S. 37

File With _____

SECTION 131 FORM

Appeal NO: ABP 310788-22 **Defer Re O/H** ☐

TO:SEO

Having considered the contents of the submission dated/ received 8/12/22 from

applicant I recommend that section 131 of the Planning and Development Act, 2000 be/not be invoked at this stage for the following reason(s): has not been circulated pending Boards Review

E.O.: Lisa Quinn Date: 9/12/22

To EO: _____

Section 131 not to be invoked at this stage. ☐

Section 131 to be invoked – allow 2/4 weeks for reply. ☐

S.E.O.: _____ **Date:** _____

S.A.O: _____ **Date:** _____

M _____

Please prepare BP _____ **- Section 131 notice enclosing a copy of the attached submission**

to: _____

Allow 2/3/4weeks – BP _____

EO: _____ **Date:** _____

AA: _____ **Date:** _____

S. 37

File With _____

CORRESPONDENCE FORM

Appeal No: ABP 310788-22

M _____

Please treat correspondence received on 8/12/22 **as follows:**

1. Update database with new agent for Applicant/Appellant _____	
2. Acknowledge with BP 23	**1. RETURN TO SENDER with BP** _____
3. Keep copy of Board's Letter ☐	2. Keep Envelope: ☐
	3. Keep Copy of Board's letter ☐

Amendments/Comments
applicants Response to S132

4. Attach to file	
(a) R/S ☐ (d) Screening ☐	**RETURN TO EO** ☑
(b) GIS Processing ☐ (e) Inspectorate ☐	
(c) Processing ☐	

	Plans Date Stamped ☐
	Date Stamped Filled in ☐
EO: Lisa Quinn	**AA:** Lisa Q
Date: 9/12/22	**Date:** 9/12/22

Lisa, Lita

Aisling Reilly

From:	John Willoughby <jwilloughby@mkoireland.ie>
Sent:	Thursday 8 December 2022 15:14
To:	Appeals2
Cc:	Lita Clarke; Eoin McCarthy
Subject:	ABP Ref. 310788 - Further Information Response - Croagh Wind Farm , County Sligo (20251)
Attachments:	2022.12.08 - ABP FI Response Cover Letter Sligo - 180511-c - F.pdf
Follow Up Flag:	Follow up
Flag Status:	Completed

Dear An Bord Pleanála,

Please see attached a Response to a Request for Further Information issued by An Bord Pleanála on 11th November 2022 in relation to case reference ABP-310788-21.

Can you please confirm receipt of this submission ahead of the 5.30pm deadline today?

If you require anything further please let me know.

Kind regards,
John

John Willoughby
Project Planner

MKO
Tuam Road, Galway, H91 VW84

Offices in Galway and Dublin
mkoireland.ie | +353 (0)91 735 611

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An Bord Pleanála,
64 Marlborough St,
Rotunda,
Dublin 1,
D01V902

Our Ref: 180511-c
Your Ref: ABP-310788-21

8th December 2022

Re: Response to Request for Further Information – Croagh Wind Farm
Permission for the Construction of 2 no. Wind turbines, 1 no. Meteorological Mast and all associated site development works in the townlands of Carrowmore, and Carrownyclowan, County Sligo.

Dear Sir/Madam,

I refer to the Request for Further Information (RFI) issued by An Bord Pleanála (ABP) by letter dated 11th November 2022 in relation to the abovementioned project. The terms of the RFI were noted and considered in detail by the Applicant. The detail provided as part of this response in respect of the RFI has been prepared in consultation with Fehily Timoney & Company (FT), Hydro Environmental Services Ltd. (HES) and AWN Consulting (AWN). Responses from each respective consultant are enclosed with this letter.

In the letter of 11th November 2022, ABP requested the following:

> *"In considering all the information and submissions on the file including Chapter 8 of the EIAR, the Peat and Spoil Management Plan submitted as Appendix 4-2 of the EIAR, the Geotechnical and Peat Stability Assessment Report submitted as Appendix 8-1 of the EIAR and the applicant's response to the further information request from the Planning Authority provided as Appendix A Stability Analysis of Borrow Pits, Peat Repositories and Settlement Ponds, the Board could not be satisfied that the proposed repositories would be effective in providing for the permanent retention of peat and other materials and that the mitigation measures, inclusive for the proposed drainage system, would be adequate to ensure that there would be no significant risk of adverse environmental impacts or serious injury to properties in the vicinity of the proposed development.*
>
> *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 rock at the repository locations, and the hillside siting of the northernmost repository and the associated clear felling of forestry.*
>
> *Furthermore, the Board noted that the proposed development is located in a low noise environment and that there are substantial separation distances between proposed turbines and existing houses in the area. However, the Board noted that the applicant has acknowledged that*

there is residual potential for adverse effects arising from low frequency noise and amplitude modulation and is committed to investigating such adverse effects if they arise. The Board is seeking further information from the applicant on how the issue would be mitigated in the event that adverse effects arise."

In response to the above matters, the following documents and details have been prepared and enclosed with this response, which clarify the above matters.

Geotechnical Information and Peat Stability Assessment of the Peat & Spoil Repositories and Borrow Pit

FT have prepared a comprehensive Geotechnical and Peat Stability Assessment Response which is enclosed as Appendix 1 to this letter. FT's Response documents provide further clarity in relation to the Location of Proposed Borrow Pit and Repositories including the existing land use and ground conditions as well as the type and condition of the rock, the construction of Borrow Pit and Peat Repositories, Stability of Borrow Pit and Repositories and Contingency Measures Specifically for Peat Repository Locations.

Water Quality and Drainage Control

HES have prepared a letter setting out the requested information relating to Water Quality and Drainage Control relating to the Borrow Pit and Peat & Spoil Repositories which is enclosed with this letter as Appendix 2 which concludes that:

Comprehensive drainage proposals have been prepared for the Croagh Wind Farm development. The Updated Drainage Plans submitted with the Further Information submission to the planning authorities in April 2021, are backed up with supporting calculations..... The details provided are comprehensive, comply with IFI requirements and are of a detailed construction phase design standard that provide the highest level of protection recommended by the EPA.

The drainage management proposal for this development, including those at the peat repositories and borrow pit, are technically sound and based on many years of experience of working on similar sites. They include fail-safe and several levels of controls in series3. The application of the drainage management as outlined will ensure compliance with EU Surface Water Regulations and WFD requirements while also maintaining the baseline hydrology of the site and downstream receiving waters (surface water and groundwater).

All tree felling will be undertaken by implementation of standard forestry mitigation as detailed in the EIAR and FIR responses.

Clear Felling of Forestry within the Borrow Pit and Peat & Spoil Repository Areas

As part of the above request, ABP appear to be seeking clarity in relation the clear felling of forestry within the peat and spoil repository areas and borrow pit.

MKO, Tuam Road, Galway, Ireland. H91 VW84
+353 (0)91 735611 | info@mkoireland.ie | www.mkoireland.ie | @mkoireland
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A detailed methodology for the felling works associated with the Croagh Wind Farm development was provided in Section 2.73.1.1 of the Further Information Response document submitted to Leitrim County Council (Pl. Ref. 20/120) in April 2021. Maps highlighting the areas of forestry to be felled were included as Appendix 13 of the same Further Information Response document.

MKO wish to take this opportunity to clarify that while the trees within the peat and spoil repository areas will be felled, the remaining tree stumps will be left in situ so as to reduce ground disturbance, in so far as possible. Tree stumps will only be removed from areas where excavation of peat and spoil is to take place (i.e. for the base of the perimeter berms surrounding the peat and spoil repository areas). No excavation of peat and spoil will take place within peat and spoil repository areas.

Visual Aid for Borrow Pit and Peat Repository

Computer-generated representations of the Borrow Pit and the Peat and Spoil Repositories have been prepared by TANTEK 4D to provide ABP with further clarity as to how these elements will look during, and upon the completion, of the construction phase of the Croagh Wind Farm development. These representations are based on the plans and cross-sections that were provided as part of the EIAR and the Further Information Response documentation. These representative visualisations are enclosed as Appendix 3.

Environmental Noise relating to the operation of the Croagh Wind Farm development

AWN have prepared a response to the matters concerning environmental noise relating to the operation of the Croagh Wind Farm development, including details in respect of low frequency noise and amplitude modulation, enclosed at Appendix 4. The response prepared by AWN concludes that at no point in the EIAR Chapter nor the FI documents (submitted to the Local Authorities) is it stated that there is a residual potential for adverse effects arising from either low-frequency noise nor amplitude modulation. The Response prepared by AWN goes on to conclude that:

> *"This technical note has been prepared in response to a request for Further Information from ABP in relation to the planning application for the Croagh Wind Farm.*
>
> *It is re-iterated that at no point in the EIAR nor the FI documents is it stated that there is a residual potential for adverse effects arising from either low-frequency noise nor amplitude modulation.*
>
> *The submitted noise impact assessment is robust and has been carried out in line with current standards and best practice guidelines (i.e. Planning Guidelines for Wind Development 2006 and IOA GPG). In addition to these guidelines, discussion has been provided in relation to matters such as Low frequency noise, Infrasound, and Amplitude Modulation. The submitted EIAR Noise and Vibration assessment , as supplemented by the FI responses to Sligo and Leitrim County Councils, demonstrates that the proposed development can operate within the noise criteria derived from the relevant guidance. This document has reiterated the relevant sections of the EIAR to comprehensively address the concerns raised by the F.I. request, and confirms the measures which will be implemented in full to ensure any issue will be mitigated in the unlikely event of adverse effects arising as a result of low frequency noise or amplitude modulation."*

We trust that the above and enclosed clarifies matters and that *the Board can now be satisfied the proposed repositories will be effective in providing for the permanent retention of peat and other materials and that the proposed measures, inclusive of the proposed drainage system, are adequate to ensure that there will be no significant risk of adverse environmental impacts or serious injury to properties in the vicinity of the proposed development.* We respectfully request that given the information that is now before the Board, the Board will uphold the Planning Authority's Decision to Grant Permission for the proposed development.

Should you require anything further please do not hesitate to get in touch.

Yours faithfully,

John Willoughby

John Willoughby, B.A., M.Sc., MIPI
MKO
jwilloughby@mkoireland.ie
Tel: 091 735611

Encl.

- Appendix 1: Geotechnical and Peat Stability Assessment Response - Prepared by Fehily Timoney and Company
- Appendix 2: Water Quality and Drainage Control Response prepared by Hydro Environmental Services Ltd.
- Appendix 3: Computer-generated, representations of Borrow Pit and Peat & Spoil Repositories prepared by TANTEK 4D
- Appendix 4: Operational Phase Environmental Noise Response Prepared by AWN Consulting
- Appendix 5: An Bord Pleanála Request for Further Information (Ref. 310788).

APPENDIX 1 - Geotechnical and Peat Stability Assessment Response

Prepared by Fehily Timoney & Company

MKO, Tuam Road, Galway, Ireland. H91 VW84
+353 (0)91 735611 | info@mkoireland.ie | www.mkoireland.ie | @mkoireland
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FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

CROAGH WIND FARM

RESPONSES TO ABP FURTHER INFORMATION REQUEST

Prepared for: **MKO Ltd**

Date: December 2022

Unit 6, Bagenalstown Industrial Park, Bagenalstown,
Co. Carlow, R21 XW81, Ireland
T: +353 59 9723800 E: info@ftco.ie

CORK | DUBLIN | CARLOW

www.fehilytimoney.ie

CROAGH WIND FARM

RESPONSES TO ABP FURTHER INFORMATION REQUEST

User is responsible for Checking the Revision Status of this Document

Rev. No.	Description of Changes	Prepared by:	Checked by:	Approved by:	Date:
0	Draft for Comment	IH	TC	BdH	28.11.22
1	Final	IH	TC	BdH	01.12.22
2	Final	IH	TC	BdH	05.12.22
3	Final (including borrow pit)	IH	TC	BdH	07.12.22
4	Final	IH	TC	BdH	08.12.22

Client: MKO Ltd

Keywords: Geotechnical, Peat Stability, Risk Assessment

Abstract: Fehily Timoney (FT) were requested by MKO on behalf of Futurenergy Ireland, to prepare responses to a Further Information Request received from An Bord Pleanala (ABP) following the Planning submission for 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 90 members of staff, including engineers, scientists, planners and technical support staff. FT deliver projects in Ireland and internationally in our core competency areas of Waste Management, Environment and Energy, Civils Infrastructure, Planning and GIS and Data Management.

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

This response was written by Ian Higgins (FT Principal Geotechnical Engineer, MSc in Geotechnical Engineering). Ian is a Principal Geotechnical Engineer with Fehily Timoney and has over 20 years' experience in geotechnical engineering and wind farm developments, such as Derrinlough Wind Farm, Coom Green Energy Park and Oweninnny Wind farm (detailed design).

1.2 An Bord Pleanala (ABP) Further Information Request

The following further information request was received:

In considering all the information and submissions on file including Chapter 8 of the EIAR, the Peat and Spoil Management Plan submitted as Appendix 4-2 of the EIAR, the Geotechnical and Peat Stability Assessment Report as submitted as Appendix 8-1 and applicant's response to the further information request from the Planning Authority provided as Appendix A Stability Analysis of Borrow Pits, Peat Repositories and Settlement Ponds, the Board could not be satisfied that the proposed repositories would be effective in providing for the permanent retention of peat and other materials and that the mitigation measures, inclusive of the proposed drainage system, would be adequate to ensure that there would be no significant risk of adverse environmental impacts or serious injury to properties in the vicinity of the proposed development.

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.

1.3 Information Provided to Date

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

- The results of peat depth probing, the peat stability assessment, and the results of the trial pitting undertaken across the site are contained in the Peat Stability Assessment Report. A total of four site visits and two sets of trial pitting were undertaken over a two year period, providing information on

both the repository locations and across the site in general. An additional site visist was undertaken in November 2022. Land use remains the same as described in the EIAR.

- A construction methodology and plan and section drawings for the two peat repositories is contained in Section 7.5 of the Peat & Spoil Management Plan.
- Responses to FI requests from Sligo and Leitrim County Councils. This included stability calculations for the borrow pit and the two repositories.

2. RESPONSE TO AN BORD PLEANALA FURTHER INFORMATION REQUEST

2.1 Location of Peat Repositories

The locations for the peat repositories were chosen following a review of data from ground investigations (such as peat probes and trial pits) and contour survey data. The locations were chosen based on the following:

- Being in locations of relatively shallow peat. Peat depths for the northern repository ranged from 0.3 to 1m (Figure 2.2), from 0.6 to 2.7m at the southern repository (1.7m on average, Figure 2.3), and 0.5 to 1.7m at the borrow pit (average of 1.2m, Figure 2.4) compared to a range of 0 to 8.2m and an average peat depth of 2.2m across the entire site. This is important because all peat below the proposed perimeter berms around the repositories has to be removed to provide a competent base for the berms, and if the peat is too deep then all of the storage space within the repository would be needed to store the peat excavated from beneath the berms
- At locations where ground investigation had indicated the presence of relatively shallow peat, underlain by a firm to stiff Clay (Glacial Till) and also the presence of weathered rock relatively close to the surface (southern repository) to ensure that the ground has sufficient bearing capacity for the proposed berms. Relevant ground investigation comprised a series of trial pits. Trial pit TP01 MKO was undertaken at the southern repository,(Figure 2.5), and trial pits TP3 and TP7A were undertaken at the northern repository (Figure 2.6). 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 (Figure 2.7).
- At locations with relatively flat slopes, as steep slopes would require large berms that would only be able to store a small volume of peat. Slope angles at the repository locations vary from 2-6 degrees (southern repository) to 2-8 degrees (northern repository). The slope angle range across the entire site was 2-12 degrees.
- Avoiding areas of weak peat – shear vane readings at the two repository locations ranged from 23-38kPa at the northern repository and 20-40kPa at the southern repository, which are significantly higher than the lowest recorded across the site (6kPa) and are representative of firm, well drained peat.
- Being relatively close to existing access tracks, which meant that only very short sections of new access tracks would be required to access these areas. This limits the amount of clearance work required to access the repository locations and makes best use of the existing infrastructure on the site.

2.2 Construction of Borrow Pit and Peat Repositories

2.2.1 Borrow Pit

As noted in Section 7.4 of the Peat & Spoil Management Plan (Appendix 4-2 of the EIAR) the following will be followed in the construction and reinstatement of the borrow pit. A cross section of the borrow pit is shown in Figure 7.1 of this submission and have been reproduced from the Peat & Spoil Management Plan (Appendix 4-2 of the EIAR).

The borrow pit shall be constructed as follows:

(1) The rock within the borrow pit footprint will be removed by a combination of breaking and blasting, depending on its excavatability, which will be determined from confirmatory ground investigation carried out at the borrow pit.

(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 may be required depending on extraction operations.

(3) It may be possible to excavate the rock from the borrow pit whilst leaving in place upstands/segments of intact rock which will help to retain the placed peat and spoil. The upstands/segments of intact rock will essentially act as engineered rock buttresses within the borrow pit. If upstands cannot be left in place, engineered berms will be constructed using crushed rock.

(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. 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 of the borrow pit and progress towards the borrow pit entrance/rock buttress. Leaving in place upstands/segments of intact rock which will help to retain the placed peat spoil and will allow the borrow pit to be developed and infilled in cells.

(7) 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 and spoil to prevent any surface peat and spoil run-off. A buttress up to 7m (approx.) in height will be required.

(8) The rock buttress will be founded on Glacial Till or bedrock i.e. competent strata. The founding stratum for the rock buttress should be inspected and approved by the Project Geotechnical Engineer.

(9) In order to prevent water retention occurring behind the buttresses, the buttresses will be constructed of coarse boulder fill with a high permeability. The buttress will be constructed of well graded granular rock fill of about 100mm up to typically 500mm in size. In addition, drains will be placed through the buttresses to allow surface water to drain from the surface of the placed peat.

(10) 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 to 60 degrees.

(11) The use of temporary access ramps and long reach excavators during the placement of the excavated peat and spoil will be required.

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

(13) A layer of geogrid to strengthen the surface of the placed peat and spoil within the borrow pit may be required and will be determined and instructed by the Project Geotechnical Engineer.

(14) 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 prevent run-off from ponding and lodging in the reinstated area.

(15) Control of groundwater within the borrow pit may be required and measures will be determined as part of the confirmatory ground investigation programme. A temporary pump and suitable outfall locations may be required during construction. Refer to EIAR Chapter 4 and 9 for drainage details.

(16) A settlement pond has been designed at the lower side/outfall location of the borrow pit.

(17) Supervision by the Project Geotechnical Engineer is required for the development of the borrow pit.

(18) All the above-mentioned general guidelines and requirements will be undertaken by the Contractor during construction.

In addition to the above included in Section 7.5 of the Peat & Spoil Management Plan the following is noted to ensure the stability of the borrow pit berm.

(1) Prior to construction of the perimeter berm, all peat and soft clay will be removed from below the footprint of the berms, temporarily stored locally, and placed in the borrow pit.

(2) A level surface in the underlying stiff Clay (Glacial Till) or Weathered Bedrock will be prepared before placing and compacting the rock fill used to construct the berms.
(3) The berms will be completed prior to any peat being placed within the repositories. The top of the berm will be a minimum of 2m in width and will be 0.5m higher than the final height of placed peat.
(4) As the berms are slightly higher than the retained peat, drains will be provided at regular intervals through the berms, 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.

2.2.2 Peat Repositories

As noted in Section 7.5 of the Peat & Spoil Management Plan (Appendix 4-2 of the EIAR) the following will be followed in the construction of the peat repositories. Cross sections of both repositories are shown in Figure 7-2 (southern repository) and 7-3 (northern repository) of this submission and have been reproduced from the Peat & Spoil Management Plan (Appendix 4-2 of the EIAR) but including a minor edit to show the base of the proposed perimeter berms (also referred to stone buttresses) as horizontal or benched into the existing slope on sidelong ground.

(1) All stone buttresses for the repository areas will be founded on glacial till soil or bedrock i.e. competent strata. The founding stratum for each stone buttress will be inspected and approved by the Project Geotechnical Engineer.
(2) 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. In addition, drains will be placed through 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 45 degrees. The stone buttresses will be sufficiently widened (to 4m in width) 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 (refer to Figures A and B in the HES response to the FI Request for further details).
(6) A settlement pond will be required at the lower side of the repository areas, as shown on the drainage drawings within the EIAR and referenced in the HES response (Figure A and B) to the FI request.
(7) A granular layer of material will be placed at the base of the stored spoil immediately upslope of the stone buttresses to act as a drainage layer. This drainage layer will aid in preventing a build-up of pore water pressure behind the stone buttress.
(8) 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.
(9) The surface of the stored peat will be shaped to allow efficient run-off of water from the stored peat.
(10) Supervision by the Project Geotechnical Engineer is required for the construction of the repository area.

In addition to the above included in Section 7.5 of the Peat & Spoil Management Plan the following is noted to ensure the stability of the repositories.

(1) Prior to construction commencing, confirmatory ground investigation will be undertaken to confirm the founding levels for the perimeter berms at both repository locations.
(2) Prior to construction of the perimeter berms, all peat and soft clay will be removed from below the footprint of the berms, temporarily stored locally, and eventually placed either in the repository or the borrow pit.
(3) A level surface in the underlying Clay (Glacial Till) or Weathered Bedrock will be prepared before placing and compacting the rock fill used to construct the berms.
(4) The berms will be completed prior to any peat being placed within the repositories. The top of the berm will be a minimum of 2m in width and will be 0.5m higher than the final height of placed peat.
(5) As the berms are slightly higher than the retained peat, drains will be provided at regular intervals through the berms, 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) In the first year following completion of the repositories, monitoring will be undertaken every two months to inspect the condition of the repositories.

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. An 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 2.1: Aerial photo of material storage area at Lenalea Wind Farm

2.3 Stability 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 berms

for the repositories on a flat bench, as noted in Section 2.2 above. Additionally, a 10kPa live load has been added to the top of the berm in the undrained case to mimic temporary construction loading during construction. Outputs from the stability analysis are shown in Appendix B of this submission and the results are summarised in Table 2.2.

A stability check has been undertaken to demonstrate the stability of the proposed perimeter berms around the borrow pit and peat repositories. Slope stability has been checked using Talren 5 slope stability software. The analysis was carried out without using partial factors, and as such a minimum Factor of Safety (FoS) of 1.3 is required to demonstrate the stability of the proposed berms, as explained in Section 2.5 and 7.1 of the Peat Stability Assessment Report (Appendix 4-1 of the EIAR). The previous code of practice for earthworks BS 6031:1981 (BSI, 1981), provided advice on design of earthworks slopes. It stated that for a first-time failure with a good standard of site investigation the design FoS should be greater than 1.3. In addition, a check was undertaken as part of this FI response to ensure that the berms complied with the requirement of Eurocode 7 (EC7). 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 ratio (ODR), where an ODR of >1 is stable, and an ODR of <1 is unstable.

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

The following material properties have been used in the stability assessment. A 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 peat within the repository locations 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 20-40kPa at the southern repository) and as such this is considered conservative.

Table 2.1: 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)	21	-	46	0
Retained Peat within Borrow Pit/ Repository (disturbed)	10.5	2	5	2
Glacial Till	20	75	34	0.5
Bedrock	21	-	34	250

2.3.1 Borrow Pit

The berm 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 2m below ground level based on the ground investigation information, overlain by an average of 0.75m of peat and 1.25m of Glacial Till. All peat will be excavated from below the perimeter berm. The base of the rock berm will be benched into the glacial till/weathered bedrock to create a level platform. The inside slope of the perimeter berm has been modelled as a 60 degree slope, and the outside slope as 45 degrees. Groundwater has been assumed at ground level on the downslope side of the berm.

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

2.3.2 Peat Repository 1 (South)

The berm around the perimeter of the repository will be up to 7m in height. An average existing peat thickness of 1.5m has been determined from peat probes taken in the area. All peat will be excavated from below the footprint of the perimeter berm. The base of the rock berm will be benched into the glacial till to create a level platform. The internal and external slopes of the berms have been modelled at 45 degrees. Groundwater has been assumed at ground level as a conservative worst case.

2.3.3 Peat Repository 2 (North)

The berm 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 berm. The base of the rock berm will be benched into the glacial till to create a level platform. The internal and external slopes of the berms have been modelled at 45 degrees. Groundwater has been assumed at ground level as a conservative worst case.

2.3.4 Summary of Results

The stability assessment has recorded FoS results (Table 2.2) at each location of in excess of 1.3 (or 1.0 to EC7), which is considered acceptable. Outputs of the results are provided in Appendix B. This indicates that there is a low risk of peat failure associated with the construction of the Peat Repositories.

Table 2.2: Factor of Safty Results for Peat Repositories

	BS6031(1981)		Eurocode (EC7)	
	Undrained Analysis	Drained Analysis	Undrained Analysis	Drained Analysis
Borrow Pit	2.69	1.96	1.50	1.61
Peat Repository 1 (South)	2.49	1.84	1.79	1.47
Peat Repository 2 (North)	1.93	1.43	1.52	1.14

2.4 Contingency Measures Specifically for Peat Repository Locations

2.4.1 Borrow Pit

The ground at the borrow pit falls to the southwest. In the unlikely event of a failure to the northwest of the repository, a check barrage will be constructed alongside the existing Coillte access track 50m to the southwest of the repository, as this will be the most likely route, based on local topography, for a failure in this direction. This will prevent failed material from entering the adjacent Arigna River. An additional barrage location is located at a point some 240m southwest of the borrow pit, where the Arigna River passes under an existing Coillte track. This barrage will be constructed across the Arigna River, but with sufficient voids within the berm that water flow is not significantly impeded. The locations described above are illustrated on Figure 2.8.

Barrages will be constructed as described in Section 12.3 of the Peat & Spoil Management Plan (Appendix 4-2 of the EIAR) for Croagh Wind Farm. Any check barrages will be temporary in nature and will be removed if no failed material reaches the barrage. Should any failed material reach a barrage, the barrage will be required to remain in-situ to stabilise the failed material, unless the failed material is removed.

2.4.2 Peat Repository 1 (South)

The ground at the southern repository falls to the northwest and southeast. In the unlikely event of a failure to the northwest of the repository, a check barrage will be constructed alongside the existing Coillte access track present 100m to the northwest of the repository, as this will be the most likely route, based on local topography, for a failure in this direction. This will prevent failed material from entering the adjacent Arigna River.

