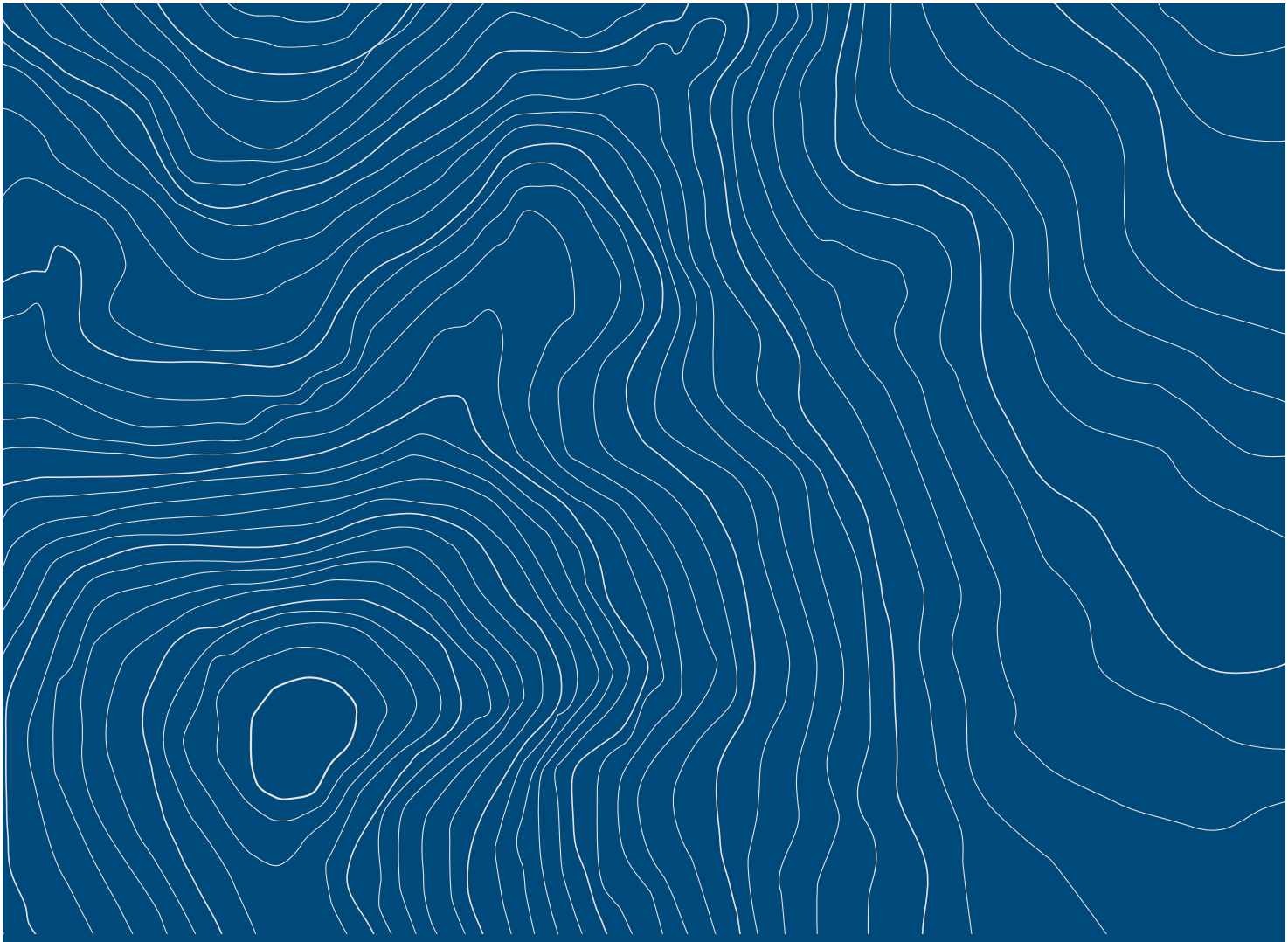

Dublin Array
Generation for generations

EIAR Volume 6: Onshore Infrastructure Technical Appendices Appendix 6.5.3-2: Dublin Array Onshore Site Investigations

Kish Offshore Wind Ltd.

RWE SLR GoBe APEM Group

www.dublinarray-marineplanning.ie

THIRD PARTY COVERSHEET

Project Name	Dublin Array		
Package	Engineering Structural/Civil		
Document Title	Causeway Geotec - Dublin Array Onshore Site Investigations A02		
Classification	Confidential		
Document Date	10 May 2023	**Pages (Inc. Cover)**	621
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RWE Revision History

RWE Revision	Date	Status / Reason for Issue	Author	Checker	Approver
01	10/05/2023	For Information	RW	SR	DO

Dublin Array Onshore Site Investigations

Client:	Dublin Array
Client's Representative:	GDG
Report No.:	21-1443E
Date:	May 2023
Status:	Final Report

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APPENDICES

Document Control Sheet

Report No.:		21-1443E			
Project Title:		Dublin Array Onshore Site Investigations			
Client:		Dublin Array			
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Revision:	A02	**Status:**	Final Report	**Issue Date:**	10th May 2023
Prepared by:		**Reviewed by:**		**Approved by:**	
 Rachel White B.A. (Mod.) Geoscience		 Sean Ross BSc MSc MIEI PGeo		 Darren O'Mahony BSc MSc MIEI EurGeol PGeo	

The works were conducted in accordance with:

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.
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.

Dublin Array Onshore Site Investigations

1 AUTHORITY

On the instructions of Gavin & Doherty Geosolutions (GDG), ("the Client's Representative"), acting on the behalf of Dublin Array ("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 onshore elements of a proposed offshore windfarm.

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, environmental sampling, groundwater and ground gas monitoring, 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 across two sites in south County Dublin. The landfall site of the project is located at Shanganagh Cliffs in Shankill. It covers an area from the Irish Sea in the east to Clifton Park in the west and is comprised primarily of green areas. The substation location is located immediately west of Carrickmines Retail Park and north of Ballyogan.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 5th September and 7th October 2022, comprised:

- eleven boreholes by sonic drilling methods
- standpipe installation in nine boreholes for groundwater and gas monitoring
- sixteen machine dug trial pits
- an infiltration test performed in six trial pits
- thirteen variable head tests (falling head)
- eight plate load tests.

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

4.2 Boreholes

Eleven boreholes as listed below in Table 1 were put to their completion by a combination of sonic drilling techniques and rotary drilling using Geobor-S methods. The boreholes were completed using a Fraste CRS XL Duo rubber-tracked sonic drilling rig.

Table 1 List of boreholes undertaken as part of the ground investigation

Location	BH ID	Depth (mbgl)
Shanganah Cliffs	WP2_BH01	30.00
	WP2_BH02	30.00
	WP2_BH03	30.00
	WP2_BH04	30.00
Ballyogan	WP1_BH01	15.00
	WP1_BH02	15.00
	WP1_BH03	15.00
	WP1_BH04	15.00
	WP1_BH06	10.50
	WP1_BH08	10.50
	WP1_BH10	10.50

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions. Fully cased sonic drilling techniques were employed to advance the boreholes of nominal 180mm diameter to a specific.

The disturbed sonic samples were placed a rigid core liner after which they were photographed and examined by a qualified and experienced Engineering Geologist, thus enabling the production of an engineering log in accordance with BS 5930: 2015: Code of practice for ground investigations.

Environmental samples were taken at suitable depths as instructed by the Client's Representative. Disturbed (small jar and bulk bag) samples were taken at standard depth intervals and at change of strata.

Standard penetration tests were carried out in accordance with BS EN 22476-3:2005+A1:2011 at standard depth intervals throughout the overburden using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment ($SPT_{(c)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix K.

Geobor-S techniques were used at the location of WP2_BH01 depth below 15m depth due to the extent of very stiff clay, with core recovery in overburden. The core was extracted in up to 1.5m lengths using an SK6L core barrel, which produced core of nominal 102mm diameter, and was placed in single channel wooden core boxes.

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

4.3 Dynamic probes

Twenty dynamic probes were conducted adjacent to trial pits at the Ballyogan site to correlate between findings in the trial pits. The probes were undertaken 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°.

Several locations were attempted on more than one occasions due to shallow terminations.

Appendix F 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 and/or gas monitoring standpipe was installed in boreholes as shown below in Table 2.

Table 2 List of standpipe installations completed as part of the ground investigations

Location	BH ID	Standpipe Type	Depth Range (mbgl)
Ballyogan	WP1_BH01	50mm gas standpipe	1.00-2.00
	WP1_BH03	50mm gas standpipe	1.00-2.00
	WP1_BH06	50mm gas standpipe	1.00-2.00
	WP1_BH08	50mm gas standpipe	1.00-2.00
	WP1_BH10	50mm gas standpipe	1.00-2.00
Shanganah Cliffs	WP2_BH01	50mm groundwater standpipe	4.50-7.50
	WP2_BH01	50mm gas standpipe	1.00-2.00
	WP2_BH02	50mm groundwater standpipe	12.00-15.00
	WP2_BH02	50mm gas standpipe	1.00-2.00
	WP2_BH03	50mm groundwater standpipe	8.10-12.00
	WP2_BH03	50mm gas standpipe	2.00-3.00
	WP2_BH04	50mm groundwater standpipe	7.50-9.00
	WP2_BH04	50mm gas standpipe	1.00-2.00

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

In December 2022, standpipes installations in WP2_BH02 and WP2_BH04 were removed at the request of Dún Laoghaire – Rathdown County Council.

4.5 Trial Pits

Sixteen trial pits, as listed below in Table 3 were excavated using a 6t or 13t tracked excavator fitted with a 300 or 600mm wide bucket, to depths up to 4.50m.

Table 3 Trial Pits undertaken as part of the ground investigation

Location	TP ID	Depths (mbgl)
Shanganah Cliffs	WP2_TP01	3.50
	WP2_TP03	3.50
	WP2_TP04	3.40
Ballyogan	WP1_TP01	2.20
	WP1_TP02	3.90
	WP1_TP03	3.60
	WP1_TP04	3.70
	WP1_TP05	3.20
	WP1_TP06	3.50
	WP1_TP07	2.90
	WP1_TP08	4.50

	WP1_TP09	2.50
	WP1_TP10	3.50
	WP1_TP11	3.70
	WP1_TP12	3.90
	WP1_TP13	1.60

Environmental samples were taken at varying depths in each trial pit.

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

4.6 Infiltration tests

An infiltration/soakaway test was carried out at six locations as listed below in Table 4 in accordance with BRE Digest 365 - Soakaways (BRE, 2016). The tests were conducted in similarly numbered trial pits.

Table 4 Soakaway tests undertaken as part of the ground investigation

Location	TP ID
Shanganah Cliffs	WP2_TP04
Ballyogan	WP1_TP03
	WP1_TP04
	WP1_TP06
	WP1_TP10
	WP1_TP11

Appendix G presents the results and analysis of the infiltration test.

4.7 Variable head permeability testing

In-situ permeability tests were carried out across both sites during drilling operations at boreholes as shown in Table 5 below. Testing was carried out in accordance with the guidance as set out in BS EN ISO 22282-2: 2012

Table 5 Summary of VHT's undertaken as part of the ground investigation

Location	BH ID	No of tests
Shanganah Cliffs	WP2_BH01	3
	WP2_BH02	2

	WP2_BH03	1
	WP2_BH04	2
Ballyogan	WP1_BH01	2
	WP1_BH03	2

The results are presented in Appendix M.

4.8 Plate load tests

Eight plate load tests were carried out at locations listed below in Table 6 in similarly numbered trial pits.

Table 6 Summary of PLT's undertaken as part of the ground investigation

Location	TP ID
Ballyogan	WP1_TP02
	WP1_TP03
	WP1_TP05
	WP1_TP06
	WP1_TP09
	WP1_TP10
	WP1_TP12
	WP1_TP13

The plate load tests were conducted as incremental loading tests in accordance with Clause 4.1 of BS1377: Part 9: 1990 (British Standards Institute, 1990). A 450mm diameter bearing plate was used with five equal loadings to a maximum pressure of approximately 500kPa, followed by unloading. Plate movements were measured using three strain gauges fitted to a remotely fixed tripod frame. Each loading increment was maintained until the plate movement had essentially stopped.

The test results provided in Appendix H are as follows:

- plots of the plate settlements, average of the three gauges, against pressure.

The Modulus of Subgrade Reaction, *k*, is estimated by applying a "best fit" to the settlement-pressure plots, and is reported in MPa/m. The numerical value represents the pressure, in kPa, on the bearing plate that induces 1.25mm of settlement.

An approximate CBR value was estimated using the guidance provided in the Interim Advice Note 73/06 (Revision 1, 2009) of the Design Guidance for Road Pavement Foundations (Draft HD25). The document provides methods to convert the measured k value to the equivalent for a 762mm diameter plate and the consequent relationship with CBR. This method of estimating an equivalent CBR value is relatively conservative.

4.9 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.

4.10 Groundwater and ground gas monitoring

Following completion of site works, groundwater and ground gas monitoring was conducted over several rounds. Ground water monitoring was carried out using a water interface probe. Ground gas measurements were carried out using a GA5000 gas meter. Groundwater monitoring will be completed every three months and gas monitoring every month over the course of a year.

The monitoring records are presented in Appendix L.

One groundwater data logger was installed in WP2_BH03 to monitor groundwater level over several months. Data downloaded has been issued electronically to the client and is not included in this report.

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.
- **compaction related:** dry density/moisture content relationship
- **soil chemistry:** BRE Test Suite A and BRE Test Suite C

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 I.

5.2 Thermal Resistivity/Hot Box Testing

Several samples were tested according to ASTM-D5334-14 for thermal resistivity of soil at Celtest's laboratories in Bangor, UK.

Testing comprised of:

- single point testing at optimum moisture content derived from optimum moisture content/dry testing
- five-point testing at varying moisture contents

The results of thermal resistivity are presented in Appendix I.

Further to this several samples were sent to Fugro for testing in their laboratory in Wallingford, UK. Testing comprised:

- moisture content
- bulk density
- maximum and minimum density of sand
- PSD
- single point thermal resistivity testing in dry, partially saturated and saturated states according to ASTM-D5334-22.

Several samples comprising more granular material were also sent to Soil Environment Services Ltd. For testing in their laboratory in Northumberland in the UK. Testing comprised:

- Thermal Resistivity/Hotbox testing according to BH8990

Results of additional testing in the subcontracted labs are presented in Appendix I.

5.3 Environmental laboratory testing of soils

Environmental testing, as specified by the Client's Representative was conducted on selected environmental soil samples by Eurofins, Chemtest at its various laboratories in the UK.

Testing was carried out according to suites set out by the Client's Representative:

- Soil Analysis Suite
- Leachate Analysis Suite
- Inert WAC

Results of environmental laboratory testing are presented in Appendix J.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping from the Geological Survey of Ireland (GSI), indicates superficial deposits underlying Shanganagh Cliff comprise Glacial Till and Alluvium, while the Ballyogan site is underlain by Glacial Till. These deposits are underlain by slates, phyllites and schists of the Maulin Formation at Shanganagh Cliffs and granites at the Ballyogan site.

6.2 Ground types encountered during investigation of the site

6.2.1 Shanganagh Cliffs

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

- **Topsoil:** encountered across the site with a thickness range of 200-300mm.
- **Made Ground (fill):** reworked sandy gravelly clay/sand/gravel fill encountered across the site to a maximum depth of 2.10m in WP2_BH02. Varying amounts of concrete, red brick, plastic, timber, rebar and ceramic pipes were encountered within the made ground.
- **Glacial Sands & Gravels**: Loose to dense gravelly silty sand and sandy silty gravel encountered greatest in extent in WP2_BH03 and WP2_BH04 adjacent to the coastline.
- **Glacial Till:** sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth often with lenses of granular material.

6.2.2 Ballyogan

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

- **Topsoil:** encountered across the site with a thickness range of 100-300mm.
- **Made Ground (fill):** reworked sandy gravelly clay encountered across the site to a maximum depth of 3.30m in WP1_TP03. Varying amounts of plastic, red brick, concrete, ducting, rebar, electrical cable and timber were encountered within the made ground across the site.
- **Glacial Till:** sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth often with lenses of granular material.
- **Bedrock (Granite**): Rockhead was encountered at a depth of 11.30m in WP1_BH01

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.

Obvious groundwater strikes were not encountered during drilling at of the borehole locations. However, it should be noted, sonic drilling utilises a lot of water which likely has masked any groundwater strikes. It should also 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.

Groundwater was encountered, during trial pit excavation at depths as shown in Table 7 below.

Table 7 Groundwater strikes encountered during trial pit excavation

GI Ref	Water Level (mbgl)	Comments
WP1_TP03	2.00	Light inflow
WP1_TP04	2.70	Light inflow
WP1_TP06	1.30	Light inflow
WP1_TP10	2.70	Fast inflow

Seasonal variation in groundwater levels should also be factored into design considerations and continued monitoring of the installed standpipes will give an indication of the seasonal variation in groundwater level.

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.

BS EN ISO 22282-2: 2012: Geotechnical investigation and testing. Geohydraulic testing – Part 2: Water permeability tests in a borehole using open systems.

