APPENDIX 4-2

PEAT AND SPOIL MANAGEMENT PLAN

Lackareagh Wind Farm

Peat and Spoil Management Plan

MKO

13 August 2024

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Report History

Ver.		Created	Staff	Approval	Staff
0	Draft Issue for Comments	25/03/2024	MS	25/03/2024	LP
1	Updated after MKO comments	24/04/2024	MS	24/04/2024	LP

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1. EXECUTIVE SUMMARY

AFRY Ireland ("AFRY") has been commissioned by MKO on behalf of EDF Renewables Ireland Ltd ("the Applicant") to complete a Peat & Spoil Management Plan (PSMP) as part of an application for planning permission for the proposed Lackareagh Wind Farm in Co. Clare (the henceforth to be referred to as the 'Proposed Project').

As detailed in Section 1.1.1 of Chapter 1, for the purposes of this EIAR, the various project components are described and assessed under the following references: 'Proposed Project', Proposed Wind Farm', 'Proposed Grid Connection Route' and 'the site'.

This report presents a Peat and Spoil Management Plan (PSMP) for the construction phase of the Proposed Project. It outlines excavation methodologies for peat and spoil across various infrastructure locations and details how these materials will be managed, reinstated, and deposited on-site. Additionally, it highlights construction methodologies for the proposed infrastructure types, estimated material volumes, and identifies on-site deposition areas.

From the site investigation findings carried out to date, there was no peat identified at the turbine locations T1, T2, T6, T7, the met mast and the associated access roads. While no peat was found at turbine location T5, a peat depth of 0.5m was observed along the spur road leading to T5.

The survey shows that the peat depth at turbine locations T3 and T4 is less than 0.5m, while at the temporary construction compound, it reaches a maximum recorded depth of 0.5m.

Overall, the peat depths recorded across proposed infrastructure locations ranges from 0m to 1.58m, with peat deeper than 1m observed between chainages T3+350 and T3+400.

The PSMP aims to ensure efficient peat and spoil management, environmental sustainability, and compliance with regulations throughout the construction process.

2. STATEMENT OF AUTHORITY

AFRY Ireland (formerly Ionic Consulting) is a leading renewable energy consultancy firm in Ireland, with offices in Dublin and Edinburgh. In July 2022, the business was acquired by AFRY – a Swedish-based international consultancy business who is a European leader in engineering, design, and advisory services across multiple industries, including infrastructure, energy, and construction. Presently, the AFRY Ireland team comprises over 30 staff members with diverse technical and management expertise.

AFRY Ireland is a technology agnostic renewable energy company, offering a comprehensive range of specialist services and technical advice throughout project lifecycles providing technical and project management services to support the development, preconstruction and construction of renewable technologies including solar PV, onshore wind, energy storage and offshore wind, throughout Ireland, the UK, and Europe.

AFRY Ireland has strong corporate credentials and a first-class in-house team, supported by our new colleagues from the wider AFRY family, allowing us to adapt our offering to each geography and the specifics of every project, on a case-by-case basis.

This report has been prepared by Liam Power (AFRY Senior Project Manager) and Manasvi Srivastava (AFRY Civil Engineer, M.E. Structural Engineering, BTech. Civil Engineering). Liam Power is the head of AFRY Ireland Civil Team and has over 25 years construction experience in all aspects of large civil engineering projects, with latter years focusing on project managing large scale renewable projects. Manasvi Srivastava is a Civil Engineer with AFRY Ireland and has over five years of experience in civil, structural, and geotechnical engineering.

3. INTRODUCTION

3.1 Project Background

The Proposed Wind Farm is located 1km north/northeast of the village of Kilbane, Co. Clare. The townlands in which the Proposed Project is located is listed in Table 1-1 in Chapter 1 of this EIAR: Introduction.

The Proposed Project will comprise 7 no. wind turbines, and associated foundations and hardstanding areas, access roads, underground cabling, permanent meteorological mast, temporary construction compound, peat and spoil management areas, tree felling, site drainage, operational stage signage, battery energy storage system, 38kV onsite substation and battery energy storage system (BESS) and associated underground 38kV cabling connecting to the existing Ardnacrusha 110kV Substation, and all ancillary works and apparatus.

A full description of the Proposed Project is included in Chapter 4 of the EIAR: Description of the Proposed Project.

This report details the peat and spoil management proposals to be implemented as part of the construction phase of the Proposed Project. The proposals set out in this report will ensure that all material generated as part of the construction phase of the Proposed Project is managed correctly.

3.2 Purpose

The objective of this report is to present a Peat and Spoil Management Plan (PSMP) for the construction phase of the Proposed Project. This report outlines the methodology for excavating peat and spoil at the turbine bases, hardstands, substation and battery storage compound, temporary construction compound, met mast, cable trenches, and access roads, as well as the how these materials will be managed, reinstated, and deposited on-site. The report also details the construction methodologies for the various elements as mentioned above and provides specific details regarding the construction types of the proposed road. Furthermore, it summarizes the estimated volumes and types of materials forecasted to be generated during the construction process, along with the location of on-site peat and spoil management areas.

This report also includes a monitoring procedure to track any potential peat movements on site during the construction of the Proposed Project and a contingency plan to be implemented in the case of a peat slide occurring. Although this PSMP provides some guidance on drainage measures for excavation and construction activities in the areas of peat, detailed information on drainage measures is included in Chapter 4 of this EIAR: Description of the Proposed Project, and Chapter 9 of this EIAR: Water.

This PSMP will be further developed upon a grant of planning permission and as the project progresses through the detailed design and construction phases and will form a part of the detailed Construction Environment Management Plan (CEMP).

4. GUIDELINES FOR PEAT MANAGEMENT

This report has been compiled in accordance with the following policy and best practice guidance:

- Best Practice Guidelines for the Irish Wind Energy Industry (Irish Wind Energy Association, 2012);
- Wind Energy Development Guidelines (Department of Housing, Planning and Local Government, 2006);
- Draft Revised Wind Energy Development Guidelines (Department of Housing, Planning and Local Government, 2019);
- Good Practice during Windfarm Construction (Scottish Renewables, SNH, SEPA & Forestry Commission Scotland, 4th Edition 2019);
- Guidance on Developments on Peatland: Site Surveys (Scottish Government, Scottish Natural Heritage and SEPA, 2017);
- Guidance on the Assessment of Peat Volumes, Reuse of Excavated Peat and the Minimisation of Waste (Scottish Renewables and SEPA, 2012);
- Peat Landslide Hazard and Risk Assessments. Best Practice Guide for Proposed Electricity Generation Developments (Scottish Government, 2017); and
- Developments on Peat and Off-Site Uses of Waste Peat (SEPA, 2017).

5. DESK STUDY AND INITIAL WALKOVER

5.1 Desk Study

A desk study of Geological Survey Ireland (GSI) mapping and aerial mapping identified the following:

- The Proposed Project infrastructure is mainly underlain by sandstone gravel, sandstone and shale till, and bedrock outcrop with peaty surface in some areas.
- The bedrock at the Proposed Project site comprises greywacke and greywacke sandstone of Broadford Formation.
- The GSI map identifies multiple geological faults intersecting the Proposed Project site. These faults include one oriented in a west-east direction, two in a northwest-southeast direction, and two running southwest-northeast. Among these, a single southwest-northeast oriented strike fault traverses across the proposed T4 turbine foundation footprint. No faults have been identified at the remaining turbine bases, hardstands, substation and battery storage compound, or the met mast locations, or any other ancillary infrastructure.

5.2 AFRY Site Walkovers

In January 2024, AFRY carried out a site walkover across the turbine locations, the substation and battery storage compound, the met mast, and the temporary construction compound.

It was observed that turbines T1, T2, T6 and T7, and the met mast are located within open farmlands and T3 and T4 are located within active commercial forestry lands. Turbine T5, the substation and battery storage compound, the temporary construction compound and the borrow pit are located in an area of forestry which, at the time of the surveys, had been recently felled and was in early stages of regeneration.

It was noted that the site is characterized by a steep topography, with most areas covered in sod and some shallow, firm peat overlay. No ponding or soft spots were observed on the site, likely due to the presence of steep slopes which facilitate efficient drainage.

For detailed information on ground conditions and stability of peat, please refer to the Geotechnical and Peat Stability Assessment included as Appendix 8-1 within the EIAR.

Photos from the January site walkover have been included within Appendix A of this report.

6. FIELDWORKS

6.1 Preliminary Fieldworks

Over 50 peat probes were carried out by MKO between April 2021 and August 2023 within the Proposed Project site. The peat probe survey has indicated that the depth of peat across the site is generally shallow, with a deeper peat pocket identified along the road leading to T3.

There was no peat identified at the turbine locations T1, T2, T6, T7, the met mast and the associated access roads. While no peat was found at turbine location T5, a peat depth of 0.5m was observed along the spur road leading to T5.

The survey shows that the peat depth at turbine locations T3 and T4 is less than 0.5m, while at the temporary construction compound, it reaches a maximum recorded depth of 0.5m.

Overall, the peat depths recorded across proposed infrastructure locations ranges from 0m to 1.58m, with peat deeper than 1m observed between chainages T3+350 and T3+400.

Results of the peat probe survey are included within Appendix B.

6.2 Further Site Investigation

The initial fieldworks were carried out in July 2022 by Causeway Geotech Limited on behalf of the Client. During this stage, trial pits were dug at three locations across the site and seven DCP tests were carried along the existing forest road to T7. Shear box testing and laboratory testing on soil and rock samples taken from trial pits were carried out.

Additional investigation works were carried out by Causeway Geotech Limited between December 2023 and January 2024 which included 14no. trial pits, 3no. rotary boreholes, 18no. heavy dynamic probes and 27no. dynamic cone penetrometers. Testing was carried out at turbine bases, hardstands, met mast, substation and battery storage compound, temporary construction compound, borrow pit and access roads. Table 1 lists the coordinates of the trial pits and dynamic probes executed at each infrastructure location. The ground investigation factual report is included within Appendix C.

Location	Trial Pit Coordinates		Dynamic Probe Coordinates	
	Easting	Northing	Easting	Northing
T1	562208.01	673986.23	562233.07	673982.35
	-	-	562232.19	673980.73
T2	562282.26	673586.76	562298.89	673609
T3	564007.76	673278.88	564002.85	673280.78

Location	Trial Pit Coordinates		Dynamic Probe Coordinates	
	-	-	564001.91	673281.35
T4	563886.6	672683.32	563892.93	672675.11
	-	-	563892.42	672674.58
T5	563977.48	672336.61	564012.3	672328.75
	-	-	564012.53	672329.04
T6	563314.91	672289.52	563321.11	672267.96
	-	-	563321.75	672268.67
T7	563391.33	671880.53	563493.13	671842.74
	-	-	563493.57	671843.18
Met Mast	562257.48	673271.87	562262.6	673266.76
Substation and BESS Compound	563610.47	672536.64	563628.39	672544.07
	563650.56	672578.40	563629.88	672544.79
	-	-	563628.36	672553.01
	-	-	563629.85	672553.73
Borrow Pit	563495.49	672475.21	-	-
	563501.42	672514.45	-	-
	563563.63	672495.96	-	-
	563565.3	672543.35	-	-

Table 1: Summary of Trial Pit and Dynamic Probe locations

7. PEAT AND SPOIL MANAGEMENT

During the construction phase of the Proposed Project, the following activities are anticipated to generate peat and spoil:

i. Construction of new excavated access roads (Type A)
ii. Upgrading of existing access roads (Type B)
iii. Excavations in peat for turbine bases, hardstands (including blade fingers and crane pads), onsite 38kV substation, battery energy storage system, permanent meteorological mast and associated hardstanding area, temporary construction compound, borrow pit
iv. Underground cabling trench along the Proposed Grid Connection Route

This will result in the generation of peat and spoil. While it is imperative to minimize the excavation arisings, it is acknowledged that some excess spoil and peat may still be generated. This unsuitable material typically consists of topsoil, peat, and glacial till. The management of peat and spoil during the construction activities as listed above are investigated individually in the following sections.

7.1 Method of Excavation

Excavation operations on the Proposed Project site will be carried out to facilitate the construction of turbine foundations, hardstands, substation and battery storage compound, met mast, temporary construction compound, borrow pit, cable trenches, and access roads as outlined above.

The general principles of excavation set out in this plan will be adhered to at all times during the construction phase.

7.2 Method of Construction

7.2.1 Turbine Bases

The diameter of the turbine foundations is 23.5m. In order to safely excavate to a suitable bearing stratum, batters of the excavation will be at 45 degrees. The formation depths for the turbine foundations are assumed to be 3.5m below ground level. According to the site investigation results, it is likely that the turbine foundations will be founded on rock, as the trial pits conducted at turbine locations indicate refusal at depths less than 3.5 meters.

The assumed excavation footprint for the turbine foundation is the turbine base diameter of 23.5m plus a 1m working area all around the base i.e. 25.5m. The volume of peat generated at each turbine location will be contingent on the peat depth, which is outlined in Table 3. The formation depths assumed for the cut and fill assessment are presented in Table 8.

The estimated peat and spoil volumes likely to arise from the construction phase of the Proposed Project are presented in Table 5.

7.2.2 Hardstands

The hardstanding areas adjacent to the turbine bases will be constructed to solid sub-formation, either bedrock or firm silt/clay subsoil underlain by bedrock. All the peat will be excavated from the hardstand footprints and no floating type construction will be used. Hardstands will be 62m x 30m in size, with two smaller tailing crane pads.

The Civil 3D model created for the hardstands geometric design was used to estimate the volume of cut and fill required to complete this element of infrastructure. This was carried out by creating a base of peat surface layer within the model, with offsets from the original ground surface layer based upon peat probe data collected from the site. The volume required to create the trapezoidal hardstand build-up with maximum batter 1(v): 2(h) was then measured directly from finished hardstand level down to suitable formation i.e. base of peat.

The estimated peat and spoil volumes likely to be generated during the construction phase of the Proposed Project are presented in Table 5.

7.2.3 Substation and Battery Energy Storage System Compound

The substation and battery energy storage system (BESS) compound were modelled using Civil 3D and primarily involves the excavation to a suitable bearing stratum. As per the trial pit and peat probe data, peaty topsoil at this location varies between 0.2m to 0.4m, which is underlain by silt.

Peat and topsoil resulting from excavation works at the substation and battery storage compound may be temporarily stockpiled in the designated area to the south. This stockpiled material will be utilized to reinstate the cut and fill batters around the substation compound. It is generally considered best practice to reinstate the excavated areas as soon as practicable upon completion of the construction phase. The remaining peat and topsoil will be utilized to build a screening berm around the perimeter of the substation and battery storage compound.

The estimated peat and spoil volumes from the substation and BESS compound are presented in Table 5.

7.2.1 Temporary Construction Compound

The temporary construction compound was modelled using Civil 3D and involve the excavation to a suitable bearing stratum, which includes removal of the topsoil and peat. The peat cover ranges between 0m and 0.5m. For this formation level, the excavation will be backfilled with 600mm of granular stone fill, compacted in layers.

The estimated peat and spoil volumes from the temporary construction compound is presented in Table 5.

7.2.2 Storage Area

The storage area will be constructed to solid sub-formation, either bedrock or firm silt/clay subsoil underlain by bedrock, similar to the turbine hardstands. The storage area is 110m x 40.5m in size. No peat was observed at this location.

7.2.3 Proposed Grid Connection Route

A 38kV underground cabling between the Proposed Wind Farm and the national electricity grid will be necessary to export the electricity generated by the Proposed Wind Farm during the operational phase. It is proposed that the Proposed Project will connect to the national grid via the Proposed Grid Connection Route, a 38kV underground cable from the proposed onsite 38kV substation to the existing 110kV Ardnacrusha Substation, Co. Clare

The Proposed Grid Connection Route is approximately 14.7km in length and is primarily located within the public road corridor.

The Proposed Grid Connection Route construction methodology, including proposals for watercourse crossings along the Proposed Grid Connection Route is described in Appendix 4-5 of the EIAR.

The Proposed Grid Connection Route underground cabling will be constructed on solid ground to EirGrid/ESB specifications. Any surplus material arisings generated during the construction of the Proposed Grid Connection Route will be disposed of in a nearby licenced waste facility and/or managed on site.

7.2.4 Access Roads

All proposed access tracks (including new and existing roads across the site) will be constructed to solid sub-formation. For excavations in peat and spoil, side slopes will be no greater than 1(v): 2(h). This slope inclination will be reviewed during construction, as appropriate. Where areas of weaker peat are encountered, then slacker slopes of 1(v): 3(h) or less will be constructed.

The Civil 3D model created for the roads geometric design was used to estimate the volume of engineering fill required to complete these access roads. This was carried out by creating a base of peat surface layer within the model, with offsets from the original ground surface layer based upon peat probing carried out across the site. The volume required to create the trapezoidal road build-up with maximum batter 1:2 is then measured directly from finished road level down to solid i.e. base of peat.

The road construction preliminary design has taken into account the following key factors:

(1) Buildability considerations

(2) Serviceability requirements for construction and wind turbine delivery and maintenance vehicles

(3) Minimise excavation arisings

(4) Requirement to minimise disruption to peat hydrology

The preliminary road construction types proposed for the Proposed Project site are summarised in Table 2.

It is to be noted that this report does not include a detailed design for the access roads on the Proposed Project. This report includes the most suitable type of road construction envisaged for each section of access road based on the ground conditions recorded during the site walkovers and site investigation results. The detailed design process will occur prior to construction commencing.

i. Construction of new excavated roads – Type A

In order to facilitate the Proposed Project, it is estimated that approximately 3.9km of new excavated access tracks will be required to be constructed. The existing roads account for approximately 67% of the total length of roads required to access the site.

These roadways will be constructed through excavation and the removal of organic material and soft subsoil to achieve a suitable formation level. A layer of geogrid or geotextile material will be laid at the formation level to separate the road building material from the subsoil. Subsequently, 450mm of granular fill material, such as Class 6F2 stone, will then be placed and compacted in layers, as specified by the detailed designer. The road will then be finished with a 150mm layer of Cl. 804 capping material.

The finished road will have a running width of 5m, with wider sections on bends and passing bays, which us detailed fully in Appendix 4-1 of this EIAR. Access road construction will be to the line and level requirements as per design/planning conditions.

A section of a new excavated road is also shown in Figure 2.

ii. Upgrade of existing roads – Type B

In order to facilitate the Proposed Project, it is proposed to utilise 2.5km of existing roads, 1.9km of which is the L7080 Local Road ('the Gap Road'), and the remaining are farm tracks. During the site survey conducted by AFRY, it was observed that the existing gap road is in relatively good condition. Upgrading of these existing tracks will likely involve both widening and resurfacing works. It is assumed that widening will typically take place on both sides of the road. However, in areas of steeper slopes, widening of existing tracks will take place on the upslope side of the road. A detailed view of the proposed road upgrade works on the L7080 Local Road can be found in Appendix 4-1 of this EIAR.

The existing roads will be widened through excavation and the removal of organic material and soft subsoil to achieve a suitable formation level. The new section of the road will be constructed by placing a 450mm of granular fill material, such as Class 6F2 stone, and compacting it in layers on top of a layer of geogrid or geotextile, depending on site conditions and as specified by the detailed designer. This road construction will be similar in build up to the construction of excavate and replace type access road. The increased

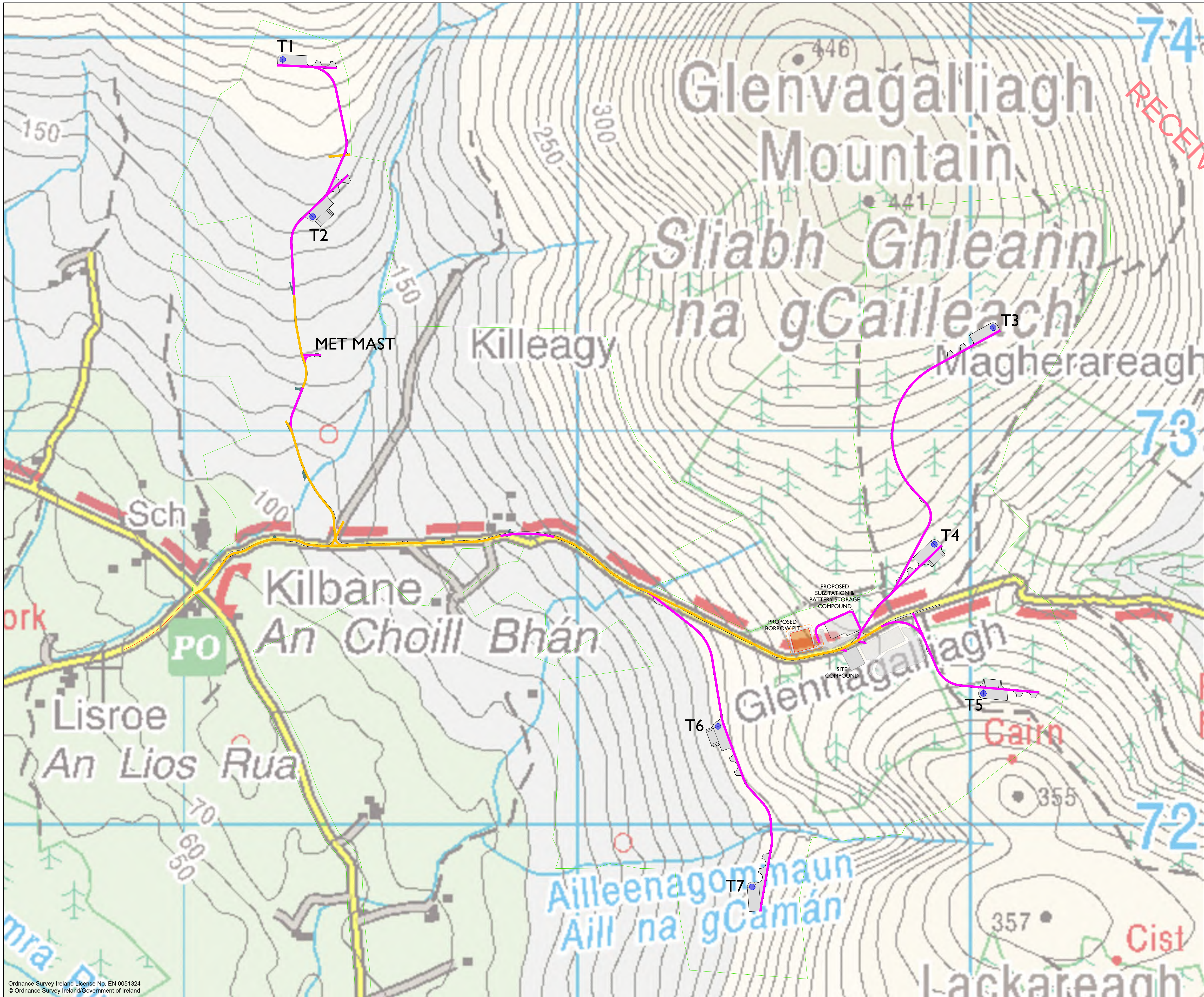
road width and the existing road surface, where necessary, will be capped with a 150mm layer of Clause 804 material.

The finished road width will have a running width of 5m, with wider sections on bends and passing bays. Access road construction will be to the line and level requirements as per design/planning conditions and outlined in Appendix 4-1.

A section of existing excavated road for upgrade is shown in Figure 2

Construction Method	Construction Type	Ground Conditions		Comment
		Typical Peat Depth	Typical Slope Inclination	
Construction of new excavate and replace access roads	Type A	<2.0m	Varies	New access road construction technique envisaged for various locations on site (to be confirmed by designer at the detailed design stage) – Figure 2
Upgrade of existing excavated access roads	Type B	<2.0m	Varies	Upgradation of existing excavated access road to the required width and finished with a layer of selected granular fill (to be confirmed by designer at the detailed design stage) – Figure 3

Table 2: General Road Construction Techniques



N
W E
S

LEGEND

EIAR SITE BOUNDARY

TURBINE LOCATION

TURBINE & HARDSTAND

ROAD TYPE LEGEND

TYPE A - PROPOSED NEW ROADS

TYPE B - UPGRADE OF EXISTING ROADS

NOTES

REV	DATE	DRAWN BY	CHECKED BY	DETAILS
C	12/08/2024	M.B.	L.P.	LAYOUT UPDATED
B	02.04.2024	M.B.	L.P.	OSI MAP UPDATED
A	21.03.2024	M.S.	L.P.	FIRST ISSUE

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PROJECT: LACKAREAGH WIND FARM
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TITLE: SITE ROAD TYPE MAP
OVERALL PLAN

REVISION: C

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M. SRIVASTAVA	21.03.2024	A3	1:10000

CHECKED AND APPROVED	DATE	STATUS	DRAWING NUMBER
L. POWER	21.03.2024	PRELIMINARY	Figure 1

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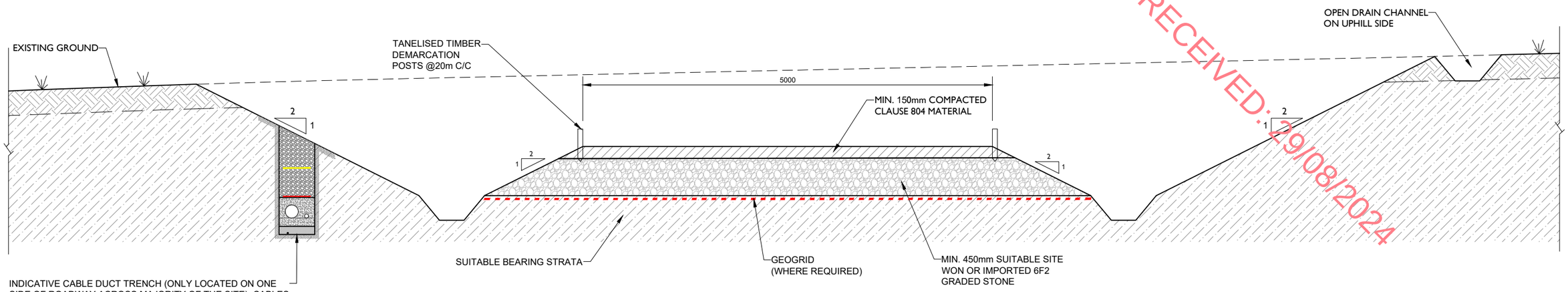
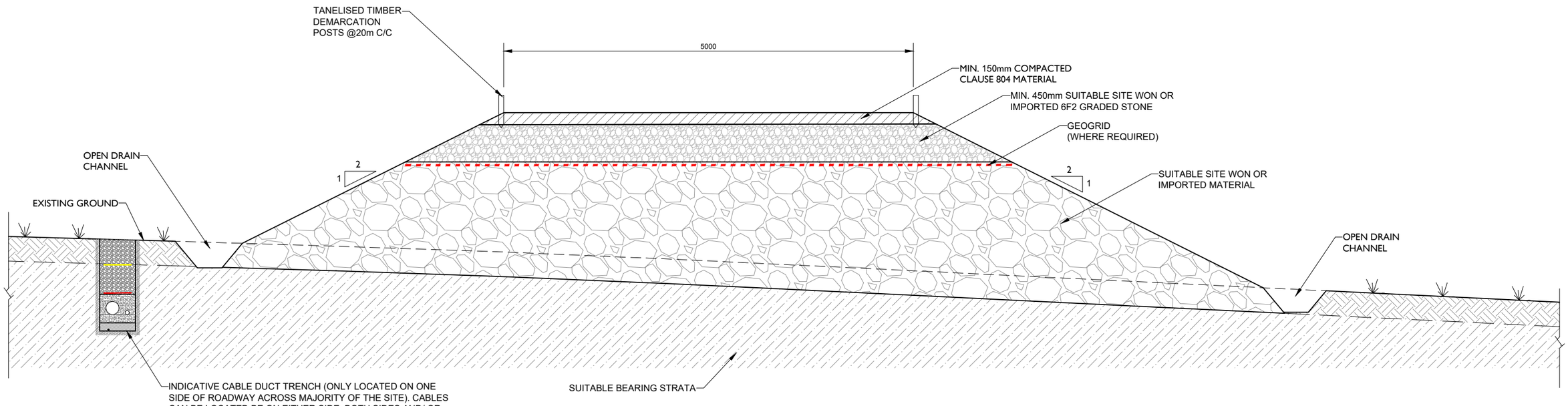


TYPE 'A' - NEW EXCAVATE & REPLACE ACCESS ROAD SECTION

(SHOWN IN CUT SCENARIO)

Scale 1:50



TYPE 'A' - NEW EXCAVATE & REPLACE ACCESS ROAD SECTION

(SHOWN IN FILL SCENARIO)

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NOTES

REV	DATE	DRAWN BY	CHECKED BY	DETAILS
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PROJECT: LACKAREAGH WIND FARM
CO. CLARE

TITLE: ACCESS ROAD TYPE 'A'
CROSS SECTIONS

REVISION: A

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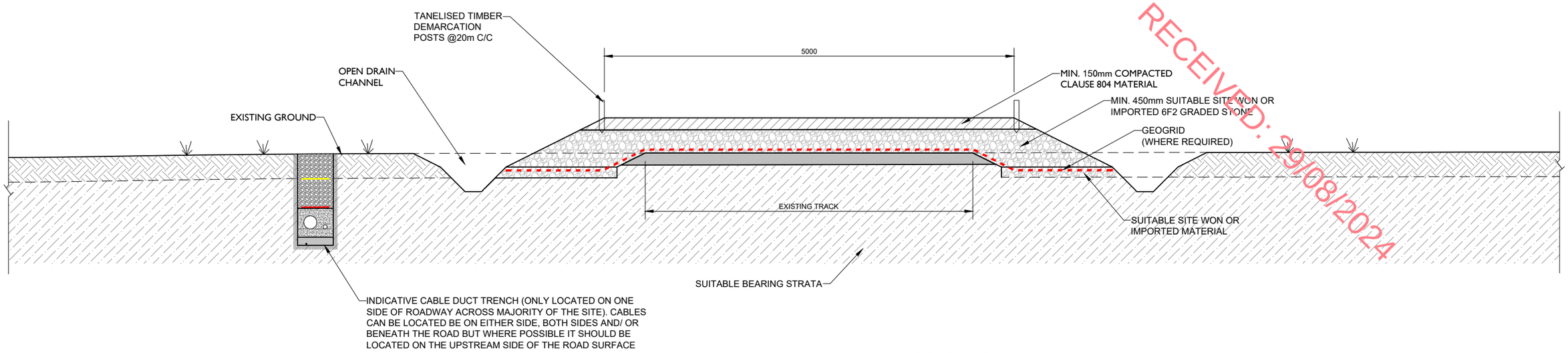
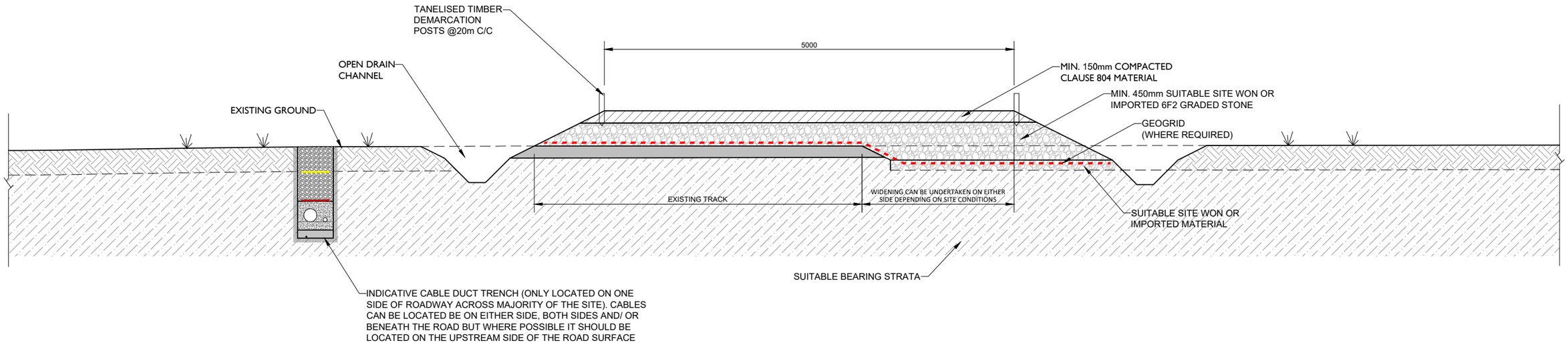


TYPE 'B' - UPGRADE OF EXISTING EXCAVATED ACCESS ROAD

(WIDENING ON BOTH SIDES)

Scale 1:50



TYPE 'B' - UPGRADE OF EXISTING EXCAVATED ACCESS ROAD

(WIDENING ON ONE SIDE)

Scale 1:50

NOTES

REV	DATE	DRAWN BY	CHECKED BY	DETAILS
A	27/03/2024	M.B.	L.P.	FIRST ISSUE

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PROJECT
LACKAREAGH WIND FARM
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TITLE
ACCESS ROAD TYPE 'B'
CROSS SECTIONS

REVISION
A

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L. POWER	27/03/2024	PRELIMINARY	Figure 3

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7.3 Estimated Peat and Spoil Volumes

As part of the site work carried out on the Proposed Project site, over 50 peat probes have been undertaken to date. Trial pits were also excavated at each turbine base location, the proposed met mast location, the substation and battery storage compound, and the borrow pit location. Although the peat probe survey and GSI mapping indicated no presence of peat at T1, T2, T5, T6, T7, the met mast, the substation and battery storage compound, and the borrow pit, trial pits revealed the presence of peaty topsoil ranging from 0.1m to 0.4m in depth.

The results of the peat probe survey and trial pit investigations allow for the classification of peat depths across the Proposed Project site into appropriate bands. Three depth classifications were established; 0m to 0.5m, 0.5m to 1m and greater than 1.5m. The maximum peat depth recorded on site, 1.58m, was observed along the road to T3 between chainages T3+350 and T3+400.

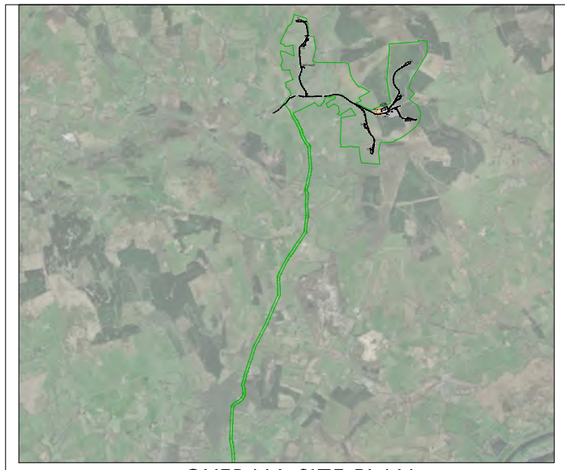
The Proposed Project layout has been superimposed upon this indicative peat depth map to estimate peat depth at a particular location and is shown in Figure 4. The peat depths at main infrastructure locations and across the access roads are listed in Table 3 and Table 4 below.

Site Location	Organic Strata	Organic Strata Depth
T1	Topsoil	0.2m
T2	Topsoil	0.2m
T3	Topsoil	0.35m
T4	Peaty topsoil	0.4m
T5	Topsoil	0.2m
T6	Topsoil	0.2m
T7	Topsoil	0.1m
Met Mast	Topsoil	0.2m
Substation and BESS Compound	Peaty topsoil	0.2m - 0.25m
Borrow Pit	Peaty topsoil	0.2m - 0.4m

Table 3: Estimated topsoil depths at main infrastructure locations

Site Location	Peat Depths
Spur to T1	0m
Spur to T2	0m
Road to Met Mast	0m
Spur to T4	0m - 0.40m
T3 - T4	0.30m - 1.58m
Spur to T5	0m - 0.50m
Spur to T6	0m - 0.10m
T6 - T7	0.30m - 0.60m

Table 4: Estimated peat depths across access roads



OVERALL SITE PLAN
(1:100,000)

N
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LEGEND

EIAR SITE BOUNDARY

PEAT DEPTHS			
NUMBER	MINIMUM LEVEL	MAXIMUM LEVEL	COLOUR
1	0.0	0.5	
2	0.5	1.0	
3	1.0	1.5	

NOTES

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B	02.04.2024	M.B.	L.P.	OSI MAP UPDATED
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TITLE
PEAT DEPTH MAP

REVISION
C

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Figure 4

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X:\3-BUI\IE\Dublin\Projects\Ireland\Lackareagh LKRH\Drawings\d012 Peat Depth Map\LKRH D012-2 Peat Depth Map

The quantity of peat and spoil material, requiring management on site has been calculated based on the cut and fill assessment and is shown in Table 5 below.

Location	Description	Estimated Peat/Topsoil Volume (m³)	Estimated Spoil Volume (m³)
7 no. turbine bases and hardstands	25.5m diameter excavation footprint for turbine foundation (23.5m turbine diameter plus 1m working area all around) with 62m x 30m hardstand areas	20,597	114,195
Met Mast	Area 25m x 15m	242	173
Substation and BESS Compound	Area 85m x 60m	2,225	13,340
Temporary construction compound	Area 80m x 50m approx.	966	0
Setdown Area	110m x 40.5m	2,363	1,150
Access Roads	Assumed 5m running surface with 6.8m wide development footprint	13,179	14,375
Borrow Pit	50m x 50m	1,438	5,750
Total		**41,010**	**148,983**

Note 1: Assumptions used in calculation of the above volumes are detailed in Section 7.8 of this report.
Note 2: A contingency factor of 15% has been applied to excavated spoil volumes, and a bulking factor of 15% has been used for excavated peat volumes to allow for expected increase in volume upon excavation and to allow for a variation in ground conditions across the site.
Note 3: Refer to table included in Section 7.8 of this report for details on cut and fill.

Table 5: Estimated Peat and Spoil Volumes

A summary of peat and spoil management volumes is presented in Table 6.

7.4 Temporary Management

To manage the material arisings effectively, the following points outline specific guidelines and practices for their temporary management and handling on-site:

- The amount of peat and spoil necessary for landscaping, reinstatement and backfilling shall be stored locally at turbine hardstands, in distinct stockpiles. Any surplus material will be promptly transported to the proposed borrow pit shown on Figure 5.
- Before stockpiling any glacial till spoil, the proposed deposition area would be stripped of topsoil/ peat which would be removed and placed in a suitable area to prevent the mixing of materials and facilitate reuse during restoration work.
- Peat will be stored on top of existing and undisturbed peat areas located only on the uphill slopes to ensure stability. The suitability of the underlying peat and the topography will be reviewed by a geotechnical engineer at the detailed design

stage and during the construction phase. This will determine the maximum height of peat that maybe stored, which shall not exceed 1.5m.

- Glacial till will not be placed on top of peat or topsoil; instead, it will be deposited only on other glacial till material.
- In order to prevent erosion and surface water contamination, silt fencing can be utilized to secure these stockpiles, where necessary.
- The excavated material which is unsuitable for use in construction will not be spread over any existing heath, bog, or grassed areas.
- Following the reinstatement of the turbine bases and hardstands, all temporarily stockpiled material not required will be removed and transported to the proposed borrow pit.
- The proposed locations for the temporary stockpiling of peat and spoil will be confirmed by the geotechnical engineer at detailed design stage.

7.5 Excavation and Storage of Peat and Spoil

As previously discussed in Section 6, the depth of peat present on the site is shallow. Trial pit findings indicate that peat is limited to the topsoil layer and is present as peaty topsoil across the site. Following a cut and fill assessment, it has been determined that approximately 41,010m^3 of topsoil will be generated on-site. Of the c. 41,010m^3, c. 30,000m^3 is proposed to be utilized for reinstatement purposes across the site.

During the construction process, the shallow peat overburden and topsoil will be stripped and temporarily stockpiled locally at the hardstands, around the substation compound, and around the storage area for it to be re-used for reinstatement. Any surplus peat, topsoil and the subsoil material underlying the peat will be excavated and promptly transported to the borrow pit.

An interceptor drain will first be excavated upslope of the temporary stockpiling areas in order to intercept existing overland flows and divert them around this area prior to discharge via a buffer zone on the downslope side. The stockpile will be sealed, and a perimeter drain installed to intercept any run-off so that it can be discharged through an appropriately designed silt trap.

A summary of peat/topsoil and spoil management volume is presented in Table 6.

Location	Peat/Topsoil Volume (m³)	Spoil Volume (m³)	Comment
Borrow Pit	11,010	5,240	See Figure LKRH d014.11 for further details
Reinstatement and landscaping	30,000	-	Peat and topsoil to be utilized for reinstatement purposes across the site.
Reuse of material around excavated turbine base and for ballast	-	4,000	Excavated area around the turbine bases to be backfilled with surplus spoil material after construction of the foundation
Reuse of material as fill volume	-	140,760	Surplus suitable cut volume to be utilized as fill material for hardstands, access roads, met mast, temporary construction compound and storage area and to backfill batter areas
Total Volume	**41,010 m³**	**150,000 m³**	

Note 1: Peat and topsoil generated at the substation and battery storage compound will be used to reinstate the cut and fill batters surrounding the substation compound. Any remaining material will be utilized to construct a screening berm along the perimeter of the substation and battery storage compound.

Table 6: Peat and Spoil Management Volume

7.6 Construction and Reinstatement of Borrow Pit

The borrow pit location is shown on Figure 1. Within the development footprint of the borrow pit, the peaty topsoil has a depth of up to 0.5m. It is proposed that approximately 15,000 cubic meters of suitable material be extracted from the borrow pit, out of which, it is estimated that roughly 10,000 cubic meters of rock can be obtained.

Following the extraction of rock from the borrow pit, it is proposed to reinstate the area using excavated peat and spoil. The extracted rock shall be employed in the construction of various wind farm infrastructure elements, including turbine foundations, hardstands, and access roads. The contractor excavating the rock will be required to ensure the development of the borrow pit in a manner that facilitates safe and secure deposition of excavated peat and spoil. It is proposed to construct dedicated cells within the borrow pit for the placement of these materials. This is to allow for the safe placement and grading of the peat and spoil using dumper trucks and excavators. Design and construction guidelines for the borrow pit are provided in the subsequent paragraphs.

