FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

DERRYCLARE PEATLAND REHABILITATION

Technical Note in Response to Further Information Required – Galway County Council (Ref. 23/60)

Prepared for:

MKO Ltd

Date: **October 2023**

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Abstract: Fehily Timoney and Company is pleased to submit this FIR response to Galway County Council (GCC) on behalf of MKO Ltd (Client). This document will aim to respond to queries raised by GCC in relation to peat stability and use of best practice in the assessment of the site.

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1. INTRODUCTION

1.1 General

The following technical note should be read in conjunction with the Geotechnical & Peat Stability Assessment Report (herein referred to as the Assessment Report).

Fehily Timoney and Company (FT) were commissioned by MKO Ltd. (Client) on behalf of Coillte (Applicant) to respond to a FIR (Ref. 23/60) issued by to the Applicant by Galway County Council on 19th April 2023.

The proposed development, as per the statutory planning notices from the planning application is:

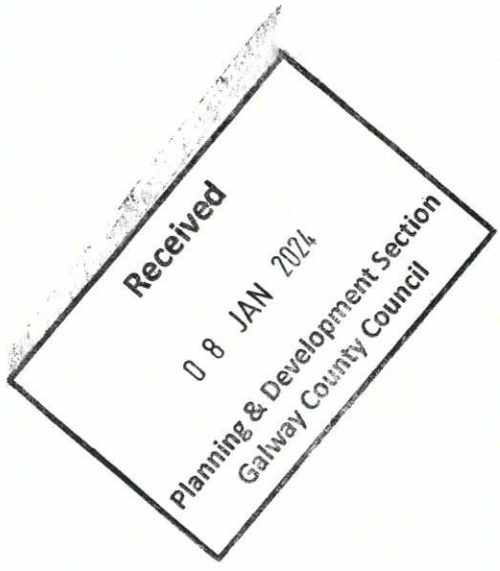
> *"PERMISSION For a ten-year planning permission consisting of: I.) The felling/removal of some 343 hectares of conifer plantation for the purposes of peatland restoration and the establishment of native woodland. ii.) Measures to restore and rehabilitate approximately 281 hectares of Atlantic blanket bog and heathland that is currently planted with lodgepole pine and Sitka spruce forests and managed for commercial forestry. iii.) Conversion of 62 hectares of conifer forestry to native woodland. iv.) Main peatland restoration measures will include tree removal, drain blocking (manual and mechanical) and ground reprofiling. v.) The control of existing invasive species on site and continued control during the restoration works to prevent their spread. vi.) Drain-blocking all existing artificial drainage and artificial land drains currently existing within the peatland restoration areas in order to restore the high water table which is necessary for blanket bog growth. vii.) Provision of silt traps at outflows to block the pathway to the Twelve Bens/Garraun Complex Special Area of Conservation. viii.) Deer fencing to protect 62 hectares of proposed native woodland. ix.) Provision of a Harvest Management Phasing Plan for the proposed project. x.) Provision of new internal access road extending to 1.58 km. xi.) Across the site there will be 4 no. temporary water-crossings constructed in order to facilitate the harvesting of the timber at the site. xii.) Provision of informational signage. xiii.) Resurfacing of up to 8.23 km of existing forestry roads. xiv.) Resurfacing of existing car park to facilitate public access. xv.) Installation of water monitoring stations for real time water monitoring during operations. xvi.) Cutting of roadside trees to improved sightline visibility at site entrance. xvii.) The application is supported by an Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS) at Derryclare and Cloonnacartan Co. Galway"*

In accordance with the provisions of Article 33 of the Planning and Development Regulations, 2001, as amended, the Applicant is required to submit additional information as set out in the Schedule of Further Information Required (GCC's FIR Ref 23/60).