CAUSEWAY GEOTECH

APPENDIX A

SITE AND EXPLORATORY HOLE LOCATION PLANS

CAUSEWAY GEOTECH

Project No.:	21-1443E	**Client:**	Dublin Array Offshore Windfarm
Project Name:	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	**Client's Representative:**	Gavin and Doherty Geosolutions (GDG)

Legend Key

- Locations By Type - SNC
- Locations By Type - TP

Title:
Exploratory Hole Location Plan - Ballyogan

Last Revised:	**Scale:**
04/11/2022	1:1750

CAUSEWAY GEOTECH

Project No.:	21-1443E	**Client:**	Dublin Array Offshore Windfarm
Project Name:	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	**Client's Representative:**	Gavin and Doherty Geosolutions (GDG)

Legend Key

- Locations By Type - SNC
- Locations By Type - TP

Title:
Exploratory Hole Location Plan - Shanganagh Cliffs

Last Revised:	**Scale:**
04/11/2022	1:2000

CAUSEWAY GEOTECH

APPENDIX B

BOREHOLE LOGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH01
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 1 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	15.00	720693.11 E 724065.27 N	15.00 m	22/09/2022	KW	Scale: 1:50
					Elevation: 88.87 mOD	End Date: 26/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
0.50	B1							MADE GROUND: Firm brown slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse.
0.50	ES1							
1.00	B2							
1.00	ES2							
1.00 - 1.65	B5							
1.50	D11							
1.50	ES3				87.22	1.65		
1.50 - 1.95	SPT (S)	N=40 (6,9/9,11,10,10)	1.50					Very stiff greyish brown slightly sandy gravelly silty CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.
1.65 - 3.00	B10							
2.00	ES4							
2.50	ES5							
3.00	D13				85.87	3.00		
3.00	ES6							
3.00 - 4.50	B12							
3.00 - 3.26	SPT (S)	50 (30 for 105mm/50 for 155mm)	3.00					Very stiff dark grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.
4.50	D14				84.37	4.50		
4.50 - 6.00	B15							
4.50 - 4.89	SPT (S)	50 (5,7/50 for 245mm)	4.50					Very stiff dark grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.
6.00	D16							
6.00 - 7.50	B17							
6.00 - 6.42	SPT (S)	N=50 (25 for 115mm/12,12,14,12)	6.00					
7.50	D18				81.37	7.50		
7.50 - 9.00	B19							
7.50 - 7.84	SPT (S)	50 (9,15/50 for 195mm)	7.50					Very stiff greyish brown slightly sandy slightly gravelly silty CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.
9.00	D20				79.87	9.00		
9.00 - 10.50	B21							
9.00 - 9.17	SPT (S)	50 (25 for 95mm/50 for 75mm)	9.00					Very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.

Water | Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0

Water Strikes

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

Casing Details

To (m)	Diam (mm)
15.00	177

Water Added

From (m)	To (m)
1.20	15.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH01
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 2 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	15.00	720693.11 E 724065.27 N	15.00 m	22/09/2022	KW	Scale: 1:50
					Elevation: 88.87 mOD	End Date: 26/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								Very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.		
10.00	D22									
10.50 - 10.60	SPT (S)	50 (25 for 85mm/50 for 20mm)	10.5		78.37	10.50		Dense greyish brown sandy clayey subangular fine to coarse GRAVEL of granite. Sand is fine to coarse.		
11.00	D23									
11.30 - 12.50	B24				77.57	11.30		Strong light whitish grey GRANITE. Slightly weathered: discolouration on joint surfaces. Discontinuities: 1. 0-15 degree joints, closely spaced (40/150/300), planar, rough, locally with orange staining on joint surfaces.		
14.00 - 15.00	B25									
					73.87	15.00		End of Borehole at 15.00m		

9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

Water Strikes

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

Casing Details

To (m)	Diam (mm)
15.00	177

Water Added

From (m)	To (m)
1.20	15.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH02
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 1 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.00	720747.59 E 724044.86 N	15.00 m	26/09/2022	KW	Scale: 1:50
					Elevation: 88.74 mOD	End Date: 27/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.50	B1							MADE GROUND: Firm brown slightly sandy slightly gravelly silty CLAY with medium cobble and boulder content. Sand is fine to coarse. Gravel is subangular fine to coarse.		
0.50	ES1				87.94	0.80				
1.00	B3							MADE GROUND: Brown slightly silty gravelly fine to coarse SAND. Gravel is subangular fine to coarse.		
1.00	ES2									
1.50 - 2.20	B7				87.24	1.50		Medium dense grey sandy subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subrounded.		
1.50 - 1.95	SPT (S)	N=23 (2,5/7,4,5,7)	1.50							
2.20 - 2.60	B8				86.54	2.20		Medium dense brown gravelly fine to coarse SAND. Gravel is subangular fine to coarse.		
2.50	ES3									
2.60 - 3.00	B9				86.14	2.60		Very stiff greyish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.		
3.00	D11									
3.00	ES4									
3.00 - 4.50	B10									
3.00 - 3.45	SPT (S)	N=37 (4,8/8,9,9,11)	3.00							
4.50	D12				84.24	4.50		Very stiff dark brownish grey slightly sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.		
4.50 - 6.00	B13									
4.50 - 4.95	SPT (S)	N=35 (6,7/7,8,10,10)	4.50							
6.00	D14									
6.00 - 7.50	B15									
6.00 - 6.26	SPT (S)	50 (25 for 95mm/50 for 160mm)	6.00							
7.50	D16									
7.50 - 7.85	SPT (S)	50 (9,16/50 for 200mm)	7.50							
7.80 - 8.30	B18				80.94	7.80		Grey COBBLES with some silty sandy gravel.		
8.30 - 9.00	B17				80.44	8.30		Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.		
9.00	D19				79.74	9.00		Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.		
9.00 - 10.50	B20									
9.00 - 9.32	SPT (S)	50 (9,12/50 for 165mm)	9.00							

Water Strikes

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

Casing Details

To (m)	Diam (mm)
15.00	177

Water Added

From (m)	To (m)
1.20	15.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH02
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 2 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.00	720747.59 E 724044.86 N	15.00 m	26/09/2022	KW	Scale: 1:50
					Elevation: 88.74 mOD	End Date: 27/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.		
10.50	D21				78.24	10.50				
10.50 - 11.50	B22							Very stiff brown slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.		
10.50 - 10.85	SPT (S)	50 (8,12/50 for 200mm)	10.5							
11.50 - 11.85	B27				77.24	11.50		Very stiff brownish grey slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.		
11.85 - 12.00	B28				76.89	11.85				
12.00	D23				76.74	12.00		Very stiff light brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.		
12.00 - 12.50	B26									
12.00 - 12.35	SPT (S)	50 (9,12/50 for 200mm)	12.0					Very stiff brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
12.50 - 13.50	B24				76.24	12.50		Dense grey gravelly fine to coarse SAND. Gravel is subanbgular fine to coarse. (Possible weathered bedrock)		
13.50 - 15.00	B25				75.24	13.50		Whitish grey BOULDER of granite. (Probable bedrock)		
					74.24	14.50		Stiff grey slightly sandy silty CLAY. Sand is fine to medium.		
					73.74	15.00		End of Borehole at 15.00m		

Water Strikes

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

Casing Details

To (m)	Diam (mm)
15.00	177

Water Added

From (m)	To (m)
1.20	15.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH03
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 1 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.00	720819.24 E 724034.16 N	15.00 m	29/09/2022	KW	Scale: 1:50
					Elevation: 88.39 mOD	End Date: 30/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.50	B1							MADE GROUND: Soft brown slightly sandy slightly gravelly CLAY with occasional rootlets and brick fragments with low cobble and boulder content. Sand is fine to coarse. Gravel is subangular fine to coarse.		
0.50	ES1									
1.00	B2									
1.00	ES2									
1.50	ES3				86.89	1.50				
1.50 - 3.00	B3							Stiff greyish brown slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
1.50 - 1.95	SPT (S)	N=24 (2,4/4,5,8,7)	1.50							
2.00	ES4									
2.50	ES5									
3.00	D8				85.39	3.00				
3.00	ES6							Very stiff brownish grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.		
3.00 - 4.50	B4									
3.00 - 3.45	SPT (S)	N=41 (6,7/9,10,10,12)	3.00							
4.50	D7									
4.50 - 6.00	B5									
4.50 - 4.95	SPT (S)	N=47 (9,10/12,12,13,10)	4.50							
6.00	D6									
6.00 - 7.50	B9									
6.00 - 6.00	SPT (S)	50 (25 for 0mm/50 for 0mm)	6.00							
7.50	D10				80.89	7.50				
7.50 - 9.00	B11							Very stiff greyish brown slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
7.50 - 7.76	SPT (S)	50 (25 for 105mm/50 for 150mm)	7.50							
9.00	D12				79.39	9.00				
9.00 - 10.50	B13							Very stiff brown slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
9.00 - 9.24	SPT (S)	50 (25 for 85mm/50 for 150mm)	9.00							

Water Strikes

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

Casing Details

To (m)	Diam (mm)
15.00	177

Water Added

From (m)	To (m)
1.20	15.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH03
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 2 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.00	720819.24 E 724034.16 N	15.00 m	29/09/2022	KW	Scale: 1:50
					Elevation: 88.39 mOD	End Date: 30/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								Very stiff brown slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
10.50	D14				77.89	10.50				
10.50 - 12.00	B18							Dense brown gravelly fine to coarse SAND with low cobble content. Gravel is subangular fine to coarse. Cobbles are subrounded.		
10.50 - 10.74	SPT (S)	50 (25 for 85mm/50 for 160mm)	10.5							
12.00	D15				76.39	12.00				
12.00 - 13.50	B19							Very dense brown very gravelly very silty fine to coarse SAND. Gravel is subrounded fine to medium.		
12.00 - 12.04	SPT (S)	50 (25 for 10mm/50 for 25mm)	12.0							
13.50	D16				74.89	13.50				
13.50 - 14.80	B20							Very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
13.50 - 13.68	SPT (S)	50 (25 for 95mm/50 for 85mm)	13.5							
14.80 - 15.00	B21				73.59	14.80				
15.00	D17				73.39	15.00		Grey slightly gravelly silty fine to coarse SAND. Gravel is subangular fine to medium.		
								End of Borehole at 15.00m		

9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

Water Strikes

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

Casing Details

To (m)	Diam (mm)
15.00	177

Water Added

From (m)	To (m)
1.20	15.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH04
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 1 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.00	720931.51 E 724033.50 N	15.00 m	30/09/2022	KW	Scale: 1:50
					Elevation: 86.92 mOD	End Date: 30/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.50	B1							MADE GROUND: Soft brown slightly sandy gravelly CLAY with high cobble and boulder content with frequent rootlets brick fragments and plastic fragments. Sand is fine to coarse. Gravel is subangular fine to coarse.		
0.50	ES1									
1.00	B2									
1.00	ES2									
1.50	B3				85.42	1.50		Stiff brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is angular fine to coarse. Cobbles are subrounded.		
1.50	D11									
1.50	ES3									
1.50 - 3.00	B4									
1.50 - 1.95	SPT (S)	N=27 (2,3/4,6,7,10)	1.50							
2.00	ES4									
2.50	ES5									
3.00	D12				83.92	3.00		Very stiff greyish brown slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.		
3.00	ES6									
3.00 - 4.50	B16									
3.00 - 3.45	SPT (S)	N=39 (5,8/7,9,9,14)	3.00							
4.50	D13									
4.50 - 4.88	SPT (S)	50 (10,14/50 for 225mm)	4.50							
6.00	D14				80.92	6.00		Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.		
6.00 - 7.50	B17									
6.00 - 6.03	SPT (S)	50 (25 for 20mm/50 for 10mm)	6.00							
7.50	D15				79.42	7.50		Very stiff greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
7.50 - 9.00	B18									
7.50 - 7.74	SPT (S)	50 (25 for 85mm/50 for 150mm)	7.50							
9.00	D21									
9.00 - 10.50	B19									
9.00 - 9.30	SPT (S)	50 (10,15/50 for 150mm)	9.00							

Water Strikes

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

Casing Details

To (m)	Diam (mm)
15.00	177

Water Added

From (m)	To (m)
1.20	15.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH04
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 2 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.00	720931.51 E 724033.50 N	15.00 m	30/09/2022	KW	Scale: 1:50
					Elevation: 86.92 mOD	End Date: 30/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								Very stiff greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
10.50	D20				76.42	10.50				
10.50 - 12.00	B22							Very stiff brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.		
10.50 - 10.76	SPT (S)	50 (25 for 110mm/50 for 150mm)	10.5							
12.00	D23									
12.00 - 12.00	SPT (S)	50 (25 for 0mm/50 for 0mm)	12.0							
12.70 - 15.00	B24				74.22	12.70		Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.		
13.50	D25									
13.50 - 13.64	SPT (S)	50 (25 for 85mm/50 for 50mm)	13.5							
15.00	D26				71.92	15.00		End of Borehole at 15.00m		

9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

Water Strikes

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

Casing Details

To (m)	Diam (mm)
15.00	177

Water Added

From (m)	To (m)
1.20	15.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH06
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 1 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.50	720732.44 E 724045.25 N	10.50 m	26/09/2022	KW	Scale: 1:50
					Elevation: 88.80 mOD	End Date: 26/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
0.50	B1							MADE GROUND: Firm brown slightly sandy slightly gravelly silty CLAY with medium cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse.
0.50	ES1							
1.00	B3							
1.00	ES2							
1.50	D13				87.30	1.50		
1.50	ES3							Very stiff dark brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
1.50 - 3.00	B9							
1.50 - 1.95	SPT (S)	N=40 (2,5/8,10,12,10)	1.50					
2.00	ES4							
2.50	ES5							
3.00	D11				85.80	3.00		
3.00	ES6							Very stiff greyish brown slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
3.00 - 4.50	B10							
3.00 - 3.38	SPT (S)	50 (8,12/50 for 225mm)	3.00					
4.50	D12				84.30	4.50		
4.50 - 6.00	B14							Very stiff greyish brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
4.50 - 4.82	SPT (S)	50 (9,10/50 for 170mm)	4.50					
6.00	D15				82.80	6.00		
6.00 - 7.25	B16							Dense grey sandy subangular fine to coarse GRAVEL. Sand is fine to coarse.
6.00 - 6.38	SPT (S)	50 (9,11/50 for 225mm)	6.00					
7.25 - 7.50	B17				81.55	7.25		Very stiff greyish brown slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
7.50	D18				81.30	7.50		
7.50 - 9.00	B19							Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
7.50 - 7.88	SPT (S)	50 (10,15/50 for 230mm)	7.50					
9.00	D20				79.80	9.00		
9.00 - 9.30	B21							Dense greyish brown silty gravelly fine to coarse SAND. Gravel is subangular fine to medium.
9.00 - 9.45	SPT (S)	N=34 (6,5/7,9,8,10)	9.00					

Water

Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0

Water Strikes

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

Casing Details

To (m)	Diam (mm)
10.50	177

Water Added

From (m)	To (m)
1.20	10.50

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH06
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 2 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.50	720732.44 E 724045.25 N	10.50 m	26/09/2022	KW	Scale: 1:50
					Elevation: 88.80 mOD	End Date: 26/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
9.30 - 9.90	B22							Dense greyish brown silty gravelly fine to coarse SAND. Gravel is subangular fine to medium.		
9.90 - 10.50	B23									
10.50	D24				78.30	10.50		End of Borehole at 10.50m		

9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

Water Strikes

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

Casing Details

To (m)	Diam (mm)
10.50	177

Water Added

From (m)	To (m)
1.20	10.50

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH08
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 1 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.00	720870.40 E 724016.62 N	10.50 m	01/10/2022	KW	Scale: 1:50
					Elevation: 88.50 mOD	End Date: 01/10/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.50	B1							MADE GROUND: Soft brown slightly sandy gravelly CLAY with high cobble content brick fragments and plastic fragments. Sand is fine to coarse. Gravel is subangular fine to coarse.		
0.50	ES1									
1.00	B2									
1.00	ES2									
1.50	B3									
1.50	D8									
1.50	ES3									
1.50 - 1.95	SPT (S)	N=26 (2,8/7,6,6,7)	1.50		86.50	2.00				
2.00	ES4							Dense brown gravelly fine to coarse SAND. Gravel is subrounded fine to medium.		
2.00 - 2.50	B4									
2.50	ES5				86.00	2.50				
2.50 - 3.00	B5							Stiff brown slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
3.00	D9				85.50	3.00				
3.00	ES6									
3.00 - 4.50	B6									
3.00 - 3.45	SPT (S)	N=36 (3,7/7,9,10,10)	3.00					Very stiff dark grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.		
4.50	D10									
4.50 - 6.00	B7									
4.50 - 4.88	SPT (S)	50 (12,13/50 for 225mm)	4.50							
6.00	D11				82.50	6.00				
6.00 - 7.50	B19							Very stiff dark grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
6.00 - 6.00	SPT (S)	50 (25 for 0mm/50 for 0mm)	6.00							
7.50	D17				81.00	7.50				
7.50 - 9.00	B21							Very stiff greyish brown slightly sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
7.50 - 7.50	SPT (S)	50 (25 for 0mm/50 for 0mm)	7.50							
9.00	D20									
9.00 - 10.50	B22									
9.00 - 9.10	SPT (S)	50 (25 for 85mm/50 for 10mm)	9.00							

Water Strikes

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

Casing Details

To (m)	Diam (mm)
10.50	177

Water Added

From (m)	To (m)
1.20	10.50

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH08
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 2 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.00	720870.40 E 724016.62 N	10.50 m	01/10/2022	KW	Scale: 1:50
					Elevation: 88.50 mOD	End Date: 01/10/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
10.50	D23				78.00	10.50		Very stiff greyish brown slightly sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
								End of Borehole at 10.50m		

