APPENDIX 4A

FEHILY TIMONEY
GEOTECHNICAL SECTION 131
RESPONSE

FEHILY TIMONEY

DESIGNING AND DELIVERING
A SUSTAINABLE FUTURE

RESPONSE TO ACP REQUEST FOR FURTHER SUBMISSIONS

CROAGH WIND FARM

Prepared for: **MKO Ltd**

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CROAGH WIND FARM

RESPONSE TO ACP REQUEST FOR FURTHER SUBMISSIONS

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Abstract: Fehily Timoney (FT) were requested by MKO on behalf of Futurenergy Ireland, to prepare an additional submission to An Coimisiun Pleanala (ACP) in relation to the proposed Croagh Wind Farm.

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1. INTRODUCTION

1.1 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 100 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. FT were also the authors of a report on behalf of the GSI and NPWS titled "Assessment of main contributing factors leading to three major peatland failures in Leitrim, Kerry and Donegal (2024)", which considered the main conditioning and triggering factors for those failures.

This technical note was written by Ian Higgins (FT Technical Director, MSc in Geotechnical Engineering). Ian is a Technical Director with Fehily Timoney and has over 25 years' experience in the design and supervision of construction of bulk earthworks, soft ground engineering, geotechnical foundation design, geotechnical monitoring and reviewing, reinforced earth design, 3rd party checking of piling and ground improvement designs, peat stability assessments and the preparation of Environmental Impact Assessments for Wind Farm developments, such as Derrinlough Wind Farm, Coom Green Energy Park and Oweninnny Wind farm (detailed design).

1.2 Summary of Information Provided to Date

The following information has been provided to date as part of the planning submission for the Proposed Development:

1.2.1 Environmental Impact Assessment Report, Proposed Croagh Wind Farm, Co, Leitrim and Co. Sligo, submitted July 2020

FT provided a Peat Stability Assessment Report and Peat & Spoil Management Plan which were included within the EIAR for the Proposed Development. These documents were prepared following several site visits to recorded peat depths and strengths across the site, as well as reviewing data from ground investigation works undertaken at specific locations across the site. The findings of the peat stability assessment was that the proposed development areas have an acceptable margin of safety and that the site is suitable for the Proposed Development. The Peat & Spoil Management Plan summarises the volumes of peat and spoil that will be generated by the Proposed Development and provided sufficient storage locations across the site for the excavated peat and spoil.

1.2.2 Responses to Further Information Requests from Sligo and Leitrim County Councils

FT provided responses to Further Information (FI) requested from both Sligo and Leitrim County Councils in 2021. The FI requests covered items such as peat stability, the stability of the proposed borrow pit, the GSI landslide susceptibility mapping and other issues around the construction of the Proposed Development.

Detailed responses were provided in relation to all of the issues raised by Sligo and Leitrim County Councils. This included an explanation of the factors that influence the peat stability risk assessment, further explanation of the stability assessment (Factor of Safety results) and the stability of excavate and replace roads. The response also included a series of stability analyses to demonstrate the stability of the borrow pit and peat repositories, as well as the settlement pond locations.

1.2.3 Responses to FI request from ABP (November 2022)

A FI request was issued by ABP on 11th November 2022 in relation to the proposed Development. In relation to the site stability, the following was noted "In particular the Board is seeking from the applicant information which demonstrates that they have a clear understanding of the existing land and ground conditions associated with the development of the proposed peat repositories, including matters relating to the final construction of the primary repository, the drainage of the peat repositories, measures required for the control of groundwater, the type and condition of the rock at the repository locations and the hillside siting of the northernmost repository and the associated clear felling of forestry."

A detailed response to this FI request was prepared by FT, detailing the reasons for choosing the peat repository locations, including updated text to describe the construction of the borrow pit and peat repositories to prove additional clarity, and providing an updated assessment of the stability of the proposed borrow pit and peat repositories to include the use of Eurocode 7 partial factors. This assessment demonstrated, similar to the previously submitted assessment, that the proposed borrow pits and peat repositories have an adequate Factor of Safety against failure.

2. SUPPLEMENTARY GROUND INVESTIGATION

Following a review of the ACP inspectors reports dated July 2022 and February 2023, it was decided to undertake further site investigation works in order to better address some of the issues raised. A summary of the supplementary investigations undertaken is provided below. The factual data from this investigation is included in Appendix B of this report, and the ground investigation locations are shown on Figures 3.2 to 3.7.

- Further investigations, in the form of boreholes and geophysical investigations, were undertaken during 2025.
- Rotary cored boreholes were drilled at the northern repository (BH02) and at the borrow pit (BH01). At the northern repository, ground conditions were recorded as very stiff slightly sandy slightly gravelly Silt to a depth of 9m bgl (base of borehole). At the borrow pit, weathered rock was recorded at a depth of 4m bgl overlain by stiff Silt and Gravel.
- The bedrock is described as a weak to very strong thinly laminated grey and black fine-grained Siltstone. Discontinuities within the bedrock are described as dipping 8-10 degrees, almost horizontal. Laboratory testing undertaken on samples of the bedrock confirmed the bedrock descriptions on the logs.
- Both weathered and intact bedrock are considered suitable for reuse as general fill materials in the construction of the Proposed Development, based on the rock descriptions and the results of the laboratory testing undertaken as part of the ground investigation.
- Additional in-situ shear vane testing of the peat was undertaken in the southern repository, with results ranging from 8.5 to 22kPa. Additional in-situ shear vane testing was undertaken at three other areas across the site where deep peat was present, with results ranging from 6.5 to 33kPa, similar to the range recorded at the southern repository and similar to the range recorded during the original site walkovers.
- The geophysical investigation provided additional data on the ground conditions at the two repositories and the borrow pit. Very shallow peat is indicated at the northern repository, underlain by stiff Silt to depth, which is similar to the ground conditions recorded in the borehole and trial pits. Thicker peat (2.0-3.0m) was indicated at the southern repository, underlain by a layer of firm Silt. At the borrow pit location very shallow peat is underlain by a mixture of Gravel and Silt to a depth of 2.0-4.0m bgl over weathered bedrock, which is similar to what was recorded in borehole BH01.
- Additional peat probing as part of the geophysical investigation indicated peat depth ranging from 0.2 to 2.0m at the northern repository and ranging from 1.7 to 3.5m at the southern repository. These results are similar to those previously recorded in these two locations.
- The ground investigation information confirms there is a suitable subgrade for the perimeter berms on the firm to stiff cohesive glacial till or on coarse granular till at a shallow depth below the peat. Note that the trial pits indicate that there could be a thin layer of soft sandy silt below the peat in some areas, which will be removed prior to construction of the berms.

The ground investigation undertaken as part of the original EIAR submission comprised a series of trial pits. Trial pit TP01_MKO was undertaken at the southern repository, and trial pits TP3 and TP7A were undertaken at the northern repository. Trial pits TP03_MKO and TP11 were undertaken within the vicinity of the borrow pit and recorded firm to stiff Clay and weathered bedrock below shallow (<1m) peat.

The results of the supplementary ground investigation confirm the findings of the original ground investigation and provide additional detail to what had already been undertaken. The results of the ground investigations have been used to derive material parameters used to update the stability assessments at the borrow pit and peat repositories, which demonstrate that the proposed design has an adequate margin of safety against failure.

3. CONSTRUCTION METHODOLOGY FOR BORROW PIT AND PEAT REPOSITORIES

3.1 Borrow Pit

The following will be undertaken in the construction and reinstatement of the borrow pit. A cross section of the borrow pit is shown in Figure 3.8 of this submission and is an updated copy of a drawing previously submitted within the Peat & Spoil Management Plan (Appendix 4-2 of the EIAR).

The borrow pit will be constructed as follows:

(1) The rock within the borrow pit footprint will be removed by a combination of digging and breaking, depending on its excavatability, which has been determined from the supplementary ground investigation carried out at the borrow pit. Based on the available ground investigation data, the bedrock will be removed using a combination of digging and breaking. Excavated rock will be used in the construction of the wind farm, including the perimeter buttresses to the borrow pit and peat repositories.

(2) It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road. Localised deepening of the borrow pit floor will be required depending on extraction operations.

(3) Internal engineered berms will be constructed using crushed rock in order to retain the placed peat and spoil in cells within the borrow pit.

(4) Slopes within the excavated rock formed around the perimeter of the borrow pit will be formed at stable inclinations to suit local in-situ rock conditions (60 degrees). Exposed sections of the rock slopes will be left with irregular faces and declivities to promote re-vegetation and provide a naturalistic appearance.

(5) The stability of the rock faces within the borrow pit will be inspected by the Project Geotechnical Engineer upon excavation to ensure stability during construction works and in the long term. This inspection will allow unfavourable rock conditions to be identified and suitable mitigation measures to be applied such as removal of loose rock, in line with best practice guidelines.

(6) Infilling of the peat and spoil will commence at the back edge (upslope side) of the borrow pit and progress towards the borrow pit entrance/internal rock berms/perimeter buttress, which allows for infilling of the borrow pit to commence before the perimeter buttress is completed.

(7) The majority of the peat and spoil contained within the borrow pit will be below the top of bedrock level, as shown on Figure 3-8, and will be retained by the in-situ bedrock, and as such will be stable.

(8) A rock buttress (containment berm) is required at the downslope edge of the borrow pit to safely retain the upper layer of infilled peat and spoil. The height of the rock buttresses constructed will be 0.5m higher than the height of the infilled peat and spoil to prevent any surface peat and spoil run-off. A buttress up to 7m (approx.) in height will be required.

(9) The rock buttress will be founded on firm or stiff Silt or medium dense gravel (Glacial Till) i.e. competent strata, which was recorded below the surface peat layer during the ground investigations undertaken and through stability analysis has been demonstrated to be a stable founding stratum (see Section 3.3 of this report). The founding stratum for the rock buttress will be inspected and approved by the Project Geotechnical Engineer. Any soft clay present will also be removed prior to constructing the buttress. The founding stratum will be benched into the existing slope with a maximum bench height of 0.5m.

(10) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability to allow for the drainage of water through the buttress. The buttress will be constructed of a coarse permeable well graded quarry run angular rockfill from the borrow pit. In addition, drains will be placed through the top of the buttresses to allow surface water to drain from the surface of the placed peat.

(11) The crest of the rock buttress will be wide enough (up to 4m) to allow construction traffic access for tipping and grading during the placement of the excavated peat and spoil. The side slopes of the rock buttress will be constructed at between 45 degrees (1V:1H, inside of rock buttress and in weathered rock) to 60 degrees (2V:1H, in intact bedrock) on the inside face, and 35 degrees (1v:1.5H) on the outside face.
(12) Temporary access ramps and long reach excavators will be used during the placement of the excavated peat and spoil.
(13) The surface of the placed peat and spoil will be shaped to allow efficient run-off of surface water from the placed arisings.
(14) A layer of geogrid to strengthen the surface of the placed peat and spoil within the borrow pit will be placed across the top of the placed peat/spoil.
(15) An interceptor drain will also be installed upslope of the borrow pit. This drain will divert any surface water away from the borrow pit and hence restrict run-off from ponding and lodging in the reinstated area.
(16) Control of groundwater within the borrow pit will be required. A temporary pump and suitable outfall to an appropriately sized settlement pond downslope of the borrow pit will be required during construction. Refer to EIAR Chapter 4 and 9 for drainage details.
(17) A settlement pond has been designed at the lower side/outfall location of the borrow pit for the construction stage of the Proposed Development.
(18) Works will be supervised and controlled by the Project Geotechnical Engineer for the development of the borrow pit.
(19) All the above-mentioned general guidelines and requirements will be undertaken by the Contractor during construction.

In addition to the above the following is noted to ensure the stability of the borrow pit buttress.

(1) Prior to construction of the perimeter buttress, all peat and soft clay, where encountered, will be removed from below the footprint of the buttress, temporarily stored in a controlled manner locally in bunds not exceeding 2m in height, on flat terrain, sealed to prevent water ingress, and permanently stored in the borrow pit.
(2) A benched surface will be prepared before placing and compacting the rock fill used to construct the buttress.
(3) The permanent crest of the buttress will be a minimum of 2m in width and will be 0.5m higher than the final height of placed peat.
(4) As the crest of the buttress is 0.5m higher than the retained peat, drains will be provided at regular intervals (every 50m) through the buttress, at the same level as the top of the peat surface, to prevent ponding of water around the edges of the borrow pit. These drains will be 150mm diameter flexible plastic drainage pipe or equivalent.

3.2 Peat Repositories

The following will be undertaken for the construction of the peat repositories. Cross sections of both repositories are shown in Figure 3-9 (southern repository) and 3-10 (northern repository) of this submission and are updates of the previously submitted drawings from the Peat & Spoil Management Plan (Appendix 4-2 of the EIAR) including minor edits to show the base of the proposed perimeter berms (also referred to as stone buttresses) as benched into the existing slope on sidelong ground and revisions to the side slopes angle proposed for the perimeter buttresses.

(1) All stone buttresses for the repository areas will be founded on firm to stiff Silt (Glacial Till) i.e. competent strata which was recorded below the surface peat layer during the ground investigations undertaken and through stability analysis has been demonstrated to be a stable founding stratum (see

Section 3.3 of this report). The founding stratum for each stone buttress will be inspected and approved by the Project Geotechnical Engineer. The founding stratum will be benched into the existing slope with a maximum bench height of 0.5m.

(2) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse angular rock fill with a high permeability processed from rock extracted from the borrow pit. A toe drain will be included along the base of the buttress to improve drainage at the bottom of the peat repository. In addition, drains will be placed through the crest of the buttresses to allow excess water to drain.

(3) The height of the stone buttresses constructed (maximum 7m) will be greater than the height of the stored peat and spoil to prevent any surface run-off. The height of the stone buttresses will be a minimum of 0.5m above the height of the placed peat and spoil to prevent any potential for saturated peat to flow out of the repository area.

(4) The side slopes of the stone buttresses shall be constructed at between 35 degrees (1V:1.5H, outside slope) and 45 degrees (1V:1H, inside slope). The stone buttresses will be sufficiently widened (to 4m in width) temporarily to allow construction traffic access for tipping purposes during the placement of the excavated peat and spoil.

(5) An interceptor drain will also be installed upslope of the repository areas. The drain will divert any surface water away from the repository area and hence prevent water from ponding in the area.

(6) A settlement pond will be constructed at the lower side of the repository areas, as shown on the drainage drawings within the EIAR.

(7) The placement of the excavated spoil will commence at the downslope edge of the repository area behind the stone buttress and placement will then continue upslope, which allows the perimeter berm to provide downslope support for the placed peat.

(8) The surface of the stored peat will be shaped to allow efficient run-off of water from the stored peat.

(9) Supervision by the Project Geotechnical Engineer is required for the construction of the repository area.

In addition to the above the following is noted to ensure the stability of the repositories.

(1) Based on ground investigation data undertaken to date, founding levels for the buttresses will be between 1.0m and 3.5m bgl.

(2) Prior to construction of the perimeter buttresses, all peat and soft clay, where encountered, will be removed from below the footprint of the buttresses, temporarily stored in a controlled manner locally in bunds not exceeding 2m in height, on flat terrain, sealed to prevent water ingress, and permanently stored either in the repository or the borrow pit.

(3) A benched platform in the underlying competent stratum, a firm to stiff Silt (Glacial Till) will be prepared before placing and compacting the rock fill used to construct the buttresses. A geotextile separator layer (terram) will be placed on the top of the competent stratum prior to placing the rock fill to prevent mixing of the soil and rock.

(4) The buttresses will be completed prior to any peat being placed within the repositories. The permanent crest of the buttresses will be a minimum of 2m in width and will be 0.5m higher than the final height of placed peat.

(5) As the buttresses are slightly higher than the retained peat, drains will be provided at regular intervals (every 50m) through the crest of the buttresses, at the same level as the top of the peat surface, to prevent ponding of water around the edges of the repositories. These drains will be 150mm diameter flexible plastic drainage pipe or equivalent. The volume of water flowing through these drains will be small, and similar to the amount of runoff currently occurring over the footprint of the repositories.

(6) During filling of the repositories, monitoring to inspect the condition of the repositories should be undertaken on a weekly basis. Following completion of the repositories, monitoring should be every two weeks for a three-month period, increasing to monthly for the remainder of the first year after this time. Following this period, as part of the normal operation and maintenance of the Proposed

Development, monitoring of the borrow pit and peat repository buttresses should be undertaken on a 6 monthly basis.

This type of peat repository (design and construction) has been successfully used on other sites to store peat and spoil material from wind farm construction. A recent example of this is Lenalea Wind Farm in Co. Donegal (a joint venture between SSE and FuturEnergy Ireland, planning references 09/50116, 12/40091, 18/50312 and 19/51521), where a material storage area with a perimeter berm of 7m in height was constructed adjacent to the on-site substation, as shown in the image below.



Figure 3.1: Aerial photo of material storage area at Lenalea Wind Farm

3.3 Stability Analysis of Borrow Pit and Peat Repositories

The stability analysis below was previously submitted as part of the FI responses to Sligo and Leitrim County Councils. These analyses have been updated slightly so that the model shows the base of the perimeter buttresses for the repositories on a benched platform, as noted in Section 3.2 above and shown in Figure 3-9 and 3-10. Additionally, a 10kPa live load has been added to the top of the buttresses in the undrained case to mimic temporary construction loading during construction (this is a typical loading as per BS6031 Code of Practice for Earthworks, 2009). Outputs from the stability analysis are shown in Appendix C of this submission and the results are summarised in Table 3.2.

A stability check has been undertaken to demonstrate the stability of the proposed perimeter buttresses around the borrow pit and peat repositories. Slope stability has been checked using SlopeW slope stability software. The analysis was carried out using partial factors, in accordance with the requirements of Eurocode 7, the design standard for geotechnical 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. Rather, it provides a result in terms of an overdesign factor (ODF), where an ODF of >1.0 is stable, and an ODF of <1.0 is unstable.

The calculations are carried out in accordance with IS EN 1997-1 (EC7). This is split into several approaches. For geotechnical design, Design Approach 1 Combination 1 (DA1C1) and 2 (DA1C2) are typically used. DA1C1 applies partial factors to permanent loads, but not to soil properties, and DA1C2 applies partial factors to soil properties, but not to permanent loads. Both combinations apply partial factors to variable loads. Typically for slope stability analyses, DA1C2 provides a more conservative result.

DA1C2, which is the governing case in this case, is used with the applicable partial material reduction factor of γM = 1.4 applied to the measured undrained peat strengths, along with the applicable partial load factors for permanent loads (γG = 1.0) and variable loads (γQ = 1.3). Note that the calculations were also carried out for DA1C1, which does not govern in this particular scenario. Tables presenting the 'overdesign' factor (or factor of safety in excess of the required minimum of 1.0) are included in Table 3.3 below.

Table 3.1: Partial Factors for Material Properties

Factor of Safety (FoS)	Partial Factor (DA1C2)
Soil Unit Weight (γ)	1.0
Soil cohesion (c')	1.25
Soil phi angle (φ)	1.25
Undrained shear strength of soil (c_u)	1.4

The stability analysis has been undertaken using both undrained (short term) and drained (long term) strength parameters.

The material properties used in the stability assessment are summarised in Table 3.2. These properties have been interpreted from the results of the various ground investigations undertaken across the site. A relatively low strength for the peat retained within the borrow pit/repositories has been used to model the effect of disturbance on the saturated peat mass. The undrained strength of the in-situ peat within the repository footprint is taken as the lowest value recorded on the site (6kPa). Peat strengths recorded at the repository locations were higher than this value, (ranging from 23-38kPa at the northern repository and 8.5-40kPa at the southern repository) and as such this design strength is considered conservative.

Table 3.2: Material Properties

Material	Unit Weight (kN/m^3)	Undrained Shear Strength, c_u (kPa)	Angle of Shearing Resistance, ϕ (degrees)	Effective Cohesive, c' (kPa)
Intact Peat	10.5	6	25	4
Granular fill (berm)	22	-	40	1
Retained Peat within Borrow Pit/ Repository (disturbed)	10.5	2	5	2
Glacial Till	20	50+5z*	34	0.5
Weathered Bedrock	22	-	45	2

* Undrained shear strength increasing with depth

3.3.1 Borrow Pit

The buttress along the western side of the borrow pit will be up to 7m in height. Peat depths recorded within the footprint of the borrow pit range from 0.5 to 1.7m. Bedrock has been assessed at 3m below ground level based on the ground investigation information, overlain by an average of 0.5 of peat and 2.5m of Glacial Till. All

peat will be excavated from below the perimeter buttress. The base of the rock buttress will be benched into the Glacial Till to create a stable platform. The inside slope of the perimeter buttress has been modelled as a 60 degree slope in bedrock, 45 degrees in the granular buttress, and the outside slope of the buttress as 35 degrees. Groundwater has been assumed at 0.5m bgl on the downslope side of the berm as a conservative assessment.

The stability analysis has been undertaken using both undrained (short term) and drained (long term) strength parameters.

3.3.2 Peat Repository 1 (South)

The buttress around the perimeter of the repository will be up to 7m in height. An average existing peat thickness of 2.5m has been determined from peat probes taken in the area. All peat will be excavated from below the footprint of the perimeter buttress. The base of the rock buttress will be benched into the glacial till to create a stable platform. The internal slopes of the buttresses have been modelled at 45 degrees, and the external slopes have been modelled at 35 degrees. Groundwater has been assumed at 0.5m bgl through the section analysed.

3.3.3 Peat Repository 2 (North)

The buttress around the perimeter of the repository will be up to 6m in height. An average existing peat thickness of 1.7m has been determined based on peat probes taken in the area. All peat will be excavated from below the footprint of the perimeter buttress. The base of the rock buttress will be benched into the glacial till to create a stable platform. The internal slopes of the buttresses have been modelled at 45 degrees, and the external slopes have been modelled at 35 degrees. Groundwater has been assumed at 0.5m bgl through the section analysed.

3.3.4 Summary of Results

The stability assessment has recorded ODF results (Table 3.3) at each location of in excess of 1.0 to EC7, which is considered acceptable. Outputs of the results are provided in Appendix C. This indicates that there is an adequate margin of safety against failure within the borrow pit and peat repositories. While the ODF for the borrow pit and Repository 2 is slightly above 1.0, this is a shallow failure within the stone buttress, and not a potential global failure that would impact on the stability of the stored peat/spoil.

Table 3.3: ODF Results for Borrow Pit and Peat Repositories (DA1C2)

Location	Eurocode (EC7) (DA1C2)	
	Undrained Analysis	Drained Analysis
Borrow Pit	1.03	1.10
Peat Repository 1 (South)	1.05	1.10
Peat Repository 2 (North)	1.20	1.04

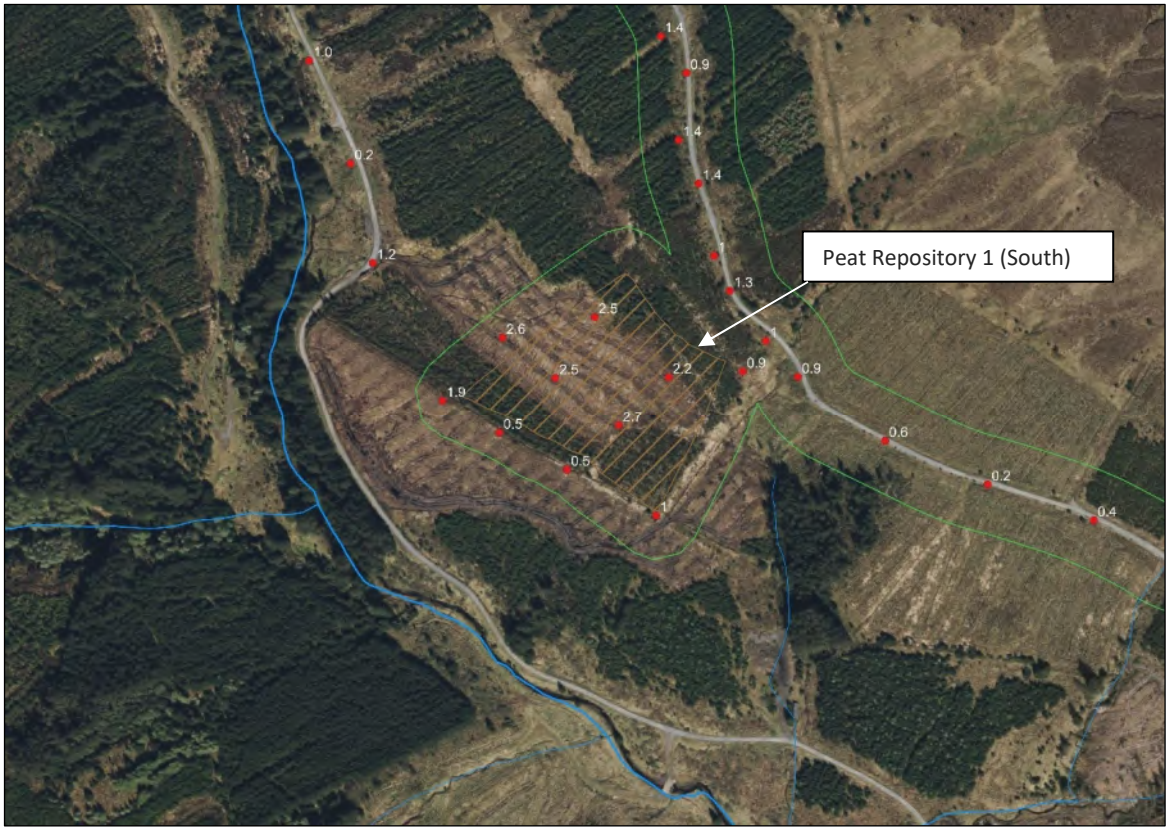


Figure 3.2: Peat probe locations (red dots) for Peat Repository 1 (South)



Figure 3.3: Peat probe locations (red dots) for Peat Repository 2 (North)



Figure 3.4: Peat Probe Locations (red dots) for Borrow Pit

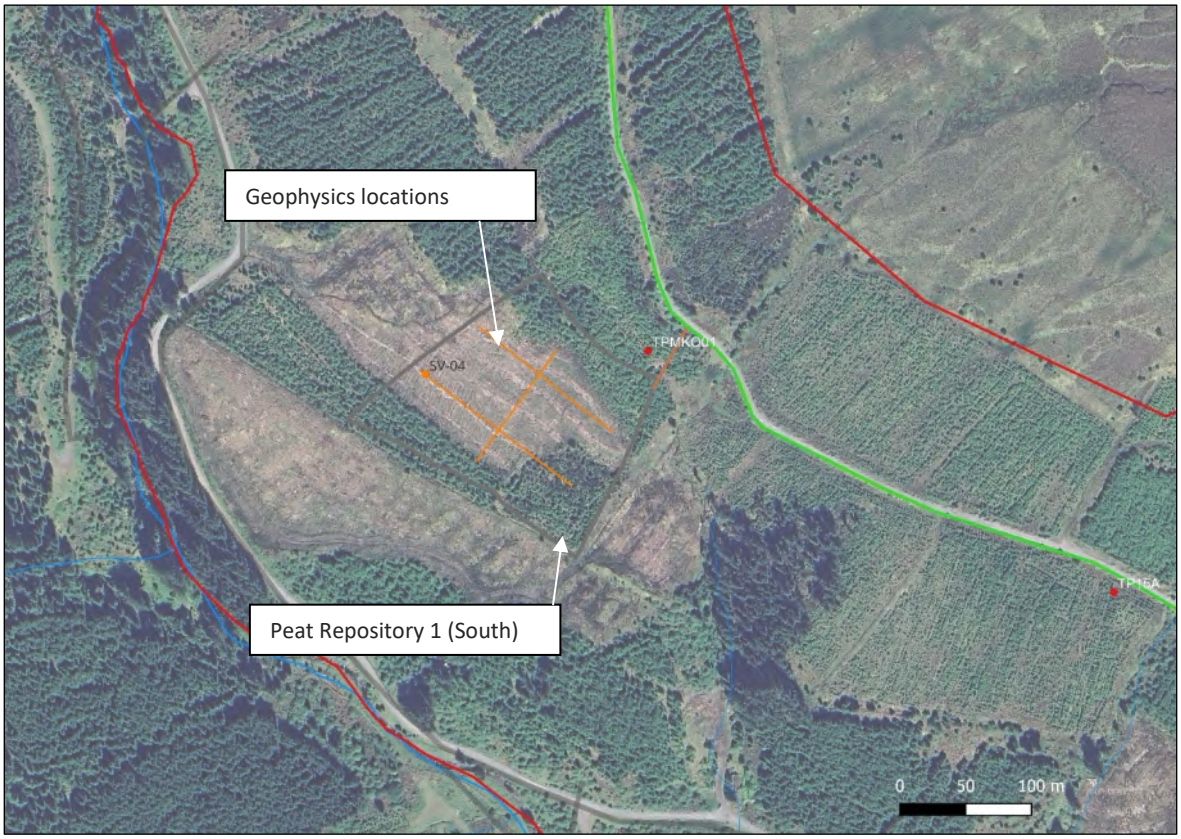


Figure 3.5: Ground Investigation Locations for Peat Repository 1 (South)