The scope of this document strictly pertains to Item 3 (a) of the Schedule of Further Information Required, as outlined below:

> *"The Irish Peat Conservation Council (IPCC) raised concerns within their initial scoping response regarding the adequacy of current "best practice approaches" to assessing peat strength and stability, these have been found wanting, owing to numerous landslides across the country. This in combination with the concerns raised by the DHLGH regarding using untrialled and untested methods of peat restoration in an upland area of the west of Ireland; the applicant is requested to provide sufficient supporting evidence demonstrating the trialling and testing of the proposed methods, including the provision of likewise case studies, providing the Local Authority with robust scientific evidence that the proposed methodologies of drain blocking, damning, drain reprofiling, stump flipping, surface smoothing, stump mulching and cross-tracking and do not pose detrimental risks of peat disturbance, peat erosion, peat stability and water quality impacts as a direct result of the development. The supporting evidence should be comprehensive and include the*

appropriateness of the proposed drain blocking using dams on slopes of greater than 6 degrees, the project proposes these works on slopes of 10 degrees which is contrary to current recommendations and untested in Ireland. Please comprehensively address this concern."



2. RESPONSE TO FIR

2.1 General

As part of the FIR, GCC queried the adequacy of current "best practice approaches" used in the Assessment Report to assess peat strength and stability. GCC also requested the provision of sufficient supporting evidence (to include case studies) to demonstrate the proposed restoration activities do not pose a detrimental risk to peat disturbance, peat erosion, peat stability and water quality.

This document addresses these queries using data already included in the Assessment Report in combination with supplementary analysis of existing site data.

2.2 Best Practice Approach for Assessing Peat Strength and Stability

FT undertook the peat analyses following the principles outlined in *The Peat Landslide Hazard and Risk Assessment Guide (2nd edition, PLHRAG, 2017)* [Ref. 1]. Determination of peat depths, strengths and resulting FoS analyses were undertaken in accordance with Eurocode 7 guidance. These are current best practice guidance for assessment of peat strength and stability and have been used on upland peat sites across Ireland.

The methodology adopted for the assessment of peat stability and risk assessment is outlined in Appendix D of the Assessment Report. In this approach, the main factors for assessing peat stability include the following:

- Geomorphological
- Qualitative (judgement)
- Index/Probabilistic (probability)
- Deterministic (factor of safety)

This approach, which is given in PLHRAG (2017) [Ref. 1] and MacCulloch (2005) [Ref. 2], is widely and routinely used in Ireland for the assessment of developments within peatland areas. It uses both qualitative and quantitative methods for assessing peat stability, thereby ensuring all of the above factors are considered when determining the sites peat stability. FT uses qualified geotechnical engineers/engineering geologists to undertake these assessments. In the case of Derryclare, the assessment was undertaken by Aaron Clarke (BSc, MSc, PGeo, EurGeol), a Chartered Principal Geologist with over 19 years' experience working in the engineering and geoscience sectors. It is deemed that fieldwork and analysis included in the Assessment Report were undertaken using current best practice and sound engineering judgement and represent a robust analysis of the site's peat strength and stability and resulting risk assessment findings.

In addition to the above and to ensure a robust assessment, the most conservative material parameters, site conditions and slope analysis method were used to assess the sites' peat strength and stability. These include the use of:

- **Conservative peat strengths** – as discussed in Section 6.1 of the Assessment Report, these values were derived from review of published information on peat strengths, resulting in the most conservative values being used for the stability analyses. Hand Shear Vane measurements within the peat were also undertaken as part of the site reconnaissance for verification purposes. In general, results from HSV testing were in excess of the conservative undrained shear strength values used in the stability analyses.
- **A 100% water level** – For the purposes of the stability analyses it was assumed that groundwater was at surface. However, a 100% water level is an unlikely scenario due to overriding site conditions, i.e., sloping terrain and the abundance of natural drainage channels (as discussed in Section 4.2 of the Assessment Report).

- **Infinite slope analysis method** – the translational or infinite slope analysis method was adopted to assess the sites slope stability. This analysis method does not consider resisting forces (such as toe loading or buttresses) and is therefore considered to be a conservative method for assessing peat slopes.
- **Surcharge from forestry machinery** – a surcharge of 10kPa was incorporated into the stability analyses to simulate the temporary load created by forestry machinery.

Considering all of the above, it is deemed that the best practice approaches and methodologies used in the Assessment Report are more than adequate to determine the site's peat strength and stability.