9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

Water Strikes

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

Casing Details

To (m)	Diam (mm)
10.50	177

Water Added

From (m)	To (m)
1.20	10.50

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH10
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 1 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.00	720905.54 E 723997.04 N	10.50 m	27/09/2022	KW	Scale: 1:50
					Elevation: 88.43 mOD	End Date: 28/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.50	B1							MADE GROUND: Soft brown slightly sandy slightly gravelly silty CLAY with low cobble and boulder content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subangular.		
0.50	ES1									
1.00	B3									
1.00	ES2									
1.50 - 1.95	SPT (S)	N=24 (2,3/5,6,6,7)	1.50		86.93	1.50		Stiff greyish brown slightly sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.		
2.30 - 3.00	B6									
2.50	ES3									
3.00	ES4				85.43	3.00		Very stiff dark grey slightly sandy gravelly silty CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.		
3.00 - 4.50	B7									
3.00 - 3.45	SPT (S)	N=47 (4,10/7,4,19,17)	3.00							
4.50	D10				83.93	4.50		Very stiff dark grey slightly sandy slightly gravelly silty CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.		
4.50 - 6.00	B9									
4.50 - 4.80	SPT (S)	50 (8,17/50 for 150mm)	4.50							
6.00	D11				82.43	6.00		Very stiff greyish brown slightly sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
6.00 - 7.50	B12									
6.00 - 6.20	SPT (S)	50 (25 for 80mm/50 for 125mm)	6.00							
7.50	D13				80.93	7.50		Very stiff greyish brown slightly sandy slightly gravelly silty CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
7.50 - 9.00	B14									
7.50 - 7.76	SPT (S)	50 (25 for 95mm/50 for 160mm)	7.50							
9.00	D15				79.43	9.00		Very stiff greyish brown slightly sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
9.00 - 10.50	B17									

Water Strikes

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

Casing Details

To (m)	Diam (mm)
10.50	177

Water Added

From (m)	To (m)
1.20	10.50

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_BH10
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates	Final Depth:	Start Date:	Driller:	Sheet 2 of 2
Sonic Drilling	Fraste CRS_XL Duo	0.00	10.00	720905.54 E 723997.04 N	10.50 m	27/09/2022	KW	Scale: 1:50
					Elevation: 88.43 mOD	End Date: 28/09/2022	Logger: DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
10.00 - 10.04	SPT (S)	50 (25 for 20mm/50 for 25mm)	10.0					Very stiff greyish brown slightly sandy gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
10.50	D16				77.93	10.50		End of Borehole at 10.50m		

9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

Water Strikes

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

Casing Details

To (m)	Diam (mm)
10.50	177

Water Added

From (m)	To (m)
1.20	10.50

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH01
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

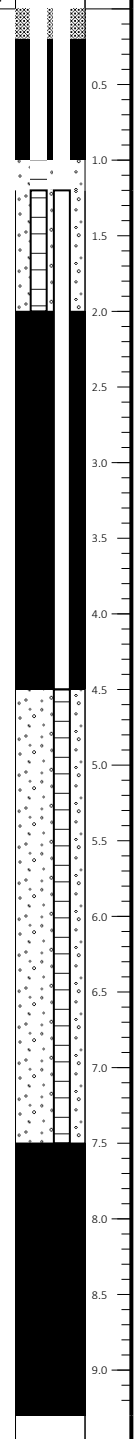
Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sonic Drilling	Fraste CRS_XL Duo	1.20	15.00	725622.03 E
Rotary Coring	Fraste CRS_XL Duo	15.00	30.00	723068.88 N

Final Depth:	30.00 m	Start Date:	19/09/2022	Driller:	KW	Sheet 1 of 4
						Scale: 1:50
Elevation:	8.84 mOD	End Date:	20/09/2022	Logger:	DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
0.00 - 0.50	B1							MADE GROUND: Firm brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.
0.50	ES1							
1.00	ES2							
1.50	ES3				7.34	1.50		
1.50 - 2.45	B4							MADE GROUND: Firm brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.
1.50 - 1.95	SPT (S)	N=27 (4,5/5,6,8,8)	1.00					
2.50	ES4				6.39	2.45		Brownish grey sandy clayey subangular fine to coarse GRAVEL. Sand is fine to coarse.
3.00	ES5				5.84	3.00		Dense grey subangular medium to coarse GRAVEL.
3.00 - 3.30	B8							
3.00 - 3.45	SPT (S)	N=33 (6,5/7,7,9,10)	1.00		5.54	3.30		Very stiff brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.
3.30 - 4.50	B9							
4.50 - 5.00	U62	Ublow=139 100% Recovery	4.50	4.00	4.34	4.50		Very stiff brown slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subrounded to subangular fine to coarse.
4.50 - 6.00	B10							
6.00	D11				2.84	6.00		Very stiff brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.
6.00 - 6.50	B12							
6.00 - 6.45	SPT (S)	N=43 (8,9/10,10,11,12)	4.50					
6.50 - 7.50	B13				2.34	6.50		Very stiff brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.
7.50	D14							
7.50 - 8.00	B16							
7.50 - 8.00	U63	Ublow=132 100% Recovery	7.50	4.00				
					0.84	8.00		Very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.
8.50 - 9.50	B17							
9.00	D15				-0.16	9.00		Very stiff greyish brown slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
9.00	D20							
9.00 - 10.40	B18							

Water

Backfill



Water Strikes

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

Casing Details

To (m)	Diam (mm)
15.00	177
30.00	200

Water Added

From (m)	To (m)
1.20	30.00

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Inspection pit hand dug to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Polymer/Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH01
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sonic Drilling	Fraste CRS_XL Duo	1.20	15.00	725622.03 E
Rotary Coring	Fraste CRS_XL Duo	15.00	30.00	723068.88 N

Final Depth:	30.00 m	Start Date:	19/09/2022	Driller:	KW	Sheet 2 of 4
						Scale: 1:50
Elevation:	8.84 mOD	End Date:	20/09/2022	Logger:	DC	FINAL

Depth (m)	Sample / Tests	Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
9.00 - 9.34	SPT (S)	50 (7,10/50 for 185mm)					9.00					Very stiff greyish brown slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
10.40 - 10.50	B19								-1.56	10.40				
10.50	D21								-1.66	10.50		Very stiff brown slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
10.50 - 10.70	U64	Ublow=150 20% Recovery					10.5	6.00				Very stiff greyish brown slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
10.50 - 12.00	B22													
12.00	D23								-3.16	12.00		Very stiff brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
12.00	D26													
12.00 - 13.30	B24													
12.00 - 12.24	SPT (C)	50 (12,13/50 for 95mm)					12.0							
13.30 - 13.50	B25								-4.46	13.30				
13.50	D29								-4.66	13.50		Very stiff grey slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
13.50	U4	Ublow=98 0% Recovery										Very stiff greyish brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
13.50 - 13.80	B28								-4.96	13.80		Very stiff dark brownish grey slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
13.80 - 15.00	B27													
15.00	D30						15.0							
15.00 - 15.60	B31													
15.00 - 15.30	SPT(C)	50 (10,15/50 for 150mm)	30											
									-6.76	15.60		NO RECOVERY: Driller notes sands and gravels. Material likely washed out.		
										(0.80)				
16.40 - 16.50	B34								-7.56	16.40				
16.50							16.5					Very stiff grey slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
16.50	D32													
16.50 - 18.00	B35													
16.50 - 16.58	SPT(C)	50 (25 for 0mm/50 for 75mm)	100											
										(3.10)				
18.00							18.0							
18.00	D33													
18.00 - 19.50	B37													

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

Casing Details		Water Added	
To (m)	Diam (mm)	From (m)	To (m)
15.00	177	1.20	30.00
30.00	200		

Remarks

Inspection pit hand dug to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Polymer/Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH01
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)
Inspection Pit	Hand Tools	0.00	1.20
Sonic Drilling	Fraste CRS_XL Duo	1.20	15.00
Rotary Coring	Fraste CRS_XL Duo	15.00	30.00

Coordinates: 725622.03 E, 723068.88 N

Final Depth: 30.00 m | Start Date: 19/09/2022 | Driller: KW

Elevation: 8.84 mOD | End Date: 20/09/2022 | Logger: DC

Sheet 3 of 4 | Scale: 1:50 | FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
18.00 - 18.08	SPT(C) 50 (25 for 10mm/50 for 75mm)	100									Very stiff grey slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
19.50								-10.66	19.50				
19.50	D36								(0.50)		NO RECOVERY: Driller notes sands and gravels. Material likely washed out.		
20.00	D40							-11.16	20.00				
20.00 - 20.55	B39	70							(0.55)		Very stiff grey slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
20.52 - 21.00	B38							-11.71	20.55		Dense greyish brown gravelly fine to coarse SAND with low cobble content. Gravel is subangular fine to coarse.		
21.00													
21.00	D41												
21.00 - 22.50	B43	30											
22.00	D42								(3.35)				
22.50													
23.30 - 23.55	B44	30											
23.30 - 23.55	B47												
23.55 - 23.90	B45												
23.90 - 24.00	B46							-15.06	23.90				
24.00						24.0		-15.16	24.00		Very stiff brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
24.00	D48										Very stiff greyish brown slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
24.00 - 24.60	B49												
24.00 - 24.26	SPT(C) 50 (10,12/50 for 105mm)	100									*24.60-24.95m: Brown gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to medium.*		
24.60 - 24.95	B50												
24.95 - 25.15	B51												
25.15 - 25.50	B52												
25.50						25.5							
25.50	D53												
25.50 - 27.00	B54												
25.50 - 25.80	SPT(S) 50 (10,15/50 for 150mm)	100							(4.50)				
27.00						27.0							
27.00	D55												
27.00 - 28.50	B56												
27.00 - 27.38	SPT(C) 50 (9,12/50 for 225mm)	100											
		TCR	SCR	RQD	FI								

Water Strikes

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

Casing Details

To (m)	Diam (mm)
15.00	177
30.00	200

Water Added

From (m)	To (m)
1.20	30.00

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Inspection pit hand dug to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Polymer/Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH01
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)
Inspection Pit	Hand Tools	0.00	1.20
Sonic Drilling	Fraste CRS_XL Duo	1.20	15.00
Rotary Coring	Fraste CRS_XL Duo	15.00	30.00

Coordinates: 725622.03 E, 723068.88 N

Final Depth: 30.00 m | Start Date: 19/09/2022 | Driller: KW

Elevation: 8.84 mOD | End Date: 20/09/2022 | Logger: DC

Sheet 4 of 4 | Scale: 1:50 | FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
											Very stiff greyish brown slightly sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
28.50						28.5		-19.66	28.50				
28.50	D57										Very stiff greyish brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
28.50 - 28.88	SPT(C) 50 (9,10/50 for 225mm)												
28.70 - 29.50	B58												
29.00	D60	80							(1.50)				
29.50 - 30.00	B59												
30.00								-21.16	30.00		End of Borehole at 30.00m		
30.00	D61												

TCR	SCR	RQD	FI

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Inspection pit hand dug to 1.20m.

Casing Details

To (m)	Diam (mm)
15.00	177
30.00	200

Water Added

From (m)	To (m)
1.20	30.00

Core Barrel	Flush Type	Termination Reason	Last Updated
	Polymer/Water	Terminated at scheduled depth.	04/05/2023

AGS

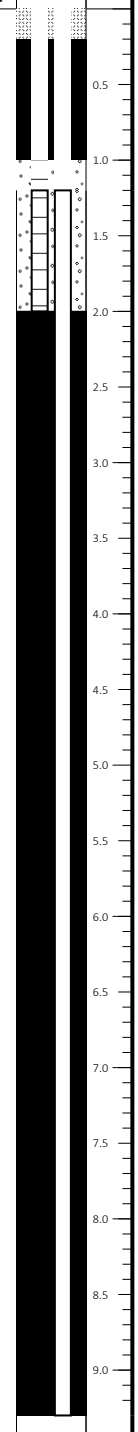
CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH02
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sconic Drilling	Fraste CRS_XL Duo	1.20	30.00	725721.13 E
				723119.98 N

Final Depth:	30.00 m	Start Date:	13/09/2022	Driller:	KW	Sheet 1 of 4
						Scale: 1:50
Elevation:	7.71 mOD	End Date:	16/09/2022	Logger:	DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
0.00		13-09-2022	13.0					
0.25 - 1.25	B2				7.46	0.25		MADE GROUND: Dark grey sandy silty subangular fine to medium GRAVEL. Sand is fine to coarse.
0.50 - 1.25	ES1							MADE GROUND: Soft brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.
0.90 - 2.10	ES2							
1.20 - 1.65	SPT (S)	N=41 (6,6/7,11,11,12)	1.50		6.46	1.25		MADE GROUND: Dense brown sandy clayey subrounded fine to coarse GRAVEL. Sand is fine to coarse.
1.25 - 1.50	B3				6.21	1.50		MADE GROUND: Dense brown gravelly fine to coarse SAND. Gravel is subrounded fine to medium.
1.50 - 1.70	ES3							
2.00	ES4							
2.10 - 3.00	B9				5.61	2.10		Dense light grey sandy subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subrounded.
2.50	ES5							
3.00	D24				4.71	3.00		Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
3.00	ES6							
3.00 - 4.50	B10							
3.00 - 3.45	SPT (S)	N=38 (3,4/7,9,10,12)	3.00					
4.50 - 5.00	U44	Ublow=129 100% Recovery	4.50	3.00	3.21	4.50		Very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.
4.50 - 5.30	B11							
5.30 - 5.90	B12				2.41	5.30		Dense brown slightly gravelly silty fine to coarse SAND. Gravel is subangular fine.
5.90 - 6.00	B13				1.81	5.90		
6.00	D25				1.71	6.00		Very stiff brown sandy silty CLAY. Sand is fine to medium.
6.00 - 6.50	B14							Dense brown gravelly silty fine to coarse SAND with occasional shell fragments. Gravel is subangular fine to medium.
6.00 - 6.45	SPT (S)	N=34 (3,7/8,10,7,9)	6.00					
6.50 - 6.70	B15				1.21	6.50		Very stiff greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular fine to coarse.
6.70 - 7.00	B16				1.01	6.70		Dense light grey sandy subangular fine to coarse GRAVEL. Sand is fine to coarse.
7.00 - 7.50	B17				0.71	7.00		Very stiff greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded to subangular fine to coarse.
7.20 - 7.85	U45	Ublow=250 100% Recovery	7.50	4.00				
7.50 - 8.50	B18				0.21	7.50		Very stiff brown slightly sandy gravelly CLAY with occasional shell fragments. Sand is fine to coarse. Gravel is subrounded fine to coarse.
8.50 - 9.00	B19				-0.79	8.50		Very stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is angular fine to coarse.
9.00	D26				-1.29	9.00		Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
9.00 - 10.30	B20							
9.00 - 9.45	SPT ()	N=50 (3,6/10,13,17,10)	9.00					



Water Strikes

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

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH02
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sconic Drilling	Fraste CRS_XL Duo	1.20	30.00	725721.13 E
				723119.98 N

Final Depth:	30.00 m	Start Date:	13/09/2022	Driller:	KW	Sheet 2 of 4
						Scale: 1:50
Elevation:	7.71 mOD	End Date:	16/09/2022	Logger:	DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
10.30 - 10.50	B21				-2.59	10.30				
10.50	D27				-2.79	10.50		Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is angular fine to medium.		
10.50 - 11.10	B22							Very stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
10.50 - 10.88	SPT ()	50 (4,8/50 for 225mm)	10.5							
11.10 - 12.00	B23				-3.39	11.10		Very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.		
12.00 - 13.50	B28				-4.29	12.00		Very stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.		
12.00 - 12.45	SPT (S)	N=50 (9,12/16,16,12,6)								
13.50 - 15.00	B29				-5.79	13.50		Very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.		
15.00 - 15.60	B30									
15.00 - 15.45	SPT (S)	N=50 (4,8/9,12,12,17)								
15.60 - 16.50	B31				-7.89	15.60		Very stiff brownish grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
16.50 - 18.00	B32									
16.50 - 16.92	SPT (S)	50 (5,8/50 for 275mm)								
18.00 - 19.50	B33				-10.29	18.00		Very stiff dark grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.		
18.00 - 18.27	SPT (S)	50 (10,15/50 for 125mm)								

9.5 10.0 10.5 11.0 11.5 12.0 12.5 13.0 13.5 14.0 14.5 15.0 15.5 16.0 16.5 17.0 17.5 18.0 18.5

Water Strikes

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

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH02
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sconic Drilling	Fraste CRS_XL Duo	1.20	30.00	725721.13 E
				723119.98 N

Final Depth:	30.00 m	Start Date:	13/09/2022	Driller:	KW	Sheet 3 of 4
						Scale: 1:50
Elevation:	7.71 mOD	End Date:	16/09/2022	Logger:	DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
19.00	D34							Very stiff dark grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.		
19.50 - 21.00	B35									
19.50 - 19.88	SPT (S)	50 (9,10/50 for 225mm)								
21.00	D36									
21.00 - 22.50	B37									
21.00 - 21.15	SPT (S)	50 (10,15/50 for 0mm)								
22.50	D38									
22.50 - 24.00	B40									
22.50 - 22.88	SPT (S)	50 (8,9/50 for 225mm)								
24.00 - 25.50	B39									
24.00 - 24.16	SPT (S)	50 (10,15/50 for 10mm)								
25.50 - 27.00	B41									
25.50 - 25.80	SPT (S)	50 (10,12/50 for 150mm)								
27.00 - 28.50	B42									