In the unlikely event of a failure occurring to the southeast of the repository, failed material may enter a small drain that flows to the Arigna River. This drain crosses an existing Coillte access track approximately 230m to the southeast of the repository. An appropriate check barrage will, should a failure occur, be constructed at this point to prevent any failed material flowing further downstream and entering the Arigna River. The locations described above are illustrated on Figure 2.9.

Barrages will be constructed as described in Section 12.3 of the Peat & Spoil Management Plan (Appendix 4-2 of the EIAR) for Croagh Wind Farm. Any check barrages will be temporary in nature and will be removed if no failed material reaches the barrage. Should any failed material reach a barrage, the barrage would be required to remain in-situ to stabilise the failed material, unless the failed material is removed.

2.4.3 Peat Repository 2 (North)

The ground level at the northern repository falls to the northwest. In the unlikely event of a peat failure, a check barrage will be constructed along the edge of forestry some 100m north/northwest of the repository. Should any failed material enter the stream flowing to the north – northwest, an alternative barrage location is located at a point some 800m north - northwest of the repository, where the stream passes below an existing Coillte track. The locations described above are illustrated on Figure 2.10.

Barrages will be constructed as described in Section 12.3 of the Peat & Spoil Management Plan (Appendix 4-2 of the EIAR) for Croagh Wind Farm. Any check barrages will be temporary in nature and will be removed if no failed material reaches the barrage. Should any failed material reach a barrage, the barrage will be required to remain in-situ to stabilise the failed material, unless the failed material is removed.

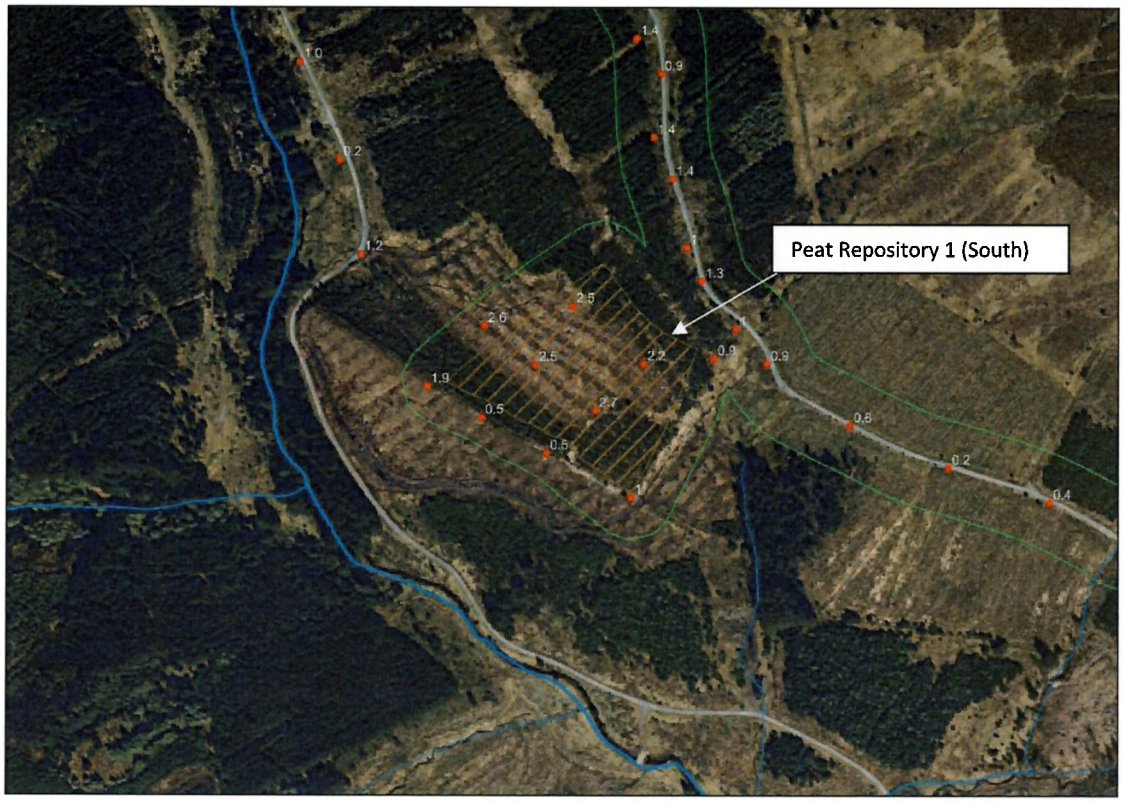


Figure 2.2: Peat probe locations (red dots) for Peat Repository 1 (South)

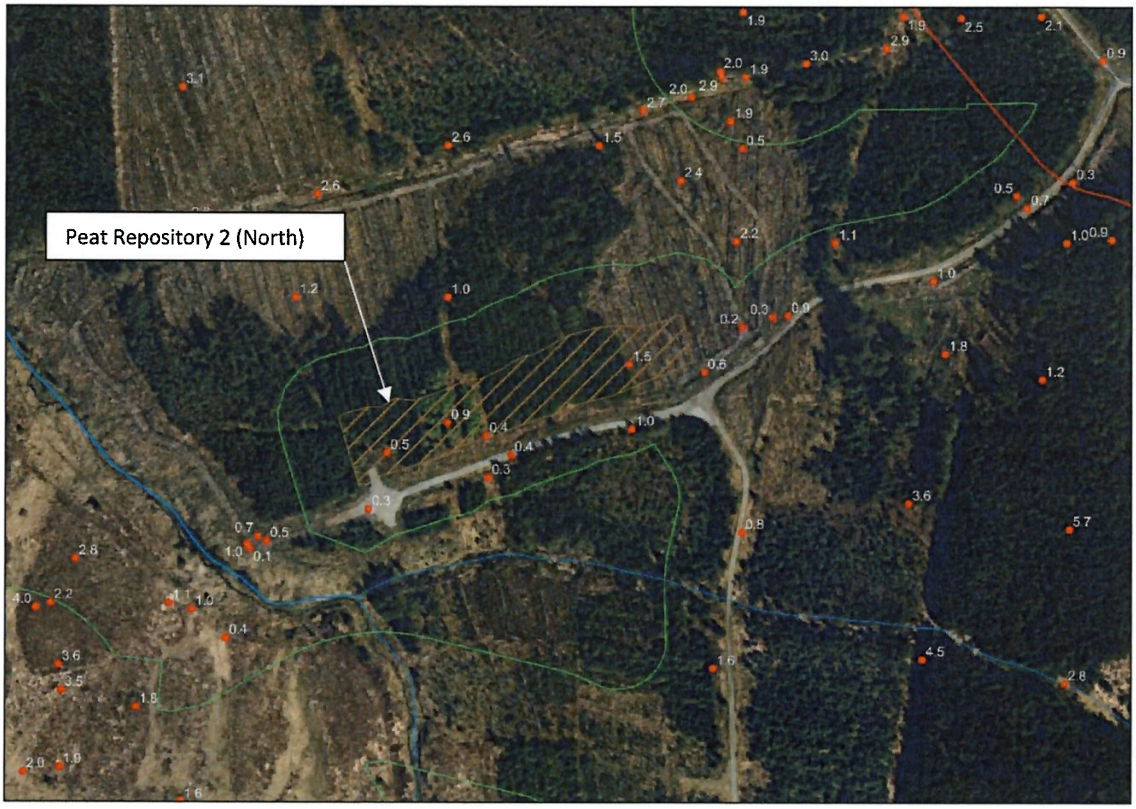


Figure 2.3: Peat probe locations (red dots) for Peat Repository 2 (North)

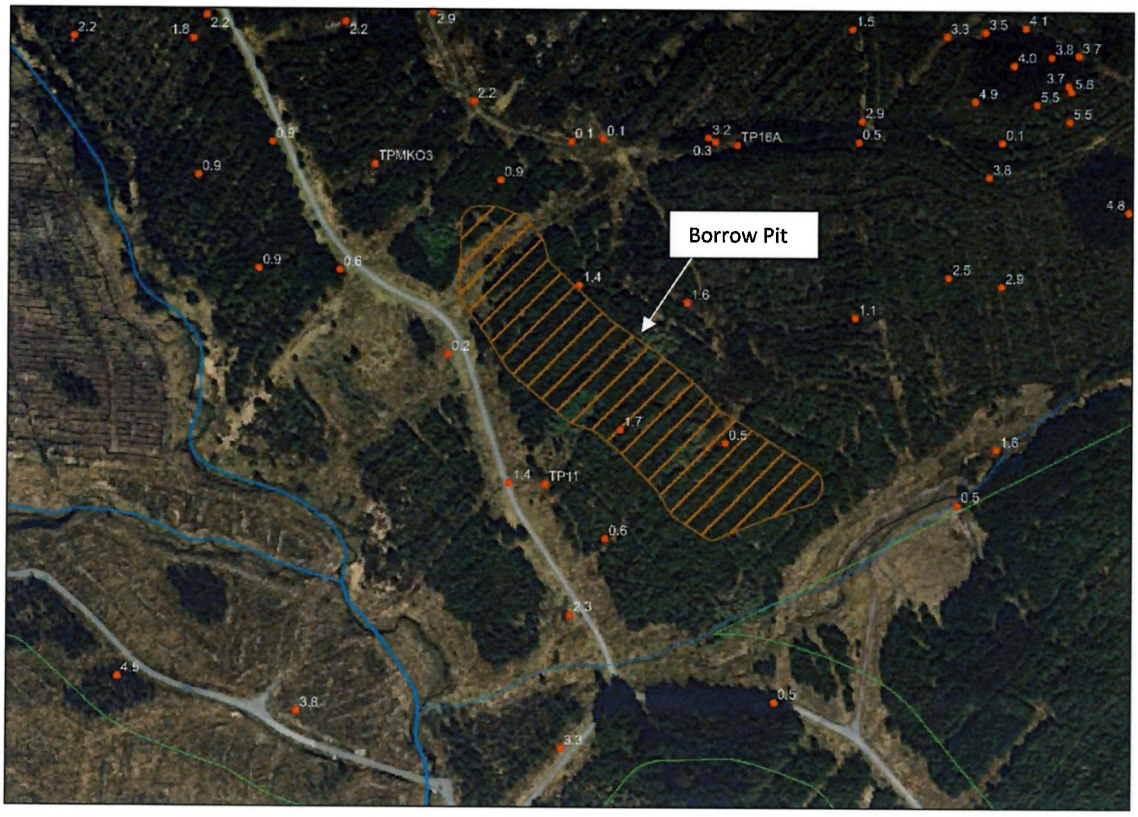


Figure 2.4: Peat probe locations (red dots) for Borrow Pit

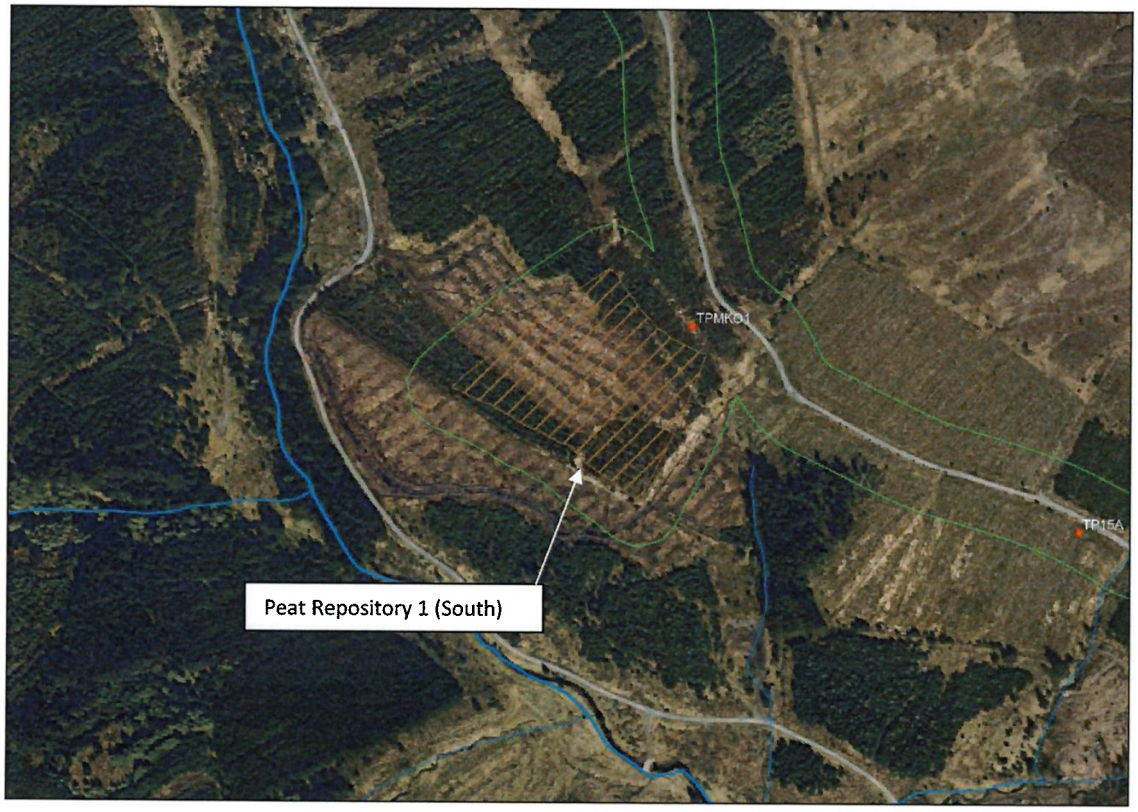


Figure 2.5: Trial Pit locations for Peat Repository 1 (South)

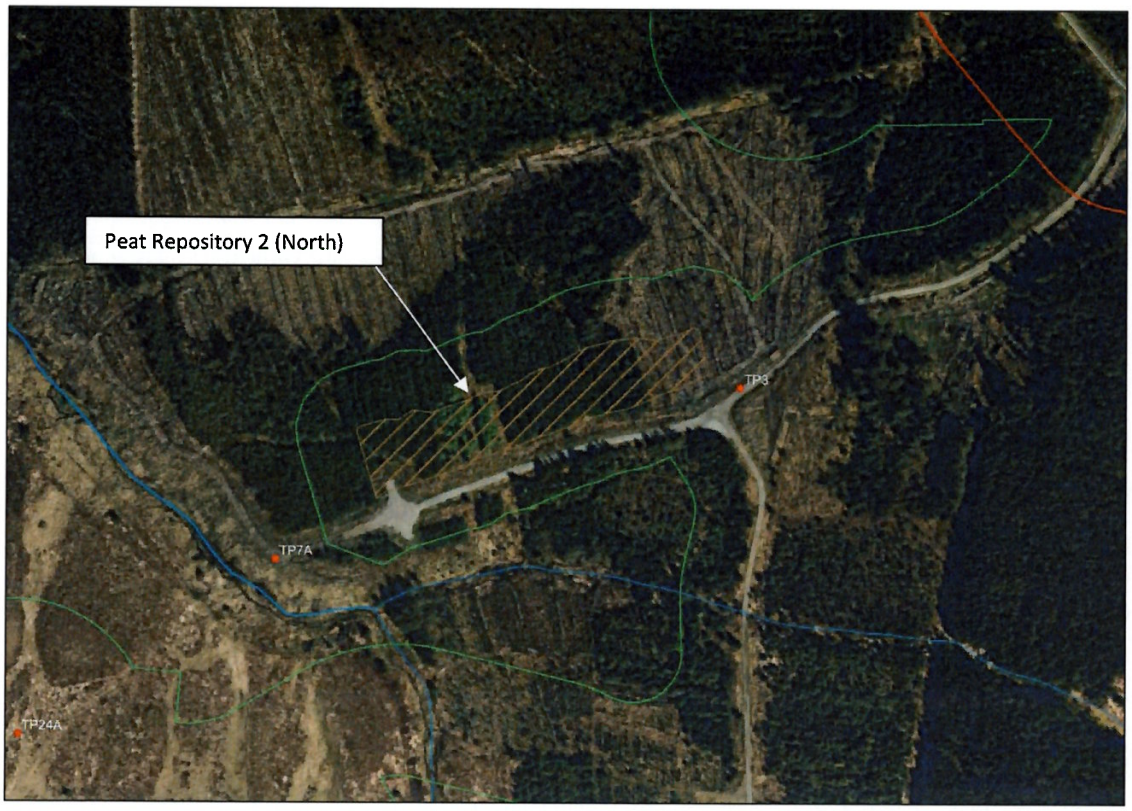


Figure 2.6: Trial Pit locations for Peat Repository 2 (North)



Figure 2.7: Trial Pit locations for Borrow Pit

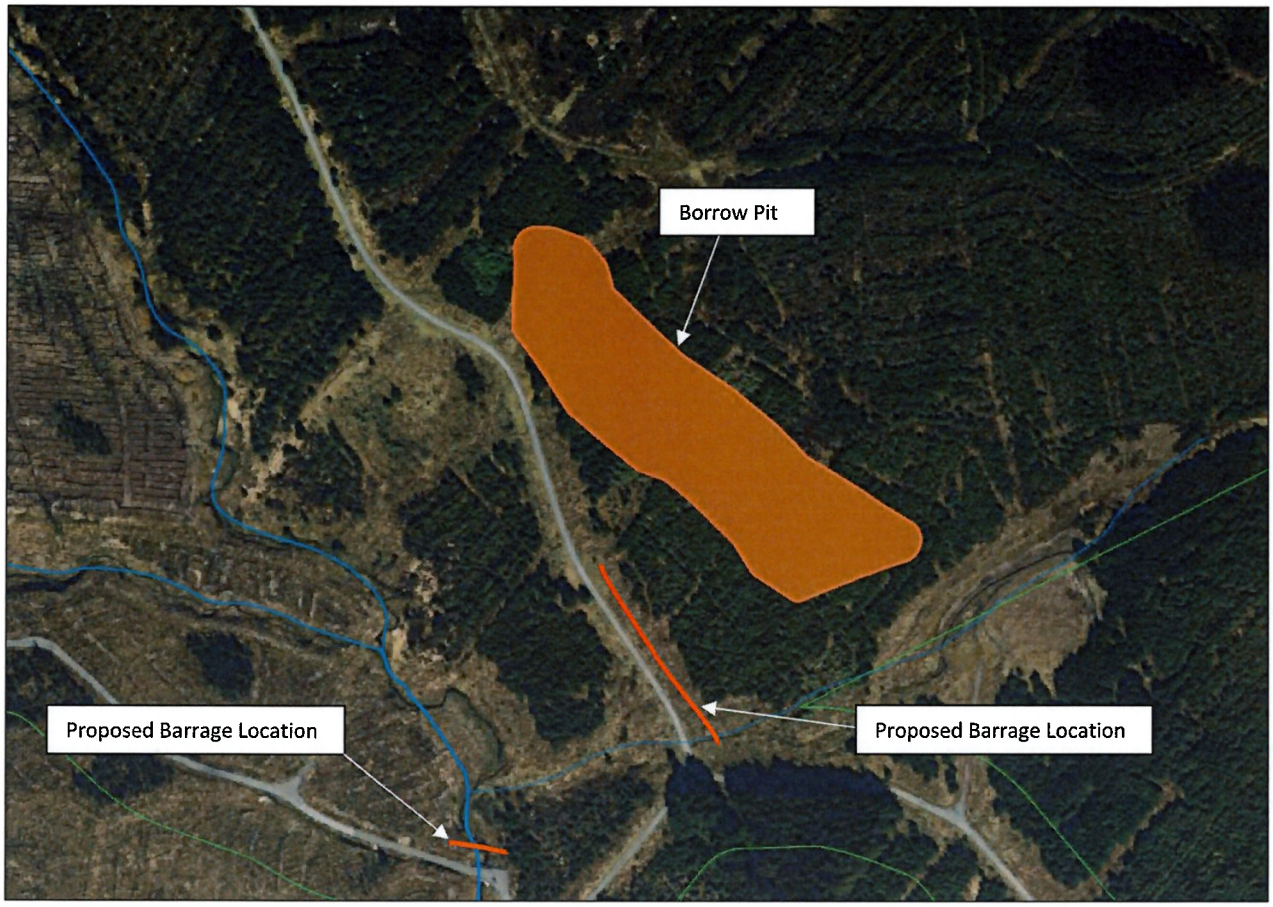


Figure 2.8: Check Barrage locations for Borrow Pit

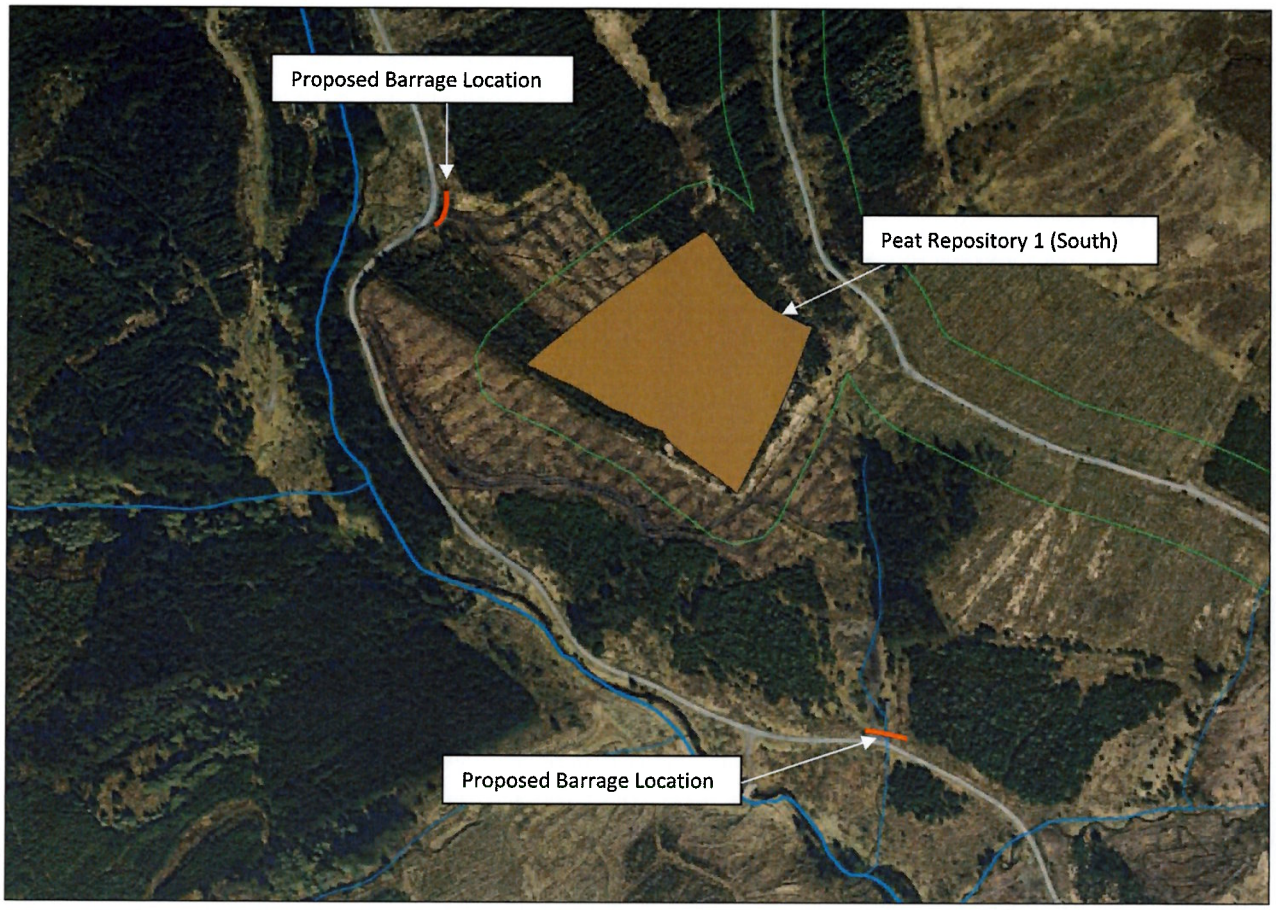


Figure 2.9: Check Barrage locations for Peat Repository 1 (South)

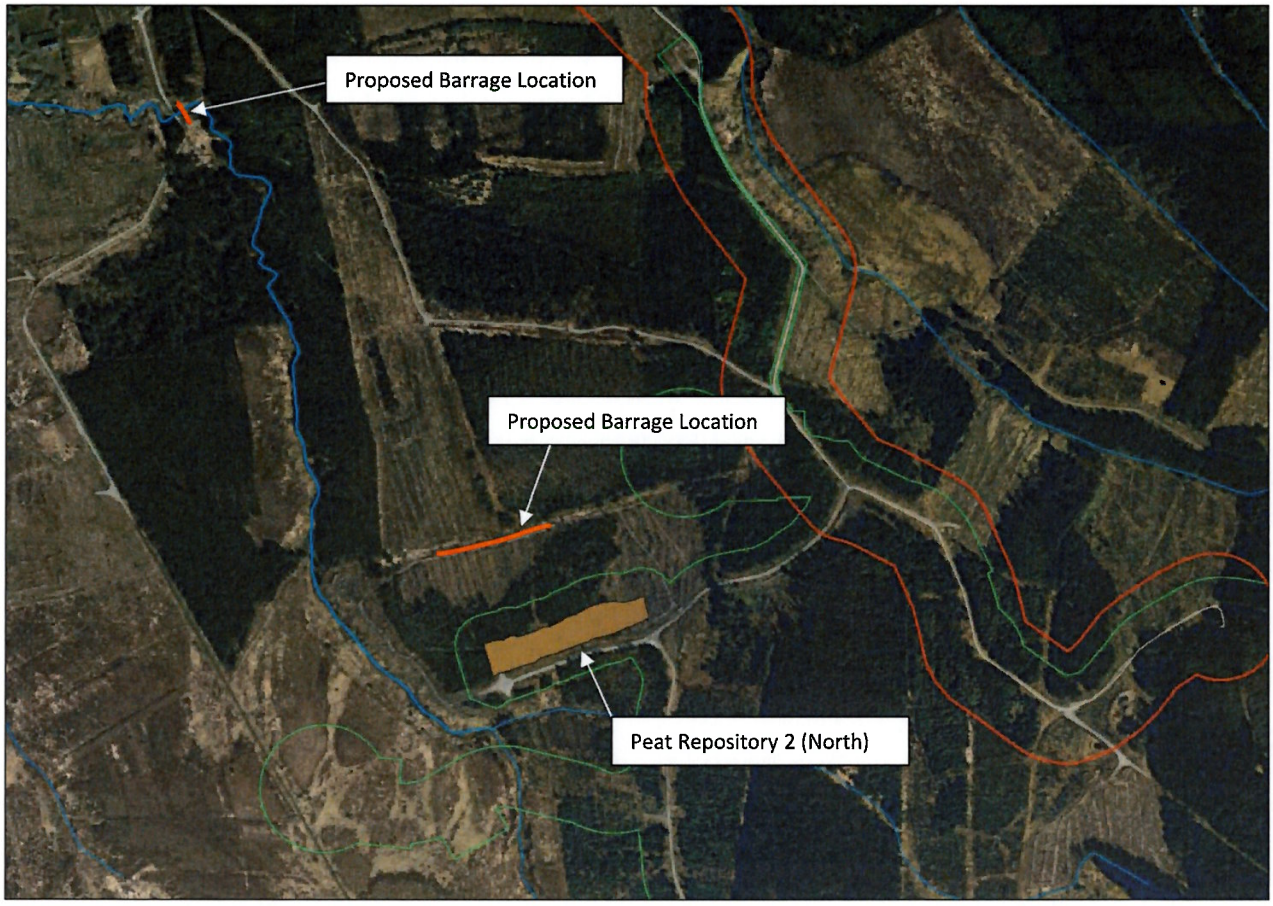


Figure 2.10: Check Barrage locations for Peat Repository 2 (North)