There are a number of guidance documents, papers and case studies relating to restoration of upland peat bog areas (referenced in Section 11 of the Assessment Report). However, there is no current guidance on the assessment of peat strength and stability specifically relating to re-wetting of blanket peat in upland terrain in Ireland or similar territories. As part of Nature Scotland's Peatland ACTION Programme [Ref. 3], a technical report to evaluate the effects of restoration activities on the stability of a number of sites across Scotland has been completed. The report is currently under review and will be published to the Nature Scotland website once the review process has been completed.

2.3 Further Assessment of Peat Stability within the Harvest Blocks

To further reinforce the findings of the Assessment Report additional analysis of the site data was undertaken as part of the FIR response. This comprises assessment of the individual harvest block areas and proposed new floated access roads.

The following tables (Table 2-1 and Table 2-2) show the range of Factor of Safety (FoS) values across each of the proposed harvest blocks. Mean FoS values are also presented. The table is highlighted in:

- **Green** when FoS is >1.3 indicating no instability;
- Orange when FoS is <1.3 and >1.0 indicating that although not in failure, these areas will be subject to appropriate monitoring and mitigation during the proposed works (as discussed in the Assessment Report).
- **Red** when FoS is <1 indicating the potential for peat instability.

Table 2-1 Undrained Factor of Safety (FoS) per harvest block.

Harvest Block	Area (Ha)	FoS Undrained (Condition 1)			FoS Undrained (Condition 2)		
		Min.	Max.	Mean	Min.	Max.	Mean
GY27_3_09	19.93	3.65	58.48	21.99	2.25	5.32	3.37
GY27_HB0009	24.86	2.60	48.10	14.74	2.05	8.02	3.96
GY27_HB0010	22.65	2.55	14.37	7.51	1.91	4.11	3.32
GY27_HB0011	17.25	3.06	9.00	5.30	2.19	4.14	2.96
GY27_HB0012	36.39	1.97	26.11	7.85	1.40	4.25	2.29
GY27_HB0013	11.01	3.63	29.02	13.42	1.49	5.80	3.24
GY27_HB0014	43.07	9.07	40.00	21.72	2.83	5.89	29.36
GY27_HB0015	9.56	3.90	46.07	24.98	2.34	4.19	3.26
GY27_HB0016	3.63	6.75	49.17	27.96	4.25	4.47	4.36
GY27_HB0017	11.56	14.40	14.40	14.40	2.40	2.40	2.40
GY27_HB0018	19.21	18.14	38.27	28.20	5.18	6.38	5.78
GY27_HB0020	5.57	5.46	5.46	5.46	2.59	2.59	2.59
GY27_HB0021	42.38	1.92	38.48	11.20	1.44	7.70	3.85
GY27_HB0022	37.01	3.29	53.39	19.93	1.92	4.85	3.25
GY27_HB0023	2.83	8.06	8.06	8.06	3.82	3.82	3.82

Harvest Block	Area (Ha)	FoS Undrained (Condition 1)			FoS Undrained (Condition 2)		
		Min.	Max.	Mean	Min.	Max.	Mean
GY27_HB0024	3.76	5.73	29.24	17.49	3.82	4.87	4.35
GY27_HB0027	45.65	2.87	6.89	5.16	2.29	4.10	3.25
GY27_HB0028	182.41	2.66	5.76	4.21	1.83	2.56	2.19
GY27_HB0029	20.4	5.39	5.39	5.39	2.22	2.22	2.22
GY27_HB0030	1.23	5.18	5.18	5.18	3.02	3.02	3.02
Minimum		**1.92**	**5.18**	**4.21**	**1.40**	**2.22**	**2.19**
Maximum		**18.14**	**58.48**	**28.20**	**5.18**	**8.02**	**29.36**
Mean		**5.51**	**26.54**	**13.51**	**2.56**	**4.54**	**4.64**

Table 2-2 Drained Factor of Safety (FoS) per harvest block.