19.0 19.5 20.0 20.5 21.0 21.5 22.0 22.5 23.0 23.5 24.0 24.5 25.0 25.5 26.0 26.5 27.0 27.5

Water Strikes

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

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH02
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sconic Drilling	Fraste CRS_XL Duo	1.20	30.00	725721.13 E
				723119.98 N

Final Depth:	30.00 m	Start Date:	13/09/2022	Driller:	KW	Sheet 4 of 4
						Scale: 1:50
Elevation:	7.71 mOD	End Date:	16/09/2022	Logger:	DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
28.50 - 30.00	B43							Very stiff dark grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.		
					-22.29	30.00		End of Borehole at 30.00m		

28.0 28.5 29.0 29.5 30.0 30.5 31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0 35.5 36.0 36.5 37.0

Water Strikes

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

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH03
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sonic Drilling	Fraste CRS-XL Duo	1.20	30.00	725882.85 E
				723092.03 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 4
30.00 m	08/09/2022	KW	Scale: 1:50
Elevation: 10.54 mOD	**End Date:** 12/09/2022	**Logger:** DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
0.00 - 0.50	B1							MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with low boulder content, occasional rootlets, and fragments of concrete red brick and plastic. Sand is fine to coarse. Gravel is subrounded to subangular.
0.10 - 9.00	B29							
0.50	ES1							
0.50 - 1.00	B2							
1.00	ES2							
						1.20		
1.20 - 1.50	B6				9.34			MADE GROUND: Stiff brown slightly sandy gravelly silty CLAY. Sand is fine to medium. Gravel is subangular fine to medium.
1.40 - 1.60	ES3				9.04	1.50		
1.50	D5							NO RECOVERY - Driller notes a void/possible drain at 1.70m.
1.50 - 1.58	SPT (S)	Hammer SN = 1398	1.50	1.00				
2.45 - 2.55	ES4				8.09	2.45		Very stiff greyish brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.
2.45 - 2.60	B8				7.94	2.60		
2.60 - 3.00	B12							Light grey mottled granite BOULDER with a little sand and gravel.
3.00 - 3.45	D10				7.54	3.00		Stiff brown slightly sandy gravelly silty CLAY. Sand is fine. Gravel is subangular fine to medium.
3.00 - 4.50	B11							
3.00 - 3.45	SPT (S)	N=29 (1,3/5,6,8,10) Hammer SN = 1398	3.00	1.60				
4.50	D54				6.04	4.50		Stiff dark brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.
4.50 - 5.00	U23	Ublow=68 100% Recovery	4.50	3.00				
4.50 - 6.00	B12							
5.00	D55							
5.00 - 5.50	B25							
6.00 - 7.50	B13							
6.00 - 6.45	SPT (S)	N=31 (2,3/5,7,9,10) Hammer SN = 1398	6.00	3.50				
6.50	D56							
6.50 - 7.00	B26							
7.50	D57				3.04	7.50		Dense brown slightly clayey gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to coarse.
7.50 - 7.75	U24	Ublow=150 0% Recovery	7.50	3.50				
7.50 - 7.80	B27				2.74	7.80		Dense brown slightly clayey sandy subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.
7.50 - 9.00	B14							
7.80	D58				2.44	8.10		Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.
7.80 - 8.10	B28							
8.10	D59							
9.00 - 10.50	B15							
9.00 - 9.43	SPT (S)	50 (7,10/50 for 275mm) Hammer SN = 1398	9.00	4.00				

Water | Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH03
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sonic Drilling	Fraste CRS-XL Duo	1.20	30.00	725882.85 E
				723092.03 N

Final Depth:	30.00 m	Start Date:	08/09/2022	Driller:	KW	Sheet 2 of 4
						Scale: 1:50
Elevation:	10.54 mOD	End Date:	12/09/2022	Logger:	DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
9.50	D60							Very stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
9.50 - 10.00	B30									
10.50 - 10.80	U39	Ublow=100 0% Recovery								
10.50 - 12.00	B16									
11.00	D61									
11.00 - 11.50	B31									
12.00 - 13.50	B17				-1.46	12.00				
12.00 - 12.38	SPT (S)	50 (11,14/50 for 225mm) Hammer SN = 1398	12.0	4.00				Very dense brown gravelly very silty fine to coarse SAND with low cobble content. Gravel is subangular to subrounded fine to medium.		
12.50	D62									
12.50 - 13.00	B32									
13.50 - 15.00	B18									
13.50 - 13.95	SPT (C)	N=49 (6,9/10,12,12,15) Hammer SN = 1398	13.5	4.00						
14.00	D63									
14.00 - 14.50	B33									
15.00 - 16.50	B19									
15.00 - 15.30	SPT (C)	40 (6,10/40 for 150mm) Hammer SN = 1398	15.0	8.00						
15.50	D64									
15.50 - 16.00	B34									
16.50 - 17.00	B20				-5.96	16.50				
16.50 - 16.88	SPT (S)	50 (15,10/50 for 225mm) Hammer SN = 1398	16.5	8.00				Very dense dark brown slightly silty fine to coarse SAND and subangular to subrounded fine to coarse GRAVEL with low cobble content.		
17.00	D65									
17.00 - 17.50	B35									
18.00 - 19.50	B21				-7.46	18.00				
18.00 - 18.38	SPT (S)	50 (14,11/50 for 225mm) Hammer SN = 1398	18.0	8.00				Very dense brown slightly silty sandy subangular to subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse.		
18.50	D66									
18.50 - 19.00	B36									

Water Strikes

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

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH03
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sonic Drilling	Fraste CRS-XL Duo	1.20	30.00	725882.85 E
				723092.03 N

Final Depth:	30.00 m	Start Date:	08/09/2022	Driller:	KW	Sheet 3 of 4
						Scale: 1:50
Elevation:	10.54 mOD	End Date:	12/09/2022	Logger:	DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								Very dense brown slightly silty sandy subangular to subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse.		
19.50	D67									
19.50 - 20.00	B37									
19.50 - 22.00	B22									
19.50 - 19.73	SPT (S)	50 (25 for 75mm/50 for 150mm) Hammer SN = 1398	19.5	8.00						
20.00	D68									
20.00 - 21.00	B39									
20.00 - 21.00	B46									
21.00 - 22.50	B40				-10.46	21.00				
21.00 - 21.30	SPT (S)	50 (8,12/50 for 150mm)	21.0	4.00				Very stiff dark greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.		
21.50	D69									
21.50 - 22.00	B47									
22.50 - 24.00	B41									
22.50 - 22.88	SPT (S)	50 (10,1/50 for 225mm)	22.5	4.00						
23.00	D70									
23.00 - 23.50	B48									
24.00 - 25.50	B42									
24.00 - 24.30	SPT (S)	50 (9,16/50 for 150mm)	24.0	4.00						
24.50	D71									
24.50 - 25.00	B49									
25.50 - 27.00	B43				-14.96	25.50				
25.50 - 25.72	SPT (S)	50 (20,5/50 for 75mm)	25.5	4.00				Very stiff dark greyish brown slightly sandy slightly gravelly CLAY with low cobble and boulder content. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles are subrounded. Boulders are subrounded.		
26.00	D72									
26.00 - 26.50	B50									
27.00 - 28.50	B44									
27.50	D73									
27.50 - 28.00	B51									

Water Strikes

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

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH03
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sonic Drilling	Fraste CRS-XL Duo	1.20	30.00	725882.85 E
				723092.03 N

Final Depth:	30.00 m	Start Date:	08/09/2022	Driller:	KW	Sheet 4 of 4
						Scale: 1:50
Elevation:	10.54 mOD	End Date:	12/09/2022	Logger:	DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
28.50 - 30.00	B45							Very stiff dark greyish brown slightly sandy slightly gravelly CLAY with low cobble and boulder content. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles are subrounded. Boulders are subrounded.		
28.50 - 28.72	SPT (S)	50 (21,4/50 for 75mm)	28.5	4.00						
29.00	D74									
29.00 - 29.50	B52									
					-19.46	30.00		End of Borehole at 30.00m		

28.0 28.5 29.0 29.5 30.0 30.5 31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0 35.5 36.0 36.5 37.0

Water Strikes

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

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH04
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sonic Drilling	Fraste CRS-XL Duo	0.00	30.00	725932.62 E
				723154.07 N

Final Depth:	30.00 m	Start Date:	05/09/2022	Driller:	KW+KW	Sheet 1 of 4
						Scale: 1:50
Elevation:	10.83 mOD	End Date:	08/09/2022	Logger:	DC	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					10.63	0.20		TOPSOIL: Firm brown slightly sandy slightly gravelly silty CLAY with occasional rootlets. Sand is fine to coarse. Gravel is subrounded fine to medium.
					10.43	0.40		
0.50	ES1							MADE GROUND: Firm dark brown slightly sandy slightly gravelly CLAY Sand is fine to coarse. Gravel is subrounded fine to medium.
					10.15	0.68		
1.00	ES2							MADE GROUND: Soft light brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.
1.00 - 1.45	SPT (S)	N=50 (1,2/6,6,4,34)	0.00	0.00	9.63	1.20		MADE GROUND: Stiff light greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.
1.10 - 1.20	B6							
1.20 - 1.60	D1				9.38	1.45		
1.20 - 1.60	D56							MADE GROUND: Very stiff brown slightly sandy slightly gravelly silty CLAY Sand is fine to coarse. Gravel is subangular fine to medium.
1.50	ES3				9.13	1.70		MADE GROUND: Light grey possible CONCRETE.
2.00 - 2.30	B7							Very stiff greyish brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is angular fine to medium.
2.00 - 2.30	ES4							
					8.28	2.55		NO RECOVERY
3.00 - 3.15	ES5				7.83	3.00		Firm locally soft brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.
3.00 - 3.45	D2							
3.00 - 3.45	D57							
3.00 - 3.45	SPT (S)	N=5 (1,2/1,1,2,1)	3.00	0.00				
3.20 - 3.50	B8							
3.20 - 3.50	ES6							
4.00 - 4.25	B9				6.83	4.00		Very stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.
4.50	B10				6.33	4.50		Very stiff light brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.
4.50 - 4.95	D3							
4.50 - 4.95	SPT (S)	N=32 (3,5/5,7,9,11)	4.50	0.50				
5.30 - 5.70	B11							
6.00 - 6.40	B12							
6.00 - 6.45	D4							
6.00 - 6.45	SPT (S)	N=48 (6,7/10,10,14,14)	6.00	0.50				
6.50 - 6.80	B13				4.33	6.50		Very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subrounded fine to medium.
					4.03	6.80		Very stiff light brown slightly sandy slightly gravelly clayey SILT. Sand is fine. Gravel is subrounded fine to medium.
7.00 - 7.50	B14							
7.50 - 7.80	B15				3.33	7.50		Very dense light grey silty sandy subangular fine to medium GRAVEL with frequent shell fragments. Sand is fine to coarse.
7.50 - 7.85	D5							
7.50 - 7.82	SPT (S)	50 (7,12/50 for 170mm)	7.50	0.50	3.03	7.80		Very dense greyish brown sandy silty clayey subrounded fine to coarse GRAVEL with frequent shell fragments . Sand is fine to coarse.
8.20 - 8.50	B16							Very stiff brown slightly sandy slightly gravelly silty CLAY with occasional shell fragments. Sand is fine to coarse. Gravel is subangular fine to medium.
8.50 - 8.65	B17				2.33	8.50		Very dense brownish grey sandy clayey subangular medium to coarse GRAVEL with occasional shell fragments. Sand is fine to coarse.
8.65 - 9.00	B18				2.18	8.65		Very stiff brown silty CLAY.
9.00 - 9.18	B19				1.83	9.00		Very stiff brown sandy silty CLAY. Sand is fine to medium.
9.00 - 9.15	SPT (S)	50 (25 for 75mm/50 for 75mm)	9.00	4.50	1.65	9.18		Very dense brown fine to coarse SAND with occasional shell fragments.
9.18 - 9.25	B20				1.58	9.25		

Water | Backfill

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH04
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sonic Drilling	Fraste CRS-XL Duo	0.00	30.00	725932.62 E
				723154.07 N

Final Depth:	30.00 m	Start Date:	05/09/2022	Driller:	KW+KW	Sheet 2 of 4
Elevation:	10.83 mOD	End Date:	08/09/2022	Logger:	DC	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
9.25 - 9.74	B21									
9.74 - 10.70	B22				1.09	9.74		Very stiff dark greyish brown slightly sandy slightly gravelly silty CLAY with occasional shell fragments. Sand is fine to coarse. Gravel is subangular fine.		
10.50 - 10.95	SPT (C)	N=50 (8,10/12,12,14,12)	10.5	4.50						
10.70 - 11.50	B23				0.13	10.70		Very stiff light greyish brown sandy gravelly SILT with occasional shell fragments. . Sand is fine to coarse. Gravel is subrounded to subangular fine to coarse.		
11.50 - 11.95	B24				-0.67	11.50		Very dense light brownish grey sandy gravelly SILT with occasional shell fragments. Sand is fine to coarse. Gravel is subangular fine to medium.		
11.95 - 12.25	B25				-1.12	11.95		Very dense light greyish brown silty gravelly fine to coarse SAND with occasional shell fragments. Gravel is subangular fine to medium.		
12.00 - 12.40	SPT (C)	50 (7,11/50 for 255mm)	12.0	5.00						
12.25 - 12.38	B26				-1.42	12.25		Very dense light greyish brown sandy clayey angular fine to medium GRAVEL. Sand is fine to coarse.		
12.38 - 12.70	B27				-1.55	12.38		Light grey BOULDERS.		
12.70 - 13.00	B28				-1.87	12.70		Very dense dark grey sandy subangular fine to medium GRAVEL. Sand is fine to coarse.		
13.00 - 13.15	B29				-2.17	13.00		Very stiff greyish brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
13.15 - 13.50	B30				-2.32	13.15		Very dense light brown clayey sandy subangular fine to coarse GRAVEL. Sand is fine to coarse.		
13.50 - 13.80	B31				-2.67	13.50		Very dense dark brownish grey sandy silty subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subrounded.		
13.50 - 13.65	SPT (C)	50 (25 for 75mm/50 for 75mm)	13.5	5.00						
13.80 - 14.20	B32				-2.97	13.80		Very dense light greyish brown sandy silty subangular fine to coarse GRAVEL with low boulder content. Sand is fine to coarse.		
14.20 - 14.40	B33				-3.37	14.20		Very dense dark grey sandy silty subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.		
14.40 - 14.60	B34				-3.57	14.40		Light grey BOULDERS.		
14.60 - 15.00	B35				-3.77	14.60		Very dense light greyish brown sandy subrounded to subangular fine to coarse GRAVEL. Sand is fine to coarse.		
15.00 - 16.50	B36				-4.17	15.00		Very dense light greyish brown sandy silty subrounded to subangular fine to coarse GRAVEL. Sand is fine to coarse.		
15.00 - 15.42	SPT (C)	50 (7,10/50 for 270mm)	15.0	9.00						
16.50 - 16.92	SPT (C)	50 (8,10/50 for 275mm)	16.5	10.0						
17.00 - 17.70	B37									
17.70 - 18.00	B38				-6.87	17.70		Very dense greyish brown sandy clayey subrounded to subangular fine to coarse GRAVEL. Sand is fine to coarse.		
18.00 - 19.50	B39				-7.17	18.00		Very dense greyish brown sandy subrounded to subangular fine to coarse GRAVEL. Sand is fine to coarse.		
18.00 - 18.38	SPT (C)	50 (8,9/50 for 225mm)	18.0	10.0						

Water Strikes

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

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH04
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sonic Drilling	Fraste CRS-XL Duo	0.00	30.00	725932.62 E
				723154.07 N

Final Depth:	30.00 m	Start Date:	05/09/2022	Driller:	KW+KW	Sheet 3 of 4
Elevation:	10.83 mOD	End Date:	08/09/2022	Logger:	DC	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
19.50 - 21.00	B40				-8.67	19.50				
19.50 - 19.88	SPT (C)	50 (9,10/50 for 225mm)	19.5	10.0				Very dense greyish brown silty sandy subrounded to subangular fine to coarse GRAVEL. Sand is fine to coarse.		
21.00 - 22.70	B47				-10.17	21.00				
21.00 - 21.30	SPT (C)	50 (7,10/50 for 155mm)	21.0	10.0				Very dense greyish brown sandy subrounded to subangular fine to coarse GRAVEL. Sand is fine to coarse.		
22.50 - 22.85	SPT (C)	50 (7,11/50 for 200mm)	22.5	10.0						
22.70 - 23.00	B48				-11.87	22.70		Very dense grey slightly sandy subrounded to subangular fine to medium GRAVEL. Sand is fine to coarse.		
23.00 - 23.15	B49				-12.17	23.00		COBBLES (possibly granite)		
23.15 - 23.25	B50				-12.32	23.15		COBBLES		
23.25 - 24.00	B51				-12.42	23.25		Very dense greyish brown sandy subrounded to subangular medium to coarse GRAVEL. Sand is fine to coarse.		
24.00 - 24.22	SPT (C)	50 (10,15/50 for 75mm)	24.0	10.0	-13.17	24.00		NO RECOVERY		
24.50 - 25.50	B52				-13.67	24.50		Very dense subrounded to subangular fine to coarse GRAVEL,		
25.50 - 25.70	B53				-14.67	25.50				
25.50 - 25.65	SPT (C)	50 (25 for 75mm/50 for 75mm)	25.5	7.00	-14.87	25.70		Very dense brown sandy subrounded to subangular medium to coarse GRAVEL. Sand is fine to coarse.		
25.70 - 26.10	B54							Very stiff brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular fine to medium.		
26.10 - 27.00	B55				-15.27	26.10		Very stiff dark grey slightly sandy slightly gravelly silty CLAY . Sand is fine to coarse. Gravel is subrounded to subangular fine to coarse.		

