access Road GY27R0054

PP007 (view E)

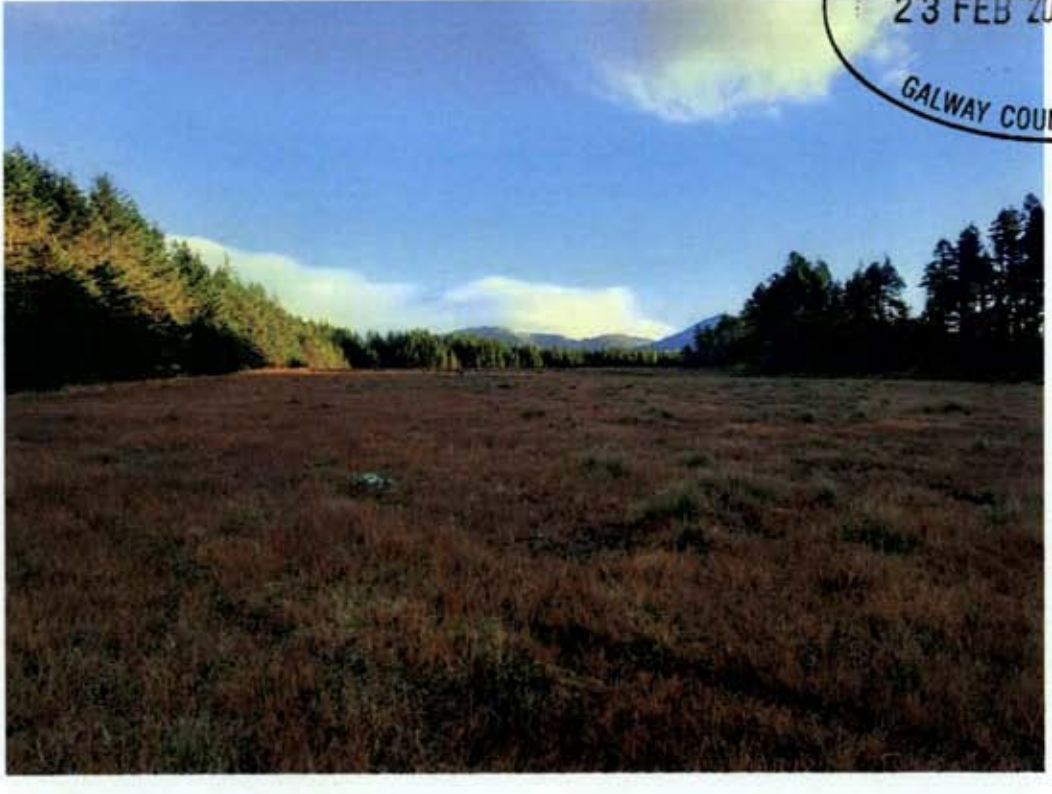
PP071 (view N)



Flat peatland area between RHBs GY27_HB0016 and GY27_HB0017

PP001 (view E)

PP002 (view E)



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APPENDIX B

Peat Stability Risk Registers

23 FEB 2023 00 60
GALWAY COUNTY COUNCIL

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_3_09

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.1 - 2.0	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.25 (u), 1.46 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	2	4	8	Low	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0009

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.2 - 3.7	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.05 (u), 1.04 (d)	3	4	12	Medium	No	See Below	2	4	8	Low
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	1	4	4	Negligible	No		1	4	4	Negligible
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	4	4	16	Medium	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	3	4	12	Medium	No		2	4	8	Low
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	3	4	12	Medium	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Post works monitoring of the site be undertaken by experienced geotechnical staff over a period of no less than 12 months;
iii	Use of experienced geotechnical staff for supervision of the proposed works;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Temporarily stabilise wet peat using stacked branches or trunks laid across the access routes.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0010

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.4 - 4.3	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.91 (u), 2.55 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	5	4	20	High	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	3	4	12	Medium	No		2	4	8	Low
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	4	4	16	Medium	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Post works monitoring of the site be undertaken by experienced geotechnical staff over a period of no less than 12 months;
iii	Use of experienced geotechnical staff for supervision of the proposed works;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Temporarily stabilise wet peat using stacked branches or trunks laid across the access routes.

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0011

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.9 - 2.0	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.19 (u), 3.06 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	2	4	8	Low	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0012

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.0 - 2.5	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.40 (u), 0.79 (d)	5	4	20	High	No	See Below	2	4	8	Low
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	2	4	8	Low	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Post works monitoring of the site be undertaken by experienced geotechnical staff over a period of no less than 12 months;
iii	Use of experienced geotechnical staff for supervision of the proposed works;
iv	Use of experienced contractors and trained operators to carry out the work;
v	A FOS of 0.79 was calculated at peat probe location PP029 assuming 100% water level. When recalculated at 50% wat… (alternative value) the drained FOS increased from 0.79 to 1.88. As a result it is anticipated that the risk of peat instability is negligible. Ho…e to the initial FOS result of <1 it is recommended that post works monitoring be undertaken by experienced geotechnical staff over a period of no less than 12 months;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0013

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.0 - 0.7	
Control Required:	Yes	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.45 (u), 1.16 (d)	3	4	12	Medium	No	See Below	2	4	8	Low
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible.
ii	Post works monitoring of the site be undertaken by experienced geotechnical staff over a period of no less than 12 months;
iii	Use of experienced geotechnical staff for supervision of the proposed works;
iv	Use of experienced contractors and trained operators to carry out the work;
v	A FOS of 1.16 was calculated at peat probe location PP023 assuming 100% water level. When recalculated at 50% water level (conservative value) the drained FOS increased from 1.16 to 1.36. As a result it is anticipated that the risk of peat instability is negligible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0014