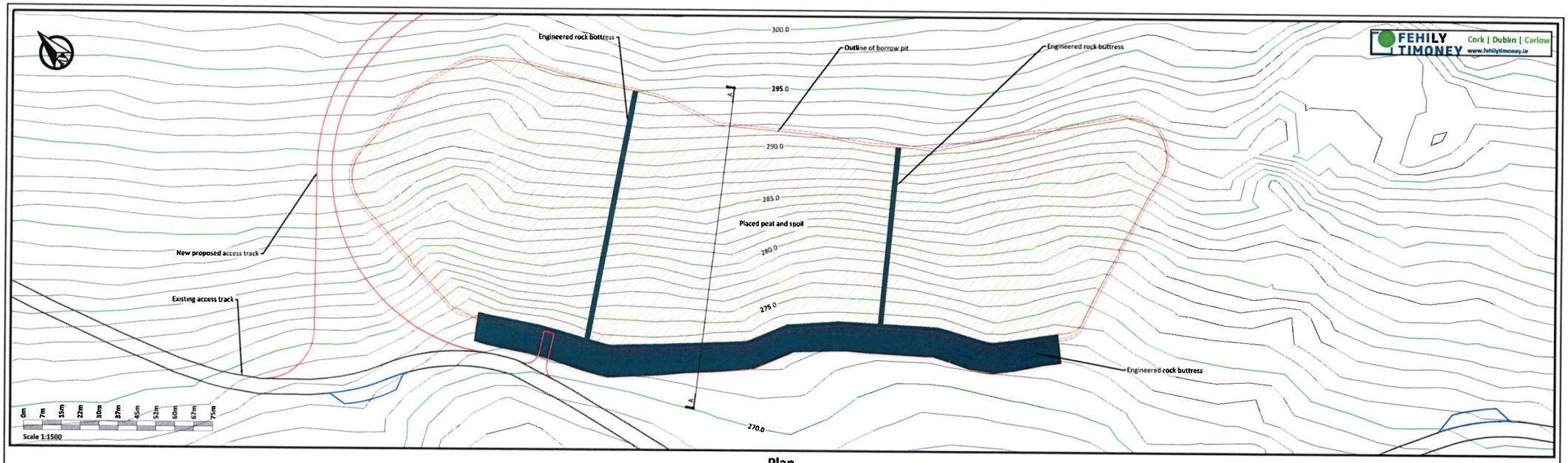
3. REFERENCES

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

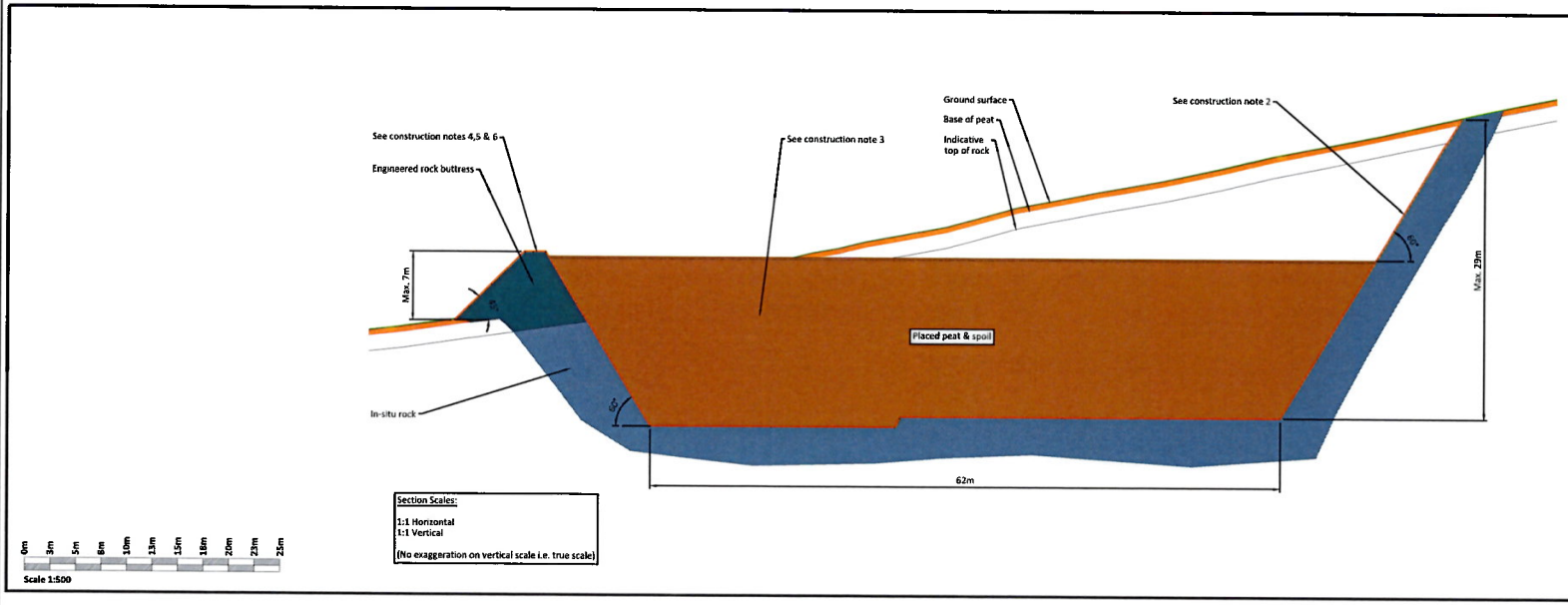
Fehily Timoney & Company (FTC) (2021). Croagh Wind Farm. Responses to Leitrim County Council Further Information Schedule. March 2021.

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

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



Plan
Scale 1:1500



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.

(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. Leaving in place upstands/segments of intact rock which will help to retain the placed peat & spoil and will allow the borrow pit to be developed and infilled in cells.

(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 likely 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 7.4 of the Peat & Spoil Management Plan.

Section
Scale 1:500

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Scale (@ A3) 1:1500

Date - 08.12.22

FIGURE 7-1 : BORROW PIT - PLAN & CROSS SECTION DETAILS

Drawn - POR
Checked - IH
Rev - F

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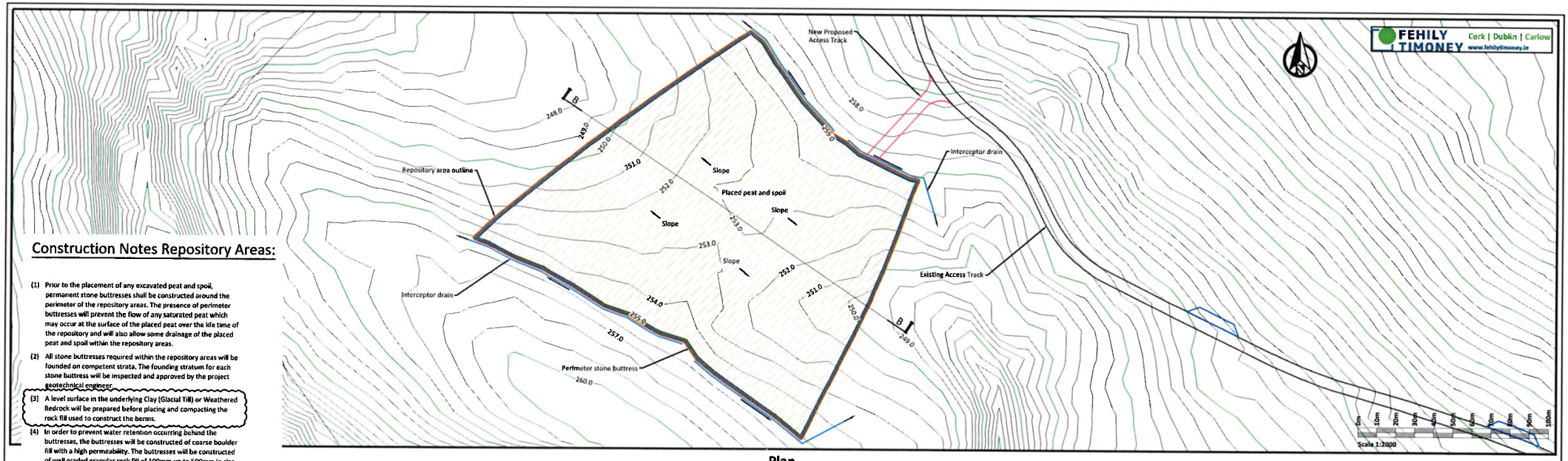
Thursday 8 December 2022



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. The founding stratum for each stone buttress will be inspected and approved by the project geotechnical engineer.

(3) A level surface in the underlying Clay (Glacial Till) or Weathered Bedrock 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 greater 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 45 degrees. 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.

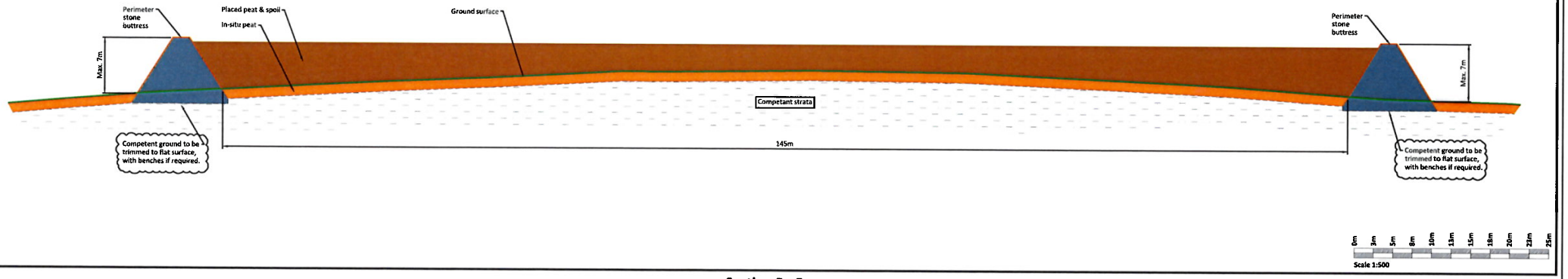
(8) A silting pond will be at the lower side of the repository areas.

(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 for the construction of the repository area.

(12) Further details on the construction of the repository area are included within Section 7.5 of the Peat & Spoil Management Plan.



Section B - B

Scale 1:500

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Scale (@ A3) 1:2000

Date - 06.12.22

FIGURE 7-2 : REPOSITORY AREA 1 - PLAN & CROSS SECTION DETAILS

Drawn - POR

Checked - EH

Rev - E

Tuesday 6 December 2022

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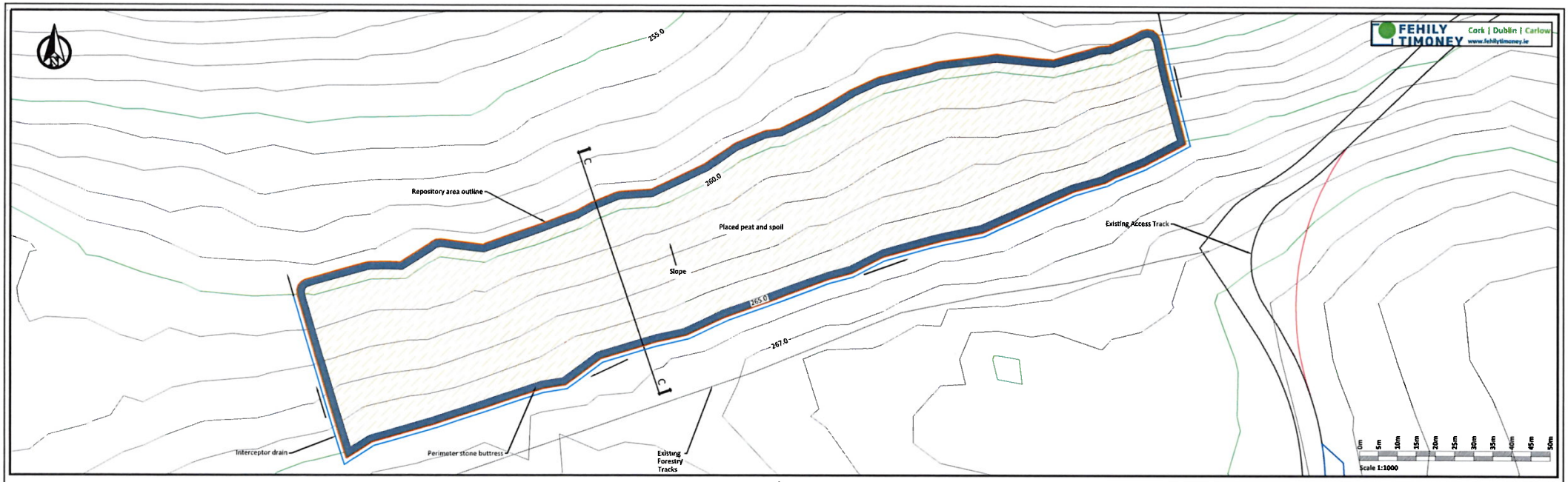


Plan

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. The founding stratum for each stone buttress will be inspected and approved by the project geotechnical engineer.

(3) A level surface in the underlying Clay (Glacial Till) or Weathered Bedrock 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 greater 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 45 degrees. 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.

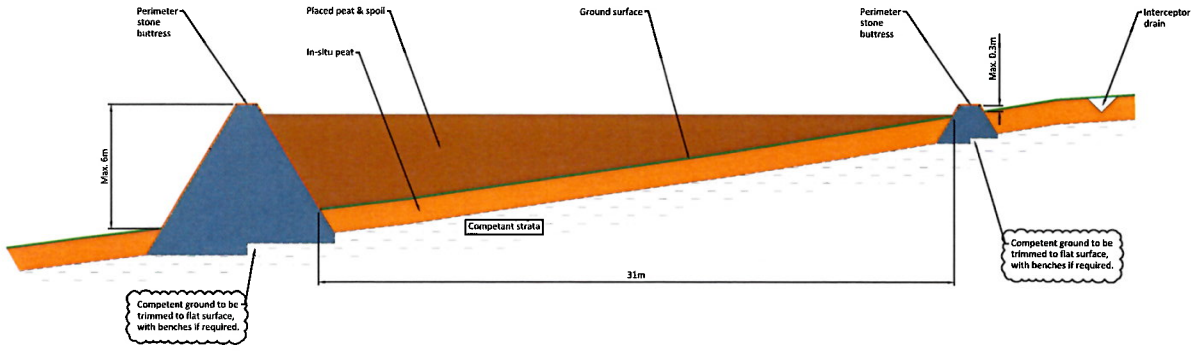
(8) A silting pond will be at the lower side of the repository areas.

(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 for the construction of the repository area.

(12) Further details on the construction of the repository area are included within Section 7.5 of the Peat & Spoil Management Plan.



Section C - C

Scale 1:250

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Scale (@ A3) 1:1000

Date - 06.12.22

FIGURE 7-3 : REPOSITORY AREA 2 - PLAN & CROSS SECTION DETAILS

Drawn - POR

Checked - IH

Rev - F

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Tuesday 6 December 2022

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

APPENDIX A

Trial Pit Logs

FEHILY TIMONEY

Fehily Timoney & Co.
The Grainstore
Singletons Lane
Bagenalstown
Co. Carlow
R21 XA66 Ireland

Tel: +353-59-9723800
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):	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
							Firm brown fibrous Peat
	0.30 - 0.70	B	B1	0.30			Soft light grey/brown sandy clayey Silt. Shear vane strength recordings of 30, 28, 32 & 33kPa
				0.70			Firm and stiff grey slightly sandy very gravelly Silt/Clay with occasional cobbles
				2.10			Stiff, locally very stiff grey slightly sandy very gravelly Silt/ Clay with frequent cobbles. Traces of orange mottling noted in layer.
				3.20			End of Pit at 3.200m

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

Plant Used:

FEHILY TIMONEY	Fehily Timoney & Co. The Grainstore Singletons Lane Bagenalstown Co. Carlow R21 XA66 Ireland	Tel: +353-59-9723800 Email: info@ftco.ie Web: www.fehilytimoney.ie	**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 (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results/Sample Ref				
							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

FEHILY TIMONEY	Fehily Timoney & Co. The Grainstore Singletons Lane Bagenalstown Co. Carlow R21 XA66 Ireland	Tel: +353-59-9723800 Email: info@ftco.ie Web: www.fehilytimoney.ie	# 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): Depth 3.20	Scale 1:25
Client:	Coillte			Logged GK

Water Strike	Samples & In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results/Sample Ref				
							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:

FEHILY TIMONEY
30 YEARS

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

FEHILY TIMONEY
30 YEARS

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

FEHILY TIMONEY

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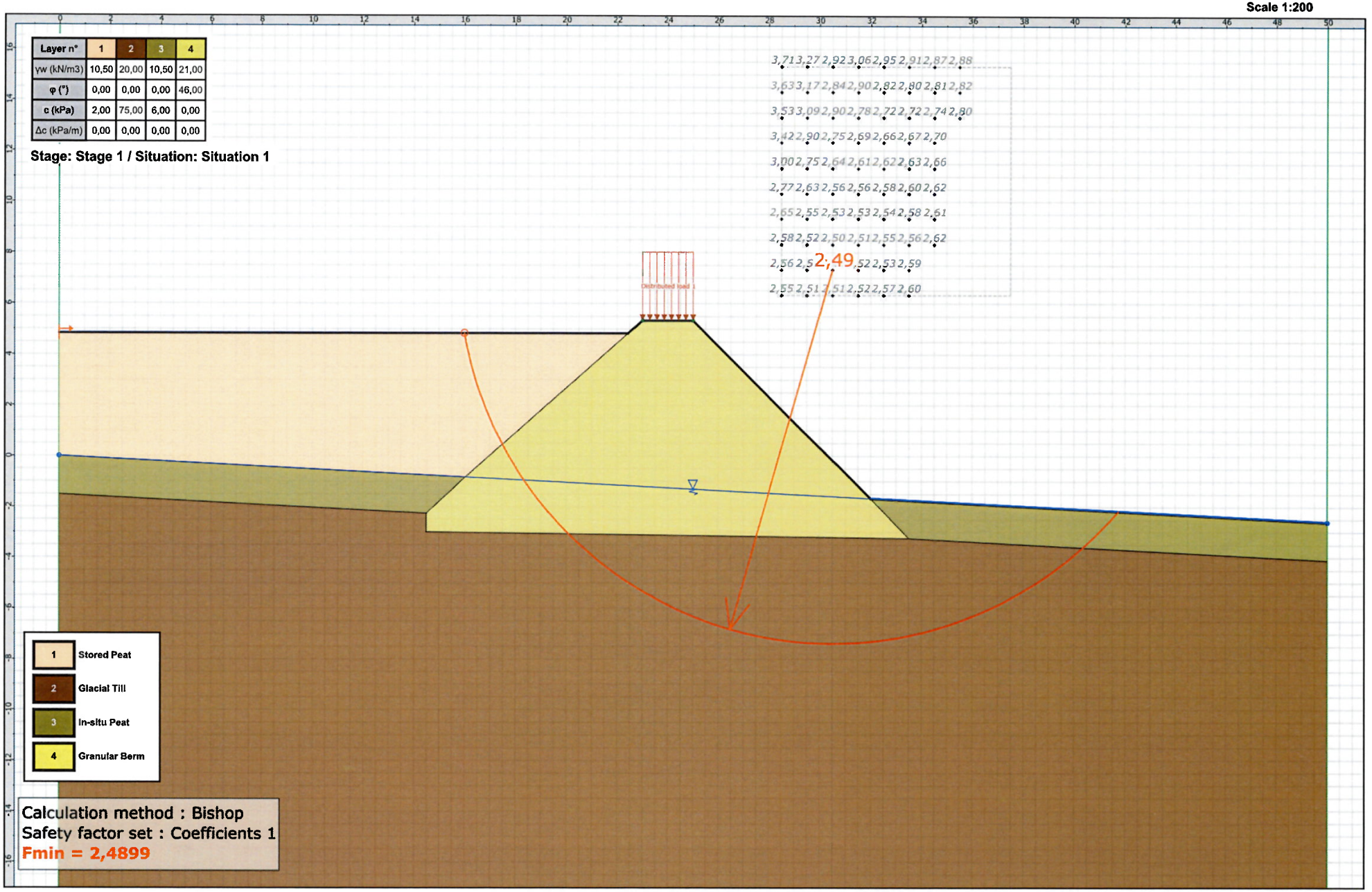
APPENDIX B

Stability Analysis Outputs

Scale 1:200

Layer n°	1	2	3	4
γw (kN/m3)	10,50	20,00	10,50	21,00
φ (°)	0,00	0,00	0,00	46,00
c (kPa)	2,00	75,00	6,00	0,00
Δc (kPa/m)	0,00	0,00	0,00	0,00

Stage: Stage 1 / Situation: Situation 1



terrasol
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Talren v5
v5.2.9

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Calculation made by : Fehily Timoney & Company

Project : Peat Repository 1 (undrained)

Scale 1:200

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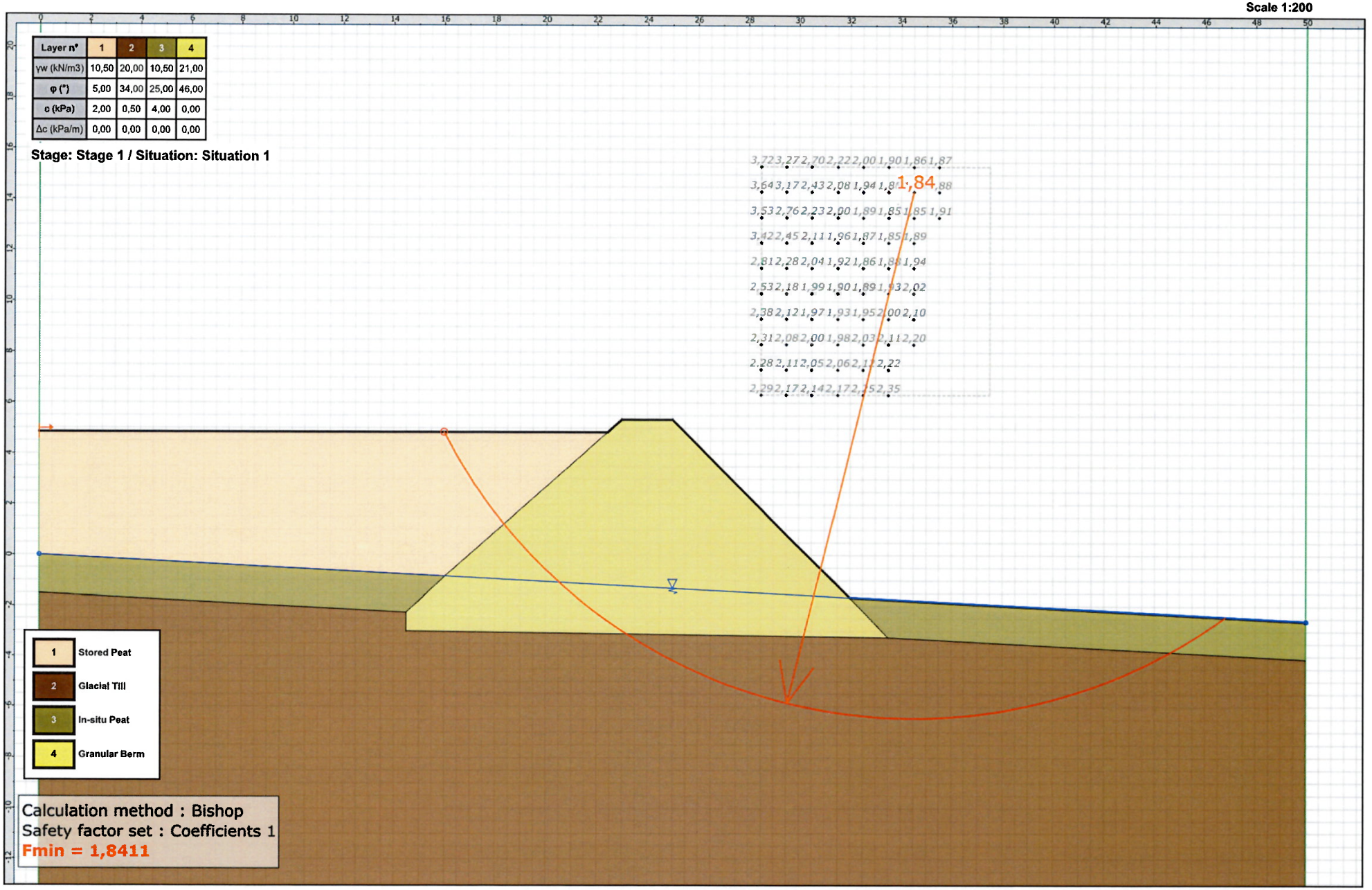
Δc (kPa/m)	0,00	0,00	0,00	0,00