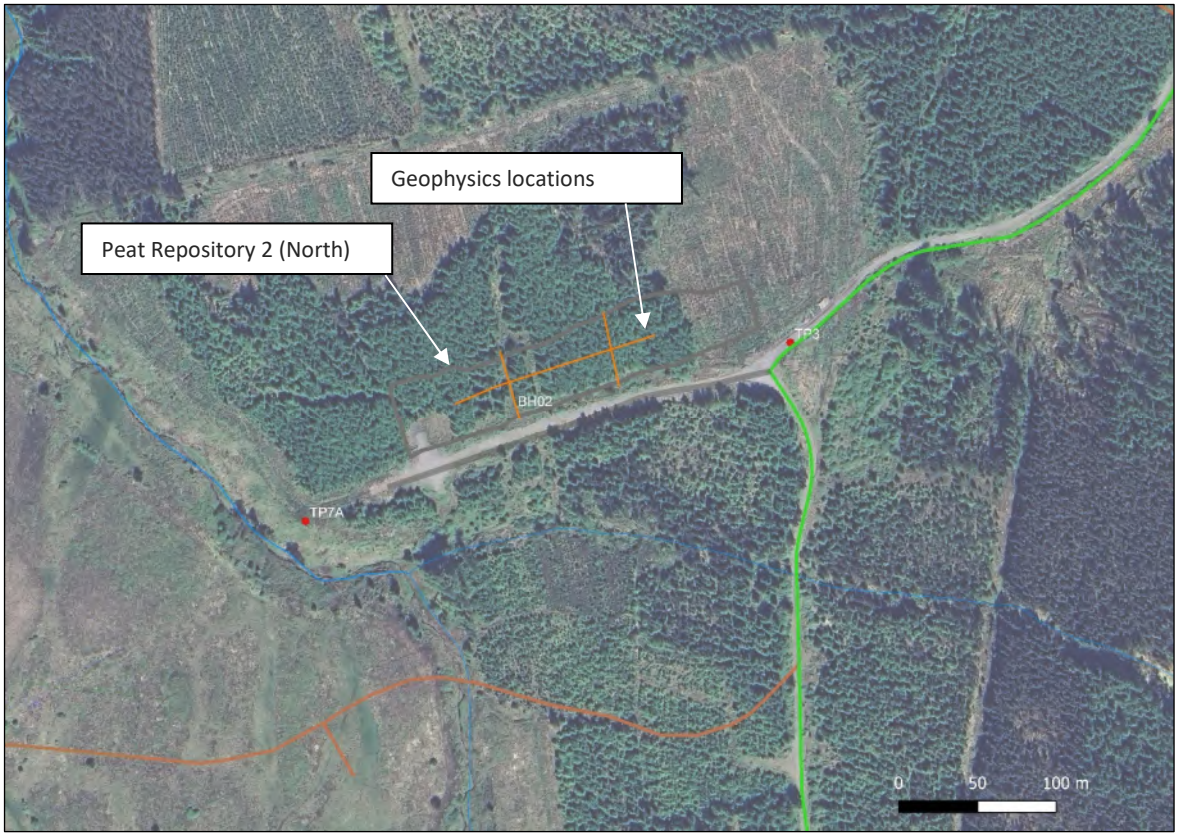


Figure 3.6: Ground investigation locations for Peat Repository 2 (North)

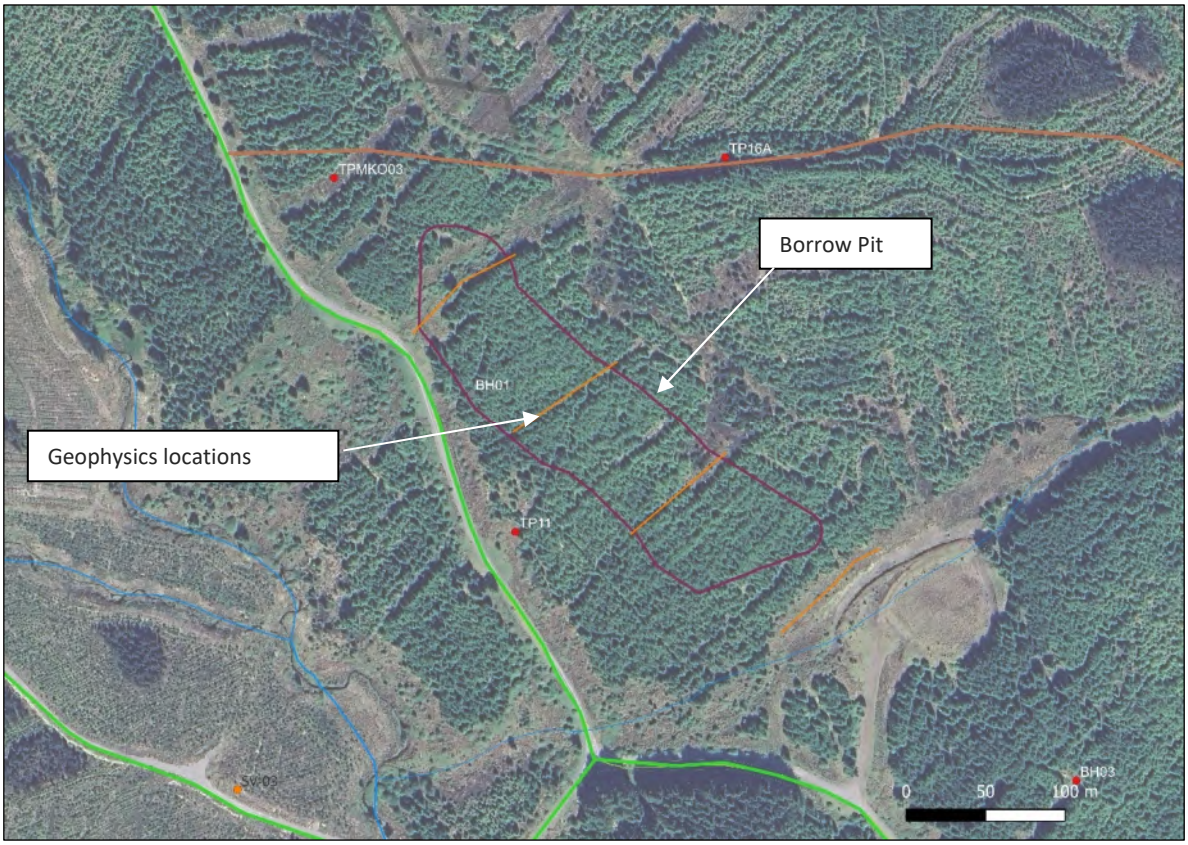


Figure 3.7: Ground Investigation Locations for Borrow Pit

4. CONSIDERATION OF INSPECTORS REPORT IN RESPECT OF PEAT STABILITY

4.1 An Coimisiún Pleanála (ACP) Inspectors Report

Two separate sets of reports were provided, one for Sligo County Council and one for Leitrim County Council. An original inspectors report dated July 2022 and an Addendum report dated February 2023 were received for both.

4.2 Rebuttal to An Coimisiún Pleanála (ACP) Inspectors Report

The table below summarises the issues raised in the Inspector's Reports linked to peat stability and provides a response against each.

Issue Raised linked to Peat Stability	Response
The classification of the site by Geological Survey Ireland as being of low to moderately high landslide susceptibility.	This would apply to almost any upland blanket bog site. The GSI classification is a guide to the potential susceptibility of a particular area to landslides, and it should not be taken as a reason to preclude a site from development. The landslide susceptibility mapping is also not specific to peatlands and doesn't take into account all of the factors that would influence peat stability. The GSI classification is a starting point for any assessment, and an appropriate peat stability assessment specific to a site which is undertaken by an appropriately experienced geotechnical engineer following the relevant guidelines would supersede the GSI classification.
The high density of historical landslides in this area, including three landslides within the site itself.	Historical landslides were specifically discussed within the Peat Stability Report. Historical failures in areas of cutover peat should not preclude the development of an adjacent forested site. While the access track to one of the turbines crosses the failure scar of a historic failure, this would be constructed as a founded road on solid ground underlying the peat and would not apply any additional loading to the surrounding peatland. As such the construction of this track would not increase the likelihood of a peat failure in this area.
The numerous mapped faults in the area, including two within the site.	There is no reason why this would have any effect on the impact assessment, EIAR or peat stability assessment. There is no obvious direct link between fault zones and peat instability.
The upland and sloping nature of the terrain.	This would be true of any upland blanket bog site and would not be considered to be a significant constraint in the development of a site. Developments can be constructed on sloping terrain without peat stability issues provided a peat stability assessment is undertaken and a suitable construction methodology is followed.
The high rainfall levels prevalent in this location.	Rainfall is no higher at the Proposed Development site than similar upland sites in Counties Sligo, Leitrim, Donegal and Mayo that have previously been granted planning permission, so it is unclear why this is being referenced. If this logic is to be

	used consistently, then no upland site would be deemed suitable for development.
Blanket bog being the dominant soil type at the site.	The presence of blanket bog on a site should not preclude it from development. Numerous upland blanket bog sites have been safely developed for renewable energy projects.
The low permeability of the limestone bedrock on the site, leading to a high water table.	It is unclear why this would be a cause for particular concern in relation to peat stability. The presence of a high water table is not unusual. This would not change the likelihood of a peat failure.
The high density of drainage channels throughout the site, both natural and man-made.	Such drainage channels indicate that the site is well drained, and that waterlogging of ground is unlikely. Well drained sites also typically have higher peat strengths than poorly drained sites. Again, this would be typical of an upland forested site anywhere in Ireland.
The timing of construction works outside of the breeding season for birds coinciding with wetter periods.	The construction phase of the Proposed Development is expected to be between 12 to 18 months in duration. Therefore, some works will naturally occur outside of the bird breeding season. It is noted that heavy rainfall events can occur at any time of year, both during and outside of the bird breeding season. Section 3.2.2.2 of the Surface Water Management Plan (submitted with the Further Information Responses to both local authorities) details the pre-emptive site drainage management measures including how the works programme for the construction stage of the development will take account of weather forecasts and predicted rainfall in particular. Large excavations and movements of peat/subsoil or vegetation stripping will be suspended or scaled back if heavy rain is forecast. The extent to which works will be scaled back or suspended will relate directly to the amount of rainfall forecast.
The expansive areas of trees to be clear felled, with peat soils and subsoils subsequently exposed.	While there may be a small amount of additional surface runoff following felling, and the potential for erosion of any exposed soils, this would be a short-term impact and would reduce to a negligible impact once these areas have revegetated. These trees will be clearfelled when mature even if the Proposed Development is not consented, as in any commercial forestry in upland or other areas. Any clearfelling will be undertaken in accordance with all of the relevant guidance which is designed to minimise any impacts arising.
The extensive water crossings and crossing upgrades required.	A total of 9 no. new watercourse crossings will be required as part of the Proposed Development, while a total of 16 no. water crossing upgrades will be required. The watercourse crossings will be constructed/upgraded to the specifications of the OPW bridge design guidelines 'Construction, Replacement or Alteration of Bridges and Culverts - A Guide to Applying for Consent under Section 50 of the Arterial Drainage Act, 1945', and in consultation with Inland Fisheries Ireland. With the implementation of the appropriate design and construction

	methodologies proposed, the construction or upgrade of water crossings will have no bearing on peat stability.
The deep peat at turbine locations and along existing and proposed access roads.	Peat depths were <2.5m at eight of the ten turbine locations, which would not be considered particularly deep. Excavation and construction in deeper peat areas can be undertaken safely provided appropriate mitigation measures, including sufficiently detailed construction methodologies, are developed and followed, as detailed in the Application documents for the Proposed Development.
The significant volumes of peat and other spoil material requiring excavation, handling, storage and management on the site.	With appropriate mitigation measures and management of construction the movement of this volume of material should not pose a significant risk to peat stability or sensitive receptors. Excavation and storage of materials within the borrow pit and peat repositories has been detailed within the original EIAR submission and also within this report.
The instability associated with the works and movement of waste material, including the necessity for placement of vast volumes of waste peat and other spoil materials in three large repositories on bogland hilly terrain.	Any development on upland blanket bog will involve the excavation, movement and placement of a large volume of material. The best (and most stable) location to store this material is either within a borrow pit or a repository which has been specifically designed for this purpose, as is the case at Croagh. Analyses have been provided that demonstrate that the proposed borrow pit and repositories are stable.
The construction of high retaining stone buttresses required to contain waste peat and other spoil.	The proposed buttresses have been designed using appropriate design standards, founded on competent material and have been adequately sized to retain the material to be stored in the borrow pit/peat repositories.
The peat-dominated nature of the soils at the repository locations.	The entire site is peat-dominated (as are most wind farm sites in Ireland), and this has been factored into the design of the repository locations by experienced geotechnical engineers in accordance with relevant codes and standards for works in this type of environment.
The lack of a clear understanding of the land and ground conditions associated with the development of the proposed peat repositories, including matters relating to the final construction of the primary repository, the drainage of the peat repositories, measures required for the control of groundwater, the type and condition of rock at the repository locations, and the hillside siting of the northernmost repository and the associated clear felling of forestry	See Section 3 of this technical note for the construction methodology and the results of the stability analyses for the peat repositories.
The construction works culminating in interference with the natural terrain by the development of the turbine bases and the hardstanding areas, the construction of access roads cutting across contours on bogland, the provision of preferential flow paths for surface waters, and road widening and improvement works along existing internal roads	This is the same type of impact as for any wind farm development on an upland site in Ireland. These potential impacts have been assessed within the EIAR, in line with the EPA Guidelines, and appropriate mitigation measures proposed to minimise any impacts. The design of the proposed Development has also been developed to minimise any such impacts wherever possible.

The proposed highly complex system of drainage and the very precise nature of the application of many of the proposed measures required for their functionality	The drainage system proposed for the Croagh Wind Farm development is detailed but it is not complex. The overall aim of the drainage system is to keep clean water clean by diverting it around works areas and to treat potentially silt-laden runoff from works areas. This type of drainage system has been successfully implemented on numerous wind farm sites across the country. The level of detail that has been included as part of the application is appropriate for a wind energy development.

5. REFERENCES

Fehily Timoney & Company (FT) (2021). Croagh Wind Farm. Responses to Sligo County Council Further Information Schedule. March 2021.

Fehily Timoney & Company (FT) (2021). Croagh Wind Farm. Responses to Leitrim County Council Further Information Schedule. March 2021.

Fehily Timoney & Company (FT) (2020). Geotechnical & Peat Stability Assessment Report for Croagh Wind Farm, Co. Leitrim/Sligo. June 2020.

Fehily Timoney & Company (FT) (2020). Peat & Spoil Management Plan for Croagh Wind Farm, Co. Leitrim/Sligo. June 2020.

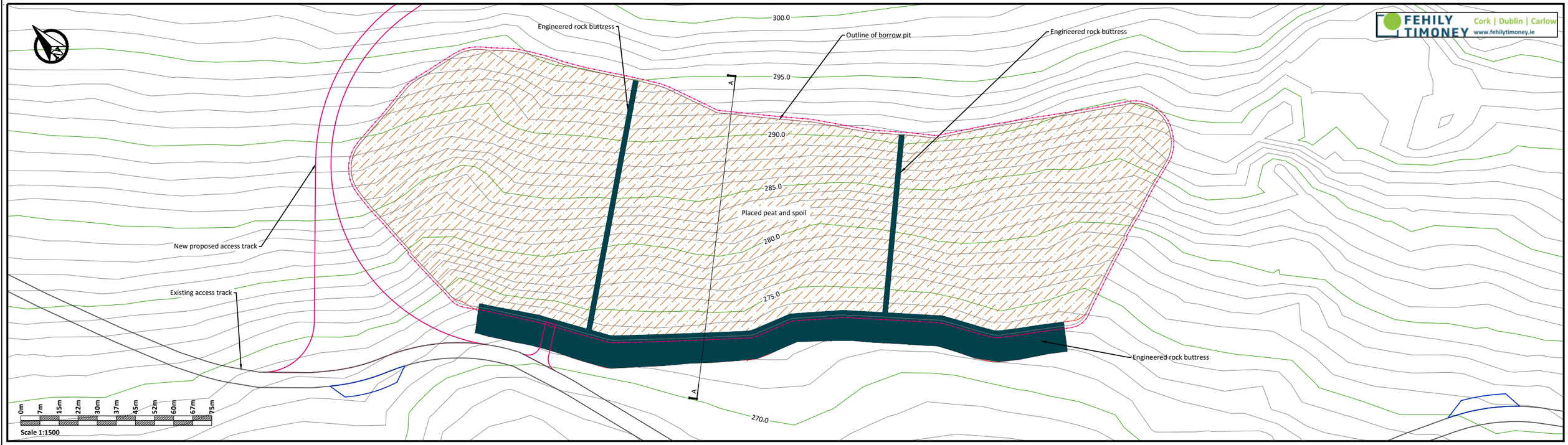
Fehily Timoney & Company (FT) (2022). Responses to ABP Further Information Request. December 2022.

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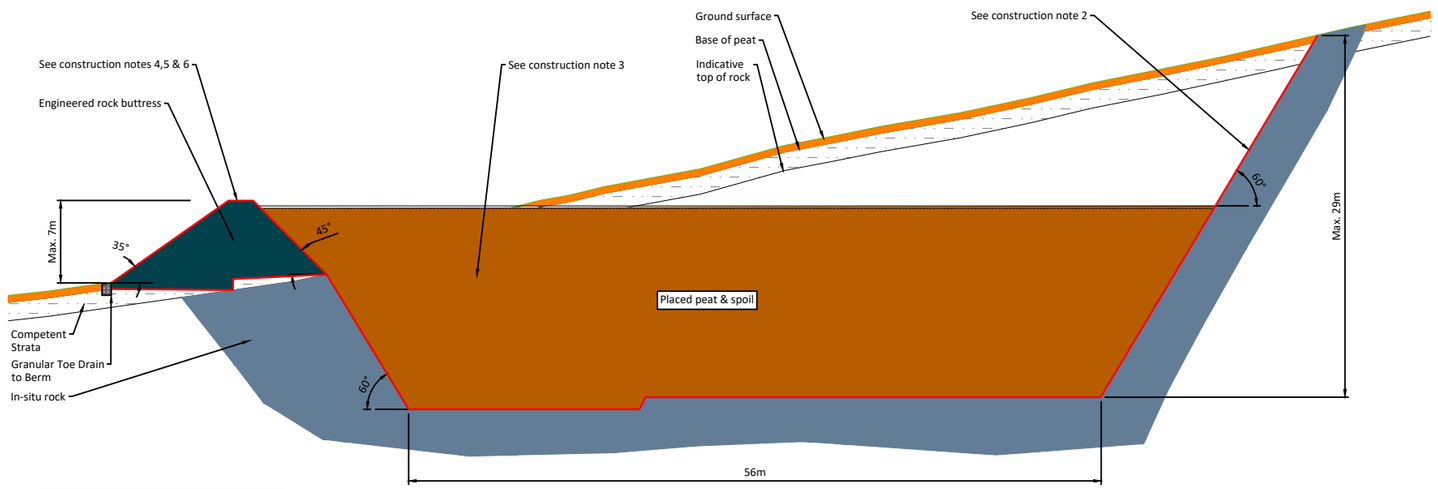
APPENDIX A

Drawings



Plan

Scale 1:1500



Section Scales:

1:1 Horizontal
1:1 Vertical

(No exaggeration on vertical scale i.e. true scale)

0m 3m 5m 8m 10m 13m 15m 18m 20m 23m 25m

Scale 1:500

Section

Scale 1:500

Construction Notes Borrow Pit:

(1) It is proposed to construct the borrow pit so that the base of the borrow pit is below the level of the adjacent section of access road.

(2) Slopes within the excavated rock formed around the perimeter of the borrow pit will be formed at stable inclinations to suit local in-situ rock conditions (60 degrees).

(3) Infilling of the peat & spoil will commence at the back edge of the borrow pit and progress towards the borrow pit entrance/rock buttress.

(4) A rock buttress is required at the downslope edge of the borrow pit to safely retain the infilled peat and spoil. The height of the rock buttresses constructed will be greater than the height of the infilled peat & spoil to prevent any surface peat & spoil run-off. A buttress up to 7m (approx.) in height is will to be required.

(5) The rock buttress will be founded on competent strata. The founding stratum for the rock buttress will be inspected and approved by the project geotechnical engineer.

(6) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability.

(7) The surface of the placed peat & spoil will be shaped to allow efficient run-off of surface water from the placed arising's.

(8) Control of groundwater within the borrow pit will be required.

(9) Further guidelines on the construction of the borrow pit are included within Section 3 of this report.

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Scale (@ A3)
1:1500

Date - 04.03.26

FIGURE 3-8 : BORROW PIT - PLAN & CROSS SECTION DETAILS

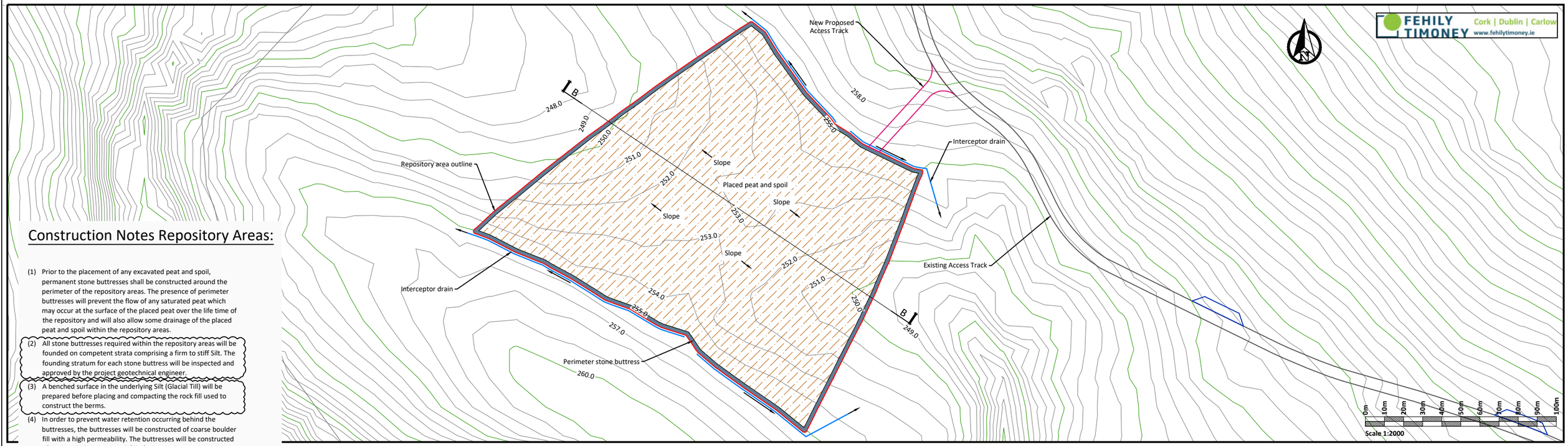
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Checked - IH

Rev - H

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Thursday 12 March 2026



Plan

Scale 1:2000

Construction Notes Repository Areas:

(1) Prior to the placement of any excavated peat and spoil, permanent stone buttresses shall be constructed around the perimeter of the repository areas. The presence of perimeter buttresses will prevent the flow of any saturated peat which may occur at the surface of the placed peat over the life time of the repository and will also allow some drainage of the placed peat and spoil within the repository areas.

(2) All stone buttresses required within the repository areas will be founded on competent strata comprising a firm to stiff Silt. The founding stratum for each stone buttress will be inspected and approved by the project geotechnical engineer.

(3) A benched surface in the underlying Silt (Glacial Till) will be prepared before placing and compacting the rock fill used to construct the berms.

(4) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability. The buttresses will be constructed of well graded granular rock fill of 100mm up to 500mm in size.

(5) The height of the stone buttresses constructed will be 0.5m higher than the height of the stored peat and spoil to prevent any surface run-off.

(6) The side slopes of the stone buttresses will be constructed at 35 degrees on the outside and 45 degrees on the inside face. The stone buttresses will be widened to allow construction traffic access for tipping purposes during the placement of the excavated peat and spoil.

(7) An interceptor drain will also be installed upslope of the repository areas.

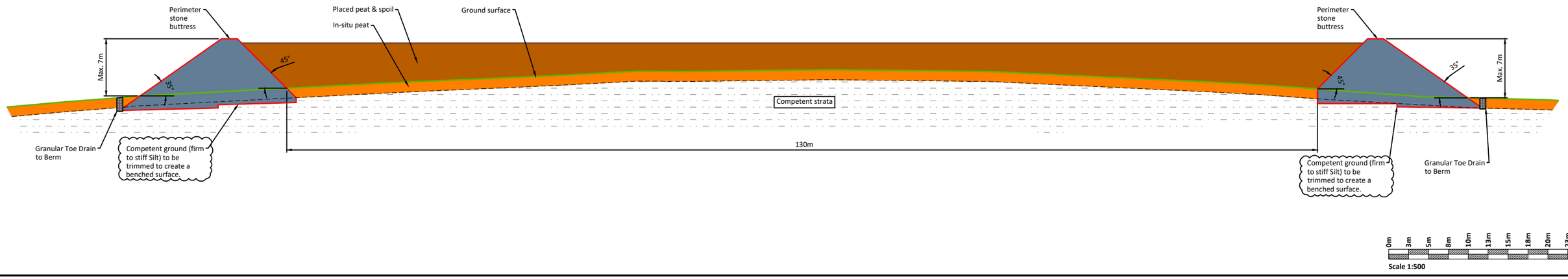
(8) A silting pond will be constructed at the lower side of the repository areas.

(9) The placement of the excavated spoil will commence at the downslope edge of the repository area against the stone buttress and placement will then continue upslope.

(10) The surface of the stored spoil will be shaped to allow efficient run-off of water from the stored spoil.

(11) Supervision by the project geotechnical engineer is required for the construction of the repository area.

(12) Further details on the construction of the repository area are included within Section 3 of this report.



Section B - B

Scale 1:500

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Date - 04.03.26

FIGURE 3-9 : REPOSITORY AREA 1 - PLAN & CROSS SECTION DETAILS

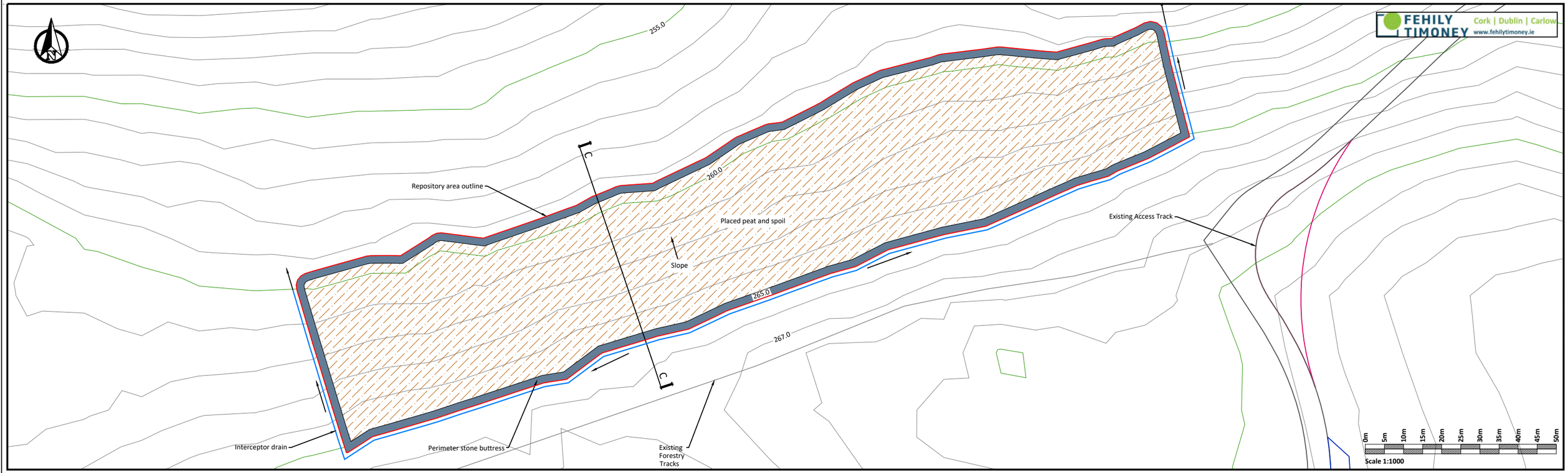
Drawn - POR

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Rev - G

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Thursday 12 March 2026



Plan

Scale 1:1000

Construction Notes Repository Areas:

(1) Prior to the placement of any excavated peat and spoil, permanent stone buttresses shall be constructed around the perimeter of the repository areas. The presence of perimeter buttresses will prevent the flow of any saturated peat which may occur at the surface of the placed peat over the life time of the repository and will also allow some drainage of the placed peat and spoil within the repository areas.

(2) All stone buttresses required within the repository areas will be founded on competent strata comprising a firm to stiff Silt. The founding stratum for each stone buttress will be inspected and approved by the project geotechnical engineer.

(3) A benched surface in the underlying Silt (Glacial Till) will be prepared before placing and compacting the rock fill used to construct the berms.

(4) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability. The buttresses will be constructed of well graded granular rock fill of 100mm up to 500mm in size.

(5) The height of the stone buttresses constructed will be 0.5m higher than the height of the stored peat and spoil to prevent any surface run-off.

(6) The side slopes of the stone buttresses will be constructed at 35 degrees on the outside and 45 degrees on the inside face. The stone buttresses will be widened to allow construction traffic access for tipping purposes during the placement of the excavated peat and spoil.

(7) An interceptor drain will also be installed upslope of the repository areas.

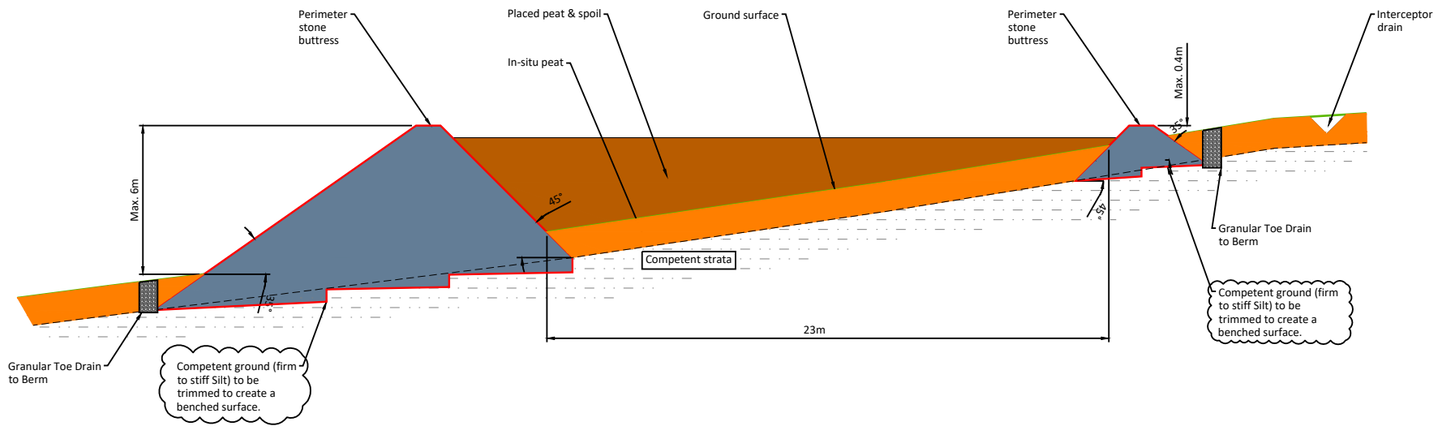
(8) A silting pond will be constructed at the lower side of the repository areas.