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.1 - 2.0	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.83 (u), 2.30 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	1	4	4	Negligible	No		1	4	4	Negligible
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	2	4	8	Low	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0015

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.1 - 1.5	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.34 (u), 1.56 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	1	4	4	Negligible	No		1	4	4	Negligible
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0016

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.1 - 1.7	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 4.25 (u), 2.19 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0017

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.0 - 0.20	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.40 (u), 1.92 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	1	4	4	Negligible	No		1	4	4	Negligible
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0018

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.2 - 0.4	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 5.18 (u), 4.44 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0020

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.9 - 1.3	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.59 (u), 2.19 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0021

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.2 - 3.3	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.44 (u), 1.92 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	2	4	8	Low	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	1	4	4	Negligible	No		1	4	4	Negligible
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	3	4	12	Medium	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
iii	Use of experienced geotechnical staff for supervision of the proposed works;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Temporarily stabilise wet peat using stacked branches or trunks laid across the access routes.

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0022

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.1 - 1.4	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.92 (u), 2.39 (d)	1	4	4	Negligible	No	See Below		4	0	Not Applicable
2	Evidence of sub peat water flow	1	4	4	Negligible	No			4	0	Not Applicable
3	Evidence of surface water flow	2	4	8	Low	No			4	0	Not Applicable
4	Evidence of previous failures/slips	1	4	4	Negligible	No			4	0	Not Applicable
5	Type of vegetation	1	4	4	Negligible	No			4	0	Not Applicable
6	General slope characteristics upslope/downslope from probe location	1	4	4	Negligible	No			4	0	Not Applicable
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No			4	0	Not Applicable
8	Evidence of mechanically cut peat	1	4	4	Negligible	No			4	0	Not Applicable
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No			4	0	Not Applicable
10	Evidence of bog pools	1	4	4	Negligible	No			4	0	Not Applicable
11	Relatively deep peat	1	4	4	Negligible	No			4	0	Not Applicable

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0023

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.9	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 4.03 (u), 8.50 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	1	4	4	Negligible	No		1	4	4	Negligible
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0024

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.2 - 2.4	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 3.82 (u), 4.15 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0027

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.4 - 4.0	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.29 (u), 3.28 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	4	4	16	Medium	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
iii	Use of experienced geotechnical staff for supervision of the proposed works;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Temporarily stabilise wet peat using stacked branches or trunks laid across the access routes.

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0028

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.3 - 3.1	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.83 (u), 1.06 (d)	3	4	12	Medium	No	See Below	2	4	8	Low
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	3	4	12	Medium	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Post works monitoring of the site be undertaken by experienced geotechnical staff over a period of no less than 12 months;
iii	Use of experienced geotechnical staff for supervision of the proposed works;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Temporarily stabilise wet peat using stacked branches or trunks laid across the access routes.
	A FOS of 1.06 (d) was calculated at peat probe location PP023 assuming 100% water level. When recalculated at 50% water level (conservative value) the drained FOS increased from 1.06 to 2.39. As a result it is anticipated that the risk of peat instability is negligible.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0029

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	0.0 - 0.7	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.22 (u), 1.84 (d)	1	4	4	Negligible	No		1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No	See Below	2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

RHB ID:	GY27_HB0030

Grid Reference (Eastings, Northings):	N/A	N/A
Distance to Watercourse (m)	< 50	
Min & Max Measured Peat Depth (m):	1.4	
Control Required:	No	

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 3.02 (u), 2.07 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix E.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

Location:	GY27R0025

Grid Reference (Eastings, Northings):	Varies
Distance to Watercourse (m)	< 50
Min & Max Measured Peat Depth (m):	0.0- 2.8
Control Required:	No

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.00 (u), 1.64 (d)	1	4	4	Negligible	No		1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No	See Below	2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

Location:	GY27R0026

Grid Reference (Eastings, Northings):	Varies
Distance to Watercourse (m)	< 50
Min & Max Measured Peat Depth (m):	0.0 - 0.3
Control Required:	No

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 6.12 (u), 5.92 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	1	4	4	Negligible	No		1	4	4	Negligible
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

Location:	GY27R0027

Grid Reference (Eastings, Northings):	**Varies**
Distance to Watercourse (m)	**< 50**
Min & Max Measured Peat Depth (m):	**0.0 - 1.4**
Control Required:	**No**

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.22 (u), 1.84 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

Location:	GY27R0049

Grid Reference (Eastings, Northings):	Varies
Distance to Watercourse (m)	< 50
Min & Max Measured Peat Depth (m):	0.0 - 0.8
Control Required:	No

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.73 (u), 4.25 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

Location:	GY27R0052

Grid Reference (Eastings, Northings):	Varies
Distance to Watercourse (m)	< 50
Min & Max Measured Peat Depth (m):	0.0
Control Required:	No

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = N/A (no peat)	1	4	4	Negligible	No		1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No	See Below	2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

Location:	GY27R0054

Grid Reference (Eastings, Northings):	Varies
Distance to Watercourse (m)	< 50
Min & Max Measured Peat Depth (m):	0.0 - 2.0
Control Required:	No