Stage: Stage 1 / Situation: Situation 1



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Project : Peat Repository 1 (drained)

Scale 1:200

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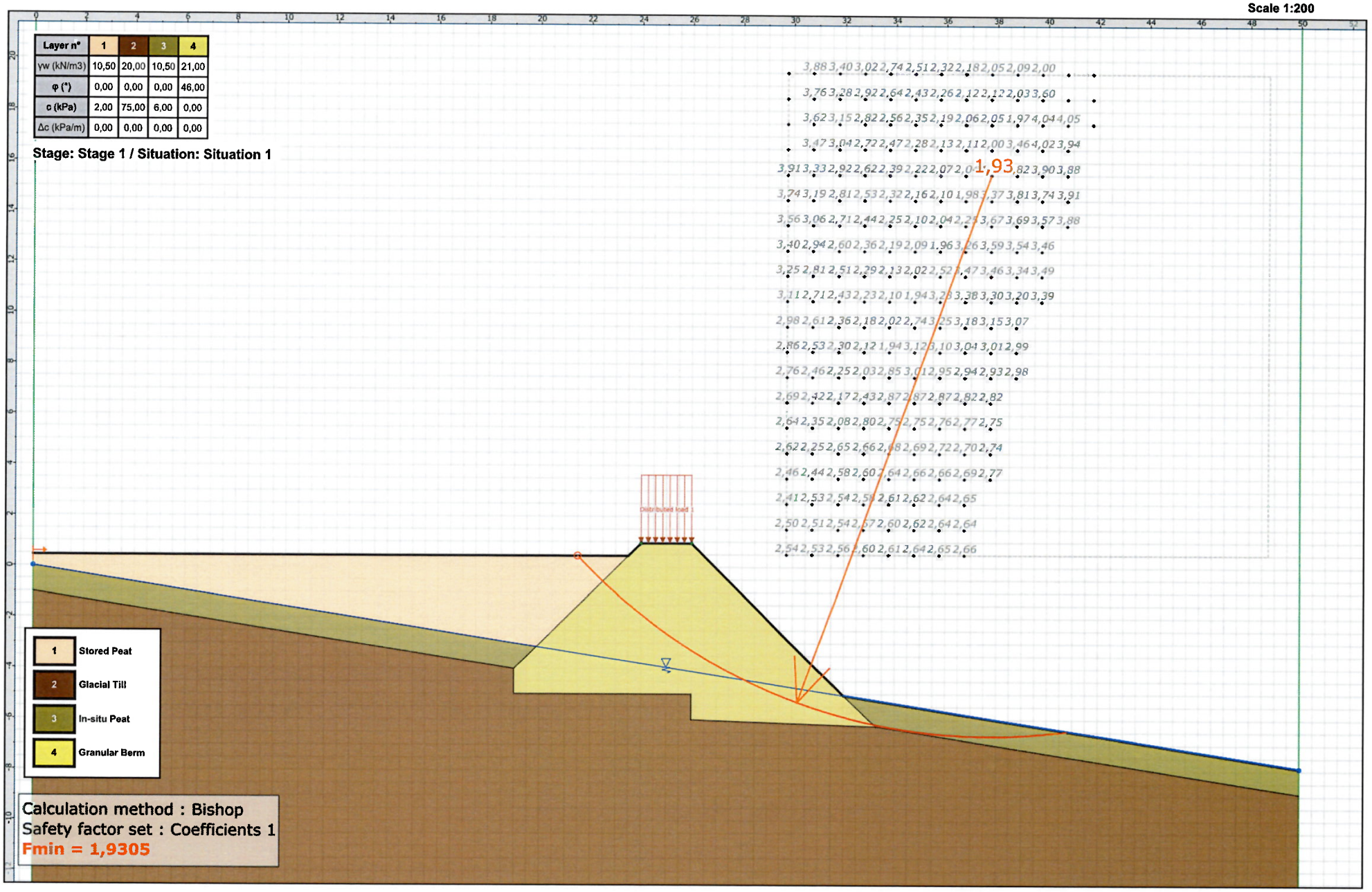
Stage: Stage 1 / Situation: Situation 1



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Printed on : 29-Nov-2022 12:44:09
Calculation made by : Fehily Timoney & Company

Project : Peat Repository 2 (undrained)

Scale 1:200

Layer n°	1	2	3	4	5
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φ (°)	5,00	34,00	24,00	46,00	34,00
c (kPa)	2,00	0,50	5,00	0,00	250,00
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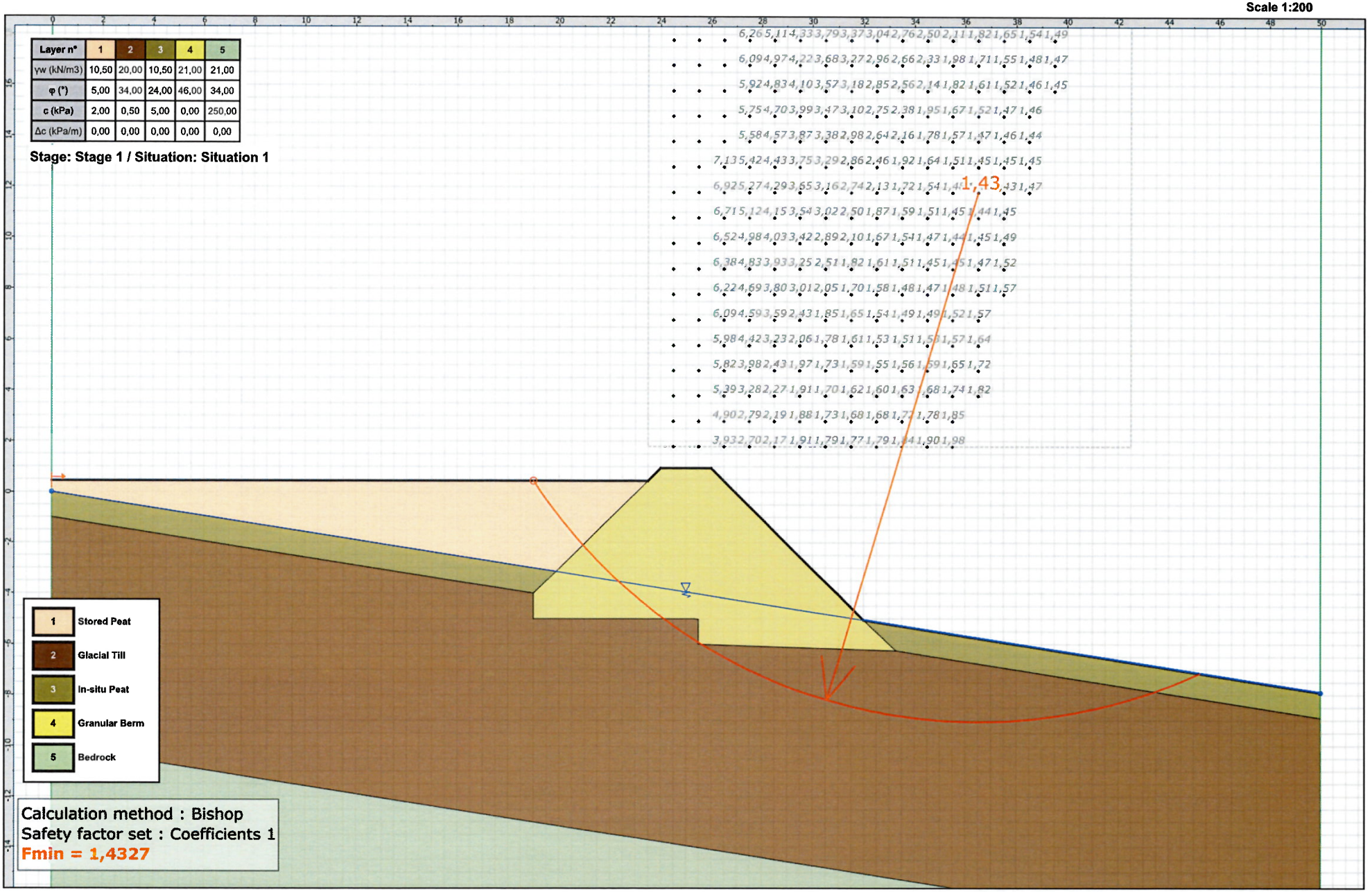
Stage: Stage 1 / Situation: Situation 1



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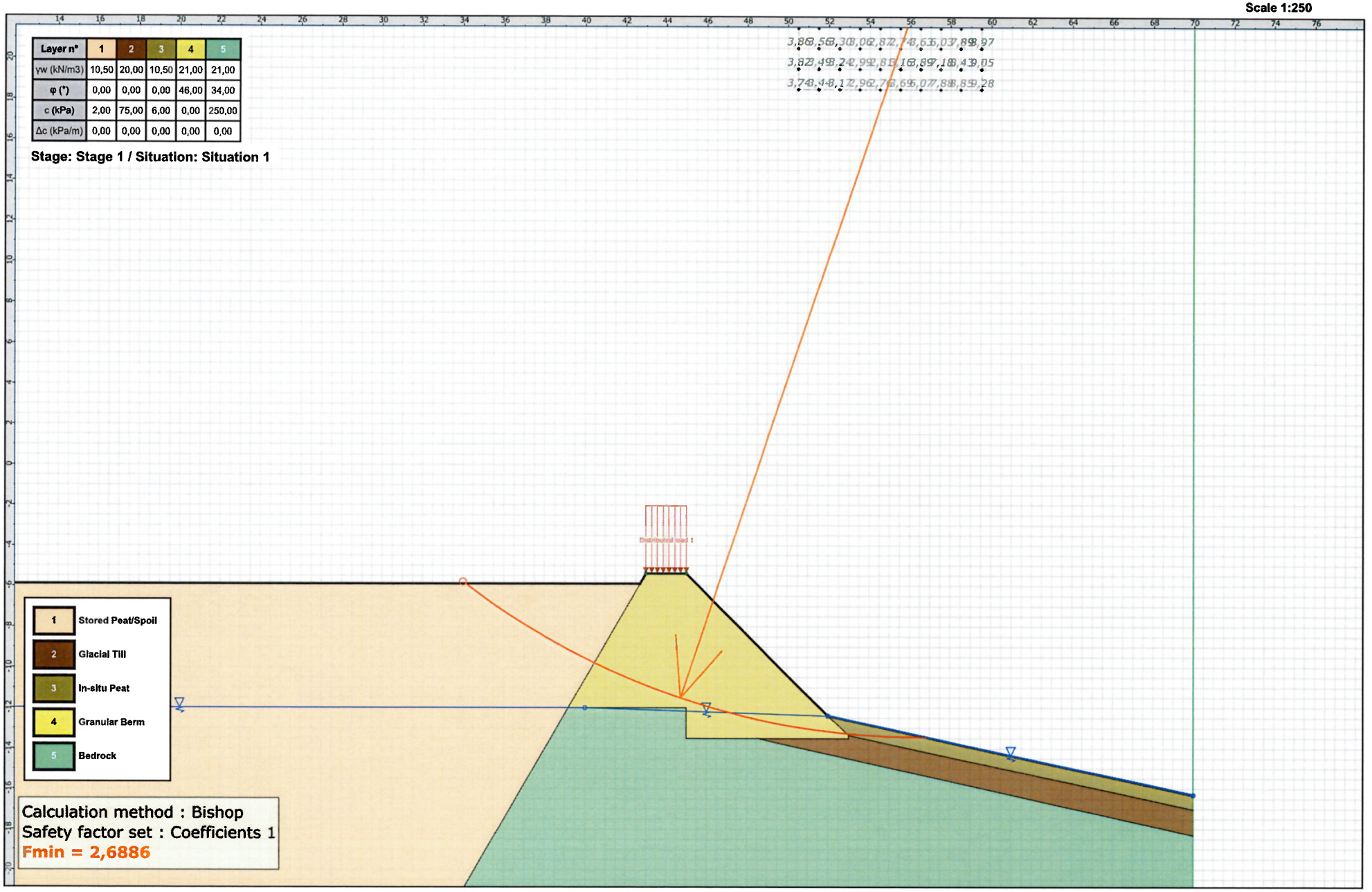

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Talren v5
v5.2.9

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Calculation made by : Fehily Timoney & Company

Project : Borrow Pit (undrained)

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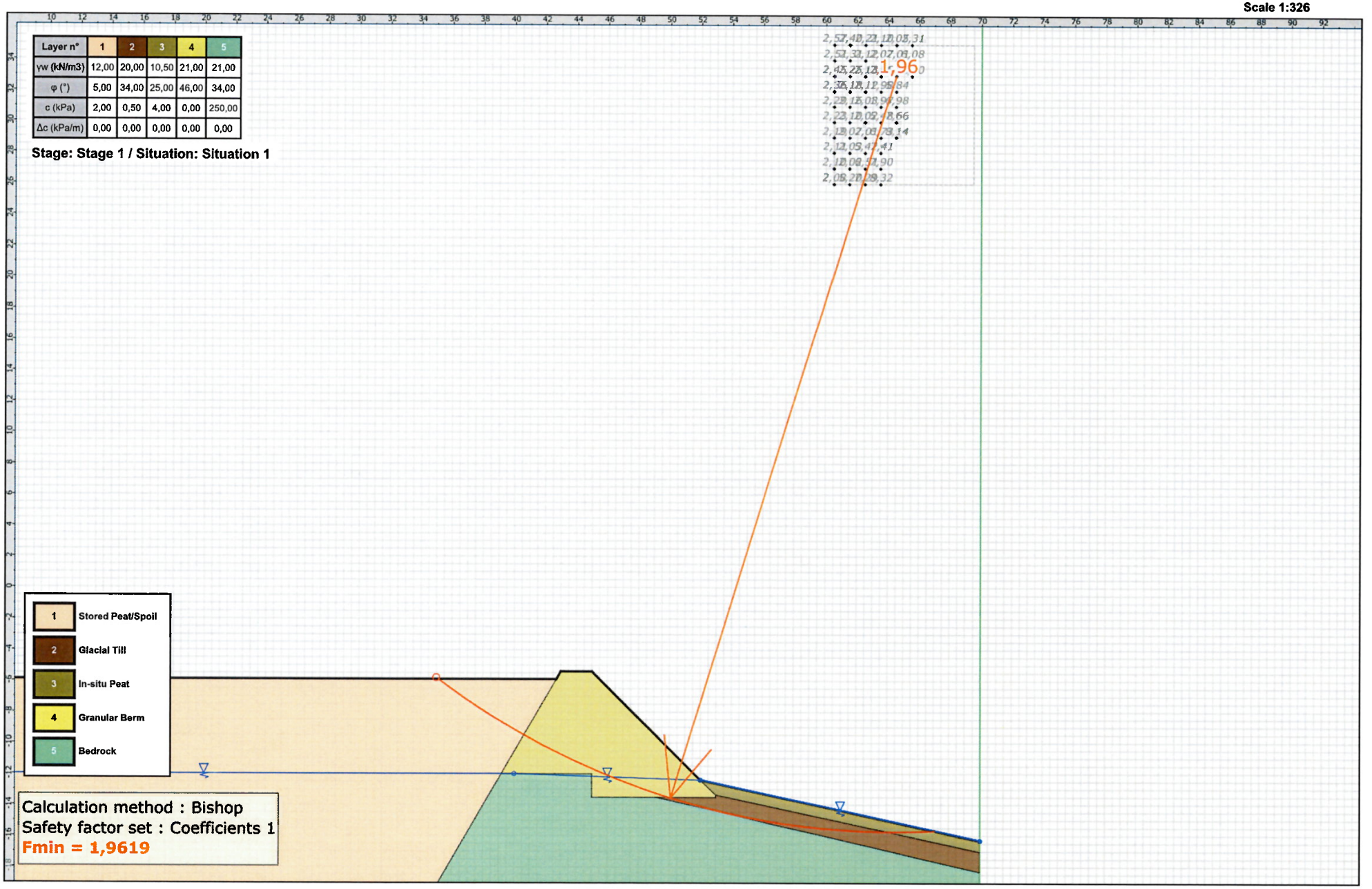

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Talren v5
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Calculation made by : Fehily Timoney & Company

Project : Borrow Pit (drained)

Scale 1:200

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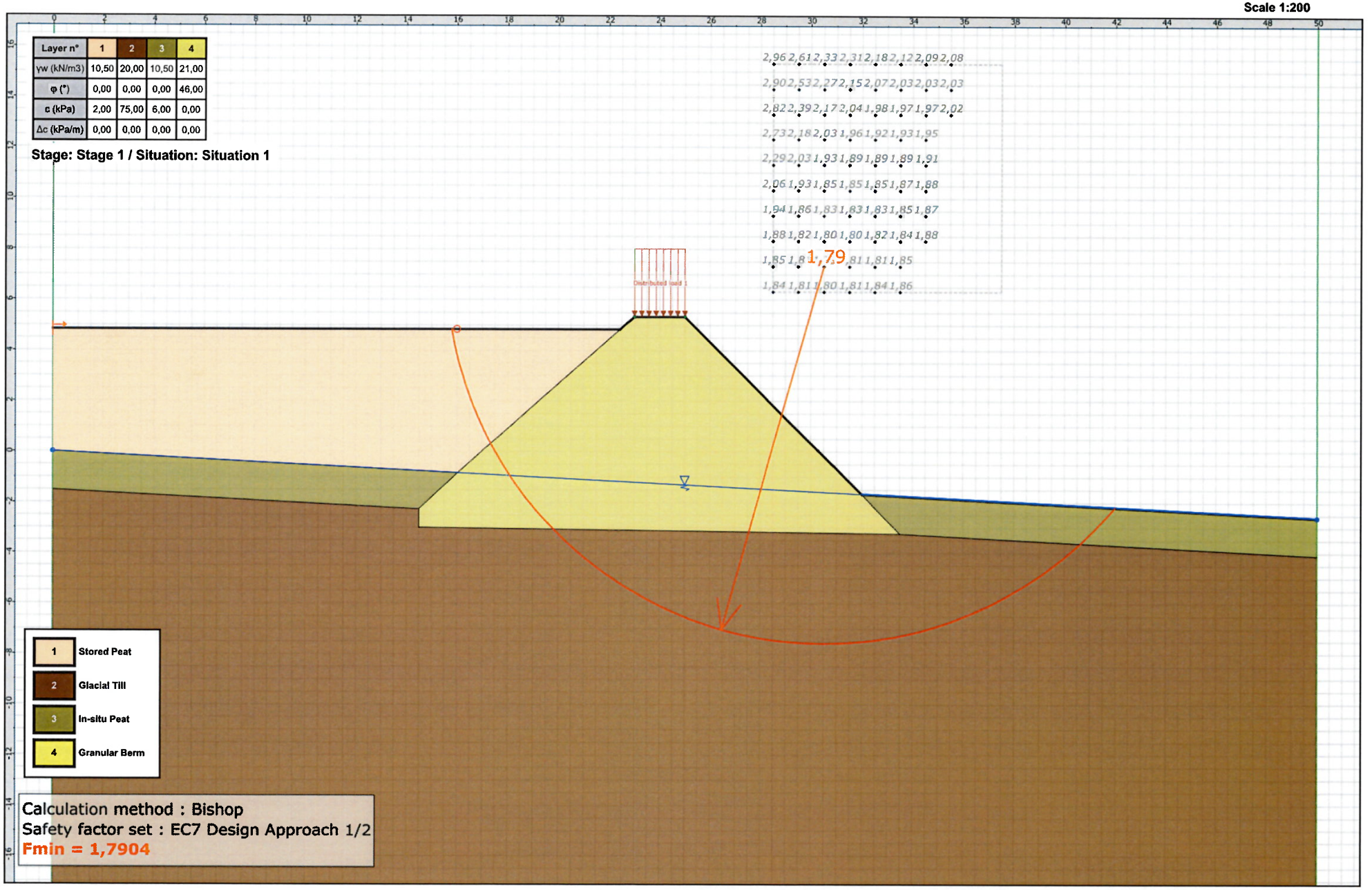
φ (°)	0,00	0,00	0,00	46,00
c (kPa)	2,00	75,00	6,00	0,00
Δc (kPa/m)	0,00	0,00	0,00	0,00

Stage: Stage 1 / Situation: Situation 1



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Talren v5
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Project : Peat Repository 1 (undrained EC7)

Scale 1:200

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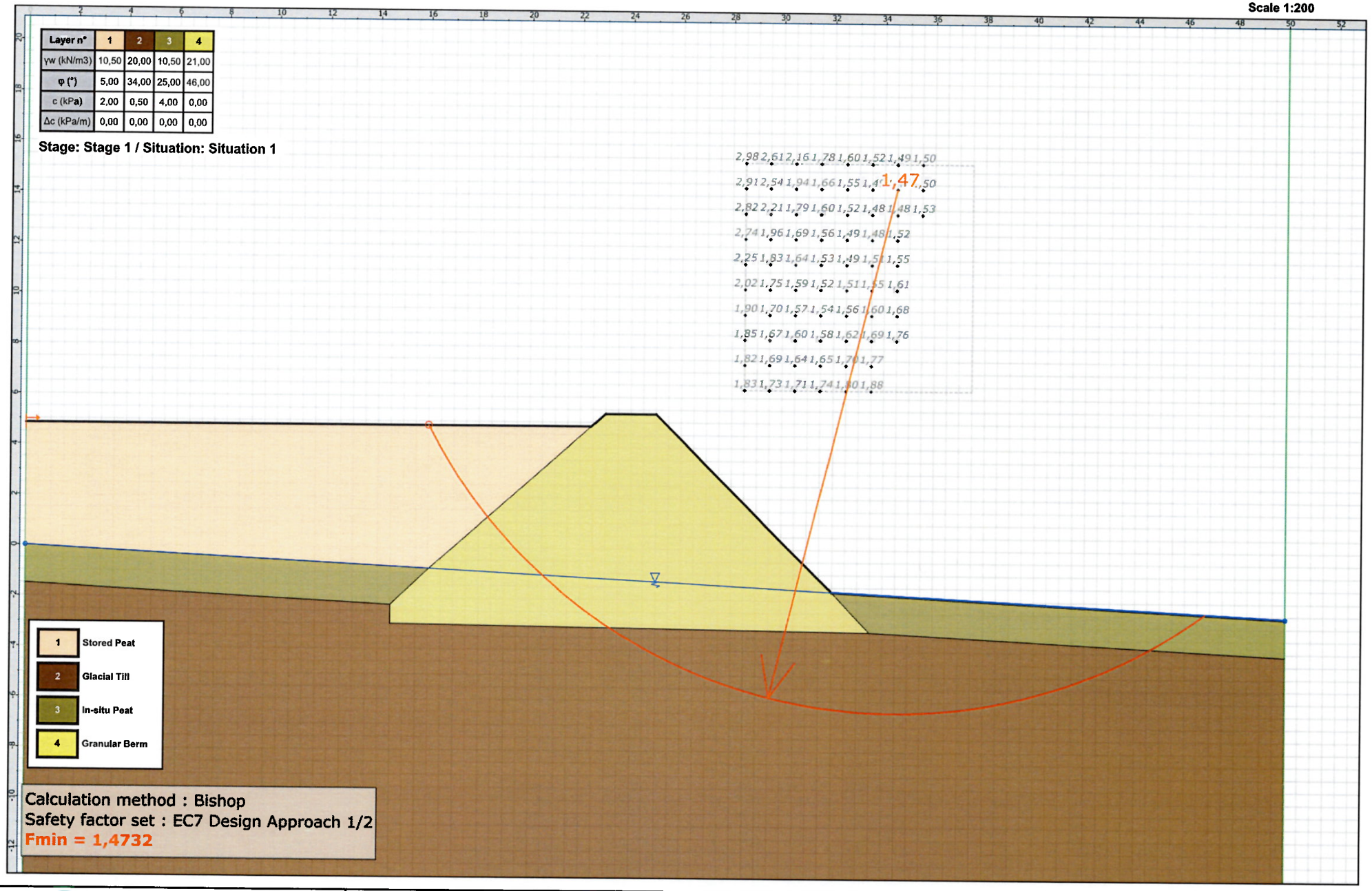
Δc (kPa/m)	0,00	0,00	0,00	0,00

Stage: Stage 1 / Situation: Situation 1



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Talren v5
v5.2.9

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Calculation made by : Fehily Timoney & Company

Project : Peat Repository 1 (drained EC7)