(9) The placement of the excavated spoil will commence at the downslope edge of the repository area against the stone buttress and placement will then continue upslope.

(10) The surface of the stored spoil will be shaped to allow efficient run-off of water from the stored spoil.

(11) Supervision by the project geotechnical engineer is required for the construction of the repository area.

(12) Further details on the construction of the repository area are included within Section 3 of this report.



Section C - C

Scale 1:250

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Scale (@ A3) 1:1000

Date - 04.03.26

FIGURE 3-10 : REPOSITORY AREA 2 - PLAN & CROSS SECTION DETAILS

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Checked - IH

Rev - H

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APPENDIX B

Trial Pit Logs (2017/2019)
Ground Investigation (2026)

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R21 XA66 Ireland

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Email: info@ftco.ie
Web:
www.fehilytimoney.ie

Trial Pit Log

TrialPit No
TP 3
Sheet 1 of 1

Project Name:	**Carrane Hill Wind Farm**	Project No. 1726	Coords (E,N): 583802.00 823870.00 Level:	Date 25/10/2017
Location:	Carrane Hill Co. Leitrim/Sligo	Dimensions (m): Depth 3.20		Scale 1:25
Client:	Coillte			Logged GK

Water Strike	Samples & In Situ Testing: Depth	Type	Results/Sample Ref	Depth (m)	Level (m)	Legend	Stratum Description
	0.30 - 0.70	B	B1	0.30			Firm brown fibrous Peat
				0.70			Soft light grey/brown sandy clayey Silt. Shear vane strength recordings of 30, 28, 32 & 33kPa
				2.10			Firm and stiff grey slightly sandy very gravelly Silt/Clay with occasional cobbles
				3.20			Stiff, locally very stiff grey slightly sandy very gravelly Silt/ Clay with frequent cobbles. Traces of orange mottling noted in layer.
							End of Pit at 3.200m

1
2
3
4

Remarks: No groundwater encountered, small flow of surface water into excavation noted.

Plant Used:

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Trial Pit Log

TrialPit No
TP7A
Sheet 1 of 1

Project Name:	**Croagh Wind Farm**	Project No. P1989	Coords (E,N): 583494.00 823756.00 Level: 893.82	Date 01/05/2019
Location:	County Leitrim/Sligo	Dimensions (m):		Scale 1:25
Client:	McCarthy Keville O'Sullivan	Depth 3.50		Logged GK

Water Strike	Samples & In Situ Testing: Depth	Type	Results/Sample Ref	Depth (m)	Level (m)	Legend	Stratum Description
							Firm brown/black pseudo-fibrous Peat
				0.50	893.32		Very soft and soft light brown/grey sandy clayey Silt
				0.70	893.12		Firm brown/grey sandy very gravelly Silt/Clay with occasional cobbles. Cobbles are angular and sub-rounded. Localised angular fragments of shale noted in layer. Orange mottling/staining noted in layer
				1.70	892.12		Stiff, locally very stiff, blue/grey very gravelly Silt/Clay with occasional cobbles and boulders. Cobbles and boulders are angular and sub-rounded. Cobble and boulder content increases with depth
	2.70 - 2.90	B	B11				
				3.50	890.32		End of Pit at 3.500m

1 2 3 4

Remarks: No groundwater encountered.

Plant Used:
13tN tracked excavator

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Trial Pit Log

TrialPit No
TP 11
Sheet 1 of 1

Project Name:	**Carrane Hill Wind Farm**	Project No. 1726	Coords (E,N): 585661.00 822368.00 Level:	Date 24/10/2017
Location:	Carrane Hill Co. Leitrim/Sligo	Dimensions (m):		Scale 1:25
Client:	Coillte	Depth 3.20		Logged GK

Water Strike	Samples & In Situ Testing: Depth	Type	Results/Sample Ref	Depth (m)	Level (m)	Legend	Stratum Description
							Spongy brown and black fibrous and amorphous Peat
				0.90			Soft to firm light grey/grey sandy clayey Silt. Shear vane strength recordings of 38, 32 & 37kPa
				1.40			Firm light grey/grey sandy clayey Silt.
				1.80			Firm grey sandy gravelly Silt/Clay with occasional cobbles
				3.00			Stiff light brown/grey sandy gravelly Silt/Clay with frequent cobbles
				3.20			End of Pit at 3.200m

1 2 3 4

Remarks: No groundwater encountered, significant flow of surface water into excavation.

Plant Used:

RECORD OF TRIAL PIT TP01_MKO

Project Number: P1989 **Project Name:** Croagh Wind Farm

Trial Pit Number: TP01_MKO **Trial Pit Location: N E**

Date: 13 September 2019 **Logged by:** MW (MKO)

Depth From (m)	Depth To (m)	Soil Description	Sample No.	Sample Depth (m)
0	0.30	Soft brown PEAT		
0.30	0.85	Grey sandy clayey Silt		
0.85	2.9	Firm blue/grey slightly sandy very gravelly Silt/Clay		
2.9	3.4	Weathered shale in a silt/clay matrix		

Notes:

1. Trial pit dry upon completion.
2. Trial pit backfilled upon completion.



TP01_MKO

RECORD OF TRIAL PIT TP03_MKO

Project Number: P1989 **Project Name:** Croagh Wind Farm

Trial Pit Number: TP03_MKO **Trial Pit Location: N E**

Date: 13 September 2019 **Logged by:** MW (MKO)

Depth From (m)	Depth To (m)	Soil Description	Sample No.	Sample Depth (m)
0	0.35	Soft brown PEAT		
0.35	0.85	Very soft to soft light brown/grey sandy clayey Silt		
0.85	2.2	Firm blue/grey slightly sandy very gravelly Silt/Clay with occasional cobbles		
2.2	3.3	Weathered shale in a silt/clay matrix		

Notes:

1. Trial pit dry upon completion.
2. Trial pit backfilled upon completion.



TP03_MKO

IRISH DRILLING LIMITED

LOUGHREA, CO. GALWAY, IRELAND

CONTRACT DRILLING
SITE INVESTIGATION

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Fax: (091) 847 687

email: info@irishdrilling.ie

CROAGH WIND FARM
(2025 WORKS)

SITE INVESTIGATION CONTRACT
FACTUAL REPORT

FuturEnergy Ireland,
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Dublin 2,

FTCO,
Bagenalstown Industrial Park,
Royal Oak Road,
D02 DC97.
Bagenalstown,
Co. Carlow.

	Prepared by	Approved by	Rev. Issue Date:	Revision No.
	Ronan Killeen	Declan Joyce	22nd October 2025	25_LM _102/01
Signature				

FOREWORD

The borehole records have been compiled from an examination of the samples by a Geotechnical Engineer and from the Drillers' descriptions.

The report presents an opinion on the configuration of the strata within the site based on the borehole results. The assumptions, though reasonable, are given for guidance only and no liability can be accepted for changes in conditions not revealed by the boreholes.

The fieldwork was carried out in accordance with IS EN 1997-2 and BS5930:2015+A1:2020 Code of Practice for Site Investigations with precedence given to IS EN 1997-2 where applicable.

Contents:

1.0	Introduction
2.0	The Site & Geology
3.0	Fieldwork
4.0	Laboratory Testing

Book 1 of 1

Appendix 1	Borehole Records (Rotary Core)
Appendix 2	Shear Vane Test Results
Appendix 3	Groundwater Readings
Appendix 4	Laboratory Test Results
Appendix 5	Photographs (Rotary Core)
Appendix 6	Site Plans

1.0 Introduction.

Irish Drilling Ltd. (IDL) was instructed by FTCO Consulting Engineers, on behalf of FuturEnergy Ireland to carry out a site investigation at the site of the proposed Croagh Wind Farm Project.

This site investigation was carried out to provide detailed factual geotechnical information of the underlying ground conditions for the proposed wind farm.

The fieldwork for commenced on September 22nd 2025 and was completed on September 26th 2025.

2.0 Site & Geology

The site is located west of Drumkeeran near the border of Counties Leitrim and Sligo.

The fieldwork was carried out predominantly on and/or agricultural lands and/or within dense forestation.

Weather conditions in general were quite variable with the majority of the fieldwork carried out over a typical autumn period in Ireland.

Site Plans, prepared by the client's representatives to show approximate fieldwork locations, are included with this report.

The following were the main published information sources used:
Geological Map of Ireland: 1:750,000 scale map series.

Site investigation data is available as point source data along the proposed route, and the majority of the ground in between the points can only be assumed to follow the characteristics of the nearest available data.

<u>Overview of Subsoil Geology</u>

Glacial Till:

Glacial Till is what was often referred to as Boulder Clay. It is a diverse material that is largely deposited sub-glacially and has a wide range of characteristics due to the variety of parent materials and different processes of deposition. Tills are often tightly packed, unsorted, heterogeneous, unbedded, and can have a wide range of particle sizes and types, which are often but not exclusively angular or sub-angular.

The type of parent material plays a critical role in providing the particles that create different subsoil permeability with sandstones giving rise to a high proportion of sand sized grains in the till matrix, clean limestones providing a relatively high proportion of silt, while shales, shaly limestones and mudstones break down to the finer clay sized particles.

Glacial Outwash Deposits:

Deposition of sand and gravel takes place mainly when glaciers are melting, which gives rise to large volumes of meltwater with great erosive and transporting power. The subsoils deposited in this environment are predominantly, but not exclusively, rounded to subrounded gravel and sand, with the finer fractions of clay and silt washed out.

Peat:

The deposition of peat occurred in post-glacial periods and is generally associated with the start of warmer and wetter climatic conditions. Peat is an unconsolidated usually dark brown to black organic material comprising a mixture of decomposed and undecomposed plant matter that accumulated in an acidic waterlogged environment. Peat has an extremely high-water content generally averaging over 90% by volume.

Solid Geology
The Geological Map of Ireland: 1:500,000 scale map series indicate that the site is underlain by the Gowlaun Shale Rock Formations.

3.0 Fieldwork.

3.1 Fieldwork Plant:
The following plant was mobilised to site to carry out fieldwork operations:

GT110 GoTract Rotary Core Drill rig Rig.
H70 Geotool Shear Vane Equipment.

Fieldwork carried out to date has included the following:

3.2 Rotary Core Boreholes:
Two rotary core boreholes were carried out to establish overburden conditions and rockhead and to establish the nature and integrity of the underlying rock.

The boreholes were completed using wireline drilling techniques, and HQ size (64mm core diameter, 96mm hole diameter) drill strings to recover soil and rock core samples.

A water based flush system was used as the drilling medium while a biodegradable polymer gel was also used where necessary to aid the drilling and soil / rock recovery process.

The samples were stored in wooden boxes and returned to the laboratory where there were logged and photographed by a Geotechnical Engineer and presented for testing.

The rotary core boreholes were carried out to depths ranging from 9.00m to 10.20m below ground level.

A 50mm diameter standpipe was installed in borehole BH01 and as instructed by the Client's Engineer, to allow for monitoring of groundwater levels over a prolonged period of time.

A summary of water levels recorded during the fieldwork period is included with this report as Appendix 3.

Detailed engineering logs for the rotary core boreholes completed are included with this report in Appendix 1.

3.2 In-Situ Shear Vane Tests:
In-situ tests consisting of Geonor H70 Shear Vane tests were completed at four locations. The tests were carried out to depths ranging from 2.50m to 4.00m below ground level and the records of same are included as Appendix 2.

3.3 General Summary:
Borehole BH 02 was set out on site using a Trimble CU Bluetooth GPS Surveying Unit and the co-ordinates are included on the logs presented in the appendices.

BH 02 co-ordinates are reported to Irish Transverse Mercator (ITM) with Reduced Levels recorded relative to Malin Head Datum and with an accuracy level of + or – 0.10m.

Due to dense forestation borehole location BH 01 and Shear Vane locations SV01-SV04 were set out on site using a Garmin Handheld GPS Surveying Unit and the co-ordinates are included on the logs presented in the appendices.

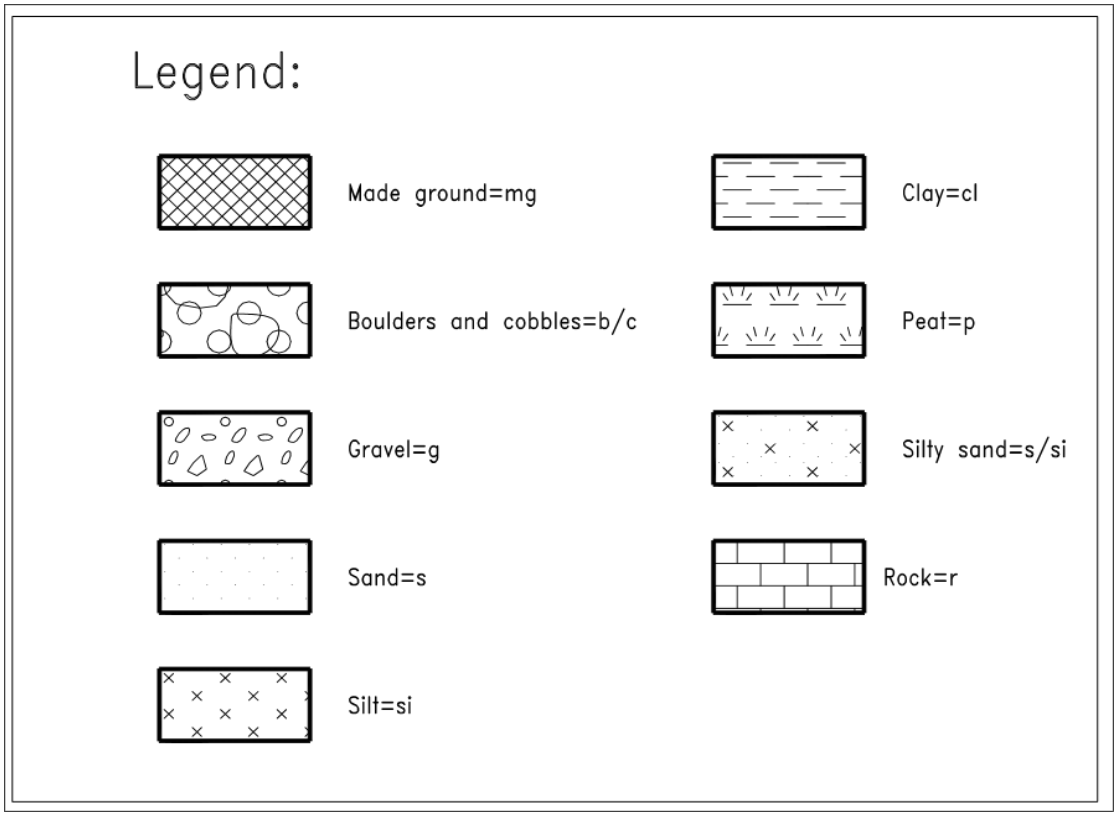
Ground conditions encountered during the completion of the fieldwork were typical and as expected for this region and predominantly consisted of Glacial Tills overlying bedrock.

The Glacial Tills in general consisted of slightly sandy slightly gravelly silt with cobbles and boulders and/or silty sands and/or gravels with cobbles and boulders.

Intact bedrock was encountered in borehole BH 01 at a depth of 8.70m below ground level. Weathered bedrock was also encountered borehole BH 01 at a shallower depth. Bedrock was not encountered in borehole BH 02 before borehole termination at a depth of 9.00m below ground level.

Bedrock is predominantly described as very strong, locally strong thinly-laminated, black, fine-grained Siltstone.

The following Key Legend Table details the symbology used on the engineering logs to describe ground conditions encountered:



The fieldwork was carried out in accordance with IS EN 1997-2 and BS5930:2015+A1:2020 Code of Practice for Site Investigations with precedence given to IS EN 1997-2 where applicable.

4.0 Laboratory Testing

Representative samples recovered from the boreholes and trial pits were scheduled for testing in the laboratory.

The test schedules were prepared by the Client's Engineer and included some or all of the following tests on rock core samples:

Test Type:	Number
Point Load	03

The test schedules were carried out at the IDL Laboratory located at Loughrea, County Galway.

Soil and/or rock core samples were recovered from the completion of rotary core boreholes and the records of all laboratory test results are included with this report as Appendix 4.

The soil and rock descriptions as noted on the borehole logs are in general visual descriptions as observed and logged by our Engineers and are described in accordance with IS EN 1997-2 and BS5930:2015+A1:2020 Code of Practice for Site Investigations.

Soils descriptions (cohesive or otherwise) are also initially assessed based on the texture and 'feel' of the soil materials as witnessed by our Geotechnical Engineers and in accordance with IS EN 1997-2 and BS5930:2015+A1:2020.

Where laboratory classification tests have been carried out on soil and/or rock samples then these visual descriptions have been amended accordingly to take into account the results of these classification tests.

The records of all fieldwork, laboratory test results and photographs are included in the appendices of this Factual Report.

Ronan Killeen
Chartered Engineer
Irish Drilling Limited
October 22nd 2025

Appendix 1
Borehole Records
(Rotary Core)

Irish drilling LTD

DRILLHOLE LOG

Project	Location	DRILLHOLE No
Croagh WF 2025	Co Leitrim	**BH-01**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
2025LM102	25-09-25 26-09-25		E 585,633.5 N 822,455.3

Engineer	Sheet	Status
FTCO	1 of 2	DRAFT

RUN DETAILS						STRATA		
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Index	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION		
						Discontinuities	Detail	Main
0.00	13 -				(1.60)	0.00 - 4.00 : overburden.		Subangular fine to coarse brown sandstone GRAVEL with cobbles. Cobbles are of brown sandstone.
1.60	21 -				(1.40)			Stiff black slightly gravelly SILT. Gravel is angular fine of black siltstone.
3.00	53 (26)				(1.00)			Subangular fine to coarse brown sandstone and black siltstone GRAVEL.
4.00						4.00 - 6.00 Non-intact as probable weathered rock with closely and very closely spaced discontinuities. No recovery as washout of fines during drilling. No record of cavities		Probable weathered rock. Strong and medium strong thinly laminated dark grey and black fine grained siltstone recovered as angular fine to medium gravel sized clasts with a little black silt.
4.50	47 (14)							
6.00	40	NR			(4.70)	6.00 - 8.60 Non-intact as probable weathered rock as subangular and angular fine to coarse gravel sized clasts with a little black silt. No recovery as washout of fines during drilling. No record of cavities		
7.50	54							

Instrument/Backfill

Drilling Progress and Water Observations							
Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing
			3.00	96			

Rotary Flush			
From (m)	To (m)	Type	Return (%)
0	10.2	Water	100

GENERAL REMARKS

BH terminated at 10.20m bgl on REs instruction. 50mm standpipe installed. Co-ordinates provided by client representatives and set out on site using handheld GPS Unit.

All dimensions in metres Scale 1:50	Client: FuturEnergy Ireland	Method/ Plant Used CS-14		Driller PMcG	Logged By EAT

IDL AGS4 UK DH (SPTS) CROAGH WF RC FILE 1 OCT 9 2025.GPJ ID GINT AGS 4_0_4.GDT 22/10/25

Irish drilling LTD

DRILLHOLE LOG

Project	Location	DRILLHOLE No
Croagh WF 2025	Co Leitrim	**BH-01**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
2025LM102	25-09-25 26-09-25		E 585,633.5 N 822,455.3

Engineer	Sheet	Status
FTCO	2 of 2	DRAFT

RUN DETAILS					STRATA			
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Index	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities / Detail	DESCRIPTION: Main	Instrument/ Backfill
	-							
8.60	-				8.70			
		NI				8.60 - 8.70 Non-intact as stiff black silt. 8.70 - 10.20 DISC, very closely and closely spaced, dipping 8 to 10°, planar, smooth, with 0.5 to 1mm thick black silt smear.	Very strong locally strong thinly laminated black fine grained SILTSTONE.	
	100 (89) 14	12			(1.50)			
		28					9.70-9.80m: medium strong.	
02.09 10.20		NI			10.20	10.00 - 10.20 Non-intact as angular fine and medium gravel sized clasts - possible drilling induced.		

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing
02/09/25	17.30	10.20					

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

BH terminated at 10.20m bgl on REs instruction. 50mm standpipe installed. Co-ordinates provided by client representatives and set out on site using handheld GPS Unit.

All dimensions in metres Scale 1:50	Client: FuturEnergy Ireland	Method/ Plant Used: CS-14		Driller: PMcG	Logged By: EAT

IDL AGS4 UK DH (SPTS) CROAGH WF RC FILE 1 OCT 9 2025.GPJ ID GINT AGS 4_0_4.GDT 22/10/25

Irish drilling LTD

DRILLHOLE LOG

Project	Location	DRILLHOLE No
Croagh WF 2025	Co Leitrim	**BH-02**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
2025LM102	22-09-25 22-09-25	264.43	E 583,627.3 N 823,824.7

Engineer	Sheet	Status
FTCO	1 of 2	DRAFT

RUN DETAILS / STRATA

Depth / Date	TCR (SCR) RQD	(SPT) Fracture Index	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities	Detail	Main	Instrument/ Backfill
0.00	7 - -					0.00 - 9.00 : overburden.		Very stiff black slightly sandy slightly gravelly SILT with cobbles. Sand is coarse. Gravel is subangular fine to medium of assorted grey sandstone and assorted black siltstone. Cobbles of brownish grey sandstone and brownish grey quartzite.	
1.50	20 - -								
3.00	20 - -								
4.50	20 - -				(9.00)				
6.00	13 - -								
7.50									

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing

Rotary Flush

From (m)	To (m)	Type	Return (%)
0	9	Water	100

GENERAL REMARKS

BH terminated at 9.00m bgl on REs instruction. BH backfilled.

All dimensions in metres Scale 1:50	Client: FuturEnergy Ireland	Method/ Plant Used: CS-14		Driller: PMcG	Logged By: EAT

IDL AGS4 UK DH (SPTS) CROAGH WF RC FILE 1 OCT 9 2025.GPJ ID GINT AGS 4_0_4.GDT 22/10/25

Irish drilling LTD

DRILLHOLE LOG

Project	Location	DRILLHOLE No
Croagh WF 2025	Co Leitrim	**BH-02**

Job No	Date	Ground Level (m OD)	Co-Ordinates ()
2025LM102	22-09-25 22-09-25	264.43	E 583,627.3 N 823,824.7

Engineer	Sheet	Status
FTCO	2 of 2	DRAFT

RUN DETAILS					STRATA			
Depth / Date	TCR (SCR) RQD	(SPT) Fracture Index	Red'cd Level	Legend	Depth (Thick-ness)	DESCRIPTION: Discontinuities	Detail	Main
22.09 9.00	13 - -		255.43		9.00			Very stiff black slightly sandy slightly gravelly SILT with cobbles. Sand is coarse. Gravel is subangular fine to medium of assorted grey sandstone and assorted black siltstone. Cobbles of brownish grey sandstone and brownish grey quartzite. *(continued)*

Instrument/ Backfill

Drilling Progress and Water Observations

Date	Time	Depth	Casing Depth	Casing Dia	Core Dia mm	Water Strike	Water Standing
22/09/25	17.30	9.00					

Rotary Flush

From (m)	To (m)	Type	Return (%)

GENERAL REMARKS

BH terminated at 9.00m bgl on REs instruction. BH backfilled.

All dimensions in metres Scale 1:50	Client: FuturEnergy Ireland	Method/ Plant Used: CS-14		Driller: PMcG	Logged By: EAT

IDL AGS4 UK DH (SPTS) CROAGH WF RC FILE 1 OCT 9 2025.GPJ ID GINT AGS 4_0_4.GDT 22/10/25

Appendix 2
In-Situ Shear Vane Test Records

In-Situ Shear Vane Test Results

Date:	September 25th and 26th 2025	Tested By:
Location:	Croagh Wind Farm	PC
Vane Model:	H70	PMcG
Vane Diameter:	76mm X 110mm	RMcL

Test No.	Shear Kpa	Remould Kpa	Co-Ordinates: Easting:	Northing
SV 01			585129	823089
0.50m	22	2		
1.00m	9	0.5		
1.50m	6.5	1		
2.00m	13.5	2.7		
2.50m	13.5	5.4		
3.00m	19	5.6		
3.50m	24.5	12		
Refusal at 3.50m				
SV 02			584758	823295
0.50m	17	1.5		
1.00m	6.5	0.5		
1.50m	10	1		
2.00m	13.5	2.5		
2.50m	11	2.5		
3.00m	20	5		
3.50m	22	6.5		
4.00m	23	6.5		
Refusal at 4.00m				
SV 03			585486	822206
0.50m	11	2.5		
1.00m	8	2		
1.50m	11	2.5		
2.00m	10.5	2.5		
2.50m	14.5	4		
3.00m	21	3		
3.50m	26	6		
4.00m	33	10		
Refusal at 4.00m				
SV 04			586064	821444
0.50m	13.5	1		
1.00m	8.5	0.5		
1.50m	12	1		
2.00m	17	2.5		
2.50m	22	3		
Refusal at 2.50m				

Remarks:

Fieldwork locations surveyed using Garmin Handheld GPS Unit.

Appendix 3
Groundwater Readings

IRISH DRILLING LTD.
Loughrea Co. Galway

Tel: (091) 841274 Fax: (091) 880861

Project: Croagh Wind Farm
Client: Greensource
Location: Co Leitrim
Date: 20/10/2025

Sheet No. 1
Checked: RK

Water Levels in Standpipes

Boreholes	Date 26.09.2025						Remarks
BH 01	3.05m						50mm standpipe

Remarks:
All readings record depth from ground level to top of water level.

Appendix 4
Laboratory Test Results

IDL

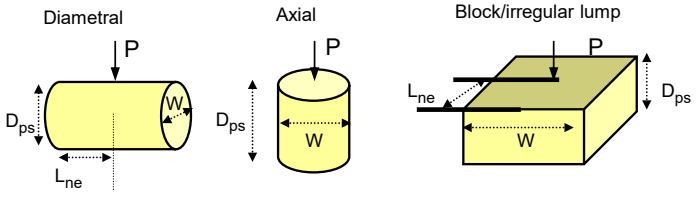
Point Load Strength Index Tests
Summary of Results

Project No.: 2025LM102

Project Name: Croagh WF 2025

Borehole No.	Sample			Specimen		Rock Type and Test condition	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index		Remarks (including water content if measured)
	Top Depth	Base Depth	Type	Ref	Top		Type (D, A, I, B)	Direction (L, P or U)		Lne	W	Dps	Dps'			Is	Is(50)	
	m	m			m					mm	mm	mm	mm	kN	mm	MPa	MPa	
BH-01	3.00	4.5	C	4.2-4.3	4.20		D	L	YES		63.4		63.4	1.0	63.4	0.2	0.3	Weak
BH-01	8.60	10.2	C	9.3-9.4	9.30		D	L	YES		63.4		63.4	8.1	63.4	2.0	2.2	Strong
BH-01	8.60	10.2	C	9.7-9.8	9.70		D	L	YES		63.4		63.4	4.4	63.4	1.1	1.2	Medium Strong

Test Type
D - Diametral, A - Axial, I - Irregular Lump, B - Block
Direction
L - parallel to planes of weakness
P - perpendicular to planes of weakness
U - unknown or random
Dimensions
Dps - Distance between platens (platen separation)
Dps' - at failure (see ISRM note 6)
Lne - Length from platens to nearest free end
W - Width of shortest dimension perpendicular to load, P



Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise
Detailed legend for test and dimensions, based on ISRM, is shown above.
Size factor, F = (De/50)0.45 for all tests.