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.59 (u), 2.19 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	2	4	8	Low	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

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P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

Location:	New Access Road (South)

Grid Reference (Eastings, Northings):	Varies
Distance to Watercourse (m)	< 50
Min & Max Measured Peat Depth (m):	0.1 - 1.1
Control Required:	No

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 2.83 (u), 2.30 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	1	4	4	Negligible	No		1	4	4	Negligible
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	1	4	4	Negligible	No		1	4	4	Negligible

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
ii	Assure appropriate supervision of the site is undertaken by the appointed contractor using suitably experienced personnel;
iii	Use of experienced contractors and trained operators to carry out the work;

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Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

P22-263 Derryclare Peatland Rehabilitation - Peat Stability Risk Register (Rev 0)

Location:	New Access Road (North)

Grid Reference (Eastings, Northings):	Varies
Distance to Watercourse (m)	< 50
Min & Max Measured Peat Depth (m):	0.2 - 3.0
Control Required:	Yes

		Pre-Control Measure Implementation						Post-Control Measure Implementation			
Ref.	Contributory/Qualitative Factors to Potential Peat Failure	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating	Control Required	Control measures to be implemented during construction	Prob (Note 2)	Impact (Note 3)	Risk	Risk Rating
1	FOS = 1.44 (u), 1.92 (d)	1	4	4	Negligible	No	See Below	1	4	4	Negligible
2	Evidence of sub peat water flow	1	4	4	Negligible	No		1	4	4	Negligible
3	Evidence of surface water flow	2	4	8	Low	No		2	4	8	Low
4	Evidence of previous failures/slips	1	4	4	Negligible	No		1	4	4	Negligible
5	Type of vegetation	2	4	8	Low	No		2	4	8	Low
6	General slope characteristics upslope/downslope from probe location	2	4	8	Low	No		2	4	8	Low
7	Evidence of very soft/soft clay at base of peat	1	4	4	Negligible	No		1	4	4	Negligible
8	Evidence of mechanically cut peat	1	4	4	Negligible	No		1	4	4	Negligible
9	Evidence of quaking or buoyant peat	5	4	20	High	No		2	4	8	Low
10	Evidence of bog pools	1	4	4	Negligible	No		1	4	4	Negligible
11	Relatively deep peat	3	4	12	Medium	No		2	4	8	Low

	Control Measures to be Implemented Prior to/and During Rehabilitation Woks
i	Maintain hydrology of area as far as possible;
iii	Use of experienced geotechnical staff for supervision of the proposed works;
iv	Use of experienced contractors and trained operators to carry out the work;
v	Access routes shall be locally re-aligned to avoid areas of buoyant peat.

Note
(1) FOS abbreviations are: u: FOS for undrained analysis, d: FOS for drained analysis.
(2) Probability assessed as per Table A and B of Appendix D in PSA.
(3) Impact based on distance of infrastructure element to nearest watercourse.

PLANNING & DEVELOPMENT SECTION
23 FEB 2023 0060
GALWAY COUNTY COUNCIL

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX C

Calculated FOS for Peat Slopes on Site

PLANNING & DEVELOPMENT SECTION
23 FEB 2023 00 60
GALWAY COUNTY COUNCIL

Calculated FoS of Natural Peat Slopes for Derryclare Peatland Rehabilitation - Undrained Analysis (All)