Scale 1:200

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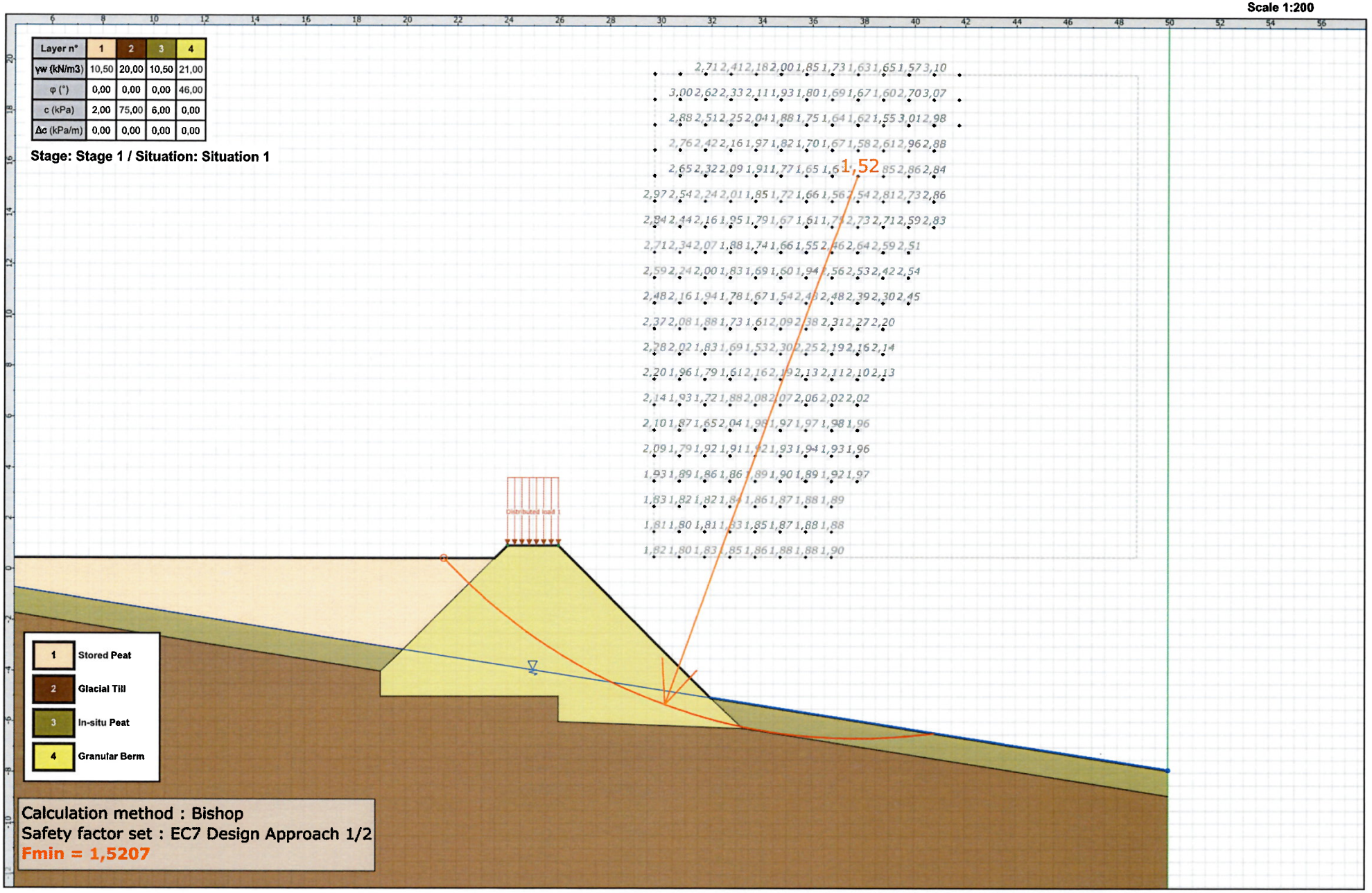
Δc (kPa/m)	0,00	0,00	0,00	0,00

Stage: Stage 1 / Situation: Situation 1



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Talren v5
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Project : Peat Repository 2 (undrained EC7)

Scale 1:200

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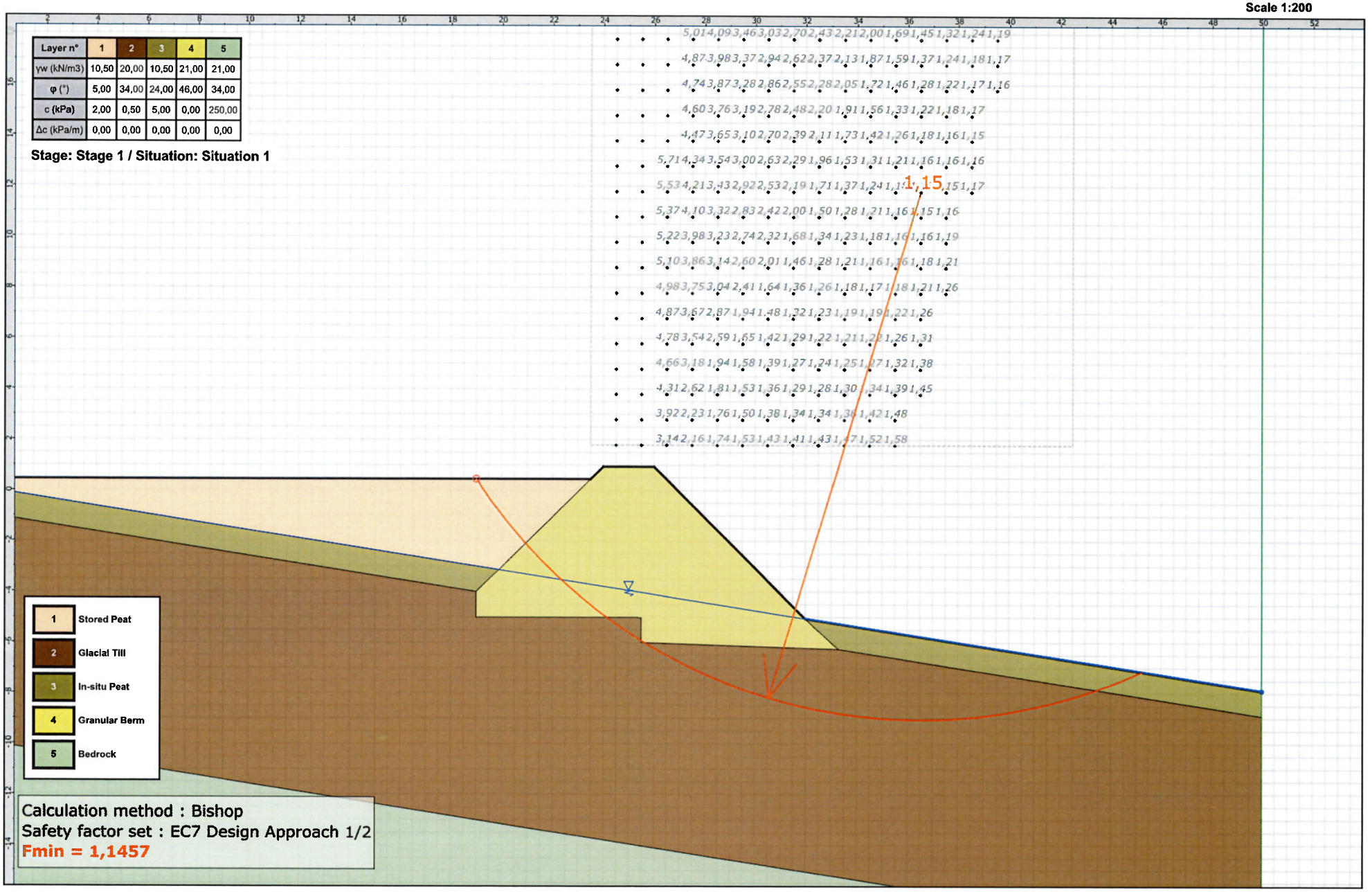
φ (°)	5,00	34,00	24,00	46,00	34,00
c (kPa)	2,00	0,50	5,00	0,00	250,00
Δc (kPa/m)	0,00	0,00	0,00	0,00	0,00

Stage: Stage 1 / Situation: Situation 1



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Talren v5
v5.2.9

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Project : Peat Repository 2 (drained EC7)

Scale 1:250

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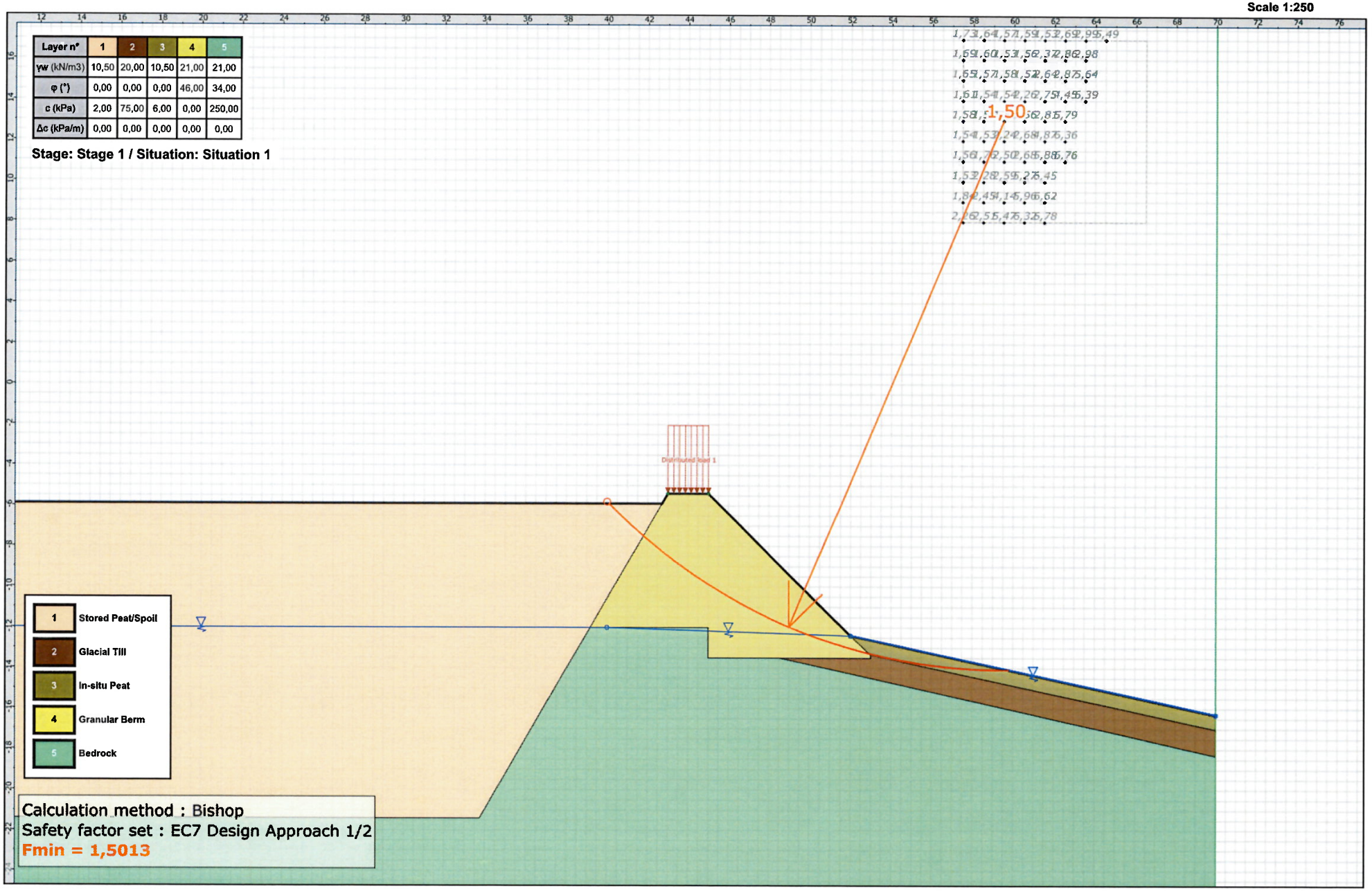
c (kPa)	2,00	75,00	6,00	0,00	250,00
Δc (kPa/m)	0,00	0,00	0,00	0,00	0,00

Stage: Stage 1 / Situation: Situation 1



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Printed on : 07-Dec-2022 10:22:40
Calculation made by : Fehily Timoney & Company

Project : Borrow Pit (undrained EC7)

Scale 1:330

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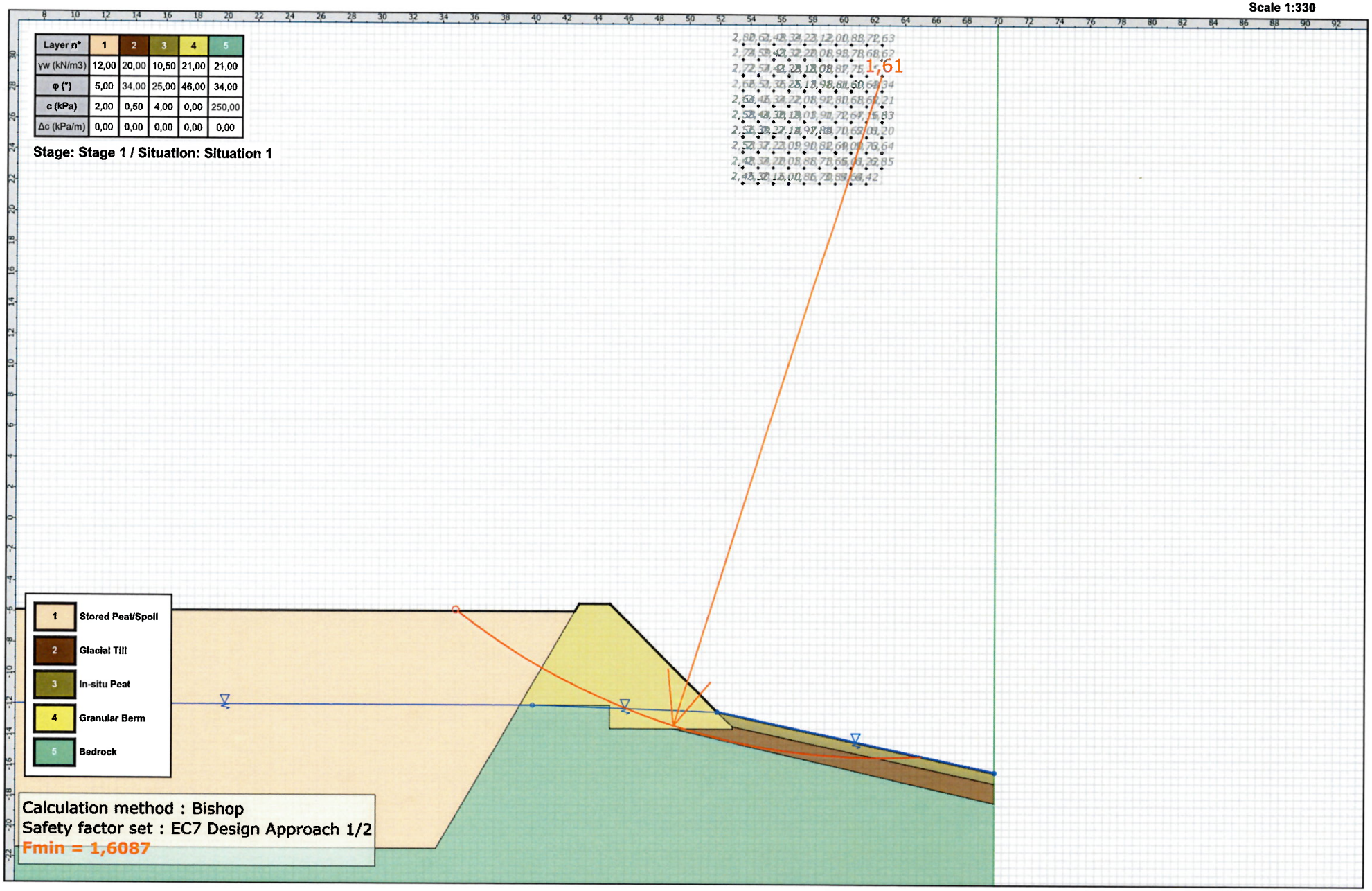
c (kPa)	2,00	0,50	4,00	0,00	250,00
Δc (kPa/m)	0,00	0,00	0,00	0,00	0,00

Stage: Stage 1 / Situation: Situation 1



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Talren v5
v5.2.9

Printed on : 07-Dec-2022 12:39:41
Calculation made by : Fehily Timoney & Company

Project : Borrow Pit (drained EC7)

FEHILY TIMONEY

CONSULTANTS IN ENGINEERING, ENVIRONMENTAL SCIENCE & PLANNING

www.fehilytimoney.ie

CORK OFFICE
Core House
Pouladuff Road,
Cork, T12 D773,
Ireland
+353 21 496 4133

Dublin Office
J5 Plaza,
North Park Business Park,
North Road, Dublin 11, D11 PXT0,
Ireland
+353 1 658 3500

Carlow Office
Unit 6
Bagenalstown Industrial Park,
Bagenalstown, Co. Carlow,
R21 XW81, Ireland
+353 59 972 3800

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QUALITY ISO 9001:2015 NSAI Certified
ENVIRONMENT ISO 14001:2015 NSAI Certified

APPENDIX 2 - Water Quality and Drainage Control Response

Prepared by Hydro Environmental Services

MKO, Tuam Road, Galway, Ireland. H91 VW84
+353 (0)91 735611 | info@mkoireland.ie | www.mkoireland.ie | @mkoireland
McCarthy Keville O'Sullivan Ltd. t/a MKO. Registered in Ireland No. 462657. VAT No. IE9693052R.

HYDRO ENVIRONMENTAL SERVICES

22 Lower Main St
Dungarvan
Co.Waterford
Ireland

tel: +353 (0)58 44122
fax: +353 (0)58 44244
email: info@hydroenvironmental.ie
web: www.hydroenvironmental.ie

Date: 8th December 2022
Our Ref: P1459-4_0001

MKO
Tuam Road
Galway,
Ireland,
H91 VW84

F.A.O. Mr Eoin McCarthy

Dear Mr McCarthy

Re: Response to a Further Information Request by An Bord Pleanála Regarding the Proposed Croagh Windfarm, Co. Leitrim (ABP Ref: 310789-21/Co. Sligo (ABP-310788-21)

1.0 INTRODUCTION

Hydro-Environmental Services (HES) was commissioned by MKO Ireland (MKO) to respond to specific items of the Further Information Request issued by An Bord Pleanála on 11th November 2022 relating to the proposed Croagh Wind Farm development (ABP Ref: 310789-21 & 310788-21).

This response deals with matters raised in relation to water quality/drainage control with regard the proposed peat repositories. Geotechnical matters/ground conditions relating to the proposed peat repositories will be responded to separately by Fehily Timoney and Company (FTC).

> *"In considering all the information and submissions on the file including Chapter 8 of the EIAR, the Peat and Spoil Management Plan submitted as Appendix 4-2 of the EIAR, the Geotechnical and Peat Stability Assessment Report submitted as Appendix 8-1 of the EIAR and the applicant's response to the further information request from the Planning Authority provided as Appendix A Stability Analysis of Borrow Pits, Peat Repositories and Settlement Ponds, the Board could not be satisfied that the proposed repositories would be effective in providing for the permanent retention of peat and other materials and that the mitigation measures, inclusive of the proposed drainage system, would be adequate to ensure that there would be no significant risk of adverse environmental impacts or serious injury to properties in the vicinity of the proposed development ".*

> *"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 rock at the repository locations, and the hillside siting of the northernmost repository and the associated clear felling of forestry".*

2.0 STATEMENT OF QUALIFICATIONS

Hydro-Environmental Services (HES) has extensive wind farm drainage and hydrogeological experience relevant to this project. Wind farm environmental impact assessment in respect of geology, hydrology and hydrogeology is a core business area for HES presently and also over the past 15 years. Wind farm drainage design/management requires experience both as a civil/drainage engineer, a hydrologist and as a hydrogeological specialist. HES have these combined experiences and expertise. HES have worked on over 120 wind farm projects in Ireland and Northern Ireland. Many of these required assessments of existing drainage features and streams and water quality data. HES work at all stages of wind farm developments including feasibility stage, layout design, drainage design/planning stage, construction management stage and post construction monitoring.

HES's experience also covers the key area of water quality and drainage controls and mitigation during the construction phase of wind farm developments. HES work at EIAR/planning stage to assist with development of the optimal site layout which involves development of hydrological constraints maps and interaction with geotechnical and ecological specialists and with site designers.

HES specialises in wetland and peatland eco-hydrology (hydrology of wetland systems and dependant ecosystems). We also complete flood risk assessments for all types of developments across the country.

Michael Gill (BA, BAI, Dip Geol., MSc, MIEI) is an Environmental Engineer and Hydrogeologist with over 18 years' environmental consultancy experience in Ireland. Michael has completed numerous hydrological and hydrogeological impact assessments of wind farms and renewable projects in Ireland. He has substantial experience in surface water drainage design and SUDs design and surface water/groundwater interactions. For example, Michael has worked on the EIS/EIAR for Oweninny WF, Cloncreen WF, Derrinlough WF and Yellow River WF, and over 100 other wind farm-related projects. Michael was involved in the Land, Soils and Geology and Water Chapters for the EIAR and also the follow up FIR's from Sligo and Leitrim County Councils.

David Broderick is a hydrogeologist with over 14 years' experience in both the public and private sectors. Having spent two years working in the Geological Survey of Ireland working mainly on groundwater and source protection studies David moved into the private sector. David has a strong background in groundwater resource assessment and hydrogeological/hydrological investigations in relation to developments such as quarries and wind farms. David has worked on the EIS for Oweninny WF, Glenmore WF, Yellow River WF, and over 80 other wind farm-related projects. David was involved in the Land, Soils and Geology and Water Chapters for the EIAR and the follow up FIR's from Sligo and Leitrim County Councils.

3.0 PEAT REPOSITORY & BORROW PIT DRAINAGE CONTROLS

The proposed locations of the peat repositories (2 no.) were determined to be the most appropriate and suitable areas for peat repositories based on a detailed geotechnical, hydrological, and ecological constraints assessment of the wind farm site (see Chapter 7 - Biodiversity, Chapter 8 (Land, Soils and Geology), Chapter 9 (Hydrology/Hydrogeology).

The most northern peat repository is located approximately 60m north of a headwater stream of the Killanummery River. At this peat repository all drainage is to the north, and the repository is separated from the stream channel to the south and west by local topographic highs (i.e. areas of high ground). From a hydrological perspective, the repository has been intentionally located here so that it does not drain directly to the Killanummery stream, as drainage/runoff is in a northerly direction (away from stream) where it is collected and treated in a controlled manner as described below.

Similarly, the most southern peat repository was purposely located in a similar topographical setting (i.e. drainage/runoff from the peat repository is not directly towards the watercourse). The southern repository is separated from the Arigna River channel to the west and southwest by local topographic highs and therefore all drainage is to the northeast and away from the Arigna River.
The updated drainage plans that were submitted with the Request for Further Information (RFI) response to Sligo Co. Co. (Appendix 1 of Further Information Response [FIR] PL. 20/251) and Leitrim Co. Co. (Appendix 2 of Further Information Response [FIR] P. 20/120). Drawing no. 0511-23 and 0511-27 show the proposed detailed drainage for the peat repositories (refer to **Figure A** and **Figure B** below for plan abstracts), and as noted in the RFI response are comprehensive and of construction stage design detail and also were intended to comply with Inland Fisheries Ireland (IFI) requirements, as part of their submission on the planning application. HES RFI Response Report Section 3, pg 38 (Appendix 2 of FIR P.20/120 Letrim Co. Co. RFI) states:

> *"Comprehensive drainage proposals are presented in this RFI response for the Croagh Wind Farm development. The Updated Drainage Plans are backed up with supporting calculations. The details provided herein are comprehensive, comply with IFI requirements, and are of a detailed construction phase design standard".*

Also, a geotechnical assessment of the borrow pits, proposed repositories and all settlement pond locations was completed by Fehily Timoney and Company in the Sligo/Leitrim Co. Co. response.

While the drainage submitted plans are very detailed, they are not complex. Indeed, similar plans have been approved by ABP for several other WF sites (e.g. Glenmore WF: ABP Ref: PL 03.245392 / Clare Co. Co. Planning Ref: 14/575; Cloncreen WF: 19.PA0047; Ardderroo WF: ABP Ref: 303086-18), and detailed plans such as these have been implemented successfully at constructed wind farm sites (e.g. Glenmore WF: ABP Ref: PL 03.245392 / Clare Co. Co. Planning Ref: 14/575; Cloncreen WF: 19.PA0047).

A summary of the peat repository drainage control approach for this wind farm, which is detailed in FIR 20/251 (Sligo Co. Co.) & 20/120 (Leitrim Co. Co.) and Appendix 4.5 of the EIAR is provided below:

- An engineered perimeter berm will be constructed to enclose the proposed repositories;
- The perimeter berm will be made of suitable engineering fill (granular rock fill – 100mm to 500mm). The perimeter berm design accounts for the full weight/load of the enclosed peat and spoil volume;
- During the initial emplacement of subsoil at the repositories (to create perimeter berms), silt fences, straw bales and biodegradable matting will be used to control surface water runoff from the enclosure;
- The repositories will be enclosed areas, and as such associated drainage can be easily contained and managed;
- Drainage from the repositories will be directed to settlement ponds as shown in **Figure A** and **Figure B** below; (Please note that all settlement pond locations were subject to a geotechnical assessment, refer to Appendix 3 of FIR P. 20/120 and Appendix 2 of FIR PL. 20/251);
- Settlement ponds at peat repositories have been designed to allow a 24hr retention time as per EPA guidance (2006)[1] which is the highest level of protection recommended by the EPA with regard to retention time of fine silt (0.004mm). This high level of retention and treatment was specifically prescribed to deal with the

[1] *Environmental Management Guidelines - Environmental Management in the Extractive Industry (Non-Scheduled Minerals) (EPA, 2006).*

peat and silty/clayey nature of the local subsoil; (detailed calculations for the settlement ponds can be found in FIR 20/251 (Sligo Co. Co.) & 20/120 (Leitrim Co. Co.)
- Discharge from settlement ponds will be released in a controlled manner to avoid erosion (i.e. laminar/non-turbulent flow) outside the 50m buffer of the nearby watercourses;
- Silt fencing will remain in place between the settlement pond outfall and local watercourses until the repository has vegetated;
- Surface water discharge/runoff from the repositories will be rainfall dependant, intermittent, and will depend on preceding rainfall amounts. Therefore, there will not always be a discharge from the repositories via the proposed drainage outfalls (i.e. during dry periods);
- There will be no requirement to control/manage groundwater inflows as we explain further below;
- Build up of water in the storage areas will be prevented by using semi-permeable berms that allow the repository to drain slowly; and,
- Once the repositories have been seeded and a vegetation/suitable grass layer is established on the surface (after 0.6 months – 1 year, i.e. one growing season), the risk to downstream surface water quality is low, as this vegetation cover prevents erosion/weathering of previously exposed peat/spoil.

At each stage of repository development (construction and operation) the above control measures will be implemented in full to ensure the protection of downstream water quality.

Based on an analysis of the site geology (See EIAR Chapter 8) no specific controls for groundwater management are required. This is because, the emplaced spoil/peat will be placed above ground level (on top of the in-situ peat), and therefore there will be no potential for groundwater to enter the enclosed cells/berms from below the repository. The engineered berms will be founded onto the underlying competent strata, however this will not give rise to groundwater inflows into the storage area because there no deep excavations will be required. Discharge from the storage areas will be solely rainfall, and proposed drainage controls will be robust in nature to accommodate flows equivalent to a 10-year return period storm event. This design approach is robust given that the repositories will likely have stabilised by vegetation cover within a year.

Construction details of the peat repository areas are given in Section 7 of the Fehily Timoney and Company Peat and Spoil Management Plan submitted as Appendix 8.1 of the EIAR. The expanded construction methodology will be provided by FT in a separate response to this FI request.