Date Printed: 21/10/2025

Approved By:

Table: 1

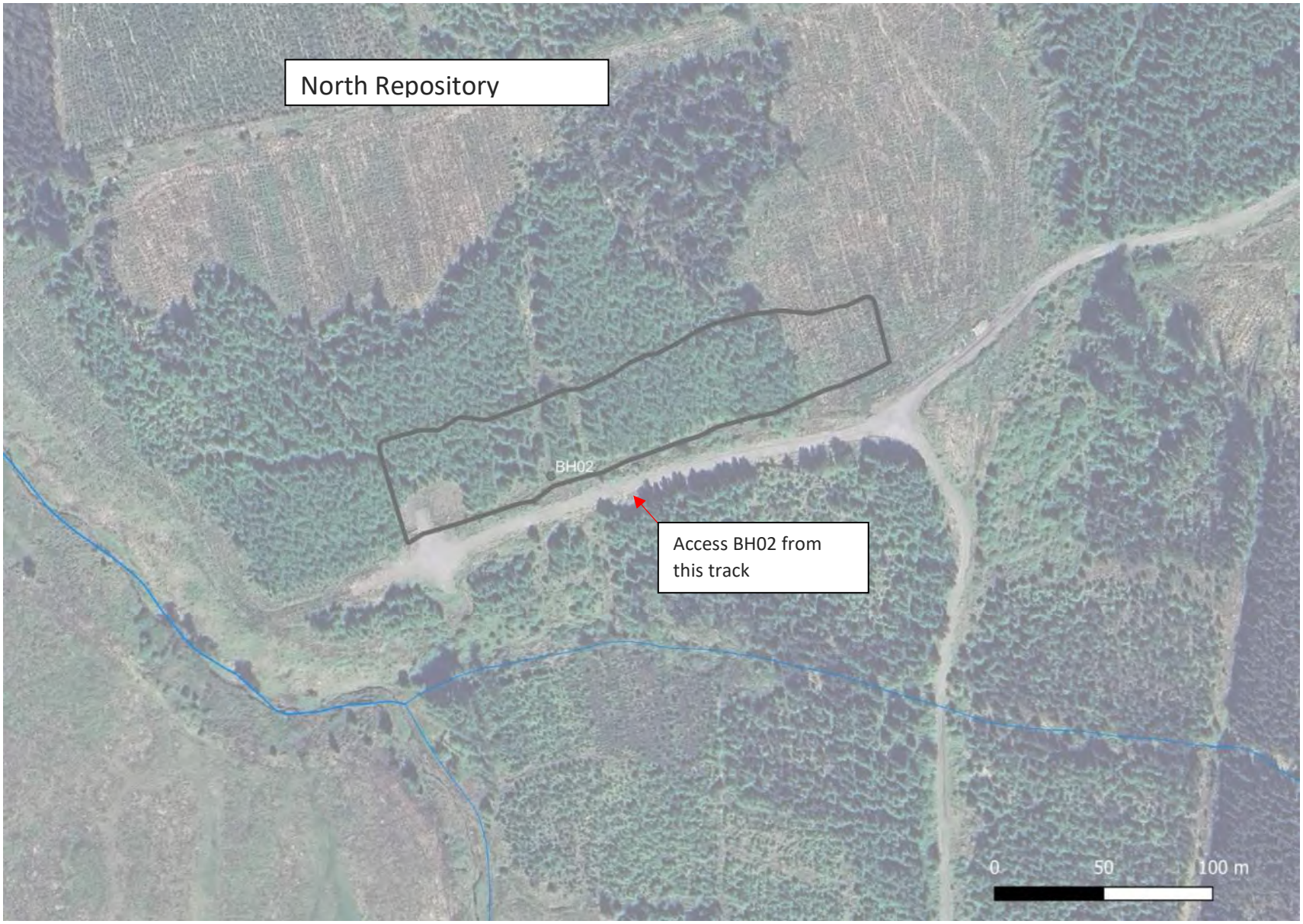
sheet: 1

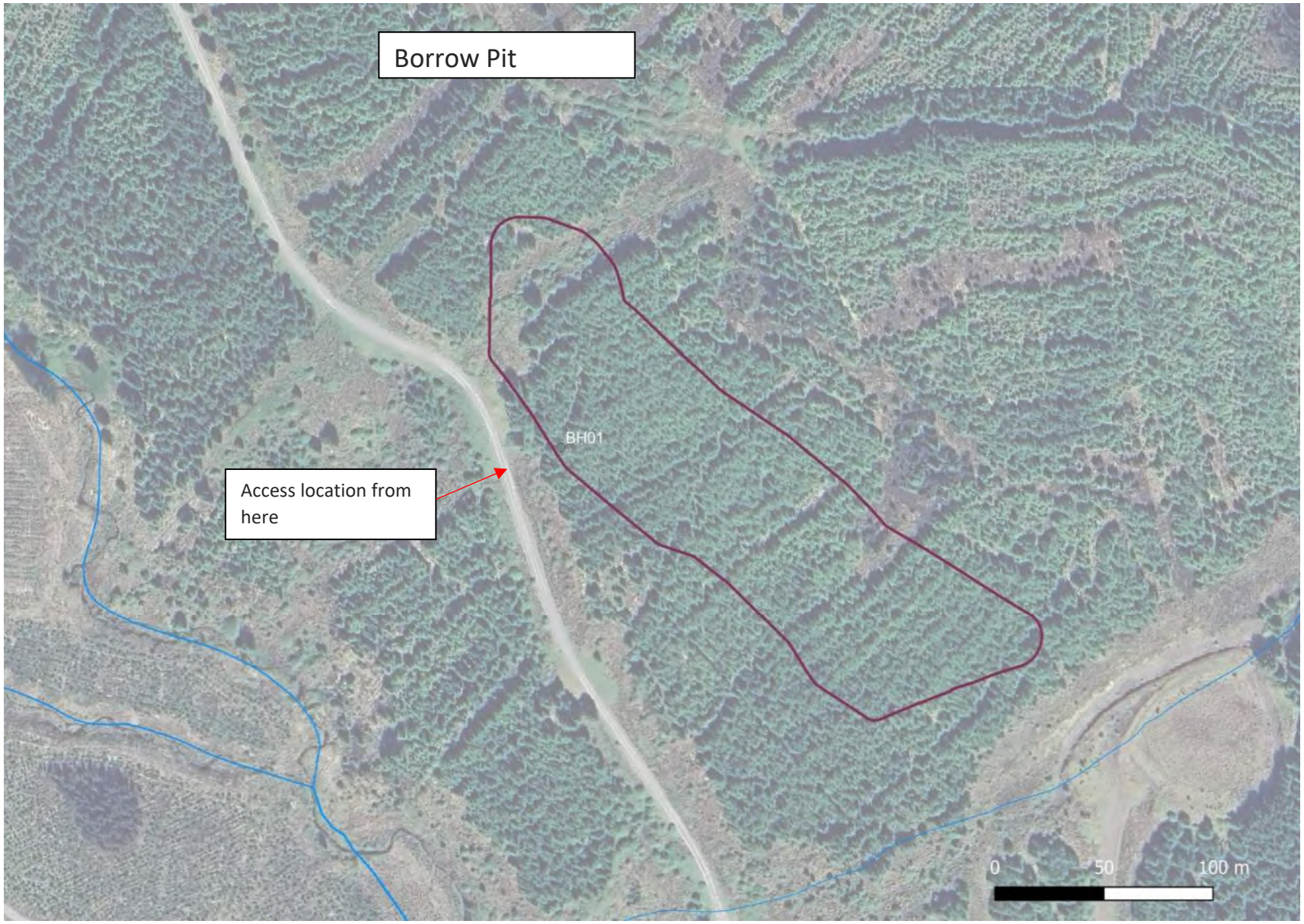
Tested in: Irish Drilling Ltd.(IDL), Old Galway Road, Loughrea, Co. Galway, Ireland. H62VX39
Approved Signatures: Dympna Darcy (DCD) Lab Manager, Declan Joyce (DJ) Chartered Geotechnical Engineer, Ronan Killeen (RK) Quality Manager.

Appendix 5
Photographs (Rotary Core)


Croagh Windfarm,
Drumkeeran,
Co. Leitrim
2025 LM 102
BH 1
Box
1.2
Croagh Windfarm,
Drumkeeran,
Co. Leitrim
2025 LM 102
BH 2
Box
1

Appendix 6
Site Plans


North Repository
BH02
Access BH02 from this track
0
50
100 m


Borrow Pit
BH01
Access location from here
0
50
100 m


SV-02
SV-01
SV-03
SV-04
0
500 m

Croagh Windfarm

Croagh, County Leitrim

Geophysical Survey

Report Status: Draft

MGX Project Number: 6910

MGX File Reference: 6910d-005.doc

11th November 2025

Confidential Report To:

Fehily Timoney & Co.
Unit 6
Bagenalstown Industrial Park
Royal Oak Road
Co. Carlow
R21 XW81

Report submitted by:
Minerex Geophysics Limited

Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare, W23X7Y5
Ireland
Tel.: 01-6510030
Email: info@mgx.ie

Issued by:

Author: Jan Stach (Geophysicist)

Reviewer: John Connaughton PGeo (Senior Geophysicist)

Minerex Geophysics Limited

Subsurface Geophysical Investigations

EXECUTIVE SUMMARY

1. Minerex Geophysics Ltd. (MGX) carried out a geophysical survey consisting of the methods 2D-Resistivity (ERT), Seismic Refraction (p-wave) and push probing. The survey was carried out for the ground investigation for the proposed Croagh Windfarm, County Leitrim.
2. The main objectives of the survey are to determine the ground conditions under the site, to determine the depth to rock and the overburden thickness, to estimate the strength or stiffness or compaction of overburden and the rock quality, and to map the extent of soft ground layers.
3. The survey was carried out across three sperate locations. The Northern Repository, The Borrow Pit and The Southern Repository.
4. **Northern Repository:** The data is modelled with a total of three layers. There is 0.2 – 2 m of peat (Layer 1), underlain by 0.5 – 3 m of firm sandy gravelly clay and silt (Layer 2a).
5. From 1 – 3.5 m below ground level (bgl), the data is interpreted as poor to fair weathered shale or stiff to very stiff sandy gravelly clay and silt (Layer 3a).
6. This layer most likely consists of very stiff sandy gravelly clay and silt to a depth of at least 10 m bgl which matches with the results from BH2.
7. **Borrow Pit:** Peat (Layer 1) is modelled with a thickness of up to 1.1 m bgl but is not present in the SW of the site.
8. There is 1 – 6 m of firm sandy gravelly clay and silt (Layer 2a) or medium dense clayey silty sand and gravel (Layer 2b) across the area underlain by poor to fair weathered shale or sandstone or stiff to very stiff sandy gravelly clay and silt (Layers 3a & 3b) from 2 – 7 m bgl.
9. BH1 indicates non-intact weathered rock from 4 m bgl in the south of the site, described as siltstone at depth.
10. **Southern Repository:** Peat thicknesses are modeled from 1.7 – 4 m bgl across this area.
11. This is underlain by firm sandy gravelly clay and silt (Layer 2a).
12. The depth to the top of rock is interpreted at 10 – 15 m bgl, the accuracy of this interpretation is reduced due to the effect of the deep peat layer on the data.
13. Direct ground investigation information has been used where it was available and abbreviated borehole logs were added to the cross sections.

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3. RESULTS AND INTERPRETATION 6

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3.4 Interpretation of Resistivity and Seismic Refraction 8

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List of Tables, Maps and Figures:

Title	Pages	Document Reference
Table 1: Geophysical Survey Locations and Acquisition Parameters	1 x A4	6910d_Tab1.xls
Table 2: Summary of Interpretation	In text	In text
Map 1: Geophysical Survey Location Map - Northern Repository	1 x A3	6910d_Drawings.dwg
Map 2: Geophysical Survey Location Map - Borrow Pit	1 x A3	6910d_Drawings.dwg
Map 3: Geophysical Survey Location Map - Southern Repository	1 x A3	6910d_Drawings.dwg
Map 4: Locations and Results of Push Probes - Northern Repository	1 x A3	6910d_Drawings.dwg
Map 5: Locations and Results of Push Probes - Southern Repository	1 x A3	6910d_Drawings.dwg
Figure 1a: Models of Geophysical Survey - Northern Repository	1 x A3	6910d_Drawings.dwg
Figure 1b: Models of Geophysical Survey - Borrow Pit	1 x A3	6910d_Drawings.dwg
Figure 1c: Models of Geophysical Survey - Southern Repository	1 x A3	6910d_Drawings.dwg
Figure 2a: Interpretation of Geophysical Survey - Northern Repository	1 x A3	6910d_Drawings.dwg
Figure 2b: Interpretation of Geophysical Survey - Borrow Pit	1 x A3	6910d_Drawings.dwg
Figure 2c: Interpretation of Geophysical Survey - Southern Repository	1 x A3	6910d_Drawings.dwg

1. INTRODUCTION

1.1 Background

Minerex Geophysics Ltd. (MGX) carried out a geophysical survey for the ground investigation for the Croagh Windfarm. The survey consisted of 2D-Resistivity (ERT), Seismic Refraction (p-wave) and push probing. The survey was commissioned by Fehily Timoney & Co.

This survey utilized two complementary geophysical methods to improve the final interpretation. The role of geophysics as a non-destructive fast method is to provide a geological interpretation over a wide area to complement direct ground investigation at specific locations. The direct ground investigation results can be used to improve the initial geophysical results and interpretation.

The survey was carried out at three locations, the Northern and Southern Repository and the Borrow Pit. Initially GPR surveying had been proposed at the two repositories however due to the ground conditions, it was agreed to carry out push probing for peat thickness along the lines instead of GPR.

1.2 Objectives

The main objectives of the geophysical survey were:

- To determine the ground conditions under the site
- To determine the depth to rock and the overburden thickness
- To estimate the strength or stiffness or compaction of overburden materials and the rock quality
- To determine the type of overburden and rock
- To detect lateral changes within the geological layers
- To map the extent of possible very soft ground layers (peat)

1.3 Site Description

The site is located in the townland Garvagh Glebe (North Repository) Braud Phark (Borrow Pit) and Bolleymaguire (Southern Repository).

The northern repository (Map 1) consists of mature forestry. A forest track at the south of the area was used to access the site and the survey lines were cleared by the client. The ground sloped down from the track towards the north.

The Borrow Pit (Map 2) is located in mature forestry as well. An access track to the SW was used for access and survey lines were cleared by the client. One line was carried out close to a small stream in the NW of the

area. Two lines were carried out on fire breaks and the SE line was carried out in a clear area beside the forest.

The Southern Repository (Map 3) site is located in an area of cleared forest. The ground is rough with uneven ground and tree stumps. The area was accessed from a track approx. 100 m to the west.

1.4 Geology

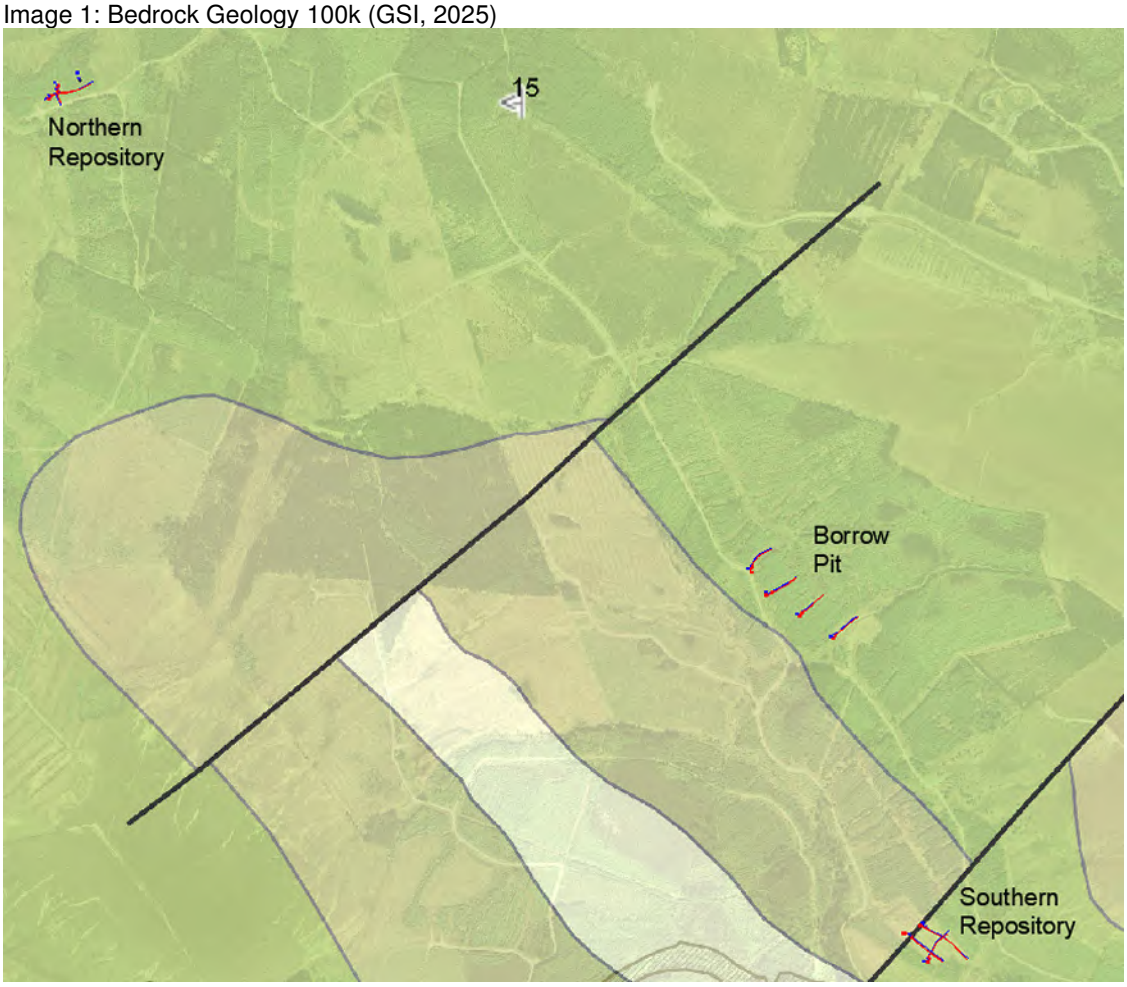
Online geological maps of Ireland (GSI, 2025) give the following information:

The overburden geology consists of blanket peat at all three locations.

In terms of rock, The Northern Repository, The Borrow Pit and the east of the Southern Repository are underlain by the Dervvone Shale Formation, described as shale and minor turbiditic sandstone. The west of the Southern Repository is underlain by the Gowlaun Shale Formation, described as dark grey silty sideritic shale. There is a SW-NE fault between the two formations dissecting the Southern Repository site.

The nearest shallow rock noted is 200 m south of the Southern Repository.

Image 1: Bedrock Geology 100k (GSI, 2025)



1.5 Report

This report includes the results and interpretation of the geophysical survey. Maps, figures and tables are included to illustrate the results of the survey. More detailed descriptions of geophysical methods and measurements can be found in GSEG (2002), Milsom (1989) and Reynolds (1997).

The description of soil, rock and the use of geotechnical terms (soft, stiff, dense etc) follows Eurocode (2007) and BSI (2020) standards. The terms are defined in the standards and the physical parameters are related from experience. This geophysical survey has been acquired, processed, interpreted and reported in accordance with these guidelines.

An aerial image was used as the map background as we did not receive a topographical survey map or Ordnance Survey background map. Elevations were surveyed on site and are used in the vertical sections.

The interpretative nature and the non-invasive survey methods must be taken into account when considering the results of this survey and Minerex Geophysics Limited, while using appropriate practice to execute, interpret and present the data, give no guarantees in relation to the existing subsurface.

2. GEOPHYSICAL SURVEY

2.1 Methodology

The methodology consists of using 2D-Resistivity and Seismic Refraction surveying at the three sites along lines proposed by the client. Additional push probing was carried out at the two repository sites in lieu of GPR surveying which could not be carried out due to the rough terrain.

The survey locations are indicated on Mapa 1, 2 and 3. The lines, locations and parameters are tabulated in Table 1.

2.2 2D-Resistivity (ERT)

2D-Resistivity lines were surveyed with electrode spacing of 3 m, up to 55 electrodes per set-up and line lengths of between 63 and 162 m per set-up. The readings were taken with a Tigre Resistivity Meter, Imager Cables, stainless steel electrodes and a laptop with ImagerPro acquisition software.

During 2D-Resistivity surveying, data is acquired in the form of linear arrays using a suite of metal electrodes. A current is induced into the ground via a pair of electrodes whilst a potential difference is measured across a second pair of electrodes. This allows for the recording of the apparent resistivity in a two-dimensional arrangement below the line. The data is inverted after the survey to obtain a model of subsurface resistivities. The generated model resistivity values and their spatial distribution can then be related to typical values for different geological materials.

The penetration depth of a resistivity set-up increases towards the centre where it reaches an approx. value of 1/6th of the array length.

2.3 Seismic Refraction (p-waves)

Seismic refraction lines were surveyed with geophone spacing of 2 m and 24 geophones per set-up resulting in a 46 m length per set-up. The recording equipment consisted of a 24 Channel GEOMETRICS ES-3000 engineering seismograph with 4.5Hz vertical geophones. The seismic energy source consisted of a hammer and plate and a seismograph gun in soft ground areas. A zero-delay trigger was used to start the recording. Normally 7 shot points per p-wave set-up were used.

Set-ups were acquired in longer continuous lines using common shot points between set-ups and concatenating into longer lines at the processing stage.

The seismic refraction survey method focuses on propagating p-waves travelling through the subsurface, which are generated by a seismic source. As the wave propagates through the subsurface, its velocity varies as it travels through overburden, rock with different elastic properties, and along geological boundaries.

Velocity data is recorded via the surveying equipment, which is then processed, allowing geological layer thicknesses and boundaries to be established.

Seismic Refraction generally determines the depth to horizontal or near horizontal layers where the compaction or strength or rock quality changes with an accuracy of around 20% of the depth to that layer. Where the layers are shallower than the geophone spacing depth deviations of +- 1m to top of layers can occur. Where low velocity layers or shadow zones are present (e.g., below solid ground surface) or where layers dip with more than 20 degree angle the accuracy becomes much less. Deep peat at the Southern Repository has an effect on the data and caused a reduction in the accuracy of the results below the peat layer.

The seismic refraction set-ups with 46m individual length have a reasonable penetration depth of around 10m. An internationally accepted maximum depth estimate for a seismic refraction set-up is 1/6 of the set-up length including offshots. The depth penetration varies according to the velocity structure of the subsurface. At the Southern Repository, a deep peat layer reduced the depth penetration of the models to approx. 5 m below ground level (bgl). At the Northern Repository and the Borrow Pit, a depth of 10m bgl is used where the seismic modelling was ended as deeper modelling becomes less meaningful.

2.4 Push Probing For Peat

Push probing was carried out at the two repository sites in lieu of a GPR survey to determine the depth of peat. Push probing was also carried out at the Borrow Pit as peat was identified across some of the site during surveying.

The probes are pushed vertically into the ground until a large increase in resistance is felt. The depth is measured and the location is recorded by RTK-GPS.

2.5 Site Work

The data acquisition was carried out between the 6th and 14th of October 2025. The weather conditions were fair throughout the acquisition period. Health and safety standards were adhered to at all times The locations and elevations were surveyed with a Carlson NR3 RTK-GPS to accuracy < 0.05m.

3. RESULTS AND INTERPRETATION

The interpretation of geophysical data is executed utilizing the known response of geophysical measurements, typical physical parameters for subsurface features that may underlay the site, and the experience of the authors.

The interpretation is based on the methods available in each area. 2D-Resistivity and seismic refraction was conducted at all locations and a layered ground model interpretation is based on seismic velocities with the additional interpretation based on the resistivities is discussed in the text below. Push probing was carried out at the two repositories and the results from this survey are used to calibrate the peat layers interpreted in the geophysical survey data.

3.1 2D-Resistivity (ERT)

The 2D-Resistivity data was positioned and inverted with the RES2DINV inversion package. The programme uses a smoothness constrained least-squares inversion method to produce a 2D model of the subsurface resistivities from the recorded apparent resistivity values. Three variations of the least squares method are available and for this project the Jacobian Matrix was recalculated for the first three iterations, then a Quasi-Newton approximation was used for subsequent iterations. Each dataset was inverted using seven iterations resulting in a typical RMS error of <3.0%. The resulting models were colour contoured with the same resistivity scale for all lines and they are displayed as cross sections (Figure 1a – 1c).

Resistivities are characteristic for certain overburden and rock types. If there is a high content of clay minerals (which are electrically conductive) then the overburden resistivity will be lower than as if there is a high content of clastic grains like sand or gravel. The purer the clay and the lower the sand and gravel content, the lower the resistivity. Water content in overburden layers can influence the resistivities, but generally clay content has a more dominating effect.

Within bedrock types like shale and sandstone, high resistivities indicate a fresh, strong, unweathered rock. As the weathering in the rock increases the resistivity gets lower because of weathering products, remineralisation of rock and infill of cracks, faults and voids with clay and water. Weathering within rock is typically indicated by lower resistivity values in the cross sections.

The resistivities cover a range typical for materials from clay rich overburden or peat (low resistivities) to fresh strong unweathered bedrock (high resistivities). The ranges have been taken into the consideration for the interpretation. Across the three locations, the resistivities are mostly below 250 Ωm. Within the overburden, low resistivities values (<125 Ωm) typically indicate sandy gravelly clay and silt overburden, Medium values (125 to 250 Ωm) show a clayey silty sand and gravel overburden. Within the rock layer, low resistivities indicate a shale bedrock while some medium resistivities may indicate shale or sandstone.

3.2 Seismic Refraction (p-wave)

The seismic refraction data was positioned and processed with the SEISIMAGER software package to give a layered model of the subsurface. The number of layers has been determined by analysing the seismic traces and a total of 3 layers are used in the models. All seismic lines were subject to a standardised processing sequence which consisted of a topographic correction which was based on integrated elevation data, first break picking, tomographic inversion, travel-time computation via ray-tracing and velocity modelling. Residual deviations of typically 0.4 to 1.8 msec RMS have been obtained for each line. Following each processing stage QC procedures were adhered to. The resulting layer boundaries are shown as thick lines overlaid on the 2D-Resistivity cross sections (Figure 1a – 1c). The average seismic velocities obtained within the layers are annotated on the sections as bold black numbers.

The p-wave seismic velocity is closely linked to the density of subsurface materials and to parameters like compaction, stiffness, strength and rock quality. The higher the density of the subsurface materials the higher the seismic velocity. More compacted, stiffer, denser and stronger material will have a higher seismic velocity. For rock, the seismic velocity is higher when the rock is stronger, less weathered and has a higher quality. If the rock is more weathered, broken, fractured, fissured or karstified then the seismic velocity will be reduced compared to that of intact fresh rock.

Because of the above relationship, the seismic refraction method and seismic velocities are suitable to investigate ground where the layers get denser, more compacted and stronger with depth. A disadvantage is that some materials may have the same seismic velocity: Very stiff to hard or very dense highly consolidated overburden and a weathered rock can have the same seismic velocity range (as is the case in the layer 3 below).

The modelled seismic data has created the following layered ground model:

Layer 1 has seismic velocities of 150 – 400 m/s. This overburden primarily consists of peat. The layer is significantly thicker at the Southern Repository where it extends up to 4 m bgl. The layer is up to 2 m in thickness at the Northern Repository and at the borrow pit it is up to 1 m in thickness.

Layer 2 was modelled with a velocity range of 750 – 1100 m/s The velocity indicates overburden material with firm or medium dense strength or compaction. This layer has a thickness of up to 3 m in the Northern Repository, between 1 and 6 m in the Borrow Pit and is the deepest layer interpreted at the Southern Repository.

Layer 3 velocities of 1900 – 2500 m/s indicate a weathered rock. The layer can also contain very stiff to hard or very dense overburden. The depth to the top of this layer is 1.5 – 3.5 m bgl in the Northern Repository and 2 – 6.5 m in the Borrow Pit. This is the deepest layer interpreted to a depth of 10 m bgl at the Northern Repository and the Borrow Pit.

3.3 Push Probing

Map 4 shows the results from the push probe survey at the Northern Repository and Map 5 at the Southern Repository. Each black spot indicates a probe location with the depth of peat written above it to a maximum depth of 3.5m bgl.

There is a bit of give and take in the peat depth and presence of peat, because other very soft layers like soft silt and soil may be intermingled with peat. At the Northern Repository, peat depths are generally between 0.6 – 2 m with one reading given as 0.2 m close to the forest track in the south.

At the Southern Repository, peat depths range from 1.7 m to over 3.5 m which was the deepest depth that was surveyed with the push probes.

3.4 Interpretation of Resistivity and Seismic Refraction

Table 2 summarises the interpretation. The stiffness or compaction of overburden and the rock strength or quality have been estimated from the seismic velocity. The estimation of the excavatability for the bedrock has been made according to the caterpillar chart published in Reynolds (1997). The geotechnical assessment for rippability will have to take factors like rock type and jointing into account and the estimation in this report is solely based on the seismic velocities.

Interpreted cross sections are shown in Figure 2a – 2c. The interpretation has been made from all available information. For overburden layers and the top of the rock the seismic refraction data has been used as seismic refraction is the best method to delineate layer boundaries. The resistivity model values have been used to delineate overburden material and rock types.. Resistivity data is better suited to show overburden material, rock types and features within the rock while seismic refraction velocities are indicating the change of compaction, stiffness or rock quality with depth.

Table 2: Summary of Interpretation

Layer	General Seismic Velocity Range (m/sec)	General Resistivity Range (Ωm)	Stiffness or Compaction or Rock Quality	Interpretation	Estimated Excavation Method
1	1500 - 400	Any	Very soft	Peat or Organic Matter	Diggable
2a	750 - 1100	<250	Firm	Overburden (Sandy gravelly Clay and Silt)	Diggable
2b	750 - 1100	>250	Medium dense	Overburden (Clayey silty Sand and Gravel	Diggable

3a	1900 - 2500	<250	Poor to Fair Rock or Stiff to very stiff Overburden	Weathered Shale or sandy gravelly clay and silt	Diggable or rippable to marginal rippable
3b	1900 - 2500	>250	Poor to fair Rock	Weathered Shale or Sandstone	rippable to marginal rippable

4. CONCLUSIONS

The following conclusions are made:

- The geophysical surveys carried out for the Croagh Windfarm consisted of 2D-Resistivity (ERT), Seismic Refraction (p-wave), and push probing.
- Surveying was carried out at three locations, The Northern Repository, Borrow Pit and Southern Repository.
- The same interpretation layers were used at the three locations. The data was modelled with 3 layers based on seismic velocities and Layers 2 and 3 was divided using the electrical resistivities (into Layers 2a, 2b, 3a and 3b).
- At the **Northern Repository**, there is a 0.2 – 2.0 m layer of very soft or loose peat underlain by 0.5 – 3 m of firm sandy gravelly clay and silt.
- Layer 3a occurs at a depth of 1 – 3.5 m bgl. This layer is interpreted as poor to fair weathered shale or stiff to very stiff sandy gravelly clay and silt. This layer extends to at least 10 m bgl. BH2, carried out close to line R1 shows at least 9 m of silt in this locations.
- Resistivities to a depth of 25 m bgl do not indicate a change in overburden type to this depth.
- The seismic refraction velocities within layer 3, the low resistivities to depths of up to 20 m bgl and the results from BH2 all indicate deep sandy gravelly clay and silt at this location.
- At the **Borrow Pit**, there is peat interpreted to a maximum depth of 1.1 m on the NE of line R4 but no peat interpreted in the SW of line R4 and it is generally very thin along lines R5, R6 and R7.
- This layer is underlain by firm sandy gravelly clay and silt or medium dense clayey silty sand and gravel with a thickness of 1 – 6 m.
- The deepest layer modelled at the Borrow Pit is interpreted as poor to fair weathered shale or sandstone or stiff to very stiff sandy gravelly clay and silt. The depth to the top of this layer ranges from 2 – 7 m bgl. Higher resistivities at the SW of lines R4 and R5 indicate a change from shale to sandstone.
- BH1, carried out between R4 and R5 describes gravel and silt overburden underlain by a non-intact weathered rock from 4 m bgl. This rock is described as siltstone at a depth of 8.7 - 10.2 m.
- The seismic refraction velocities and resistivities at this location are higher than at the Northern Repository which increase the likelihood of layer 3a consisting of poor to fair weathered rock rather than of overburden. BH1 is likely within the area interpreted by Layer 3b, poor to fair weathered shale or sandstone.