Water Strikes

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

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_BH04
	Client: Dublin Array Offshore Windfarm	
	Client's Rep: Gavin and Doherty Geosolutions (GDG)	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Inspection Pit	Hand Tools	0.00	1.20	
Sonic Drilling	Fraste CRS-XL Duo	0.00	30.00	725932.62 E
				723154.07 N

Final Depth:	30.00 m	Start Date:	05/09/2022	Driller:	KW+KW	Sheet 4 of 4
Elevation:	10.83 mOD	End Date:	08/09/2022	Logger:	DC	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
28.50 - 30.00	B58									
28.50 - 28.72	SPT (C)	50 (9,16/50 for 75mm)	28.5	4.50						
					-19.17	30.00		End of Borehole at 30.00m		

28.0 28.5 29.0 29.5 30.0 30.5 31.0 31.5 32.0 32.5 33.0 33.5 34.0 34.5 35.0 35.5 36.0 36.5 37.0

Water Strikes

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

Casing Details

To (m)	Diam (mm)
30.00	177

Water Added

From (m)	To (m)
1.20	30.00

Chiselling Details

From (m)	To (m)	Time (hh:mm)

Remarks

Inspection pit hand dug to 1.20m.
No noticeable groundwater strikes encountered - water added during drilling.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	04/05/2023

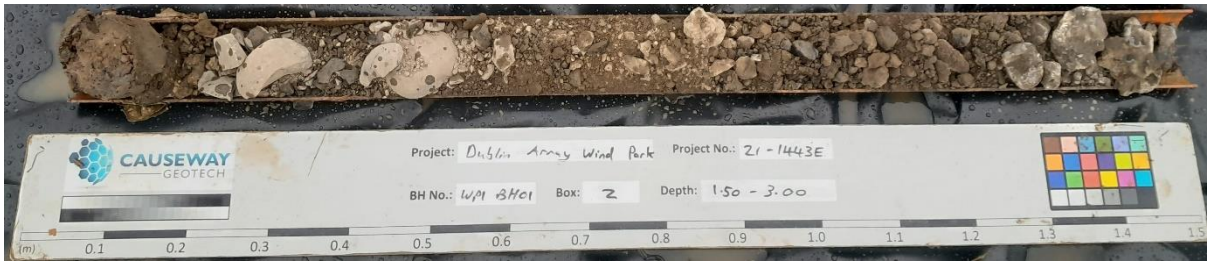
AGS

CAUSEWAY GEOTECH

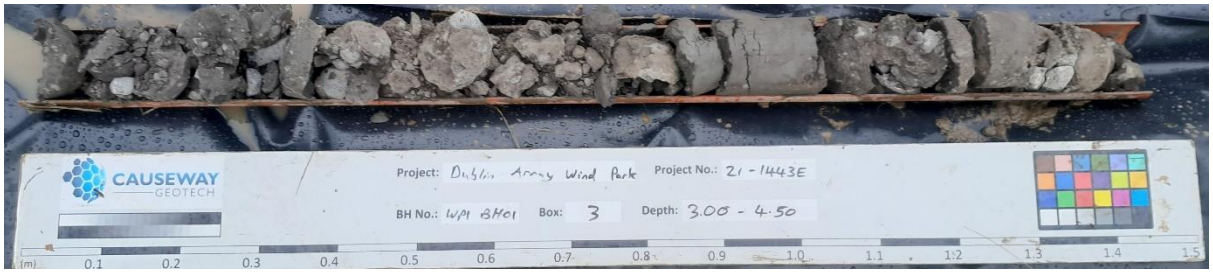
APPENDIX C

CORE PHOTOGRAPHS

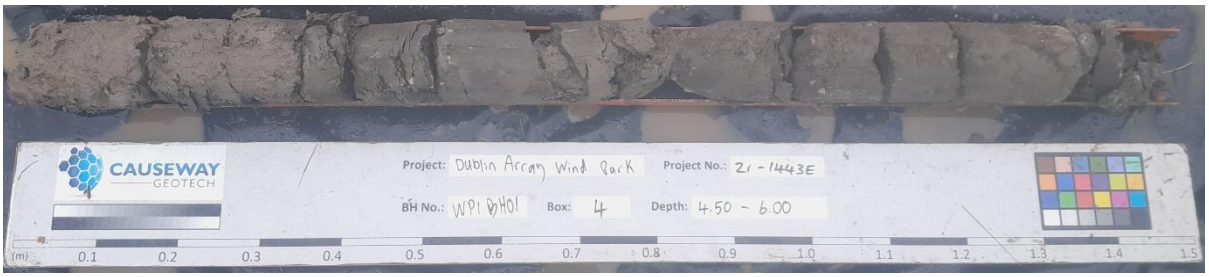
WP1_BH01: Box 1 (0.00-1.50m)



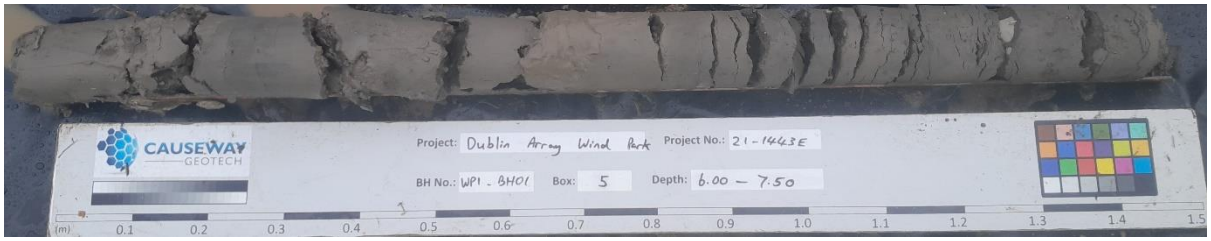
WP1_BH01: Box 2 (1.50-3.00m)



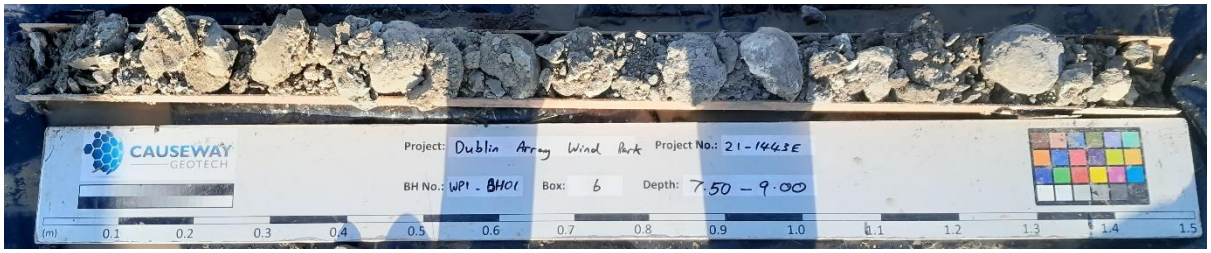
WP1_BH01: Box 3 (3.00-4.50m)



WP1_BH01: Box 4 (4.50-6.00m)

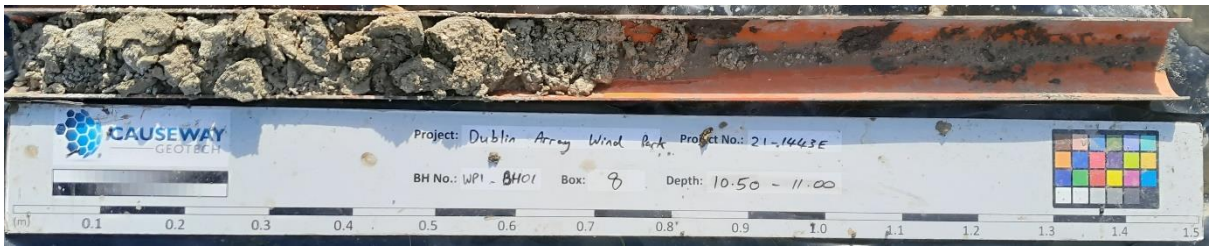


WP1_BH01: Box 5 (6.00-7.50m)

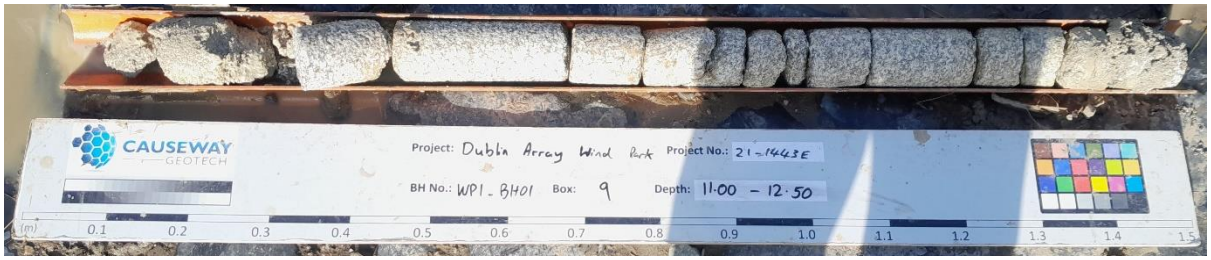


WP1_BH01: Box 6 (7.50-9.00m)

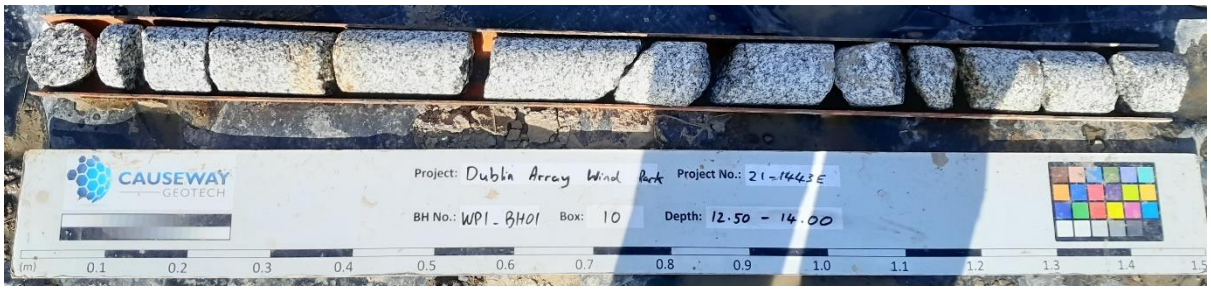
WP1_BH01: Box 7 (9.00-10.50m)



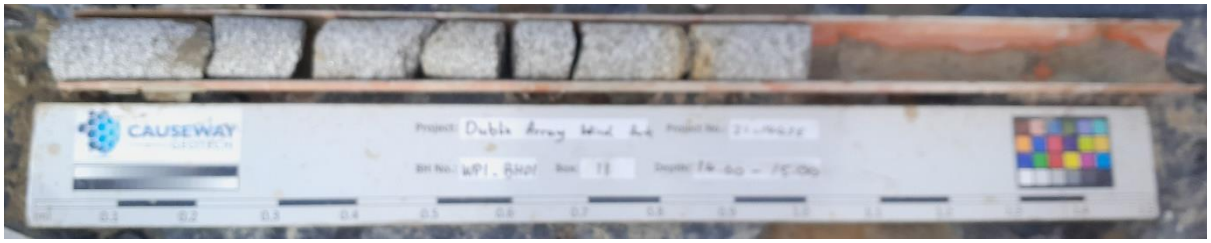
WP1_BH01: Box 8 (10.50-11.00m)



WP1_BH01: Box 9 (11.00-12.50m)



WP1_BH01: Box 10 (12.50-14.00m)



WP1_BH01: Box 11 (14.00-15.50m)

WP1_BH02: Box 1 (1.50-3.00m)

WP1_BH02: Box 2 (3.00-4.50m)

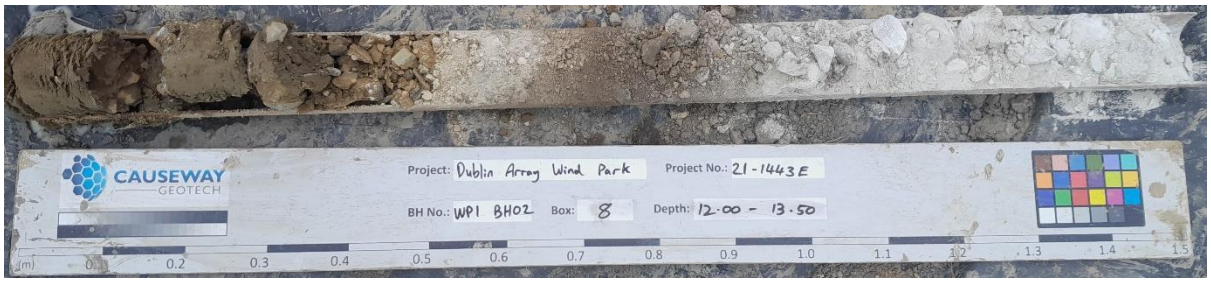
WP1_BH02: Box 3 (4.50-6.00m)

WP1_BH02: Box 4 (6.00-7.50m)

WP1_BH02: Box 5 (7.50-9.00m)

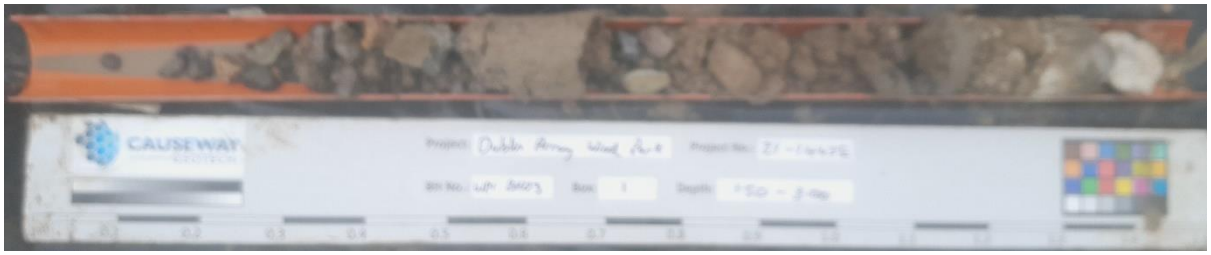
WP1_BH02: Box 6 (9.00-10.50m)

WP1_BH02: Box 7 (10.50-12.00m)

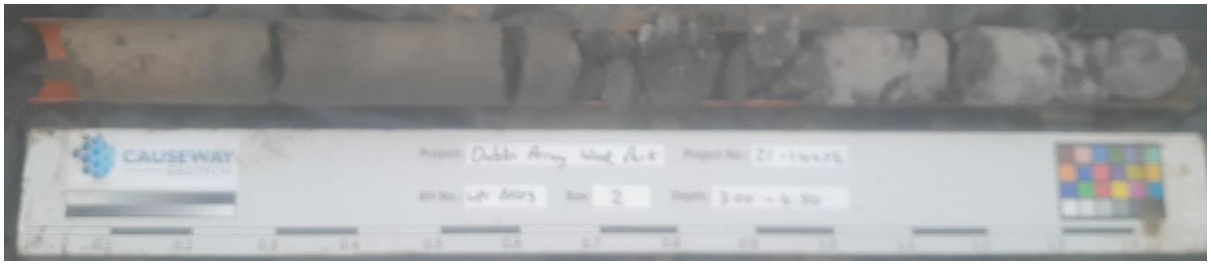


WP1_BH02: Box 8 (12.00-13.50m)

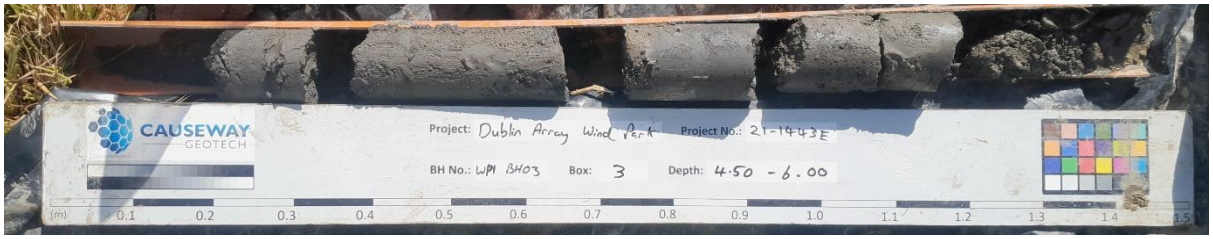
WP1_BH02: Box 9 (13.50-15.00m)



WP1_BH03: Box 1 (1.50-3.00m)