Location ID	Easting	Northing	Slope	Undrained shear strength	Bulk unit weight of Peat	Peat Depth	Surcharge Equivalent Placed Fill Depth (m)	Factor of Safety for Load Condition	
			β (deg)	c_u (kPa)	γ (kN/m^3)	(m)	Condition (2)	Condition (1)	Condition (2)
POI008	482611	752382	26	7	10	1.0	2.0	1.78	0.89
PP001	482609	749095	3	4	10	2.3	3.3	3.33	2.32
PP002	482320	749000	2	4	10	4.7	5.7	2.44	2.01
PP005	482680	749025	22	10	10	0.2	1.2	14.40	2.40
PP006	482765	749336	2	4	10	2.0	3.0	5.73	3.82
PP008	482363	749127	12	10	10	0.1	1.1	49.17	4.47
PP009	482583	749242	2	4	10	1.7	2.7	6.75	4.25
PP011	482206	749475	10	10	10	1.5	2.5	3.90	2.34
PP012	482264	749725	5	4	10	0.1	1.1	46.07	4.19
PP013	482406	749851	3	4	10	0.3	1.3	25.51	5.89
PP014	482070	749771	15	10	10	0.1	1.1	40.00	3.64
PP015	482684	750202	5	4	10	0.5	1.5	9.21	3.07
PP016	482761	749596	11	10	10	0.2	1.2	26.69	4.45
PP017	482634	749806	3	4	10	0.9	1.9	8.50	4.03
PP018	482963	750194	3	4	10	2.0	3.0	3.83	2.55
PP019	482976	749777	12	10	10	0.9	1.9	5.46	2.59
PP020	483501	750555	16	10	10	0.7	1.7	5.39	2.22
PP021	483745	750464	8	10	10	0.3	1.3	29.02	5.80
PP022	483642	750375	5	4	10	0.3	1.3	15.36	3.54
PP023	483344	751147	26	10	10	0.7	1.7	3.63	1.49
PP024	483417	750829	18	10	10	0.6	1.6	5.67	2.13
PP026	483174	752276	2	4	10	1.7	2.7	6.75	4.25
PP027	483078	752463	18	10	10	0.7	1.7	4.86	2.00
PP029	482980	752049	12	10	10	2.5	3.5	1.97	1.40
PP030	483895	750428	4	4	10	1.5	2.5	3.83	2.30
PP031	482904	752249	12	10	10	0.8	1.8	6.56	2.81
PP032	482762	752604	18	10	10	0.4	1.4	8.51	2.43
PP033	482597	752661	28	10	10	0.6	1.6	4.02	1.51
PP034	482625	752356	25	10	10	0.7	1.7	4.02	1.58
PP035	482683	752186	25	10	10	0.1	1.1	26.11	2.37
PP036	483474	752944	4	4	10	3.0	4.0	1.92	1.44
PP037	483717	752858	3	4	10	3.0	4.0	2.55	1.91
PP038	483697	752633	4	4	10	0.9	1.9	6.39	3.03
PP039	483646	752383	3	4	10	0.2	1.2	38.27	6.38
PP040	483941	752573	4	4	10	0.4	1.4	14.37	4.11
PP041	484121	752342	3	4	10	2.0	3.0	3.83	2.55
PP042	483687	753092	15	10	10	0.4	1.4	10.00	2.86
PP043	484107	753036	3	4	10	1.7	2.7	4.50	2.83
PP044	484148	752727	2	4	10	1.7	2.7	6.75	4.25
PP045	483916	752944	6	10	10	0.2	1.2	48.10	8.02
PP046	483904	753255	6	10	10	3.7	4.7	2.60	2.05
PP047	483619	752151	3	4	10	0.9	1.9	9.00	4.14
PP048	484102	752159	3	4	10	2.5	3.5	3.06	2.19
PP049	483419	753292	3	4	10	0.9	1.9	8.50	4.03
PP050	484522	749946	3	4	10	0.5	1.5	15.31	5.10
PP051	484214	749932	3	4	10	1.8	2.8	4.25	2.73
PP053	483929	750241	1	4	10	2.8	3.8	8.19	6.03
PP057	483765	751418	15	10	10	0.2	1.2	20.00	3.33
PP058	483563	751608	15	10	10	0.4	1.4	10.00	2.86
PP059	483333	751876	11	10	10	0.1	1.1	53.39	4.85
PP060	483020	752883	8	10	10	0.9	1.9	8.06	3.82
PP061	483173	753020	6	10	10	0.3	1.3	38.48	7.70
PP062	483200	753245	3	4	10	0.8	1.8	10.20	4.37
PP063	483856	751645	7	10	10	0.2	1.2	41.34	6.89
PP064	484048	751547	3	4	10	0.3	1.3	30.61	6.12
PP068	483350	750098	5	4	10	0.8	1.8	5.76	2.56
PP069	483212	749946	8	10	10	1.4	2.4	5.18	3.02
PP070	483320	749794	10	10	10	2.2	3.2	2.66	1.83
PP071	483186	749290	7	10	10	1.2	2.2	6.89	3.76
PP072	482537	749459	20	10	10	0.1	1.1	31.11	2.83
PP073	483479	749434	3	4	10	1.7	2.7	4.50	2.83
PP074	482917	749455	10	10	10	0.2	1.2	29.24	4.87
PP075	482424	749313	2	4	10	1.1	2.1	10.43	5.46
PP076	483289	751386	5	4	10	1.4	2.4	3.29	1.92
PP077	483127	751776	13	10	10	0.4	1.4	13.04	3.38
PP078	482674	749994	10	10	10	1.6	2.6	3.65	2.25
PP079	482372	749553	8	10	10	0.8	1.8	9.07	4.03
PP080	482835	749798	10	10	10	0.1	1.1	58.48	5.32
PP081	483258	749473	2	4	10	1.8	2.8	6.37	4.10
PP082	483263	753386	7	10	10	1.9	2.9	4.35	2.85
PP083	483183	753650	6	10	10	2.3	3.3	4.18	2.91
PP084	483487	752687	8	10	10	0.4	1.4	18.14	5.18
PP085	483671	749426	2	4	10	4.0	5.0	2.87	2.29
							Minimum =	1.78	0.89
							Maximum =	58.48	8.02
							Average =	13.66	3.48

Notes:

(1) Assuming a bulk unit weight for peat of 10kN/m^3

(2) Assuming a surcharge equivalent to fill depth of 1m of peat i.e. 10kPa.

(3) Slope inclination (β) based on site readings and site contour plans.

(4) A lower bound undrained shear strength, cu for the peat of 4kPa (slopes < 6 degrees) and 10kPa (slopes > 6 degrees) were selected for the assessment. It should be noted that a cu of 4/10kPa for the peat is considered a conservative value for the analyses and is not representative of all peat present across the site. In reality the peat has a significantly higher undrained strength.

(5) Peat depths based on probes carried out by FT.

(6) For load conditions see report text.