The proposed borrow pit at the site will also be used as peat storage area when bedrock extraction is complete. The proposed drainage controls at the borrow pit storage area are the same as for the repositories (refer to **Figure C** below for drainage plan abstract), the only difference is that groundwater inflows are factored into the borrow pit settlement pond hydraulic design as the majority of the peat will be stored below ground level and therefore there is potential for groundwater seepages during backfilling.

However, once the borrow pit is fully backfilled, there are unlikely to be any groundwater inflows, as the borrow pit will be backfilled to ground level (in-situ peat will displace the potential for groundwater inflows). Similar to the repositories, surface water discharge/runoff from the back filled borrow pit will be rainfall dependant.

The design of the borrow pit drainage is detailed in FIR 20/251 (Sligo Co. Co.) & 20/120 (Leitrim Co. Co.)

Impacts from forestry felling are assessed in the EIAR at Section 9.5.3.1 and conclude that with the implementation of standard forestry mitigation (as detailed in the EIAR and FIR response) the impacts will be imperceptible.

Prior to the commencement of ground works at the repositories (including tree felling) the following key temporary drainage measures will be installed in existing forestry drainage network to ensure the protection of all downstream receiving waters:

- All existing dry forestry drains that intercept the proposed works area will be temporarily blocked down-gradient of the works using forestry check dams/silt traps;
- Clean water diversion drains will be installed upgradient of the works areas; and,
- Check dams/silt fence arrangements (silt traps) will be placed in all existing forestry drains that have surface water flows and also along existing forestry roadside drains;

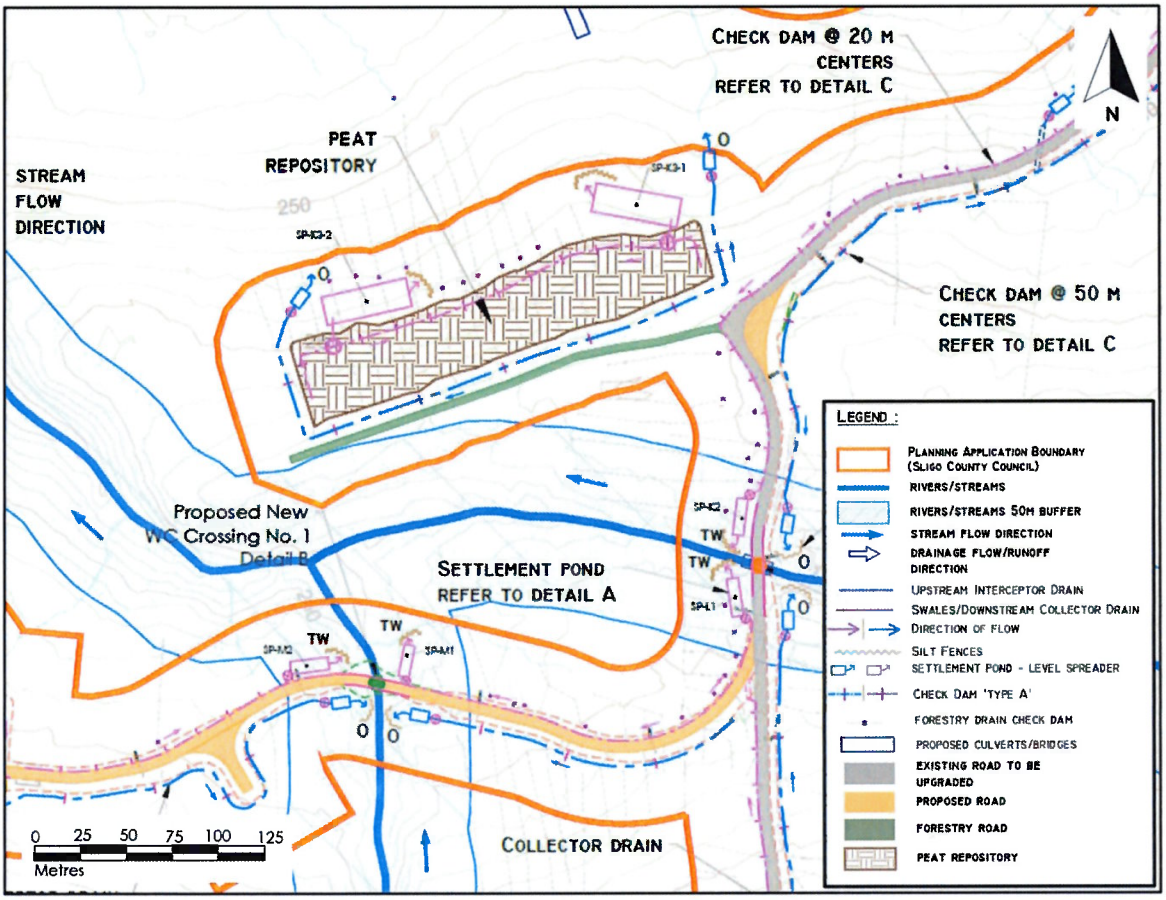


Figure A: Proposed Drainage at the most Northern Peat Repository and showing the Killanummery stream (Abstract of Drainage Drawing 0511-23 Rev B)

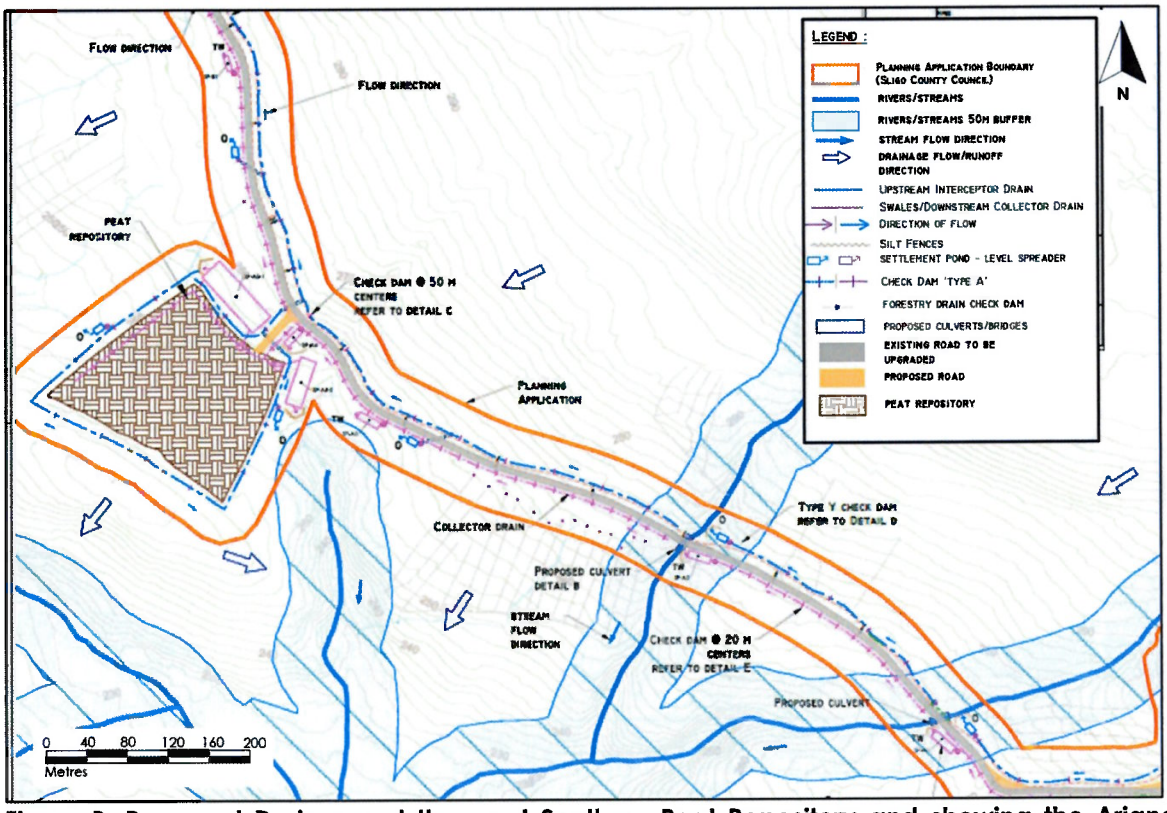


Figure B: Proposed Drainage at the most Southern Peat Repository and showing the Arigna River channel to the west and southwest (Abstract of Drainage Drawing 0511-27 Rev B).

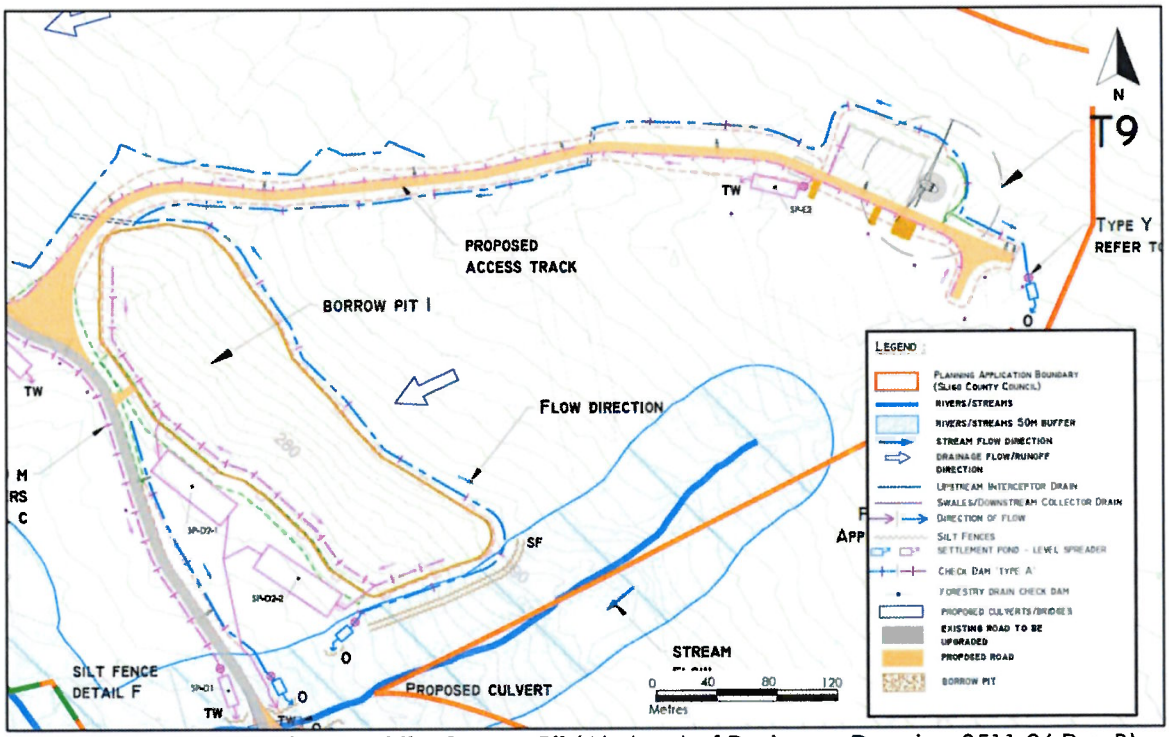


Figure C: Proposed Drainage at the Borrow Pit (Abstract of Drainage Drawing 0511-26 Rev B).

(Please note that Figure A, Figure B and Figure C are for illustrative purposes only to demonstrate the drainage proposals at the peat repositories and borrow pit. Please refer to the referenced drawings for the complete drainage plan at these locations).

APPENDIX 3 – Computer-generated, representations of Borrow Pit and Peat & Spoil Repositories prepared by TANTEK 4D

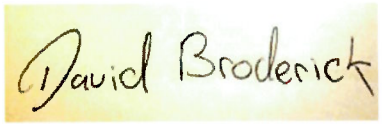
4.0 CLOSURE

Comprehensive drainage proposals have been prepared for the Croagh Wind Farm development. The Updated Drainage Plans submitted with the Further Information submission to the planning authorities in April 2021 , are backed up with supporting calculations (HES, 2021(a), 2021(b))[2]. The details provided are comprehensive, comply with IFI requirements and are of a detailed construction phase design standard that provide the highest level of protection recommended by the EPA.

The drainage management proposal for this development, including those at the peat repositories and borrow pit, are technically sound and based on many years of experience of working on similar sites. They include fail-safe and several levels of controls in series[3]. The application of the drainage management as outlined will ensure compliance with EU Surface Water Regulations and WFD requirements while also maintaining the baseline hydrology of the site and downstream receiving waters (surface water and groundwater).

All tree felling will be undertaken by implementation of standard forestry mitigation as detailed in the EIAR and FIR responses.

Yours sincerely,



David Broderick
BSc, MSc - Hydrogeologist

2 *Geological, Hydrological & Hydrogeological Responses to Submissions in relation to Croagh Wind Farm, Co. Leitrim – (Planning Ref: P.20/120) (HES, 2021 (a).*
Geological, Hydrological & Hydrogeological Responses to Submissions in relation to Croagh Wind Farm, Co. Sligo – (Sligo Planning Ref: P.20/251) (HES, 2021 (b).
3 Surface water quality protection is not reliant on just one element of the drainage system. They are not stand alone but occur as part of a treatment train of systems (i.e., check dams, silt traps, settlement ponds etc) that will be applied in series to ensure protection of downstream watercourses. This is detailed in the Sligo and Leitrim FI responses.

© HYDRO-ENVIRONMENTAL SERVICES

22 Lower Main Street, Dungarvan, Co. Waterford, X35 HK11
T: +353-(0)58-441 22 **F:** +353-(0)58-442 44 **E:** info@hydroenvironmental.ie

www.hydroenvironmental.ie

MKO, Tuam Road, Galway, Ireland. H91 VW84
+353 (0)91 735611 | info@mkoireland.ie | www.mkoireland.ie | @mkoireland
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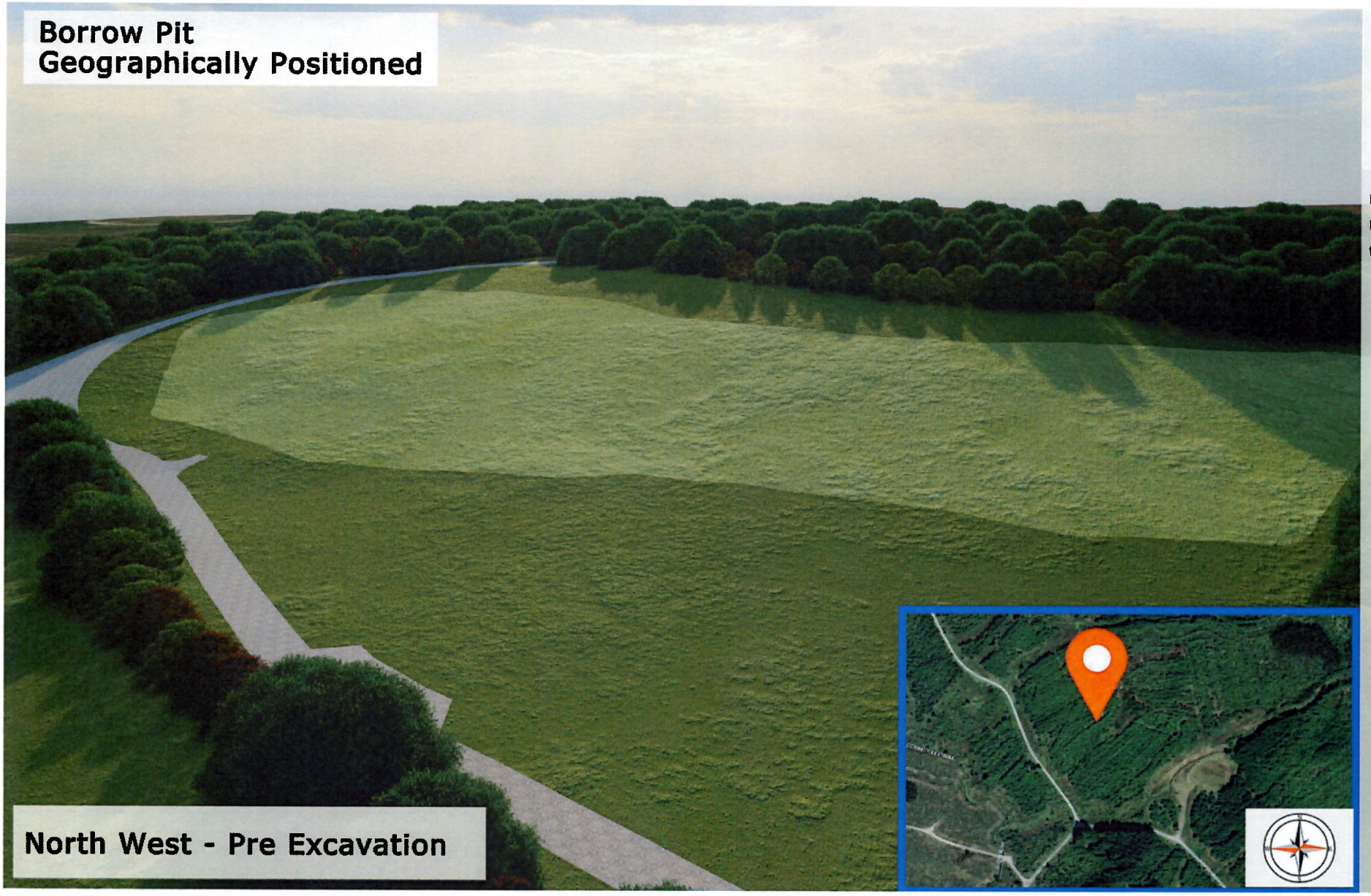
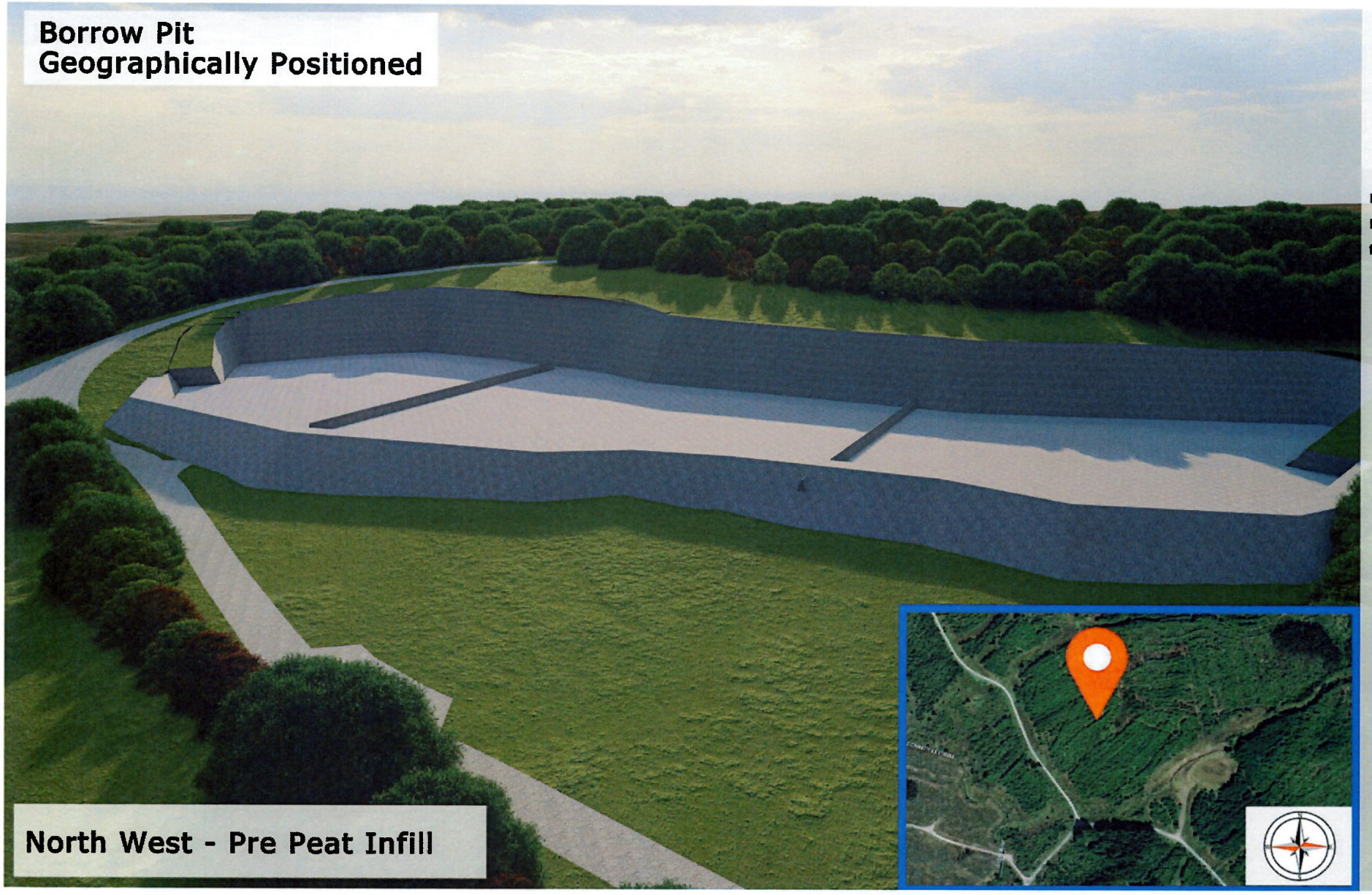
Borrow Pit
Geographically Positioned



North West - Pre Excavation

Please refer to drawing:
P1459-1-0121-A1-0511-26-00B
for proposed drainage design

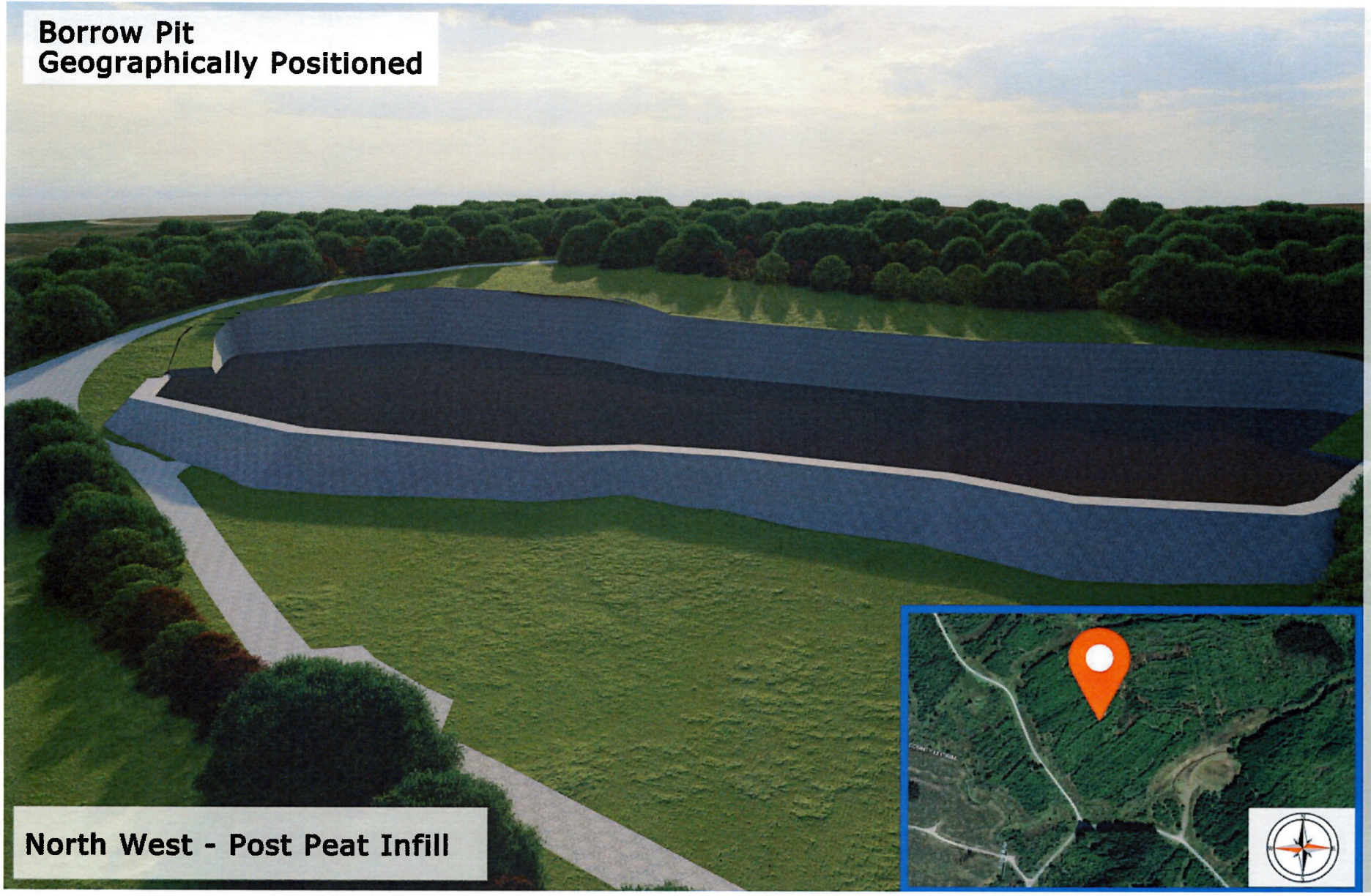
Borrow Pit
Geographically Positioned



North West - Pre Peat Infill

Please refer to drawing:
P1459-1-0121-A1-0511-26-00B
for proposed drainage design