Prior to stripping of peaty topsoil, a cut-off drain will first be excavated upslope of the borrow pit, as shown on Figure 5, in order to intercept existing overland flows and divert them around the borrow pit prior to discharge via a buffer zone on the downslope side. The shallow peat overburden will then be stripped and temporarily stockpiled; vegetated-side upwards where possible, forming a berm around the borrow pit in order for it to be re-used in its reinstatement on completion. Any subsoil material overlying the rock will

then be excavated and stockpiled separately from the peat. The stockpile will be sealed, and a perimeter drain installed to intercept any run-off so that it can be discharged through an appropriately designed silt trap.

To effectively manage potential effects from borrow pit activities, a series of open drains will be constructed within the area to isolate runoff containing increased concentrations of suspended solids. The drainage system, comprised of check dams, will attenuate the flow and provide additional storage capacity during exceptional rainfall events. This design will prevent contaminated runoff from mixing with clean catchment runoff.

Settlement ponds will be implemented as an additional mitigation measure. These ponds have been designed with a modular approach to accommodate varying runoff volumes. In the event that larger areas of runoff need to be treated at a single discharge point, the size of the settlement pond can be increased proportionately.

Borrow pit extraction will be closely monitored and inspected by a geotechnical engineer to ensure proper management and safety. The contractor will assess work practices and suspend operations during periods of heavy rainfall to minimize excessive runoff. Extraction methods will be determined based on rock quality, with excavators utilizing various attachments for efficient stone removal. In some cases, blasting may be recommended as a safer alternative to rock breaking.

It is proposed to construct the borrow pit so that its base level is below the level of the adjacent section of access road. As excavation progresses into the back edge of the borrow pit, the base of the borrow pit may be raised to suit local conditions. Localised deepening of the borrow pit floor may be required depending on extraction operations.

Various excavator sizes will be employed for extraction, with larger excavators removing rock from the excavation face and floor and smaller excavators assisting with rock removal, stockpiling, and loading. The excavation sides will be sloped at an angle determined by the rock type, with regular geotechnical inspections ensuring stability and safety.

Public access to the borrow pit will be restricted, and secure fencing, edge protection, and warning signs will be installed around the perimeter. Additionally, a berm will be constructed at the leading edge to ensure safe distances are maintained between articulated dumper trucks and the borrow pit during loading operations.

Upon completion of extraction activities at the borrow pit, the excavated area will be utilized for the long-term storage of peat and spoil material generated during the construction of turbine bases, hardstands, access roads, 38kV substation and BESS compound, and storage area, ensuring efficient and responsible use of the site resources.

Following the reinstatement of the borrow pit, the surface of the deposited materials will be profiled to a maximum gradient of 5% to ensure stability and promote revegetation. The area will be revegetated with harvested turves, where feasible, or allowed to regenerate naturally under the guidance of the project ecologist. Consistent monitoring of the deposition areas will be necessary throughout the construction process, with particular attention given during periods of wet weather or snowmelt, to identify and address any potential indicators of peat instability in a timely manner.

7.7 Excavated Peat and Spoil Management

Following the reinstatement of the turbine bases and hardstands, all surplus material shall be transported and disposed at the proposed borrow pit. No permanent stockpiles of peat or spoil will be left anywhere on site after completion of the construction works.

The excess peaty topsoil for reinstatement or landscaping purposes will be managed in a manner that prevents any significant or negative environmental effect and avoids causing pollution in nearby surface waterbodies due to erosion or surface runoff. Excess peat will also be used to level out gradients near the turbine bases, hardstands and access tracks as well as infill depressions left exposed by the construction works.

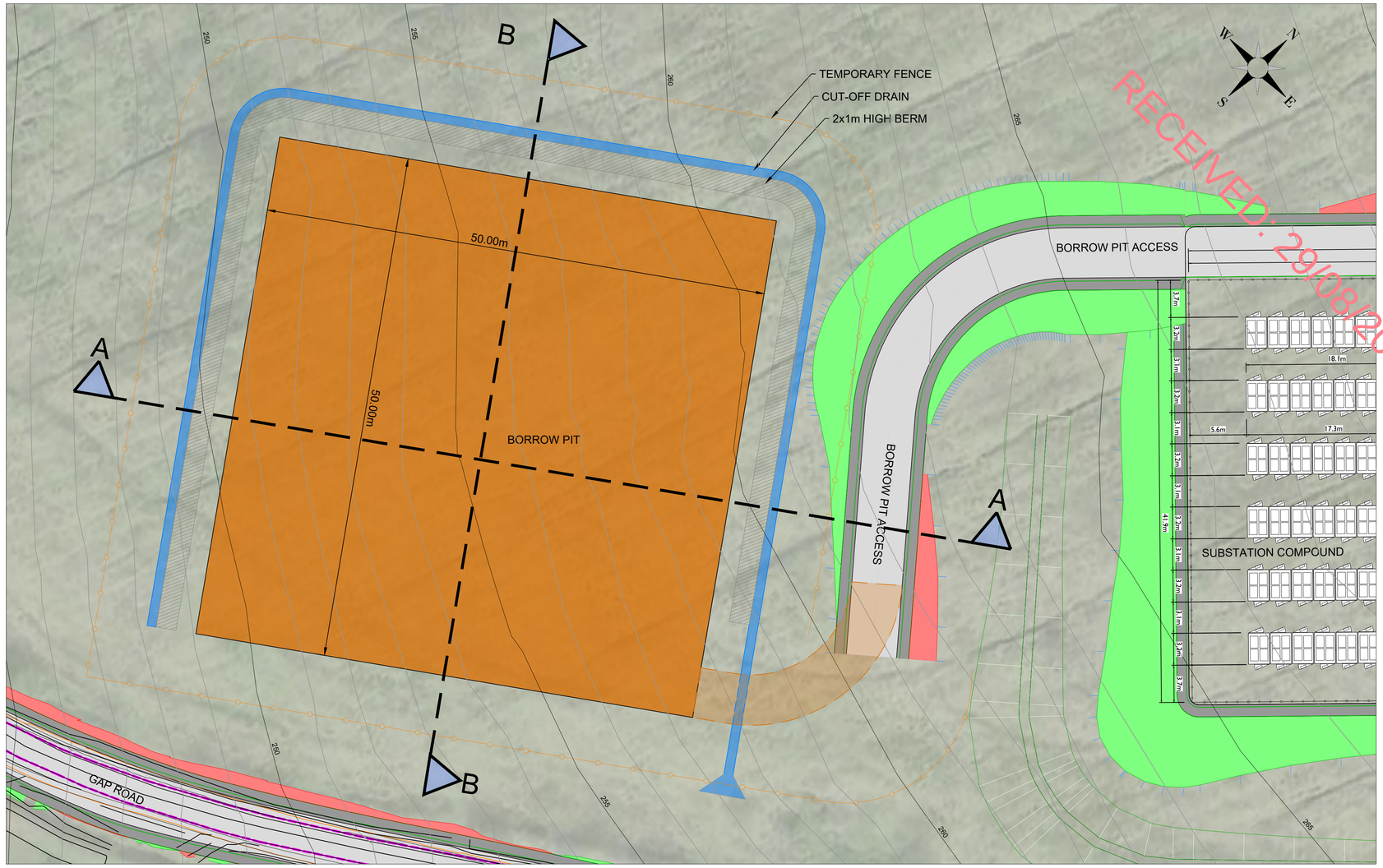
Implementing the following general control measures during the construction phase at the Proposed Project site will aid in minimizing the risks associated with peat instability:

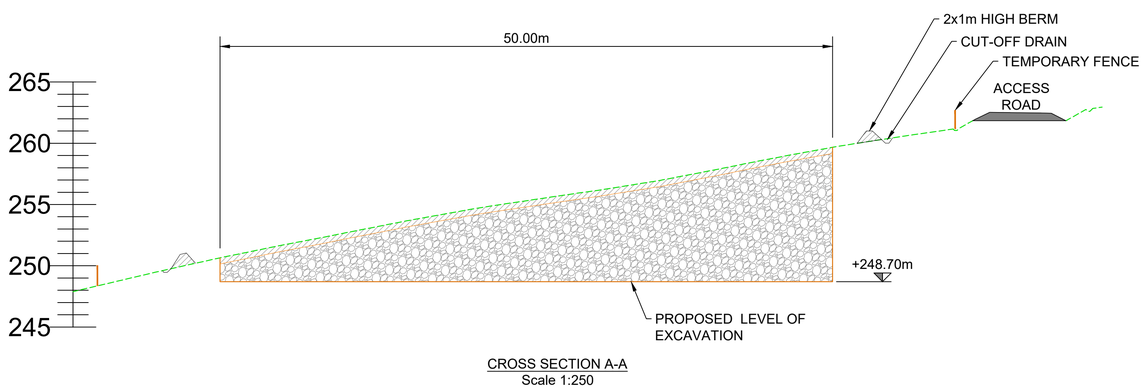
1. Excavated spoil will not be deposited on the downslope or upslope edges of adjacent peat soils.
2. The sides within excavated peat will be sloped back at an angle of 30 degrees to the horizontal to prevent slippage.
3. Temporary deposition of excavated soils will only be allowed in areas with peat depth less than 0.5m.
4. Materials will not be stockpiled, and heavy machinery will not be parked on peat surfaces.
5. Low ground bearing pressure machines will be used on areas of peat exceeding 1m depth.
6. Machinery use on peat surfaces will be minimized. The use of vibrating rollers may not be permitted on peat surfaces, particularly on steep slopes.
7. The length and duration of unsupported excavations in peat will be minimized.
8. Existing drainage patterns in peat will be maintained whenever possible, and any uncontrolled discharges of water onto peat will be prevented.
9. Upslope cut-off drains must be installed in advance of construction activities to prevent water build up in excavations.
10. Deposition of excavated material will not occur outside designated areas; temporary stock piling will take place within the development footprint of turbine hardstands before reinstatement and disposal at proposed deposition areas.
11. Any excavations will be immediately backfilled with suitable material when available.
12. Regular inspections of all slopes will be carried out to monitor the development of tension cracks.
13. A qualified geotechnical and/or environmental engineer will conduct regular site visits and assessments to monitor the potential for a peat slide regularly during construction.
14. Upon commencement of the reinstatement works, guidance from a suitably qualified environmental professional will be sought to confirm the methodology and programme.
15. Exclusion zones delineating the working corridor will be established around all working areas using post and rope fences. No activity will be permitted past this fence.
16. The environmental manager or other designated person will conduct induction training and toolbox talks with site staff to explain the risks associated with

working on peat and with, the procedures for reducing the risk of peat slides, and the location of exclusion zones.

17. Strict adherence to method statements is required at all times, and any deviation from the agreed work methodology must be approved by a suitably qualified environmental professional or the site geotechnical engineer in advance of the works commencing.
18. Particular attention will be paid to conditions during and after heavy rainstorms, especially following extended dry periods when the likelihood of peat movement is higher. The site supervisor will suspend work if either work practices or weather conditions are deemed unsafe.

After reinstatement is completed, the borrow pit site will be re-vegetated using the topsoil, sod or harvested peat.





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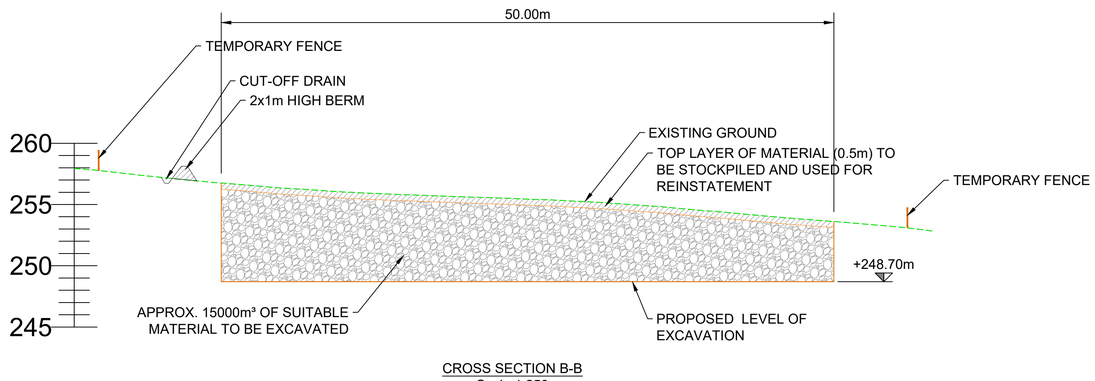

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NOTES

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PROJECT
LACKAREAGH WIND FARM

TITLE
BORROW PIT
LAYOUT AND CROSS SECTIONS

REVISION
A

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Figure 5

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X:\3-BUI\EDub\Projects\Ireland\Lackareagh LKRH\Drawings\0014 Borrow Pit Details\LKRH 0014.1 Borrow Pit Design Plan And Sections

7.8 Cut and Fill Assessment

AFRY carried out an earthworks assessment for the site that quantifies the overall volume of cut and fill required for the construction of the Proposed Project. The cut and fill assessment is presented on the drawings included in Appendix 4-1 of the EIAR: Site Layout Drawings.

7.8.1 Assumptions for the cut and fill assessment

- The assumed excavation footprint for the turbine foundation is the turbine base diameter of 23.5m plus 1m working area all around the base i.e. 25.5m.
- Typical hardstand requirements from turbine suppliers were assumed for the cut & fill assessment i.e. hardstand area for main crane measuring 62m x 30m.
- The assumed width of the access tracks is 5m.
- Typical gradient requirements from turbine suppliers were assumed for the cut & fill assessment i.e. maximum gradients of 16%.
- A 1(v): 2(h) slope for all excavation faces was assumed for the cut & fill assessment.
- The assumed minimum dig depths for the cut and fill assessment at main infrastructure locations are presented in the below.

Location	Minimum Dig Depth (bgl)
T1 hardstand	0.2m
T2 hardstand	0.2m
T3 hardstand	0.35m
T4 hardstand	0.4m
T5 hardstand	0.2m
T6 hardstand	0.2m
T7 hardstand	0.1m
Met Mast	0.2m
Temporary Construction Compound	0.3m
Substation and BESS Compound	0.4m
Storage Area	0.3m

Table 7: Summary of minimum dig depths at main infrastructure locations

The results of the cut and fill earthworks assessment include the following:

- Site plan drawings showing the extent of cut & fill earthworks at all infrastructure locations across the entire site.
- A summary of cut and fill earthwork volumes provided in the table below.

A summary of excavated cut and fill volumes calculated for the Proposed Project site are given in Table 8.

Location	Description	Estimated Peat/Topsoil Volume (m³)	Estimated Spoil (Re-usable Material) Volume (m³)	Fill Volume (m³)	Stone Requirements (m³)
T1	25.5m diameter excavation footprint for turbine foundation (23.5m turbine diameter plus 1m working area all around) with 62m x 30m hardstand areas	20,597	9,373	1,500	1,750
T2			16,675	3,500	2350
T3			5,060	5,500	1800
T4			863	32,200	1900
T5			4,543	15,100	1800
T6			26,105	8,200	1600
T7			51,578	2,650	2350
Met Mast	Area 25m x 15m	242	173	250	230
Substation and BESS Compound	Area 85m x 60m	2,225	13,340	3,000	2650
Temporary Construction Compound	Areas 80m x 50m and	966	0	15,250	1200
Storage Area	Area 90m x 25m	2,363	1,150	7,500	3050
Access Roads	Area 110m x 40.5m	13,179	14,375	31,450	10,950
Borrow Pit	Area 50m x 50m	1,438	5,750	0	0
Total		**41,010**	**148,983**	**126,100**	**31,630**

Table 8: Cut and Fill Assessment – Earthwork and Stone Volumes

7.8.2 Commentary on Earthworks Volume

It is to be noted that the earthwork volumes given in Table 8 above are indicative and for information purposes only and subject to detailed design. This section of the report should be read in conjunction with Sections 7.3, 7.5 and 7.6 of the report which summarise the peat and spoil volumes for site and the deposition area on site.

In summary:

1) The total volume of peat/topsoil requiring management on site is estimated at 35,660m³. After applying a bulking factor of 15%, this volume estimates to 41,010m³. A major volume of this material, 30,000m³, will be used for reinstatement purposes and landscaping across the site. The remaining volume will be deposited in the borrow pit.
2) The total volume of spoil generated on site is estimated at 129,550m³. After applying a contingency factor of 15%, this volume estimates to 148,983m³. Trial pit assessments confirm its suitability for reuse as fill material. Therefore, a significant volume, 140,760m³, of this spoil will be utilized as fill material for hardstands, access roads, met mast, temporary construction compound and storage area. About 4,000m³ of spoil will be used to backfill the excavated areas around the turbine bases and the remaining will be deposited in the borrow pit.
3) A contingency factor of 15% has already been applied to spoil volumes to allow for a variation in ground conditions.
4) A bulking factor of 15% has already been applied to the generated peat volumes to allow for expected bulking upon excavation and to allow for a variation in ground conditions.

8. MONITORING PROCEDURE

8.1 Peat Stability Monitoring

The preliminary site investigation has not identified any areas with a risk of peat instability. In the event that the detailed site investigation during the design stage reveals such areas, the following monitoring procedure, adopted from plans for wind farms in similar soil conditions, will be implemented:

To monitor possible peat movements, it is proposed to install sighting posts upslope and downslope of the access roads at staggered intervals at locations where the peat depth is greater than 2m for excavated access roads. Additional monitoring locations will be required at infrastructure locations with deeper peat deposits. The sightlines are to consist of the following:

- A line of wooden stakes (typically 1 to 1.5m long) placed vertically into the peat to form a straight line.
- Each set of sighting line shall comprise 6 no. posts at 5m centres that is a line 25m long.
- A string line shall be attached to the first and last posts and all intervening posts shall be adjusted so they are just touching the string line.
- Lines of sighting posts shall be placed across the existing slope about 5m away from the area to be worked. The posts will be located along the road at 10m intervals in areas of deep peat (say greater than 1m). Where there are relatively steeper slopes or softer ground a sighting line shall be placed down the slope, or at any location where monitoring would be deemed useful.
- Each line of sighting posts shall be uniquely referenced with each post in the line given a reference. The post reference shall be marked on each post (e.g. reference 1-1, 1-2, 1-3, 1-4, 1-5, and 1-6 for posts in line 1).
- The sighting lines shall be monitored at the beginning of each working day, and during the day where considered appropriate (e.g. when working activity is concentrated at a specific location or after each critical step in the construction process).
- Monitoring of the posts will comprise sighting along the line and recording any relative movement of posts from the string line.
- Where increased movements are recorded, the frequency of monitoring will be increased.
- A monitoring record will be kept of the date, time and relative movement of each post, if any. This record shall be updated and stored as a spreadsheet.

8.2 Contingency Plan

The following contingency plan has been adopted from plans for wind farms with similar soil conditions.

8.2.1 Excessive Movement

Where there is excessive movement or continuing peat movement recorded at a monitoring location or identified at any location within the site but no apparent signs of distress to the peat (e.g. cracking, surface rippling etc.) then the following shall be carried out:

i. All activities (if any) will cease within the affected area.
ii. Increased monitoring at the location will be carried out. The area will be monitored, as appropriate, until such time as movements have ceased.
iii. Re-commencement of activities shall only start following a cessation of movement and agreement with all parties (geotechnical engineer, contractor and client).

8.2.2 Onset of Peat Slide

Where there is the onset or actual detachment of peat (e.g. cracking, surface rippling etc.) then the following shall be carried out:

i. On alert of a peat slide incident, all activities (if any) in the area will cease and all available resources will be diverted to assist in the required mitigation procedures.
ii. Action will be taken to prevent a peat slide reaching any watercourse by constructing check barrages on land.. Due to the terrain and the inability to predict locations of potential peat slides, it may not be possible to implement any on-land prevention measures, in this case a watercourse check barrage will be implemented.
iii. All relevant authorities (i.e. Clare County Council, Inland Fisheries Ireland and National Parks and Wildlife Service) should be notified if a peat slide event occurs on site.
iv. For localised peat slides that do not represent a risk to any surface watercourse and have essentially come to rest, the area will be stabilised initially by rock infill, if required. The failed area and surrounding area will then be assessed by the engineering staff and stabilisation procedures implemented. A monitoring regime will be put in place which will be decided by the geotechnical engineer based on the site conditions.
v. The area will be monitored, as necessary, until any observed movements have ceased, with the duration to be determined by the geotechnical engineer based on site conditions and stability assessment.

8.2.3 Check Barrage

Whilst it is not anticipated that a peat slide will occur on site, as a contingency a check barrage procedure is included below.

Check barrages are constructed in order to prevent any peat arising from a peat slide entering into surface watercourses. The most effective method of preventing any peat slide debris from travelling downstream in a watercourse is the use of a check barrage. A check barrage comprises the placement of rock fill across a watercourse. The check barrage is a highly permeable construction that will allow the passage of water but will prevent peat debris from passing through. Rock fill would comprise well-graded coarse rock pieces from about 300mm up to typically 1000mm.

The rock fill for the check barrage will be sourced as close as possible to the site. A stockpile of material will be available as a contingency measure prior to construction work commencing. The size of the barrage will vary depending on the scale of the peat debris to be contained and the geometry of the watercourse at the barrage location. In general due to the low speed of a peat slide there is little impact force and most of the lateral load is due to fluid pressure on the upslope face of the barrage.

Typically, the check barrage will fill the entire channel width of the watercourse up to a height of 3 to 4m with a crest width of typically 2m and side slopes of about 45 degrees depending on the geometry of the barrage location.

The check barrage construction procedure is as follows:

i. Access to the check barrage location shall be along the existing access roads on the wind farm site and/or along public roads, where possible. When it is necessary to form the barrage then rock fill will be placed across the watercourse to effectively block the passage of peat debris.
ii. Operatives employed to carry out the construction of the check barrage will be inducted by means of a briefing by on-site supervisors as to the proposed location of the check barrage.
iii. The check barrage provides containment for peat debris in the unlikely event of a peat slide. Further remedial measures may be required and will be assessed by all parties and carried out as soon as is safe to do so when the location and extent of the failure is established.
iv. Where a barrage was constructed as a precaution and no peat debris reached the watercourse then the barrage will be removed as soon as is agreed with all parties.

9. SUMMARY AND CONCLUSION

Observations from site walkovers indicate that the topography of the site is relatively steep. The findings of the site investigation data suggest favourable subsoil conditions and shallow peat depths across the site. The ground conditions at this site present several opportunities to reduce the extent of excavation and/or increase re-use opportunities as good practice measures. These include:

- reduction of dig depth required for site infrastructure.
- reducing the extent of excavation of the new access tracks by using less intrusive methods to achieve a sufficient degree of levelling.
- maximization of suitable excavated materials for engineering fill and landscaping purposes.
- appropriate utilization of excavated material for track verge reinstatement and profiling.

While several opportunities for excavated material reuse exist, it is acknowledged that some volume of material generated during the construction process will necessitate on-site management. Therefore, a range of strategies for peat and spoil management across the Proposed Project site have been identified, including deposition within the designated borrow pit, reuse as fill material and ballast, landscaping and reinstatement. The proposal aims to either reuse or deposit the excavated material locally at its point of origin, thereby mitigating the effect of long-haul transportation routes.

To summarize, the total volume of peat and spoil requiring management on site is estimated to be approximately 189,993m^3. This peat and spoil will be managed within the Proposed Project site, with 144,760m^3 for reuse as outlined above, 16,250m^3 to be deposited within the borrow pit, and 30,000m^3 to be used for landscaping and reinstatement.

APPENDIX A – PHOTOS FROM SITE WALKOVER

Photo 1: End of the storage area looking downhill

Photo 2: On storage area platform looking up at T5

Photo 3: Storage area platform

Photo 4: At the storage area looking down the gap road

Photo 5: At the gap road looking up at T5 location

Photo 6: Access road to T5

APPENDIX B – PEAT PROBE RESULTS

X(ITM)	Y(ITM)	Peat Depth (m)
563541	671766	1
563549	671630	0.6
563556	672091	0.1
563636	671883	0.3
563650	671540	0.4
563727	671655	0.4
563559	671514	0.4
563607	671477	0.4
563951	672807	0.7
563915	672800	1
563776	672925	0.9
563762	672944	1.58
563869	672830	0.5
563834	672861	0.6
563747	672966	1.55
563745	672963	0.4
563756	672951	1.57
563747	672967	1.56
563709	672846	0.2
563698	672806	1.54
563687	673002	0.7
563699	672897	0.5
563793	671691	0.3
563870	671682	0.5
564348	671742	1.52
564457	671716	3
564169	672037	0.7
564120	672105	0.2
564255	671823	0.3
564260	671948	1
563855	672481	0.5
563782	672463	0.6
563966	672232	0.2
563902	672373	0.3
563732	672727	0.3
563747	672694	0.2
563707	672784	1.53
563708	672785	0.4
563471	672233	0

563485	672156	0.2
563747	672646	0.4
563528	672573	0.4
563500	672562	0.2
563454	672548	0.2
563446	672540	0.2
563448	672541	0.3
563447	672519	0.3
563451	672510	0.2
563502	672546	0.2
563638	672616	0.3
563692	672449	0.5
563665	672432	0.5
564123	672367	0
564084	672369	0
564053	672371	0
564087	672370	0
563655	672490	0.4
563634	672475	0.5
564014	673300	0.3
562322	673188	0
563857	672847	0.6
563820	672752	0.3
563867	672751	0.4
563833	672740	0.3
563664	672553	0
563720	672497	0
563271	671817	0

APPENDIX C – GROUND INVESTIGATION FACTUAL REPORT

Lackareagh Wind Farm – Ground Investigation

Client:	MKO
Client's Representative:	AFRY
Report No.:	23-1870
Date:	March 2024
Status:	Final for Issue

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Approved: ISO 9001 • ISO 14001 • OHSAS 18001

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APPENDICES

Document Control Sheet

Report No.:		23-1870			
Project Title:		Lackareagh Wind Farm, Co. Clare – Ground Investigation			
Client:		MKO			
Client's Representative:		AFRY			
Revision:	A00	**Status:**	Final for issue	**Issue Date:**	21st March 2024
Prepared by:		**Reviewed by:**		**Approved by:**	
 Carin Cornwall BSc MSc PhD		 Matthew Gilbert MEarthSci FGS		 Matthew Graham BEng(Hons) MIEI	

The works were conducted in accordance with:

UK Specification for Ground Investigation 2nd Edition, published by ICE Publishing (2012)

British Standards Institute (2015) BS 5930:2015+A1:2020, Code of practice for ground investigations.

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland

Laboratory testing was conducted in accordance with:

British Standards Institute BS 1377:1990 parts 2, 4, 5, 7 and 9

METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015+A1:2020, The Code of Practice for Ground Investigation.

Abbreviations used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler).
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler).
P	Nominal 100mm diameter undisturbed piston sample.
B	Bulk disturbed sample.
LB	Large bulk disturbed sample.
SB	Sonic bulk disturbed sample.
D	Small disturbed sample.
C	Core sub-sample (displayed in the Field Records column on the logs).
L	Liner sample from dynamic sampled borehole.
W	Water sample.
ES / EW	Soil sample for environmental testing / Water sample for environmental testing.
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained).
SPT (c)	Standard penetration test using 60 degree solid cone.
(x,x/x,x,x,x)	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length.
(Y for Z/ Y for Z)	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given seating or test length 'Z' (mm).
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm).
HVP / HVR	In situ hand vane test result (HVP) and vane test residual result (HVR). Results presented in kPa.
V VR	Shear vane test (borehole). Shear strength stated in kPa. V: undisturbed vane shear strength VR: remoulded vane shear strength
Soil consistency description	In cohesive soils, where samples are disturbed and there are no suitable laboratory tests, N values may be used to indicate consistency on borehole logs – a median relationship of Nx5=Cu is used (as set out in Stroud & Butler 1975).
dd-mm-yyyy	Date at the end and start of shifts, shown at the relevant borehole depth. Corresponding casing and water depths shown in the adjacent columns.
▽	Water strike: initial depth of strike.
▼	Water strike: depth water rose to.
Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015+A1:2020	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.
(xxx/xxx/xxx)	Spacing between discontinuities (minimum/average/maximum) measured in millimetres.

Lackareagh Wind Farm, Co. Clare

1 AUTHORITY

On the instructions of AFRY Consulting Engineers, ("the Client's Representative"), acting on the behalf of MKO ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a proposed wind farm.

This report details the work carried out both on site and in the geotechnical and chemical testing laboratories; it contains a description of the site and the works undertaken, the exploratory hole logs and the laboratory test results.

All information given in this report is based upon the ground conditions encountered during the ground investigation works, and on the results of the laboratory and field tests performed. However, there may be conditions at the site that have not been taken into account, such as unpredictable soil strata, contaminant concentrations, and water conditions between or below exploratory holes. It should be noted that groundwater levels usually vary due to seasonal and/or other effects and may at times differ to those recorded during the investigation. No responsibility can be taken for conditions not encountered through the scope of work commissioned, for example between exploratory hole points, or beneath the termination depths achieved.

This report was prepared by Causeway Geotech Ltd for the use of the Client and the Client's Representative in response to a particular set of instructions. Any other parties using the information contained in this report do so at their own risk and any duty of care to those parties is excluded.

2 SCOPE

The extent of the investigation, as instructed by the Client's Representative, included boreholes, trial pits, soil sampling, in-situ and laboratory testing, and the preparation of a factual report on the findings.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted on the proposed site of Lackareagh Wind Farm, located in the townlands of Shannaknock and Killeagy in County Clare. The site includes forestry and farmland. It is bordered by forested land to the east, and fields to the north, south, and west. Kilbane village is located immediately west of the site.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 11th December 2023 and 29th January 2024, comprised:

- three boreholes by rotary drilling
- a standpipe installation in one borehole
- eighteen dynamic probes
- fourteen machine dug trial pits
- indirect CBR tests at twenty-seven locations.

The exploratory holes and in-situ tests were located as instructed by the Client's Representative, and as shown on the exploratory hole location plan in Appendix A.

4.2 Boreholes

Three boreholes (RC-SC-01 – RC-SC-03) were put to their completion by rotary drilling techniques only. The boreholes were completed using a low ground bearing tracked Comacchio 405 drilling rig.

Symmetrix-cased full hole rotary percussive drilling techniques were employed to advance the boreholes to bedrock, after which rotary coring was employed to recover core samples of the bedrock. SPTs were carried out at standard intervals throughout the overburden, with small and bulk disturbed samples obtained where possible through the soil strata.

The core was extracted in up to 1.5m lengths using a metric T2-101 core barrel, which produced core of nominal 84mm diameter, and was placed in triple channel wooden core boxes.

The core was subsequently photographed and examined by a qualified and experienced Engineering Geologist, thus enabling the production of an engineering log in accordance with *BS 5930: 2015+A1:2020: Code of practice for ground investigations*.

Appendix B presents the borehole logs, with core photographs presented in Appendix C.

4.3 Dynamic probes

Eighteen dynamic probes were conducted using the DPSHB method as described in BS EN ISO 22476-3:2005+A1:2011. The method entails a 63.5kg hammer falling 0.75m onto a 50.5mm diameter cone with an apex angle of 90°.

Appendix D provides the dynamic probe logs in the form of plots, against depth, of the number of blows per 100mm penetration.

4.4 Standpipe installations

A groundwater monitoring standpipe was installed in borehole RC-SC-02.

Details of the installations, including the depth range of the response zone, are provided in Appendix B on the individual borehole logs.

4.5 Trial Pits

Fourteen trial pits (TP-MM-01, TP-SC-01 – TP-SC-06, and TP-T1-01 – TP-T7-01) were excavated using a 13t tracked excavator fitted with a 600mm wide bucket, to depths of 1.20-3.40m.

Disturbed (small jar and bulk bag) samples were taken at standard depth intervals and at change of strata.

Any water strikes encountered during excavation were recorded along with any changes in their levels as the excavation proceeded. The stability of the trial pit walls was noted on completion.

Appendix E presents the trial pit logs with photographs of the pits and arising provided in Appendix F.

4.6 Indirect CBR tests (DCP)

An indirect CBR test was conducted at twenty-seven locations (DCP01-DCP27) using a Dynamic Cone Penetrometer (DCP). The equipment was developed in conjunction with the UK Transport Research Laboratory, and is discussed in Highways England CS229 (2020) which refers to the methodology described in TRL Overseas Road Note 18 (1999).

The test results are presented in Appendix G in the form of plots of the variation with depth of the penetration per blow. Straight lines have been fitted to the plots and the CBR for each depth range estimated using the following relationship, which is taken from TRRL Overseas Road Note 8 (1990), *A user's manual for a program to analyse dynamic cone penetrometer data*.

$$\text{Log CBR} = 2.48 - 1.057 \text{ Log (mm/blow)}$$

The frequently elevated CBR values are a consequence of the coarse-grained content of the penetrated soils and are often not representative of the soil matrix.

4.7 Surveying

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R10 GPS system employing VRS and real time kinetic (RTK) techniques.

The plan coordinates (Irish Transverse Mercator) and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole location plan presented in Appendix A shows these as-built positions.

5 LABORATORY WORK

Upon their receipt in the laboratory, all disturbed samples were carefully examined and accurately described, and their descriptions incorporated into the borehole logs.

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.
- **soil chemistry:** pH and water soluble sulphate content

Laboratory testing of soils samples was carried out in accordance with British Standards Institute: *BS 1377, Methods of test for soils for civil engineering purposes; Part 1 (2016), and Parts 2-9 (1990).*

The test results are presented in Appendix H.

5.2 Geotechnical laboratory testing of rock

Laboratory testing of rock sub-samples comprised:

- point load index
- unconfined compressive strength (UCS) tests

Test	Test carried out in accordance with
Point load index	ISRM Suggested Methods (1985) Suggested method for determining point-load strength. Int. J. Rock Mech. Min. Sci. Geomech. Abstr. 22, pp. 53–60
Uniaxial compression strength tests	ISRM Suggested Methods (1981) Suggested method for determining deformability of rock materials in uniaxial compression, Part 2 and

	ISRM (2007) Ulusay R, Hudson JA (eds) The complete ISRM suggested methods for rock characterization, testing and monitoring, 2007

The test results are presented in Appendix H.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise glacial till. These deposits are underlain by greywacke of the Broadford Formation and potentially red conglomerate, sandstone, and mudstone of the Old Red Sandstone.

6.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Topsoil:** encountered typically in 200-400mm thickness, occasionally with peat.
- **Glacial Till:** sandy gravelly silty clay, frequently with low cobble content and occasional beds of gravel, typically soft or firm in upper horizons, becoming stiff at depth.
- **Bedrock (Greywacke):** Rockhead was encountered at depths ranging from 2.20-2.50m.

6.3 Groundwater

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

Groundwater was encountered as seepage in trial pits TP-SC-01, TP-SC-02, TP-SC-04, TP-SC-06, and TP-T7-01 at 0.40-2.30m.

Groundwater was not noted during drilling at any of the borehole locations. However, it should be noted that the casing used in supporting the borehole walls during drilling may have sealed out any groundwater strikes and the possibility of encountering groundwater during excavation works should not be ruled out.

It should also be noted that any groundwater strikes within bedrock may have been masked by the fluid used as the drilling flush medium.

Seasonal variation in groundwater levels should be factored into design considerations.

7 REFERENCES

Geotechnical Society of Ireland (2016), Specification & Related Documents for Ground Investigation in Ireland.

IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. National Standards Authority of Ireland.

BS 5930: 2015+A1:2020: Code of practice for ground investigations. British Standards Institution.

BS EN ISO 14688-1:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 1 Identification and description.

BS EN ISO 14688-2:2018: Geotechnical investigation and testing. Identification and classification of soil. Part 2 Principles for a classification.

BS 1377: 1990: Methods of test for soils for civil engineering purposes. British Standards Institution.

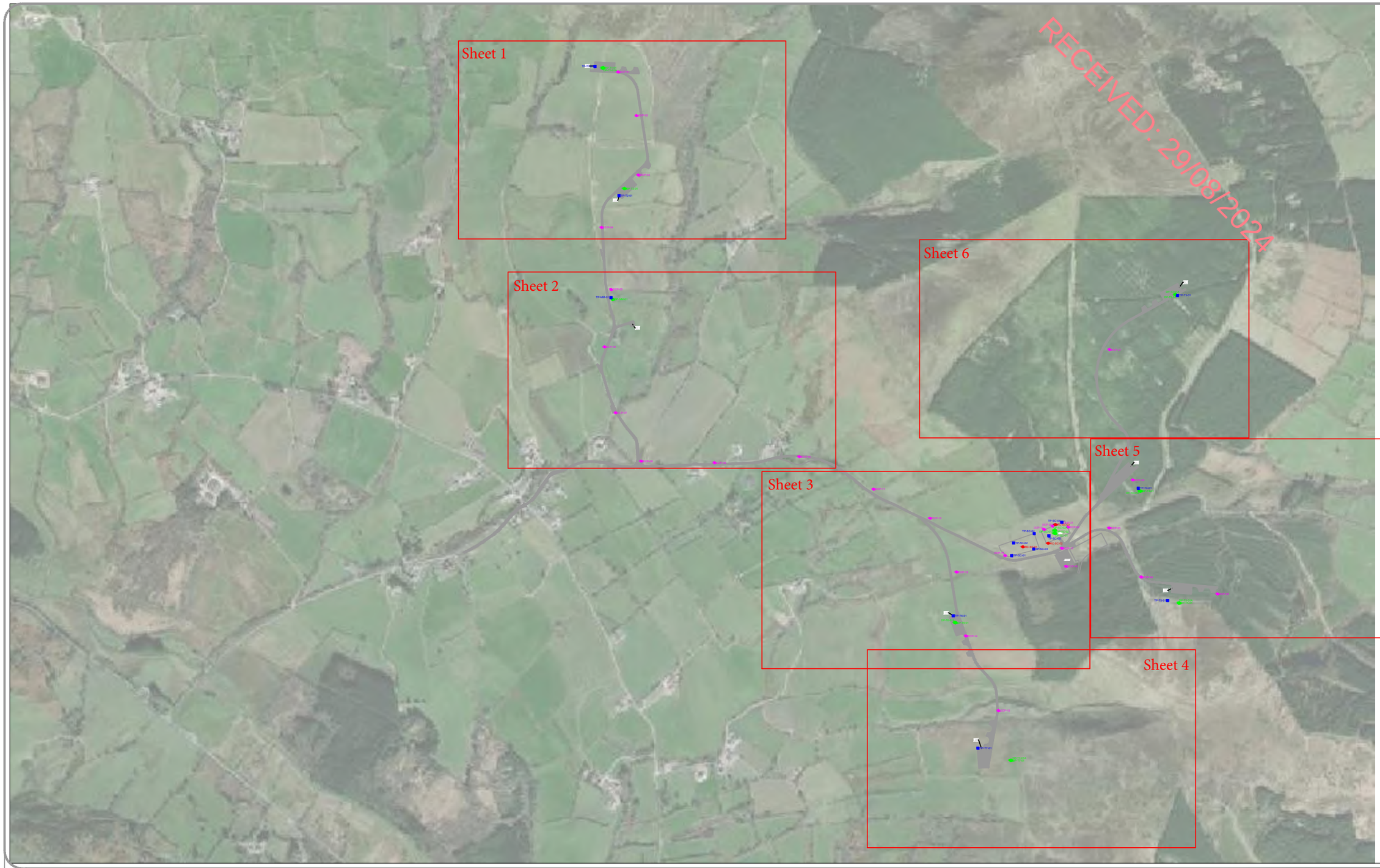
BS EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description.

BS EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test.