- The data at the **Southern Repository** indicates peat depths between 1.7 and 4 m bgl. Lower resistivities and higher seismic velocities indicate the peat is underlain by firm sandy gravelly clay and silt.
- Increases in resistivities at depths of 10 – 15 m bgl likely indicate a shale or sandstone bedrock.
- The most likely interpretation below the peat layer at this location is sandy gravelly clay and silt, increasing in compaction down to 10 – 15 m bgl and underlain by rock where the resistivities begin to increase.
- Direct ground investigation logs were provided after the survey and the results tie in well with the interpretation provided here.

5. REFERENCES

1. **BSI, 2020.** BS5930: 2015+A1:2020, Code of Practice for Ground Investigations, British Standards Institute 2020

2. **Eurocode, 2007.** EN 1997-2:2007. Eurocode 7. Part 2 Ground Investigation and Testing 2007

3. **GSEG, 2002.** Geophysics in Engineering Investigations. Geological Society Engineering Geology Special Publication 19, London, 2002

4. **GSI, 2025.** www.gsi.ie. Online Geological Map of Ireland. Geological Survey of Ireland 2025

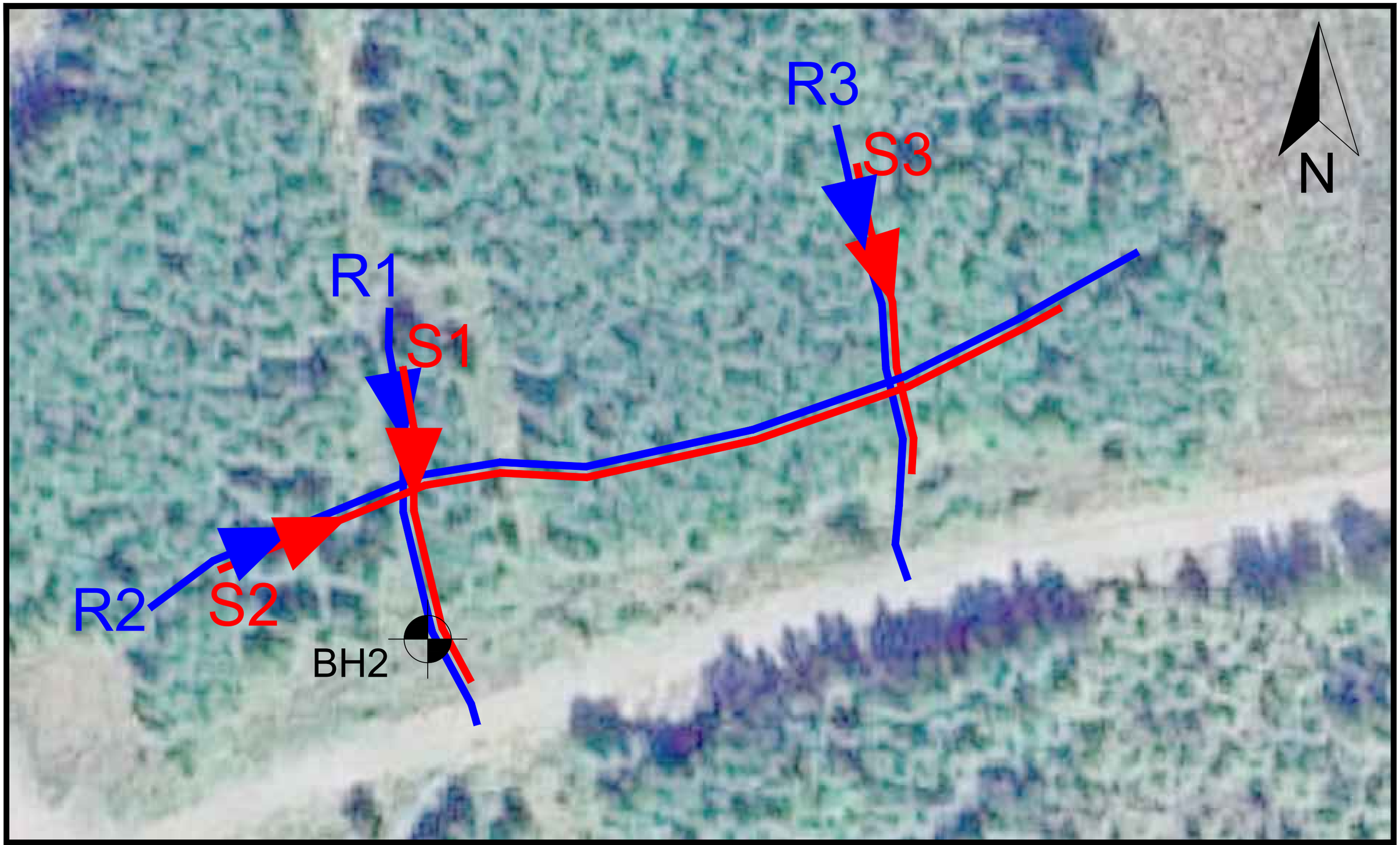
5. **Milsom, 1989.** Field Geophysics. John Wiley and Sons, 1989

6. **Reynolds, 1997.** An Introduction to Applied and Environmental Geophysics. John Wiley and Son, 1997

7. **Weaver, 1975.** Geological Factors significant in the Assessment of Rippability, 1975

Table 1: Geophysical Survey Locations and Acquisition Parameters

	2D-Resistivity (ERT) Survey				
Site	**Line**	**Electrode Spacing (m)**	**Length (m)**	**Display direction**	**Survey Type/Mode**
Northern Repository	R1	3	63	N-S	Traverse
Northern Repository	R2	3	150	W-E	Traverse
Northern Repository	R3	3	69	N-S	Traverse
Borrow Pit	R4	3	93	SW-NE	Traverse
Borrow Pit	R5	3	93	SW-NE	Traverse
Borrow Pit	R6	3	93	SW-NE	Traverse
Borrow Pit	R7	3	93	SW-NE	Traverse
Southern Repository	R8	3	162	NW-SE	Traverse
Southern Repository	R9	3	111	SW-NE	Traverse
Southern Repository	R10	3	138	NW-SE	Traverse
		SUM	**1065**		
	Seismic Refraction Survey				
Site	**Line**	**Geophone Spacing (m)**	**Length (m)**	**Display direction**	**Survey Type/Mode**
Northern Repository	S1	2	46	N-S	Single Setup
Northern Repository	S2	2	126	W-E	Concatenated
Northern Repository	S3	2	46	N-S	Single Setup
Borrow Pit	S4	2	94	SW-NE	Concatenated
Borrow Pit	S5	2	94	SW-NE	Concatenated
Borrow Pit	S6	2	94	SW-NE	Concatenated
Borrow Pit	S7	2	94	SW-NE	Concatenated
Southern Repository	S8	2	158	NW-SE	Concatenated
Southern Repository	S9	2	94	SW-NE	Concatenated
Southern Repository	S10	2	132	NW-SE	Concatenated
		SUM	**978**		



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CLIENT	Fehily Timoney & Co.
PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Map 1: Geophysical Survey Location Map - Northern Repository

SCALE:	1:500 @ A3
PROJECT:	6910
DRAWN:	JC
DATE:	14/10/2025
MGX FILE:	6910d_Drawings.dwg
STATUS:	Draft

Geophysical Survey Locations:

R2	2D-Resistivity Line
S1	Seismic Refraction Line

Locations are in Irish Transverse Mercator (ITM), Elevations are in mOD (Malin Head)

Direct Ground Investigation Locations:

RC1	Rotary Core Hole



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PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Map 2: Geophysical Survey Location Map - Borrow Pit

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PROJECT:	6910
DRAWN:	JC
DATE:	14/10/2025
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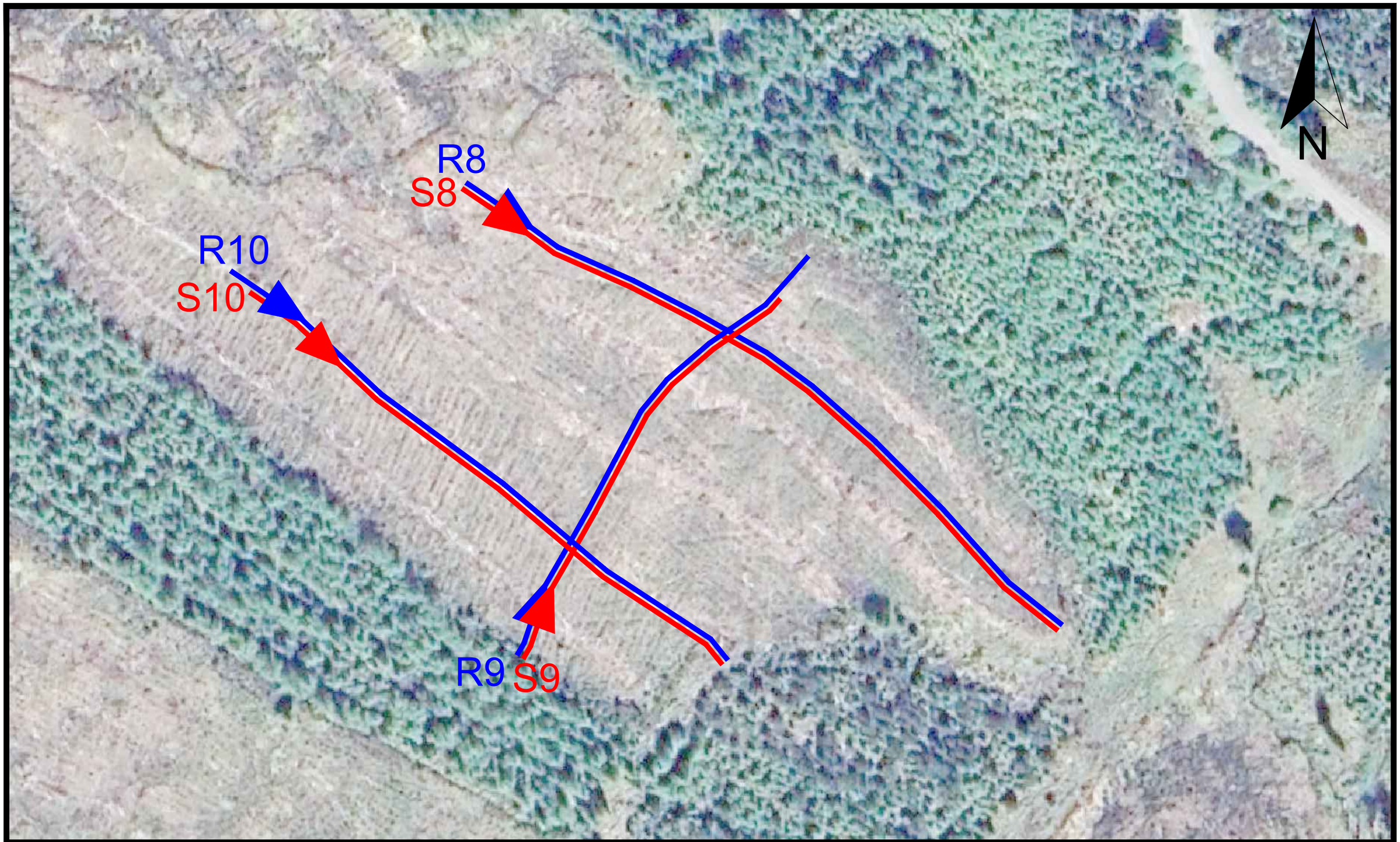
Geophysical Survey Locations:

R2	2D-Resistivity Line
S1	Seismic Refraction Line

Locations are in Irish Transverse Mercator (ITM), Elevations are in mOD (Malin Head)

Direct Ground Investigation Locations:

RC1	Rotary Core Hole



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PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Map 3: Geophysical Survey Location Map - Southern Repository

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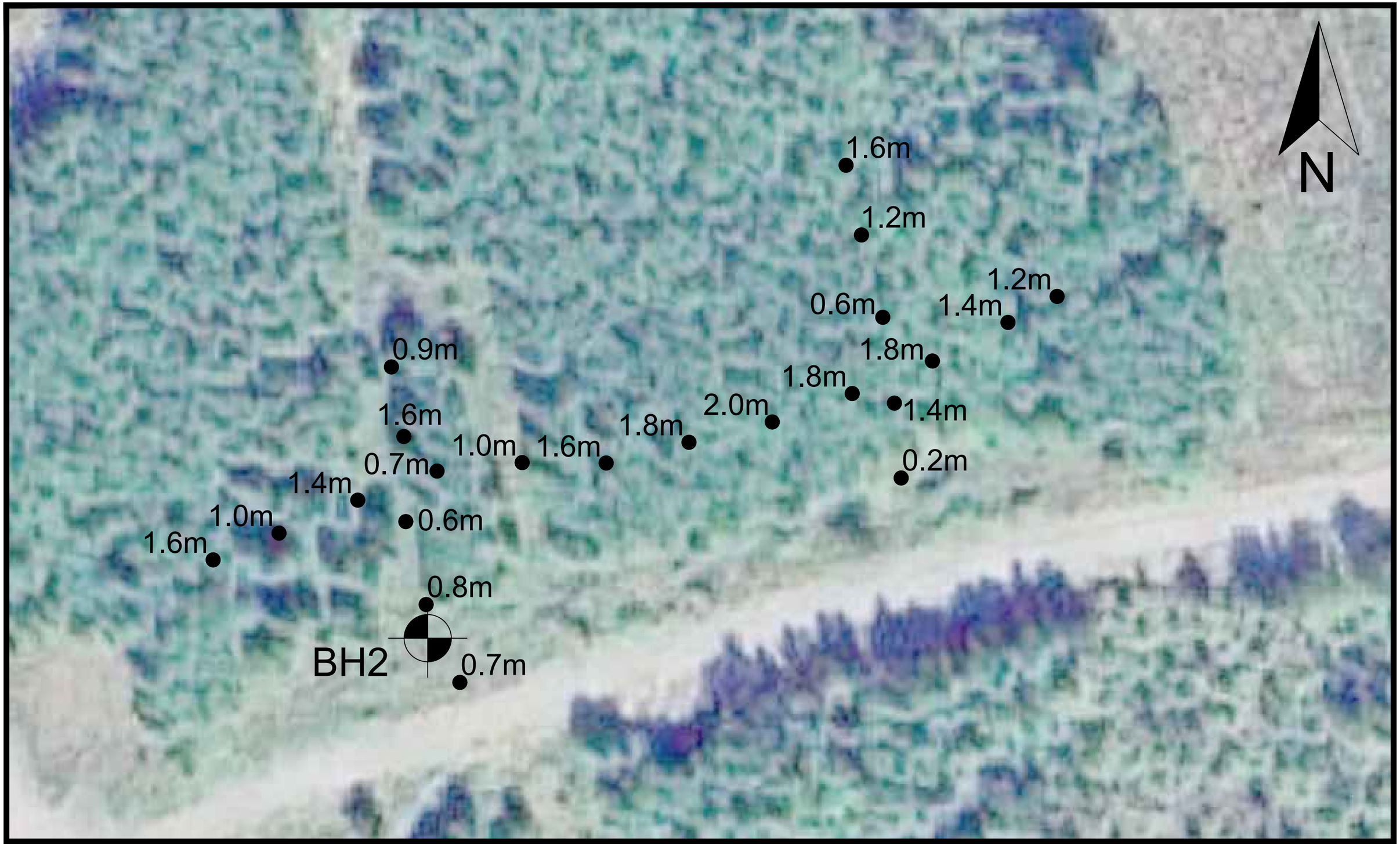
Geophysical Survey Locations:

R2	2D-Resistivity Line
S1	Seismic Refraction Line

Locations are in Irish Transverse Mercator (ITM), Elevations are in mOD (Malin Head)

Direct Ground Investigation Locations:

RC1	Rotary Core Hole



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CLIENT	Fehily Timoney & Co.
PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Map 4: Locations and Results of Push Probes - Northern Repository

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PROJECT:	6910
DRAWN:	JC
DATE:	05/11/2025
MGX FILE:	6910d_Drawings.dwg
STATUS:	Draft

Geophysical Survey Locations:

3.3m Push Probe Location and Peat Thickness



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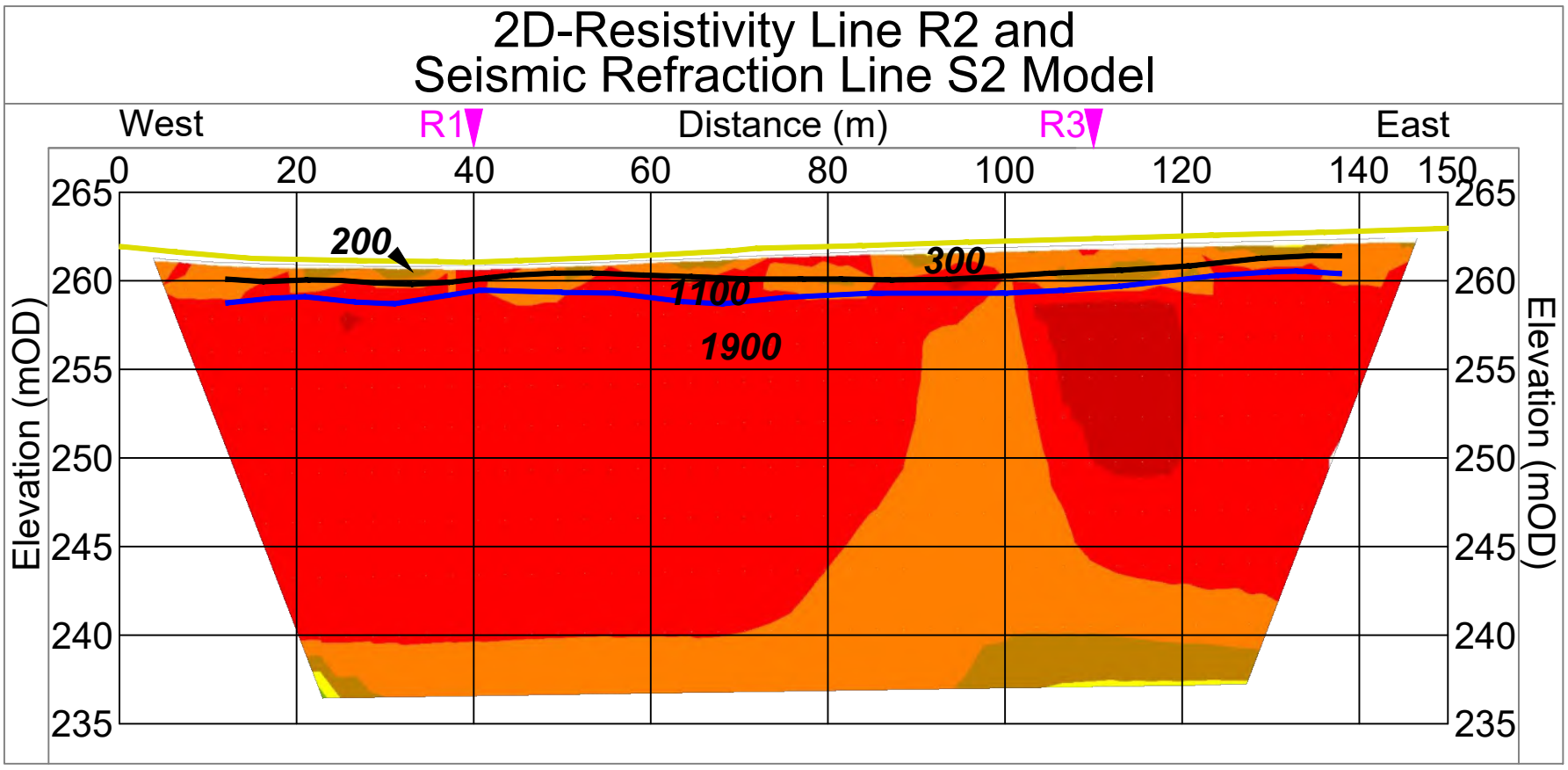
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PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Map 5: Locations and Results of Push Probes - Southern Repository

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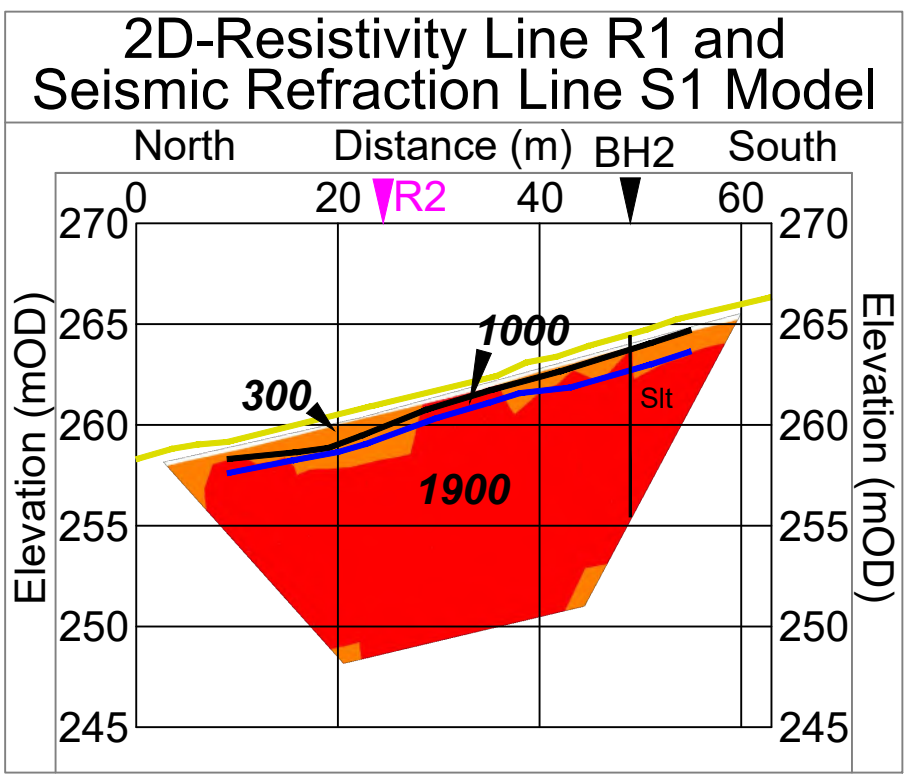
Geophysical Survey Locations:

3.3m Push Probe Location and Peat Thickness

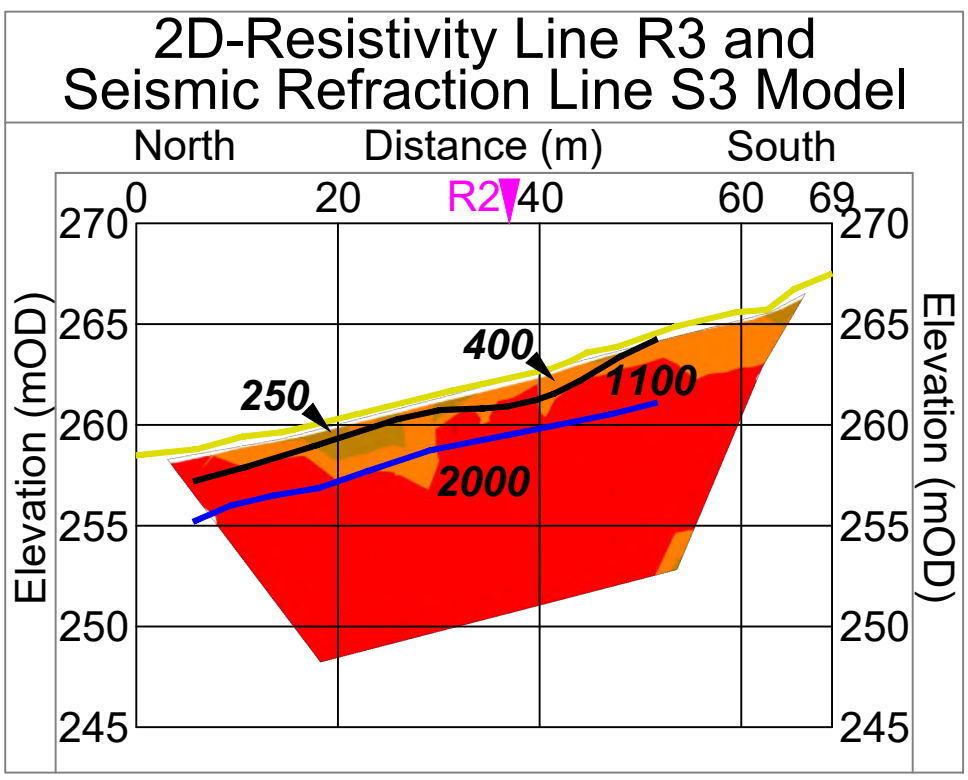
2D-Resistivity Line R2 and Seismic Refraction Line S2 Model



2D-Resistivity Line R1 and Seismic Refraction Line S1 Model



2D-Resistivity Line R3 and Seismic Refraction Line S3 Model



Abbreviated GI Logs:

BH01 Borehole Name and Location
Slt Silt

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CLIENT	Fehily Timoney & Co.
PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Fig 1a: Models of Geophysical Survey - Northern Repository

SCALE:	1:750 @ A3, VE x 2
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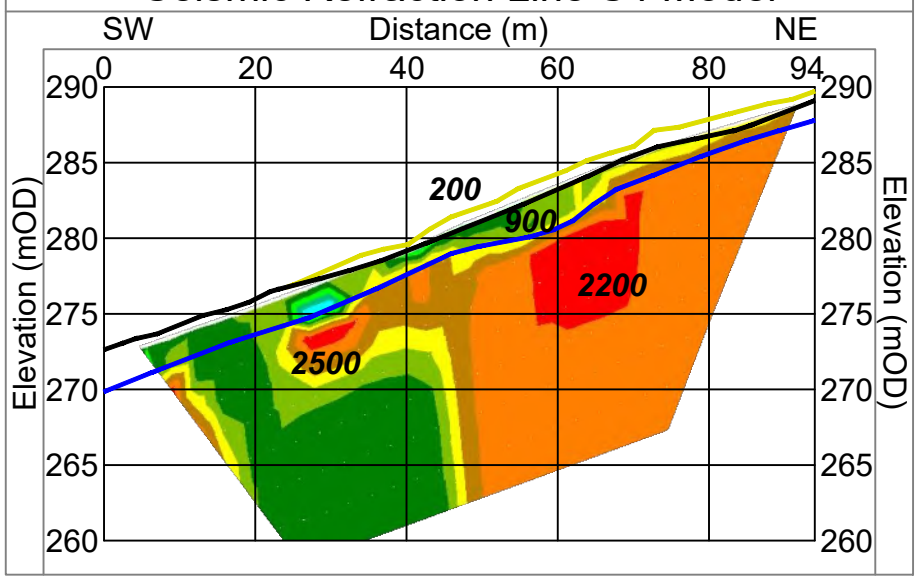
Resistivities (Ohmm)

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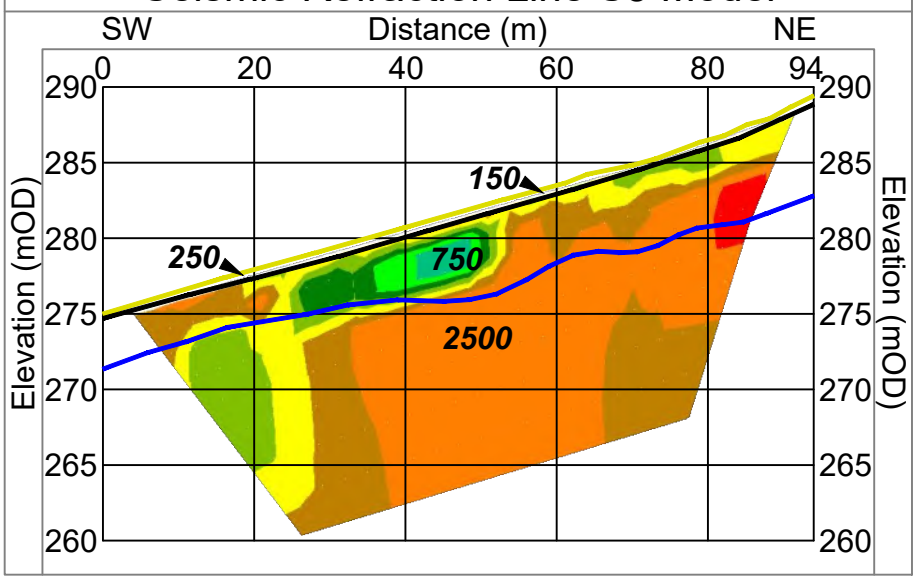
Layers from Seismic Refraction Model:

Ground Surface/Top of Layer 1 (150 - 400 m/s)
Ground Surface/Top of Layer 2 (750 - 1100 m/s)
Top of Layer 3 (1900 - 2500 m/s)
1900 Seismic Velocity in m/s