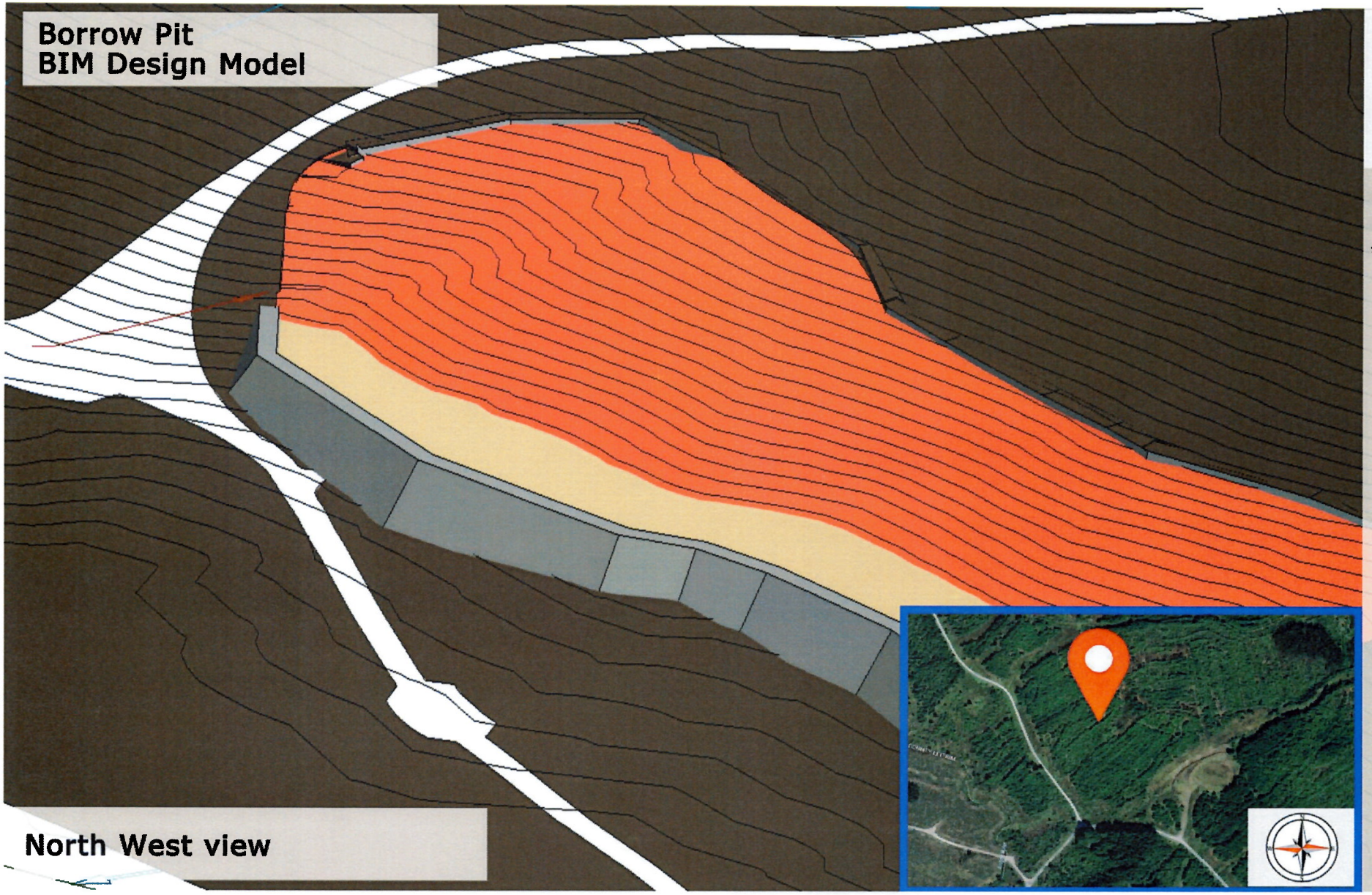
Borrow Pit
Geographically Positioned



North West - Post Peat Infill

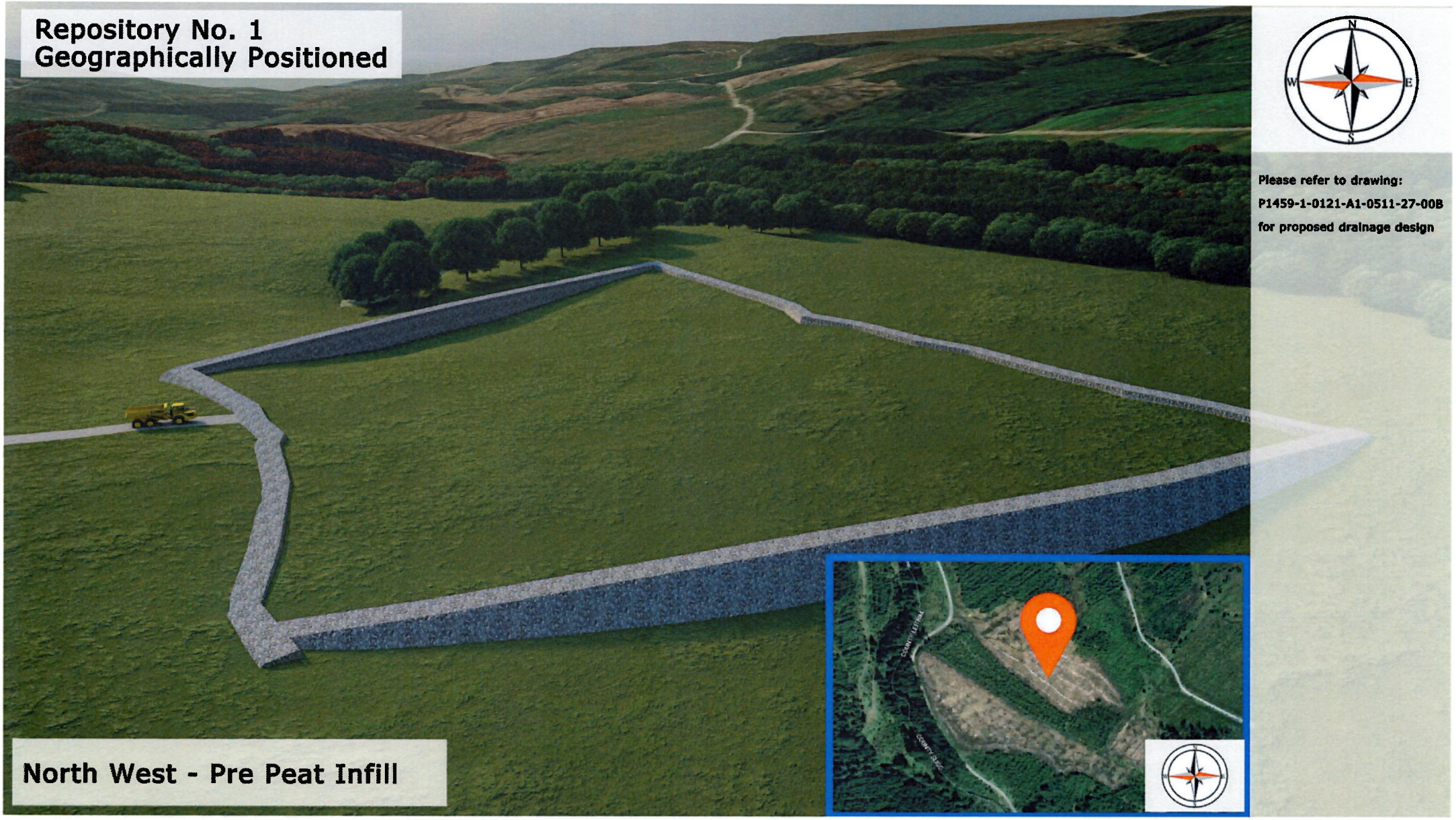
Please refer to drawing:
P1459-1-0121-A1-0511-26-00B
for proposed drainage design

Borrow Pit
BIM Design Model



North West view

Please refer to drawing:
P1459-1-0121-A1-0511-26-00B
for proposed drainage design


Repository No. 1
Geographically Positioned
N
W
E
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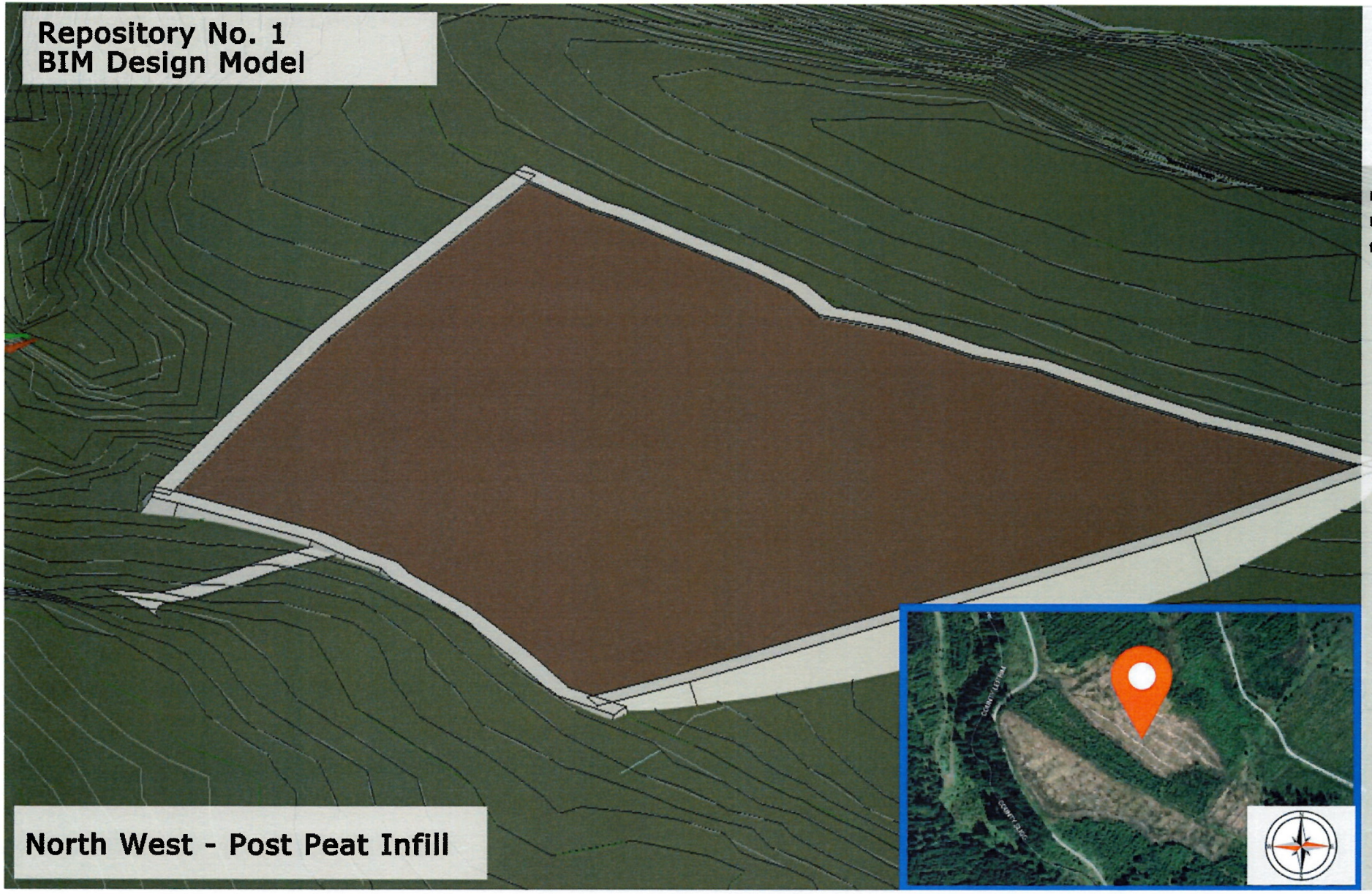
Please refer to drawing:
P1459-1-0121-A1-0511-27-00B
for proposed drainage design
North West - Pre Peat Infill

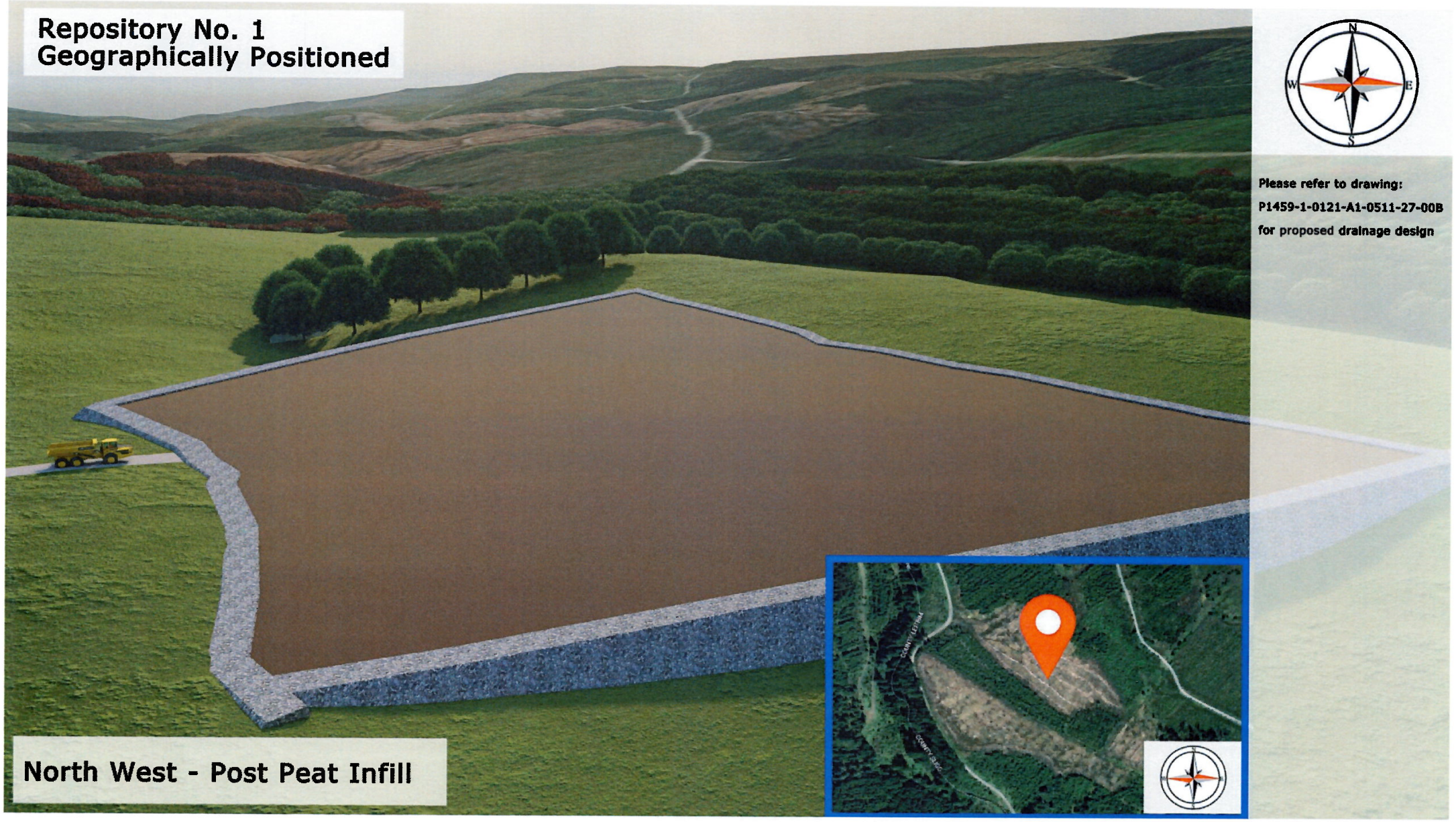
Repository No. 1
BIM Design Model



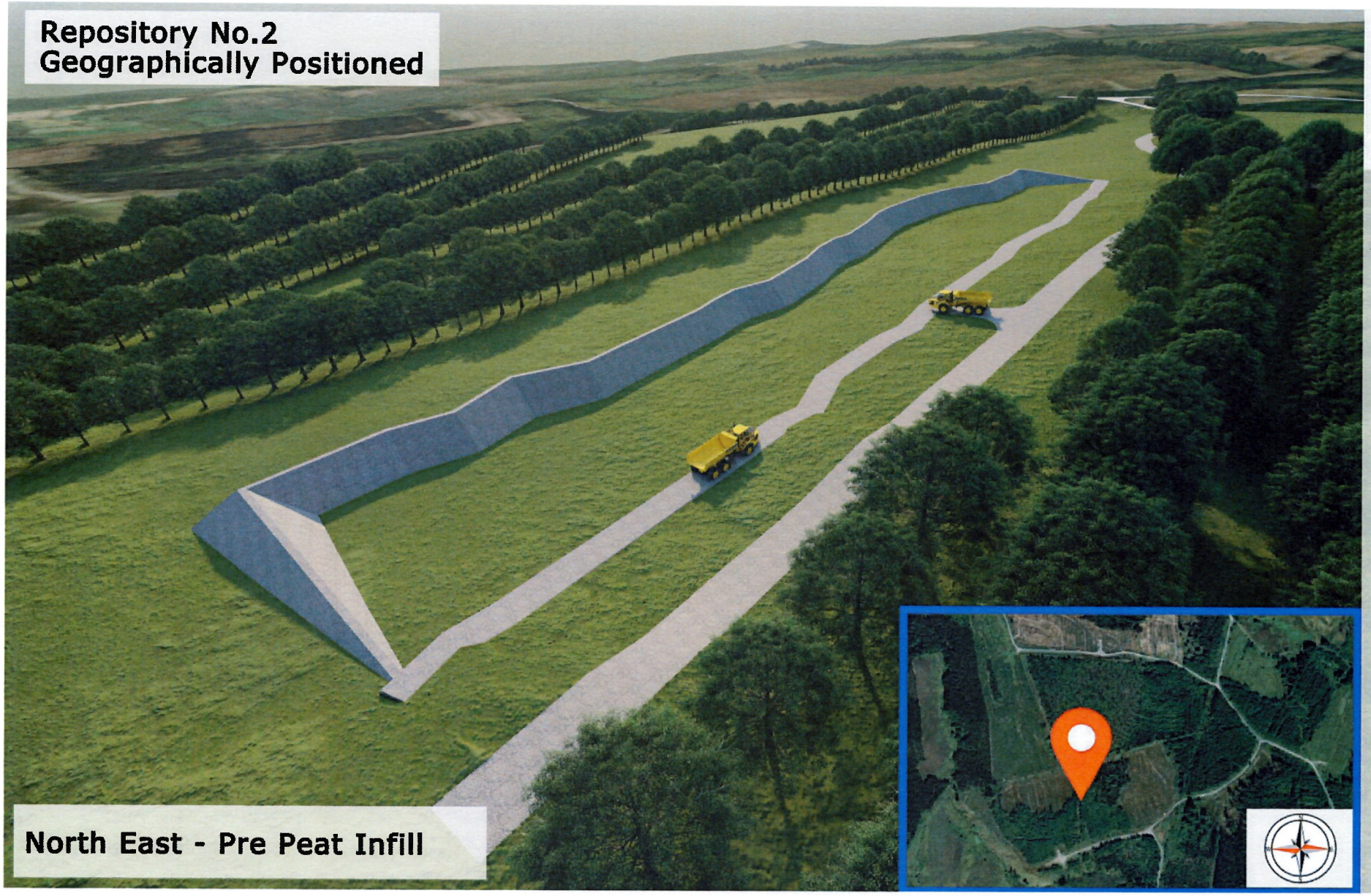


Please refer to drawing:
P1459-1-0121-A1-0511-27-00B
for proposed drainage design

Repository No. 1
Geographically Positioned



Repository No.2
Geographically Positioned



North East - Pre Peat Infill

Please refer to drawing:
P1459-1-0121-A1-0511-23-00B
for proposed drainage design

Repository No.2
BIM Design Model



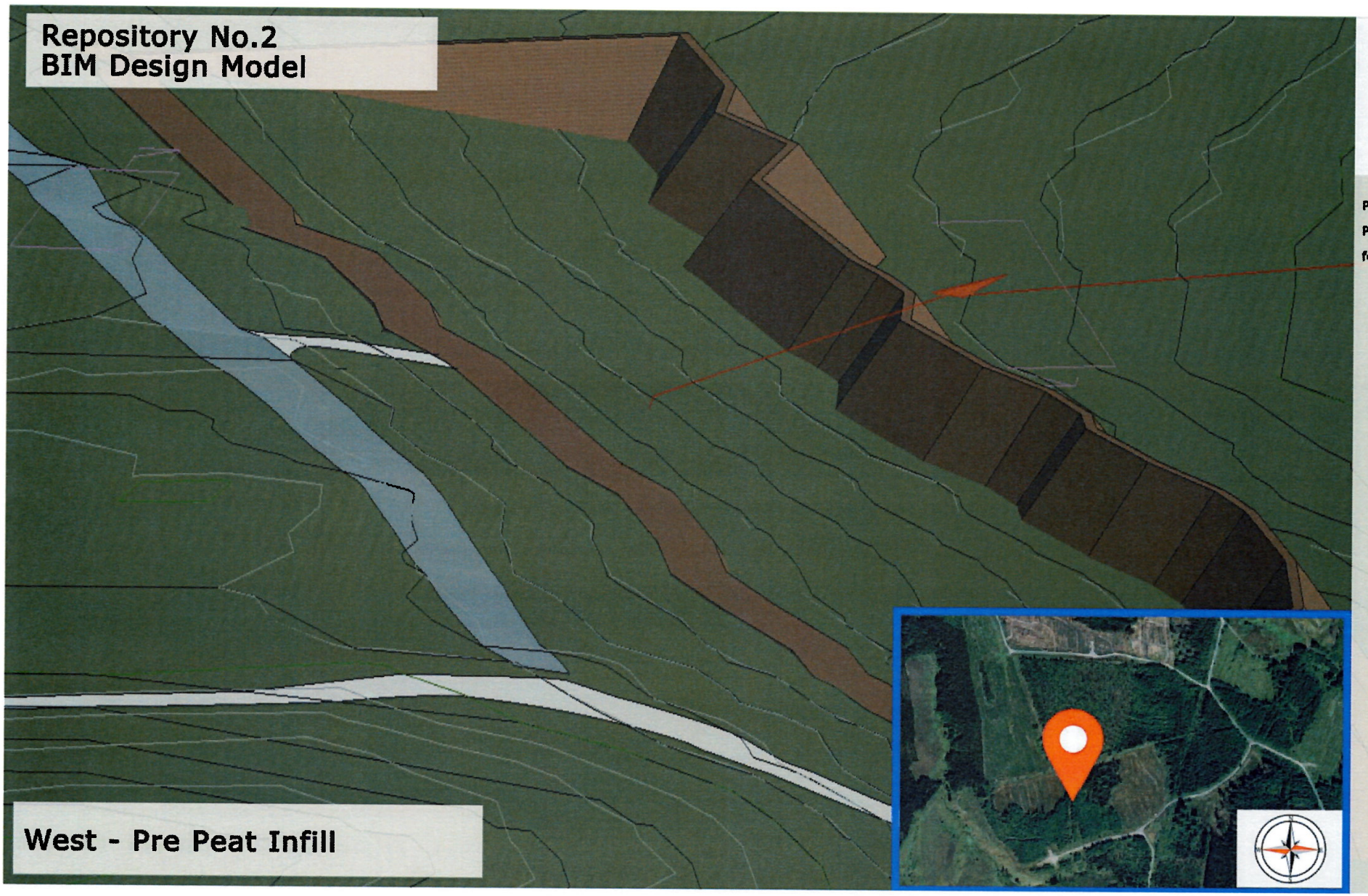
Repository No.2 Geographically Positioned



West - Pre Peat Infill

Please refer to drawing:
P1459-1-0121-A1-0511-23-00B
for proposed drainage design

Repository No.2
BIM Design Model



Please refer to drawing:
P1459-1-0121-A1-0511-23-00B
for proposed drainage design

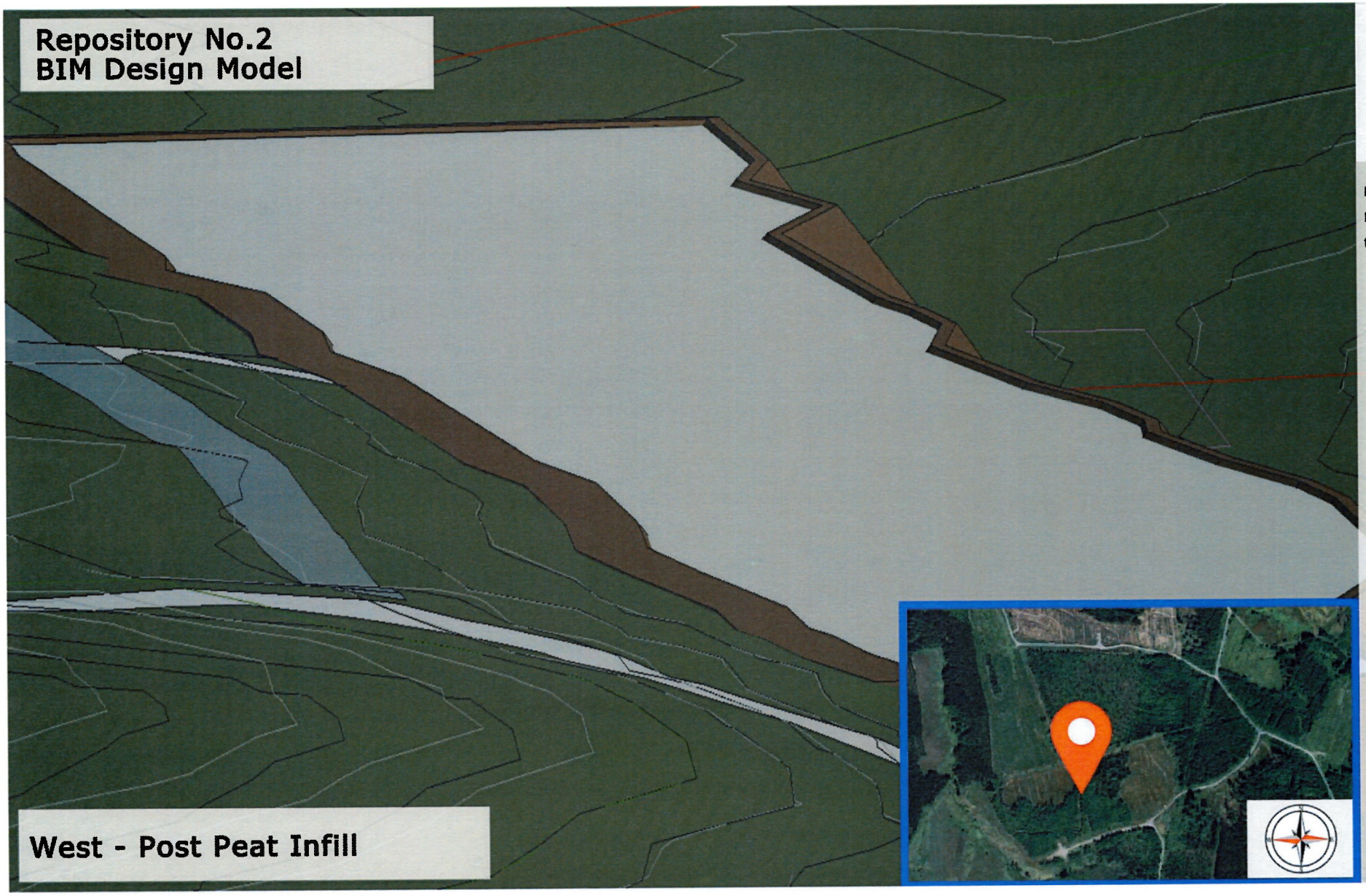
Repository No.2
Geographically Positioned