Harvest Block	Area (Ha)	FoS Drained (Condition 1) Assuming 100% Water			FoS Drained (Condition 2) Assuming 100% Water		
		Min.	Max.	Mean	Min.	Max.	Mean
GY27_3_09	19.93	1.46	23.39	9.56	1.92	5.52	3.99
GY27_HB0009	24.86	1.04	19.24	7.46	1.76	8.71	5.18
GY27_HB0010	22.65	2.55	14.37	7.83	4.14	9.19	7.70
GY27_HB0011	17.25	3.06	9.00	5.30	4.73	8.95	6.40
GY27_HB0012	36.39	0.79	10.44	3.65	1.15	9.19	2.58
GY27_HB0013	11.01	1.45	15.36	7.67	1.16	7.64	3.88
GY27_HB0014	43.07	3.63	25.51	12.56	2.30	12.73	6.25
GY27_HB0015	9.56	1.56	46.07	23.81	1.99	9.03	5.51
GY27_HB0016	3.63	6.75	19.67	13.21	3.78	9.19	6.49
GY27_HB0017	11.56	5.76	5.76	5.76	1.92	1.92	1.92
GY27_HB0018	19.21	7.26	38.27	22.76	4.44	13.79	9.12
GY27_HB0020	5.57	2.19	2.19	2.19	2.19	2.19	2.19
GY27_HB0021	42.38	1.67	15.39	5.69	2.45	9.46	4.57
GY27_HB0022	37.01	3.29	21.36	8.47	2.85	4.14	3.37
GY27_HB0023	2.83	8.50	8.50	8.50	8.71	8.71	8.71
GY27_HB0024	3.76	5.73	11.70	8.71	4.15	8.27	6.21
GY27_HB0027	45.65	2.76	6.37	4.12	3.23	8.86	5.80
GY27_HB0028	182.41	1.06	5.76	3.41	1.56	5.52	3.54
GY27_HB0029	20.4	2.16	2.16	2.16	1.84	1.84	1.84
GY27_HB0030	1.23	2.07	2.07	2.07	2.59	2.59	2.59
Minimum		**0.79**	**2.07**	**2.07**	**1.15**	**1.84**	**1.84**
Maximum		**8.50**	**46.07**	**23.81**	**8.71**	**13.79**	**9.12**
Mean		**3.24**	**15.13**	**8.24**	**2.94**	**7.37**	**4.89**

For the undrained condition (Table 2-1) all FoS values are in excess of 1.3 indicating the peat is stable.

For the drained condition (Table 2-2) one harvest block (GY27_HB0012) attained a FoS value of <1.0 (0.79) indicating the potential for peat instability. Three of the harvest blocks (GY27_HB0009, GY27_HB0012, GY27_HB0013, GY27_HB0028) attained FoS values of >1.0 but <1.3. The remaining 16 no. harvest blocks all attained FoS values in excess of 1.3 indicating the peat is stable. In addition, all maximum and mean values for the harvest blocks are in excess of 1.3. The individual survey locations within the harvest blocks that attained FoS values <1.3 are discussed further in Section 2.4.

The general paucity of low FoS values across the project area, strongly correlate to site observations made during the FT walkover surveys completed in November and December 2022. With the exception of Point of

Interest location POI008, there was no evidence of past landslip within the peat or underlying superficial deposits. POI008 (which is outside of the harvest block area) represents a historic shallow peat landslip to the east of RHB GY27_HB0012. This failure (described in greater detail in Section 3.9 of the Assessment Report) shows no indication of further movement and is deemed to pose no significant risk to the adjacent harvest blocks.

2.4 Potential Areas of Constraint

2.4.1 Harvest Blocks

Out of 70 no. locations assessed for stability, only six survey points recorded FoS values <1.3 with only one FoS value of < 1.0 recorded in harvest block GY27_HB0012. Results are summarised in Table 2-3.