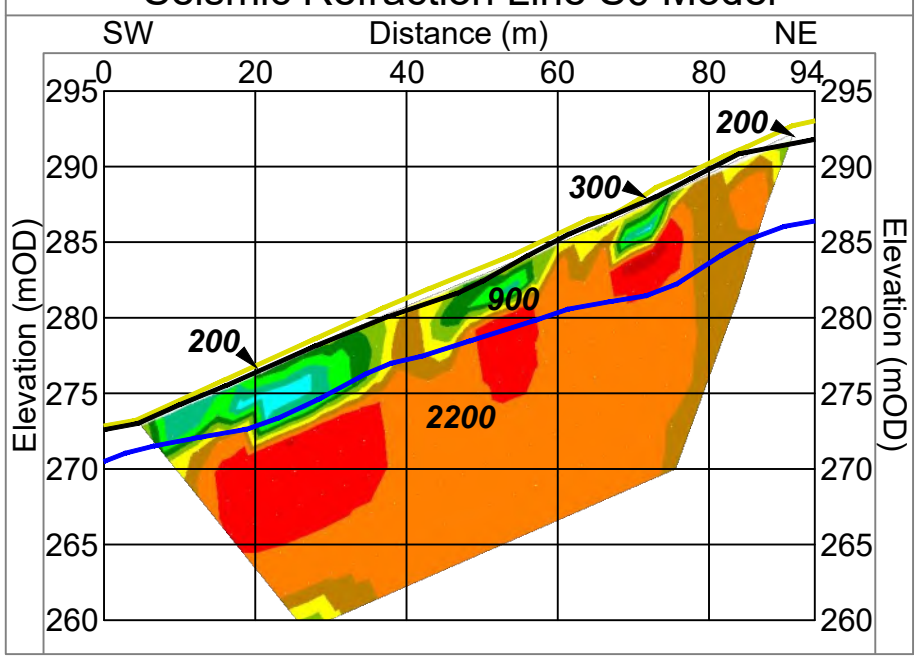
2D-Resistivity Line R4 and Seismic Refraction Line S4 Model



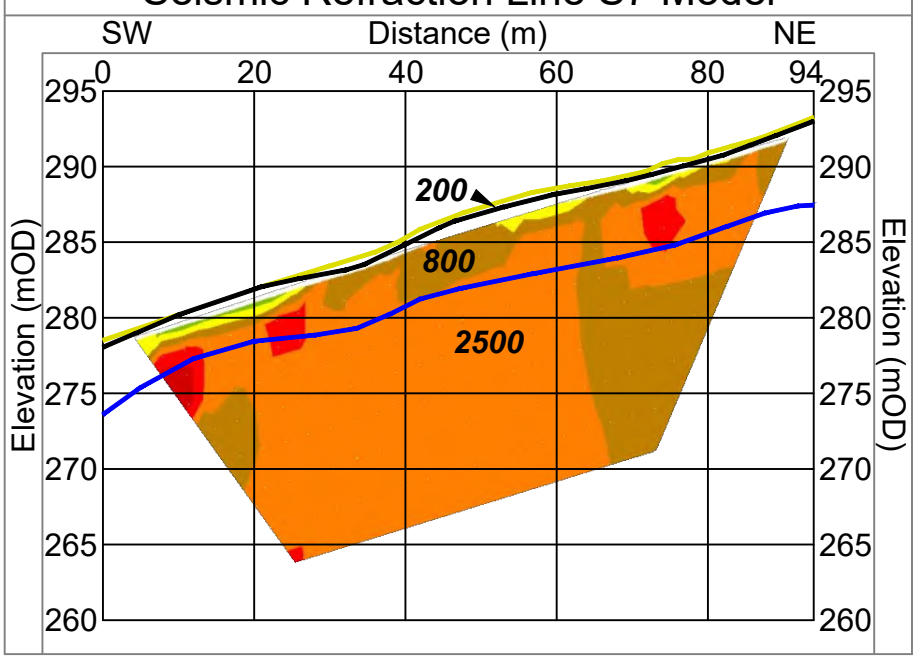
2D-Resistivity Line R5 and Seismic Refraction Line S5 Model



2D-Resistivity Line R6 and Seismic Refraction Line S6 Model



2D-Resistivity Line R7 and Seismic Refraction Line S7 Model



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PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Fig 1b: Models of Geophysical Survey - Borrow Pit

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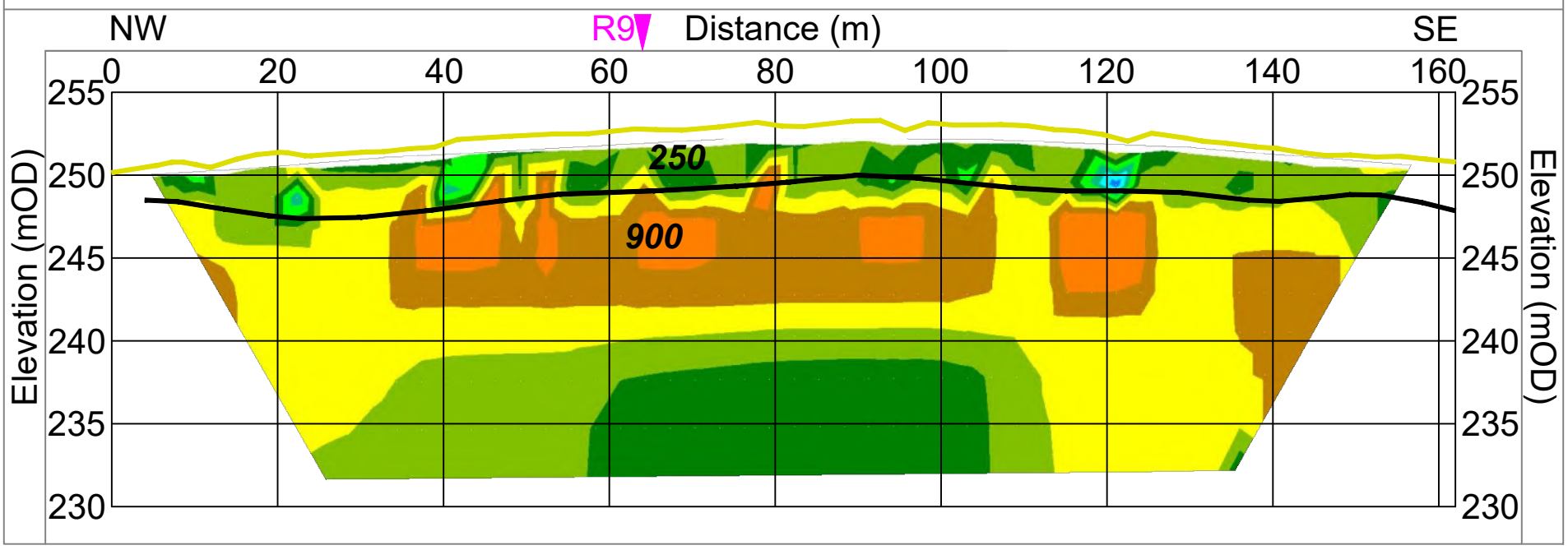
Resistivities (Ohmm)

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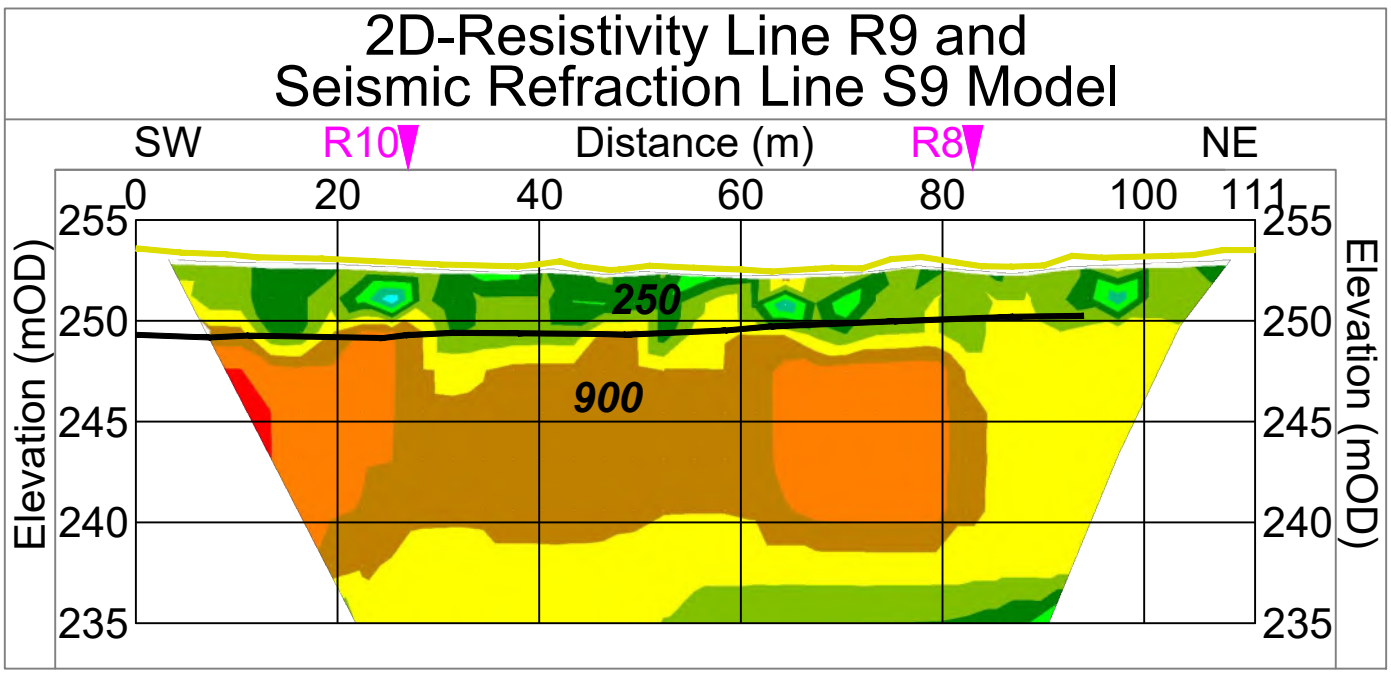
Layers from Seismic Refraction Model:

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Top of Layer 3 (1900 - 2500 m/s)
1900 Seismic Velocity in m/s

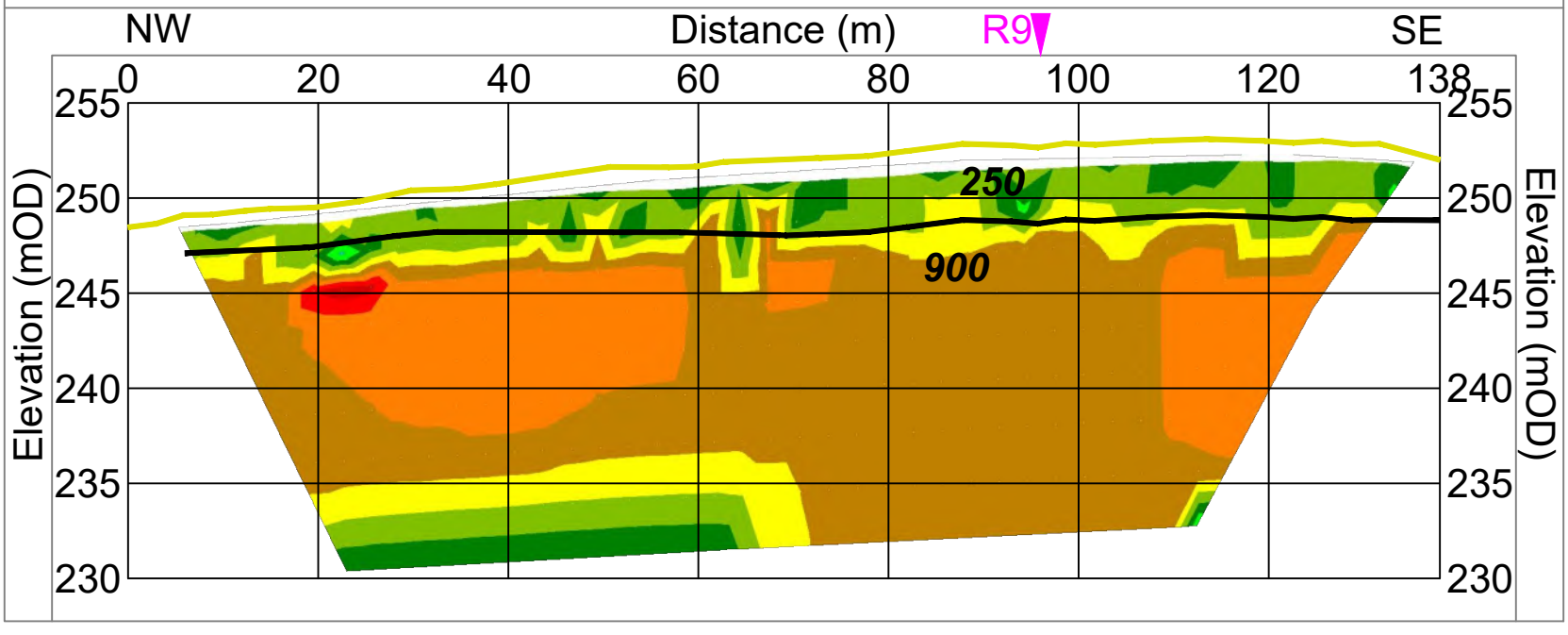
2D-Resistivity Line R8 and Seismic Refraction Line S8 Model



2D-Resistivity Line R9 and Seismic Refraction Line S9 Model



2D-Resistivity Line R10 and Seismic Refraction Line S10 Model



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PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Fig 1c: Models of Geophysical Survey - Southern Repository

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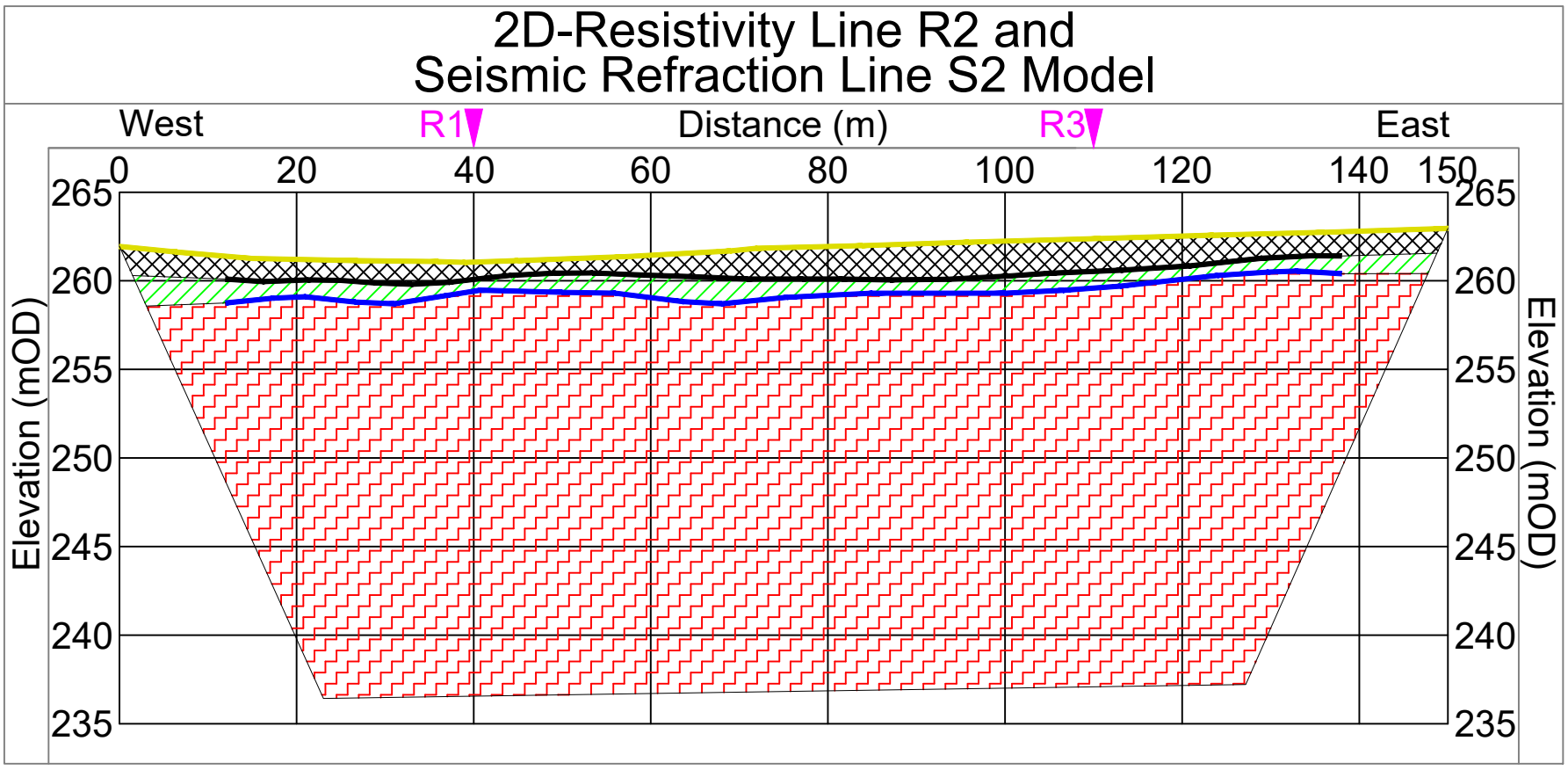
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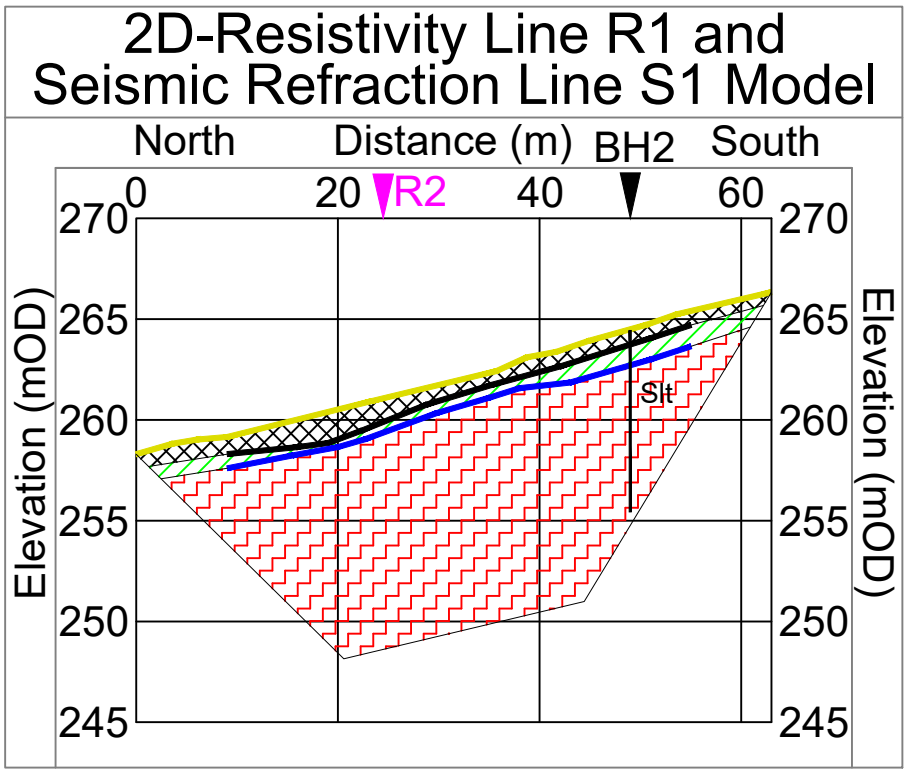
Resistivities (Ohmm)

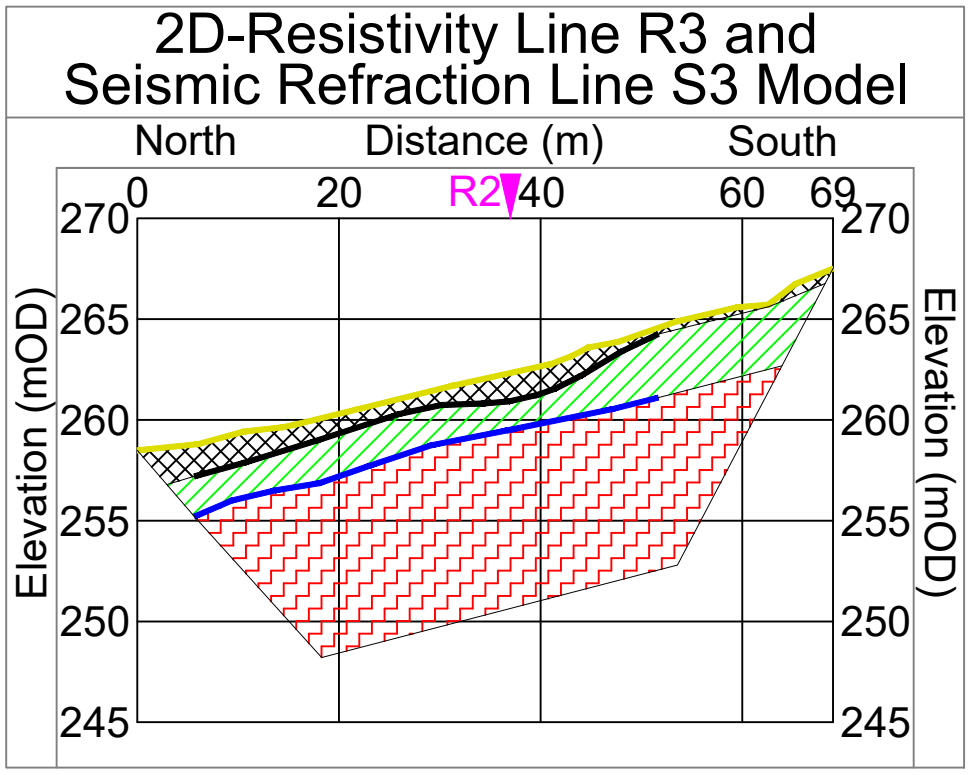
15.6 31.2 62.5 125 250 500 1000 2000

Layers from Seismic Refraction Model:

- Ground Surface/Top of Layer 1 (150 - 400 m/s)
- Ground Surface/Top of Layer 2 (750 - 1100 m/s)
- Top of Layer 3 (1900 - 2500 m/s)
- *1900* Seismic Velocity in m/s







Abbreviated GI Logs:

BH01 Borehole Name and Location
Slt Silt

Minerex
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Unit F4, Maynooth Business Campus
Maynooth, Co. Kildare
Tel. (01) 6510030
Email: info@mgx.ie
Web: www.mgx.ie

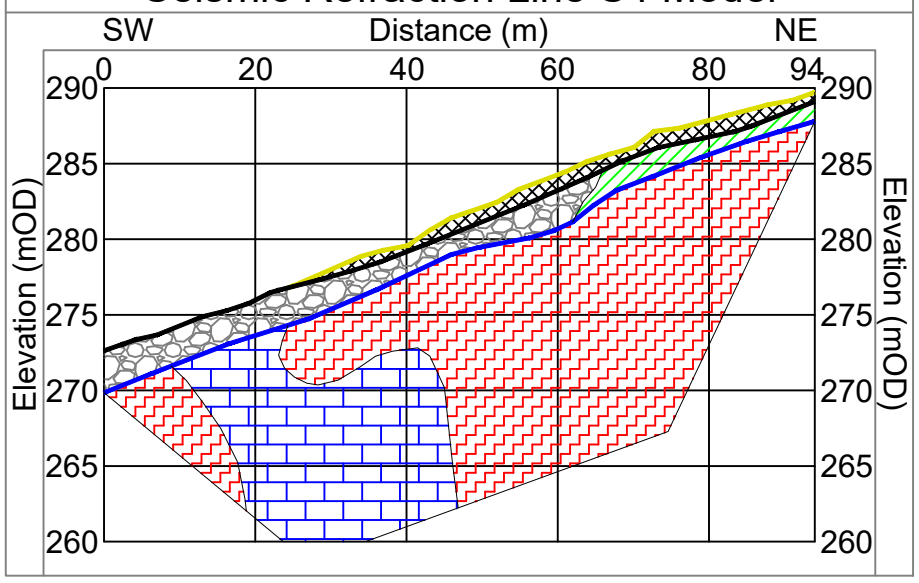
CLIENT	Fehily Timoney & Co.
PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Fig 2a: Interpretation of Geophysical Survey - Northern Repository

SCALE:	1:750 @ A3, VE x 2
PROJECT:	6910
DRAWN:	JS
DATE:	05/11/2025
MGX FILE:	6910d_Drawings.dwg
STATUS:	Draft

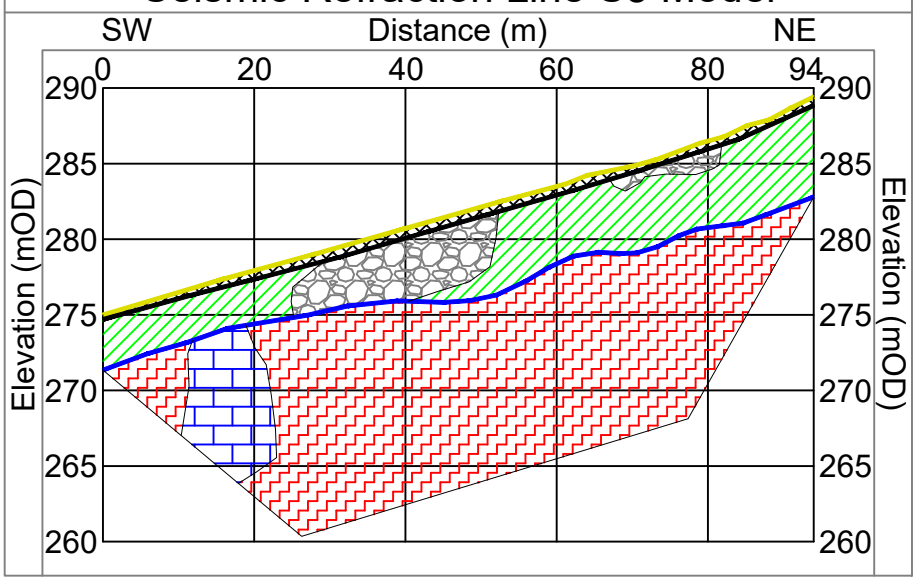
Interpretation Figures:

1 Very Soft Peat
2a Firm sandy gravelly Clay and Silt
2b Medium dense clayey silty Sand and Gravel
3a Poor to fair weathered Shale or Stiff to very stiff sandy gravelly clay and silt
3b Poor to fair weathered shale or sandstone

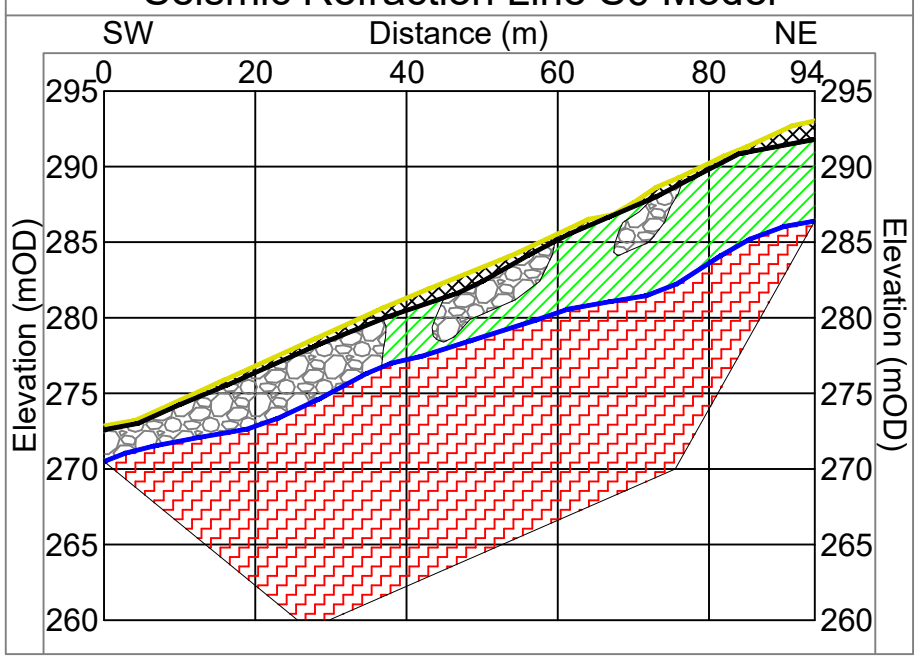
2D-Resistivity Line R4 and Seismic Refraction Line S4 Model



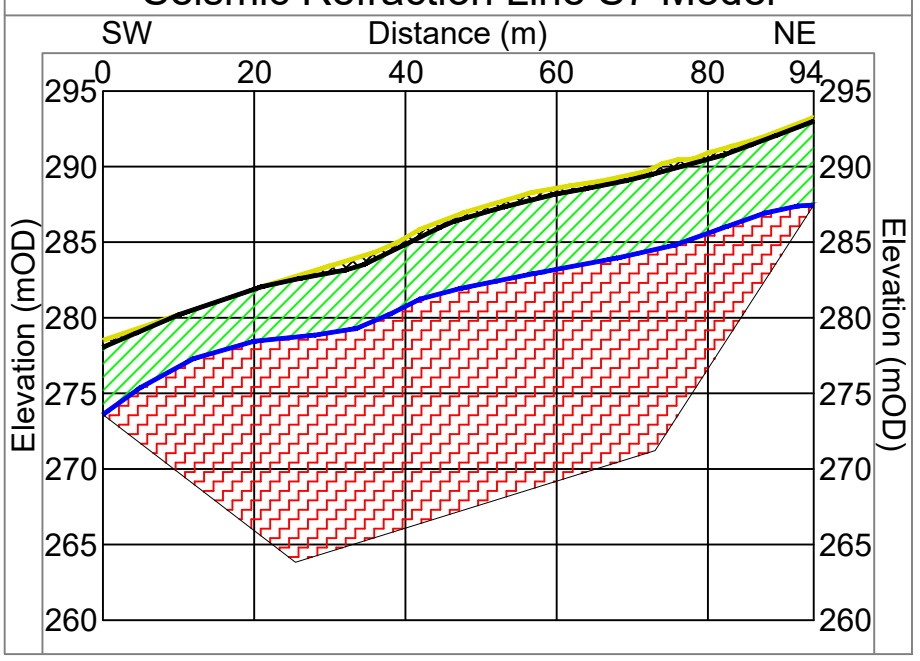
2D-Resistivity Line R5 and Seismic Refraction Line S5 Model