West - Post Peat Infill

Please refer to drawing:
P1459-1-0121-A1-0511-23-00B
for proposed drainage design

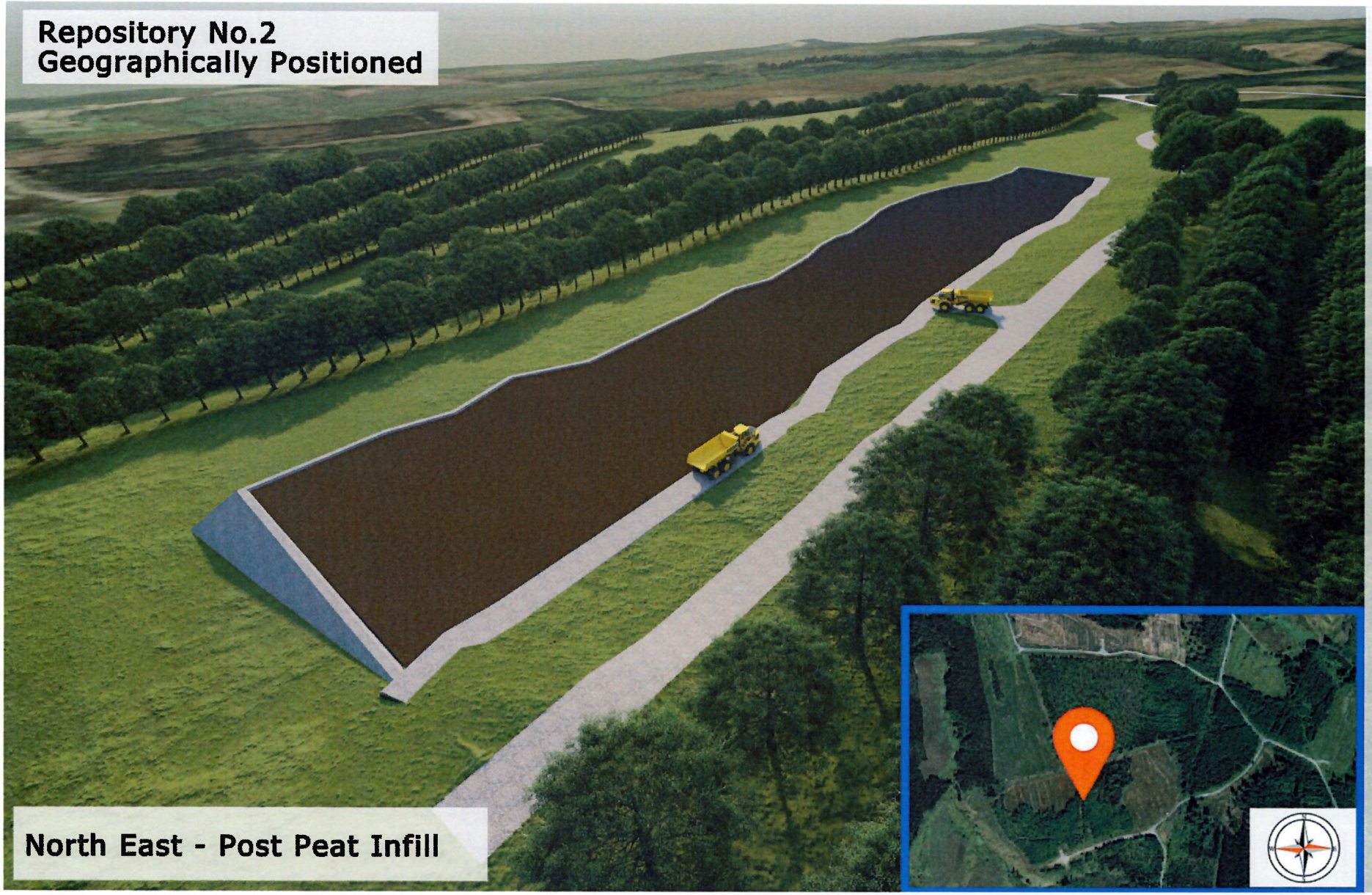
Repository No.2
BIM Design Model



West - Post Peat Infill

Please refer to drawing:
P1459-1-0121-A1-0511-23-00B
for proposed drainage design

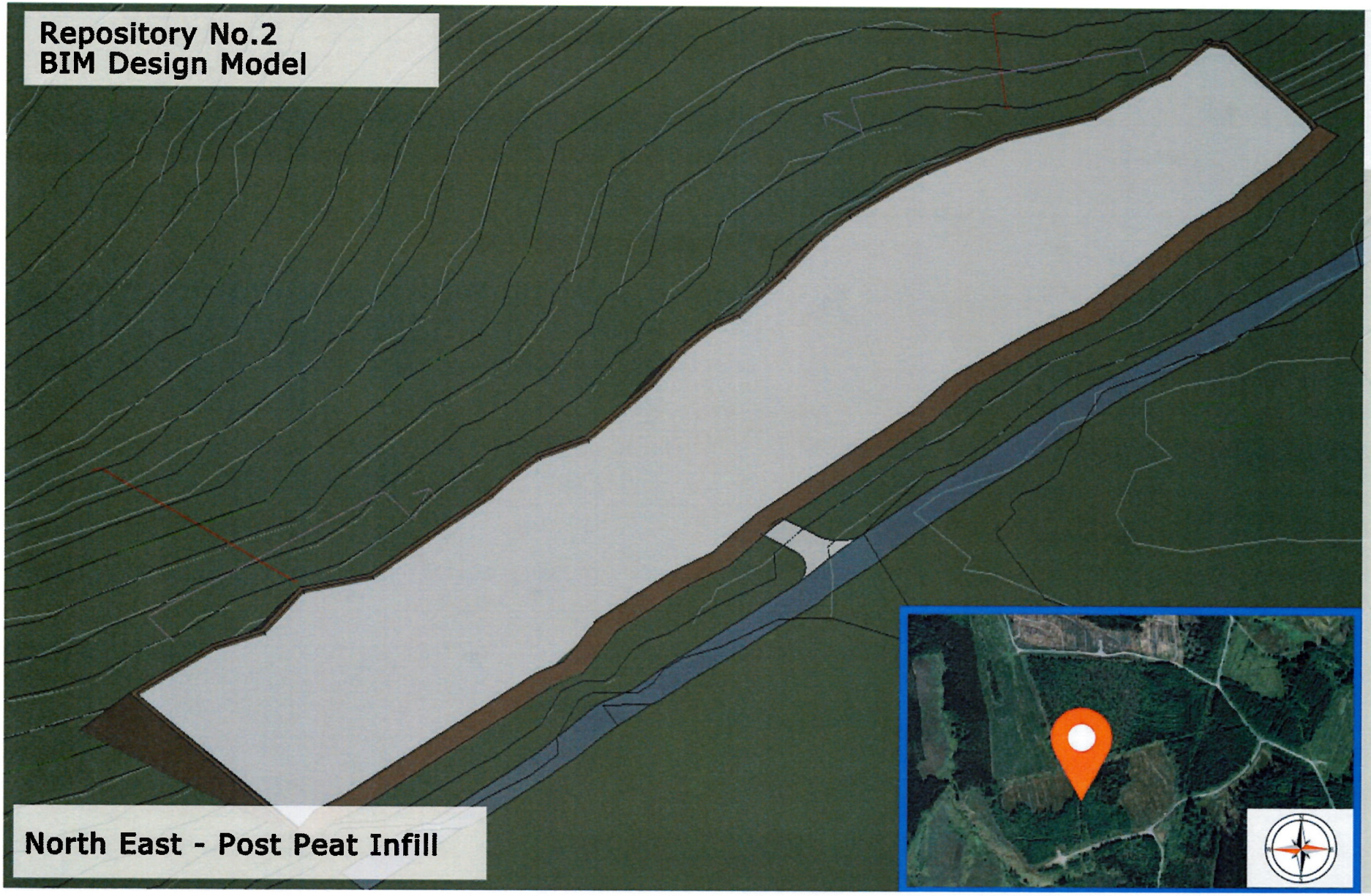
Repository No.2
Geographically Positioned



North East - Post Peat Infill

Please refer to drawing:
P1459-1-0121-A1-0511-23-00B
for proposed drainage design

Repository No.2
BIM Design Model





Please refer to drawing:
P1459-1-0121-A1-0511-23-00B
for proposed drainage design

APPENDIX 4 - Operational Phase Environmental Noise Response

Prepared by AWN Consulting

MKO, Tuam Road, Galway, Ireland. H91 VW84
+353 (0)91 735611 | info@mkoireland.ie | www.mkoireland.ie | @mkoireland
McCarthy Keville O'Sullivan Ltd. t/a MKO. Registered in Ireland No. 462657. VAT No. IE9693052R.

awnconsulting
A Trinity Consultants Company

The Tecpro Building,
Clonshaugh Business & Technology Park,
Dublin 17, Ireland.

T: + 353 1 847 4220
F: + 353 1 847 4257
E: info@awnconsulting.com
W: www.awnconsulting.com

227501.0731/NL01
8 December 2022

MKO
Tuam Road,
Galway
H91 VW84

To whom it may concern,

RE: CROAGH WIND FARM NOISE RFI: (ABP-310788-21 and ABP-310789-21)

A decision was made by Leitrim County Council (LCC) and Sligo County Council to grant permission for the proposed Croagh Wind Farm (hereafter referred to as the Wind Farm Ref P20-120 and 20.251.

The application was appealed to An Bord Pleanála (ABP) and as part of that process, ABP has made a request for further information (RFI) in relation to the environmental noise from the operation of the Wind Farm. AWN Consulting have prepared this technical letter to respond to the points raised in the RFI in relation to environmental noise.

1.0 INVOLVEMENT IN PROPOSED DEVELOPMENT AND STATEMENT OF AUTHORITY

AWN are the noise consultants for this project and prepared Chapter 11 Noise and Vibration of the submitted Environmental Impact Assessment Report (EIAR) and carried out the assessments presented therein.

AWN is a multidisciplinary consultancy offering specialist design advice and expert witness services in respect of a wide range of engineering and environmental disciplines. AWN has a head office in Dublin and hosts Ireland's largest acoustic consultancy team with fourteen full-time consultants working in the field. The company has extensive experience in issues relating to wind farm noise having been involved in numerous wind farm projects across the island of Ireland.

Cork Office
Unit 5, ATS Building,
Carrigaline Industrial Estate,
Carrigaline, Co. Cork.
T: + 353 21 438 7400
F: + 353 21 483 4606

AWN Consulting Limited
Registered in Ireland No. 319812

The following staff members were involved in the preparation of the Wind Farm Assessment:

Mike Simms (Principal Acoustic Consultant) holds a BE and MEngSc in Mechanical Engineering and is a member of the Institute of Acoustics (MIOA) and of the Institution of Engineering and Technology (MIET). Mike has worked in the field of acoustics for 20 years. He has extensive experience in all aspects of environmental surveying, noise modelling and impact assessment for various sectors including, wind energy, industrial, commercial and residential.

Dermot Blunnie (Principal Acoustic Consultant) holds a BEng (Hons) in Sound Engineering, MSc in Applied Acoustics and has completed the Institute of Acoustics (IOA) Diploma in Acoustics and Noise Control. He has been working in the field of acoustics since 2008 and is a member of the Institute of Engineers Ireland (MIEI) and the Institute of Acoustics (MIOA). He has extensive knowledge and experience in relation to commissioning noise monitoring and impact assessment of wind farms as well as a detailed knowledge of acoustic standards and proprietary noise modelling software packages. He has commissioned noise surveys and completed noise impact assessments for numerous wind farm projects within Ireland.

Leo Williams holds a BA, BAI (Mechanical and Manufacturing Engineering) and a MAI (Mechanical and Manufacturing Engineering). He is an Associate Member of the Institute of Acoustics (IOA) and has completed the IOA Diploma in Acoustics and Noise Control. He has over five years' experience working in the field of acoustics and has prepared numerous environmental impact assessment chapters for various developments such as infrastructural developments, mixed use developments and specialises in wind energy development projects.

AWN was commissioned to conduct a detailed appraisal of the noise and vibration impacts associated with both the construction, operation and decommissioning of the proposed Croagh Wind Farm.

AWN carried out the baseline noise monitoring aspect of the assessment, conducted detailed noise modelling with consideration of cumulative impacts and prepared the noise and vibration section of the submitted EIAR.

The noise and vibration assessment carried out as part of the submitted EIAR is considered robust, comprehensive and in line with best practice as set out in the *Wind Energy Development Guidelines for Planning Authorities* published by the Department of the Environment, Heritage and Local Government (2006) and *A Good Practice Guide to the Application of ETSU-R-97 for the Assessment and Rating of Wind Turbine Noise* (IOA, 2013); however, appropriate clarifications and further discussion are presented in the following sections of this technical note to clarify, expand, and highlight relevant previous statements within the submitted EIAR and address the items raised in the Further Information request.

AWN Consulting also prepared documents responding to a request for Further Information from Sligo County Council and Leitrim County Council, in document references MS/18/10451NT07 (Sligo) and MS/18/10451NT08 (Leitrim) both dated 3rd March 2021.

2.0 NOISE ISSUES RAISED IN THE F.I. REQUEST

The F.I. request states the following in relation to Noise:

> *Furthermore, the Board noted that the proposed development is in a low noise environment and that there are substantial separations distances between proposed turbines and existing houses in the area. However, the Board noted that the applicant has acknowledged that there is residual potential for adverse*

effects arising from low frequency noise and amplitude modulation and is committed to investigating such adverse effects if they arise. The Board is seeking further information from the applicant on how this issue would be mitigated in the event that adverse effects arise.

Each of the issues; namely low-frequency noise and amplitude modulation are discussed in turn in the following sections.

3.0 LOW-FREQUENCY NOISE (LFN)

It is confirmed that neither the EIAR Chapter nor the FI documents state that there is a residual potential for adverse effects arising from low-frequency noise.

Section 11.3.3.1 of the EIAR discussed low-frequency noise in relation to wind turbines:

> *Low Frequency Noise is noise that is dominated by frequency components less than approximately 200Hz whereas Infrasound is typically described as sound at frequencies below 20Hz. In relation to Infrasound, the following extract from the EPA document Guidance Note for Noise Assessment of Wind Turbine Operations at EPA Licensed Sites (NG3) (EPA, 2011) is noted here:*
>
> > *"There is similarly no significant infrasound from wind turbines. Infrasound is high level sound at frequencies below 20 Hz. This was a prominent feature of passive yaw "downwind" turbines where the blades were positioned downwind of the tower which resulted in a characteristic "thump" as each blade passed through the wake caused by the turbine tower. With modern active yaw turbines (i.e. the blades are upwind of the tower and the turbine is turned to face into the wind by a wind direction sensor on the nacelle activating a yaw motor) this is no longer a significant feature."*

The chapter continues:

> *The UK Institute of Acoustics Bulletin in March 2009 included a statement of agreement between acoustic consultants regularly employed on behalf of wind farm developers, and conversely acoustic consultants regularly employed on behalf of community groups campaigning against wind farm developments (IAO JS2009). The intent of the article was to promote consistent assessment practices, and to assist in restricting wind farm noise disputes to legitimate matters of concern. In relation to the issue of infrasound, the article states the following:*
>
> > *"Infrasound is the term generally used to describe sound at frequencies below 20 Hz. At separation distances from wind turbines which are typical of residential locations the levels of infrasound from wind turbines are well below the human perception level. Infrasound from wind turbines is often at levels below that of the noise generated by wind around buildings and other obstacles.*
> >
> > *Sounds at frequencies from about 20 Hz to 200 Hz are conventionally referred to as low-frequency sounds. A report for the DTI in 2006 by Hayes McKenzie concluded that neither infrasound nor low frequency noise was a significant factor at the separation distances at which*

people lived. This was confirmed by a peer review by a number of consultants working in this field. We concur with this view."

The article concludes that:

> *"from examination of reports of the studies referred to above, and other reports widely available on internet sites, we conclude that there is* ***no robust evidence that low frequency noise*** *(including 'infrasound') or ground-borne vibration from wind farms,* ***generally has adverse effects on wind farm neighbours****". [Emphasis added]*

The following recommendation, which is committed to by the developer and will be implemented in full, is presented within the Mitigation Operational Phase section of the noise chapter, section 11.5.5.1 states:

> *In the unlikely event that an issue with low frequency noise is associated with the proposed development once operational, it is recommended that an appropriate detailed investigation be undertaken. Due consideration should be given to guidance on conducting such an investigation which is outlined in Appendix VI of the EPA document entitled Guidance Note for Noise: Licence Applications, Surveys and Assessments in Relation to Scheduled Activities (NG4) (EPA, 2016). This guidance is based on the threshold values outlined in the Salford University document Procedure for the assessment of low frequency noise complaints, Revision 1, December 2011.*

The above statement from the EIAR confirms the guidance which will be followed in the event that LFN is suspected. If an issue is confirmed, measures to mitigate LFN at noise-sensitive locations will be implemented through operational controls for the relevant turbine type, which may include turbine curtailment and/or stopping turbines under specific operational conditions.

Notwithstanding the above, AWN confirms that low-frequency noise issues due to the operation of the proposed wind turbines are not expected at the noise-sensitive locations ((refer to Appendix 8 [Figure 1] of Further Information Response PL. 20/251)

4.0 AMPLITUDE MODULATION (AM)

It is confirmed that the neither the EIAR nor the FI documents state that there is a residual potential for adverse effects arising from amplitude modulation.

From Section 11.3.3.2.1 of the EIAR, *Frequency of Occurrences of AM:*

> *Research by Salford University commissioned by the Department of Environment Food and Rural Affairs (DEFRA), the Department of Business, Enterprise and Regulatory Reform (BERR) and the Department of Communities and Local Government (CLG) investigated the issue of AM associated with wind turbine noise. The results were reviewed and published in the report Research into Aerodynamic Modulation of Wind Turbine Noise (2007). The broad conclusions of this report were that aerodynamic modulation was only considered to be an issue at 4, and a possible issue at a further 8, of 133 sites in the UK that were operational at the time of the study and considered within the review. At the 4 sites where AM was confirmed as an issue, it was considered that conditions associated with AM might occur between about 7 and 15% of the time. It also emerged that for three out of the four sites the complaints have subsided, in one case due to the introduction of a turbine*

control system. The research has shown that AM is a rare and unlikely occurrence at operational wind farms.

It should be noted that AM is associated with wind turbine operation and it is not possible to predict an occurrence of AM at the planning stage. It should also be noted that it is a rare event associated with a limited number of wind farms. While it can occur, it is the exception rather than the rule.

RenewableUK Research Document states the following in relation to matter:

Page 68 Module F	*"even on those limited sites where it has been reported, its frequency of occurrence appears to be at best infrequent and intermittent."*
Page 6 Module F	*"It has also been the experience of the project team that, even at those wind farm sites where AM has been reported or identified to be an issue, its occurrence may be relatively infrequent. Thus, the capture of time periods when subjectively significant AM occurs may involve elapsed periods of several weeks or even months."*
Page 61 Module F	*"There is nothing at the planning stage that can presently be used to indicate a positive likelihood of OAM occurring at any given proposed wind farm site, based either on the site's general characteristics or on the known characteristics of the wind turbines to be installed."*

The last paragraph of this section is quoted here:

Where it occurs, AM is typically an intermittent occurrence, therefore assessment may involve long-term, post-commissioning measurements. The 'Reference Method' for measuring AM outlined in the IoA AMWG document will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including mitigation.

Within the mitigation section of the EIAR, 11.5.5.2, the following is stated:

In the unlikely event that a complaint is received which indicates potential amplitude modulation (AM) associated with turbine operation, the operator shall employ an independent acoustic consultant to assess the level of AM in accordance with the methods outlined in the Institute of Acoustics (IoA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, A Method for Rating Amplitude Modulation in Wind Turbine Noise (August 2016) or subsequent revisions (August 2016).

The measurement method outlined in the IoA AMWG document, known as the 'Reference Method', will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, which can be used to evaluate different operational conditions including mitigation.

The following commitments are provided to confirm how the operator would address AM during the operational phase of the Proposed Development, if AM were to arise at a noise-sensitive location:

In the event of a confirmed complaint which indicates potential amplitude modulation (AM) associated with turbine operation, the operator will employ a qualified acoustic consultant to assess the level of AM in accordance with the methods outlined in the Institute of Acoustics (IOA) Noise working Group (Wind Turbine Noise) Amplitude Modulation Working Group (AMWG) namely, Institute of Acoustics IOA Noise Working Group (Wind Turbine Noise) Amplitude Modulation Working Group Final Report: A Method for Rating Amplitude Modulation in Wind Turbine Noise (9 August 2016).

The measurement method outlined in the IOA AMWG document, known as the 'Reference Method', will provide a robust and reliable indicator of AM and yield important information on the frequency and duration of occurrence, and wind conditions under which it is found, which will be used to evaluate mitigation requirements.

These mitigation measures, if required, will consist of the implementation of operational controls for the relevant turbine type, which will include turbine curtailment and/or stopping turbines under specific operational conditions.

5.0 CONCLUSION

This technical note has been prepared in response to a request for Further Information from ABP in relation to the planning application for the Croagh Wind Farm.

It is re-iterated that at no point in the EIAR nor the FI documents is it stated that there is a residual potential for adverse effects arising from either low-frequency noise nor amplitude modulation.

The submitted noise impact assessment is robust and has been carried out in line with current standards and best practice guidelines (i.e. Planning Guidelines for Wind Development 2006 and IOA GPG). In addition to these guidelines, discussion has been provided in relation to matters such as Low frequency noise, Infrasound, and Amplitude Modulation. The submitted EIAR Noise and Vibration assessment , as supplemented by the FI responses to Sligo and Leitrim County Councils, demonstrates that the proposed development can operate within the noise criteria derived from the relevant guidance. This document has reiterated the relevant sections of the EIAR to comprehensively address the concerns raised by the F.I. request, and confirms the measures which will be implemented in full to ensure any issue will be mitigated in the unlikely event of adverse effects arising as a result of low frequency noise or amplitude modulation.

Yours sincerely,

Mike Simms

MIKE SIMMS
Principal Acoustic Consultant

DERMOT BLUNNIE
Principal Acoustic Consultant

APPENDIX 5: An Bord Pleanála Request for Further Information (Ref. 310788).

Our Case Number: ABP-310788-21

Planning Authority Reference Number: 20251

Your Reference: Coillte CGA

An Bord Pleanála

MKO
Tuam Road
Galway
Co. Galway
H91 VW84

MKO
Received on
14 NOV 2022
180911
Eoin Mc Carthy

Date: 11 November 2022

Re: 10-year planning permission with 30-year operational life. Construction of 2 wind turbines, 1 Meteorological Mast and all associated site development works. A concurrent planning application is being lodged with Leitrim County Council. An Environmental Impact Assessment Report (EIAR) and a Natura Impact Statement (NIS) have been submitted.
Towlands of Carrowmore , and Carrownyclowan , County Sligo

Dear Sir / Madam,

I have been asked by An Bord Pleanála to refer to the above-mentioned appeal.

The Board has examined the appeal and is of the opinion that certain information is necessary for the purpose of enabling it to determine the appeal.

In accordance with section 132 of the Planning and Development Act, 2000, (as amended), you are required to submit, on or before **8th December, 2022**, the following:

In considering all the information and submissions on the file including Chapter 8 of the EIAR, the Peat and Spoil Management Plan submitted as Appendix 4-2 of the EIAR, the Geotechnical and Peat Stability Assessment Report submitted as Appendix 8-1 of the EIAR and the applicant's response to the further information request from the Planning Authority provided as Appendix A Stability Analysis of Borrow Pits, Peat Repositories and Settlement Ponds, the Board could not be satisfied that the proposed repositories would be effective in providing for the permanent retention of peat and other materials and that the mitigation measures, inclusive of the proposed drainage system, would be adequate to ensure that there would be no significant risk of adverse environmental impacts or serious injury to properties in the vicinity of the proposed development.

Teil Tel (01) 858 8100
Glao Áitiúil LoCall 1890 275 175
Facs Fax (01) 872 2684
Láithreán Gréasáin Website www.pleanala.ie
Ríomhphost Email bord@pleanala.ie

64 Sráid Maoilbhríde
Baile Átha Cliath 1
D01 V902

64 Marlborough Street
Dublin 1
D01 V902

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 rock at the repository locations, and the hillside siting of the northernmost repository and the associated clear felling of forestry.

Furthermore, the Board noted that the proposed development is located in a low noise environment, and that there are substantial separation distances between proposed turbines and existing houses in the area. However, the Board noted that the applicant has acknowledged that there is residual potential for adverse effects arising from low frequency noise and amplitude modulation and is committed to investigating such adverse effects if they arise. The Board is seeking further information from the applicant on how this issue would be mitigated in the event that adverse effects arise.

If the information required is not received before the end of the specified period, the Board will dismiss or otherwise determine the appeal without further notice to you in accordance with section 133 of the 2000 Act, (as amended). Your submission in response to this notice must be received by the Board not later than **5.30 p.m. on the date specified above**.

Please quote the above appeal reference number in any further correspondence.

Yours faithfully,

Lisa Quinn
Executive Officer
Direct Line: 01-8737158

BP71 Registered Post

Teil	**Tel**	(01) 858 8100
Glao Áitiúil	**LoCall**	1890 275 175
Facs	**Fax**	(01) 872 2684
Láithreán Gréasáin	**Website**	www.pleanala.ie
Ríomhphost	**Email**	bord@pleanala.ie

64 Sráid Maoilbhríde
Baile Átha Cliath 1
D01 V902

64 Marlborough Street
Dublin 1
D01 V902