Table 2-3 Survey point locations with FoS values <1.3

Survey Point Location ID	Associated Harvest Block	ITM Easting	ITM Northing	Slope Angle (°)	Peat Depth (m bgl)	FoS Drained (Condition 1) Assuming 100% Water	FoS Drained (Condition 2) Assuming 100% Water
PP023	GY27_HB0013	483344	751147	26	0.7	1.45	1.16
PP029	GY27_HB0012	482980	752049	12	2.5	0.79	1.19
PP033	GY27_HB0012	482597	752661	28	0.6	1.61	1.15
PP034	GY27_HB0012	482625	752356	25	0.7	1.61	1.24
PP046	GY27_HB0009	483904	753255	6	3.7	1.04	1.76
PP070	GY27_HB0028	483320	749794	10	2.2	1.06	1.56

The low FoS results recorded in PP023 (Harvest Block GY27_HB0013), PP046 (GY27_HB0009) and PP070 (Harvest Block GY27_HB0028) are isolated occurrences with all adjacent survey points showing FoS values in excess of 1.3 as illustrated in Figure 6-2 of the Assessment Report. The remaining survey points presented in Table 2-3 all occur within Harvest Block GY27_HB0012, an area of upland terrain, typically associated with shallow peat deposits (<1m).

The geomorphology at each of the survey points can be described as having a pronounced hummocky topography. This coupled with the occurrence of both observed and mapped [Ref. 4] bedrock outcropping, indicates the presence of shallow rock. Similar terrain can be clearly seen in the adjacent land to the north, south and west of the site, where there is significantly less vegetation coverage to obscure the terrain in its natural state (Plate 1).

Plate 1 **Photo taken from PP003 - western extent of site (view west)**

As discussed in Section 4.2 of the Assessment Report, the bedrock outcrop pattern observed during the site walkovers form a series of staggered ridges across the site. These ridges generally form perpendicular to the direction of slope. Their presence is particularly evident in the upland areas to the west of the site. At these locations, the ridges form natural breaks across the slopes, thereby restricting the presence of laterally continuous peat layers. The areas of deeper peat found within the upland areas (such as at PP029) are often confined to pockets representing low points within the underlying bedrock, illustrated in Figure 1. Such terrain may not prevent small isolated peat slippages; however, it is believed that it does significantly reduce the risk of large-scale translational failures within the peat.

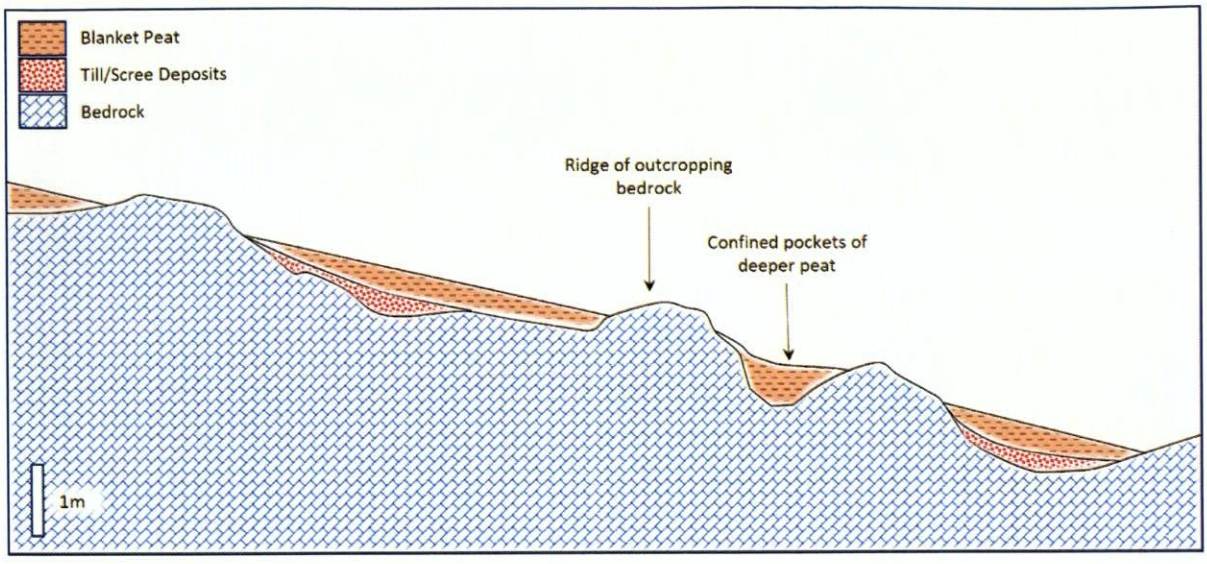


Figure 1 Conceptual cross-section through upland area (based on field observations)