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Calculated FoS of Natural Peat Slopes for Derryclare Peatland Rehabilitation - Drained Analysis (All)

Location ID	Slope	Design c'	Bulk unit weight of Peat	Unit weight of Water	Depth of in situ Peat	Friction Angle	Surcharge Equivalent Placed Fill Depth (m)	Equivalent Total Depth of Peat (m)	Factor of Safety for Load Condition									
	α (deg)	c' (kPa)	γ (kN/m³)	γ_w (kN/m³)	(m)	ø' (deg)	Condition (2)	Condition (2)	Condition (1) 0% Water	Condition (1) 25% Water	Condition (1) 50% Water	Condition (1) 75% Water	Condition (1) 100% Water	Condition (2) 0% Water	Condition (2) 25% Water	Condition (2) 50% Water	Condition (2) 75% Water	Condition (2) 100% Water
PO008	16	4	10.0	10.0	1.0	25	1.0	2.0	1.97	1.73	1.49	1.25	1.03	1.46	1.34	1.22	1.11	0.99
PP001	3	4	10.0	10.0	2.3	25	1.0	3.3	13.29	10.86	9.78	9.03	9.55	11.22	9.67	8.13	6.97	5.82
PP002	2	4	10.0	10.0	4.7	25	1.0	5.7	15.76	12.46	9.12	5.79	2.44	15.57	12.51	9.86	7.11	4.35
PP005	22	4	10.0	10.0	0.2	25	1.0	1.2	6.01	6.62	6.94	6.05	5.76	2.51	2.07	2.02	1.97	1.92
PP006	2	4	10.0	10.0	2.0	25	1.0	3.0	19.09	15.75	12.41	9.07	5.73	17.18	14.95	12.73	10.50	8.27
PP008	13	4	10.0	10.0	0.1	25	1.0	1.1	21.86	21.31	20.77	20.22	19.67	9.98	9.93	9.88	3.83	3.79
PP009	2	4	10.0	10.0	1.7	25	1.0	2.7	20.10	16.76	13.42	10.08	6.75	17.64	15.50	13.40	11.30	9.19
PP011	10	4	10.0	10.0	1.5	25	1.0	2.5	4.10	3.54	2.99	2.43	1.88	3.58	3.29	3.00	2.68	1.89
PP012	5	4	10.0	10.0	0.1	25	1.0	1.1	51.46	50.07	48.74	47.40	46.07	9.52	9.40	9.28	9.15	9.03
PP013	3	4	10.0	10.0	0.3	25	1.0	1.3	34.41	32.16	29.96	27.74	25.51	14.78	14.17	13.75	13.24	12.73
PP014	13	4	10.0	10.0	0.1	25	1.0	1.1	17.74	17.21	16.67	16.44	16.00	3.19	9.16	3.13	3.08	3.04
PP015	5	4	10.0	10.0	0.5	25	1.0	1.5	14.54	13.21	11.88	10.55	9.21	8.40	7.96	7.51	7.07	6.63
PP016	11	4	10.0	10.0	0.2	25	1.0	1.2	13.09	12.48	11.88	11.28	10.68	4.18	4.08	3.98	3.88	3.78
PP017	3	4	10.0	10.0	0.9	25	1.0	1.9	17.80	15.18	12.55	10.75	8.50	12.93	11.57	10.82	9.76	8.71
PP018	3	4	10.0	10.0	2.0	25	1.0	3.0	12.72	10.50	8.28	6.05	3.83	11.43	9.47	8.48	7.50	5.52
PP019	12	4	10.0	10.0	0.9	25	1.0	1.9	4.58	3.86	3.28	2.70	2.19	4.23	2.97	2.71	2.45	2.19
PP020	16	4	10.0	10.0	0.7	25	1.0	1.7	3.79	3.38	2.97	2.56	2.16	2.51	2.93	2.18	2.01	1.84
PP021	8	4	10.0	10.0	0.3	25	1.0	1.3	14.93	14.10	13.27	12.44	11.61	6.64	5.42	5.91	5.14	4.89
PP022	5	4	10.0	10.0	0.3	25	1.0	1.3	20.69	19.93	18.62	18.49	13.20	8.67	8.57	8.16	7.95	7.84
PP023	26	4	10.0	10.0	0.7	25	1.0	1.7	2.41	2.17	1.93	1.69	1.45	1.55	1.40	1.40	1.26	1.16
PP024	18	4	10.0	10.0	0.6	25	1.0	1.6	3.70	3.34	2.99	2.63	2.27	2.29	2.15	2.01	1.88	1.75
PP026	2	4	10.0	10.0	1.7	25	1.0	2.7	20.10	16.76	13.42	10.08	6.75	17.60	15.50	13.40	11.30	9.19
PP027	18	4	10.0	10.0	0.7	25	1.0	1.7	3.88	3.02	2.99	2.96	1.94	2.04	2.00	1.94	1.79	1.64
PP029	12	4	10.0	10.0	2.5	25	1.0	3.5	3.98	2.48	1.98	1.48	0.79	1.79	1.39	1.09	1.08	1.19
PP030	4	4	10.0	10.0	1.5	25	1.0	2.5	10.50	8.83	7.17	5.50	3.83	8.07	7.07	6.07	5.07	4.07
PP031	12	4	10.0	10.0	0.8	25	1.0	1.8	4.83	4.27	3.71	3.17	2.62	3.32	3.08	2.85	2.61	2.38
PP032	18	4	10.0	10.0	0.4	25	1.0	1.4	4.84	4.48	4.12	3.76	3.40	2.41	2.90	2.29	2.10	2.06
PP033	28	4	10.0	10.0	0.6	25	1.0	1.6	3.49	2.27	2.09	1.88	1.66	1.68	1.40	1.32	1.23	1.15
PP034	25	4	10.0	10.0	0.7	25	1.0	1.7	2.01	2.90	2.12	1.86	1.60	1.69	1.51	1.44	1.34	1.24
PP035	25	4	10.0	10.0	0.1	25	1.0	1.1	11.44	11.19	10.94	10.69	10.44	1.95	1.91	1.90	1.88	1.86
PP036	4	4	10.0	10.0	3.0	25	1.0	4.0	8.58	6.92	5.25	3.59	1.91	9.11	6.85	5.00	4.29	3.59
PP037	3	4	10.0	10.0	3.0	25	1.0	4.0	11.47	9.12	7.00	4.79	2.59	10.91	9.24	7.47	5.81	4.14
PP038	4	4	10.0	10.0	0.9	25	1.0	1.9	13.00	11.39	9.71	8.03	6.35	9.69	8.90	8.11	7.32	6.54
PP039	3	4	10.0	10.0	0.2	25	1.0	1.2	47.16	44.94	42.72	40.49	38.27	15.29	14.90	14.59	14.16	13.79