CAUSEWAY GEOTECH

APPENDIX A

SITE AND EXPLORATORY HOLE LOCATION PLANS



PROJECT: Lackareagh Wind Farm, Co.Clare		TITLE: Exploratory hole layout plan			
CLIENT: MKO	KEY: TP-SC-06, RC-SC-01, DCP-20, DP-SC-02	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 05/02/2024	
ENGINEER: AFRY			DRWN: JD CHCK: MFG	SERIES: 1 of 1	DWG No: 23-1870 EHL-Overview

PROJECT: Lackareagh Wind Farm, Co.Clare		TITLE: Exploratory hole layout plan			
CLIENT: MKO	KEY: TP-SC-06, RC-SC-01, DCP-20, DP-SC-02	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 05/02/2024	
ENGINEER: AFRY			DRWN: JD CHCK: MFG	SERIES: 1 OF 6	DWG No: 23-1870 EHL-01

PROJECT: Lackareagh Wind Farm, Co.Clare		TITLE: Exploratory hole layout plan			
CLIENT: MKO	KEY: TP-SC-06, RC-SC-01, DCP-20, DP-SC-02	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 05/02/2024	
ENGINEER: AFRY			DRWN: JD CHCK: MFG	SERIES: 2 OF 6	DWG No: 23-1870 EHL-02

PROJECT: Lackareagh Wind Farm, Co.Clare		TITLE: Exploratory hole layout plan			
CLIENT: MKO	KEY: TP-SC-06, RC-SC-01, DCP-20, DP-SC-02	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 05/02/2024	
ENGINEER: AFRY			DRWN: JD CHCK: MFG	SERIES: 3 OF 6	DWG No: 23-1870 EHL-03

PROJECT: Lackareagh Wind Farm, Co.Clare		TITLE: Exploratory hole layout plan			
CLIENT: MKO	KEY: TP-SC-06, RC-SC-01, DCP-20, DP-SC-02	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 05/02/2024	
ENGINEER: AFRY			DRWN: JD CHCK: MFG	SERIES: 4 OF 6	DWG No: 23-1870 EHL-04

PROJECT: Lackareagh Wind Farm, Co.Clare		TITLE: Exploratory hole layout plan			
CLIENT: MKO	KEY: TP-SC-06, RC-SC-01, DCP-20, DP-SC-02	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 05/02/2024	
ENGINEER: AFRY			DRWN: JD CHCK: MFG	SERIES: 5 OF 6	DWG No: 23-1870 EHL-05

PROJECT: Lackareagh Wind Farm, Co.Clare		TITLE: Exploratory hole layout plan			
CLIENT: MKO	KEY: TP-SC-06, RC-SC-01, DCP-20, DP-SC-02	CAUSEWAY GEOTECH	SCALE: NTS@A3	DATE: 05/02/2024	
ENGINEER: AFRY			DRWN: JD CHCK: MFG	SERIES: 6 OF 6	DWG No: 23-1870 EHL-06

CAUSEWAY GEOTECH

RECEIVED: 29/08/2024

APPENDIX B

BOREHOLE LOGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
23-1870	Lackareagh Wind Farm	RC-SC-01
	Client: MKO	
	Client's Rep: AFRY	

Method	Plant Used	Top (m)	Base (m)
Rotary Drilling	Comacchio 405	0.00	3.00
Rotary Coring	Comacchio 405	3.00	5.20

Coordinates: 563530.12 E, 672502.61 N

Final Depth: 5.20 m | Start Date: 29/01/2024 | Driller: TA

Elevation: 257.39 mOD | End Date: 29/01/2024 | Logger: TG

Sheet 1 of 1 | Scale: 1:40 | FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								257.08	0.30		Dark brown peaty TOPSOIL.		
								256.88	0.50		Soft brown slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subangular fine to coarse.		
1.20 1.20 - 1.64	D1 SPT(C) 50 (6,7/50 for 285mm) Hammer SN = 1377										Stiff brown slightly sandy gravelly CLAY with medium cobble and boulder content. Sand is fine to coarse. Gravel is subangular fine to coarse.		
2.50 - 2.80	SPT(C) 50 (7,9/50 for 155mm) Hammer SN = 1377							254.88	2.50		Weathered GREYWACKE (recovered through percussive drilling as grey angular gravel).		
		100	100	90				254.38	3.00		Medium strong massive grey fine grained well cemented GREYWACKE with widely spaced veins of white calcite. Moderately weathered: slightly closer fracture spacing and strong orangish brown discolouration penetrating up to 30mm from joint surfaces. Discontinuities: 1. 0 to 20 degree joints, widely spaced (230/640/1250), planar, smooth with orangish brown staining on joint surfaces. 2. 50 to 70 degree joints, medium spaced (360/550/720), planar, smooth with orangish brown staining on joint surfaces.		
4.00		100	100	100	4								
5.20								252.18	5.20		End of Borehole at 5.20m		
		TCR	SCR	RQD	FI								

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diam (mm)

Core Barrel: T2-101

Remarks: Inspection pit hand dug to 1.20m

Flush Type: Air Mist

Termination Reason: Terminated at scheduled depth.

Last Updated: 21/03/2024

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
23-1870	Lackareagh Wind Farm	RC-SC-02
	Client: MKO	
	Client's Rep: AFRY	

Method	Plant Used	Top (m)	Base (m)
Rotary Drilling	Comacchio 405	0.00	3.50
Rotary Coring	Comacchio 405	3.50	6.00

Coordinates: 563608.35 E, 672513.49 N

Final Depth: 6.00 m | Start Date: 25/01/2024 | Driller: TA | Elevation: 266.60 mOD | End Date: 25/01/2024 | Logger: TG

Sheet 1 of 1 | Scale: 1:40 | FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
								266.20	0.40		Dark brown peaty TOPSOIL.
								265.80	0.80		Soft brown slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subangular fine to coarse.
1.20 1.20 - 1.62	D1 SPT(S) 50 (6,7/50 for 275mm) Hammer SN = 1377					1.20					Stiff brown sandy sandy gravelly SILT with medium cobble and boulder content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
2.50 - 2.81	SPT(S) 50 (7,8/50 for 156mm) Hammer SN = 1377					2.50		264.10	2.50		Weathered GREYWACKE (recovered through percussive drilling as grey angular gravel).
								263.60	3.00		Medium strong (locally strong) massive grey fine grained well cemented GREYWACKE. Highly weathered: reduced strength, much closer fracture spacing and pervasive orangish brown staining up to 40mm from joint surfaces. Discontinuities: 1. 0 to 30 degree joints, closely spaced (50/80/230), planar, smooth with orangish brown staining on joint surfaces. 2. 40 to 65 degree joints, medium spaced (70/220/330), planar, smooth with orangish brown staining on joint surfaces. 3. 2 no. 70 to 90 degree joints at 4.60-4.90m and 5.60-5.85m, planar occasionally undulating, smooth with orangish brown staining on joint surfaces.
		100	65	20	14						
					>20						
4.50		100	95	80	10						
5.50		100	95	70							
6.00								260.60	6.00		End of Borehole at 6.00m
		TCR	SCR	RQD	FI						

Water: Backfill

Water Strikes			
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Remarks
Inspection pit hand dug to 1.20m

Casing Details	
To (m)	Diam (mm)

Core Barrel
T2-101

Flush Type
Air Mist

Termination Reason
Terminated at scheduled depth.

Last Updated
21/03/2024

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
23-1870	Lackareagh Wind Farm	RC-SC-03

Client: MKO

Client's Rep: AFRY

Method	Plant Used	Top (m)	Base (m)
Rotary Drilling	Comacchio 405	0.00	2.50
Rotary Coring	Comacchio 405	2.50	5.50

Coordinates: 563630.55 E, 672571.08 N

Final Depth: 5.50 m | Start Date: 24/01/2024 | Driller: TA

Elevation: 275.23 mOD | End Date: 24/01/2024 | Logger: TG

Sheet 1 of 1 | Scale: 1:40 | FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								274.83	0.40		Dark brown peaty TOPSOIL.		
								274.43	0.80		Soft brown slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subangular fine to coarse.		
1.20 1.20 - 1.64	D1 SPT(C) 50 (3,4/50 for 295mm) Hammer SN = 1377										Stiff brown slightly sandy gravelly SILT with high cobble and boulder content. Sand is fine to coarse. Gravel is angular fine to coarse.		
								273.03	2.20		Weathered GREYWACKE (recovered through percussive drilling as grey angular gravel).		
								272.73	2.50		Medium strong massive brownish grey fine-grained well cemented GREYWACKE. Highly weathered: reduced strength, much closer fracture spacing and pervasive orangish brown staining up to 50mm from joint surfaces. Discontinuities: 1. 0 to 30 degree joints, closely spaced (50/80/160), planar, smooth with orangish brown staining on joint surfaces. 2. 40 to 65 degree joints, closely spaced (50/120/200), planar, smooth with orangish brown staining on joint surface		
		70	65	20	AZCL >20 8								
3.50								271.73	3.50		Medium strong (locally strong) massive grey fine-grained well cemented GREYWACKE. Slightly weathered: slightly closer fracture spacing and pervasive orangish brown staining up to 10mm from joint surfaces. Discontinuities: 1. 0 to 30 degree joints, medium spaced (140/570/910), planar, smooth with orangish brown staining on joint surfaces. 2. 70 to 90 degree joint at 3.50-3.90m, planar, smooth with orangish brown staining on joint surface.		
4.50		100	100	100	2								
		100	100	100									
5.50								269.73	5.50		End of Borehole at 5.50m		
		TCR	SCR	RQD	FI								

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)

Casing Details

To (m)	Diam (mm)

Core Barrel: T2-101

Remarks: Inspection pit hand dug to 1.20m

Flush Type: Air Mist

Termination Reason: Terminated at scheduled depth.

Last Updated: 21/03/2024

AGS

CAUSEWAY GEOTECH

RECEIVED: 29/08/2024

APPENDIX C

CORE PHOTOGRAPHS

Borehole RC-SC-01 (3.00-5.20m)

Borehole RC-SC-02 (3.50-6.00m)

Borehole RC-SC-03 (2.50-5.50m)

CAUSEWAY GEOTECH

RECEIVED: 29/08/2024

APPENDIX D

DYNAMIC PROBE LOGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-MM-01
	Coordinates 562262.60 E 673266.76 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 1 of 2 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 141.85 mOD	**Final Depth:** 12.00	**Date:** 28/01/2024	**Operator:** IC	FINAL

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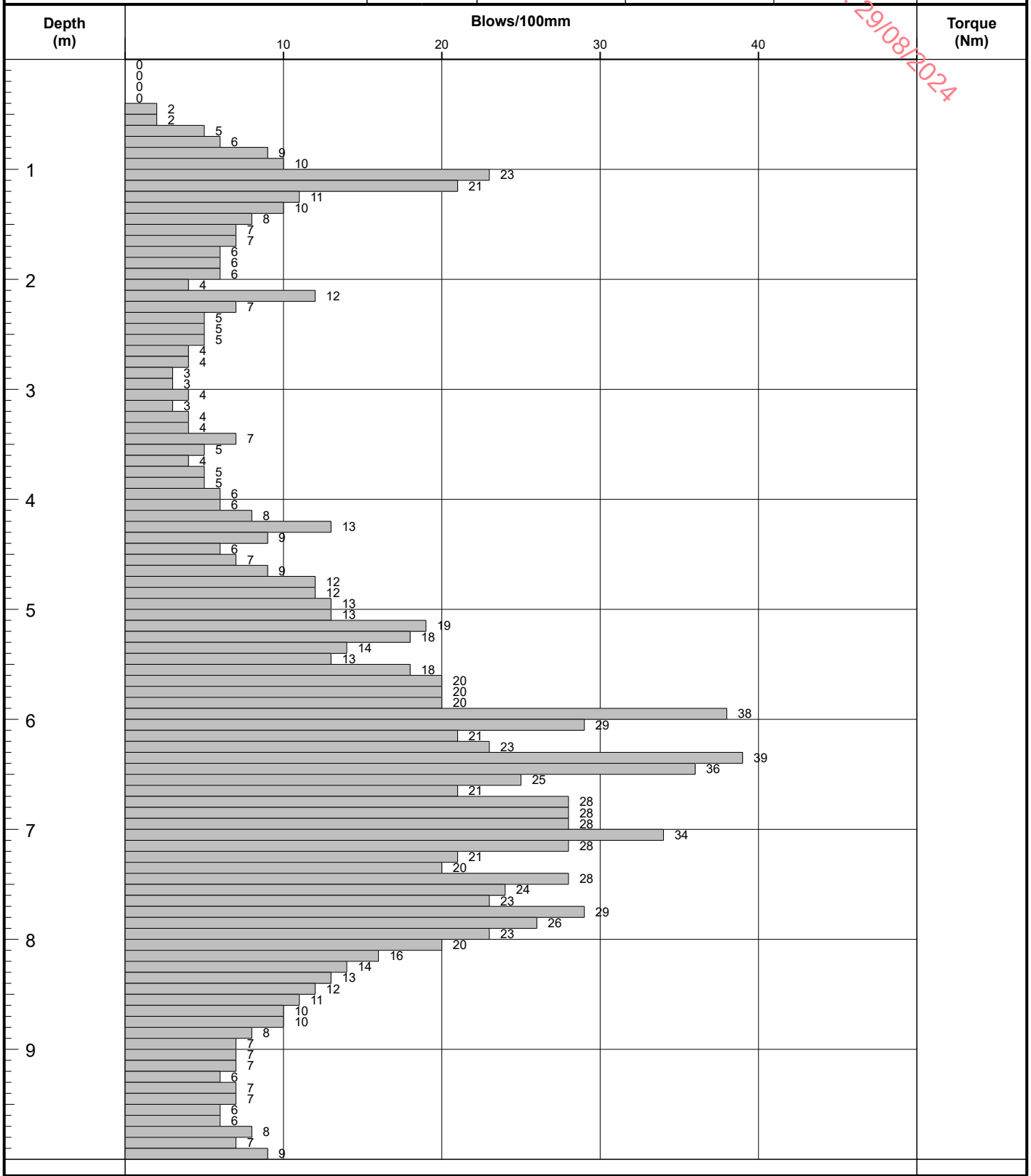
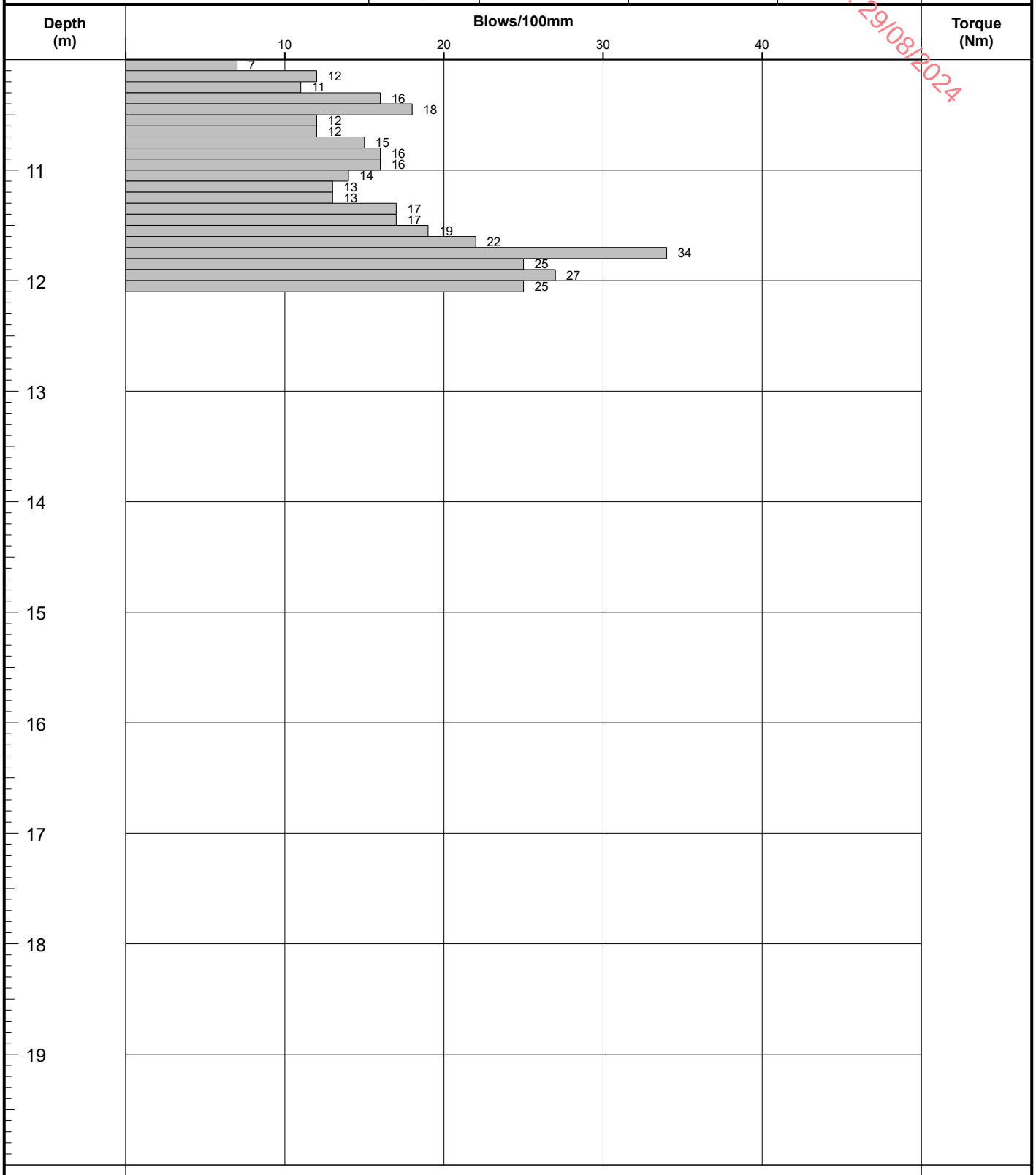


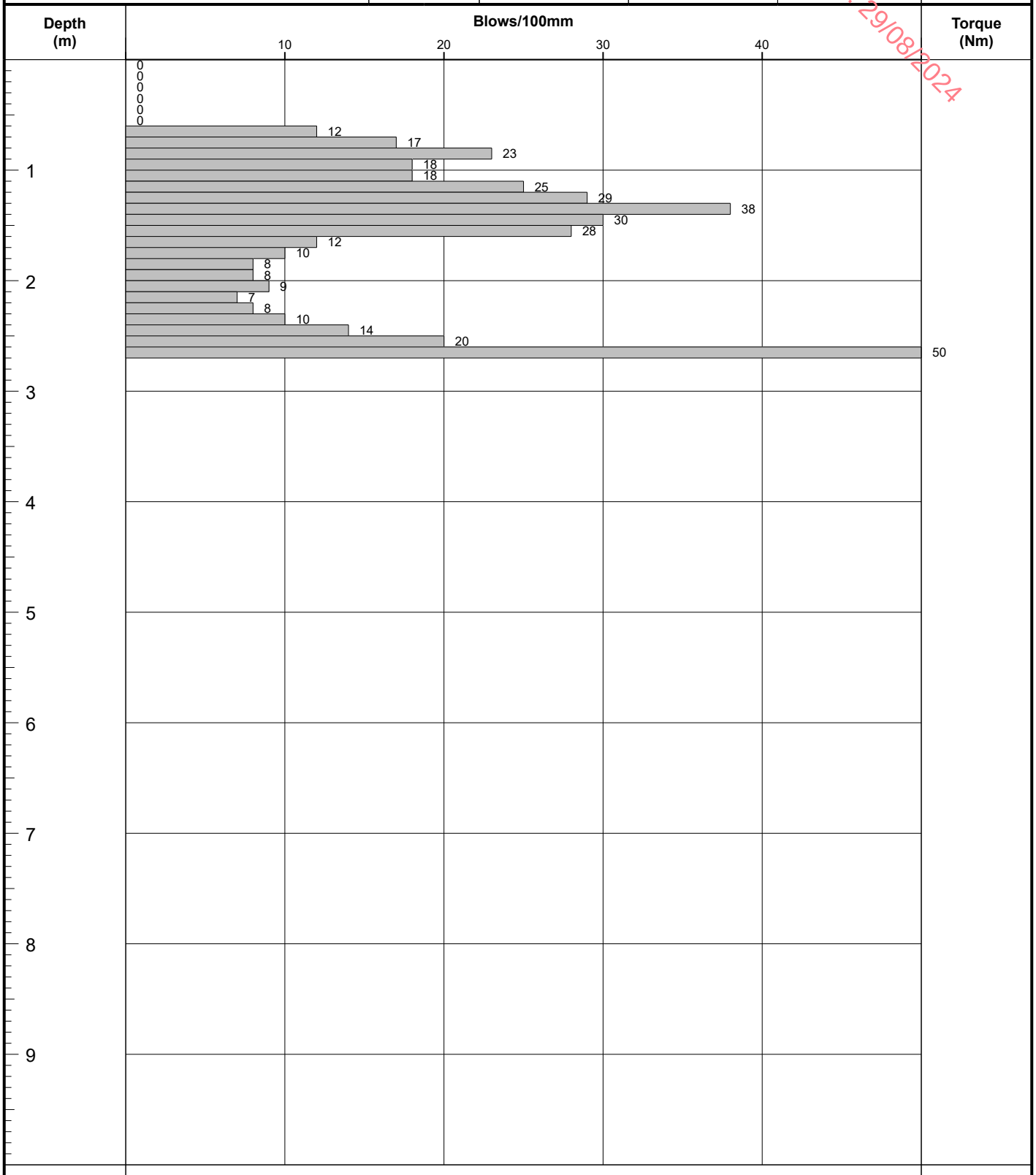
Fall Height: 750 mm	**Remarks**	
Hammer Mass: 63.5 kg		
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on Engineer's instruction	**Last Updated** 20/03/2024

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-MM-01
	Coordinates 562262.60 E 673266.76 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 2 of 2 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 141.85 mOD	**Final Depth:** 12.00	**Date:** 28/01/2024	**Operator:** IC	FINAL



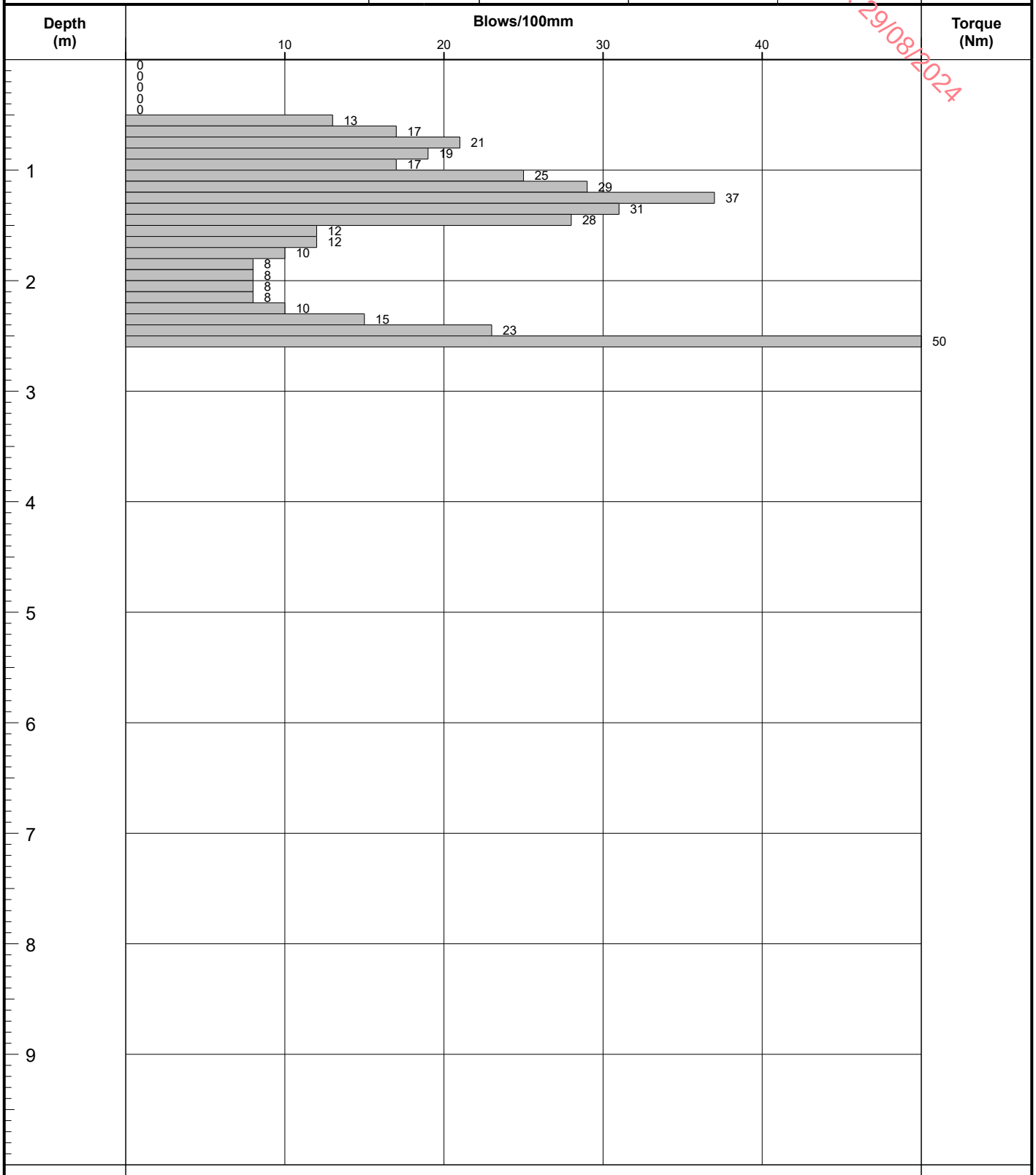
Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg	**Termination Reason**	**Last Updated**	AGS
Cone Diameter: 50.5 mm	Terminated on Engineer's instruction	20/03/2024	

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-SC-01
	Coordinates 563628.39 E 672544.07 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 272.00 mOD	**Final Depth:** 2.60	**Date:** 28/01/2024	**Operator:** IC	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg			
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024	AGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-SC-01A
	Coordinates 563629.88 E 672544.79 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 272.00 mOD	**Final Depth:** 2.50	**Date:** 28/01/2024	**Operator:** IC	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg			
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024	AGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-SC-02
	Coordinates 563628.36 E 672553.01 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 272.76 mOD	**Final Depth:** 2.00	**Date:** 28/01/2024	**Operator:** IC	FINAL

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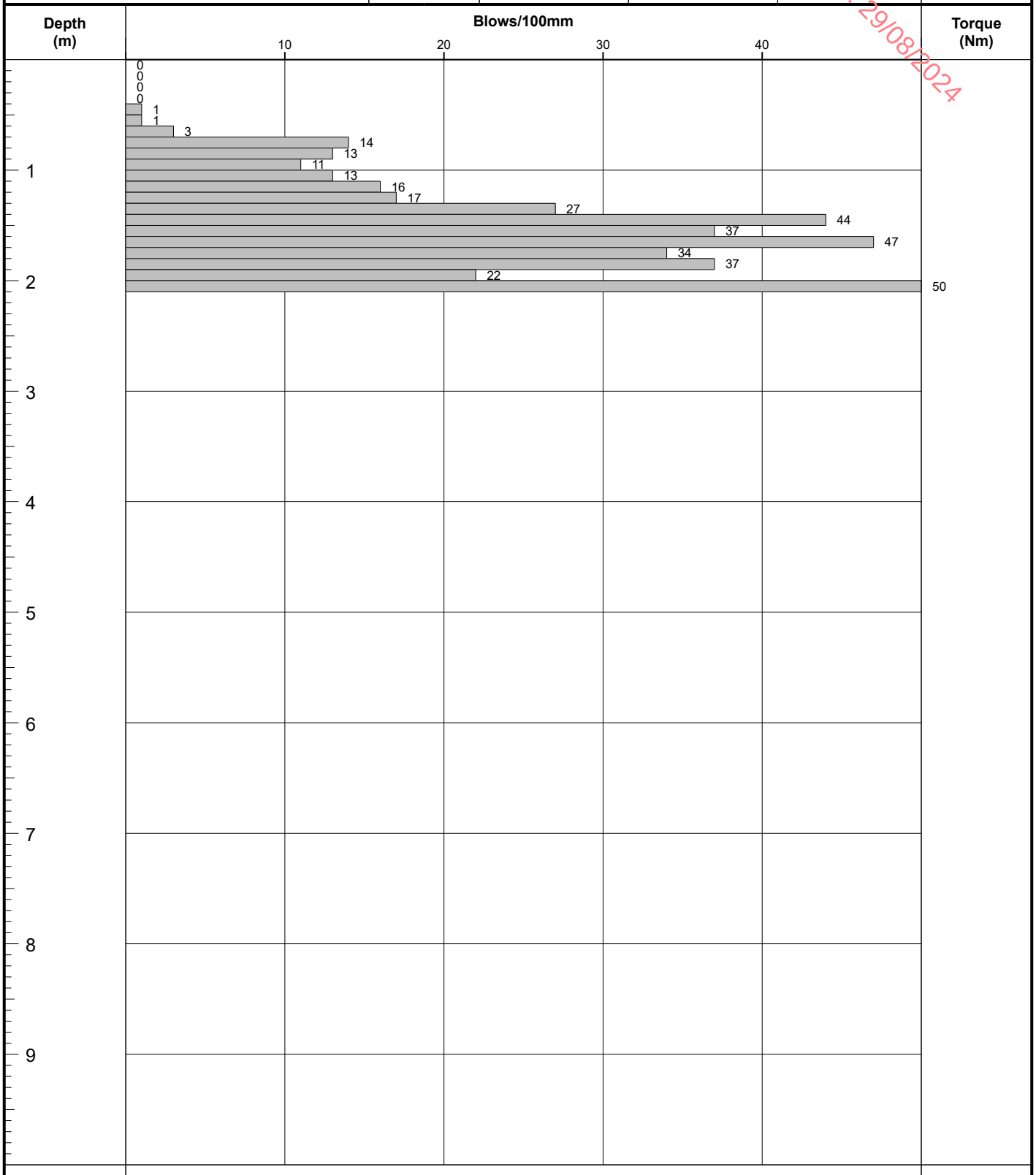
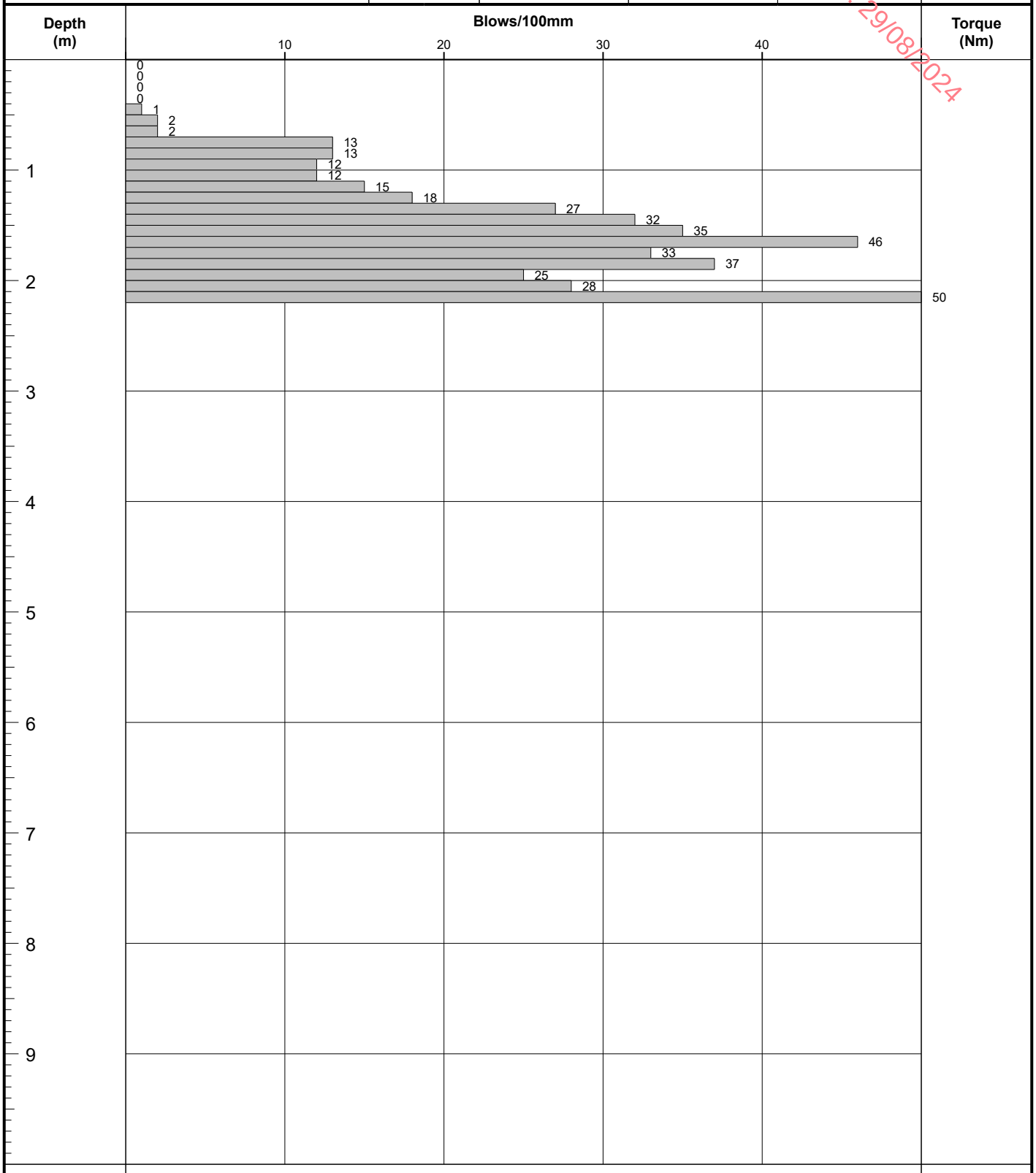


Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg			
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024	AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
23-1870	Lackareagh Wind Farm	DP-SC-02A
Coordinates	**Client:**	
563629.85 E	MKO	
672553.73 N	**Client's Representative:** AFRY	Sheet 1 of 1
		Scale: 1:50

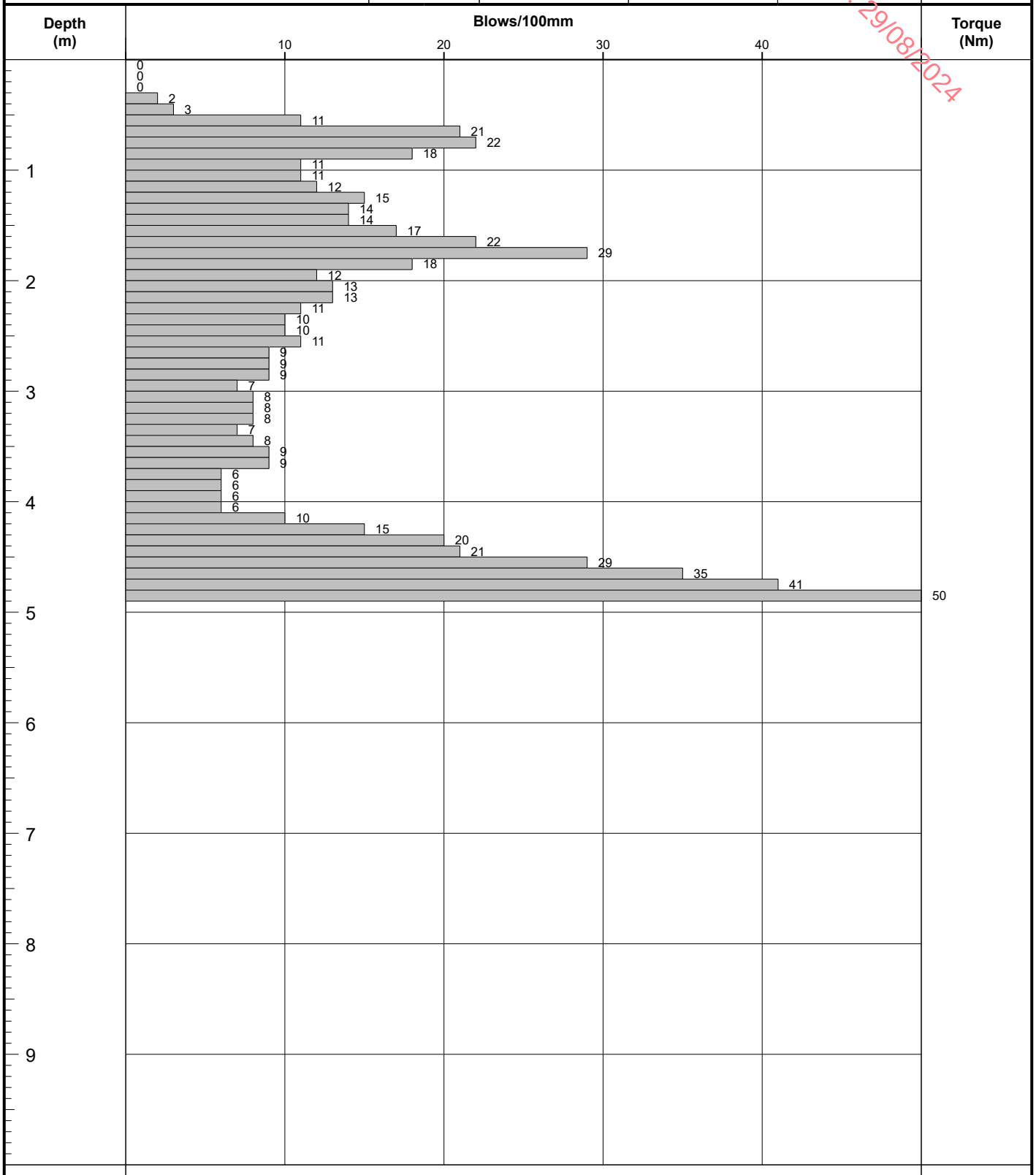
Method:	Probe Type:	Elevation	Final Depth:	Date:	Operator:	
Dynamic Probing	DPSH-B	272.76 mOD	2.10	28/01/2024	IC	FINAL



Fall Height:	Remarks	
750 mm		
Hammer Mass: 63.5 kg	**Termination Reason**	**Last Updated**
Cone Diameter: 50.5 mm	Terminated on refusal	20/03/2024

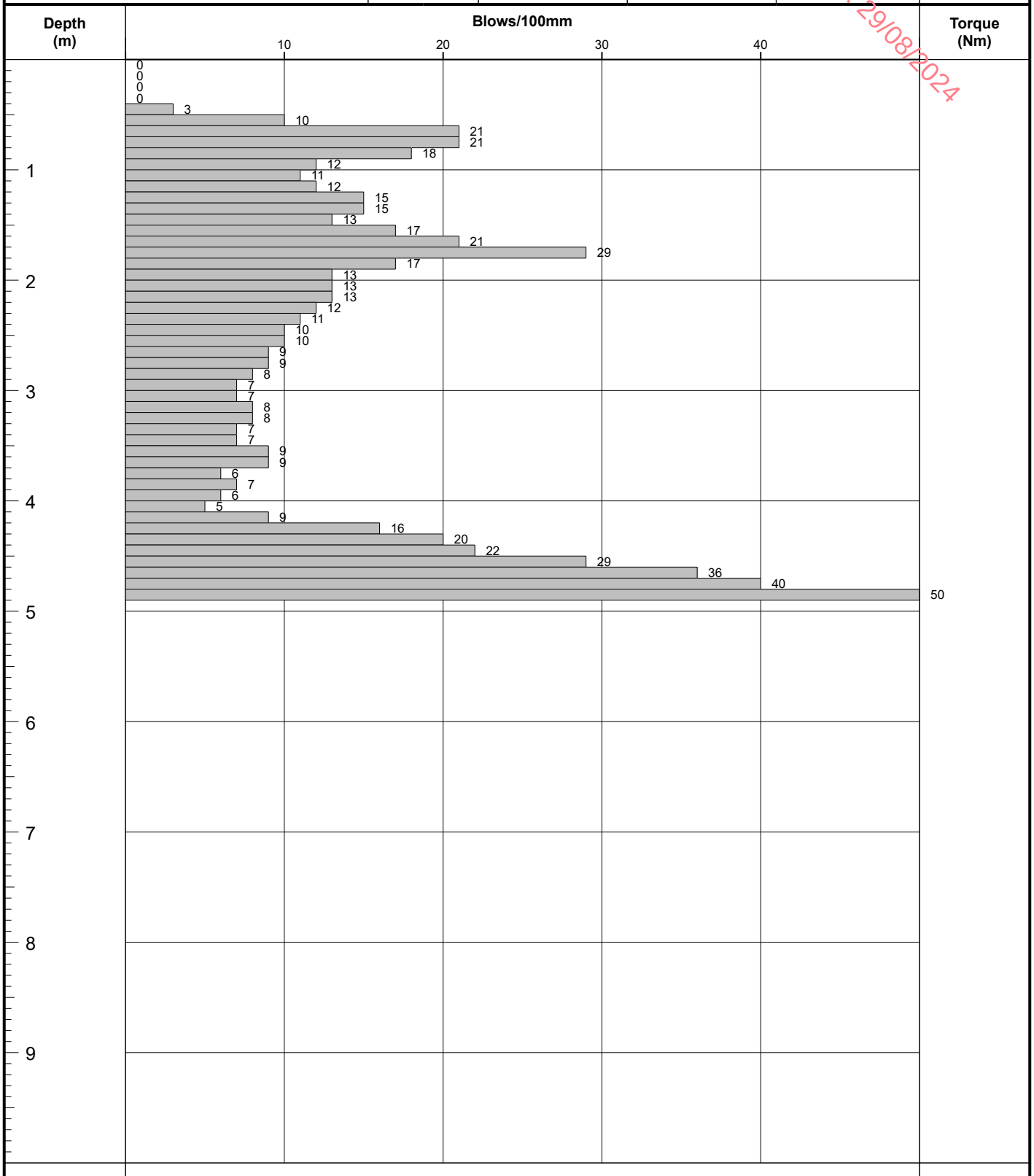
AGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-T1-01
	Coordinates 562233.07 E 673982.35 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 236.57 mOD	**Final Depth:** 4.80	**Date:** 28/01/2024	**Operator:** IC	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg			
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024	AGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-T1-01A
	Coordinates 562232.19 E 673980.73 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 236.56 mOD	**Final Depth:** 4.80	**Date:** 28/01/2024	**Operator:** IC	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg			
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024	AGS

CAUSEWAY GEOTECH

Project No.	Project Name:			Probe ID
23-1870	Lackareagh Wind Farm			DP-T2-01
Coordinates	**Client:**			
562298.89 E	MKO			
673609.00 N	**Client's Representative:** AFRY			Sheet 1 of 1 Scale: 1:50
Method: Dynamic Probing				
Probe Type: DPSH-B	**Elevation** 189.87 mOD	**Final Depth:** 7.00	**Date:** 28/01/2024	**Operator:** IC — FINAL