With the exception of POI008 (located outside of the harvest block area), evidence of historic peat failures (to include the presence of minor slippages) were not observed during the site walkovers. This is particularly pertinent due to the size of the site and the range of ongoing harvesting operations already in place. The absence of peat failures (with particular emphasis on the survey points presented in Table 2-3) illustrates that the existing peat is not readily susceptible to small-scale slippages or larger-scale translational failures.

2.4.2 Proposed Floating Roads

Two new access roads are proposed as part of the site's rehabilitation. New Access Road (South) is located to the south of the site within harvest block GY27_HB0014. New Access Road (North) is located to the north of the site spanning four harvest blocks areas (GY27_HB0009, GY27_HB0010, GY27_HB0011, GY27_HB0018 and GY27_HB0021). It is proposed to float both roads due to the presence of peat along their alignments.

Topography at the new access road locations is considerably flatter, when compared to the west of the site. Both new access road alignments generally follow the slope contours and avoid traversing excessively steep terrain. Peat depths along New Access Road (South) range from 0.1 to 1.1m bgl with a mean peat depth of 0.46m bgl. Peat depths along New Access Road (North) are deeper ranging from 0.2 to 3.0m bgl with a mean depth of 2.36m bgl. However, the majority of New Access Road (North) traverses' flat ground.

Results from the peat stability analysis at the location of both access roads is presented below:

Table 2-4 FoS range at proposed floated access roads

Floated Access Road	FoS Undrained (Condition 1)			FoS Undrained (Condition 2)			FoS Drained (Condition 1) Assuming 100% Water			FoS Drained (Condition 2) Assuming 100% Water		
	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean	Min.	Max.	Mean
New Access Road (South)	10.43	31.11	22.75	2.83	5.46	4.25	10.43	12.45	11.18	2.30	11.82	5.96
New Access Road (North)	1.92	38.27	12.28	1.44	6.38	3.19	1.92	38.27	12.60	3.10	13.79	7.41

FoS values returned from this analysis are all in excess of 1.3 in both the drained and undrained condition. The proposed alignment of both access roads were traversed during the site walkovers; site observations indicate no instability or movement within the peat along these alignments. In addition, trees and vegetation along the proposed routes showed no indication of disturbance pertaining to movement within the underlying peat deposits. In summary, it is believed that construction of floating roads at these locations poses little risk to the overall stability of the underlying peat deposits or wider study area.

3. CONCLUSIONS & RECOMMENDATIONS

3.1 Conclusions

The Assessment Report provides a robust assessment of the site. This assessment is based on current guidance documents relating to peatlands in Ireland and has been used across several peatland developments in recent years.

FoS results for the harvest blocks indicate values in excess of 1.3 with the exception of a number of isolated values of <1.3. All FoS results returned for the proposed floated access roads are in excess of 1.3.

The potential for large-scale translational failures within the harvest blocks is significantly hindered as a result of the sites geomorphology, particularly in upland areas. In addition, the absence of existing peat failures within the harvest blocks suggests that the peat has not been subject to small-scale slippages or larger-scale translational failures.

Specific applications of drain blocking, damning, drain reprofiling, stump flipping, surface smoothing, stump mulching and cross-tracking although referenced, were outside the scope of the Assessment Report. However, from FT's assessment of the site, it is believed that these activities, when undertaken in accordance with current guidelines and recommendations made in Section 10.2 of the Assessment Report, pose a low risk of triggering significant landslip within the peat deposits at Derryclare.

3.2 Recommendations

The following recommendations are made in relation to the effectiveness of the specific application of stump flipping and drain blocking at selected areas across the site and do not in any way relate to peat stability. Findings from the Assessment Report strongly indicate such activities will not result in peat instability. Note that commentary on the applications and methodologies of stump flipping and drain blocking were not within the scope of the Assessment Report.