PP040	4	4	10.0	10.0	0.4	25	1.0	1.4	21.04	19.37	17.70	16.04	14.37	10.77	10.30	9.82	9.35	8.87
PP041	3	4	10.0	10.0	2.0	25	1.0	3.0	11.72	10.50	9.28	8.05	5.83	11.45	9.97	8.48	7.00	5.52
PP042	15	4	10.0	10.0	0.4	25	1.0	1.4	5.78	5.12	4.47	4.46	4.00	2.88	2.76	2.63	2.51	2.39
PP043	3	4	10.0	10.0	1.7	25	1.0	2.7	18.40	15.18	11.95	8.73	4.50	11.75	10.03	8.95	7.51	6.13
PP044	2	4	10.0	10.0	1.7	25	1.0	2.7	20.10	16.76	13.42	10.08	6.75	17.60	15.50	13.40	11.30	9.19
PP045	6	4	10.0	10.0	0.2	25	1.0	1.2	13.69	12.57	11.46	10.35	19.24	7.64	7.41	7.17	7.06	6.90
PP046	6	4	10.0	10.0	3.7	25	1.0	4.7	5.44	4.37	3.31	2.25	1.18	3.16	4.24	3.31	2.64	1.76
PP047	3	4	10.0	10.0	0.9	25	1.0	1.9	17.90	15.68	13.45	11.23	9.00	13.03	12.01	10.99	9.97	8.96
PP048	3	4	10.0	10.0	2.5	25	1.0	3.5	12.96	9.73	7.51	5.29	3.06	11.08	9.20	7.91	6.61	4.75
PP049	3	4	10.0	10.0	0.9	25	1.0	1.9	17.80	15.18	12.55	10.75	8.50	12.93	11.57	10.82	9.76	8.71
PP050	3	4	10.0	10.0	0.5	25	1.0	1.5	24.24	21.99	19.74	17.59	15.31	14.00	13.24	12.52	11.79	11.05
PP051	3	4	10.0	10.0	1.8	25	1.0	2.8	13.15	10.93	8.70	6.48	4.25	11.64	10.20	8.77	7.34	5.91
PP053	3	4	10.0	10.0	2.8	25	1.0	3.8	34.90	28.21	21.54	14.87	8.19	32.75	27.83	22.90	17.98	13.06
PP057	15	4	10.0	10.0	0.2	25	1.0	1.2	6.74	6.81	6.87	6.44	6.00	3.07	3.00	2.91	2.86	2.75
PP058	15	4	10.0	10.0	0.4	25	1.0	1.4	5.74	5.11	4.47	4.46	4.00	2.88	2.76	2.63	2.51	2.39
PP059	11	4	10.0	10.0	0.2	25	1.0	1.2	23.71	23.15	22.59	22.03	21.46	4.64	4.29	4.23	4.18	4.13
PP060	8	4	10.0	10.0	1.2	25	1.0	2.2	6.54	5.71	4.88	4.05	3.22	4.85	4.40	4.06	3.87	3.17
PP061	6	4	10.0	10.0	1.3	25	1.0	2.3	19.68	18.72	17.43	16.35	15.39	7.35	7.28	7.07	6.93	6.69
PP062	3	4	10.0	10.0	1.8	25	1.0	2.8	19.19	16.88	14.65	12.43	10.20	13.13	12.33	11.30	10.41	9.48
PP063	7	4	10.0	10.0	1.2	25	1.0	2.2	20.83	19.28	18.49	17.48	16.33	6.55	6.40	6.24	6.08	5.92
PP064	3	4	10.0	10.0	1.9	25	1.0	2.9	39.51	37.29	35.06	32.84	30.61	15.01	14.58	14.13	13.69	13.24
PP068	5	4	10.0	10.0	0.8	25	1.0	1.8	11.09	9.76	8.42	7.09	5.76	7.99	7.46	6.75	6.11	5.52
PP069	8	4	10.0	10.0	1.4	25	1.0	2.4	5.89	4.56	3.75	2.90	2.07	4.74	4.04	3.56	3.08	2.59
PP070	10	4	10.0	10.0	2.2	25	1.0	3.2	3.71	3.05	2.39	1.73	1.06	3.38	2.82	2.47	2.01	1.56
PP071	7	4	10.0	10.0	1.2	25	1.0	2.2	6.55	5.60	4.65	3.71	2.76	5.01	4.29	4.27	3.75	3.23
PP072	20	4	10.0	10.0	0.1	25	1.0	1.1	18.73	16.41	15.79	12.77	12.45	2.41	2.38	2.35	2.33	2.30
PP073	3	4	10.0	10.0	1.7	25	1.0	2.7	13.40	11.18	8.95	6.72	4.50	11.75	10.33	8.99	7.51	6.13
PP074	10	4	10.0	10.0	0.2	25	1.0	1.2	14.59	13.64	12.69	11.74	10.80	11.70	4.59	4.48	4.37	4.26
PP075	2	4	10.0	10.0	1.1	25	1.0	2.1	13.79	10.44	17.10	13.75	10.41	14.81	17.07	13.42	13.17	12.91
PP076	5	4	10.0	10.0	1.4	25	1.0	2.4	8.62	7.29	5.96	4.62	3.29	7.35	6.47	5.69	4.92	4.14
PP077	13	4	10.0	10.0	0.8	25	1.0	1.8	7.29	6.75	6.21	5.72	5.21	3.97	3.24	3.21	2.98	2.89
PP078	10	4	10.0	10.0	1.6	25	1.0	2.6	6.11	5.45	4.78	4.12	3.46	4.54	3.34	3.73	2.92	1.92
PP079	8	4	10.0	10.0	0.8	25	1.0	1.8	6.95	6.22	5.29	4.46	3.63	4.93	4.26	4.19	3.81	3.48
PP080	10	4	10.0	10.0	0.1	25	1.0	1.1	26.06	25.37	24.71	24.09	23.39	6.77	6.71	6.65	6.59	6.53
PP081	2	4	10.0	10.0	1.8	25	1.0	2.8	19.72	16.39	13.05	9.71	6.37	17.43	15.92	13.16	11.01	8.86
PP082	7	4	10.0	10.0	1.9	25	1.0	2.9	9.54	6.98	4.66	2.69	1.78	6.94	4.82	3.69	3.07	2.45
PP083	6	4	10.0	10.0	1.3	25	1.0	2.3	9.11	5.00	3.89	2.79	1.67	9.00	6.83	4.96	4.29	2.91
PP084	8	4	10.0	10.0	1.4	25	1.0	2.4	10.97	9.74	8.51	8.05	7.26	5.59	5.23	4.91	4.68	4.44
PP085	2	4	10.0	10.0	4.0	25	1.0	5.0	16.21	12.88	9.56	6.23	2.87	15.43	12.96	10.31	7.64	4.96
									Minimum =	1.97	1.73	1.49	1.25	0.79	1.46	1.34	1.22	1.11	0.99
									Maximum =	51.46	50.07	48.74	47.40	46.07	32.75	27.83	22.90	17.98	13.79
									Average =	14.06	12.60	11.15	9.70	8.25	8.21	7.44	6.68	5.92	5.15