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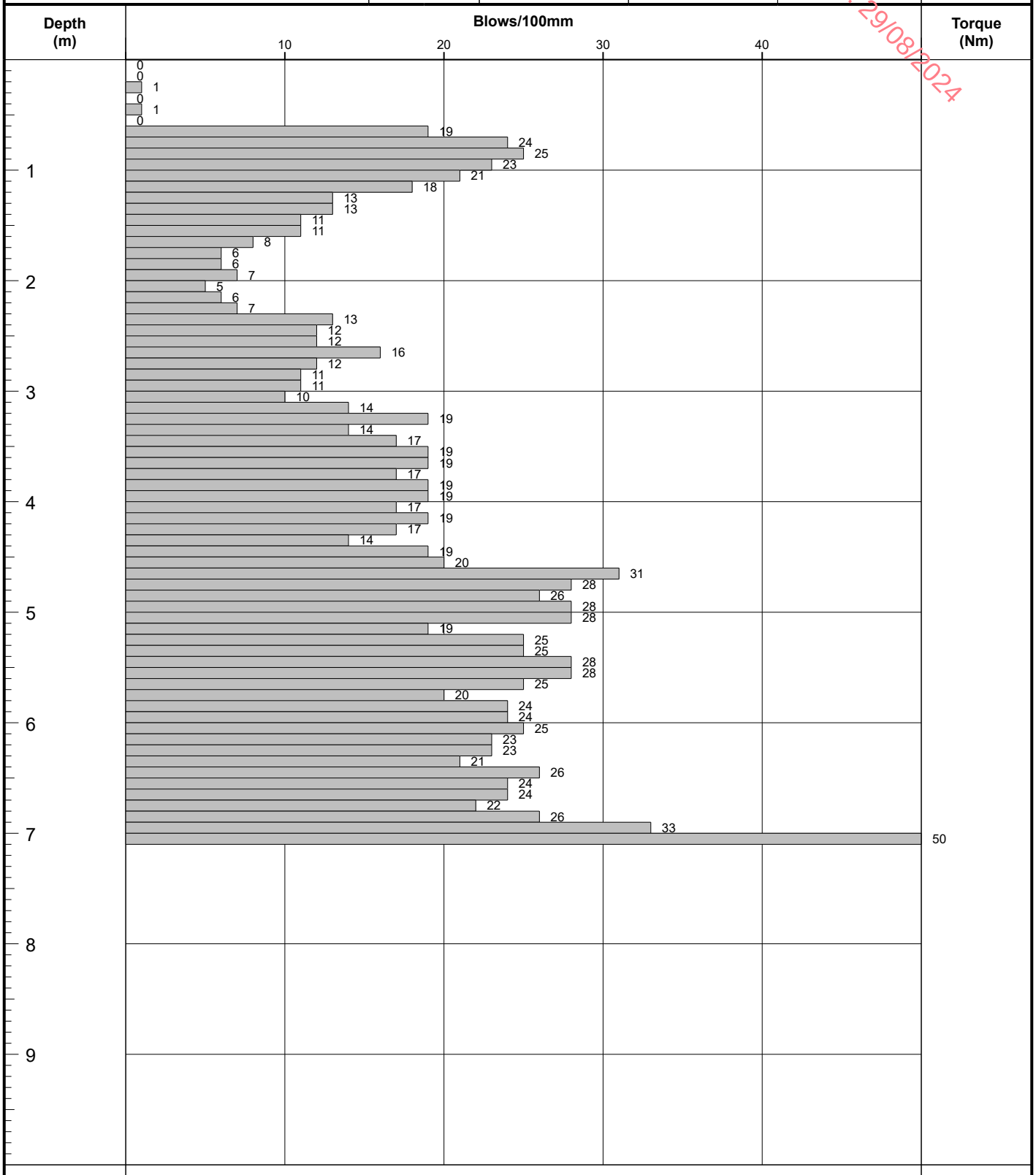
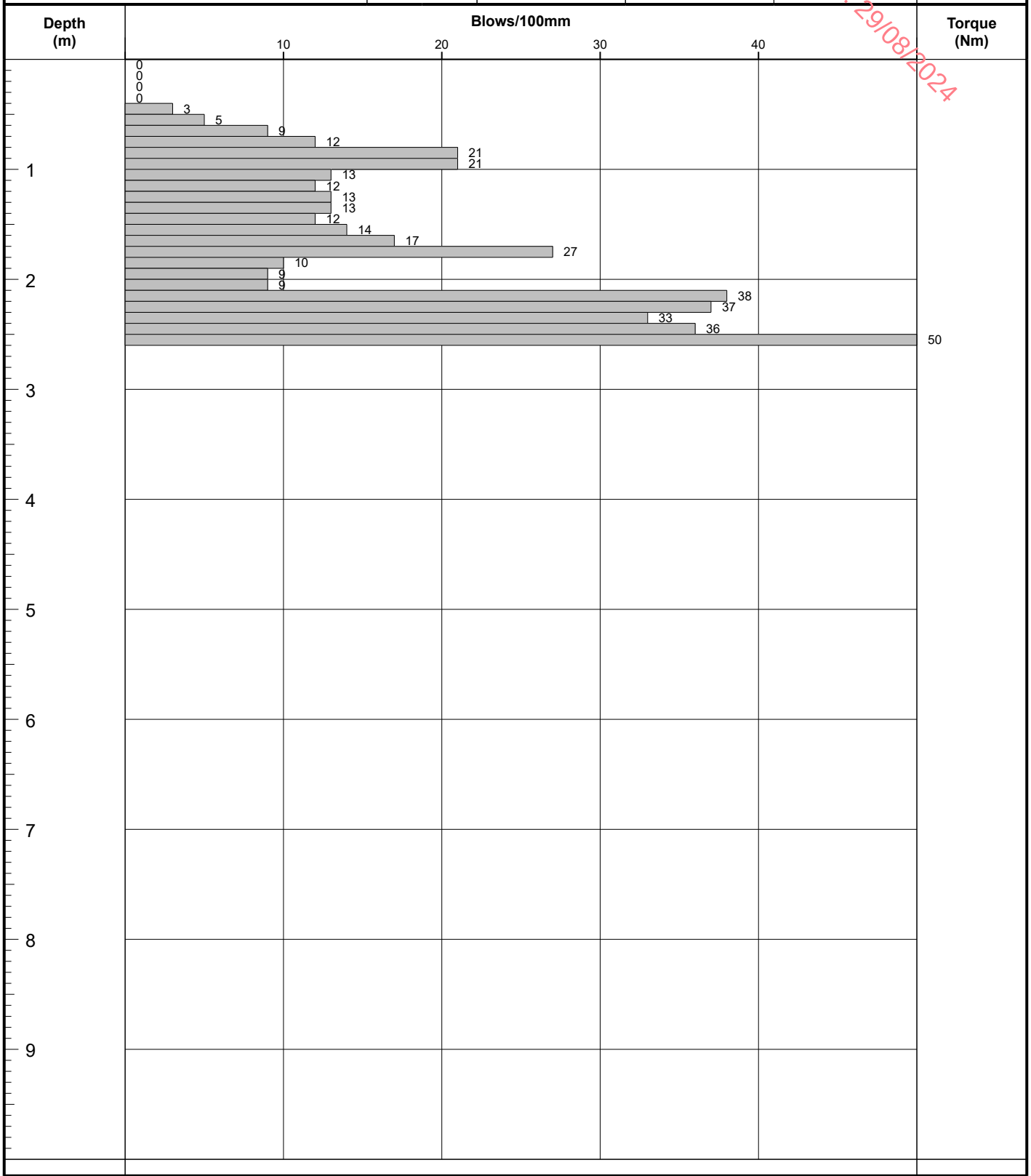


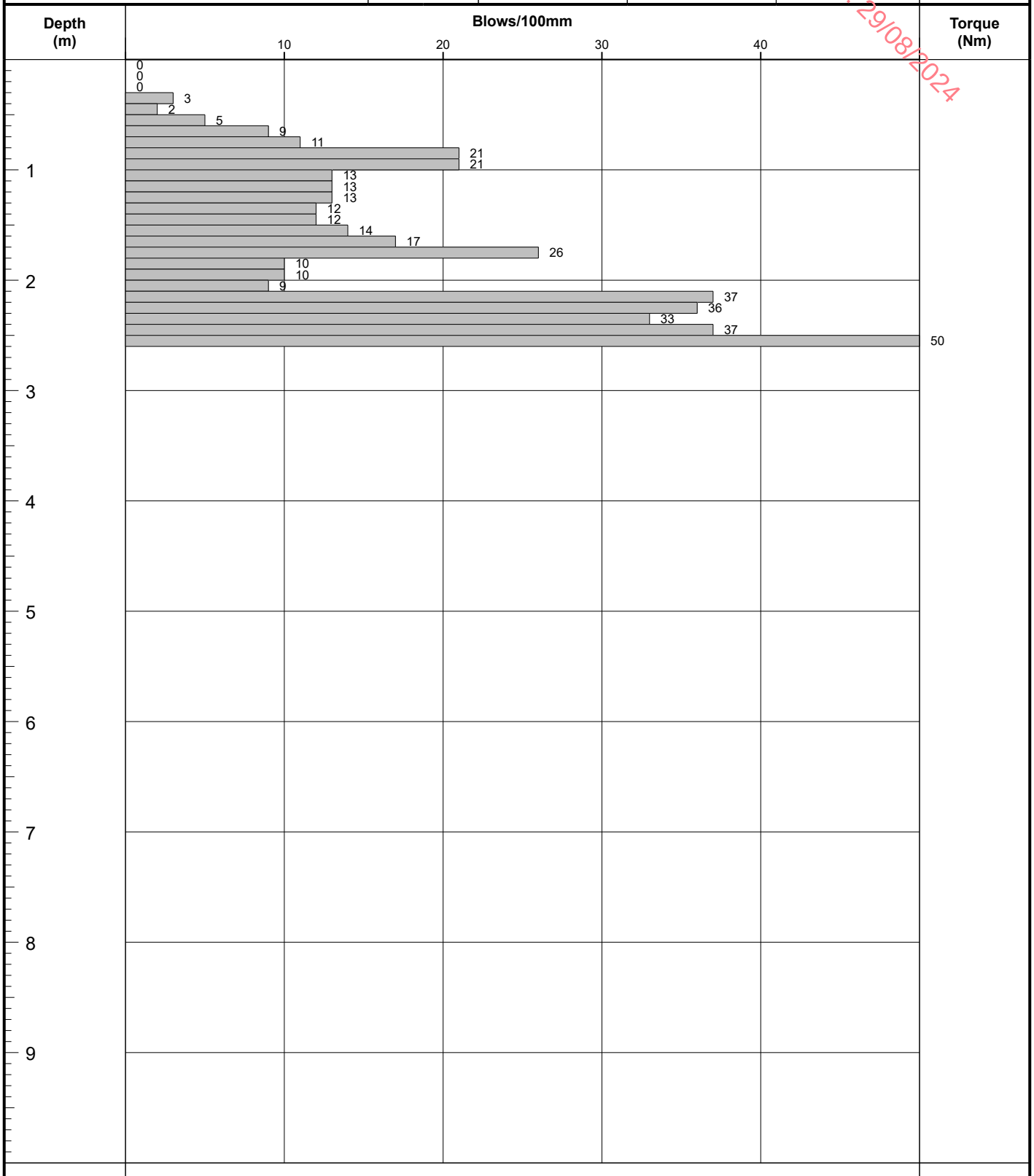
Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg			
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024	AGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-T3-01
	Coordinates 564002.85 E 673280.78 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 365.74 mOD	**Final Depth:** 2.50	**Date:** 28/01/2024	**Operator:** IC	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg			
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024	AGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-T3-01A
	Coordinates 564001.91 E 673281.35 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 365.74 mOD	**Final Depth:** 2.50	**Date:** 28/01/2024	**Operator:** IC	FINAL



Fall Height: 750 mm	**Remarks**	
Hammer Mass: 63.5 kg		
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-T4-01
	Coordinates 563892.93 E 672675.11 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 276.92 mOD	**Final Depth:** 2.20	**Date:** 28/01/2024	**Operator:** IC	FINAL

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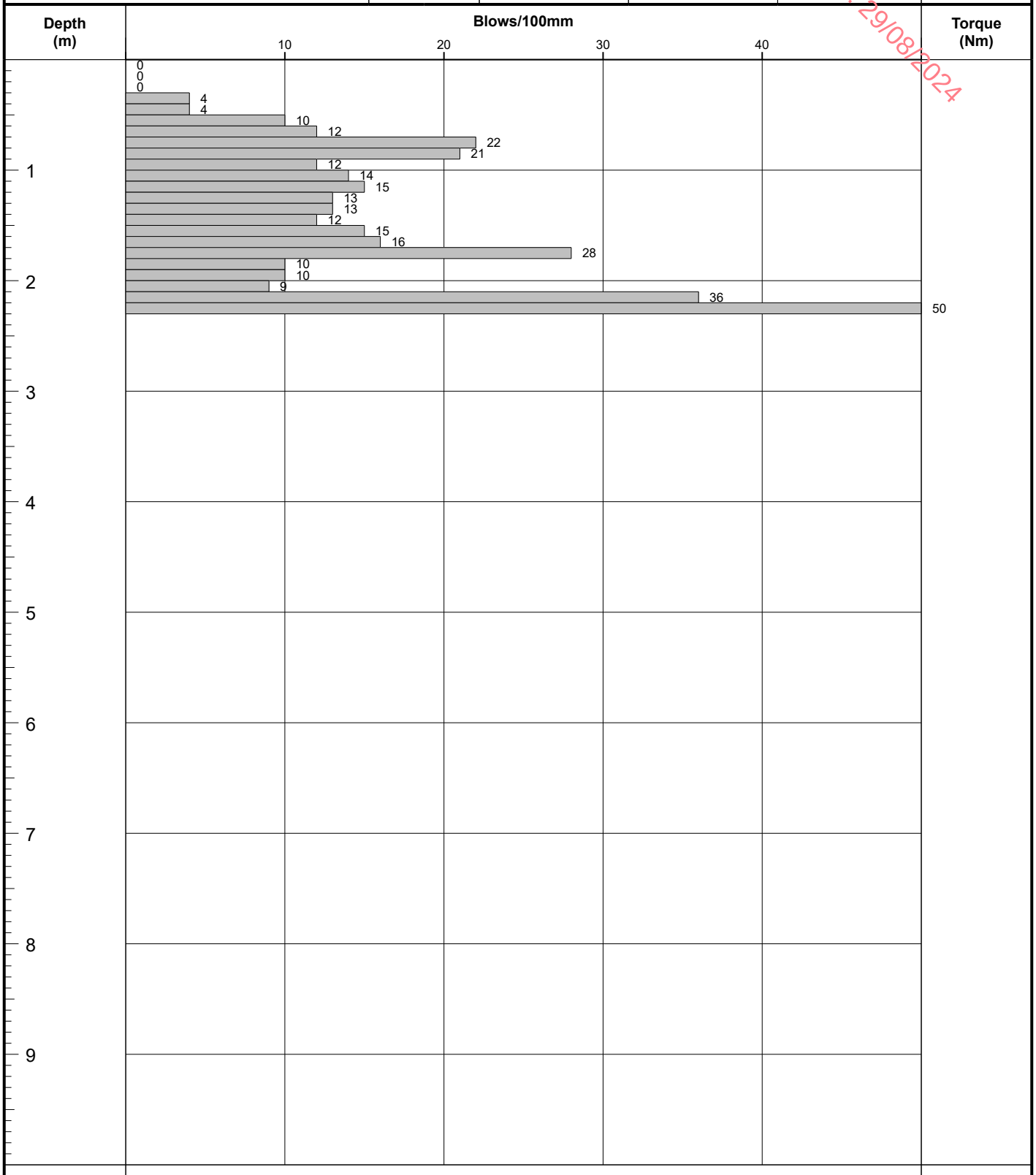
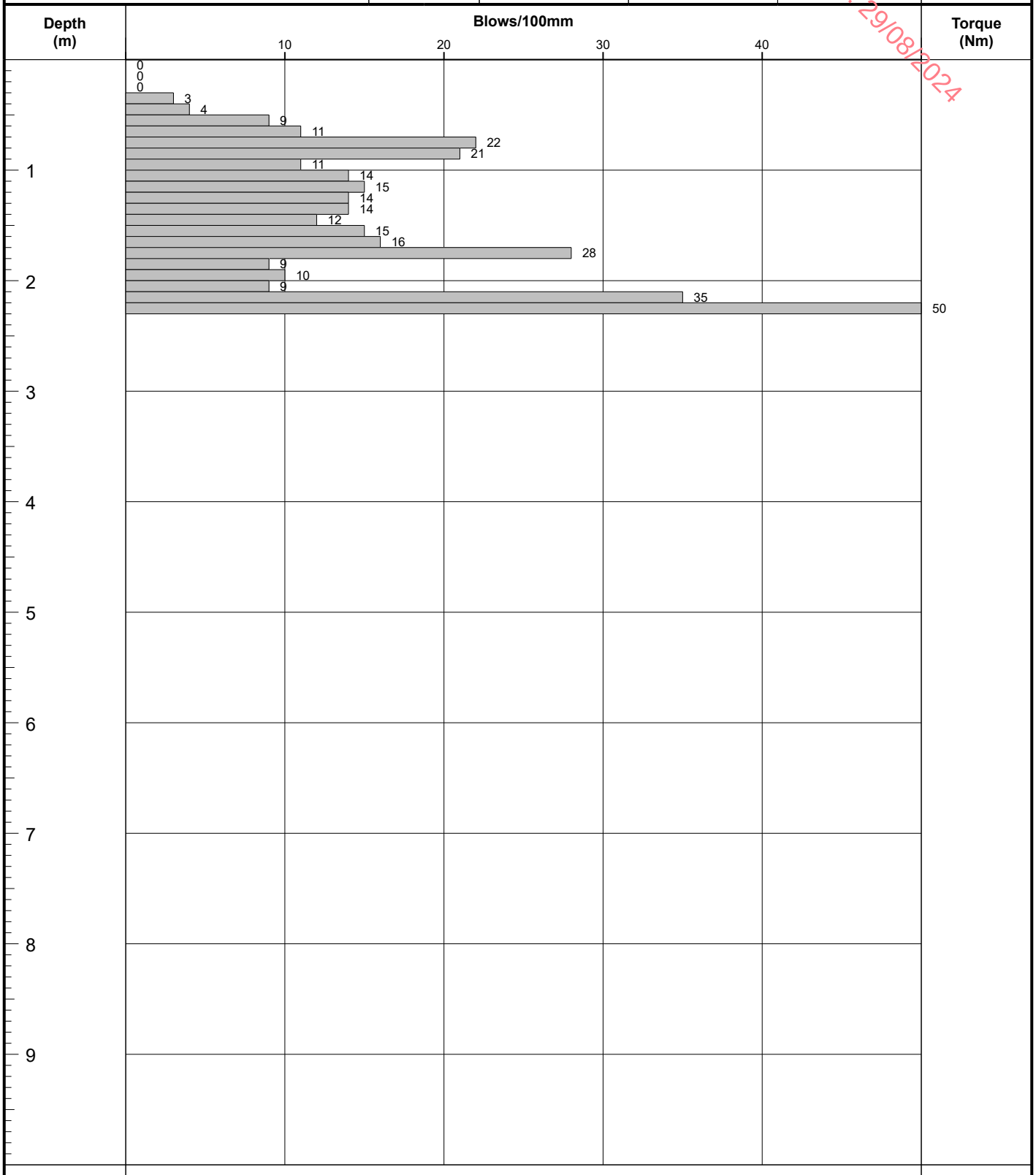


Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg			
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024	AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
23-1870	Lackareagh Wind Farm	DP-T4-01A
Coordinates	**Client:**	
563892.42 E	MKO	
672674.58 N	**Client's Representative:** AFRY	Sheet 1 of 1
		Scale: 1:50

Method:	Probe Type:	Elevation	Final Depth:	Date:	Operator:	
Dynamic Probing	DPSH-B	276.93 mOD	2.20	28/01/2024	IC	FINAL



Fall Height:	Remarks
750 mm	
Hammer Mass: 63.5 kg	
Cone Diameter: 50.5 mm	**Termination Reason:** Terminated on refusal

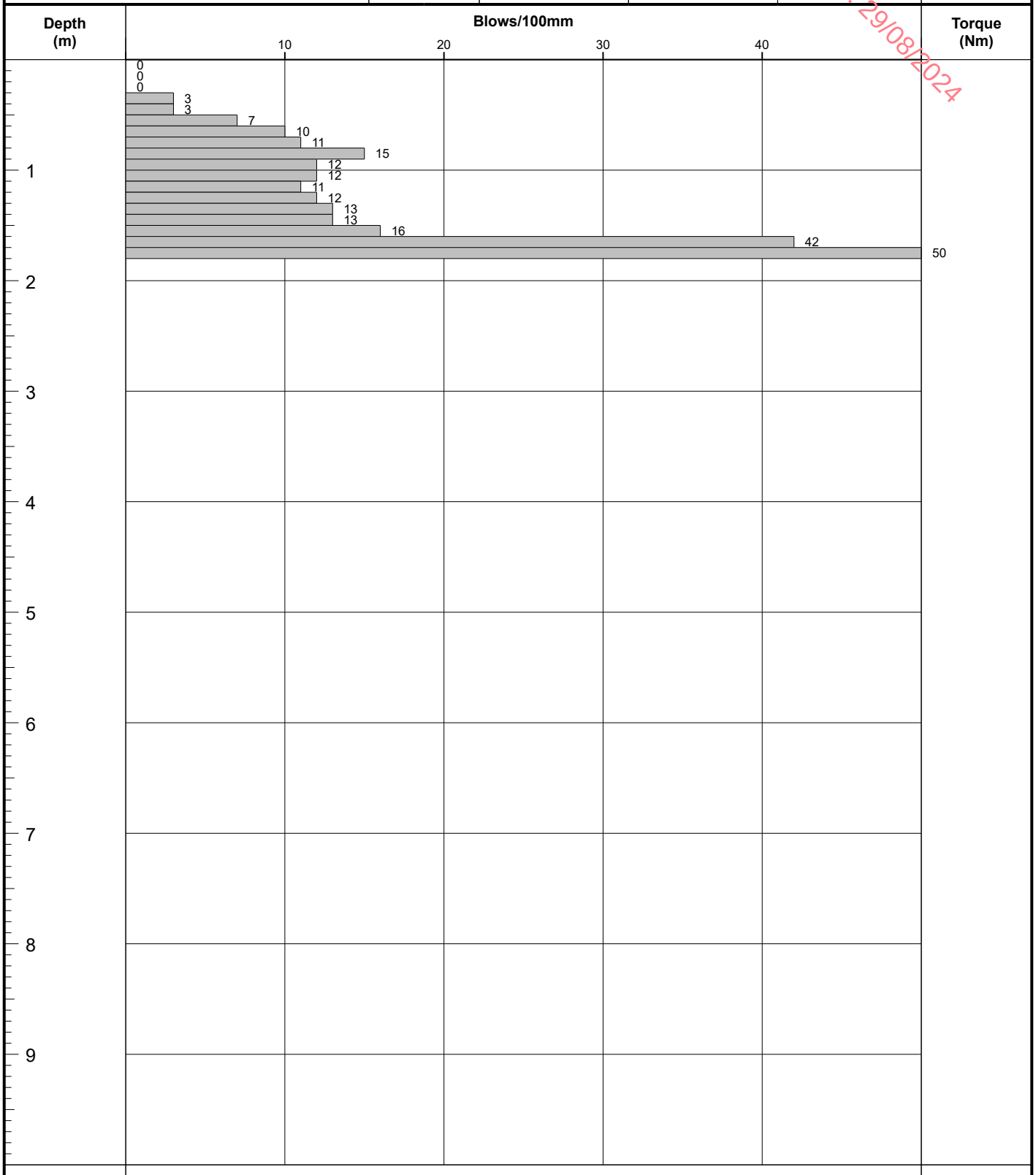
Last Updated 20/03/2024

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
23-1870	Lackareagh Wind Farm	DP-T5-01
Coordinates	**Client:**	
564012.30 E	MKO	
672328.75 N	**Client's Representative:** AFRY	Sheet 1 of 1
		Scale: 1:50

Method:	Probe Type:	Elevation	Final Depth:	Date:	Operator:	
Dynamic Probing	DPSH-B	300.02 mOD	1.70	28/01/2024	IC	FINAL



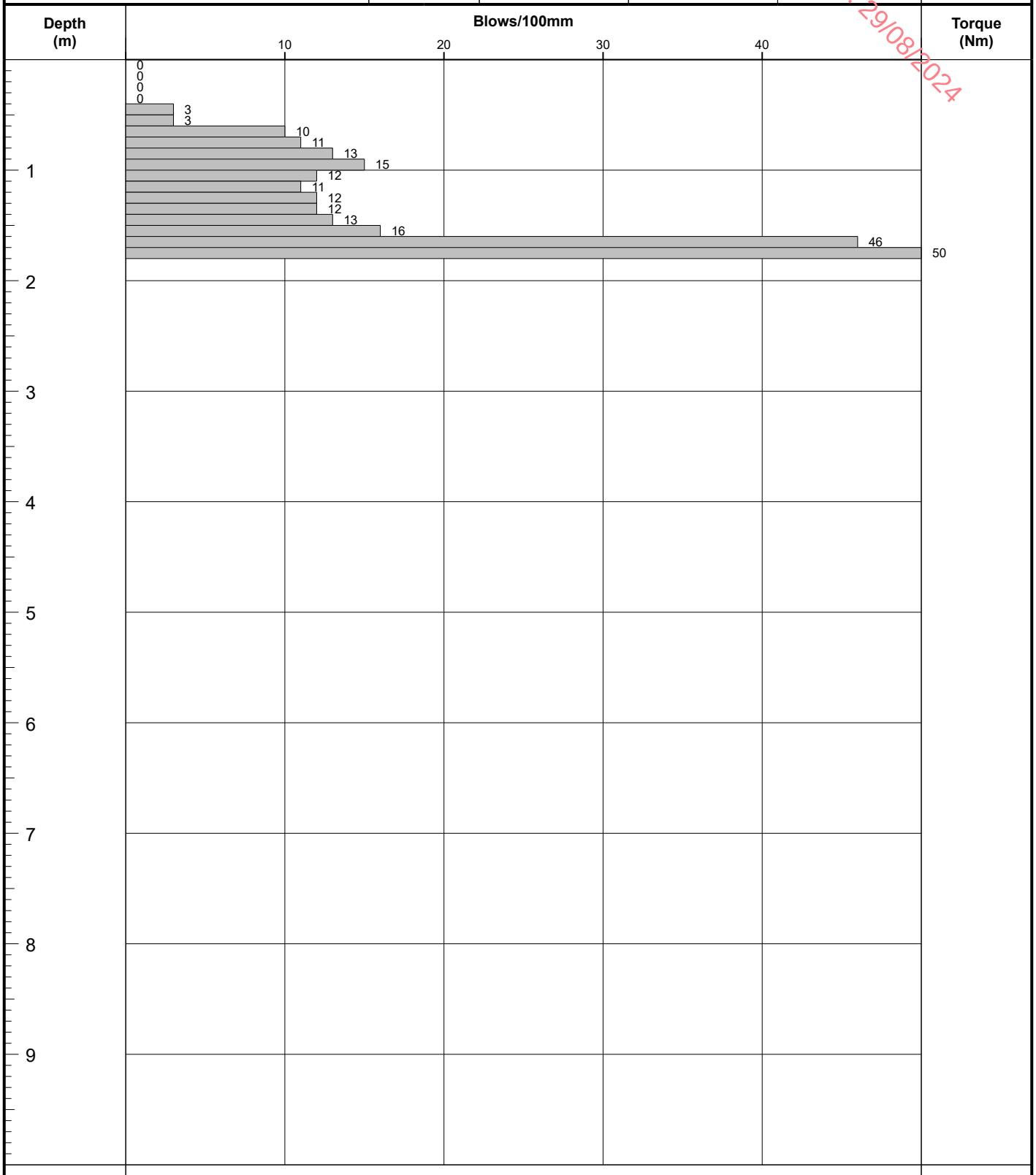
Fall Height: 750 mm	Remarks	
Hammer Mass: 63.5 kg		
Cone Diameter: 50.5 mm	Termination Reason: Terminated on refusal	Last Updated: 20/03/2024

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
23-1870	Lackareagh Wind Farm	DP-T5-01A
Coordinates	**Client:**	
564012.53 E	MKO	
672329.04 N	**Client's Representative:** AFRY	Sheet 1 of 1
		Scale: 1:50

Method:	Probe Type:	Elevation	Final Depth:	Date:	Operator:	
Dynamic Probing	DPSH-B	300.04 mOD	1.70	28/01/2024	IC	FINAL



Fall Height:	Remarks
750 mm	
Hammer Mass: 63.5 kg	
Cone Diameter: 50.5 mm	**Termination Reason:** Terminated on refusal

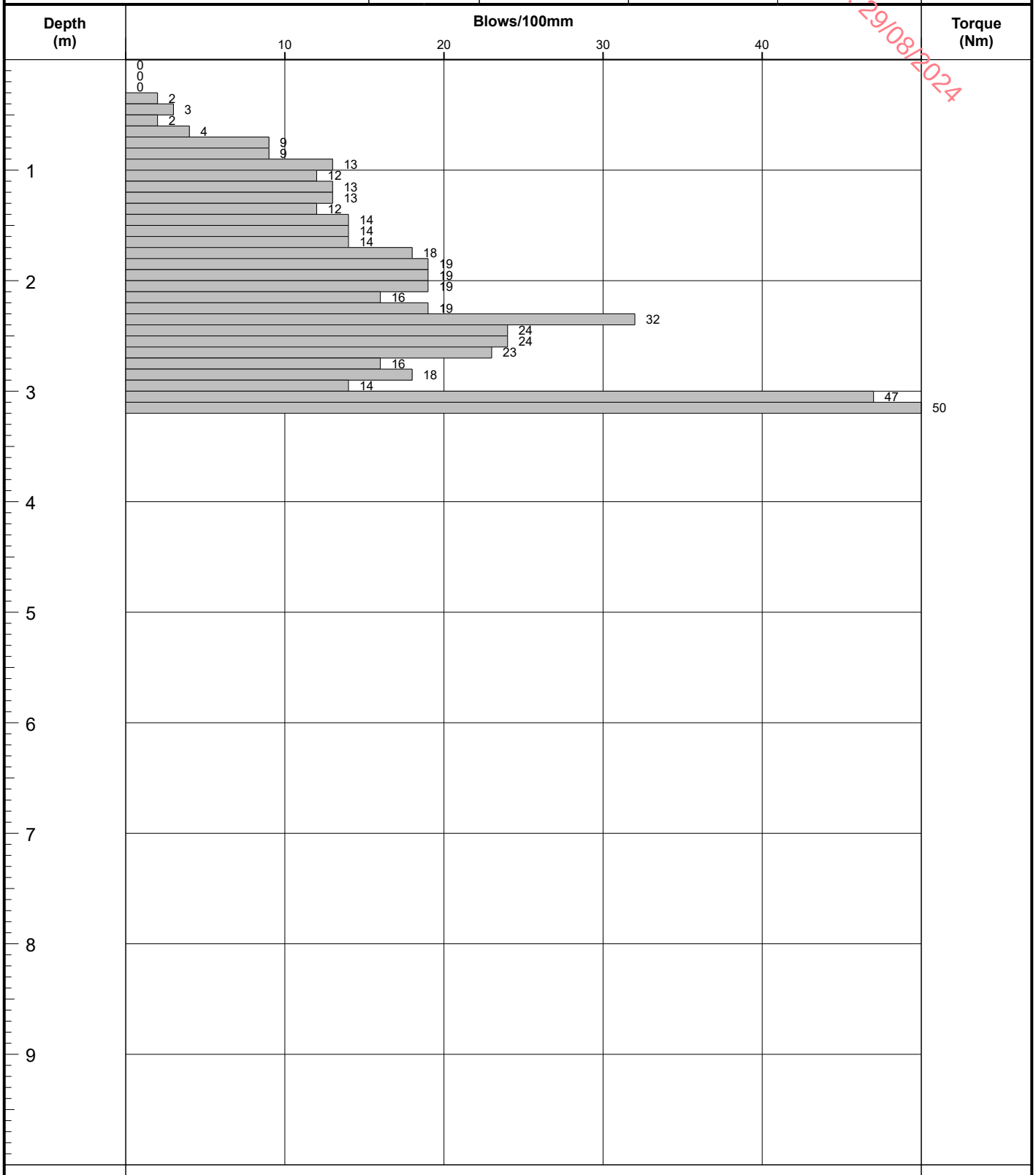
Last Updated 20/03/2024

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
23-1870	Lackareagh Wind Farm	DP-T6-01
Coordinates	**Client:**	
563321.11 E	MKO	
672267.96 N	**Client's Representative:** AFRY	Sheet 1 of 1
		Scale: 1:50

Method:	Probe Type:	Elevation	Final Depth:	Date:	Operator:	
Dynamic Probing	DPSH-B	203.16 mOD	3.10	28/01/2024	IC	FINAL

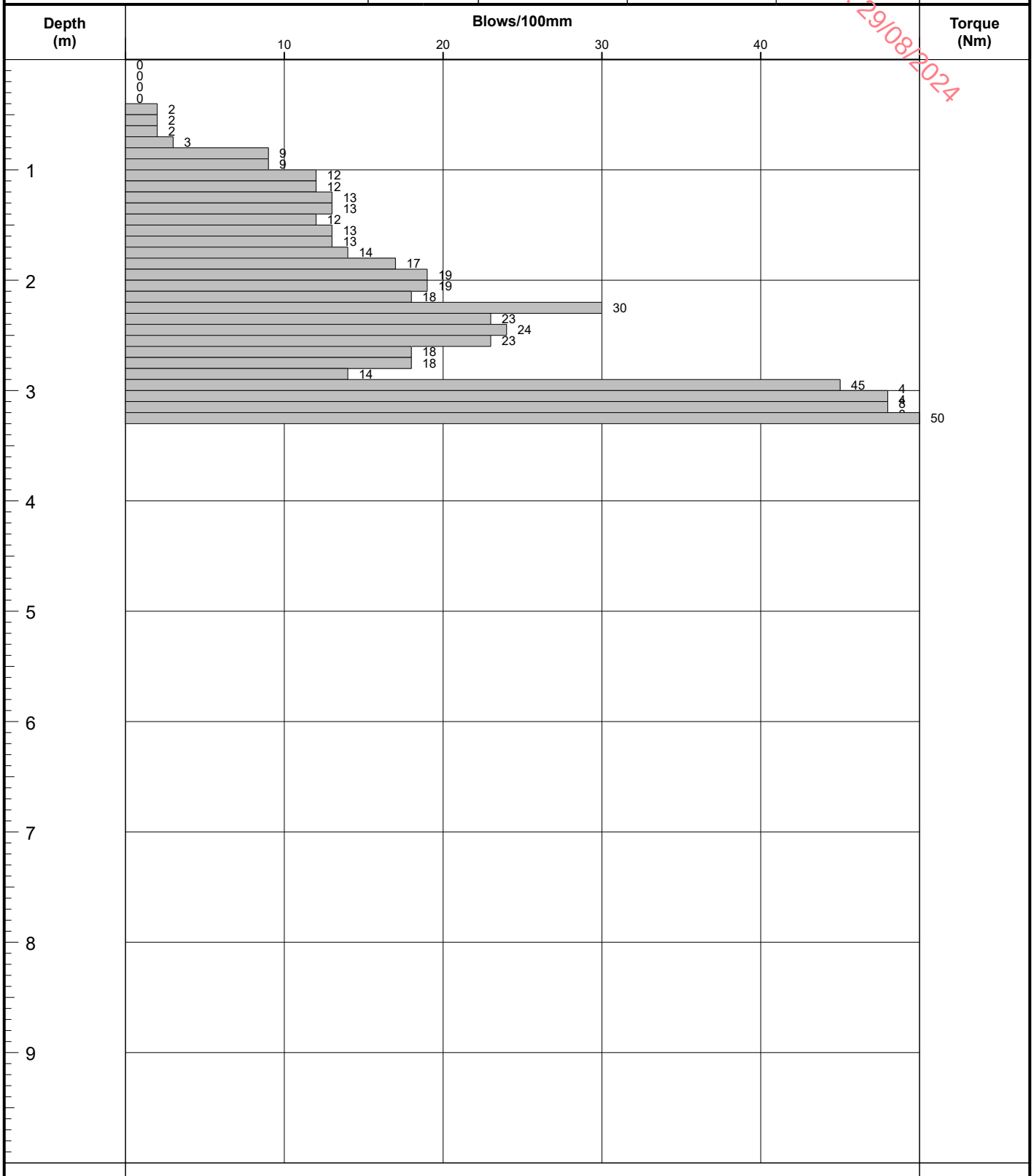


Fall Height:	Remarks
750 mm	
Hammer Mass: 63.5 kg	
Cone Diameter: 50.5 mm	**Termination Reason:** Terminated on refusal

Last Updated 20/03/2024

AGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm			**Probe ID** DP-T6-01A
	Coordinates 563321.75 E 672268.67 N	**Client:** MKO			
Method: Dynamic Probing		**Client's Representative:** AFRY			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 203.15 mOD	**Final Depth:** 3.20	**Date:** 28/01/2024	**Operator:** IC	FINAL

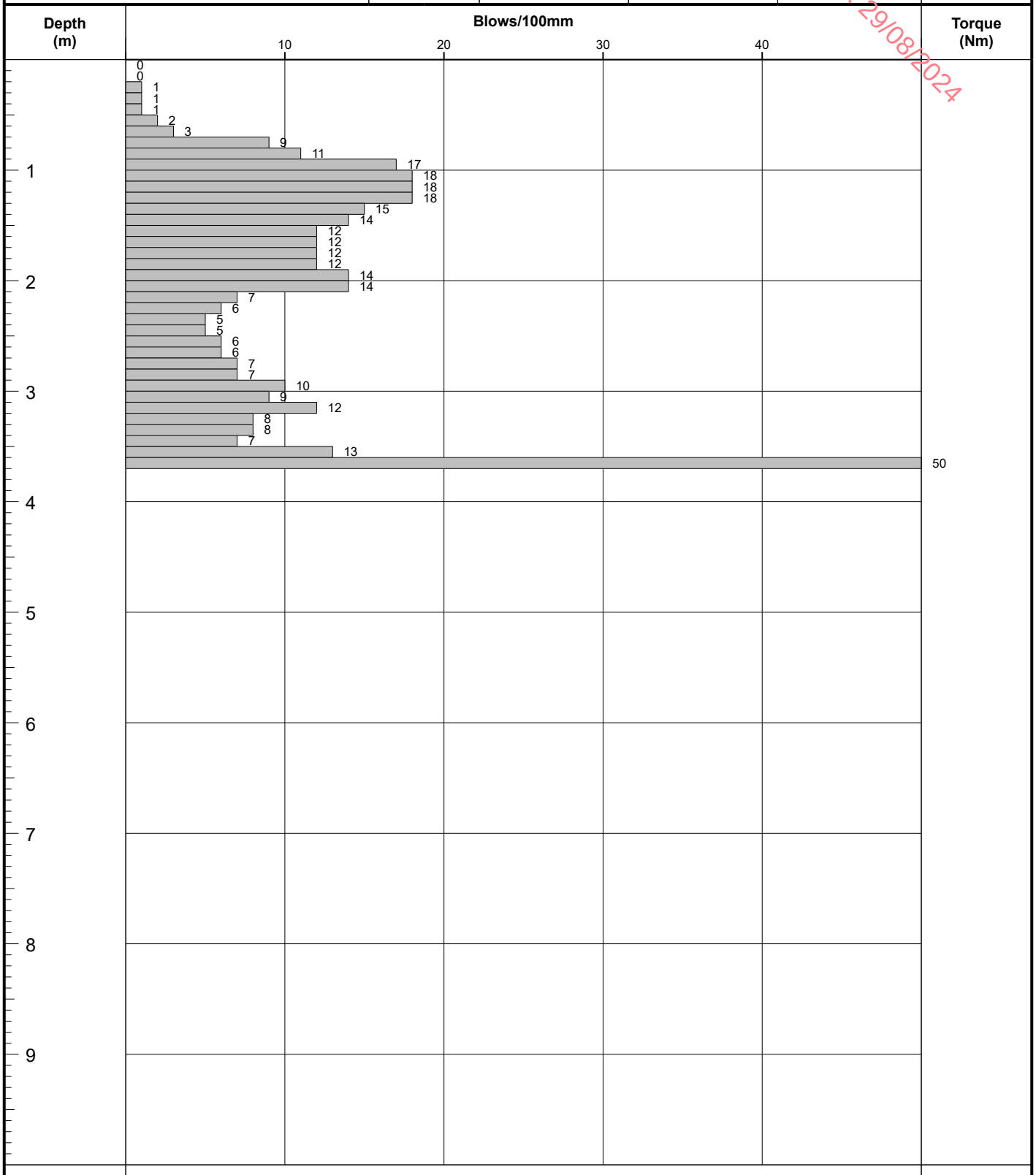


Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg			
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024	AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
23-1870	Lackareagh Wind Farm	DP-T7-01
Coordinates	**Client:**	
563493.13 E	MKO	
671842.74 N	**Client's Representative:** AFRY	Sheet 1 of 1
		Scale: 1:50

Method:	Probe Type:	Elevation	Final Depth:	Date:	Operator:	
Dynamic Probing	DPSH-B	202.54 mOD	3.60	28/01/2024	IC	FINAL



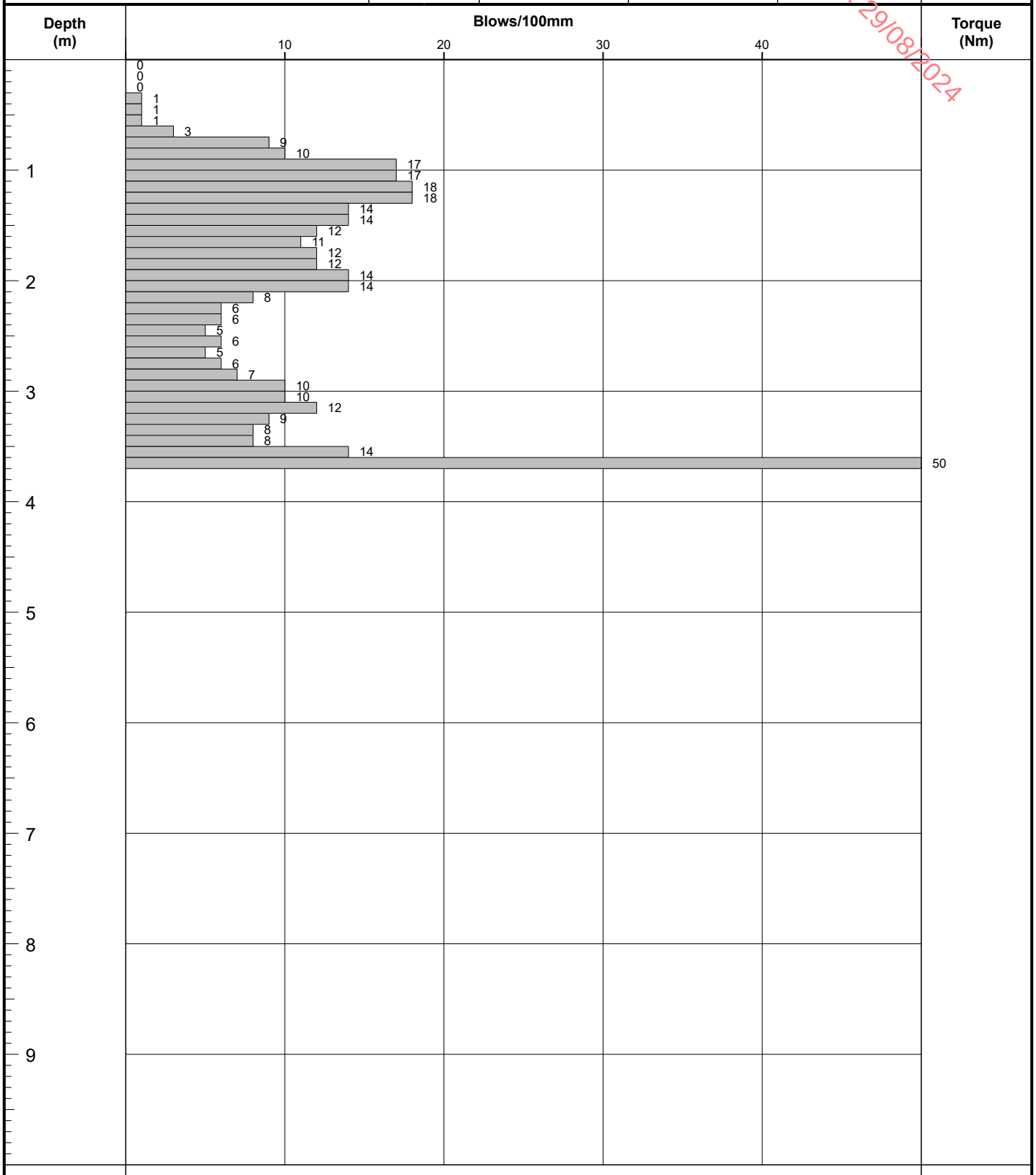
Fall Height:	Remarks
750 mm	
Hammer Mass: 63.5 kg	
Cone Diameter: 50.5 mm	**Termination Reason:** Terminated on refusal

Last Updated 20/03/2024

AGS

CAUSEWAY GEOTECH

Project No. 23-1870	**Project Name:** Lackareagh Wind Farm				**Probe ID** DP-T7-01A
Coordinates 563493.57 E 671843.18 N	**Client:** MKO				
Method: Dynamic Probing	**Client's Representative:** AFRY				Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** 202.55 mOD	**Final Depth:** 3.60	**Date:** 28/01/2024	**Operator:** IC	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 63.5 kg			
Cone Diameter: 50.5 mm	**Termination Reason** Terminated on refusal	**Last Updated** 20/03/2024	AGS

CAUSEWAY GEOTECH

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APPENDIX E

TRIAL PIT LOGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm	**Trial Pit ID** TP-MM-01
	Coordinates 562257.48 E 673271.87 N	**Client:** MKO	
Method: Trial Pitting		**Client's Representative:** AFRY	Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 141.94 mOD	**Date:** 12/12/2023	**Logger:** JAC — FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			141.74	0.20		TOPSOIL	
0.50	B1					Soft orangish brown sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse.	
0.50	D2						
			141.24	0.70		Firm light brown slightly sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is angular fine to coarse.	
1.50	B3						
1.50	D4		140.34	1.60		End of trial pit at 1.60m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 1.60
Width: 1.40
Length: 2.90

Remarks: No groundwater encountered

Stability: Stable

Termination Reason: Terminated at refusal on boulders / possible bedrock.