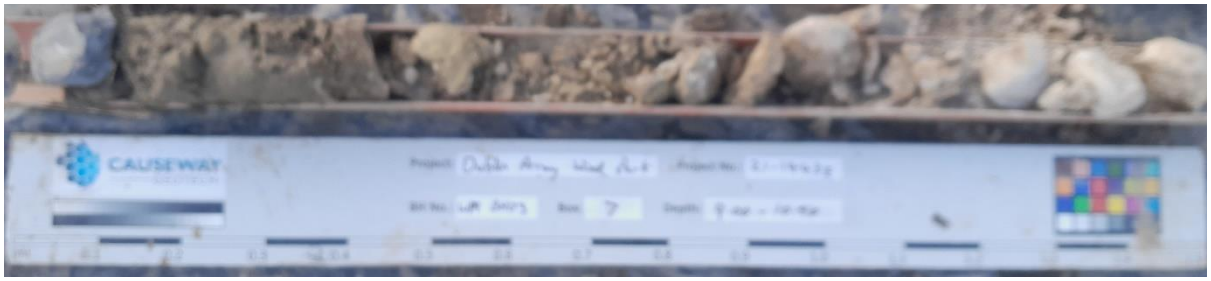
WP1_BH03: Box 2 (3.00-4.50m)



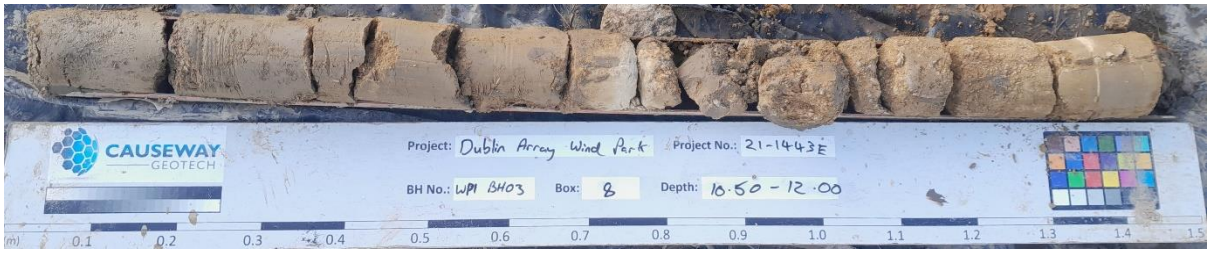
WP1_BH03: Box 3 (4.50-6.00m)

WP1_BH03: Box 4 (6.00-7.50m)

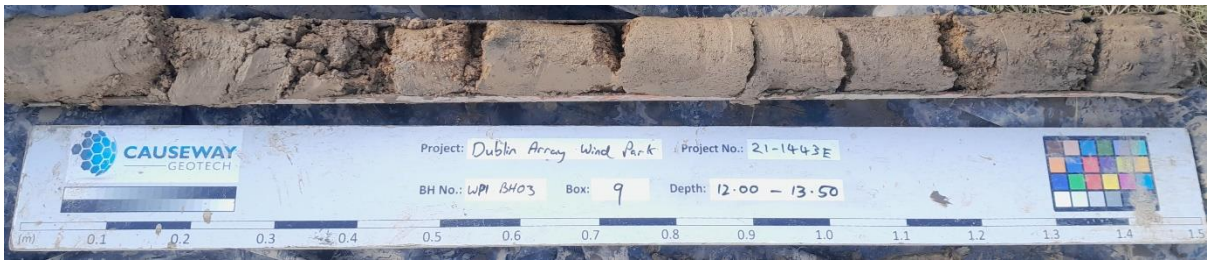
WP1_BH03: Box 5 (7.50-9.00m)



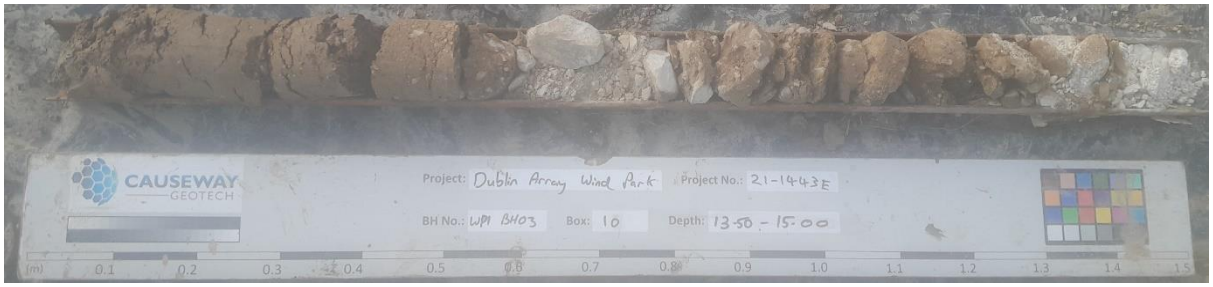
WP1_BH03: Box 6 (9.00-10.50m)



WP1_BH03: Box 8 (10.50-12.00m)



WP1_BH03: Box 9 (12.00-13.50m)



WP1_BH03: Box 10 (13.50-14.00m)

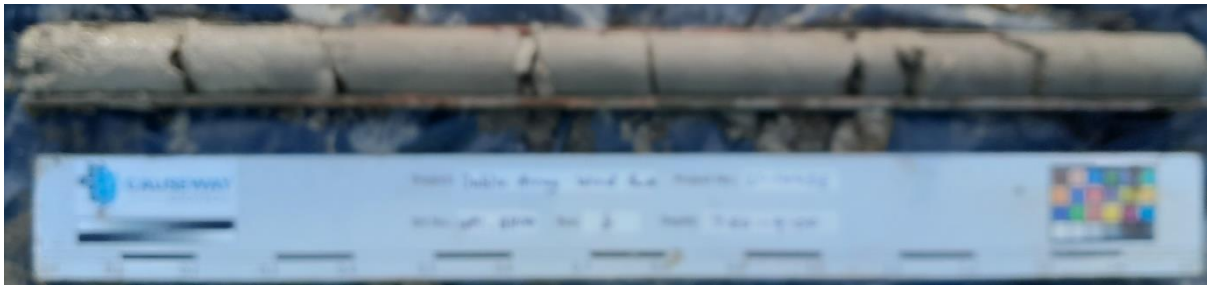
WP1_BH04: Box 1 (0.00-1.50m)

WP1_BH04: Box 2 (1.50-3.00m)

WP1_BH04: Box 3 (3.00-4.50m)

WP1_BH04: Box 4 (4.50-6.00m)

WP1_BH04: Box 5 (6.00-7.50m)

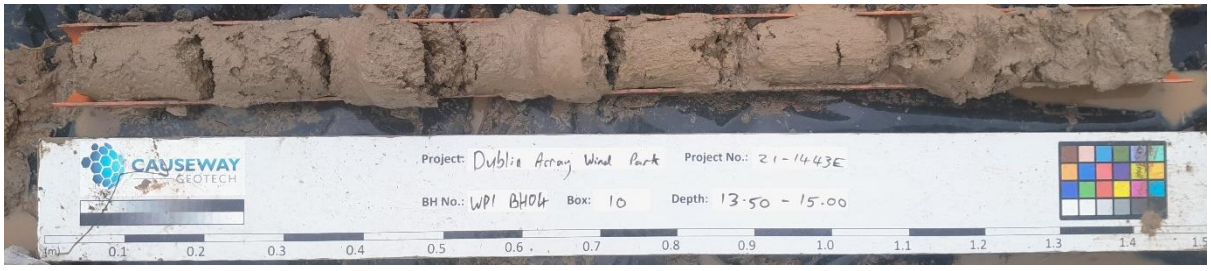


WP1_BH04: Box 6 (7.50-9.00m)

WP1_BH04: Box 7 (9.00-10.50m)

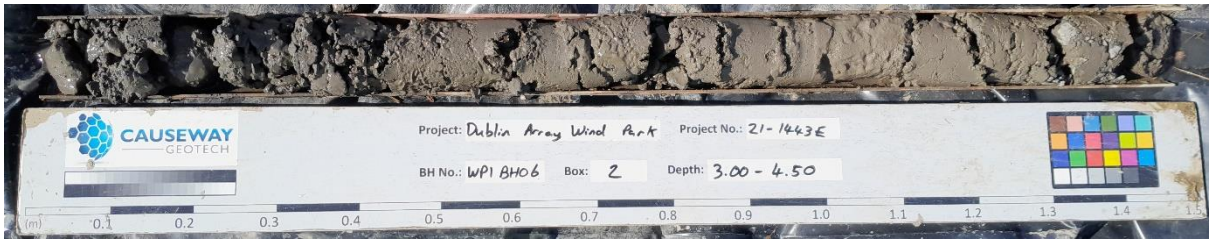
WP1_BH04: Box 8 (10.50-12.00m)

WP1_BH04: Box 9 (12.00-13.50m)

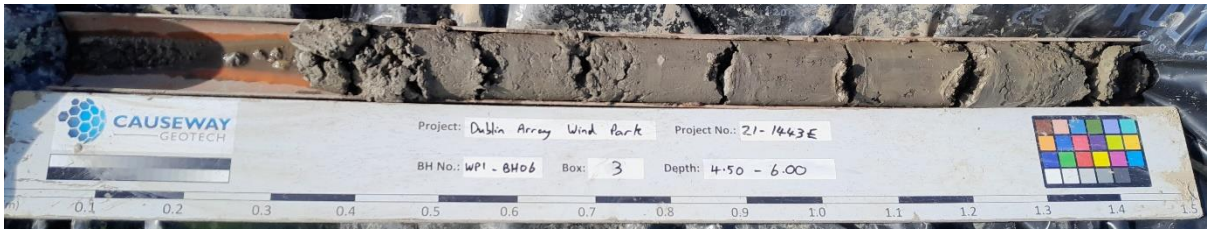


WP1_BH04: Box 10 (13.50-15.00m)

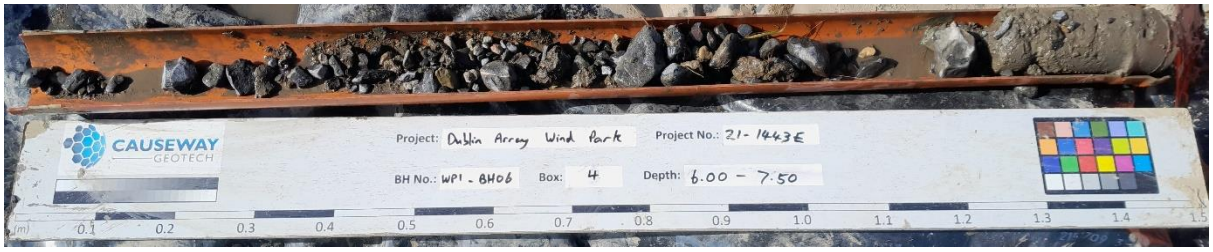
WP1_BH06: Box 1 (1.50-3.00m)



WP1_BH06: Box 2 (3.00-4.50m)



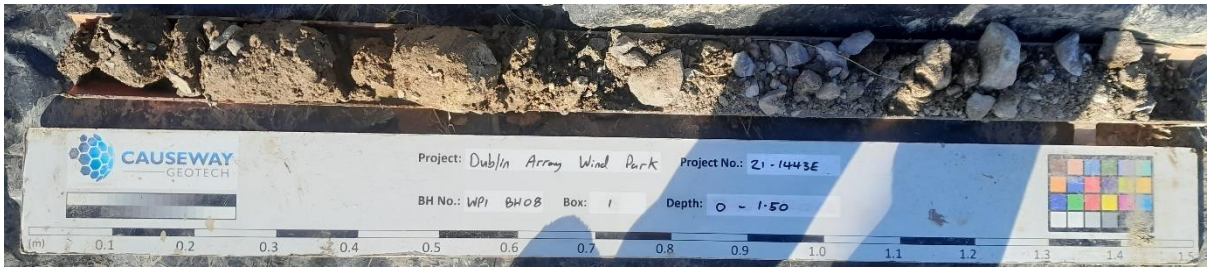
WP1_BH06: Box 3 (4.50-6.00m)



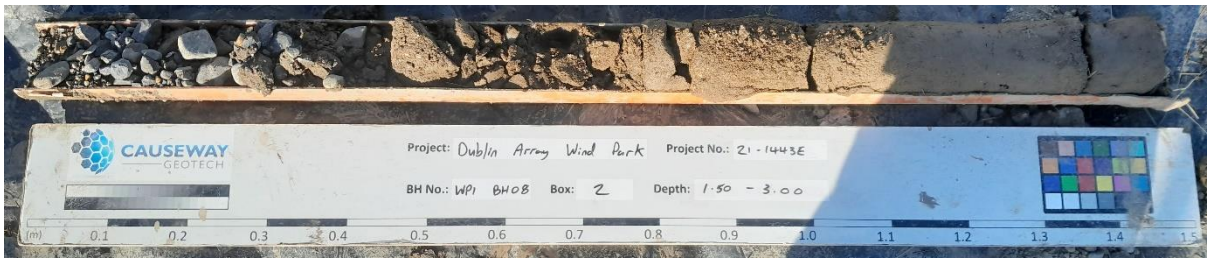
WP1_BH06: Box 4 (6.00-7.50m)

WP1_BH06: Box 5 (7.50-9.00m)

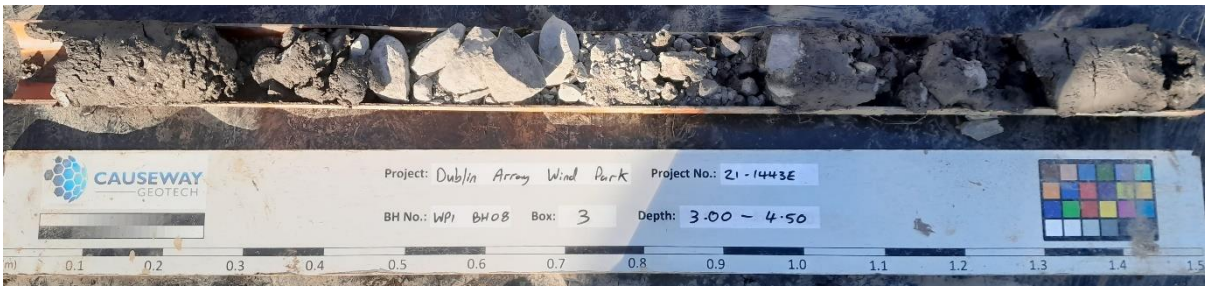
WP1_BH06: Box 6 (9.00-10.50m)



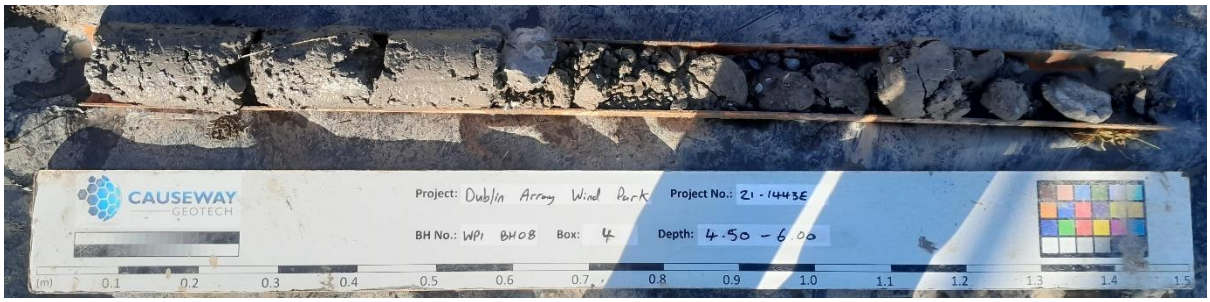
WP1_BH08: Box 1 (0.00-1.50m)



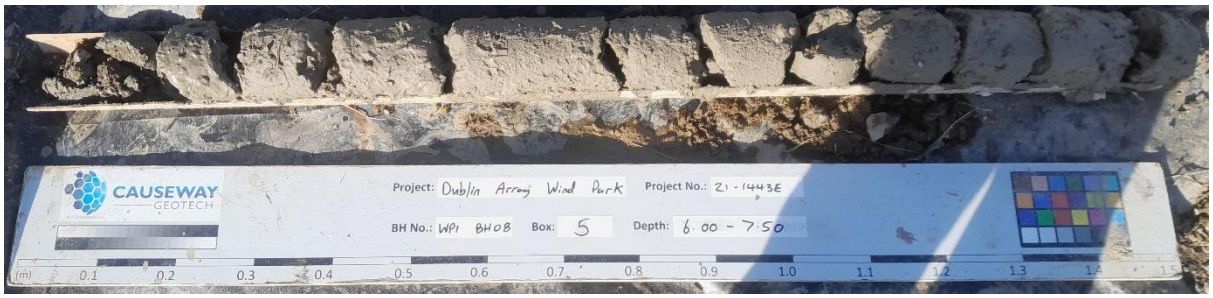
WP1_BH08: Box 2 (1.50-3.00m)



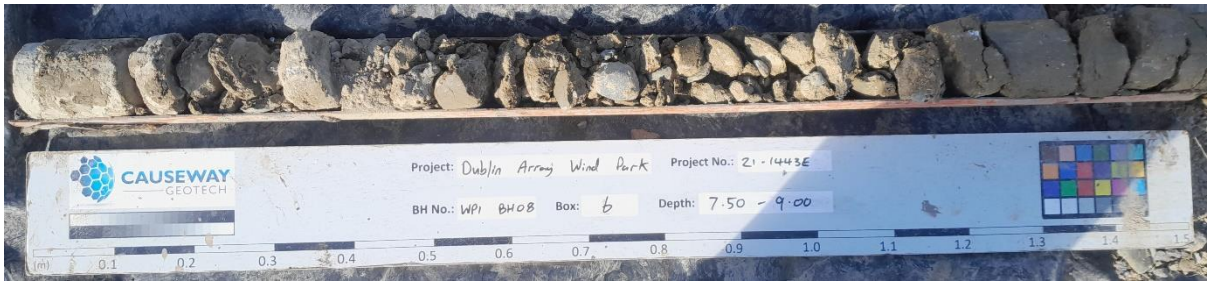
WP1_BH08: Box 3 (3.00-4.50m)