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Notes:

(1) Assuming a bulk unit weight of peat of 10 (kN/m³)
(2) Assuming a surcharge equivalent to fill depth of 1.0m.
(3) Slope inclination (β) based on site readings and contour survey plans of site.
(4) FoS is based on slope inclination and shear test results obtained from published data.
(5) Peat depths based on probes carried out by FT.
(6) For load conditions see Report text.
(7) Minimum acceptable factor of safety required of 1.3 for first-time failures based on BS: 6031:1981 Code of practice for Earthworks.

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APPENDIX D

Methodology for Peat Stability Risk Assessment

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Methodology for Peat Stability Risk Assessment

A peat stability risk assessment was carried out for each of the RHBs and along the new and existing access roads. This approach takes into account guidelines for geotechnical/peat stability risk assessments as given in PLHRAG (2017) and MacCulloch (2005). The degree of risk is determined as a Risk Rating (R), which is the product of probability (P) and impact (I). How these factors are determined and applied in the analysis is described below.

The main approaches for assessing peat stability include the following:

(a) Geomorphological

(b) Qualitative (judgement)

(c) Index/Probabilistic (probability)

(d) Deterministic (factor of safety)

Approaches (a) to (c) listed above would be considered subjective and do not provide a definitive indication of stability; in addition, a high level of judgement/experience is required which makes it difficult to relate the findings to real conditions. FT apply a more objective approach, the deterministic approach. As part of FT's deterministic approach, a qualitative risk assessment is also carried out taking into account qualitative factors, which cannot necessarily be quantified.

Probability

The likelihood of a peat failure occurring was assessed based on the results of both the quantitative results of stability calculations (deterministic approach using factors of safety) and the assessment of the severity of several qualitative factors which cannot be reasonably included in a stability calculation but nevertheless may affect the occurrence of peat instability.

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The qualitative factors used in the risk assessment are outlined in Table A and have been compiled based on FT's experience of assessments and construction in peat land sites and peat failures throughout Ireland and the UK.