Last Updated: 21/03/2024

AGS

CAUSEWAY GEOTECH

Project No. 23-1870	**Project Name:** Lackareagh Wind Farm		**Trial Pit ID** TP-SC-01
Coordinates 563495.49 E 672475.21 N	**Client:** MKO		
Method: Trial Pitting	**Client's Representative:** AFRY		Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 247.68 mOD	**Date:** 24/01/2024	**Logger:** JAC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			247.48	0.20		TOPSOIL	
						Firm light brown slightly sandy very gravelly CLAY with low cobble and boulder content. Sand is fine to coarse. Gravel is subangular fine to coarse.	
1.00	B1						
1.00	D2						
		Light flow at 1.60m	246.08	1.60		End of trial pit at 1.60m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks
1.60	Light flow at 1.60m

Depth: 1.60
Width: 1.50
Length: 3.60

Remarks:

Stability: Stable

Termination Reason Terminated on virtual refusal

Last Updated 21/03/2024

AGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm	**Trial Pit ID** TP-SC-02
	Coordinates 563501.42 E 672514.45 N	**Client:** MKO	
Method: Trial Pitting		**Client's Representative:** AFRY	Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 253.79 mOD	**Date:** 24/01/2024	**Logger:** JAC FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			253.54	0.25		Peaty TOPSOIL	
1.00 1.00	B1 D2					Firm light brown sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse.	
			252.59	1.20		Brown sandy slightly silty angular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse.	
1.60 1.60	B3 D4						
		Seepage at 2.30m	251.49	2.30		End of trial pit at 2.30m	▼

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks
2.30	Seepage at 2.30m

Depth: 2.30
Width: 1.70
Length: 4.10

Remarks:

Stability: Stable

Termination Reason: Terminated on virtual refusal

Last Updated: 21/03/2024

AGS

CAUSEWAY GEOTECH

Project No. 23-1870	**Project Name:** Lackareagh Wind Farm		**Trial Pit ID** TP-SC-03
Coordinates 563563.63 E 672495.96 N	**Client:** MKO		
Method: Trial Pitting	**Client's Representative:** AFRY		Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 260.92 mOD	**Date:** 26/01/2024	**Logger:** JAC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			260.72	0.20		Peaty TOPSOIL	
1.00 1.00	B1 D2					Firm light brown slightly sandy gravelly SILT with low cobble and boulder content. Sand is fine to coarse. Gravel is subangular fine to coarse.	
			259.22	1.70		End of trial pit at 1.70m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 1.70
Width: 1.60
Length: 4.00

Remarks:
No groundwater encountered

Stability:
Unstable

Termination Reason
Terminated on virtual refusal

Last Updated
21/03/2024

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
23-1870	Lackareagh Wind Farm	TP-SC-04
Coordinates 563565.30 E 672543.35 N	**Client:** MKO	
Method: Trial Pitting	**Client's Representative:** AFRY	Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 265.07 mOD / **Date:** 24/01/2024 / **Logger:** JAC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			264.87	0.20		Peaty TOPSOIL	
		Light seepage at 0.40				Firm light brown sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to angular fine to coarse.	▼
1.00	B1						
1.00	D2						
			263.77	1.30		Light brown sandy clayey angular fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse.	
2.00	B3						
2.00	D4						
3.00	B5						
3.00	D6						
		Light seepage at 3.40m	261.67	3.40		End of trial pit at 3.40m	▼

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks
3.40	Light seepage at 3.40m
0.40	Light seepage at 0.40

Depth: 3.40
Width: 1.60
Length: 4.20

Remarks:

Stability: Stable

Termination Reason: Terminated on virtual refusal

Last Updated: 21/03/2024

AGS

CAUSEWAY GEOTECH

Project No. 23-1870	**Project Name:** Lackareagh Wind Farm		**Trial Pit ID** TP-SC-05
Coordinates 563610.47 E 672536.64 N	**Client:** MKO		
Method: Trial Pitting	**Client's Representative:** AFRY		Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 268.99 mOD	**Date:** 24/01/2024	**Logger:** JAC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			268.79	0.20		Peaty TOPSOIL	
1.00 1.00	B1 D2					Firm light brown slightly sandy very gravelly SILT with medium cobble and boulder content. Sand is fine to coarse. Gravel is subangular fine to coarse.	
			267.79	1.20		Stiff light brown sandy gravelly CLAY with medium cobble and boulder content. Sand is fine to coarse. Gravel is angular fine to coarse.	
2.00 2.00	B3 D4						
			266.29	2.70		End of trial pit at 2.70m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 2.70
Width: 1.50
Length: 4.30

Remarks:
No groundwater encountered

Stability:
Stable

Termination Reason
Terminated on virtual refusal

Last Updated
21/03/2024

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
23-1870	Lackareagh Wind Farm	TP-SC-06
Coordinates	**Client:** MKO	
563650.56 E 672578.40 N	**Client's Representative:** AFRY	Sheet 1 of 1 Scale: 1:25
Method: Trial Pitting		
Plant: 13t Tracked Excavator	**Elevation** 276.88 mOD	**Date:** 24/01/2024
		Logger: JAC
		FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
						Peaty TOPSOIL	
			276.48	0.40		Firm light brown slightly sandy very gravelly SILT with medium cobble and medium boulder content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.	
1.00	B1						
1.00	D2						
			275.68	1.20		Light brown sandy clayey subangular to subrounded fine to coarse GRAVEL with medium cobble and boulder content. Sand is fine to coarse.	
2.00	B3						
2.00	D4						
		Moderate flow at 2.20m	274.68	2.20		End of trial pit at 2.20m	▼

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes

Struck at (m)	Remarks
2.20	Moderate flow at 2.20m

Depth: 2.20
Width: 1.60
Length: 4.20

Remarks:

Stability: Unstable

Termination Reason: Terminated on virtual refusal

Last Updated: 21/03/2024

AGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm	**Trial Pit ID** TP-T1-01
	Coordinates 562208.01 E 673986.23 N	**Client:** MKO	
Method: Trial Pitting		**Client's Representative:** AFRY	Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 235.17 mOD	**Date:** 12/12/2023	**Logger:** JAC — FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			234.97	0.20		TOPSOIL	
0.50 0.50	B1 D2					Firm orangish brown sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse.	
			234.37	0.80		Stiff light brown slightly sandy gravelly CLAY with low cobble and boulder content. Sand is fine to coarse. Gravel is angular fine to coarse.	
1.50 1.50	B3 D4						
2.50 2.50	B5 D6						
			231.97	3.20		End of trial pit at 3.20m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 3.20
Width: 1.40
Length: 3.60

Remarks: No groundwater encountered

Stability: Stable

Termination Reason: Terminated at refusal on boulders / possible bedrock.

Last Updated: 21/03/2024

AGS

CAUSEWAY GEOTECH

Project No. 23-1870	**Project Name:** Lackareagh Wind Farm		**Trial Pit ID** TP-T2-01
Coordinates 562282.26 E 673586.76 N	**Client:** MKO		
Method: Trial Pitting	**Client's Representative:** AFRY		Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 187.10 mOD	**Date:** 13/12/2023	**Logger:** JAC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			186.90	0.20		TOPSOIL	
0.40	D2		186.70	0.40		Firm orangish brown sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse.	
0.50	B1					Stiff light brown sandy gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine to coarse.	
1.00	B3						
1.00	D4		185.90	1.20		End of trial pit at 1.20m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 1.20
Width: 1.40
Length: 3.30

Remarks: No groundwater encountered

Stability: Stable

Termination Reason: Terminated at refusal on boulders / possible bedrock.

Last Updated: 21/03/2024

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
23-1870	Lackareagh Wind Farm	TP-T3-01
Coordinates	**Client:** MKO	
564007.76 E 673278.88 N	**Client's Representative:** AFRY	Sheet 1 of 1 Scale: 1:25
Method: Trial Pitting		
Plant: 13t Tracked Excavator	**Elevation** 364.65 mOD	**Date:** 11/12/2023 — **Logger:** JAC — FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
						TOPSOIL with roots and rootlets	
			364.30	0.35		Orangish brown sandy silty angular fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse.	
0.70	B1						
0.70	D2		363.85	0.80		Brownish sandy angular fine to coarse GRAVEL of greywacke with high cobble content. Sand is fine to coarse. Cobbles are angular of greywacke. (Possible weathered bedrock)	
1.70	B3						
1.70	D4						
			362.35	2.30		End of trial pit at 2.30m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 2.30
Width: 2.00
Length: 4.20

Remarks: No groundwater encountered

Stability: Unstable

Termination Reason: Terminated at refusal on boulders / possible bedrock.

Last Updated: 21/03/2024

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
23-1870	Lackareagh Wind Farm	TP-T4-01
Coordinates 563886.60 E 672683.32 N	**Client:** MKO	
Method: Trial Pitting	**Client's Representative:** AFRY	Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 276.38 mOD / **Date:** 11/12/2023 / **Logger:** JAC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
						Brown peaty TOPSOIL with roots and rootlets	
			275.98	0.40			
0.60 0.60	B1 D2					Soft light brownish grey sandy gravelly SILT with low cobble and boulder content. Sand is fine to coarse. Gravel is angular fine to coarse.	
			275.18	1.20		End of trial pit at 1.20m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 1.20
Width: 1.10
Length: 3.80

Remarks:
No groundwater encountered

Stability:
Unstable

Termination Reason
Terminated at refusal on boulders / possible bedrock.

Last Updated
21/03/2024

AGS

CAUSEWAY GEOTECH

Project No. 23-1870	**Project Name:** Lackareagh Wind Farm		**Trial Pit ID** TP-T5-01
Coordinates 563977.48 E 672336.61 N	**Client:** MKO		
Method: Trial Pitting	**Client's Representative:** AFRY		Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 301.59 mOD	**Date:** 24/01/2024	**Logger:** JAC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			301.39	0.20		TOPSOIL	
1.00	B1					Firm orangish brown slightly sandy very gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse.	
1.00	D2						
			300.09	1.50		Brown slightly sandy angular fine to coarse GRAVEL of greywacke with high cobble content. Sand is fine to coarse. Cobbles are angular of greywacke. (Possible weathered bedrock)	
1.70	B3						
			299.69	1.90		End of trial pit at 1.90m	

Water Strikes	
Struck at (m)	Remarks

Depth: 1.90
Width: 1.50
Length: 3.40

Remarks:
No groundwater encountered

Stability:
Stable

Termination Reason
Terminated on virtual refusal

Last Updated
21/03/2024

AGS

CAUSEWAY GEOTECH

Project No. 23-1870	**Project Name:** Lackareagh Wind Farm		**Trial Pit ID** TP-T6-01
Coordinates 563314.91 E 672289.52 N	**Client:** MKO		
Method: Trial Pitting	**Client's Representative:** AFRY		Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 203.45 mOD	**Date:** 12/12/2023	**Logger:** JAC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			203.25	0.20		TOPSOIL	
0.50 0.50	B1 D2					Firm orangish brown slightly sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse.	
			202.15	1.30		Stiff brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is angular fine to coarse.	
1.50 1.50	B3 D4						
2.50 2.50	B5 D6						
			200.25	3.20		End of trial pit at 3.20m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks

Depth: 3.20
Width: 1.40
Length: 3.40

Remarks:
No groundwater encountered

Stability:
Stable

Termination Reason
Terminated at refusal on boulders / possible bedrock.

Last Updated
21/03/2024

AGS

CAUSEWAY GEOTECH	**Project No.** 23-1870	**Project Name:** Lackareagh Wind Farm	**Trial Pit ID** TP-T7-01
	Coordinates 563391.33 E 671880.53 N	**Client:** MKO	
Method: Trial Pitting		**Client's Representative:** AFRY	Sheet 1 of 1 Scale: 1:25
Plant: 13t Tracked Excavator	**Elevation** 204.79 mOD	**Date:** 13/12/2023	**Logger:** JAC — FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			204.69	0.10		TOPSOIL	
						Firm orangish brown sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse.	
0.50	B1						
0.50	D2		204.19	0.60		Light brown sandy silty angular fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse.	
1.50	B3						
1.50	D4						
		Seepage at 1.80m	202.99	1.80		Stiff light brown slightly sandy very gravelly silty CLAY with low cobble and boulder content. Sand is fine to coarse. Gravel is angular fine to coarse.	▼
2.50	B5						
2.50	D6						
			201.59	3.20		End of trial pit at 3.20m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks
1.80	Seepage at 1.80m

Depth: 3.20
Width: 1.40
Length: 3.50

Remarks:

Stability: Unstable

Termination Reason: Terminated at refusal on boulders / possible bedrock.

Last Updated: 21/03/2024

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CAUSEWAY GEOTECH

RECEIVED: 29/08/2024

APPENDIX F

TRIAL PIT PHOTOGRAPHS

Trial Pit TP-MM-01

Trial Pit TP-MM-01

Trial Pit TP-MM-01

Trial Pit TP-MM-01

Trial Pit TP-SC-01

Trial Pit TP-SC-01

Trial Pit TP-SC-01

Trial Pit TP-SC-02

Trial Pit TP-SC-02

Trial Pit TP-SC-02

Trial Pit TP-SC-03

Trial Pit TP-SC-03

Trial Pit TP-SC-03

Trial Pit TP-SC-04

Trial Pit TP-SC-04

Trial Pit TP-SC-04

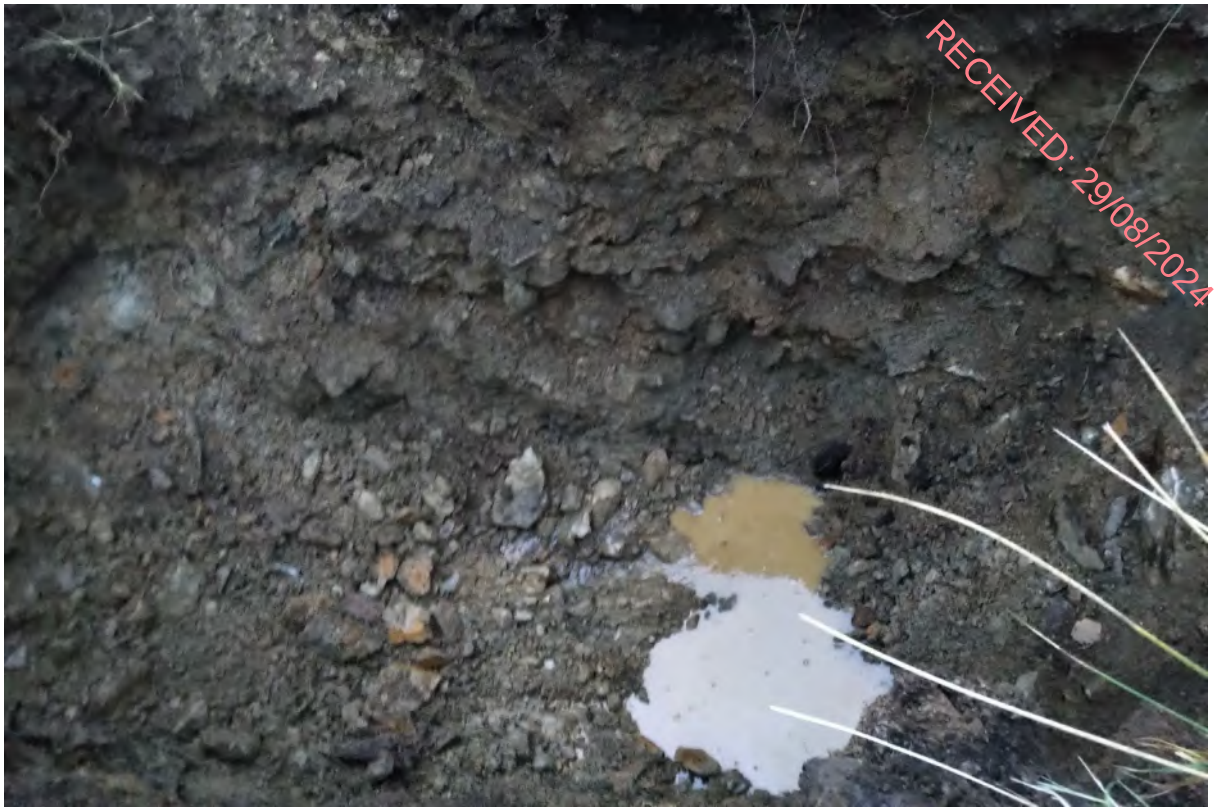
Trial Pit TP-SC-05

Trial Pit TP-SC-05

Trial Pit TP-SC-05

Trial Pit TP-SC-05

Trial Pit TP-SC-06



Trial Pit TP-SC-06

Trial Pit TP-SC-06

Trial Pit TP-T1-01

Trial Pit TP-T1-01

Trial Pit TP-T1-01

Trial Pit TP-T1-01

Trial Pit TP-T2-01

Trial Pit TP-T2-01

Trial Pit TP-T2-01

Trial Pit TP-T3-01

Trial Pit TP-T3-01

Trial Pit TP-T3-01

Trial Pit TP-T3-01

Trial Pit TP-T4-01

Trial Pit TP-T4-01

Trial Pit TP-T4-01

Trial Pit TP-T4-01

Trial Pit TP-T5-01

Trial Pit TP-T5-01

Trial Pit TP-T5-01

Trial Pit TP-T5-01

Trial Pit TP-T6-01

Trial Pit TP-T6-01

Trial Pit TP-T6-01

Trial Pit TP-T6-01

Trial Pit TP-T7-01

Trial Pit TP-T7-01

Trial Pit TP-T7-01

Trial Pit TP-T7-01

CAUSEWAY GEOTECH

RECEIVED: 29/08/2024

APPENDIX G

INDIRECT IN-SITU CBR TEST RESULTS

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

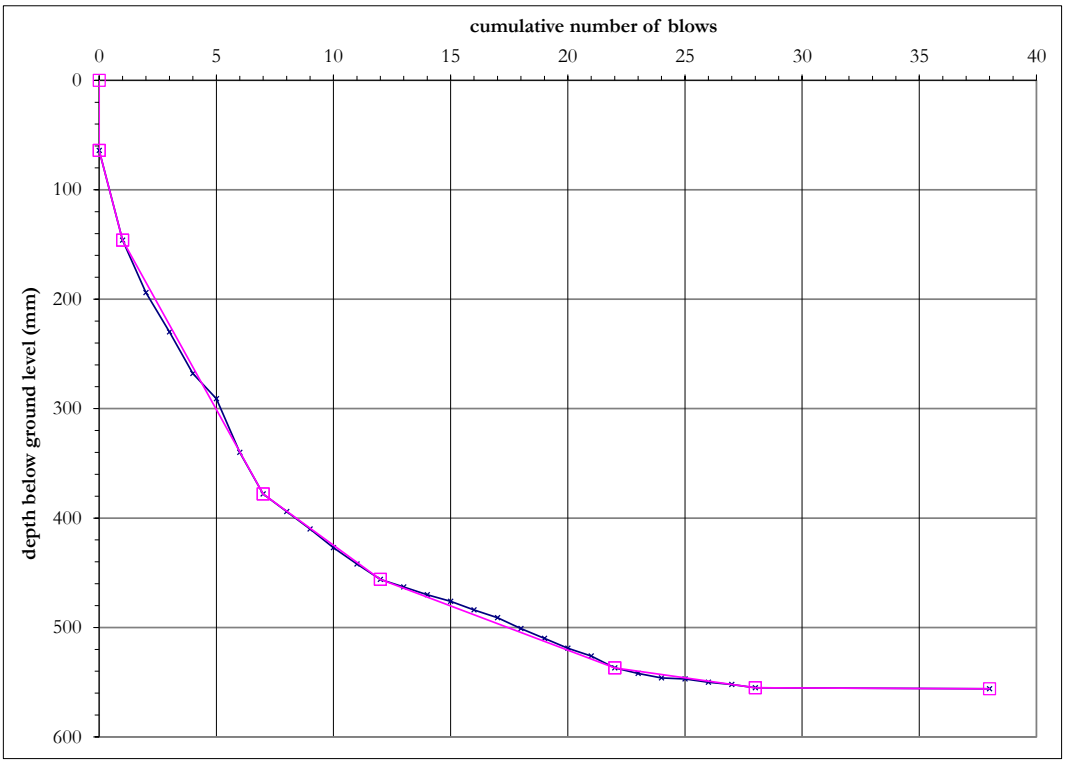
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP01
Depth bgl (m)	0.00

Date Tested	12/12/2023
Weather	Rain

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
64		
64	82	2.9
146		
146	39	6.3
378		
378	16	17
456		
456	8.1	33
537		
537	3	95
555		
555	0.1	>100
556		

CBR Range	Min: 2.9 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

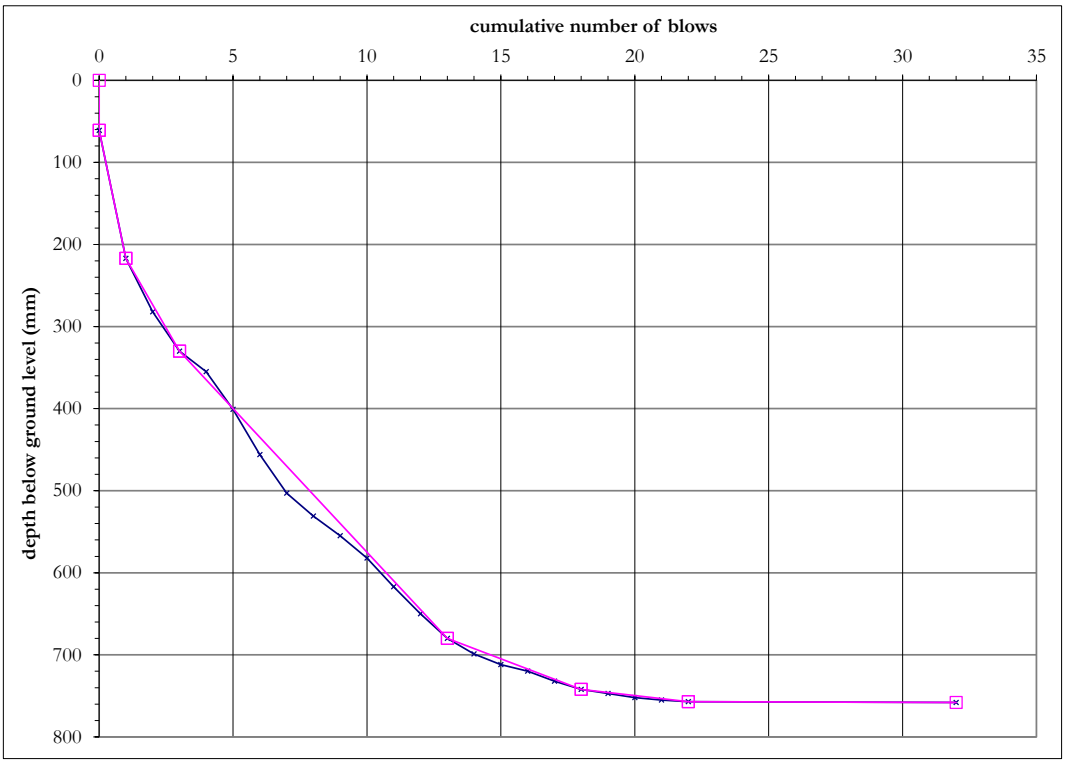
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP02
Depth bgl (m)	0.00

Date Tested	12/12/2023
Weather	Rain

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
61		
61	156	1.5
217		
217	57	4.2
330		
330	35	7
680		
680	12	21
742		
742	3.8	75
757		
757	0.1	>100
758		

CBR Range	Min: 1.5 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

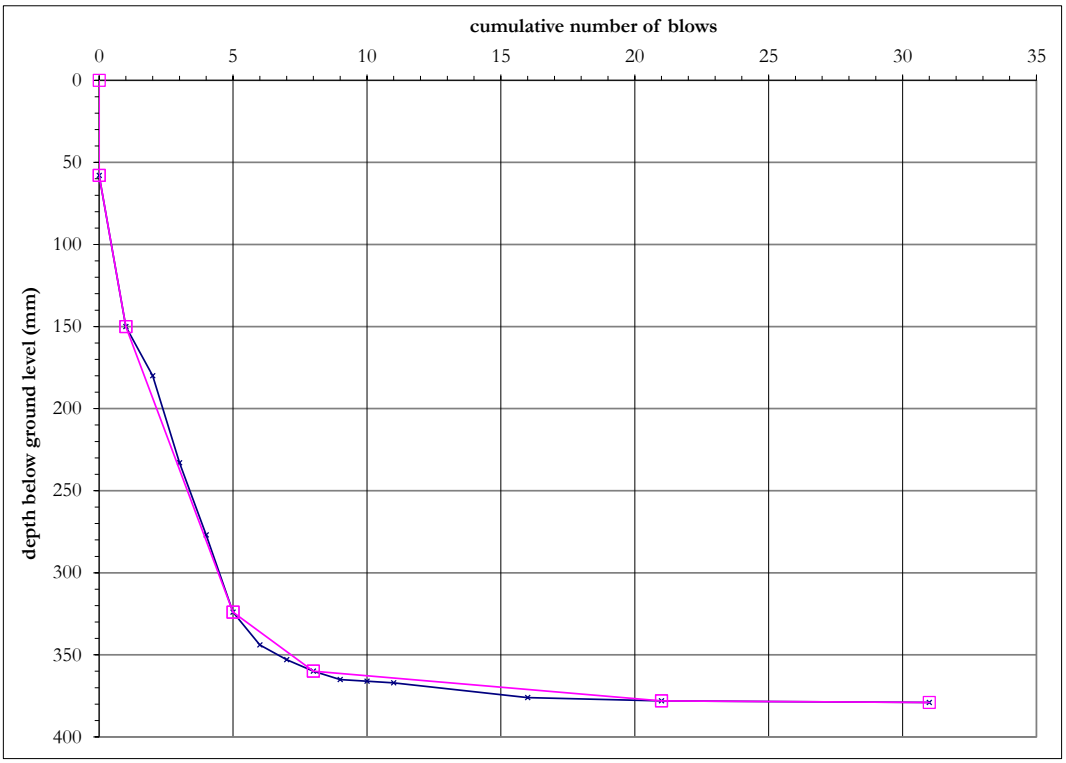
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP03
Depth bgl (m)	0.00

Date Tested	12/12/2023
Weather	Rain

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
58		
58	92	2.5
150		
150	44	5.6
324		
324	12	22
360		
360	1.4	>100
378		
378	0.1	>100
379		

CBR Range	Min: 2.5 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

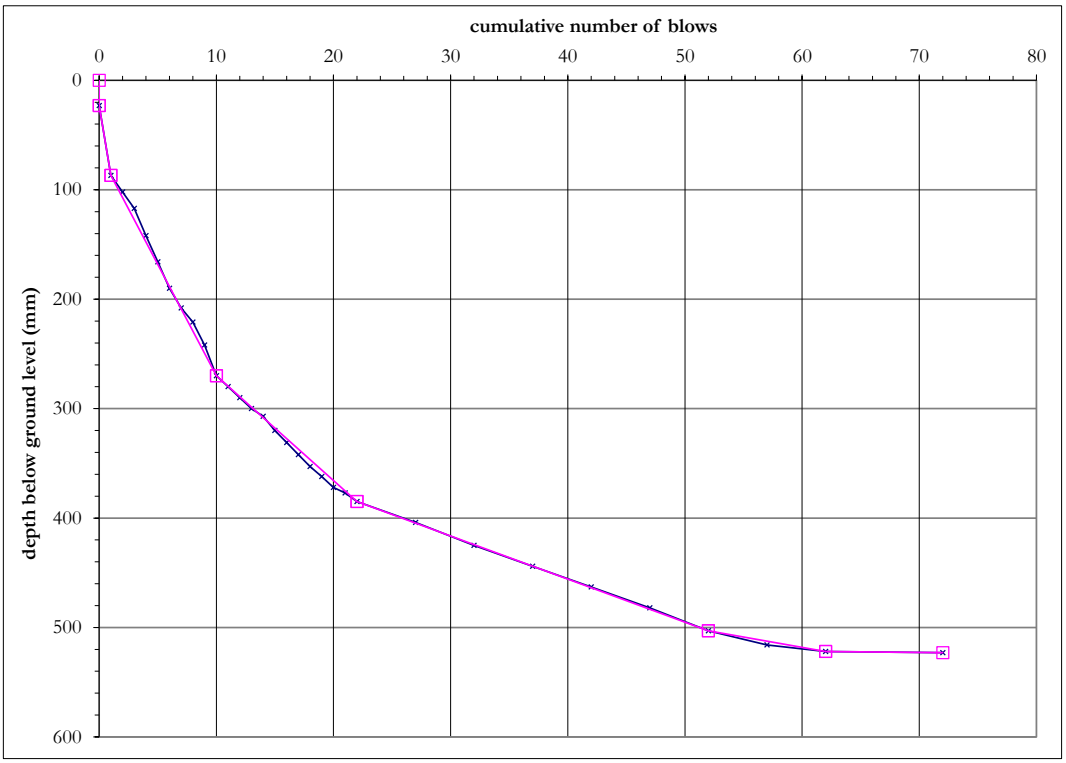
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP04
Depth bgl (m)	0.00

Date Tested	12/12/2023
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
23		
23	64	3.7
87		
87	20	13
270		
270	9.6	28
385		
385	3.9	71
503		
503	1.9	>100
522		
522	0.1	>100
523		

CBR Range	Min: 3.7 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

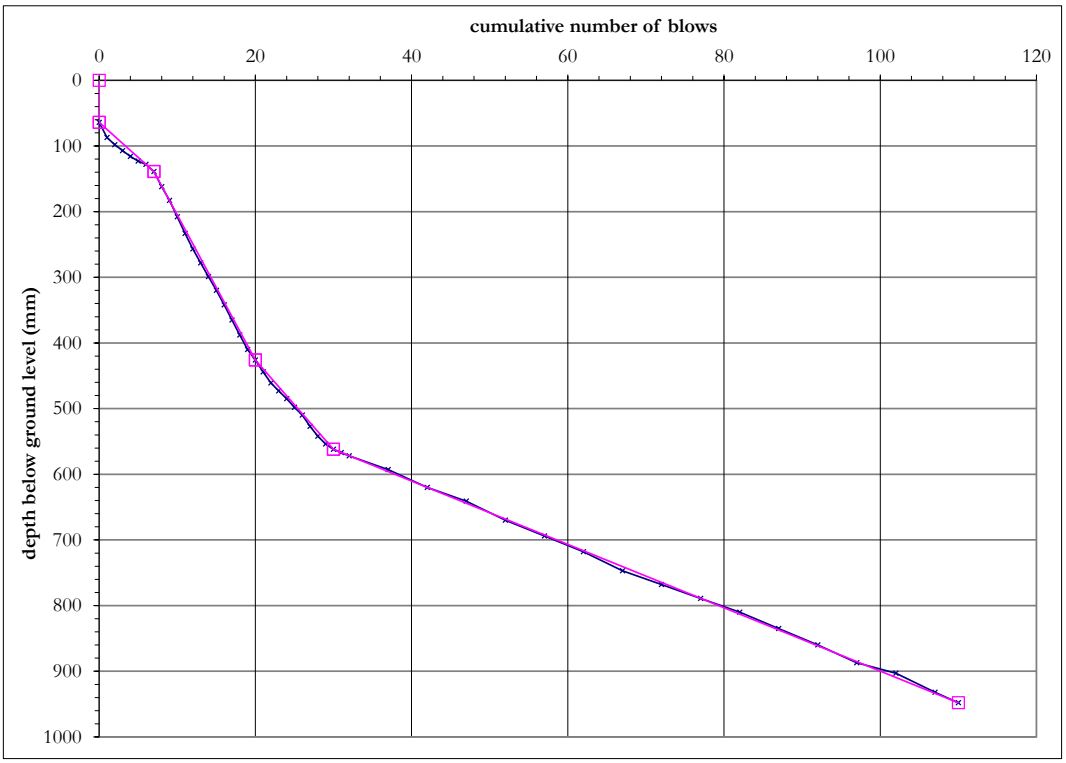
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP05
Depth bgl (m)	0.00

Date Tested	12/12/2023
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
64		
64	11	25
139		
139	22	11
426		
426	14	19
562		
562	4.8	57
948		

CBR Range	Min: 11 Max: 57	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

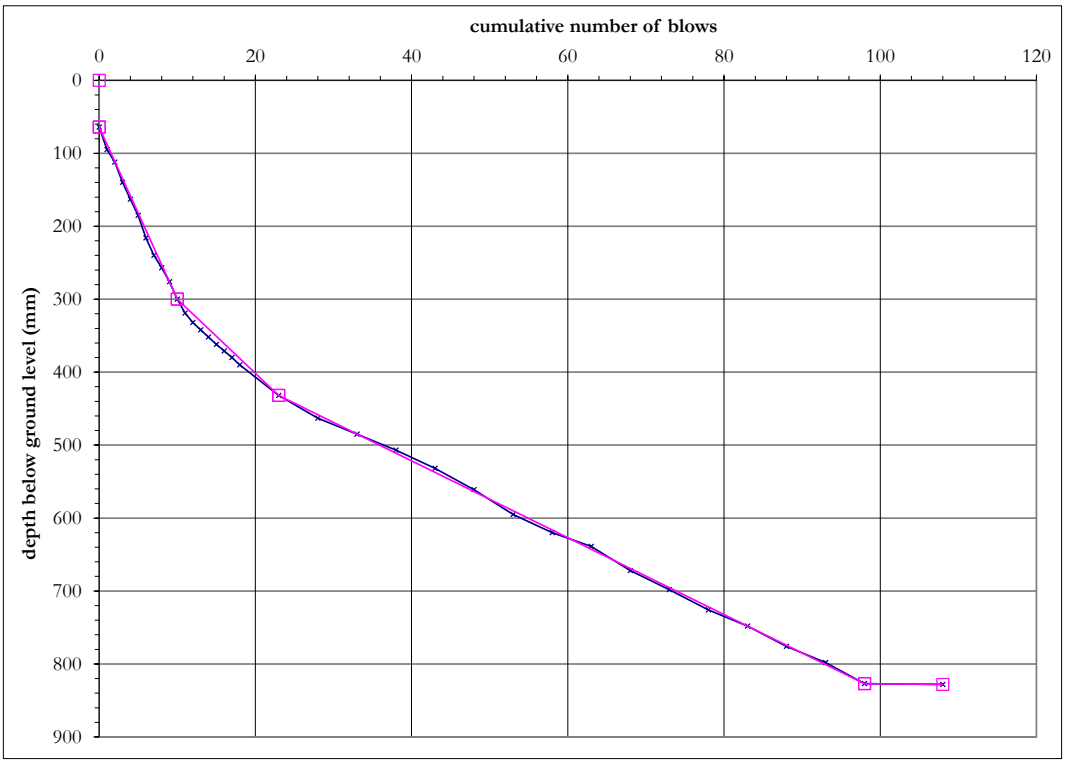
CAUSEWAY GEOTECH

Test Number	DCP06
Depth bgl (m)	0.00

Date Tested	12/12/2023
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	**Description of surface material at test depth**
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
64		
64	24	11
300		
300	10	26
432		
432	5.3	52
827		
827	0.1	>100
828		

CBR Range	Min: 11 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

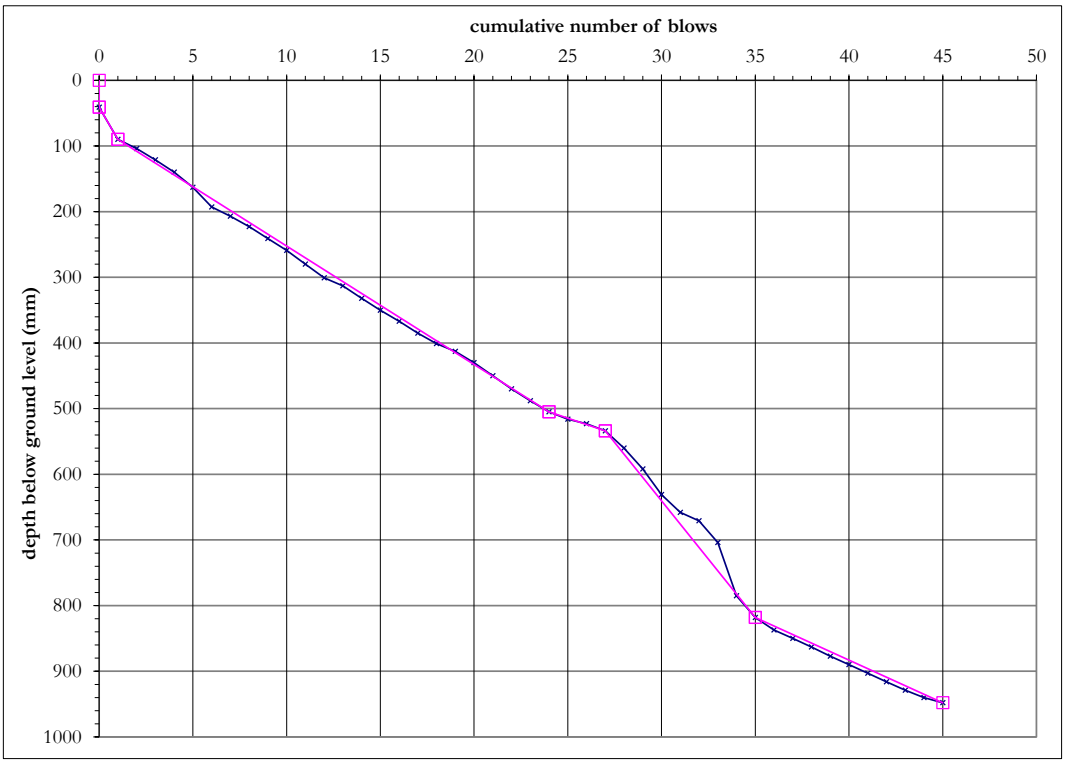
CAUSEWAY GEOTECH

Test Number	DCP07
Depth bgl (m)	0.00

Date Tested	12/12/2023
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	GRAVEL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
41		
41	49	4.9
90		
90	18	14
505		
505	9.7	27
534		
534	36	6.9
818		
818	13	20
948		