WP1_BH08: Box 4 (4.50-6.00m)



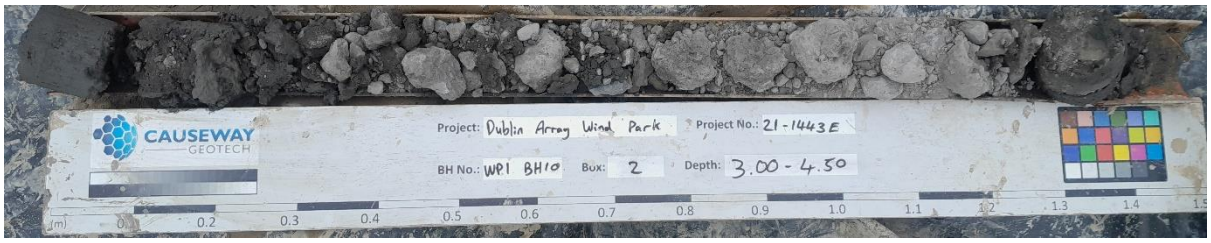
WP1_BH08: Box 5 (6.00-7.50m)



WP1_BH08: Box 6 (7.50-9.00m)

WP1_BH08: Box 7 (9.00-10.50m)

WP1_BH10: Box 1 (1.50-3.00m)



WP1_BH10: Box 2 (3.00-4.50m)

WP1_BH10: Box 3 (4.50-6.00m)

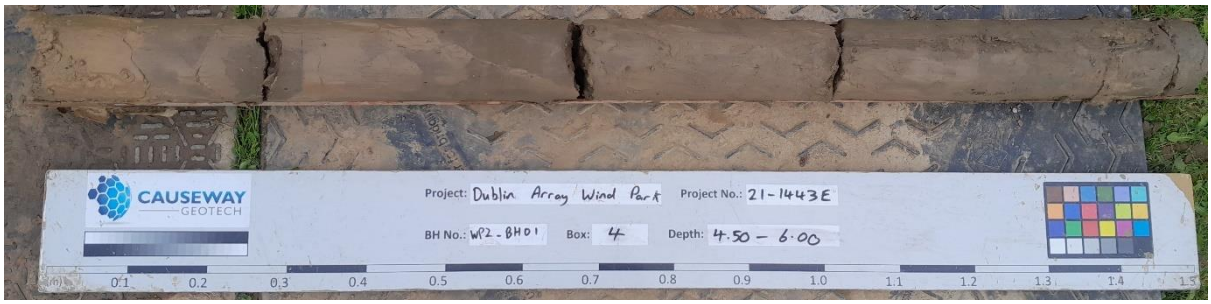
WP1_BH10: Box 4 (6.00-7.50m)

WP1_BH10: Box 5 (7.50-9.00m)

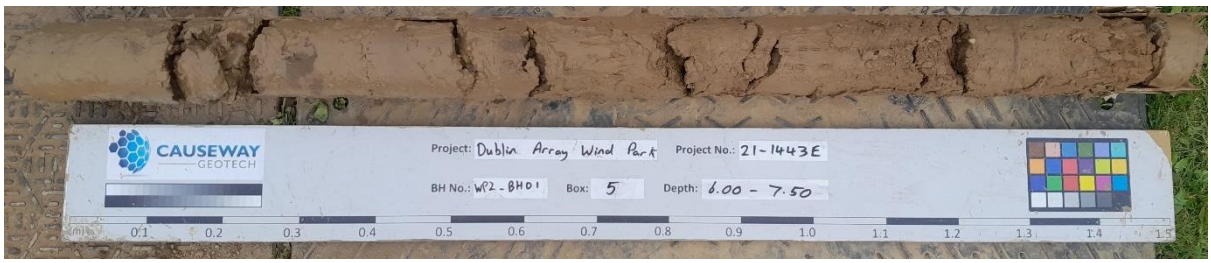
WP1_BH10: Box 6 (9.00-10.50m)

WP2_BH01: Box 2 (1.50-3.00m)

WP2_BH01: Box 3 (3.00-4.50m)

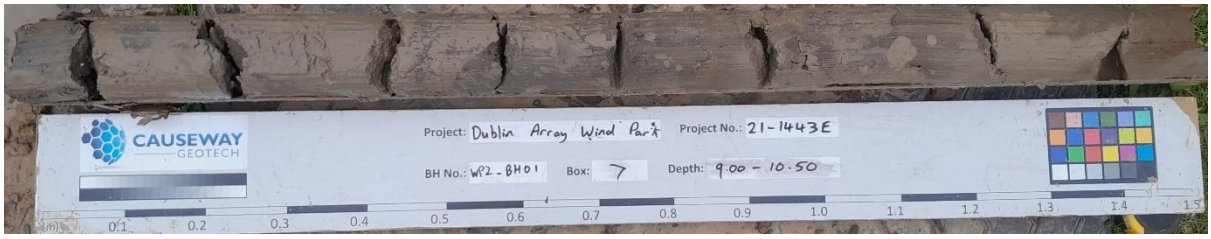


WP2_BH01: Box 4 (4.50-6.00m)



WP2_BH01: Box 5 (6.00-7.50m)

WP2_BH01: Box 6 (7.50-9.00m)



WP2_BH01: Box 7 (9.00-10.50m)

WP2_BH01: Box 8 (10.50-12.00m)

WP2_BH01: Box 9 (12.00-13.50m)

WP2_BH01: Box 10 (13.50-15.00m)

WP2_BH01: Box 11 (15.00-16.50m)

WP2_BH01: Box 12 (16.50-18.00m)

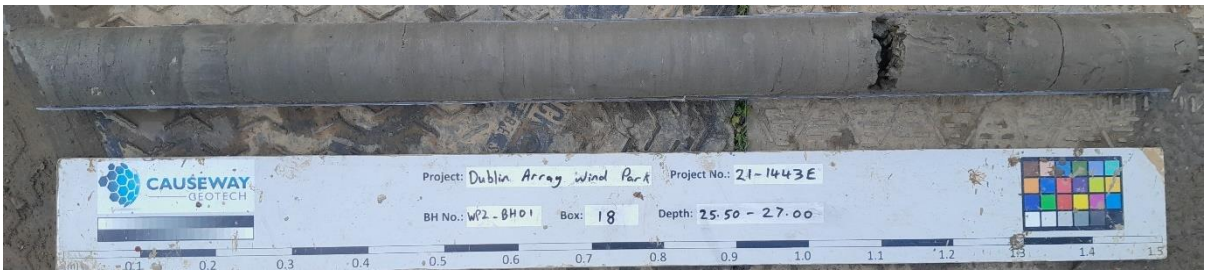
WP2_BH01: Box 13 (18.00-19.50m)

WP2_BH01: Box 14 (19.50-21.00m)

WP2_BH01: Box 14 (21.00-22.50m)

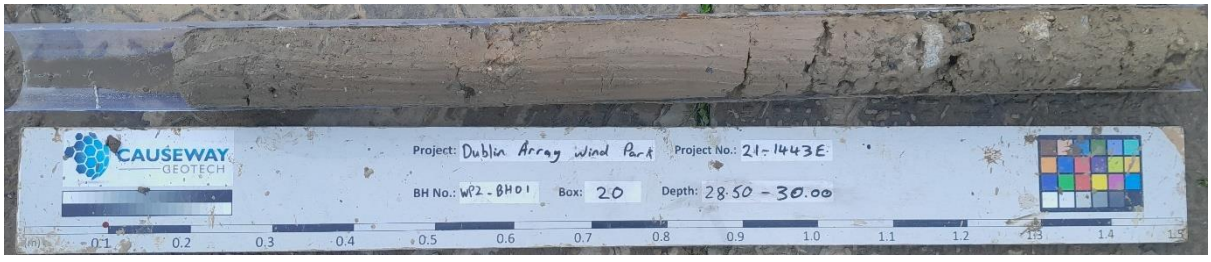
WP2_BH01: Box 14 (22.50-24.00m)

WP2_BH01: Box 14 (24.00-25.50m)



WP2_BH01: Box 14 (25.50-27.00m)

WP2_BH01: Box 19 (27.00-28.50m)



WP2_BH01: Box 20 (28.50-30.00m)

WP2_BH02: Box 1 (0.00-1.50m)

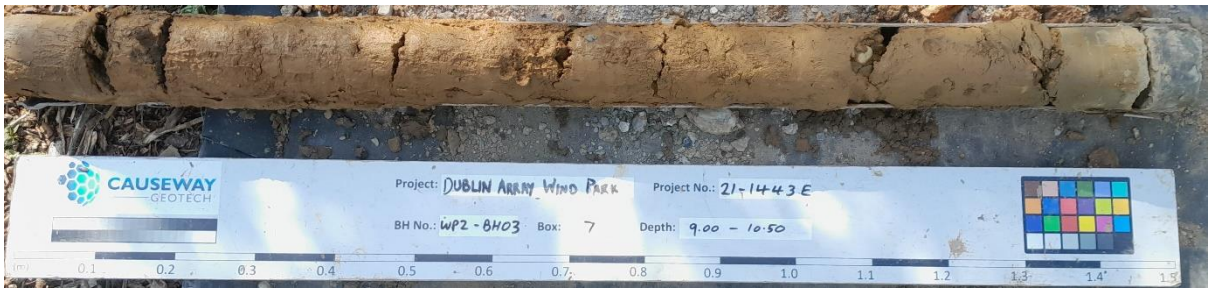
WP2_BH02: Box 2 (1.50-3.00m)

WP2_BH02: Box 3 (3.00-4.50m)

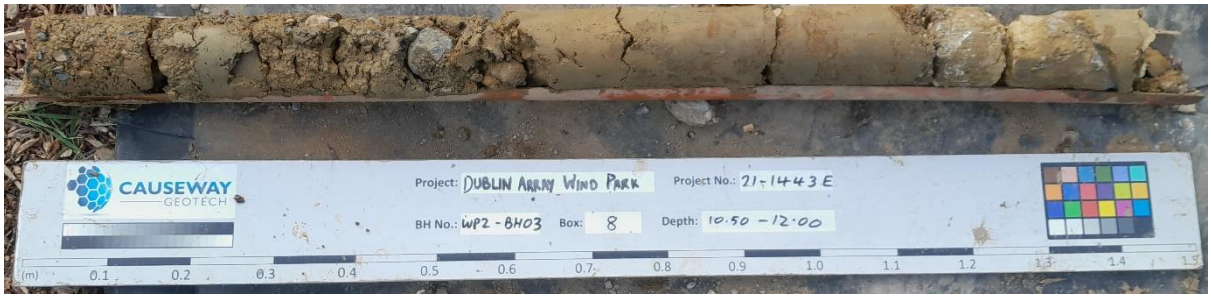
WP2_BH02: Box 4 (4.50-6.00m)

WP2_BH02: Box 5 (6.00-7.50m)

WP2_BH02: Box 6 (7.50-9.00m)



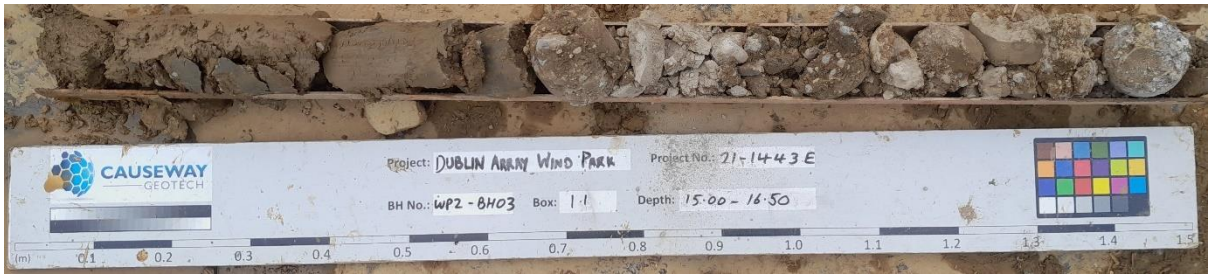
WP2_BH02: Box 7 (9.00-11.50m)



WP2_BH02: Box 8 (11.50-12.00m)

WP2_BH02: Box 9 (12.00-13.50m)

WP2_BH02: Box 10 (13.50-15.00m)



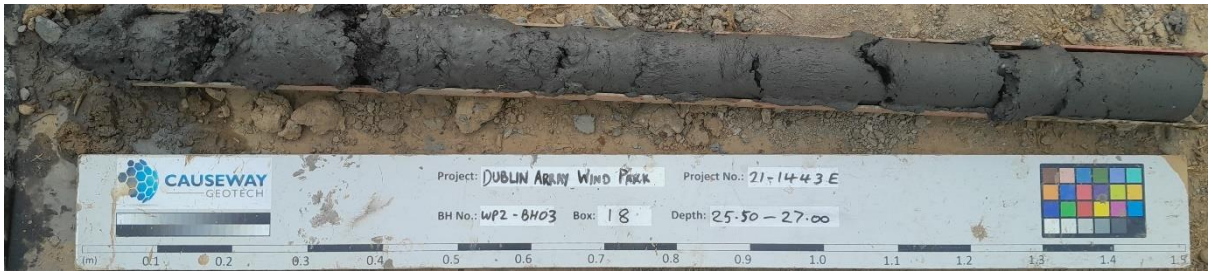
WP2_BH02: Box 11 (15.00-16.50m)

WP2_BH02: Box 12 (16.50-18.00m)

WP2_BH02: Box 13 (18.00-19.50m)

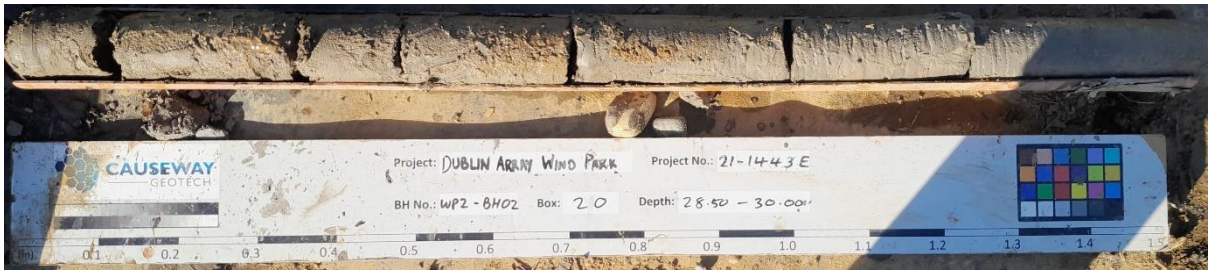
WP2_BH02: Box 14 (19.50-21.00m)

WP2_BH02: Box 15 (21.00-23.50m)



WP2_BH02: Box 18 (25.50-27.00m)

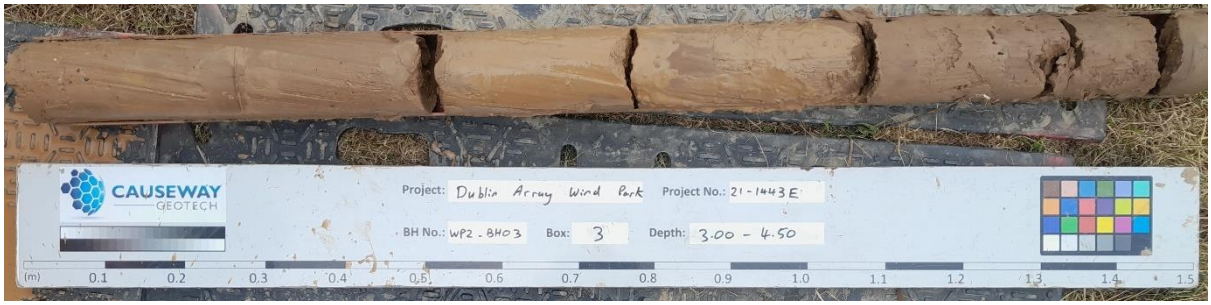
WP2_BH02: Box 19 (27.00-28.50m)



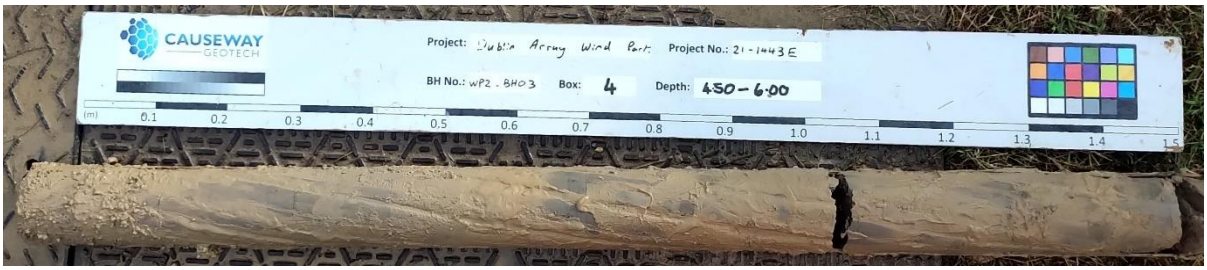
WP2_BH02: Box 20 (28.50-30.00m)