Table A: Qualitative Factors used to Assess Potential for Peat Failure

Qualitative Factor	Type of Feature/Indicator for each Qualitative Factor [1]	Explanation/Description of Qualitative Factor
Evidence of sub peat water flow	No	Based on site walkover observations. Sub peat water flow generally occurs in the form of natural piping at the base of peat. Where there is a constriction or blockage in natural pipes a build-up of water can occur at the base of the peat causing a reduction in effective stress at the base of the peat resulting in failure; this is particularly critical during periods of intense rainfall.
	Possibly	
	Probably	
	Yes	

Qualitative Factor	Type of Feature/Indicator for each Qualitative Factor [1]	Explanation/Description of Qualitative Factor
Evidence of surface water flow	Dry	Based on site walkover observations. The presence of surface water flow indicates if peat in an area is well drained or saturated and if any additional loading from the ponding of surface water onto the peat is likely.
	Localised/Flowing in drains	
	Ponded in drains	
	Springs/surface water	
Evidence of previous failures/slips	No	Based on site walkover observations. The presence of clustering of relict failures may indicate that particular pre-existing site conditions predispose a site to failure.
	In general area	
	On site	
	Within 500m of location	
Type of vegetation	Grass/Crops	Based on site walkover observations. The type of vegetation present indicates if peat in an area is well drained, saturated, etc. Vegetation that indicates wetter ground may also indicate softer underlying peat deposits.
	Improved Grass/Dry Heather	
	Wet Grassland/Juncus (Rushes)	
	Wetlands Sphagnum (Peat moss)	
General slope characteristics upslope/downslope from infrastructure location	Concave	Based on site walkover observations. Slope morphology in the area of the infrastructure location is an important factor. A number of recorded peat failures have occurred in close proximity to a convex break in slope.
	Planar to concave	
	Planar to convex	
	Convex	
Evidence of very soft/soft clay at base of peat	No	Based on inspection of exposures in general area from site walkover. Several reported peat failures identify the presence of a weak layer at the base of the peat along which shear failure has occurred.
	Yes	
Evidence of mechanically cut peat	No	Based on site walkover observations. Mechanically cut peat typically cut using a 'sausage' machine to extract

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Qualitative Factor	Type of Feature/Indicator for each Qualitative Factor [1]	Explanation/Description of Qualitative Factor
	Yes	peat for harvesting. Areas which have been cut in this manner have been linked to peat instability. The mechanical cuts can notably reduce the intrinsic strength of the peat and also allow ingress of rainfall/surface water.
Evidence of quaking or buoyant peat	No	Based on site walkover observations. Quaking/buoyant peat is indicative of highly saturated peat, which would generally be considered to have a low strength. Quaking peat is a feature on sites that have been previously linked with peat instability.
	Yes	
Evidence of bog pools	No	Based on site walkover observations. Bog pools are generally an indicator of areas of weak, saturated peat. Commonly where there are open areas of water within peat these can be interconnected, with the result that there may be sub-surface bodies of water. The presence of bog pools have been previously linked with peat instability.
	Yes	
Other	Varies	In addition to the above features/ indicators and based on site recordings the following are some of the features which may be identified: Excessively deep peat, weak peat, overly steep slope angles, etc.

Note (1) The list of features/indicators for each qualitative factor are given in increasing order of probability of leading to peat instability/failure.

It should be noted that the presence of one of the qualitative factors alone from Table A is unlikely to lead to peat instability/failure. Peat instability/failure at a site is generally the combination of a number of these factors occurring at the same time at a particular location. The probability rating assigned to the quantitative and qualitative factors is judged on a 5-point scale from 1 (indicating negligible or no probability of failure) to 5 (indicating a very likely failure), as outlined in Table B.

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Table B: Probability Scale

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

Scale	Likelihood of Qualitative Factor leading to Peat Failure	Probability of Failure
1	Negligible/None	Least
2	Unlikely	
3	Probable	
4	Likely	
5	Very Likely	Greatest

Impact

The severity of the risk is also assessed qualitatively in terms of impact. The impact of a peat failure on the environment within and beyond the immediate site is assessed based on the potential travel distance of a peat failure. Where a peat failure enters a watercourse, it can travel a considerable distance downstream. Therefore, the proximity of a potential peat failure to a drainage course is a significant indicator of the likely potential impact.

The risk is determined based on the combination of hazard and impact. A qualitative scale has been derived for the impact of the hazard based on distance of infrastructure element to a watercourse (Table C).

The location of watercourses is based on topographic maps and supplemented by site observations from walkover survey. Note that not all watercourses are shown on maps.

Table C: Impact Scale

Scale	Criteria	Impact
1	Proposed infrastructure element greater than 150m of watercourse	Negligible/None
2	Proposed infrastructure element within 150 to 101m of watercourse	Low
3	Proposed infrastructure element within 100 to 51m of watercourse	Medium

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4	Proposed infrastructure element within 50 m of watercourse	High
5	Proposed infrastructure element within 50 m of watercourse, in an environmentally sensitive area	Extremely High

Risk Rating

The degree of risk is determined as the product of probability (P) and impact (I), which gives the Risk Rating (R) as follows:

The Risk Rating is calculated from: R = P x I

Due to the 5-point scales used to assess Probability and Impact, the Risk Rating can range from 1 to 25 as shown in Table D.

Table D: Qualitative Risk Rating

Impact \ Probability	1	2	3	4	5
5	5	10	15	20	25
4	4	8	12	16	20
3	3	6	9	12	15
2	2	4	6	8	10
1	1	2	3	4	5

Risk Rating	Control Measures
17 to 25	High: avoid working in area or significant control measures required
11 to 16	Medium: notable control measures required
5 to 10	Low: only routine control measures required
1 to 4	Negligible: none or only routine control measures required

The risk rating is calculated individually for each contributory factor. Control measures are required to reduce the risk to at least a 'Low' risk rating. The control measures in response to the qualitative risk ratings are included in the peat stability risk registers for each main infrastructure element in Appendix B.

The risk rating is calculated individually for each contributory factor. Control measures are required to reduce the risk to at least a 'Tolerable' risk rating

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