2D-Resistivity Line R6 and Seismic Refraction Line S6 Model



2D-Resistivity Line R7 and Seismic Refraction Line S7 Model



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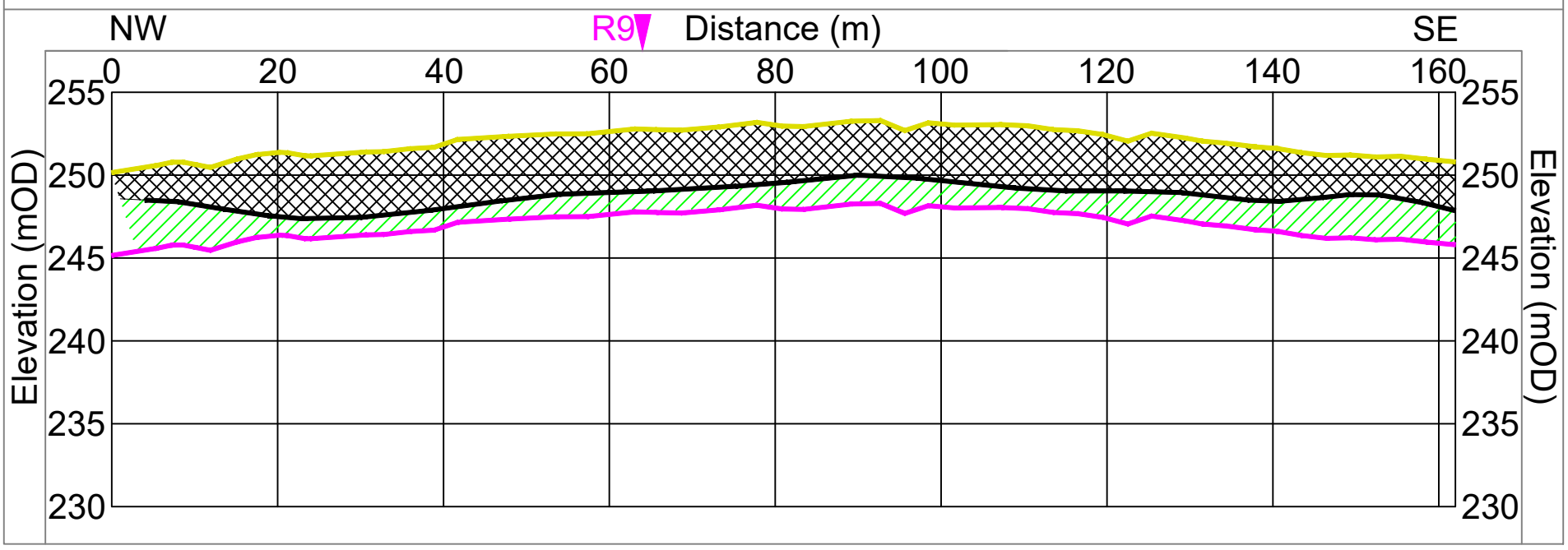
CLIENT	Fehily Timoney & Co.
PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Fig 2b: Interpretation of Geophysical Survey - Borrow Pit

SCALE:	1:1000 @ A3, VE x 2
PROJECT:	6910
DRAWN:	JS
DATE:	05/11/2025
MGX FILE:	6910d_Drawings.dwg
STATUS:	Draft

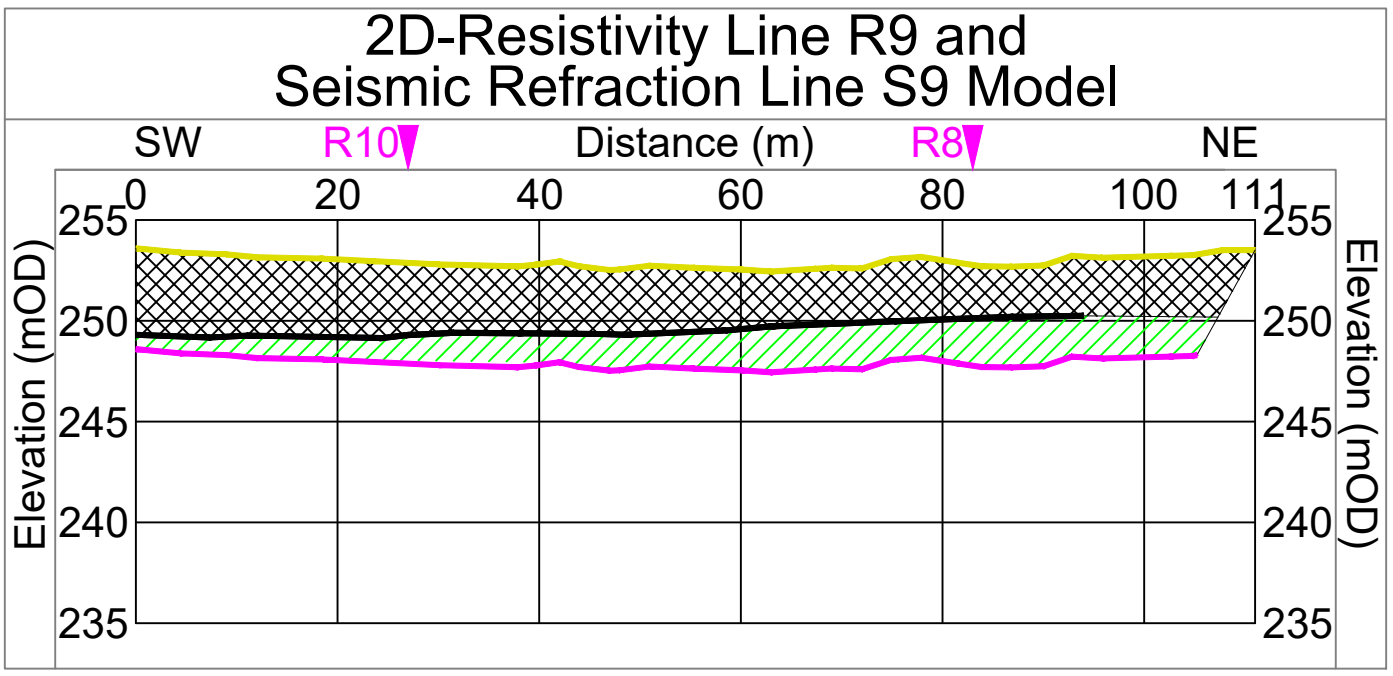
Interpretation Figures:

- 1 Very Soft Peat
- 2a Firm sandy gravelly Clay and Silt
- 2b Medium dense clayey silty Sand and Gravel
- 3a Poor to fair weathered Shale or Stiff to very stiff sandy gravelly clay and silt
- 3b Poor to fair weathered shale or sandstone

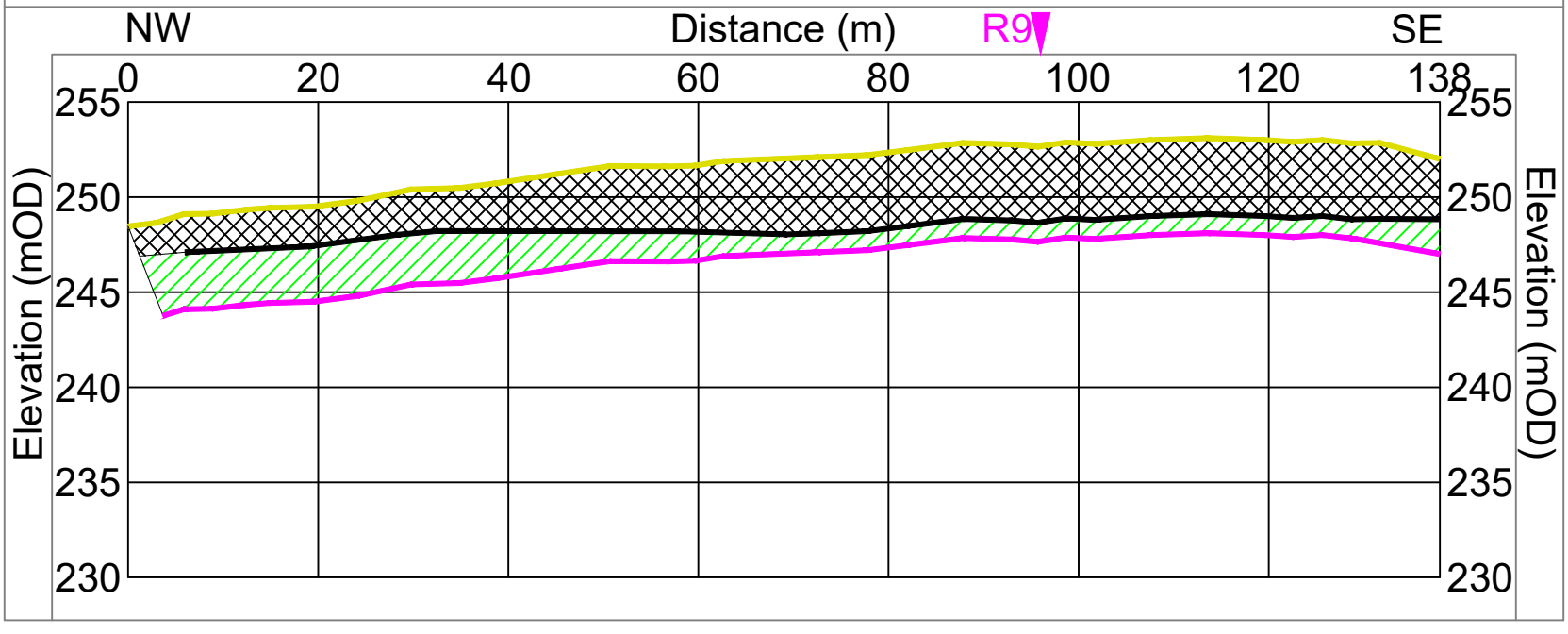
2D-Resistivity Line R8 and Seismic Refraction Line S8 Model



2D-Resistivity Line R9 and Seismic Refraction Line S9 Model



2D-Resistivity Line R10 and Seismic Refraction Line S10 Model



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CLIENT	Fehily Timoney & Co.
PROJECT	Croagh Windfarm, County Leitrim Geophysical Survey
TITLE	Fig 2c: Interpretation of Geophysical Survey - Southern Repository

SCALE:	1:750 @ A3, VE x 2
PROJECT:	6910
DRAWN:	JS
DATE:	05/11/2025
MGX FILE:	6910d_Drawings.dwg
STATUS:	Draft

Interpretation Figures:

1 Very Soft Peat
2a Firm sandy gravelly Clay and Silt
2b Medium dense clayey silty Sand and Gravel
3a Poor to fair weathered Shale or Stiff to very stiff sandy gravelly clay and silt
3b Poor to fair weathered shale or sandstone

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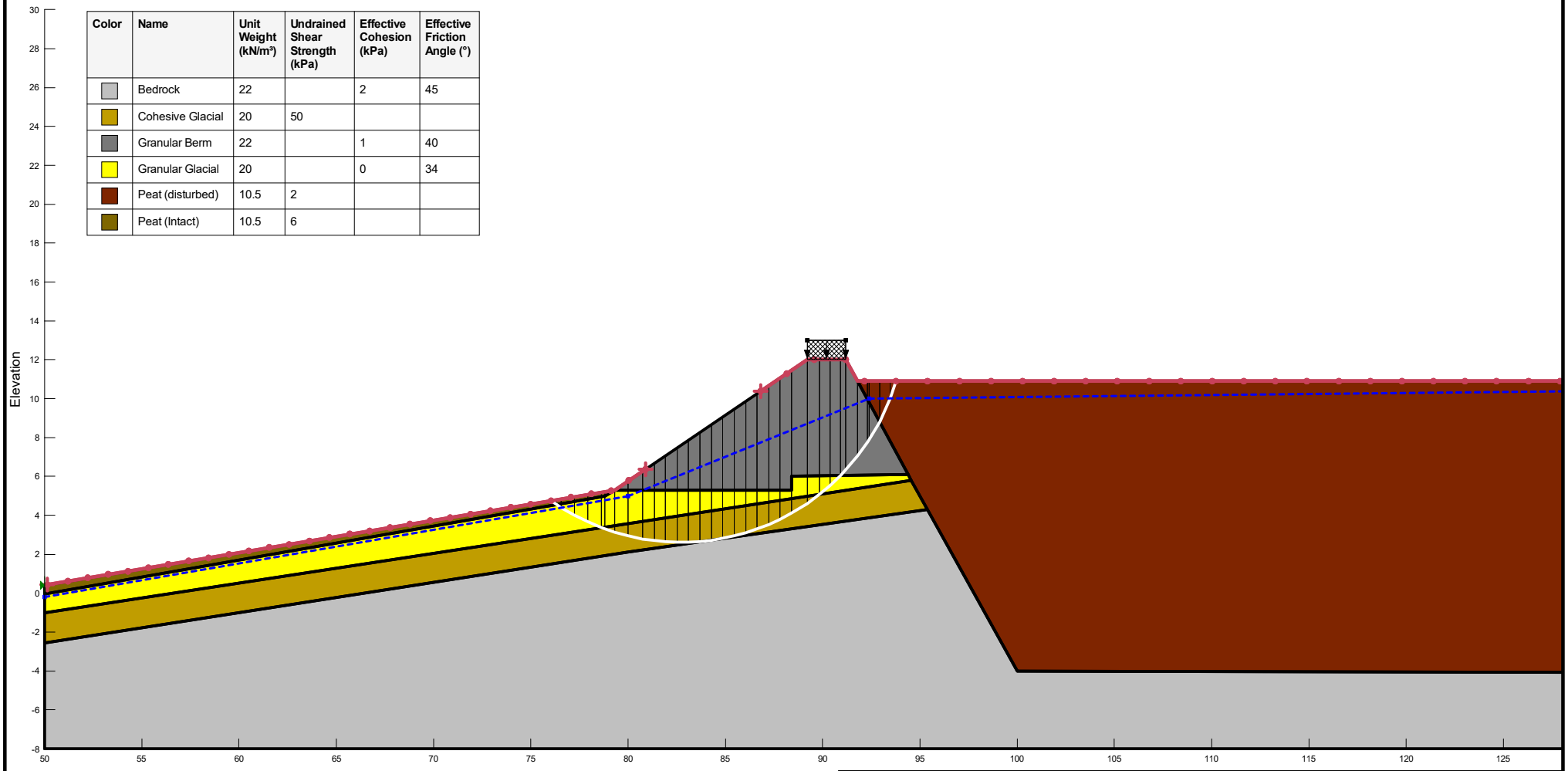
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APPENDIX C

Stability Analysis Outputs

1.18 (ODF)

Color	Name	Unit Weight (kN/m³)	Undrained Shear Strength (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock	22		2	45
	Cohesive Glacial	20	50		
	Granular Berm	22		1	40
	Granular Glacial	20		0	34
	Peat (disturbed)	10.5	2		
	Peat (Intact)	10.5	6		



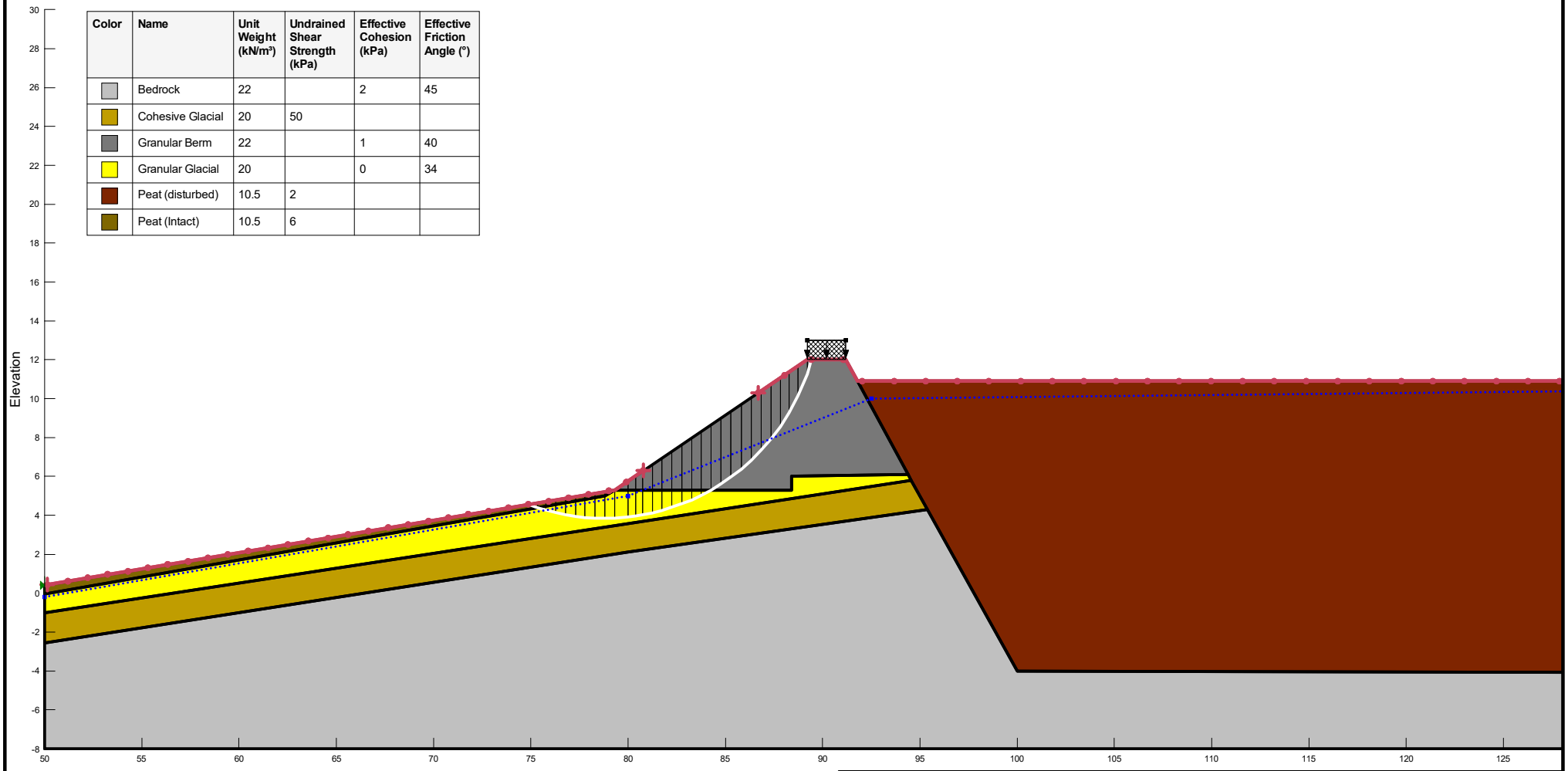
Slope Stability (DA1C1)

Borrow pit (undrained).gsz

12/03/2026 1:300

1.03 (ODF)

Color	Name	Unit Weight (kN/m³)	Undrained Shear Strength (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock	22		2	45
	Cohesive Glacial	20	50		
	Granular Berm	22		1	40
	Granular Glacial	20		0	34
	Peat (disturbed)	10.5	2		
	Peat (Intact)	10.5	6		



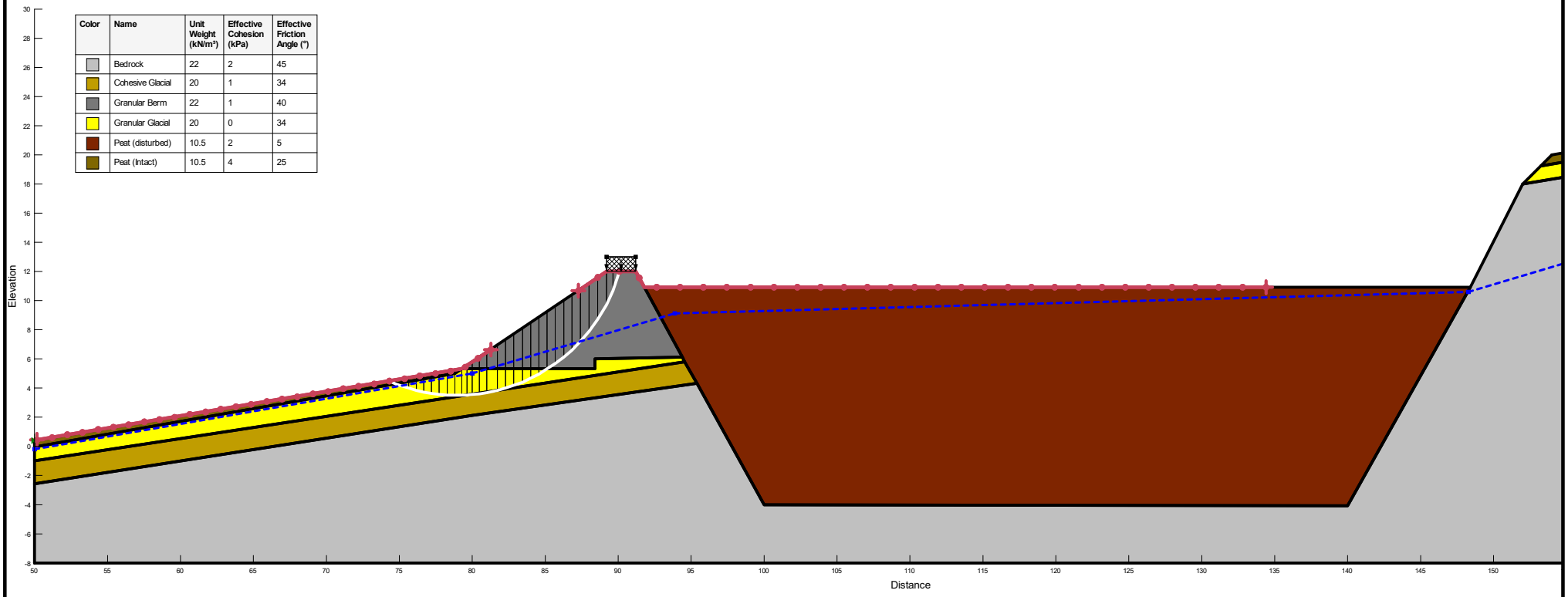
Slope Stability (DA1C2)

Borrow pit (undrained).gsz

12/03/2026 1:300

1.37 (ODF)

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock	22	2	45
	Cohesive Glacial	20	1	34
	Granular Berm	22	1	40
	Granular Glacial	20	0	34
	Peat (disturbed)	10.5	2	5
	Peat (Intact)	10.5	4	25



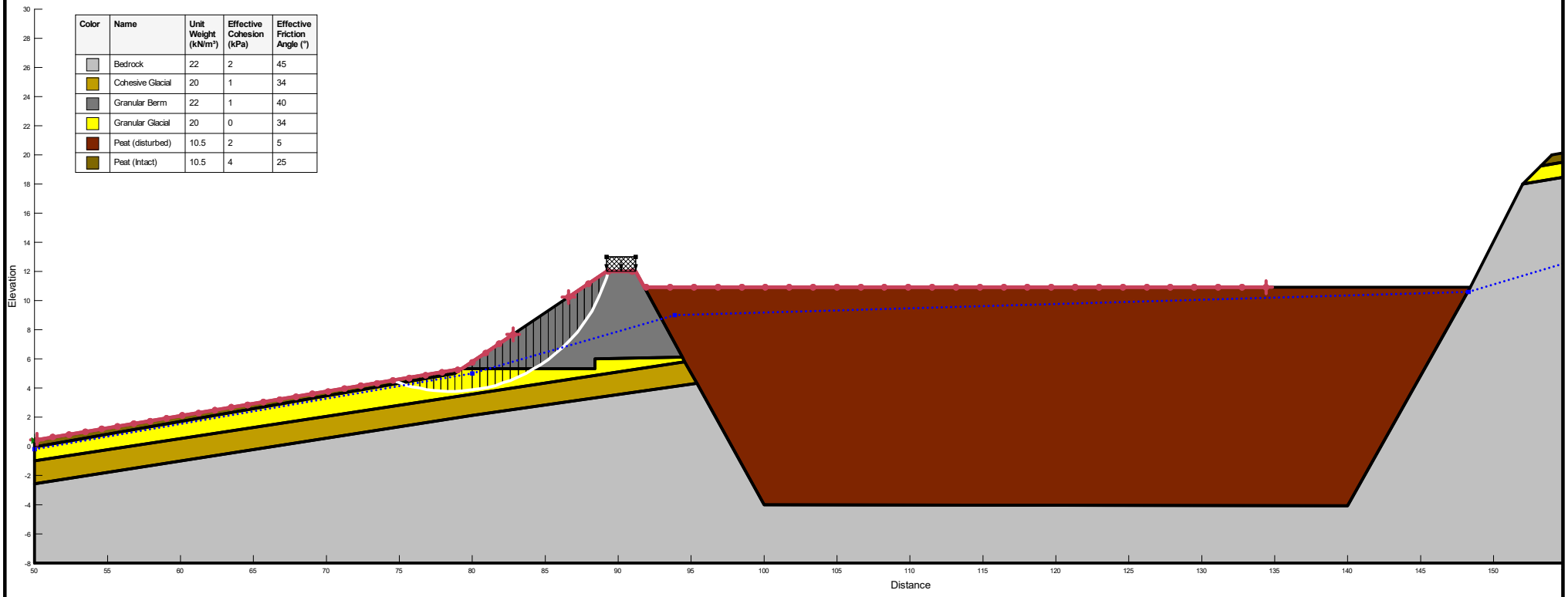
Slope Stability (DA1C1)

Borrow pit (drained).gsz

12/03/2026 1:400

1.10 (ODF)

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Bedrock	22	2	45
	Cohesive Glacial	20	1	34
	Granular Berm	22	1	40
	Granular Glacial	20	0	34
	Peat (disturbed)	10.5	2	5
	Peat (Intact)	10.5	4	25

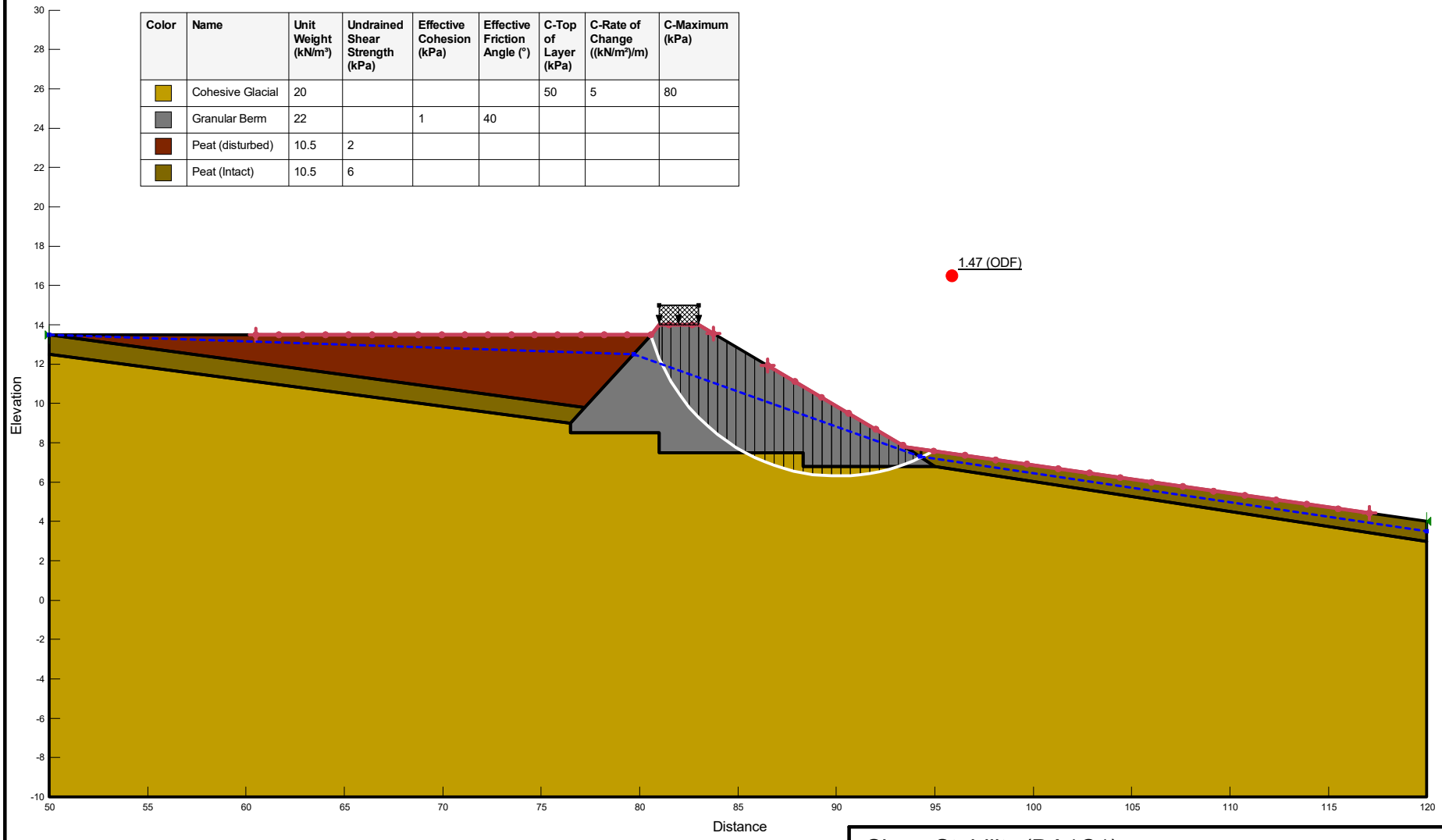


Slope Stability (DA1C2)