It is recommended to remove/reduce the requirement for stump flipping in areas of steep terrain and shallow peat (where the mean peat depth is <1m bgl). At these locations, the shallow tree root systems are typically anchored within the upper weathered zone of bedrock. As such, stump flipping at these locations would be of limited benefit.

It is also recommended to remove/reduce the requirement for drain blocking, damming and drain reprofiling in the upland harvest blocks. In these areas, the peat and underlying till and scree deposits are sufficiently drained by a pervasive network of naturally formed surface water channels. As discussed in Section 4.2 of the Assessment Report, these channels are described as being narrower and deeper than the forestry drainage and, during the time of the site walkovers, appeared to be responsible for most of the surface water drainage. It was also noted in the Assessment Report that the forestry drainage channels were typically dry, indicating that the natural surface water channels were the primarily mechanism by which the harvest blocks were drained. Therefore, removing the network of forestry drainage in such areas would be of little benefit with respect to restoring water levels to their natural state.

Table 3-1 identifies 6 no. harvest blocks where the requirement for stump flipping and/or drain blocking should either be removed or reduced:

Table 3-1 Recommended removal or reduction of drain blocking and stump flipping

Harvest Block ID	Recorded Slope Range (degrees)	Recorded Peat Depth Range (mbgl) [Mean Depth]	Comments
GY27_HB0012	2 - 28	0.0 - 2.5 [0.9]	Predominant upland terrain. Remove/reduce requirement for drain blocking and stump flipping for whole block.
GY27_HB0013	5 - 26	0.0 - 0.7 [0.5]	Predominant upland terrain. Remove/reduce requirement for drain blocking and stump flipping within western portion of block.
GY27_HB0014	2 - 20	0.1 - 2.0 [0.4]	Upland terrain. Remove/reduce requirement for drain blocking and stump flipping for whole block.
GY27_HB0015	5 - 10	0.1 - 1.5 [0.8]	Predominant upland terrain. Remove/reduce requirement for drain blocking and stump flipping for whole block.
GY27_HB0021	4 - 8	0.2 - 3.3 [1.5]	Predominant upland terrain. Remove/reduce requirement for drain blocking within western portion of block.
GY27_HB0022	5 - 15	0.1 - 1.4 [0.6]	Predominant upland terrain. Remove/reduce requirement for drain blocking and stump flipping for whole block.

4. REFERENCES

1) PLHRAG (2017). Peat Landslide Hazard and Risk Assessments: Best Practice Guide for Proposed Electricity Generation Developments. Prepared for Energy Consents Unit Scottish Government, 2nd Edition. Dated April 2017.

2) MacCulloch, F. (2005). Guidelines for the Risk Management of Peat Slips on the Construction of Low Volume/Low Cost Roads over Peat. Road Ex 11 Northern Periphery.

3) Nature Scotland's Peatland ACTION Programme: https://www.nature.scot/doc/peatland-action-technical-compendium

4) Geological Survey Ireland online Geology viewer: https://dcenr.maps.arcgis.com/apps/MapSeries/index.html?appid=a30af518e87a4c0ab2fbde2aaac3c228

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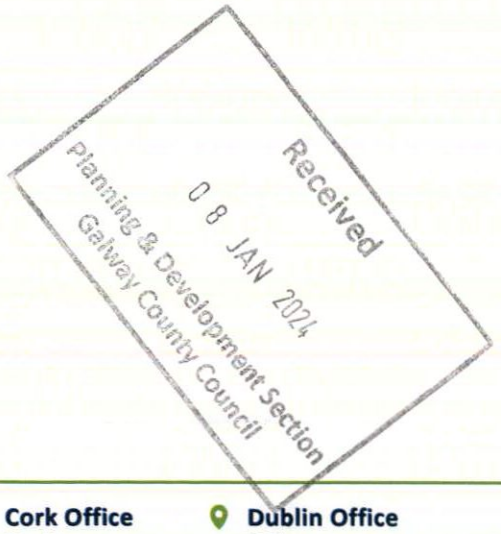

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