CBR Range	Min: 4.9 Max: 27	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

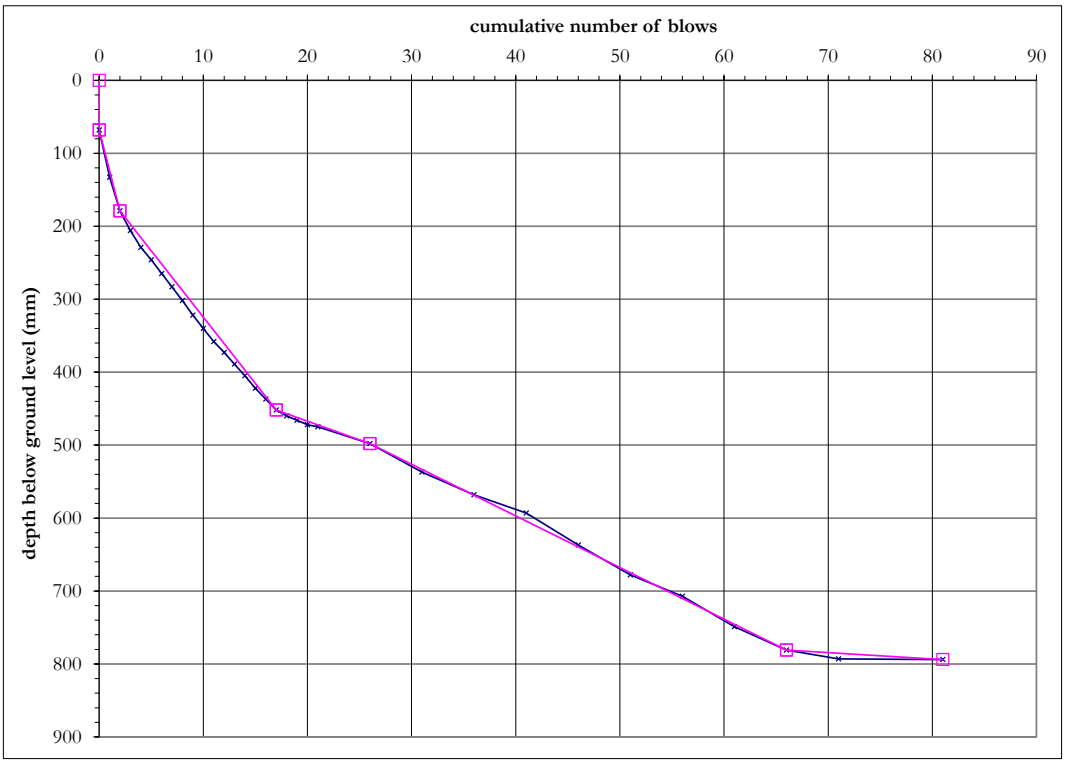
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP08
Depth bgl (m)	0.00

Date Tested	13/12/2023
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
68		
68	56	4.3
179		
179	18	14
452		
452	5.1	54
498		
498	7.1	38
781		
781	0.9	>100
794		

CBR Range	Min: 4.3 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

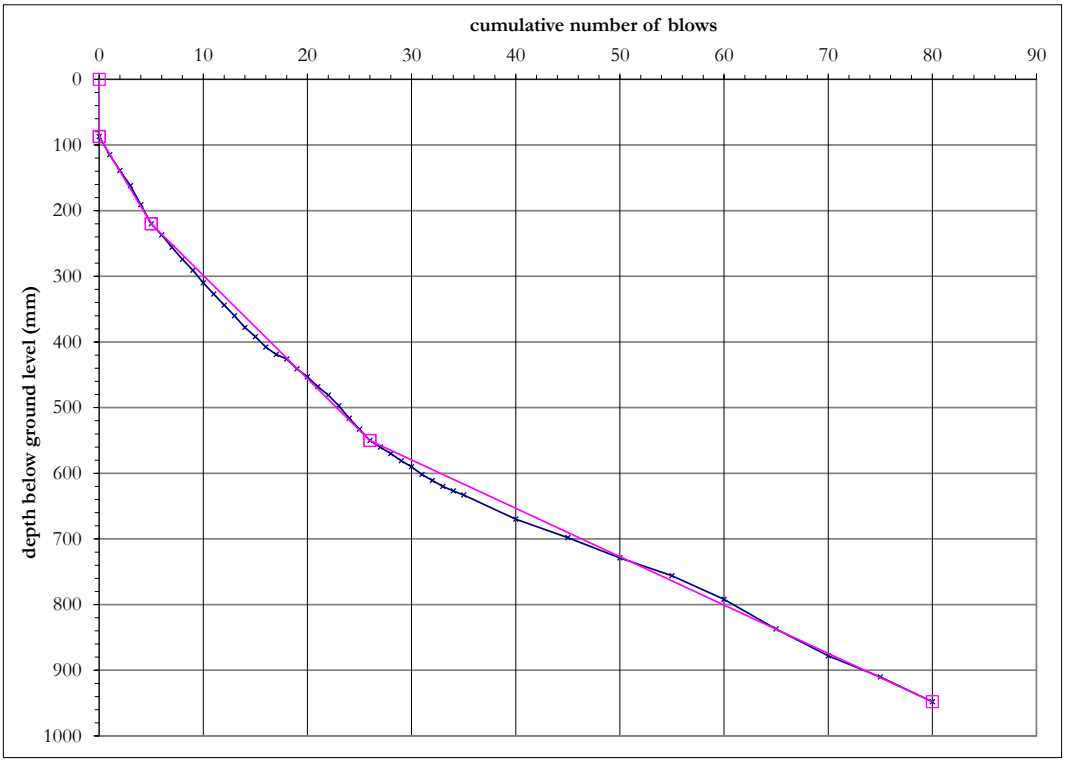
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP09
Depth bgl (m)	0.00

Date Tested	13/12/2023
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
87		
87	27	9.4
220		
220	16	16
550		
550	7.4	37
948		

CBR Range	Min: 9.4 Max: 37	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

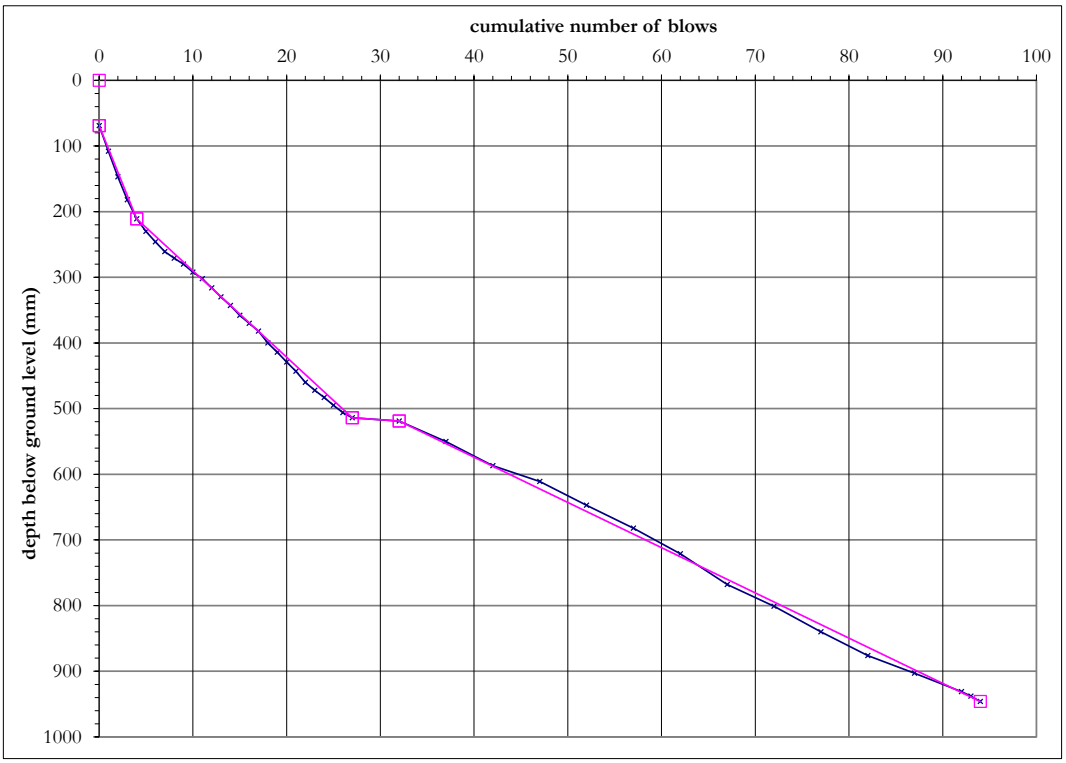
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP10
Depth bgl (m)	0.00

Date Tested	13/12/2023
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
69		
69	36	6.9
211		
211	13	20
514		
514	1	>100
519		
519	6.9	39
946		

CBR Range	Min: 6.9 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

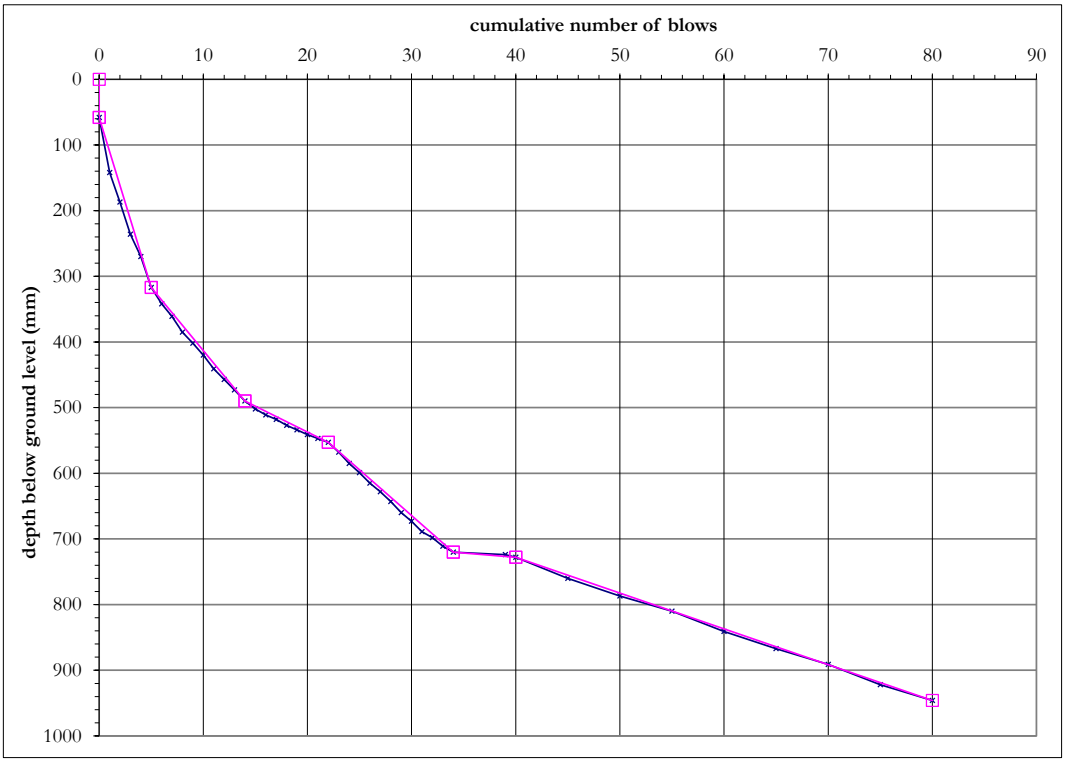
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP11
Depth bgl (m)	0.00

Date Tested	13/12/2023
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	**Description of surface material at test depth**
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
58		
58	52	4.7
317		
317	19	13
490		
490	7.9	34
553		
553	14	19
720		
720	1.3	>100
728		
728	5.5	50
946		

CBR Range	Min: 4.7 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

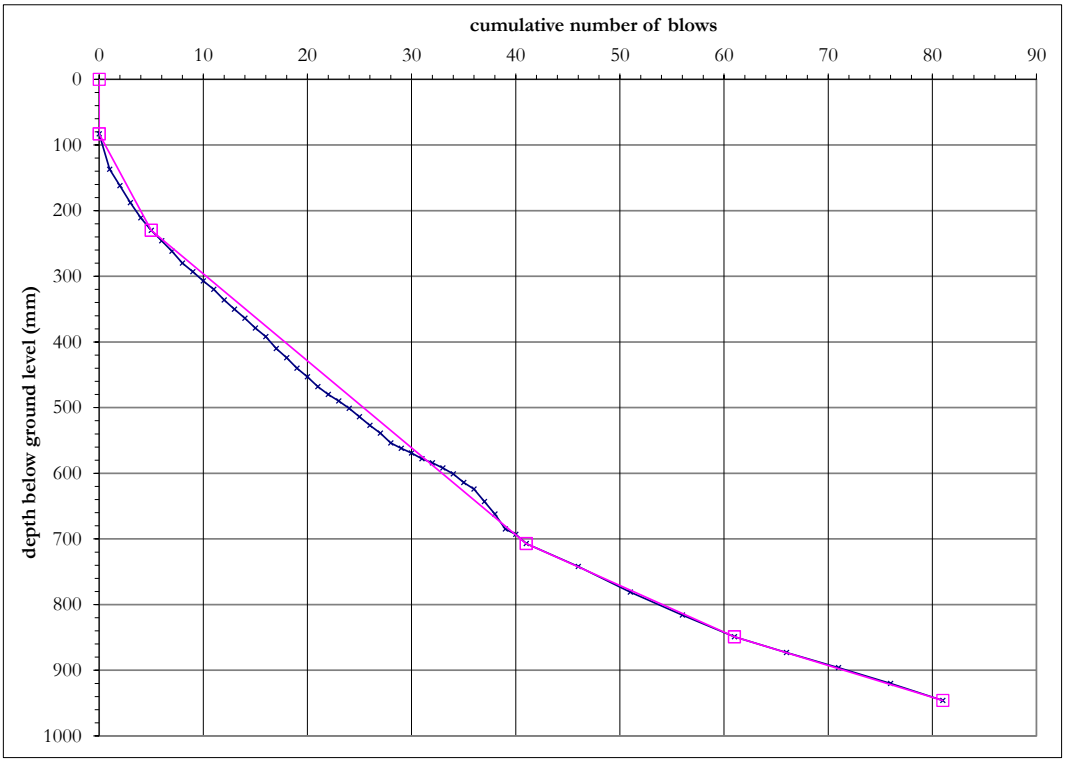
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP12
Depth bgl (m)	0.00

Date Tested	13/12/2023
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
83		
83	29	8.5
230		
230	13	20
707		
707	7.1	38
849		
849	4.9	57
946		

CBR Range	Min: 8.5 Max: 57	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

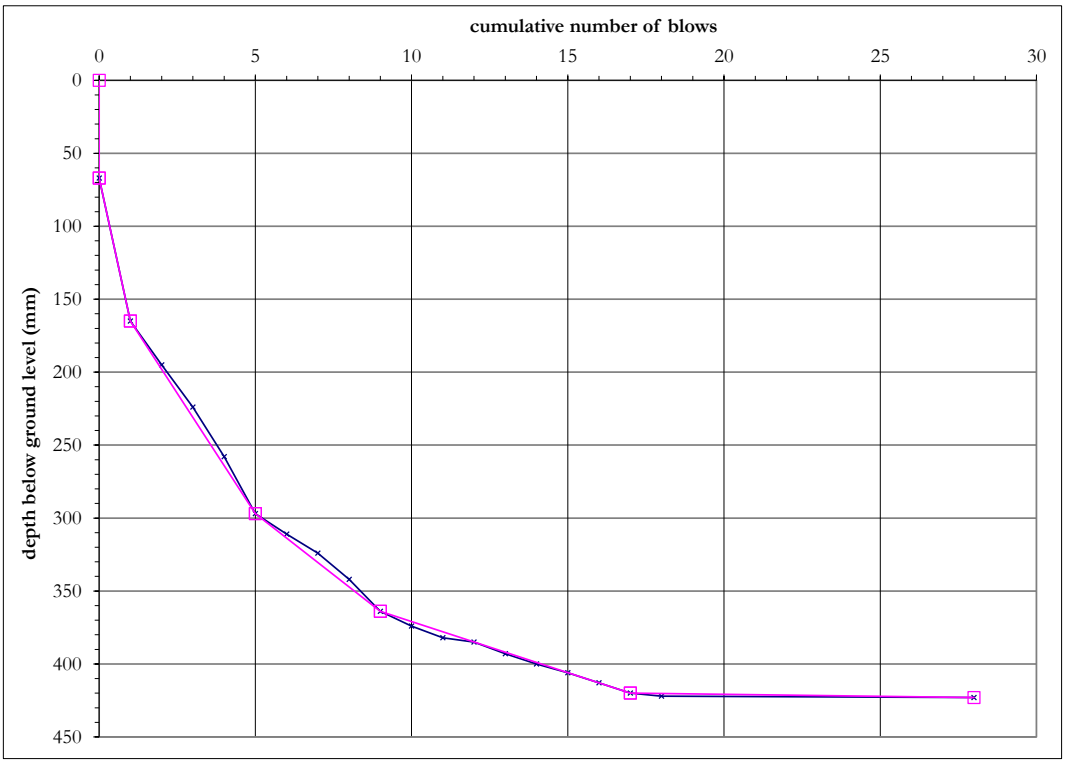
CAUSEWAY GEOTECH

Test Number	DCP13
Depth bgl (m)	0.00

Date Tested	12/12/2023
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	GRAVEL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
67		
67	98	2.4
165		
165	33	7.5
297		
297	17	15
364		
364	7	39
420		
420	0.3	>100
423		

CBR Range	Min: 2.4 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

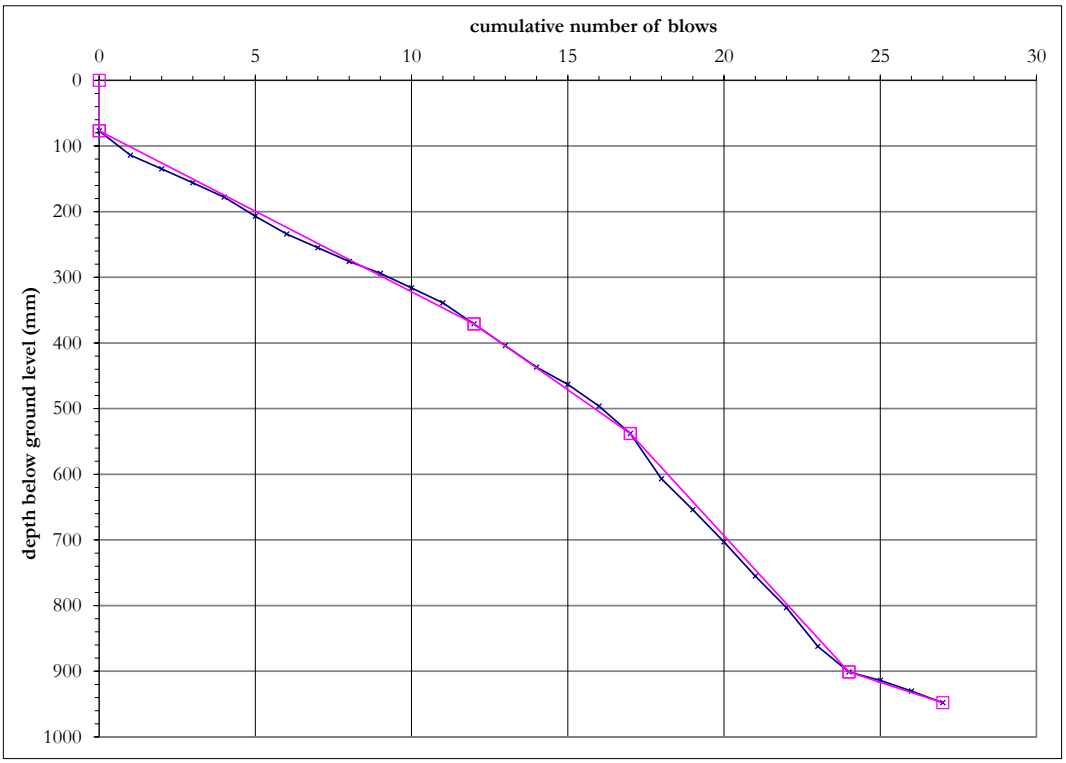
CAUSEWAY GEOTECH

Test Number	DCP14
Depth bgl (m)	0.00

Date Tested	12/12/2023
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	GRAVEL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
77		
77	25	10
371		
371	33	7.4
538		
538	52	4.6
901		
901	16	16
948		

CBR Range	Min: 4.6 Max: 16	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

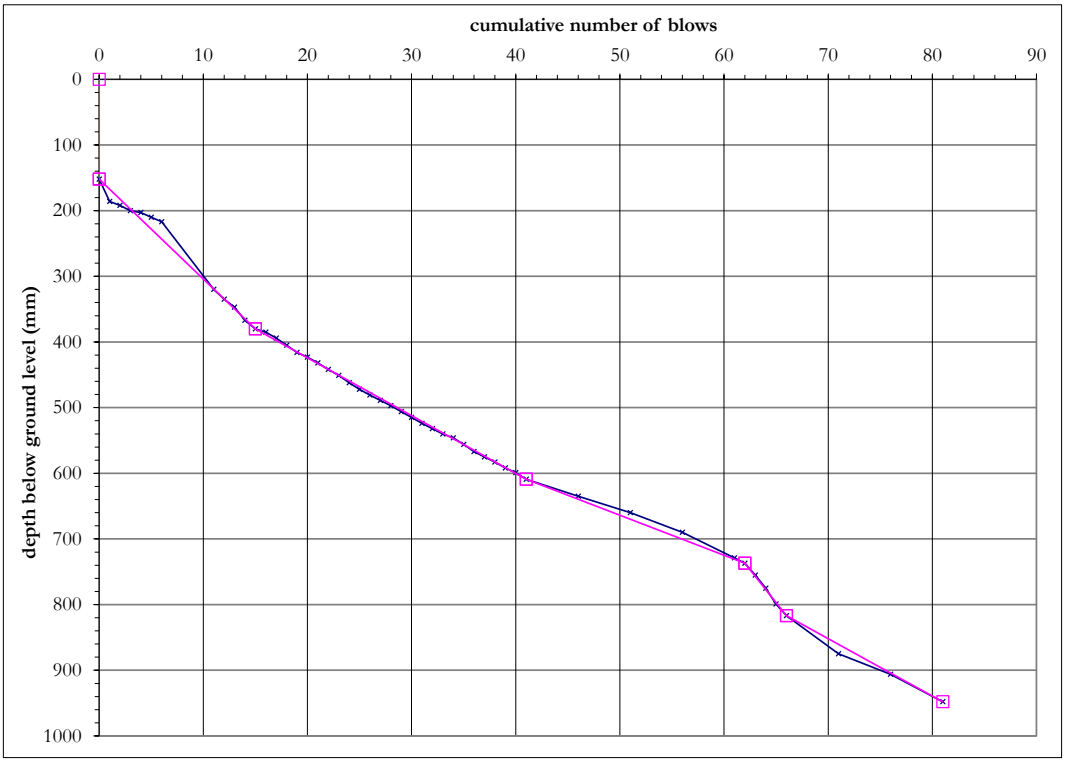
CAUSEWAY GEOTECH

Test Number	DCP15
Depth bgl (m)	0.00

Date Tested	13/12/2023
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
152		
152	15	17
380		
380	8.8	30
609		
609	6.1	45
737		
737	20	13
817		
817	8.7	31
948		

CBR Range	Min: 13 Max: 45	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

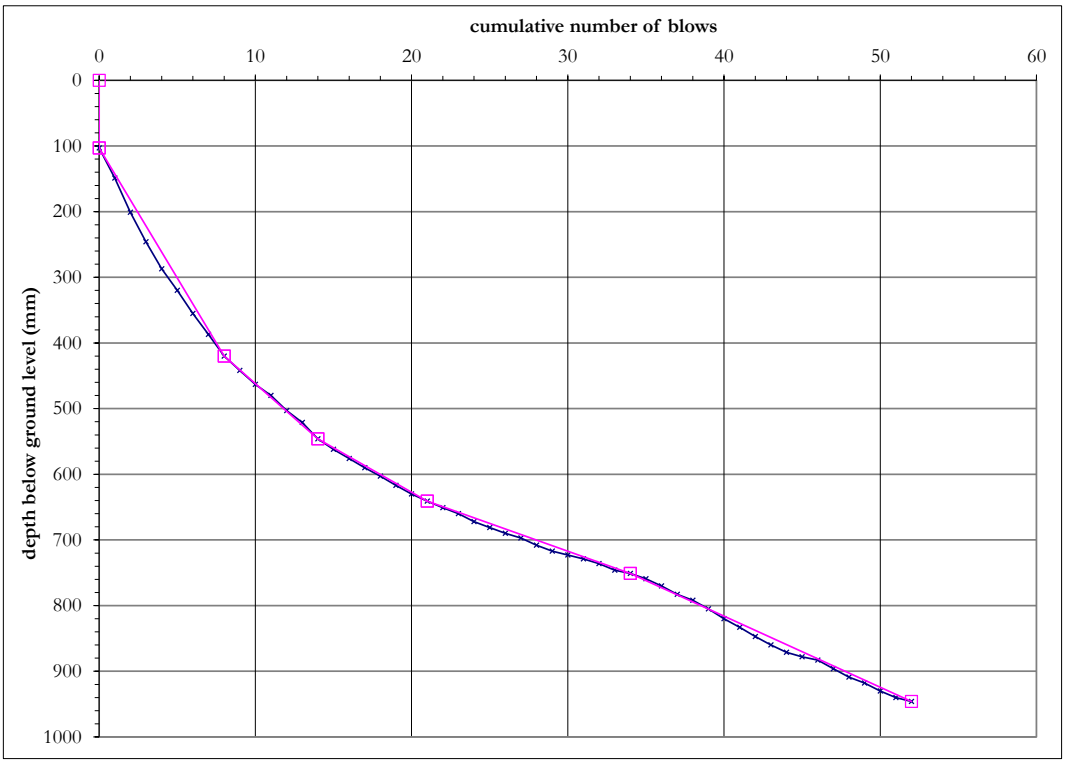
CAUSEWAY GEOTECH

Test Number	DCP16
Depth bgl (m)	0.00

Date Tested	13/12/2023
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
103		
103	40	6.2
420		
420	21	12
546		
546	14	19
641		
641	8.5	32
751		
751	11	24
946		

CBR Range	Min: 6.2 Max: 32	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

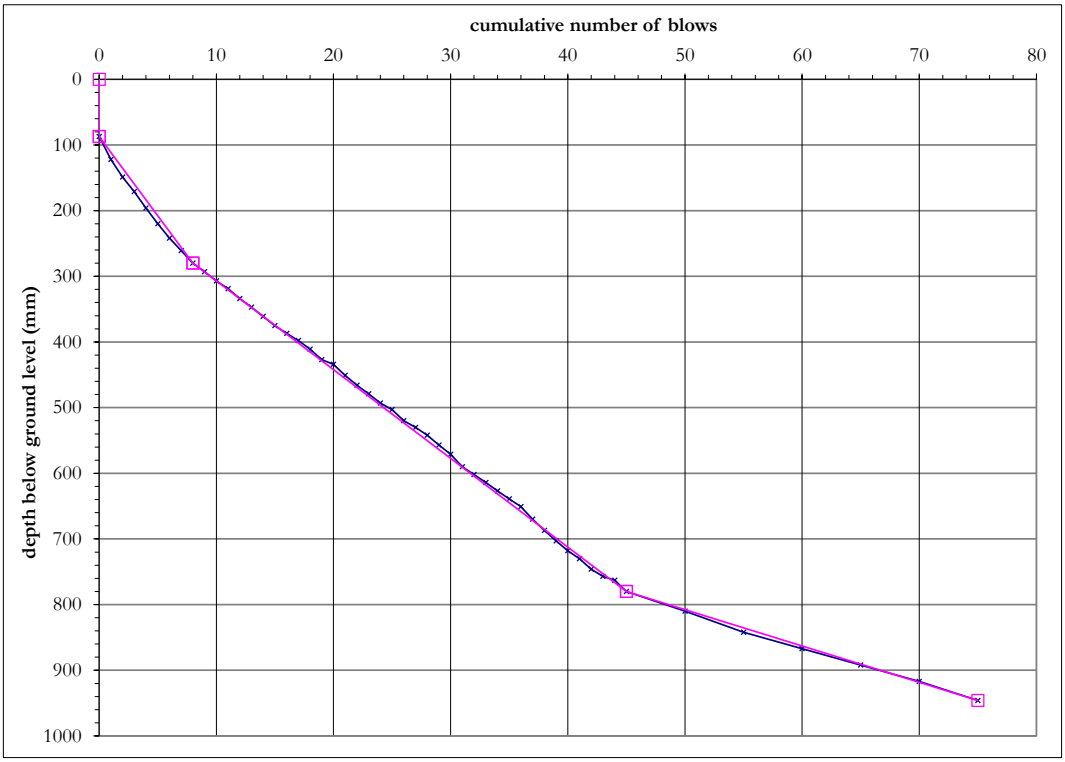
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP17
Depth bgl (m)	0.00

Date Tested	13/12/2023
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
87		
87	24	10
280		
280	14	19
780		
780	5.5	50
946		

CBR Range	Min: 10 Max: 50	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

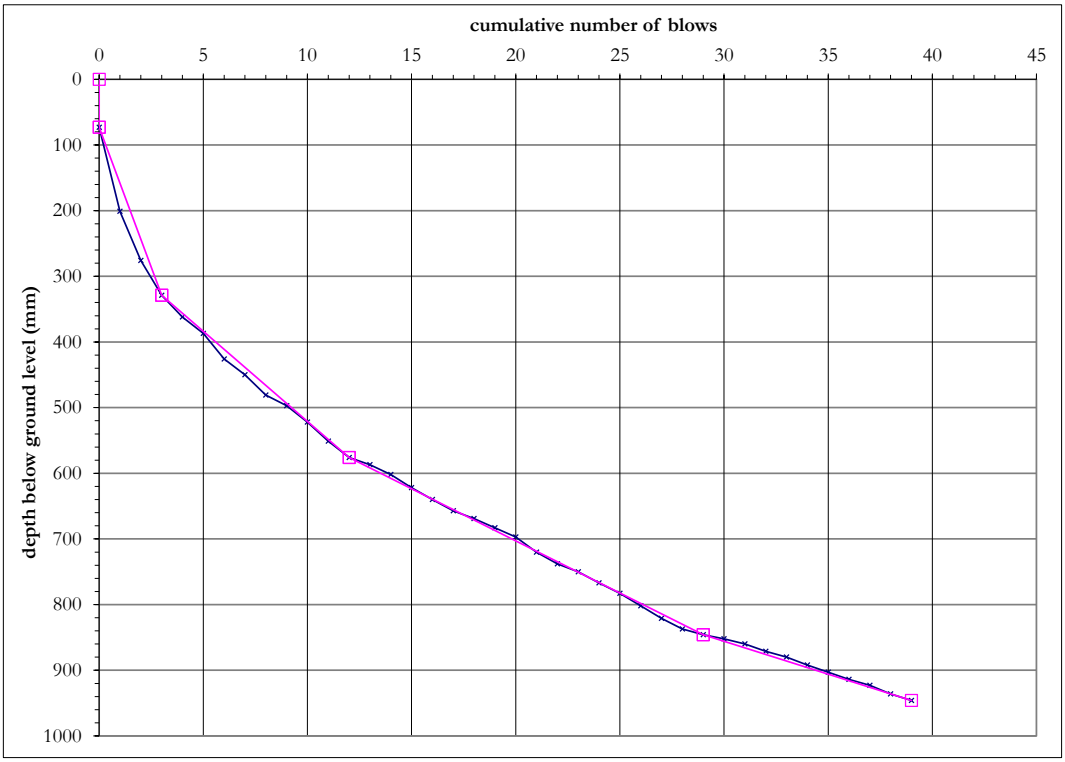
Project Number	23-1890
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP18
Depth bgl (m)	0.00

Date Tested	25/01/2024
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
73		
73	85	2.7
329		
329	27	9.1
576		
576	16	16
846		
846	10	26
946		

CBR Range	Min: 2.7 Max: 26	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		February 2024

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

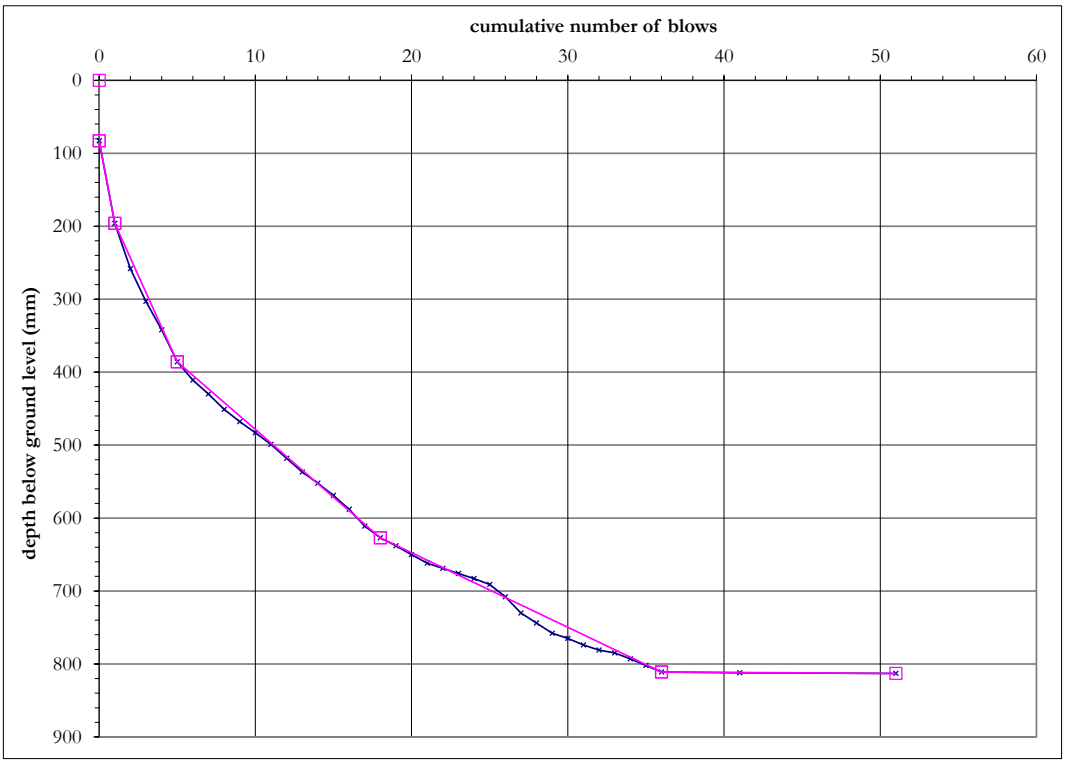
Project Number	23-1890
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP19
Depth bgl (m)	0.00

Date Tested	25/01/2024
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
83		
83	113	2
196		
196	48	5.1
386		
386	19	14
627		
627	10	26
811		
811	0.1	>100
813		

CBR Range	Min: 2 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		February 2024

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

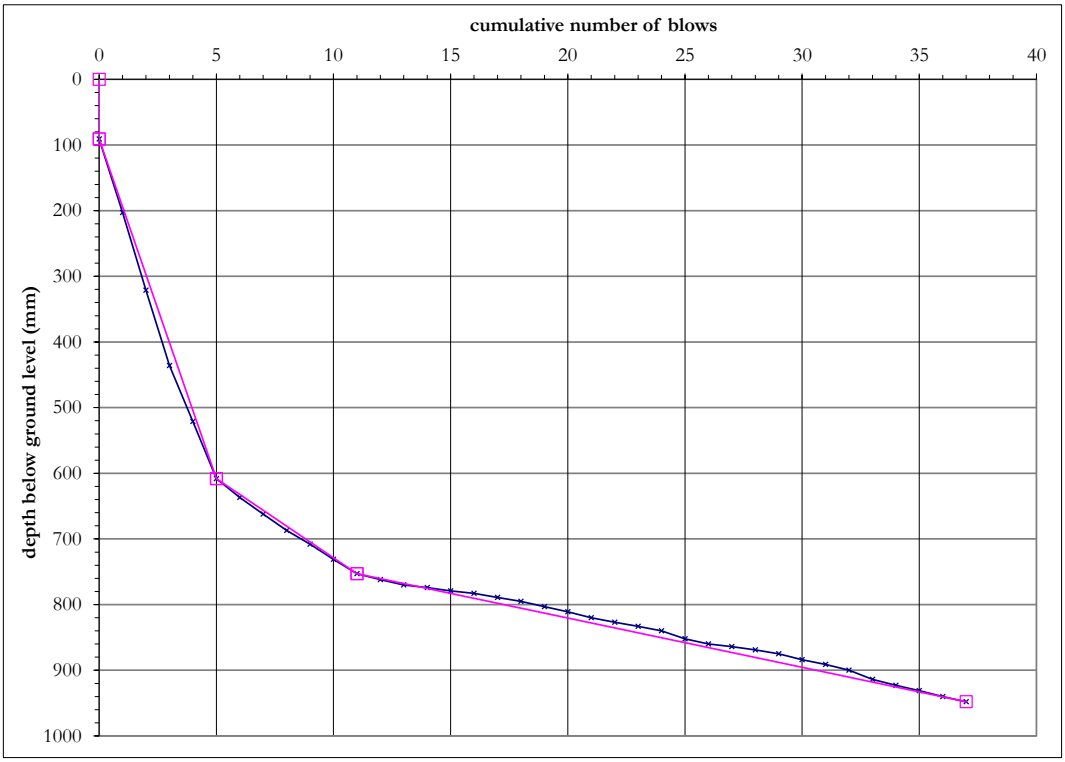
Project Number	23-1890
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP20
Depth bgl (m)	0.00

Date Tested	25/01/2024
Weather	Dry

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	**Description of surface material at test depth**
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
91		
91	103	2.2
608		
608	24	10
753		
753	7.5	36
948		

CBR Range	Min: 2.2 Max: 36	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		February 2024

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project Number	23-1890
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

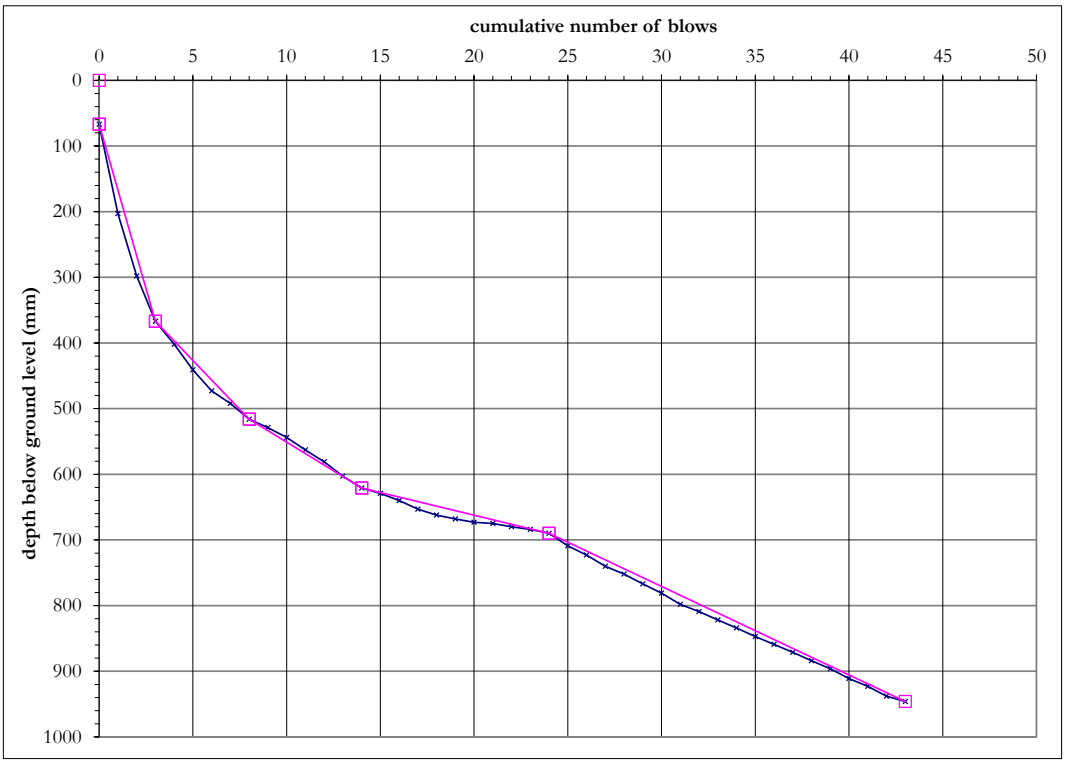
CAUSEWAY GEOTECH

Test Number	DCP21
Depth bgl (m)	0.00

Date Tested	25/01/2024
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	**Description of surface material at test depth**
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
67		
67	100	2.3
367		
367	30	8.4
516		
516	18	15
621		
621	6.9	39
690		
690	13	19
946		

CBR Range	Min: 2.3 Max: 39	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		February 2024