Borrow pit (drained).gsz

05/03/2026 1:400

Color	Name	Unit Weight (kN/m³)	Undrained Shear Strength (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)	C-Top of Layer (kPa)	C-Rate of Change ((kN/m²)/m)	C-Maximum (kPa)
	Cohesive Glacial	20				50	5	80
	Granular Berm	22		1	40			
	Peat (disturbed)	10.5	2					
	Peat (Intact)	10.5	6					

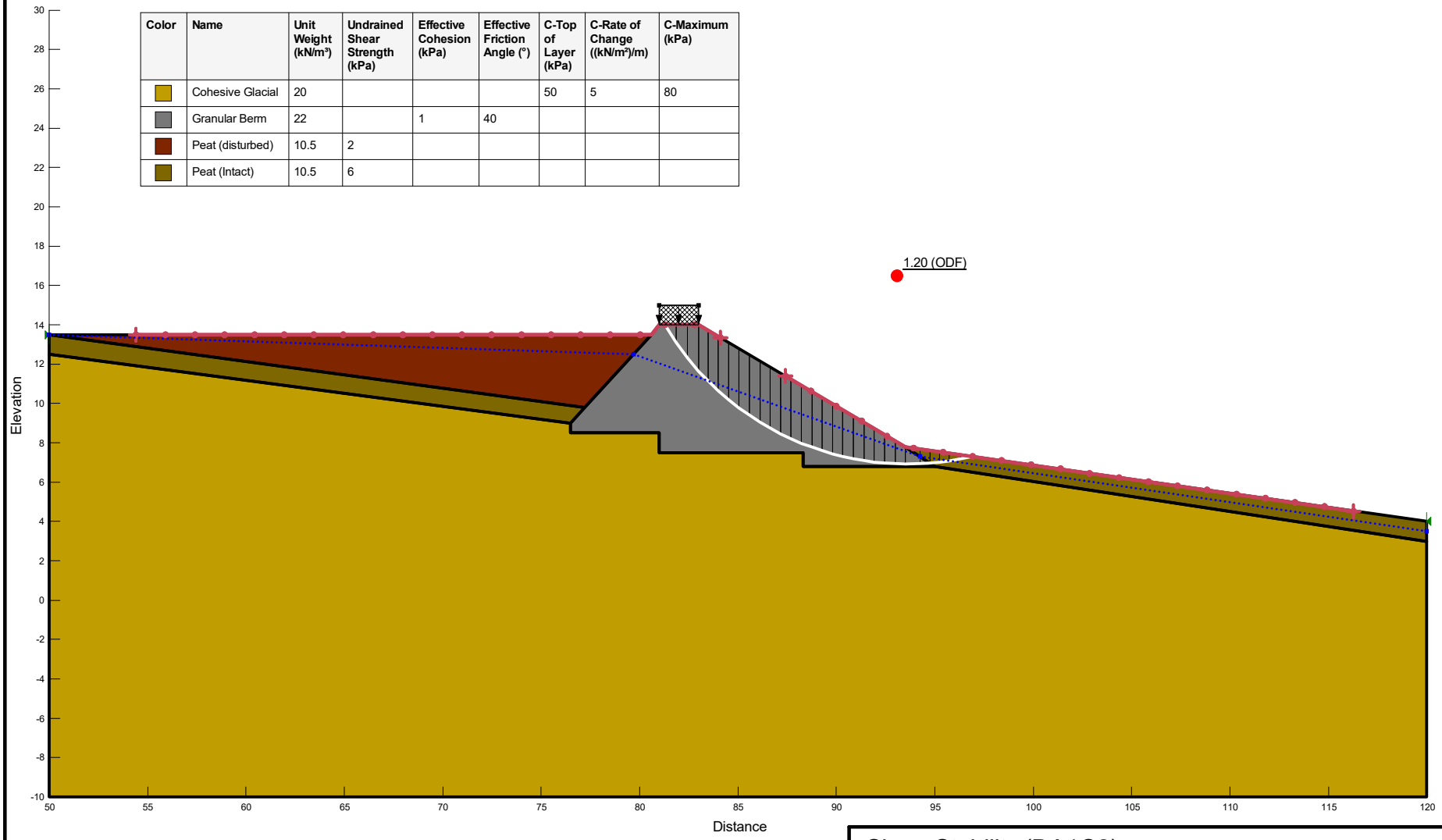


Slope Stability (DA1C1)

peat repository (N) (undrained).gsz

12/03/2026 1:300

Color	Name	Unit Weight (kN/m³)	Undrained Shear Strength (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)	C-Top of Layer (kPa)	C-Rate of Change ((kN/m²)/m)	C-Maximum (kPa)
	Cohesive Glacial	20				50	5	80
	Granular Berm	22		1	40			
	Peat (disturbed)	10.5	2					
	Peat (Intact)	10.5	6					

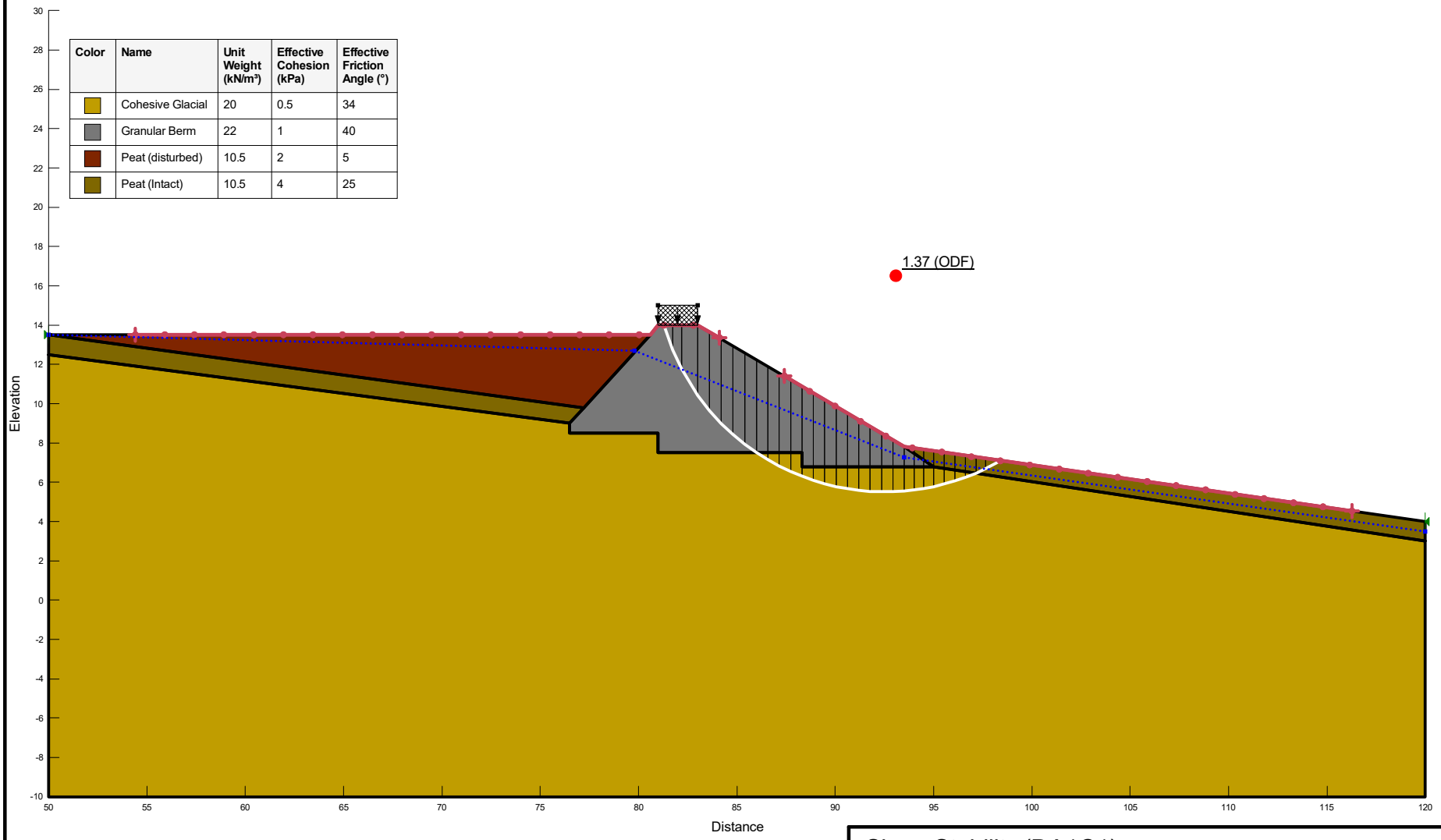


Slope Stability (DA1C2)

peat repository (N) (undrained).gsz

12/03/2026 1:300

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Cohesive Glacial	20	0.5	34
	Granular Berm	22	1	40
	Peat (disturbed)	10.5	2	5
	Peat (Intact)	10.5	4	25

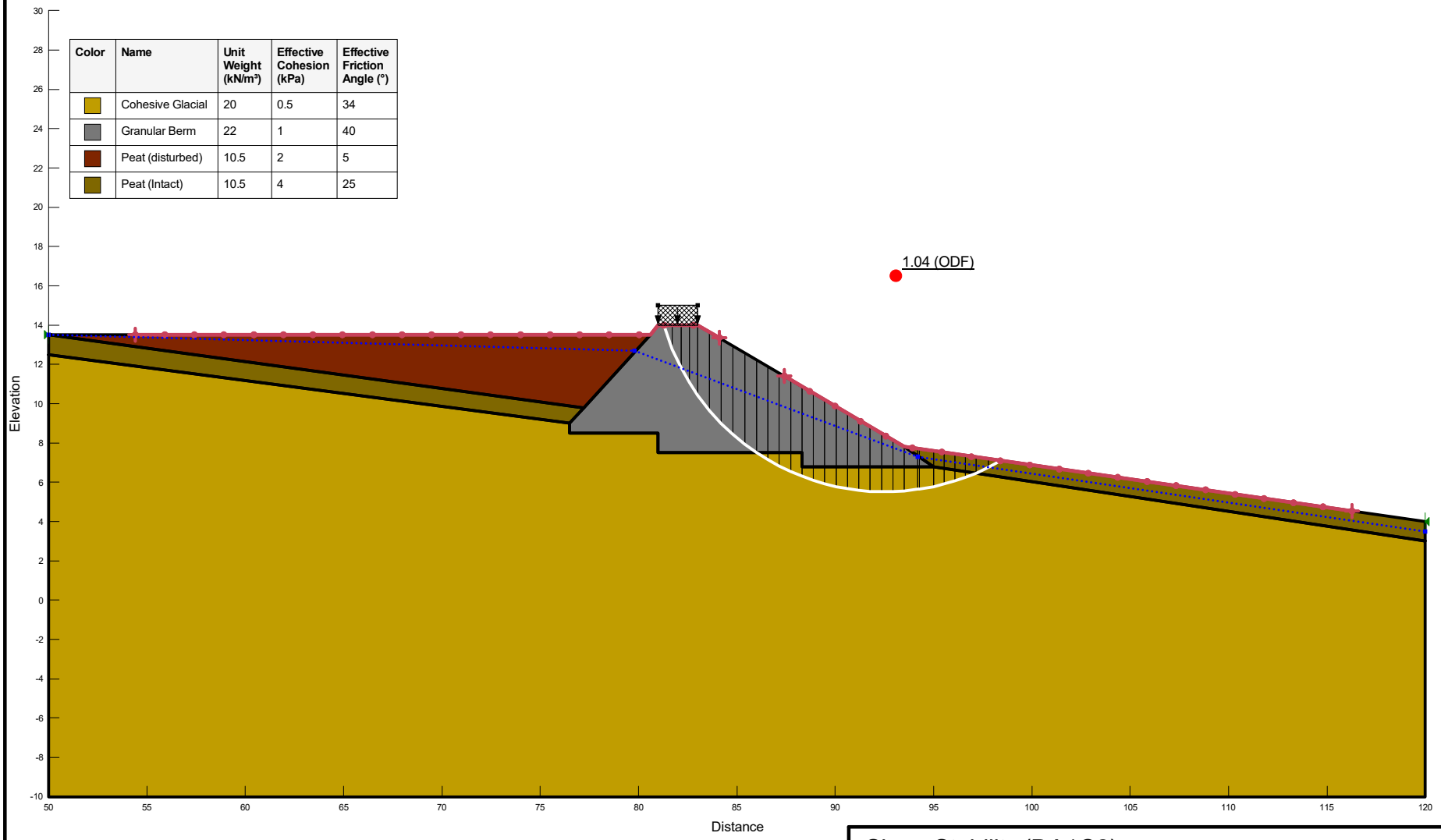


Slope Stability (DA1C1)

peat repository (N) (drained).gsz

05/03/2026 1:300

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Cohesive Glacial	20	0.5	34
	Granular Berm	22	1	40
	Peat (disturbed)	10.5	2	5
	Peat (Intact)	10.5	4	25

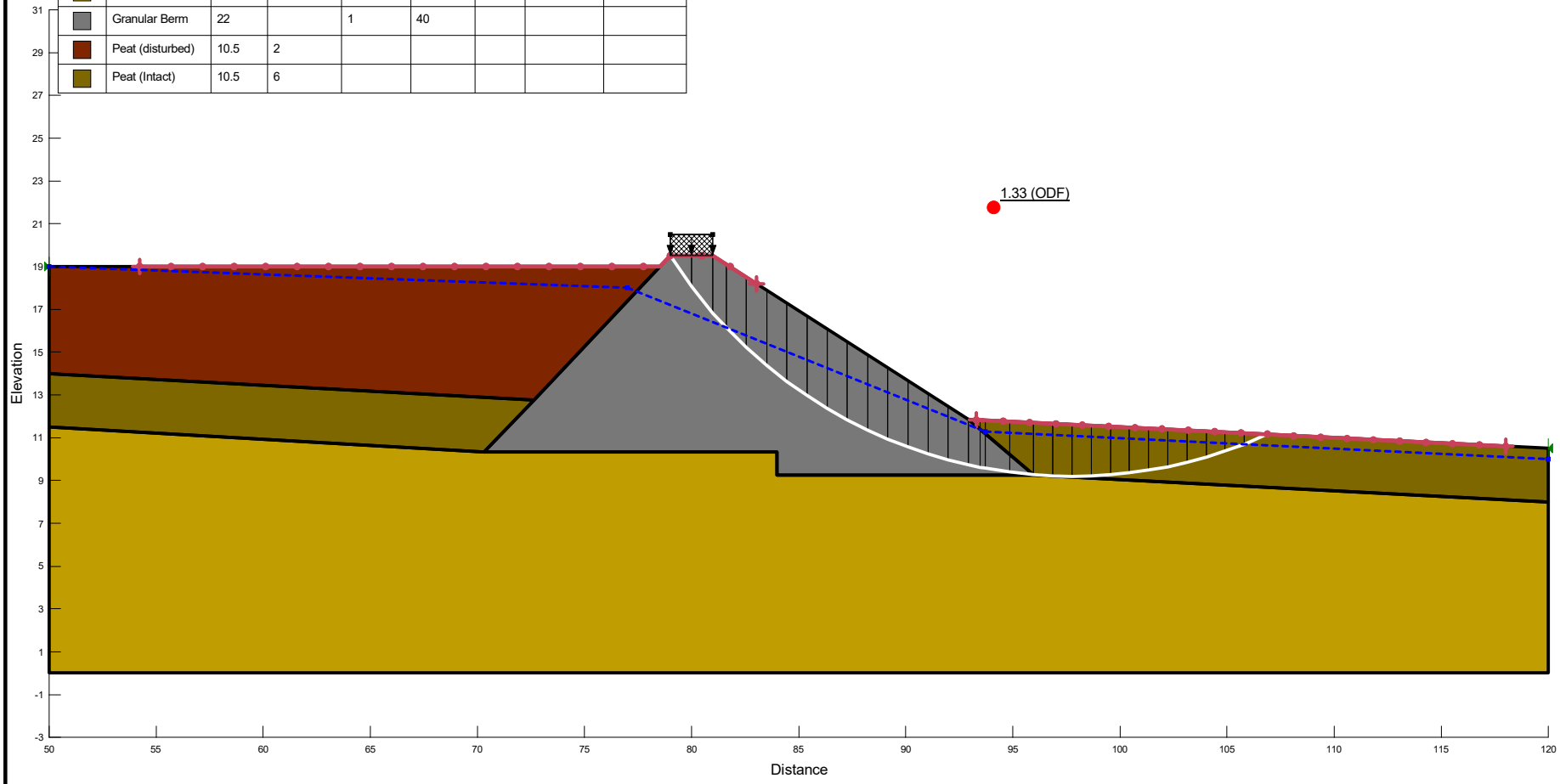


Slope Stability (DA1C2)

peat repository (N) (drained).gsz

05/03/2026 1:300

Color	Name	Unit Weight (kN/m³)	Undrained Shear Strength (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)	C-Top of Layer (kPa)	C-Rate of Change ((kN/m²)/m)	C-Maximum (kPa)
	Cohesive Glacial	20				50	5	80
	Granular Berm	22		1	40			
	Peat (disturbed)	10.5	2					
	Peat (Intact)	10.5	6					

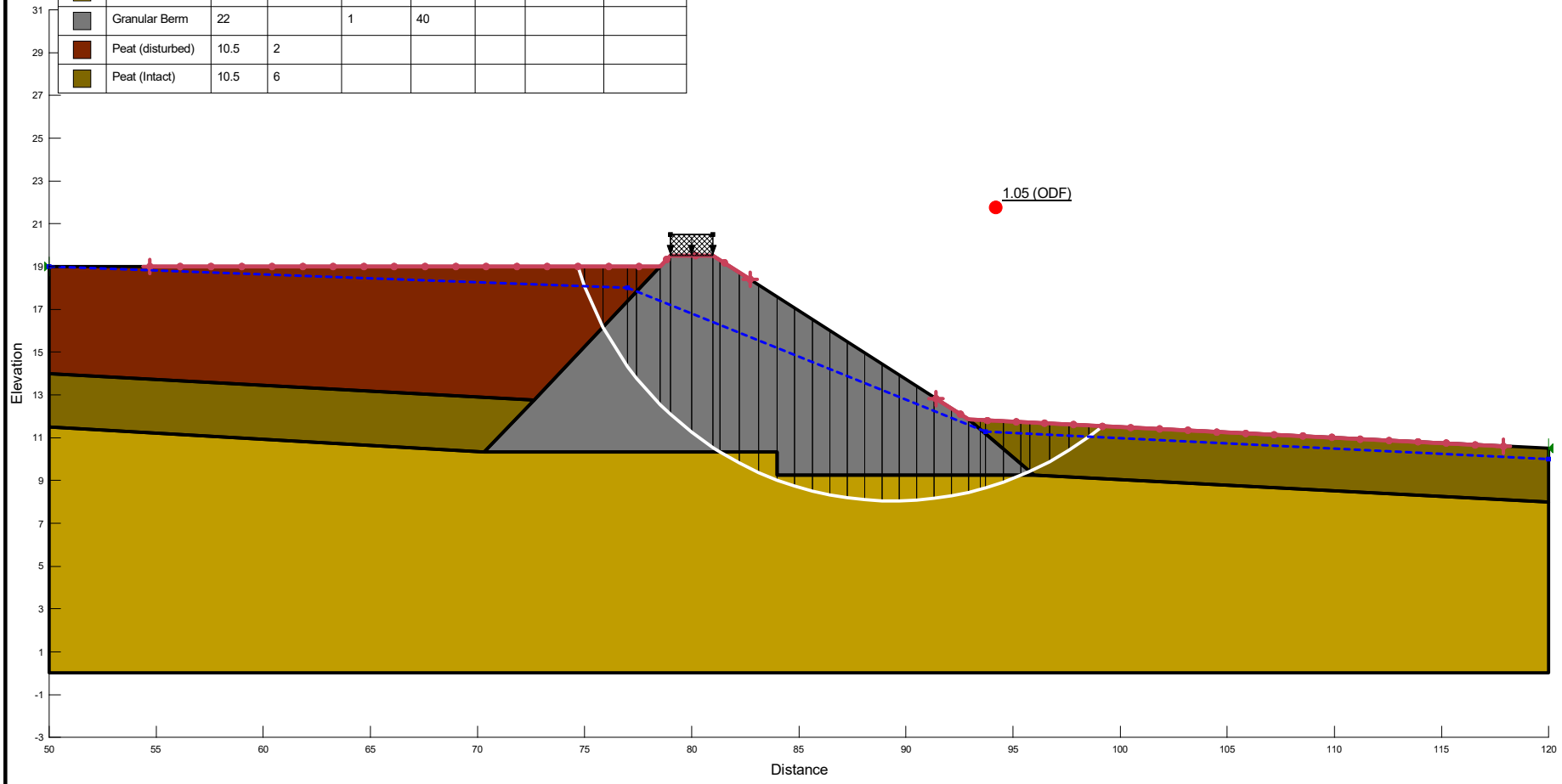


Slope Stability (DA1C1)

peat repository (S) (undrained).gsz

12/03/2026 1:300

Color	Name	Unit Weight (kN/m³)	Undrained Shear Strength (kPa)	Effective Cohesion (kPa)	Effective Friction Angle (°)	C-Top of Layer (kPa)	C-Rate of Change ((kN/m²)/m)	C-Maximum (kPa)
	Cohesive Glacial	20				50	5	80
	Granular Berm	22		1	40			
	Peat (disturbed)	10.5	2					
	Peat (Intact)	10.5	6					

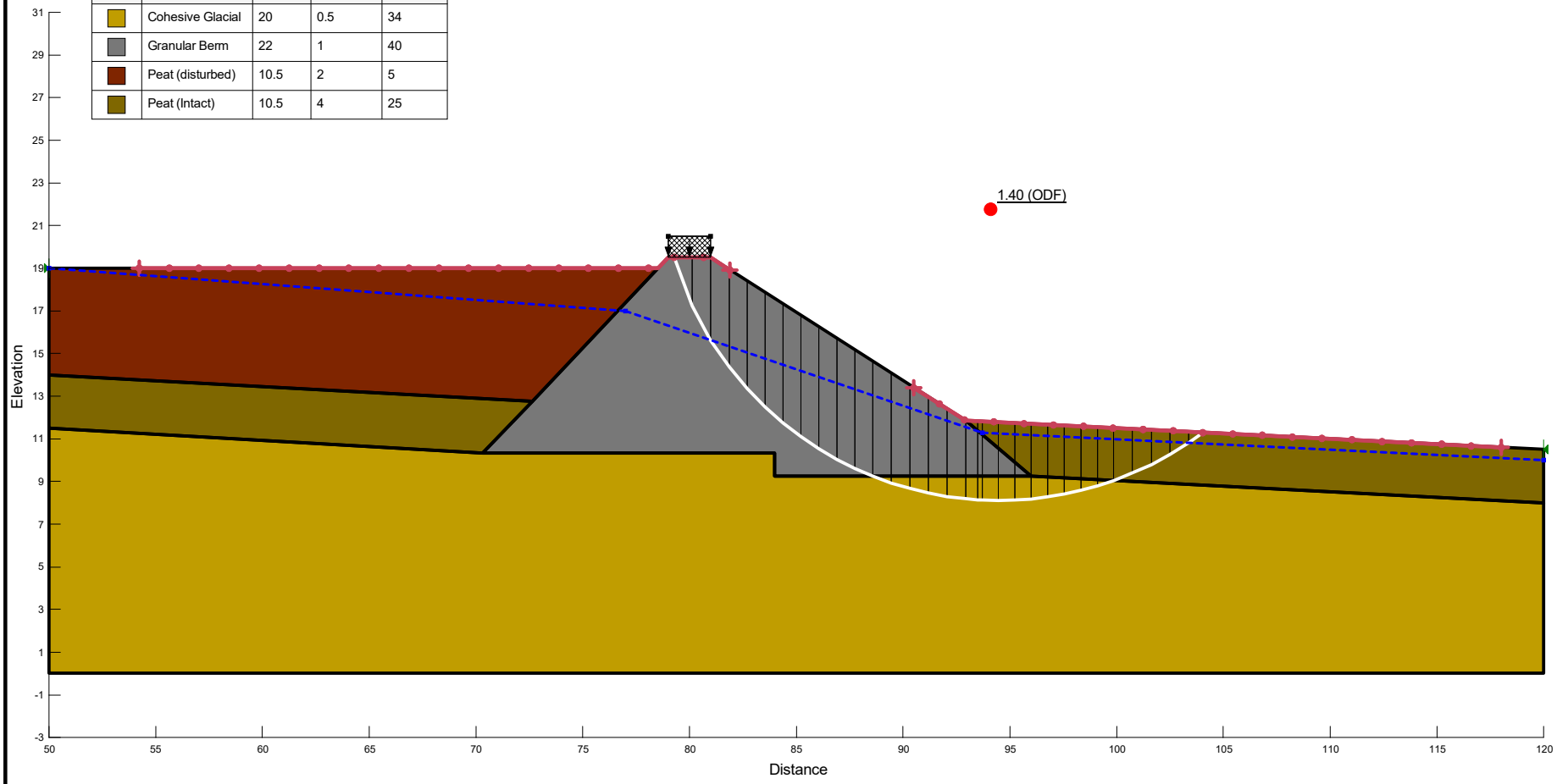


Slope Stability (DA1C2)

peat repository (S) (undrained).gsz

12/03/2026 1:300

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Cohesive Glacial	20	0.5	34
	Granular Berm	22	1	40
	Peat (disturbed)	10.5	2	5
	Peat (Intact)	10.5	4	25

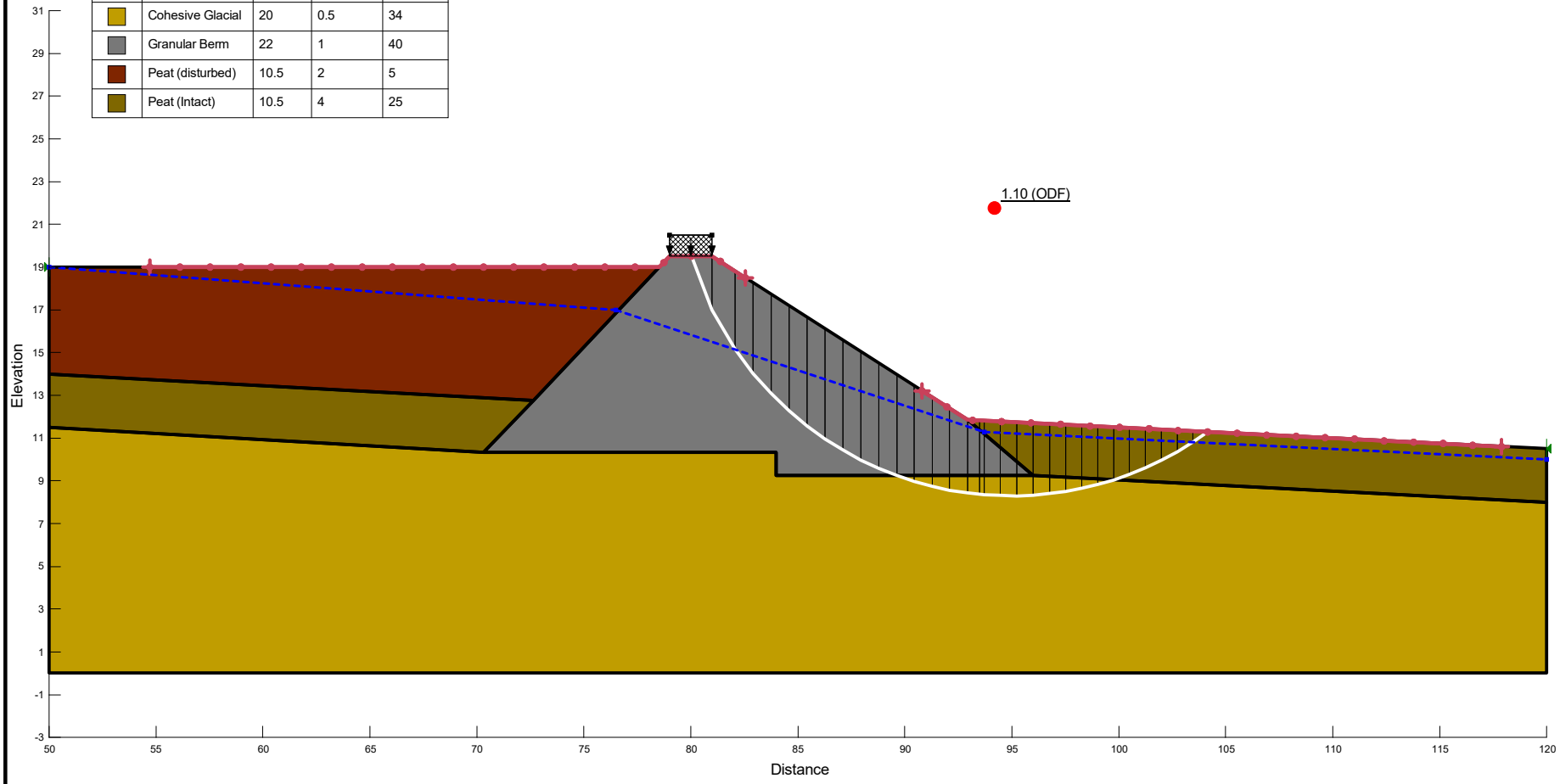


Slope Stability (DA1C1)

peat repository (S) (drained).gsz

05/03/2026 1:300

Color	Name	Unit Weight (kN/m³)	Effective Cohesion (kPa)	Effective Friction Angle (°)
	Cohesive Glacial	20	0.5	34
	Granular Berm	22	1	40
	Peat (disturbed)	10.5	2	5
	Peat (Intact)	10.5	4	25



Slope Stability (DA1C2)

peat repository (S) (drained).gsz

05/03/2026 1:300

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