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

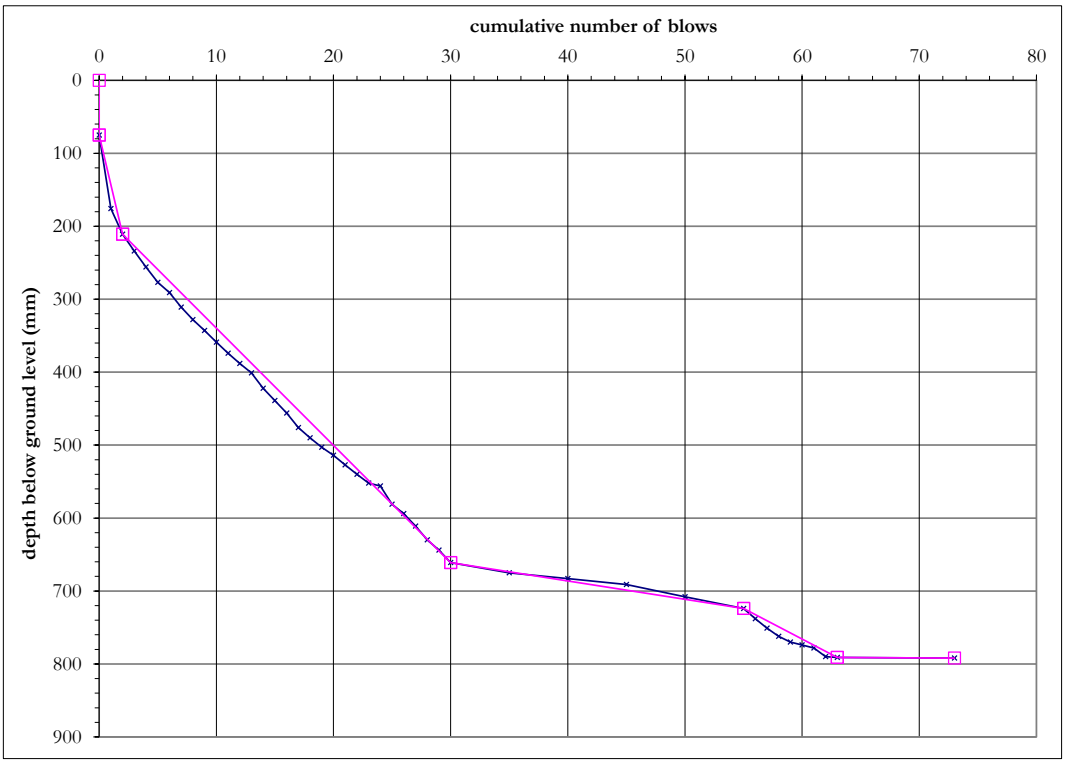
Project Number	23-1890
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP22
Depth bgl (m)	0.00

Date Tested	25/01/2024
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
75		
75	68	3.5
211		
211	16	16
661		
661	2.5	>100
724		
724	8.4	32
791		
791	0.1	>100
792		

CBR Range	Min: 3.5 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		February 2024

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

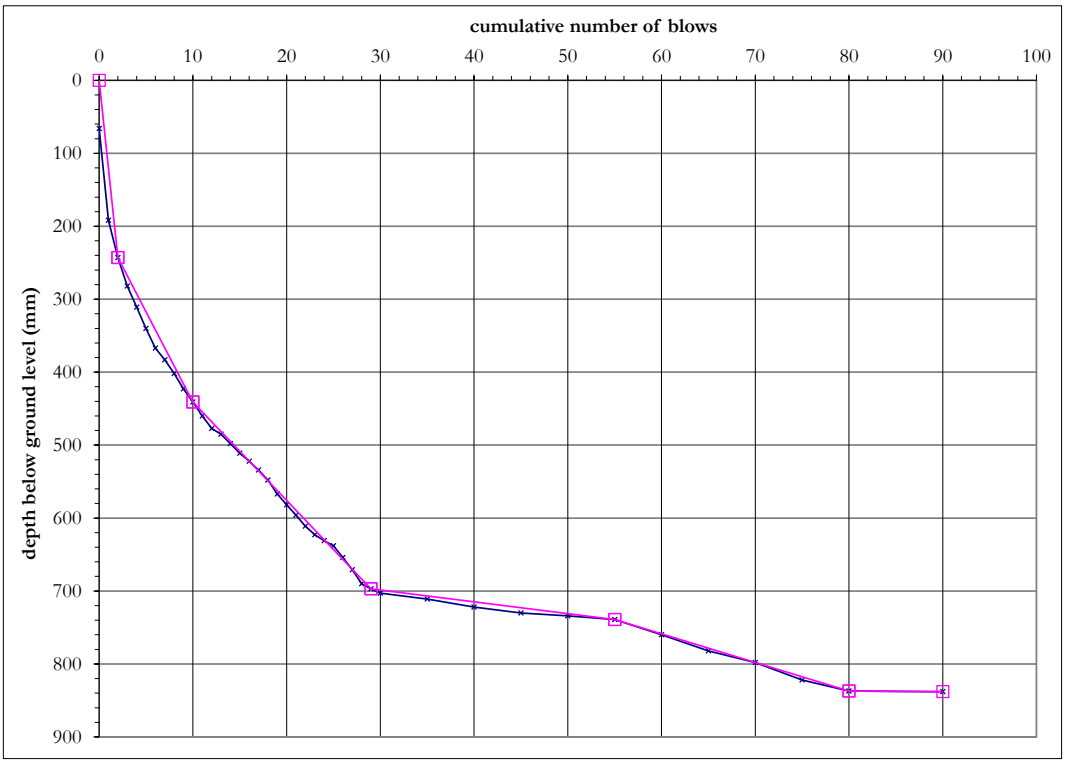
Project Number	23-1890
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP23
Depth bgl (m)	0.00

Date Tested	25/01/2024
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
243		
243	25	10
441		
441	13	19
697		
697	1.6	>100
739		
739	3.9	71
837		
837	0.1	>100
838		

CBR Range	Min: 10 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		February 2024

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

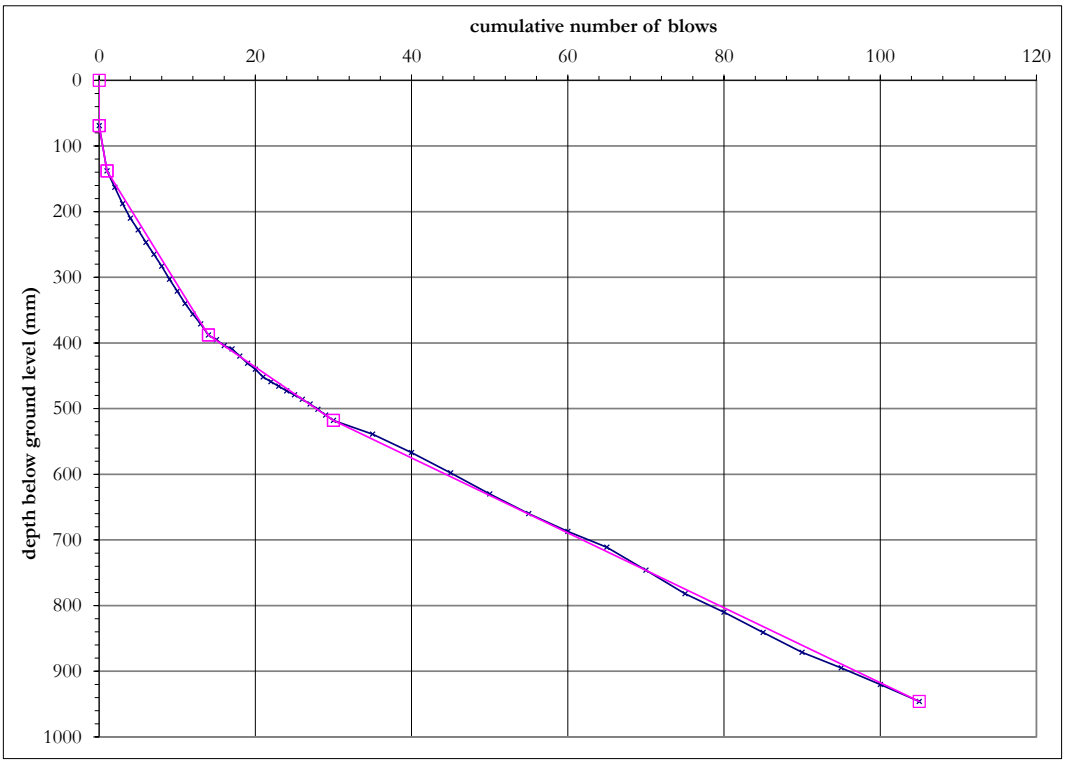
Project Number	23-1890
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP24
Depth bgl (m)	0.00

Date Tested	25/01/2024
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
69		
69	69	3.4
138		
138	19	13
388		
388	8.1	33
518		
518	5.7	48
946		

CBR Range	Min: 3.4 Max: 48	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		February 2024

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

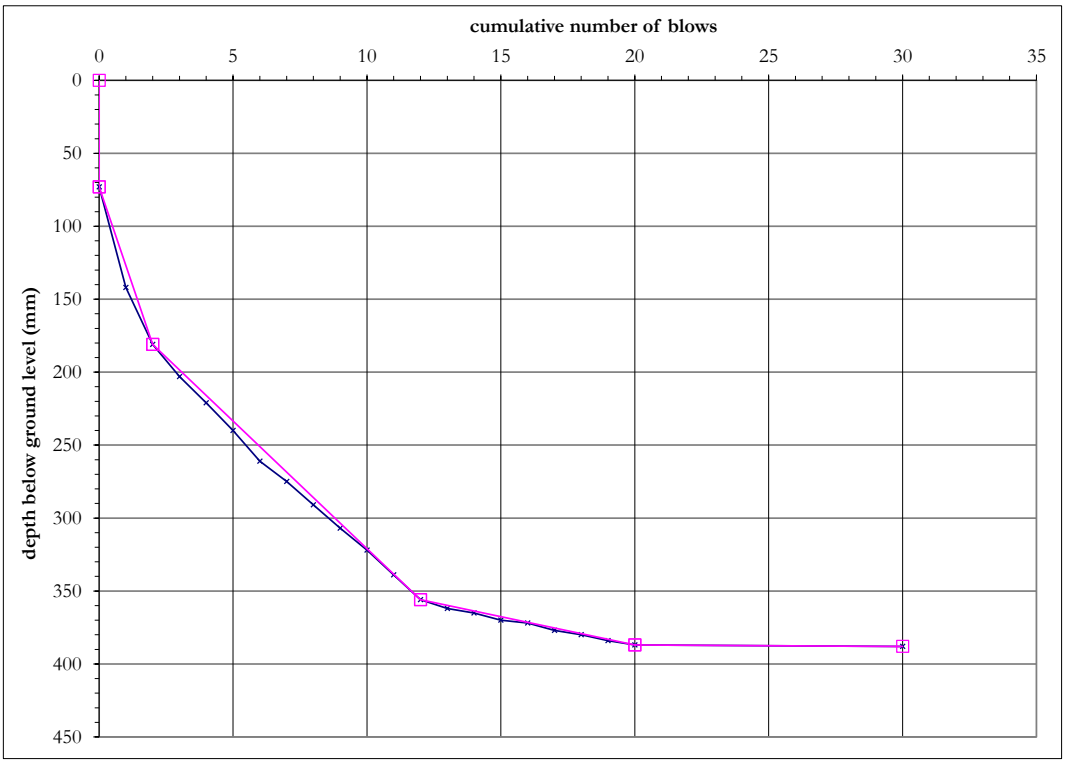
Project Number	23-1890
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP25
Depth bgl (m)	0.00

Date Tested	25/01/2024
Weather	Showers

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	**Description of surface material at test depth**
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
73		
73	54	4.5
181		
181	18	15
356		
356	3.9	72
387		
387	0.1	>100
388		

CBR Range	Min: 4.5 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		February 2024

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

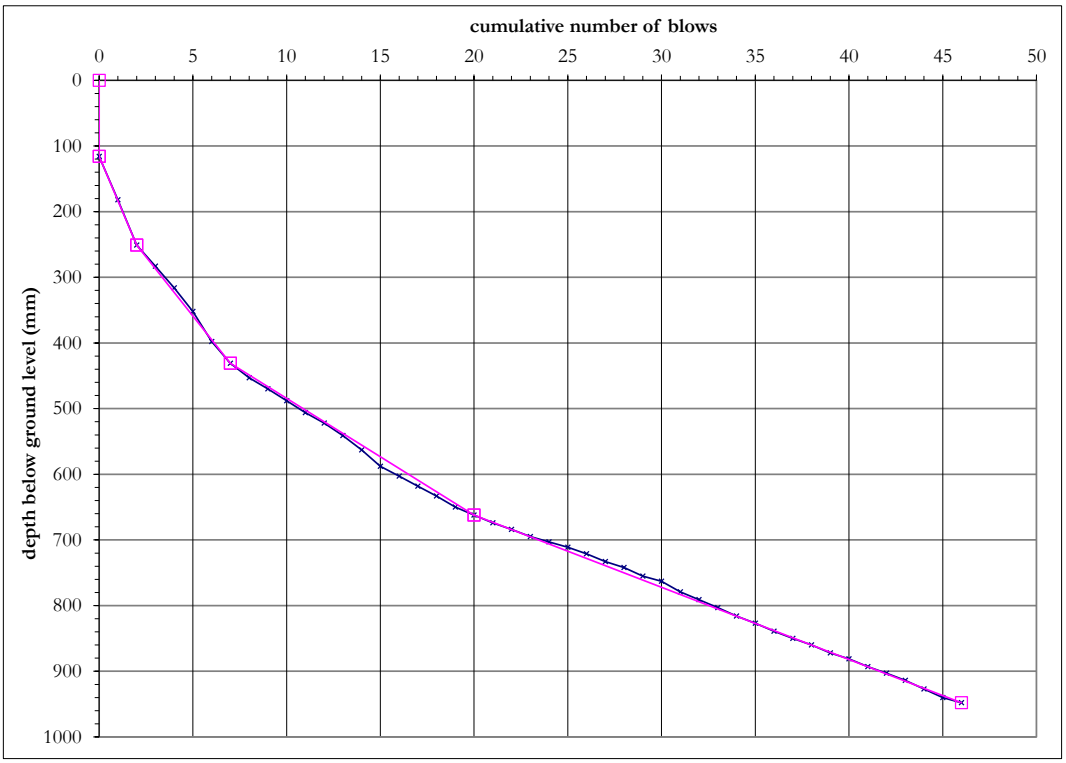
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP26
Depth bgl (m)	0.00

Date Tested	11/12/2023
Weather	Rain

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
116		
116	68	3.5
251		
251	36	6.8
431		
431	18	14
662		
662	11	24
948		

CBR Range	Min: 3.5 Max: 24	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

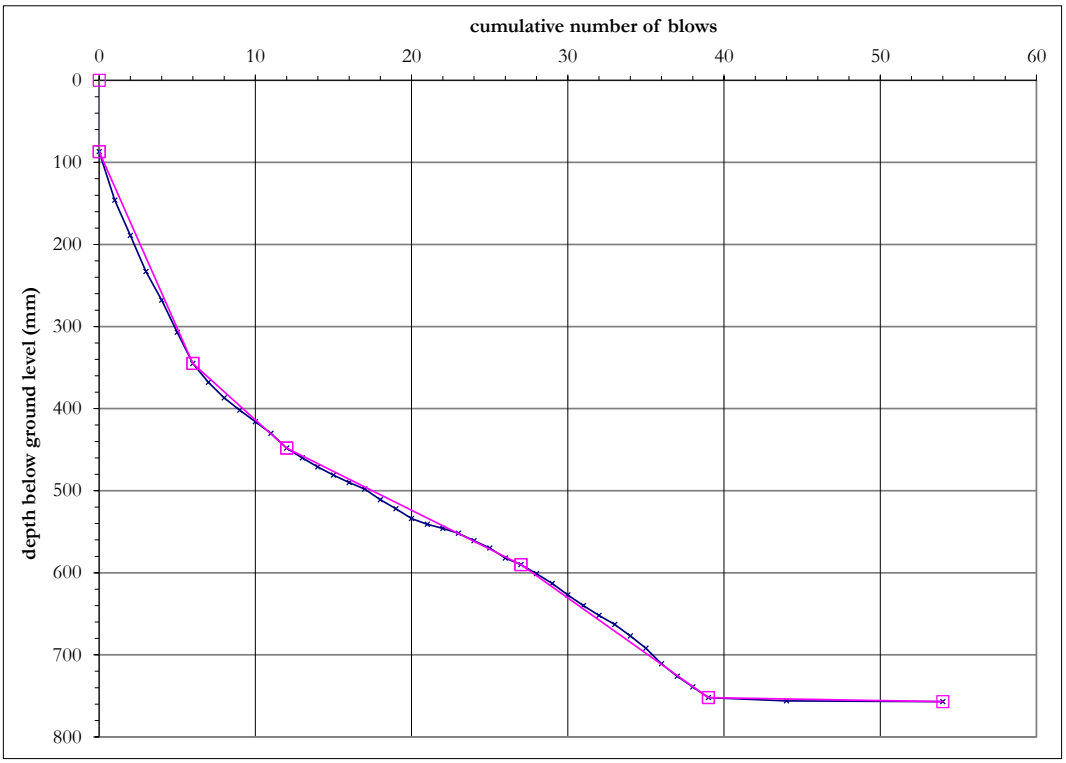
Project Number	23-1870
Project Name	Lackareagh Wind Farm, Co Clare
Site Location	Lackareagh, Co Clare

Test Number	DCP27
Depth bgl (m)	0.00

Date Tested	11/12/2023
Weather	Rain

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4 and DMRB CS 229 Rev 0
CBR calculated using the TRRL CBR DCP relationship: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) in accordance with DMRB CS 229 Rev 0

Surface preparation	Description of surface material at test depth
N/A	TOPSOIL



top / base of layer (mm)	mm/ blow	CBR (%)
0	N/A	N/A
87		
87	43	5.7
345		
345	17	15
448		
448	9.5	28
590		
590	14	19
752		
752	0.3	>100
757		

CBR Range	Min: 5.7 Max: >100	The self-weight penetration at the start of the test (shown above) has not been included in the minimum and maximum values shown to the left. The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report should not be reproduced except in full without the written approval of the laboratory.

Deviation(s) from standard procedure	None

Observations and comments	

Approved Name and Appointment		
Darren O'Mahony Director		December 2023

UKAS TESTING 10122

CAUSEWAY GEOTECH

RECEIVED: 29/08/2024

APPENDIX H

GEOTECHNICAL LABORATORY TEST RESULTS

CAUSEWAY GEOTECH

HEAD OFFICE
Causeway Geotech Ltd
8 Drumahiskey Road
Ballymoney
Co. Antrim, N. Ireland, BT53 7QL
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Registered in Northern Ireland.
Company Number: NI610766

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Causeway Geotech (IRL) Ltd
Unit 1 Fingal House
Stephenstown Industrial Estate
Balbriggan, Co Dublin, Ireland, K32 VR66
ROI: +353 (0)1 526 7465
Registered in Ireland.
Company Number: 633786

www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

12 March 2024

Project Name:	Lackareagh Wind Farm
Project No.:	23-1870
Client:	MKO
Engineer:	Albert Fry

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Contents page(s). This testing was performed between 15/02/2024 and 12/03/2024.

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 28 days from the above date after which they will be appropriately disposed of unless we receive written instructions to the contrary prior to that date.

We trust our report meets with your approval but if you have any queries or require additional information, please do not hesitate to contact the undersigned.

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

Project Name: Lackareagh Wind Farm

Report Reference: Schedule 1

The table below details the tests carried out, the specifications used, and the number of tests included in this report. Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests.

The results contained in this report relate to the sample(s) as received. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. This report shall not be reproduced other than in full, without the prior written approval of the laboratory.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Water Content of Soil	BS 1377-2: 1990: Cl 3.2	14
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	11
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	12
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	5
ROCK	Point load index	ISRM Commission on Testing Methods. Suggested Method for Determining Point Load Strength 1985	5
ROCK	Uniaxial Compressive Strength (UCS)*	ISRM Suggested Methods -Rock Characterization Testing and Monitoring, Ed. E T Brown - 1981	2

SUB-CONTRACTED TESTS

In agreement with Client, the following tests were conducted by an approved sub-contractor. All sub-contracting laboratories used are UKAS accredited.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – Subcontracted to Derwentside Environmental Testing Services Limited *(UKAS 2139)*	pH Value of Soil		14
SOIL – Subcontracted to Derwentside Environmental Testing Services Limited *(UKAS 2139)*	Sulphate Content water extract		14

Summary of Classification Test Results

CAUSEWAY GEOTECH

Project No.	Project Name
23-1870	Lackareagh Wind Farm

Hole No.	Sample				Specimen Description	Density bulk / dry Mg/m3		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type										
TP-MM-01	4	1.50		D	Brown sandy slightly gravelly clayey SILT.			26	74	40 -1pt	29	11		MI
TP-SC-01	2	1.00		D	Brown slightly sandy slightly clayey subangular fine to coarse GRAVEL.			9.9	32	31 -1pt	22	9		CL
TP-SC-02	4	1.60		D	Brown slightly sandy slightly clayey subangular fine to coarse GRAVEL.			11						
TP-SC-03	1	1.00		B	Brown sandy slightly gravelly clayey SILT.			18	38	38 -1pt	28	10		MI
TP-SC-04	6	3.00		D	Brown sandy slightly gravelly silty CLAY.			7.8	27	34 -1pt	23	11		CL
TP-SC-05	3	2.00		B	Brown slightly sandy slightly clayey subangular fine to coarse GRAVEL.			16	37	32 -1pt	21	11		CL
TP-SC-06	4	2.00		D	Brown slightly sandy slightly silty subangular fine to coarse GRAVEL.			12	25	40 -1pt	28	12		MI
TP-T1-01	6	2.50		D	Brown sandy gravelly silty CLAY.			14	49	27 -1pt	18	9		CL
TP-T2-01	4	1.00		D	Brown sandy slightly gravelly clayey SILT.			24	52	40 -1pt	29	11		MI
TP-T3-01	4	1.70		D	Brown slightly sandy slightly clayey subangular fine to coarse GRAVEL.			11						
TP-T4-01	2	0.60		D	Brown sandy slightly gravelly clayey SILT.			31	42	71 -1pt	49	22		MV
TP-T5-01	3	1.70		B	Brown gravelly slightly clayey fine to coarse SAND.			3.9						

All tests performed in accordance with BS1377:1990 unless specified otherwise

LAB 01R Version 6

Key

Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

Date Printed

03/12/2024 00:00

Approved By

Stephen Watson

UKAS TESTING

10122

CAUSEWAY GEOTECH

Summary of Classification Test Results

Project No.: 23-1870

Project Name: Lackareagh Wind Farm

Hole No.	Sample Ref	Top	Base	Type	Specimen Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
TP-T6-01	6	2.50		D	Brown sandy gravelly silty CLAY.			15	40	30 -1pt	22	8		CL
TP-T7-01	6	2.50		D	Brown sandy gravelly silty CLAY.			8.6	29	35 -1pt	24	11		CL/CI/ML/MI

All tests performed in accordance with BS1377:1990 unless specified otherwise

LAB 01R Version 6

Key

Density test | Liquid Limit | Particle density

Linear measurement unless : | 4pt cone unless : | sp - small pyknometer

wd - water displacement | cas - Casagrande method | gj - gas jar

wi - immersion in water | 1pt - single point test

Date Printed: 03/12/2024 00:00

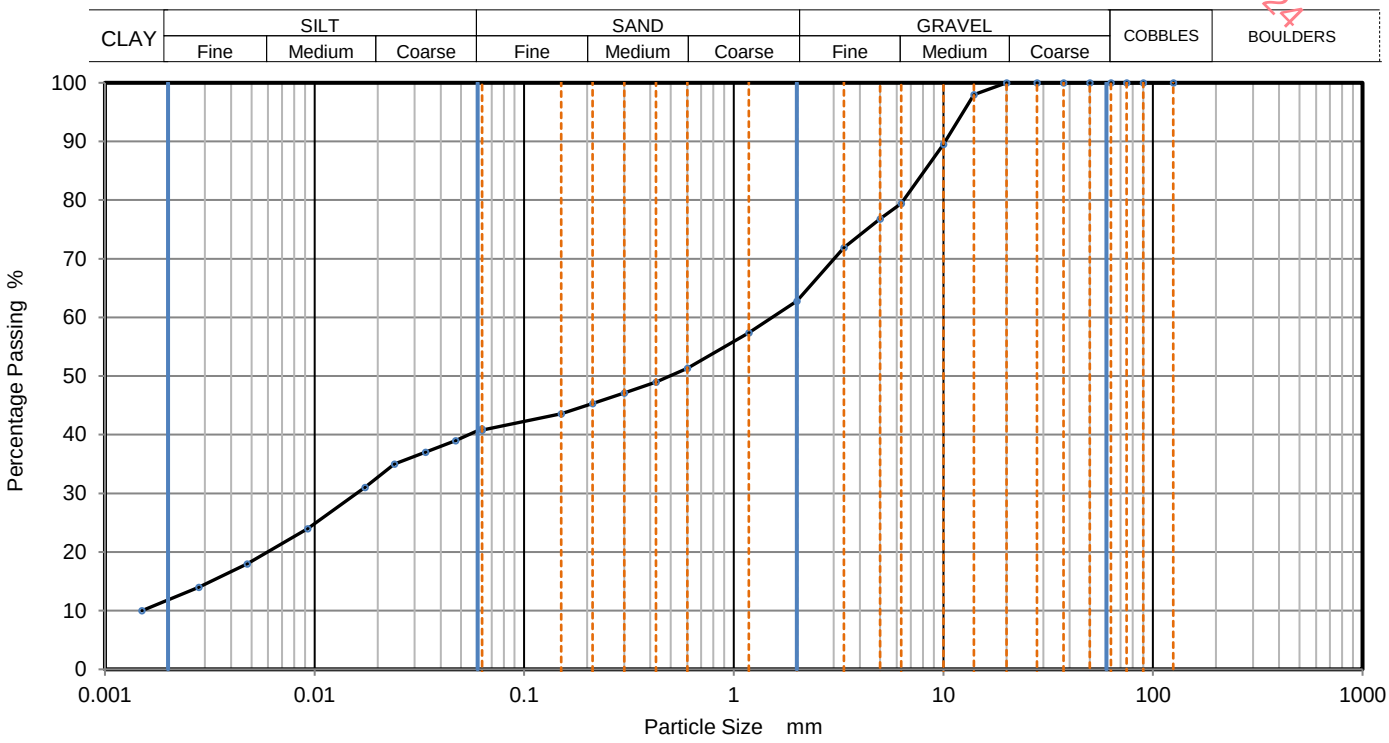
Approved By: Stephen Watson

UKAS TESTING

10122

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-MM-01
Site Name	Lackareagh Wind Farm			Sample No.	3
Specimen Description	Brown sandy slightly gravelly clayey SILT.			Sample Depth (m) Top	1.50
				Base	
Specimen Reference	2	Specimen Depth	1.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus202402153



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06289	41
90	100	0.04710	39
75	100	0.03379	37
63	100	0.02406	35
50	100	0.01737	31
37.5	100	0.00926	24
28	100	0.00477	18
20	100	0.00281	14
14	98	0.00150	10
10	90		
6.3	79		
5	77		
3.35	72		
2	63		
1.18	57		
0.6	51	Particle density	(assumed)
0.425	49	2.65	Mg/m3
0.3	47		
0.212	45		
0.15	44		
0.063	41		

Dry Mass of sample, g: 508

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	37.2
Sand	22.0
Silt	29.4
Clay	11.4

Grading Analysis		
D100	mm	
D60	mm	1.52
D30	mm	0.0154
D10	mm	0.00162
Uniformity Coefficient		940
Curvature Coefficient		0.097

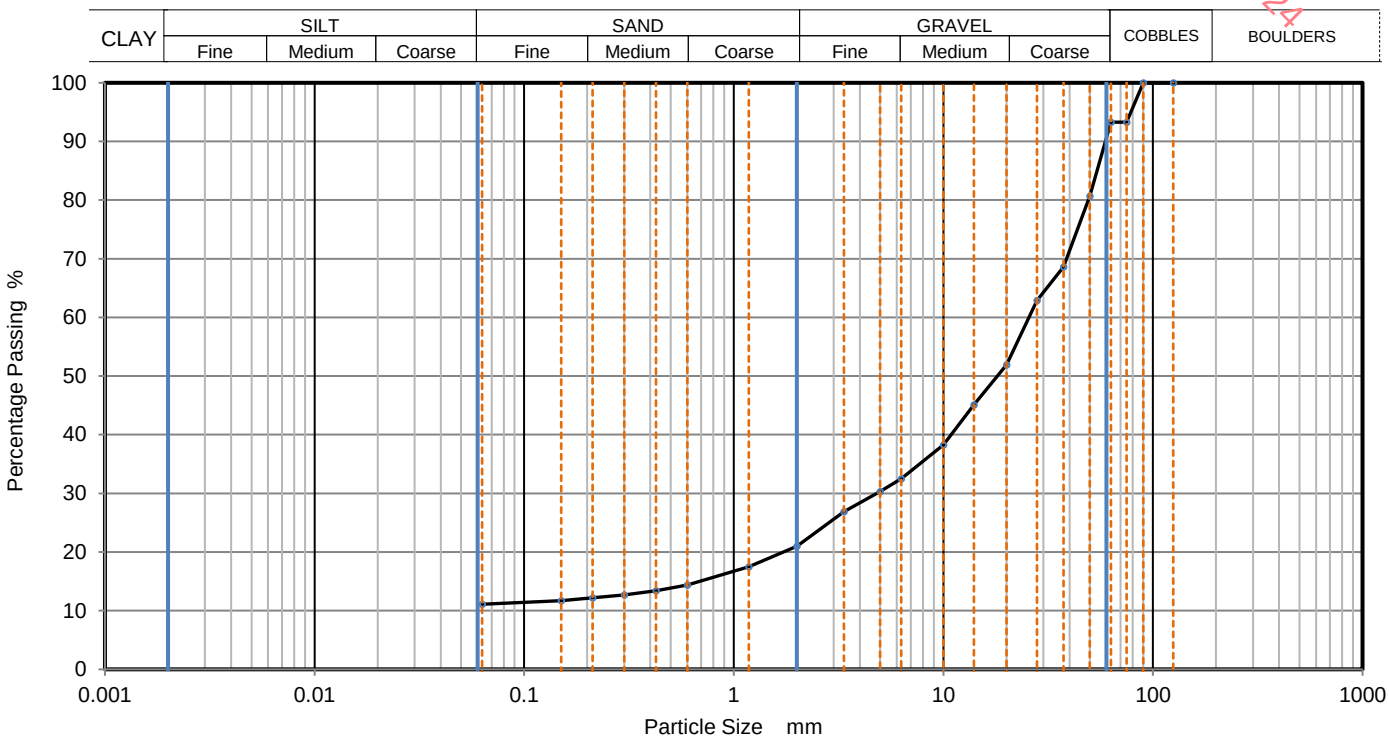
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-SC-01
Site Name	Lackareagh Wind Farm			Sample No.	1
Specimen Description	Brown slightly sandy slightly clayey subangular fine to coarse GRAVEL.			Sample Depth (m) Top	1.00
				Sample Depth (m) Base	
Specimen Reference	2	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2024021521



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	93		
63	93		
50	81		
37.5	69		
28	63		
20	52		
14	45		
10	38		
6.3	33		
5	30		
3.35	27		
2	21		
1.18	18		
0.6	14		
0.425	13		
0.3	13		
0.212	12		
0.15	12		
0.063	11		

Dry Mass of sample, g: 12050

Sample Proportions	% dry mass
Cobbles	6.7
Gravel	72.3
Sand	10.0
Fines <0.063mm	11.0

Grading Analysis		
D100	mm	
D60	mm	25.6
D30	mm	4.83
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

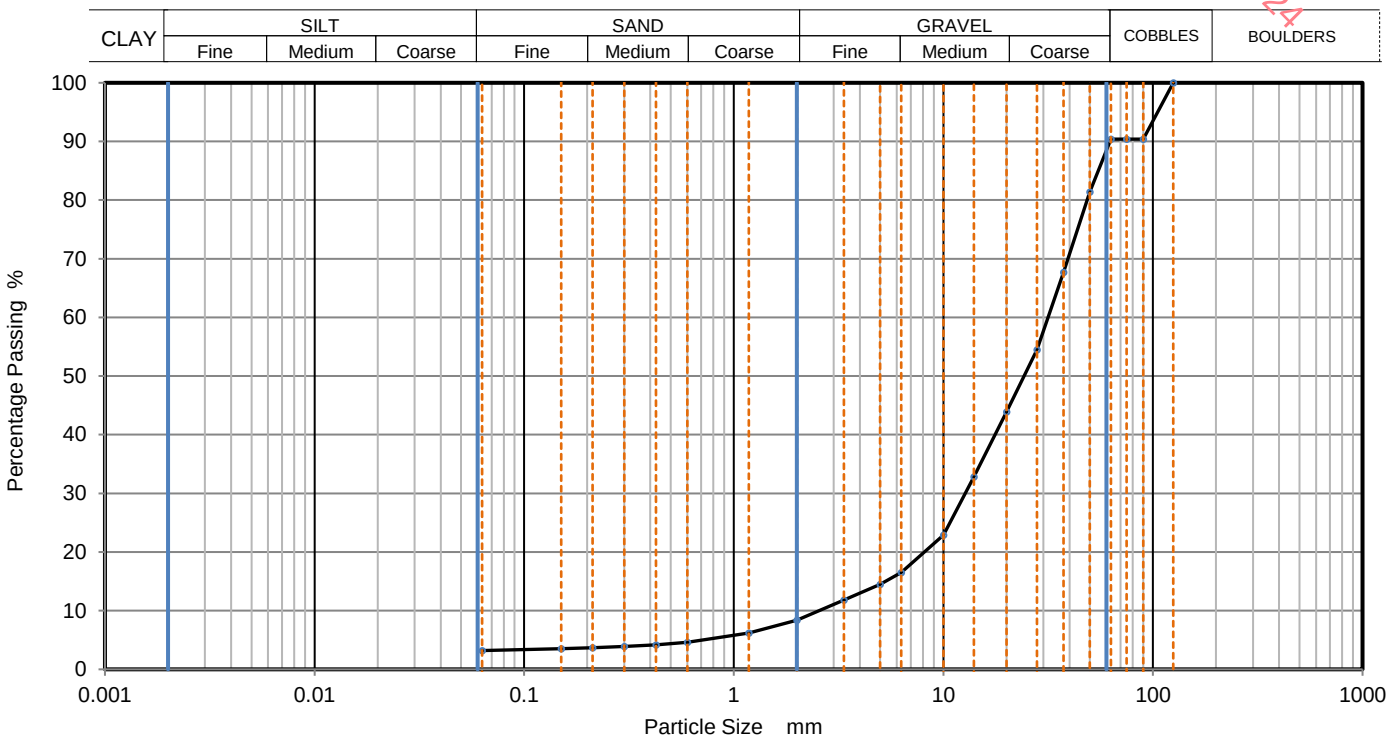
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-SC-02
Site Name	Lackareagh Wind Farm			Sample No.	3
Specimen Description	Brown slightly sandy slightly clayey subangular fine to coarse GRAVEL.			Sample Depth (m) Top	1.60
				Sample Depth (m) Base	
Specimen Reference	2	Specimen Depth	1.6 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2024021523



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	90		
75	90		
63	90		
50	81		
37.5	68		
28	55		
20	44		
14	33		
10	23		
6.3	17		
5	15		
3.35	12		
2	8		
1.18	6		
0.6	5		
0.425	4		
0.3	4		
0.212	4		
0.15	4		
0.063	3		

Dry Mass of sample, g: 12826

Sample Proportions	% dry mass
Cobbles	9.6
Gravel	82.0
Sand	5.2
Fines <0.063mm	3.0

Grading Analysis		
D100	mm	125
D60	mm	31.6
D30	mm	12.7
D10	mm	2.55
Uniformity Coefficient		12
Curvature Coefficient		2

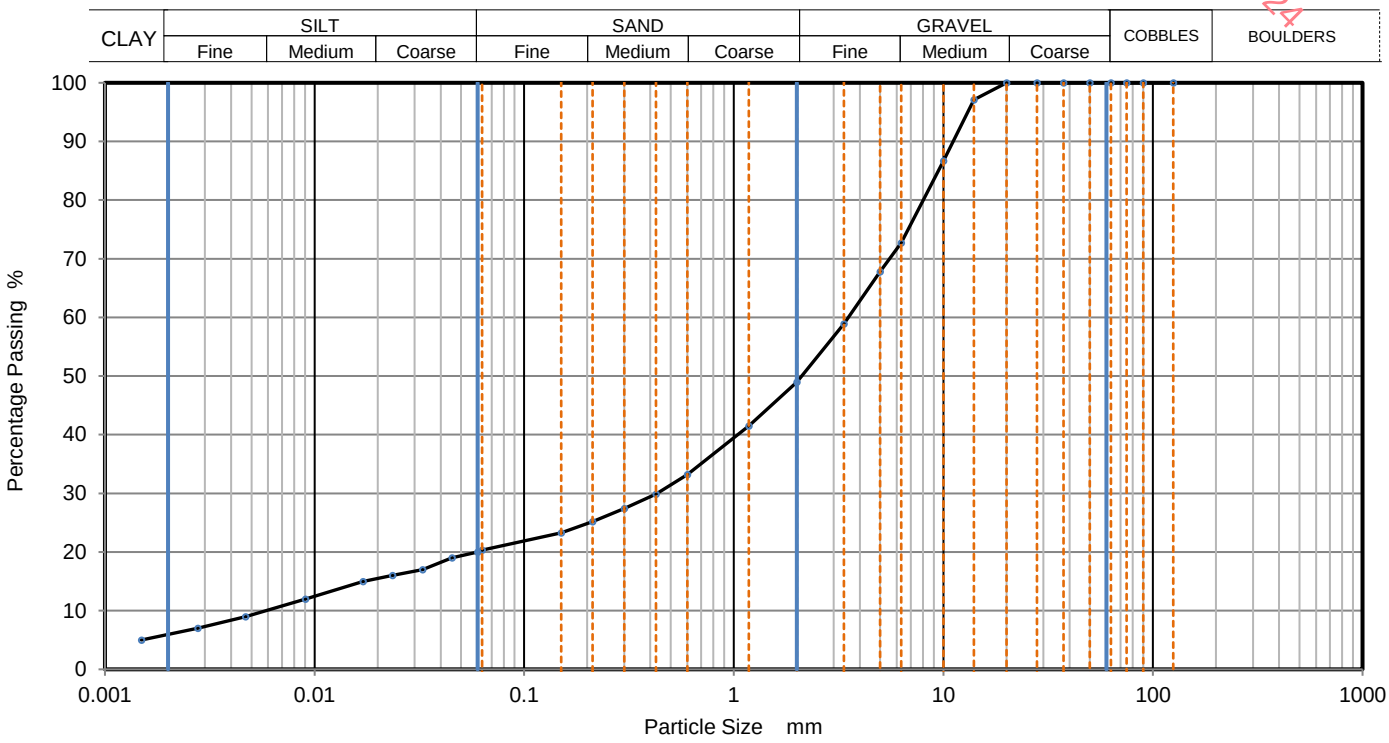
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-SC-03
Site Name	Lackareagh Wind Farm			Sample No.	1
Specimen Description	Brown sandy slightly gravelly clayey SILT.			Sample Depth (m) Top	1.00
				Sample Depth (m) Base	
Specimen Reference	4	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2024021525



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06003	20
90	100	0.04536	19
75	100	0.03282	17
63	100	0.02355	16
50	100	0.01701	15
37.5	100	0.00903	12
28	100	0.00469	9
20	100	0.00277	7
14	97	0.00149	5
10	87		
6.3	73		
5	68		
3.35	59		
2	49		
1.18	42		
0.6	33	Particle density	(assumed)
0.425	30	2.65	Mg/m3
0.3	27		
0.212	25		
0.15	23		
0.063	20		

Dry Mass of sample, g: 349

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	51.0
Sand	28.7
Silt	14.7
Clay	5.6

Grading Analysis		
D100	mm	
D60	mm	3.52
D30	mm	0.431
D10	mm	0.00567
Uniformity Coefficient		620
Curvature Coefficient		9.3

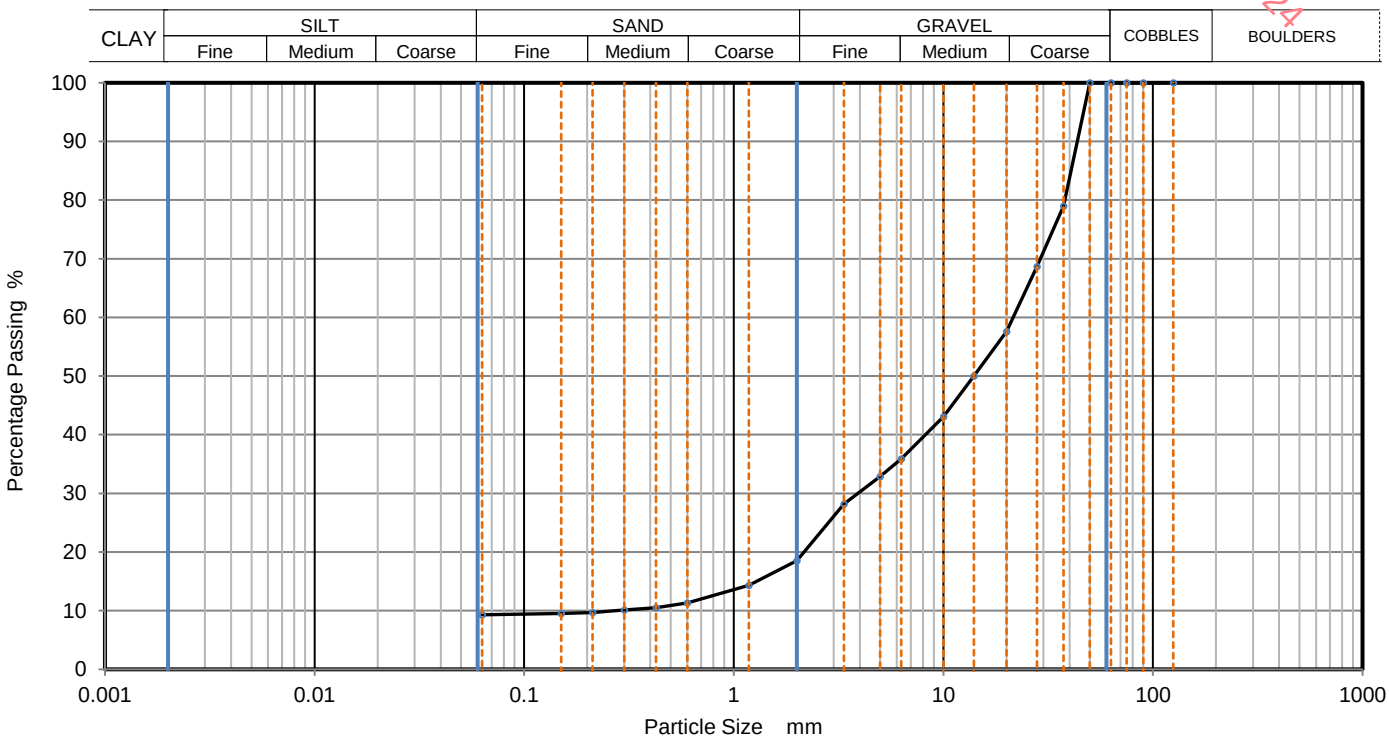
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-SC-04
Site Name	Lackareagh Wind Farm			Sample No.	3
Specimen Description	Brown gravelly slightly clayey fine to coarse SAND.			Sample Depth (m) Top	2.00
				Sample Depth (m) Base	
Specimen Reference	2	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2024021527



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	79		
28	69		
20	58		
14	50		
10	43		
6.3	36		
5	33		
3.35	28		
2	19		
1.18	14		
0.6	11		
0.425	11		
0.3	10		
0.212	10		
0.15	10		
0.063	9		

Dry Mass of sample, g: 2964

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	81.5
Sand	9.2
Fines <0.063mm	9.0

Grading Analysis		
D100	mm	
D60	mm	21.5
D30	mm	3.9
D10	mm	0.275
Uniformity Coefficient		78
Curvature Coefficient		2.6

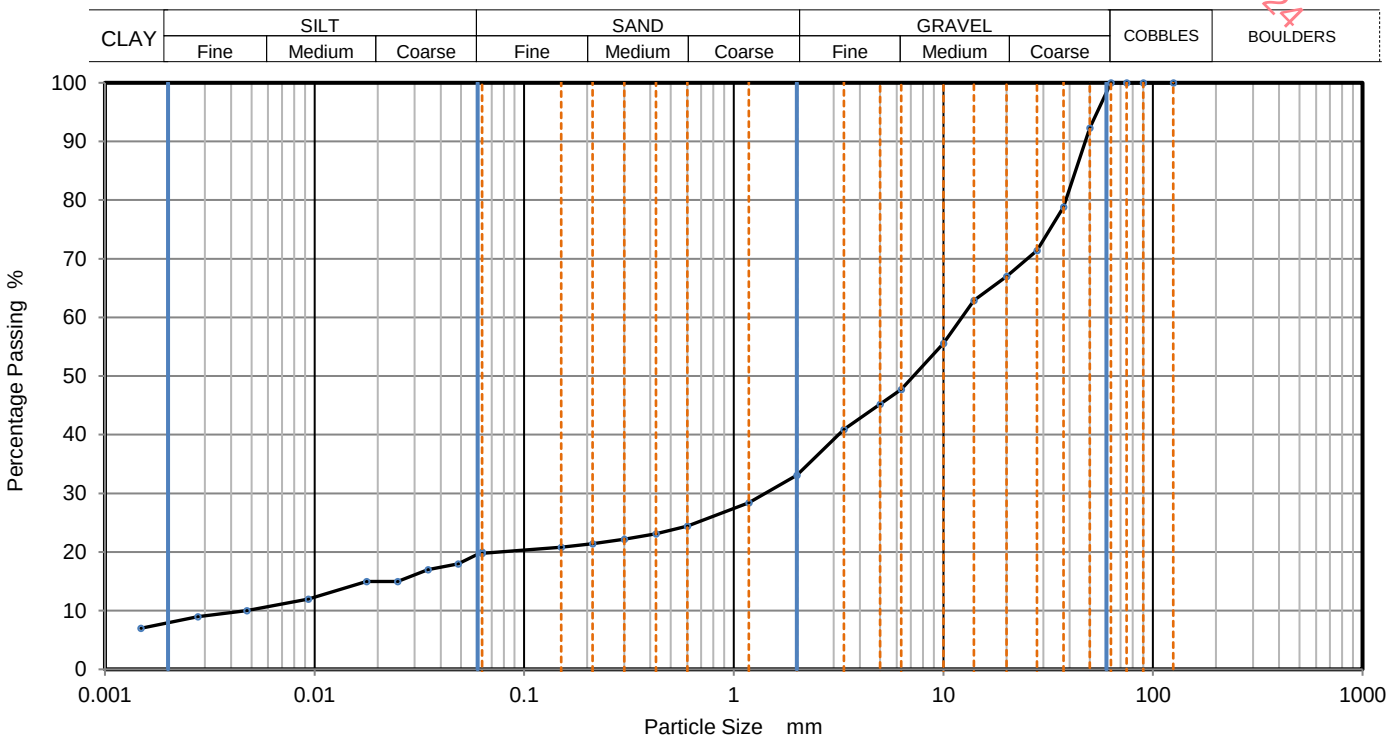
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-SC-05
Site Name	Lackareagh Wind Farm			Sample No.	1
Specimen Description	Brown sandy gravelly silty CLAY.			Sample Depth (m) Top	1.00
				Base	
Specimen Reference	2	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2024021529



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	20
90	100	0.04846	18
75	100	0.03473	17
63	100	0.02489	15
50	92	0.01771	15
37.5	79	0.00932	12
28	71	0.00475	10
20	67	0.00277	9
14	63	0.00148	7
10	56		
6.3	48		
5	45		
3.35	41		
2	33		
1.18	28		
0.6	24	Particle density	(assumed)
0.425	23	2.65	Mg/m3
0.3	22		
0.212	21		
0.15	21		
0.063	20		

Dry Mass of sample, g: 6401

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	66.9
Sand	13.3
Silt	12.2
Clay	7.6

Grading Analysis		
D100	mm	
D60	mm	12.3
D30	mm	1.41
D10	mm	0.0043
Uniformity Coefficient		2900
Curvature Coefficient		38

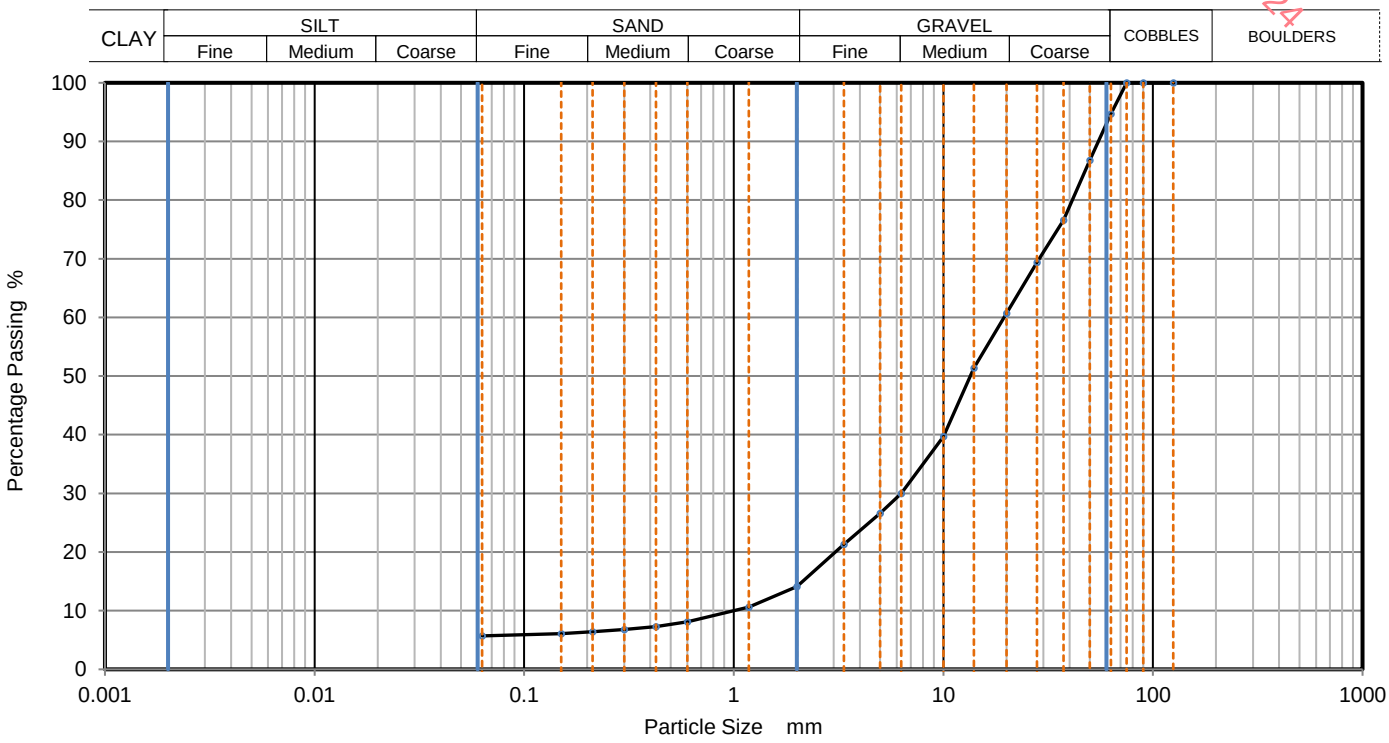
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-SC-06
Site Name	Lackareagh Wind Farm			Sample No.	3
Specimen Description	Brown slightly sandy slightly silty subangular fine to coarse GRAVEL.			Sample Depth (m) Top	2.00
				Base	
Specimen Reference	2	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2024021532



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	95		
50	87		
37.5	77		
28	69		
20	61		
14	51		
10	40		
6.3	30		
5	27		
3.35	21		
2	14		
1.18	11		
0.6	8		
0.425	7		
0.3	7		
0.212	6		
0.15	6		
0.063	6		

Dry Mass of sample, g: 10220

Sample Proportions	% dry mass
Cobbles	5.3
Gravel	80.6
Sand	8.4
Fines <0.063mm	6.0

Grading Analysis		
D100	mm	
D60	mm	19.5
D30	mm	6.3
D10	mm	0.996
Uniformity Coefficient		20
Curvature Coefficient		2.1

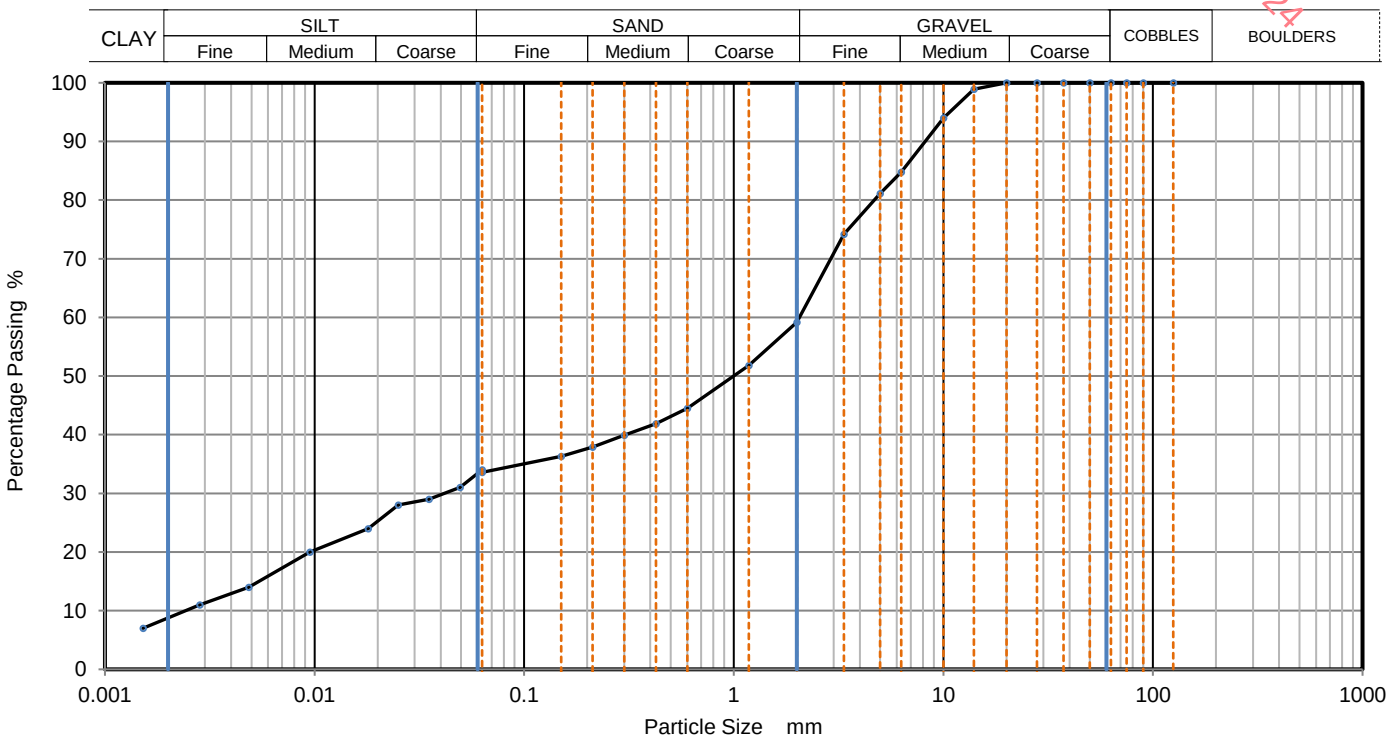
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-T1-01
Site Name	Lackareagh Wind Farm			Sample No.	3
Specimen Description	Brown sandy gravelly silty CLAY.			Sample Depth (m) Top	1.50
				Base	
Specimen Reference	2	Specimen Depth	1.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus202402155



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	34
90	100	0.04945	31
75	100	0.03519	29
63	100	0.02505	28
50	100	0.01805	24
37.5	100	0.00949	20
28	100	0.00486	14
20	100	0.00284	11
14	99	0.00152	7
10	94		
6.3	85		
5	81		
3.35	74		
2	59		
1.18	52		
0.6	45	Particle density	(assumed)
0.425	42	2.65	Mg/m3
0.3	40		
0.212	38		
0.15	36		
0.063	34		

Dry Mass of sample, g: 507

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	40.8
Sand	25.7
Silt	24.6
Clay	8.9

Grading Analysis		
D100	mm	
D60	mm	2.05
D30	mm	0.0407
D10	mm	0.00237
Uniformity Coefficient		870
Curvature Coefficient		0.34

Remarks

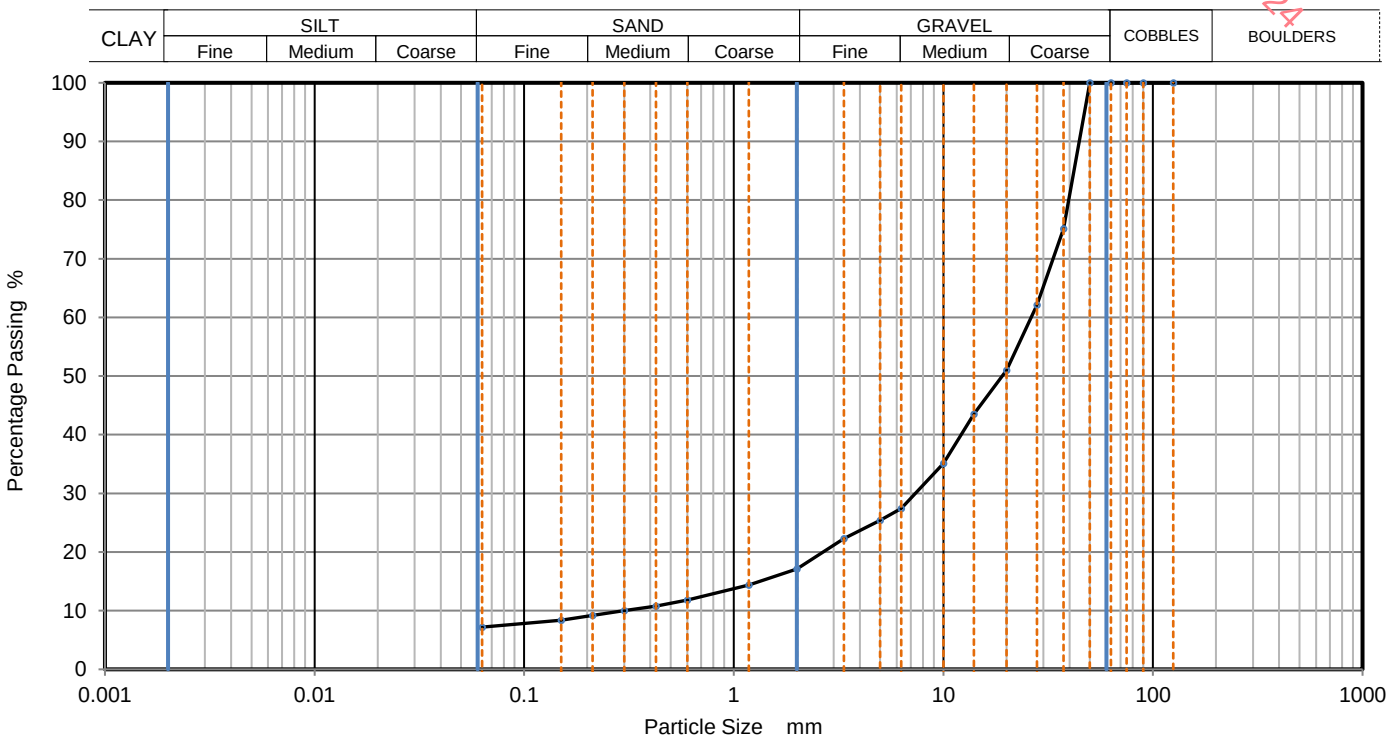
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-T3-01
Site Name	Lackareagh Wind Farm			Sample No.	1
Specimen Description	Brown slightly sandy slightly clayey subangular fine to coarse GRAVEL.			Sample Depth (m) Top	0.70
				Base	
Specimen Reference	2	Specimen Depth	0.7 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2024021510

RECEIVED: 29/08/2024



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	75		
28	62		
20	51		
14	44		
10	35		
6.3	27		
5	25		
3.35	22		
2	17		
1.18	14		
0.6	12		
0.425	11		
0.3	10		
0.212	9		
0.15	8		
0.063	7		

Dry Mass of sample, g: 3288

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	82.9
Sand	9.9
Fines <0.063mm	7.0

Grading Analysis		
D100	mm	
D60	mm	26.3
D30	mm	7.37
D10	mm	0.306
Uniformity Coefficient		86
Curvature Coefficient		6.7

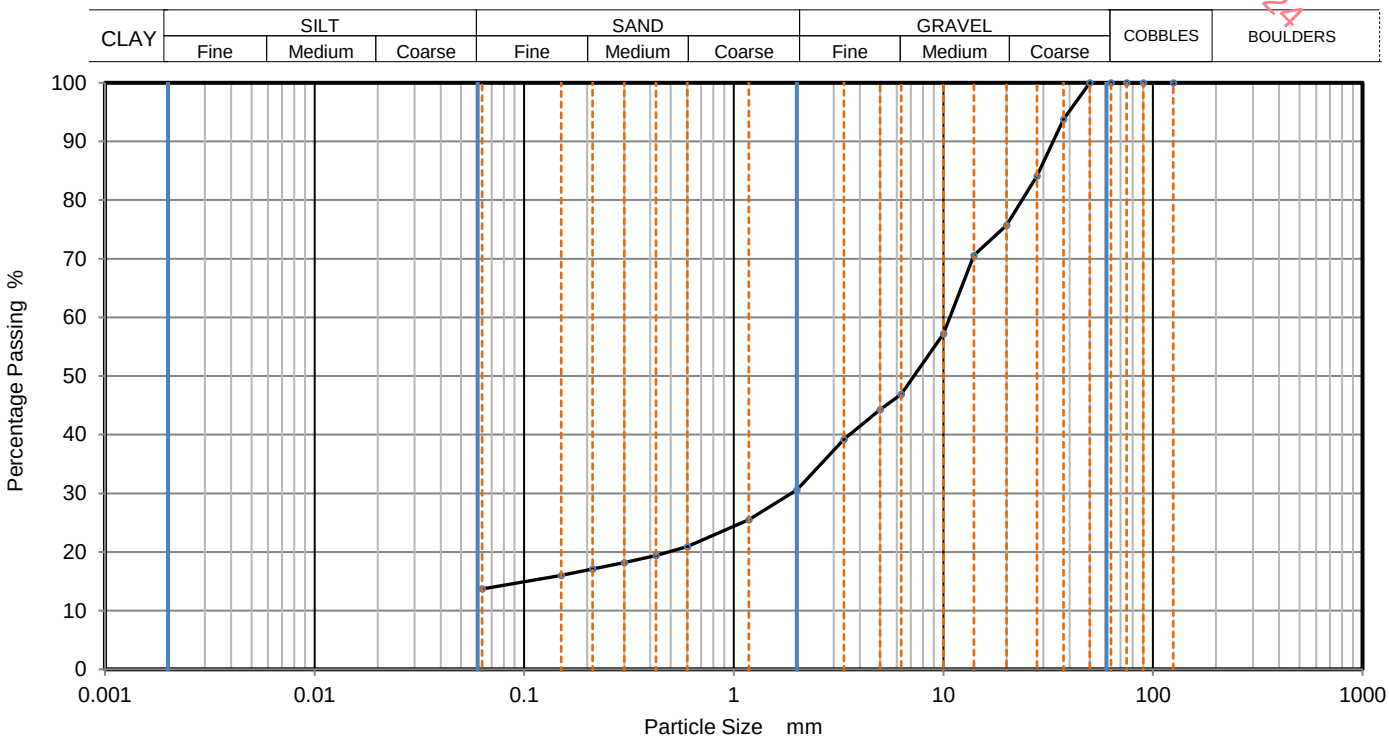
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-T5-01
Site Name	Lackareagh Wind Farm			Sample No.	1
Specimen Description	Brown slightly sandy slightly clayey subangular fine to coarse GRAVEL.			Sample Depth (m) Top	1.00
				Sample Depth (m) Base	
Specimen Reference	2	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2024021534



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	94		
28	84		
20	76		
14	71		
10	57		
6.3	47		
5	44		
3.35	39		
2	31		
1.18	26		
0.6	21		
0.425	19		
0.3	18		
0.212	17		
0.15	16		
0.063	14		

Dry Mass of sample, g: 2698

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	69.4
Sand	17.0
Fines <0.063mm	14.0

Grading Analysis		
D100	mm	
D60	mm	10.7
D30	mm	1.88
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

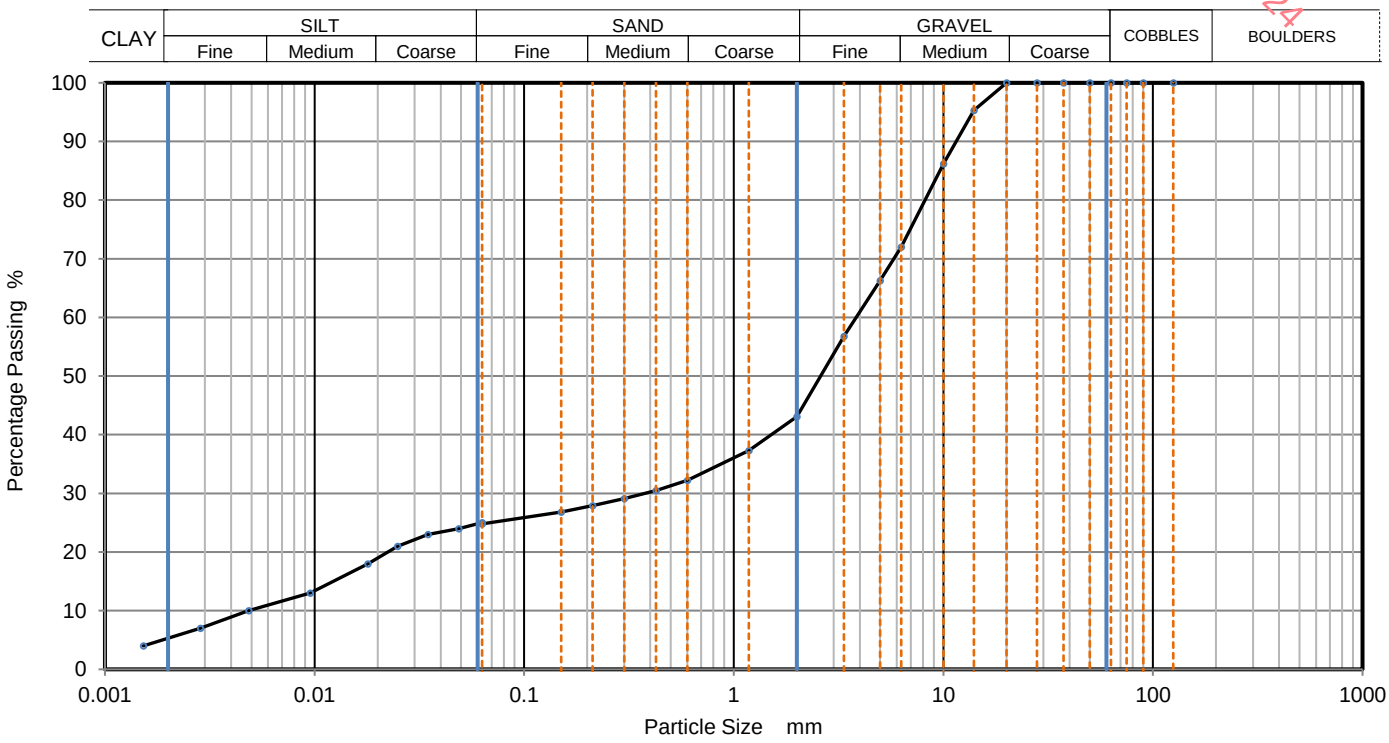
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-T6-01
Site Name	Lackareagh Wind Farm			Sample No.	1
Specimen Description	Brown sandy slightly gravelly silty CLAY.			Sample Depth (m) Top	0.50
				Sample Depth (m) Base	
Specimen Reference	2	Specimen Depth	0.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2024021515



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	25
90	100	0.04879	24
75	100	0.03473	23
63	100	0.02489	21
50	100	0.01794	18
37.5	100	0.00955	13
28	100	0.00486	10
20	100	0.00285	7
14	95	0.00153	4
10	86		
6.3	72		
5	66		
3.35	57		
2	43		
1.18	37		
0.6	32	Particle density	(assumed)
0.425	31	2.65	Mg/m3
0.3	29		
0.212	28		
0.15	27		
0.063	25		

Dry Mass of sample, g: 501

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	56.9
Sand	18.3
Silt	19.5
Clay	5.3

Grading Analysis		
D100	mm	
D60	mm	3.84
D30	mm	0.377
D10	mm	0.00495
Uniformity Coefficient		780
Curvature Coefficient		7.5

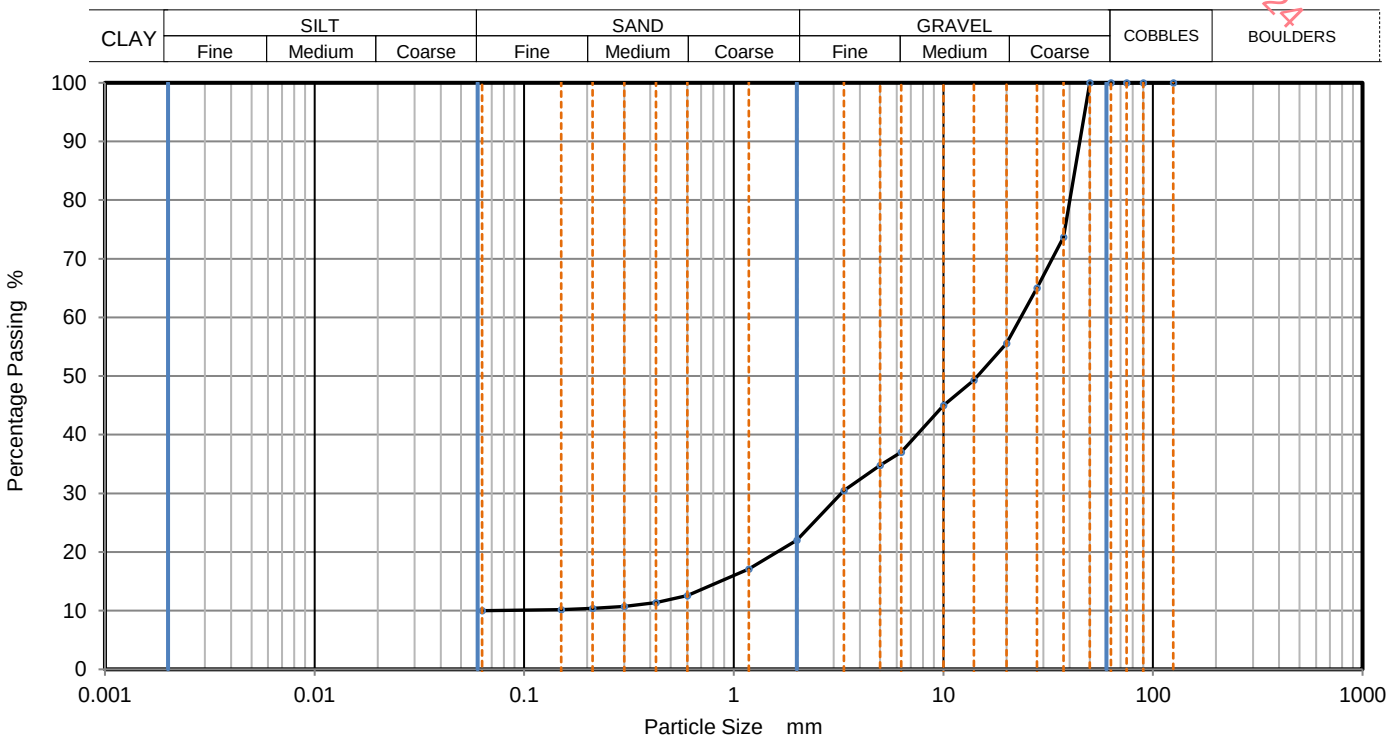
Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**23-1870**
				Borehole/Pit No.	TP-T7-01
Site Name	Lackareagh Wind Farm			Sample No.	3
Specimen Description	Brown gravelly clayey fine to coarse SAND.			Sample Depth (m) Top	1.50
				Base	
Specimen Reference	2	Specimen Depth	1.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2024021518



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	74		
28	65		
20	56		
14	49		
10	45		
6.3	37		
5	35		
3.35	31		
2	22		
1.18	17		
0.6	13		
0.425	11		
0.3	11		
0.212	10		
0.15	10		
0.063	10		

Dry Mass of sample, g	3367

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	78.0
Sand	12.0
Fines <0.063mm	10.0

Grading Analysis		
D100	mm	
D60	mm	23.4
D30	mm	3.25
D10	mm	0.0668
Uniformity Coefficient		350
Curvature Coefficient		6.7

Remarks

Preparation and testing in accordance with BS1377-2 :1990 unless noted below

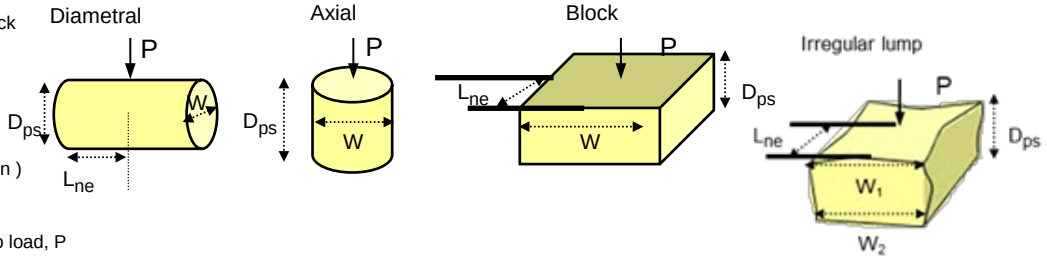
Approved
Stephen Watson

Point Load Strength Index Tests
Summary of Results

Project No.	Project Name
23-1870	Lackareagh Wind Farm

Borehole No.	Sample			Specimen		Rock Type	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index		Remarks (including water content if measured)
	Depth	Ref.	Type	Ref.	Depth		Type (D, A, I, B)	Direction (L, P or U)		Lne	W	Dps	Dps'			Is	Is(50)	
	m				m					mm	mm	mm	mm	kN	mm	MPa	MPa	
RC-SC-01	5.00	1	C	2	5.00	GREYWACKE	D	U	YES	62.0	83.4	83.4	81.0	7.3	82.2	1.1	1.4	
RC-SC-02	3.70	1	C	2	3.70	GREYWACKE	A	U	YES		83.5	110.0	104.0	10.5	105.2	0.9	1.3	
RC-SC-02	4.70	2	C	2	4.70	GREYWACKE	D	U	YES	54.7	83.5	83.5	81.0	19.0	82.2	2.8	3.5	
RC-SC-02	4.80	2	C	2	4.80	GREYWACKE	A	U	YES		83.4	63.5	64.0	11.1	82.4	1.6	2.0	
RC-SC-03	3.10	1	C	2	3.10	GREYWACKE	D	U	YES	80.3	83.3	83.3	81.0	7.0	82.1	1.0	1.3	

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



Test performed in accordance with ISRM Suggested Methods : 1985, unless noted otherwise

Detailed legend for test and dimensions, based on ISRM, is shown above.

Size factor, F = (De/50)0.45 for all tests.

LAB 17R - Version 5

Date Printed: 03/04/2024 00:00

Approved By: Stephen Watson

UKAS TESTING
10122

UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

CAUSEWAY GEOTECH

Project No.: 23-1870

Project Name: Lackareagh Wind Farm

Hole No.	Sample				Rock Type	Specimen Dimensions2			Bulk Density2	Water Content 1	Uniaxial Compression3			Remarks
	Ref	Top	Base	Type		Dia. mm	Length mm	H/D	Mg/m3	%	Condition	Mode of failure	UCS MPa	
RC-SC-01	2	4.10	4.40	C	GREYWACKE	83.3	238.0	2.9	2.69	0.6	as received	S	38.2	
RC-SC-03	2	4.00	4.50	C	GREYWACKE	83.6	237.5	2.8	2.71	0.1	as received	F	77.5	

Notes

1 ISRM p87 test 1, water content at 105 ± 3 oC, specimen as tested for UCS

2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density

3 ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials

above notes apply unless annotated otherwise in the remarks

Mode of failure :

S - Single shear MS - multiple shear

AC - Axial cleavage F - Fragmented

Test Specification	Date Printed	Approved By	Table
International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007	03/04/2024 00:00	Stephen Watson	1 sheet 1

Certificate of Analysis

Certificate Number 24-04533 *Issued:* 07-Mar-24

Client Causeway Geotech
8 Drumahiskey Road
Ballymoney
County Antrim
BT53 7QL

Our Reference 24-04533

Client Reference 23-1870

Order No (not supplied)

Contract Title LACKAREAGH WIND FARM, CO CLARE

Description 7 Soil samples.

Date Received 04-Mar-24

Date Started 04-Mar-24

Date Completed 07-Mar-24

Test Procedures Identified by prefix DETSn (details on request).

Notes Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.

Approved By

Kirk Bridgewood
General Manager

ilac-MRA UKAS TESTING 2139

Summary of Chemical Analysis
Soil Samples

Our Ref 24-04533
Client Ref 23-1870
Contract Title LACKAREAGH WIND FARM, CO CLARE

			Lab No	2307271	2307272	2307273	2307274	2307275	2307276	2307277
			.Sample ID	TP-SC-01	TP-SC-02	TP-SC-03	TP-SC-04	TP-SC-05	TP-SC-06	TP-T5-01
			Depth	1.00	1.60	1.00	3.00	2.00	2.00	1.70
			Other ID							
			Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Sampling Date	01/03/2024	01/03/2024	01/03/2024	01/03/2024	01/03/2024	01/03/2024	01/03/2024
			Sampling Time	n/s	n/s	n/s	n/s	n/s	n/s	n/s
Test	**Method**	**LOD**	**Units**							
Inorganics										
pH	DETSC 2008#		pH	7.6	6.6	6.4	6.2	5.8	6.2	6.3
Sulphate Aqueous Extract as SO4 (2:1)	DETSC 2076#	10	mg/l	1200	80	140	21	30	15	22

Key: # -MCERTS (accreditation only applies if report carries the MCERTS logo). n/s -not supplied.

Information in Support of the Analytical Results

Our Ref 24-04533
Client Ref 23-1870
Contract LACKAREAGH WIND FARM, CO CLARE

Containers Received & Deviating Samples

Lab No	Sample ID	Date Sampled	Containers Received	Holding time exceeded for tests	Inappropriate container for tests
2307271	TP-SC-01 1.00 SOIL	01/03/24	PT 500ml		
2307272	TP-SC-02 1.60 SOIL	01/03/24	PT 500ml		
2307273	TP-SC-03 1.00 SOIL	01/03/24	PT 500ml		
2307274	TP-SC-04 3.00 SOIL	01/03/24	PT 500ml		
2307275	TP-SC-05 2.00 SOIL	01/03/24	PT 500ml		
2307276	TP-SC-06 2.00 SOIL	01/03/24	PT 500ml		
2307277	TP-T5-01 1.70 SOIL	01/03/24	PT 500ml		

Key: P-Plastic T-Tub

DETS cannot be held responsible for the integrity of samples received whereby the laboratory did not undertake the sampling. In this instance samples received may be deviating. Deviating Sample criteria are based on British and International standards and laboratory trials in conjunction with the UKAS note 'Guidance on Deviating Samples'. All samples received are listed above. However, those samples that have additional comments in relation to hold time, inappropriate containers etc are deviating due to the reasons stated. This means that the analysis is accredited where applicable, but results may be compromised due to sample deviations. If no sampled date (soils) or date+time (waters) has been supplied then samples are deviating. However, if you are able to supply a sampled date (and time for waters) this will prevent samples being reported as deviating where specific hold times are not exceeded and where the container supplied is suitable.

Soil Analysis Notes

Inorganic soil analysis was carried out on a dried sample, crushed to pass a 425µm sieve, in accordance with BS1377.

Organic soil analysis was carried out on an 'as received' sample. Organics results are corrected for moisture and expressed on a dry weight basis.

The Loss on Drying, used to express organics analysis on an air dried basis, is carried out at a temperature of 28°C +/-2°C.

Disposal

From the issue date of this test certificate, samples will be held for the following times prior to disposal :-

Soils - 1 month, Liquids - 2 weeks, Asbestos (test portion) - 6 months

End of Report

CAUSEWAY GEOTECH

RECEIVED: 29/08/2024

APPENDIX I

SPT HAMMER ENERGY MEASUREMENT REPORT

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing
Unit 11
Charlwoods Road
East Grinstead
West Sussex
RH19 2HU

SPT Hammer Ref:	1377.
Test Date:	18/02/2023
Report Date:	20/02/2023
File Name:	1377..spt
Test Operator:	RWS

Instrumented Rod Data

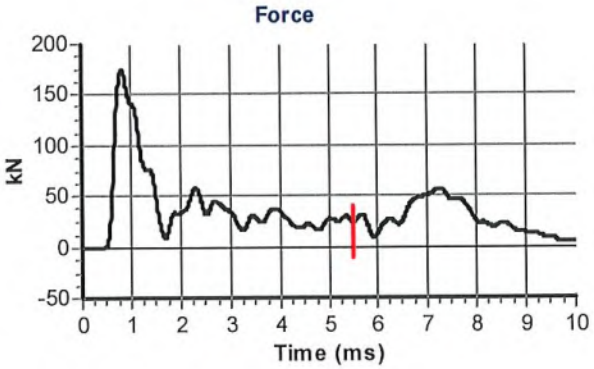
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.7
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	64786
Accelerometer No.2:	64789

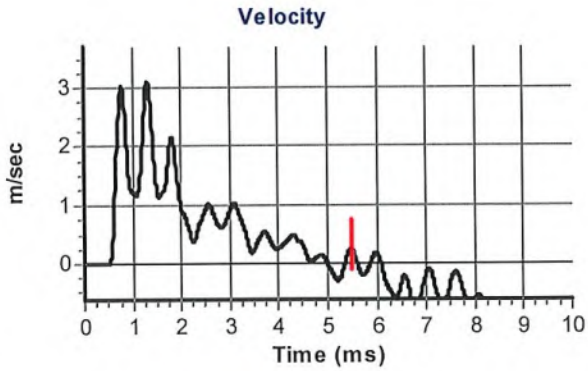
SPT Hammer Information

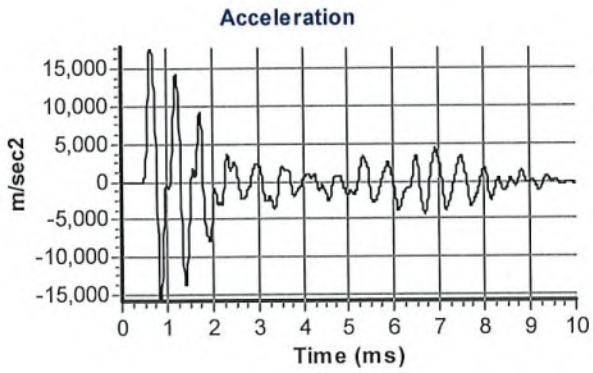
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

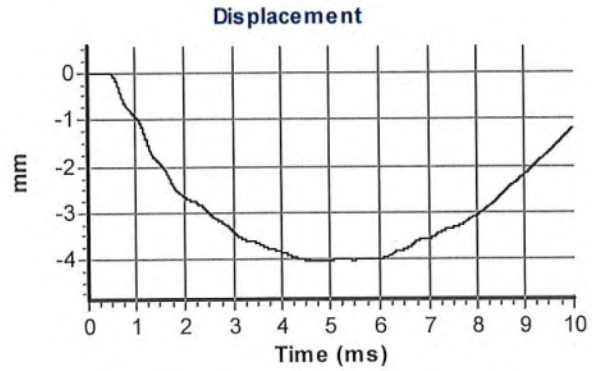
Comments / Location

CAUSEWAY









Calculations

Area of Rod A (mm2):	996
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	292

Energy Ratio E_r (%): **62**

Signed: Bob Stewart

Title: Technician

The recommended calibration interval is 12 months