WP2_BH03: Box 1 (0.00-1.50m)

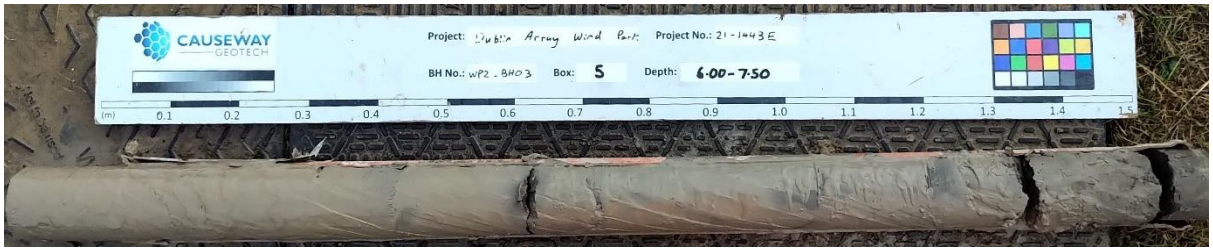
WP2_BH03: Box 2 (1.50-3.00m)



WP2_BH03: Box 3 (3.00-4.50m)



WP2_BH03: Box 4 (4.50-6.00m)



WP2_BH03: Box 5 (6.00-7.50m)

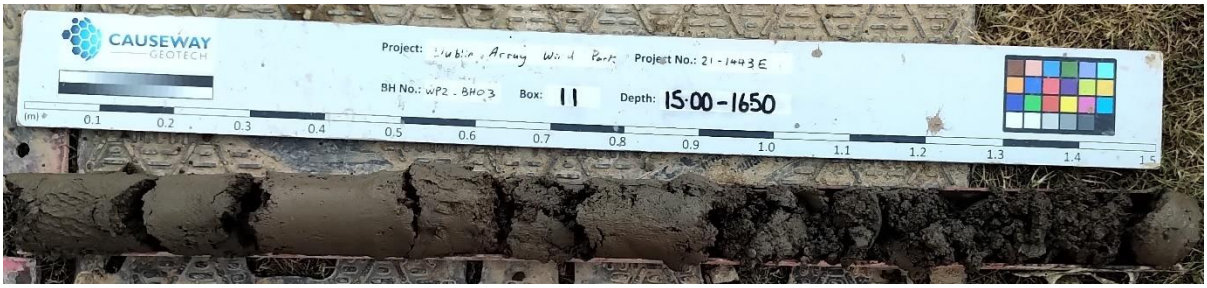
WP2_BH03: Box 6 (7.50-9.00m)

WP2_BH03: Box 7 (9.00-10.50m)

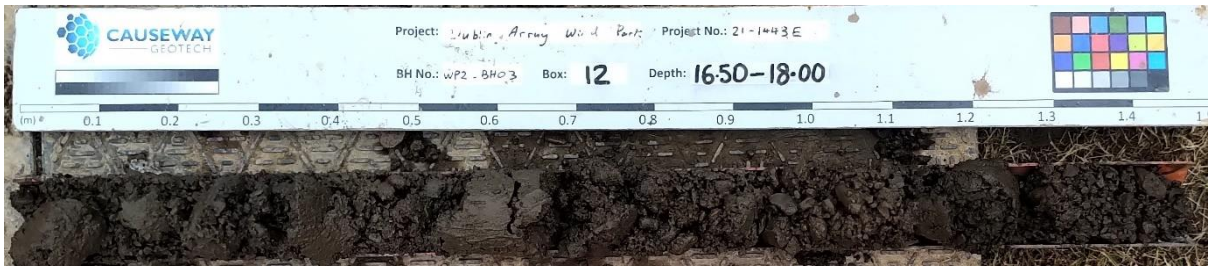
WP2_BH03: Box 8 (10.50-12.00m)

WP2_BH03: Box 9 (12.00-13.50m)

WP2_BH03: Box 7 (13.50-15.00m)



WP2_BH03: Box 8 (15.00-16.50m)



WP2_BH03: Box 9 (16.50-18.00m)

WP2_BH03: Box 10 (18.00-19.50m)

WP2_BH03: Box 11 (19.50-20.00m)

WP2_BH03: Box 15 (20.00-21.00m)

WP2_BH03: Box 16 (21.00-22.50m)

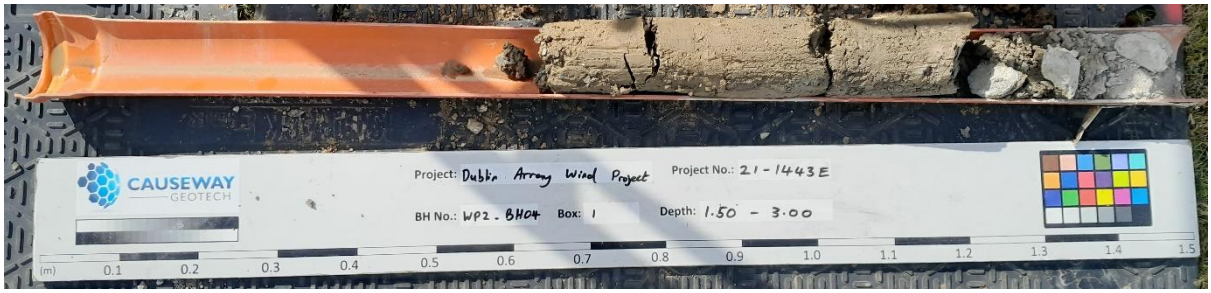
WP2_BH03: Box 17 (22.50-24.00m)

WP2_BH03: Box 15 (24.00-25.50m)

WP2_BH03: Box 16 (25.50-27.00m)

WP2_BH03: Box 20 (27.00-28.50m)

WP2_BH03: Box 21 (28.50-30.00m)

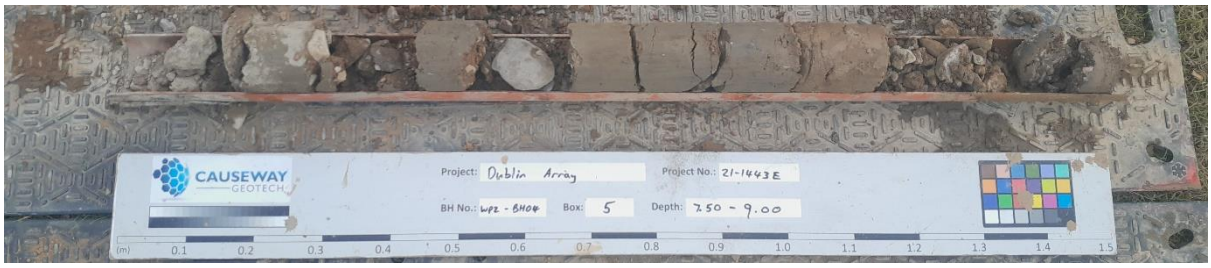


WP2_BH04: Box 1 (1.50-3.00m)

WP2_BH04: Box 2 (3.00-4.50m)

WP2_BH04: Box 3 (4.50-6.00m)

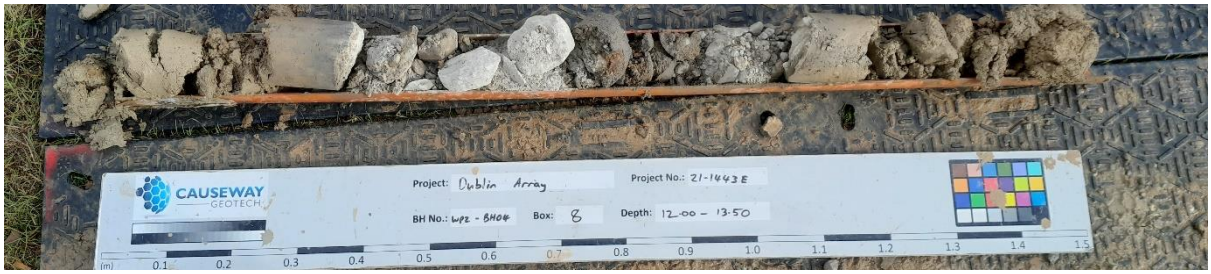
WP2_BH04: Box 4 (6.00-7.50m)



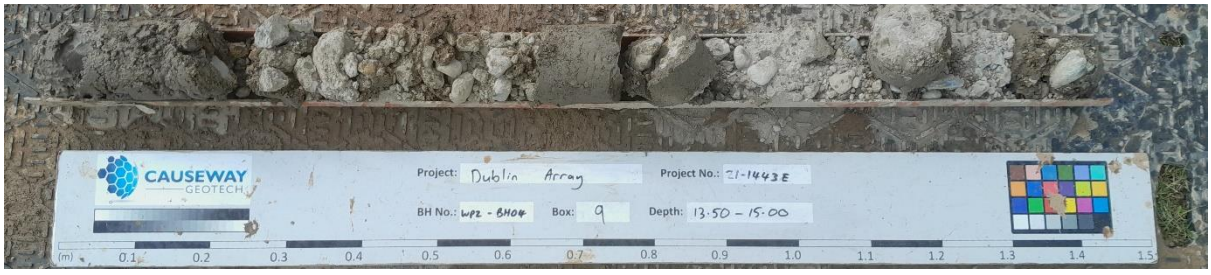
WP2_BH04: Box 5 (7.50-9.00m)

WP2_BH04: Box 6 (9.00-10.50m)

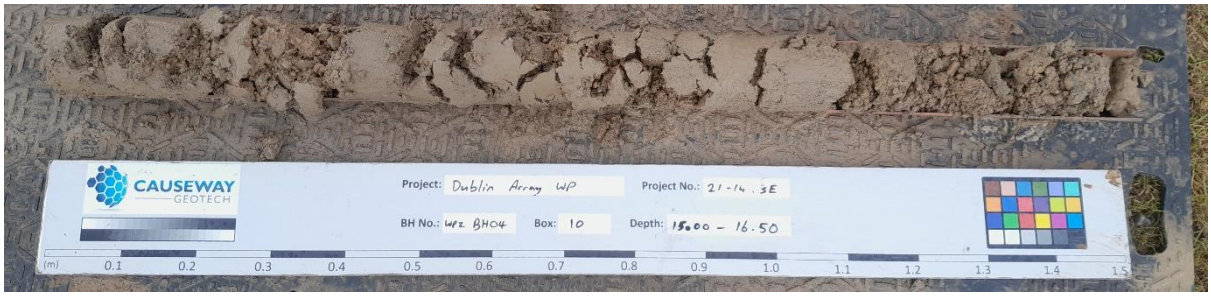
WP2_BH04: Box 7 (10.50-12.00m)



WP2_BH04: Box 8 (12.00-13.50m)



WP2_BH04: Box 9 (13.50-15.00m)



WP2_BH04: Box 10 (15.00-16.50m)

WP2_BH04: Box 11 (16.50-18.00m)

WP2_BH04: Box 12 (18.00-19.50m)

WP2_BH04: Box 13 (19.50-21.00m)

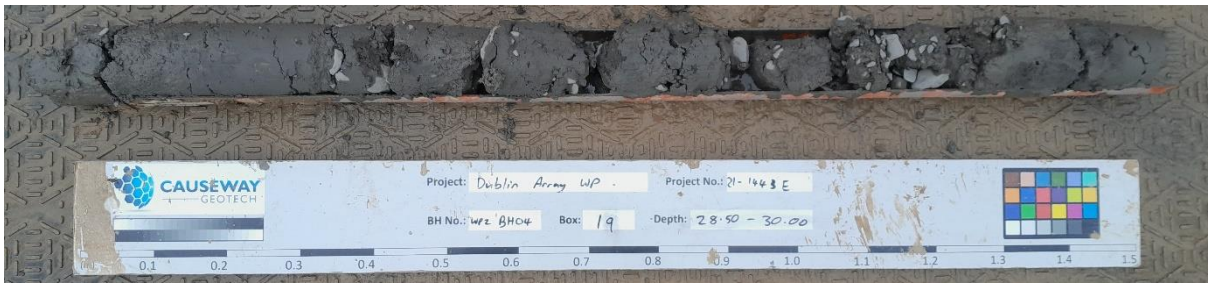
WP2_BH04: Box 14 (21.00-22.50m)

WP2_BH04: Box 15 (22.50-24.00m)

WP2_BH04: Box 16 (24.00-25.50m)

WP2_BH04: Box 17 (25.50-27.00m)

WP2_BH04: Box 18 (27.00-28.50m)



WP2_BH04: Box 19 (28.50-30.00m)

CAUSEWAY GEOTECH

APPENDIX D

TRIAL PIT LOGS

CAUSEWAY GEOTECH

Project No. 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations		**Trial Pit ID** WP1_TP01
Coordinates 720680.93 E 724039.93 N	**Client:** Dublin Array Offshore Windfarm		
Method: Trial Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)		Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 89.11 mOD	**Date:** 07/10/2022	**Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			89.01	0.10		TOPSOIL	
0.50 0.50	B4 ES1					MADE GROUND: Stiff brown slightly sandy gravelly CLAY with pieces of plastic and brick and with medium cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.	
			88.21	0.90			
1.00 1.00	B5 ES2					Light brown gravelly very clayey fine to coarse SAND. Gravel is subangular to subrounded fine to coarse.	
			87.86	1.25			
1.50 1.50	B6 ES3					Very stiff dark grey slightly gravelly sandy CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles are subrounded.	
			86.91	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

Depth: 2.20
Width: 0.70
Length: 3.00

Remarks:
No groundwater encountered.

Stability:	Termination Reason	Last Updated
Stable	Terminated on refusal.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No. 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations		**Trial Pit ID** WP1_TP02
Coordinates 720686.94 E 724082.05 N	**Client:** Dublin Array Offshore Windfarm		
Method: Trial Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)		Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 88.50 mOD	**Date:** 07/10/2022	**Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
						TOPSOIL	
			88.30	0.20		MADE GROUND: Firm to stiff brown dark slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.	
0.50	B4						
0.50	ES1						
1.00	B5						
1.00	ES2						
1.50	B6					*below 1.50m: low boulder content, boulders are subangular and up to 0.30m in size*	
1.50	ES3						
			86.30	2.20		Firm brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.	
2.50	B7						
3.50	B8						
			84.60	3.90		End of trial pit at 3.90m	

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: 3.90
Width: 0.70
Length: 3.50

Remarks: No groundwater encountered.

Stability: Stable

Termination Reason Terminated on refusal.

Last Updated 04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_TP03
Coordinates 720728.00 E 724067.87 N	**Client:** Dublin Array Offshore Windfarm	
Method: Trial Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)	Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 88.65 mOD / **Date:** 04/10/2022 / **Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			88.45	0.20		TOPSOIL	
0.50	ES1					MADE GROUND: Very stiff brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles are subangular to subrounded.	
1.00	B4						
1.00 - 1.00	ES2		87.55	1.10			
1.50	B5					MADE GROUND: Firm to stiff brown slightly sandy gravelly CLAY with low cobble and boulder content, two pieces of 10mm rebar, pieces of 50mm PVC ducting and one 0.4m fragment of concrete. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles and boulders are subrounded.	
1.50	B6						
1.50 - 1.50	ES3						
		Light inflow at 2.00m					▼
2.50	B7						
			85.35	3.30		Very stiff light greyish brown slightly gravelly sandy CLAY with medium cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles are subrounded.	
3.40	B8						
			85.05	3.60		End of trial pit at 3.60m	

Water Strikes	
Struck at (m)	Remarks
2.00	Light inflow at 2.00m

Depth: 3.60
Width: 1.00
Length: 3.00

Remarks:

Stability: Unstable

Termination Reason: Terminated on refusal.

Last Updated: 04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_TP04
Coordinates 720770.38 E 724052.44 N	**Client:** Dublin Array Offshore Windfarm	
Method: Trial Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)	Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 88.53 mOD / **Date:** 04/10/2022 / **Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			88.33	0.20		TOPSOIL	
0.50 0.50	B4 ES1					MADE GROUND: Brown very sandy slightly clayey subangular to subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded.	
1.00 1.00 - 1.00	B5 ES2						
1.50 1.50	B6 ES3						
			86.43	2.10		Light brown mottled light greyish brown very silty fine to coarse SAND. Sand is fine to coarse.	
2.30	B7						
		Light inflow at 2.70m	85.83	2.70		Light greyish brown very silty fine to medium SAND.	▼
			85.33	3.20		Stiff dark grey slightly sandy gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded.	
3.30	B8						
			84.83	3.70		End of trial pit at 3.70m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks
2.70	Light inflow at 2.70m

Depth: 3.70
Width: 0.65
Length: 2.50

Remarks:

Stability: Unstable

Termination Reason: Terminated on refusal.

Last Updated: 04/05/2023

AGS

CAUSEWAY GEOTECH

Project No. 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations		**Trial Pit ID** WP1_TP05
Coordinates 720797.91 E 724022.98 N	**Client:** Dublin Array Offshore Windfarm		
Method: Trial Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)		Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 88.66 mOD	**Date:** 05/10/2022	**Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			88.56	0.10		TOPSOIL	
						MADE GROUND: Firm to stiff dark grey slightly sandy slightly gravelly CLAY with low cobble content, strands of plastic fibres, brick fragments and pieces of electrical cable. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.	
0.50	B4						
0.50	ES1						
1.00	B5						
1.00	ES2						
						below 1.30m: becoming brownish grey	
1.50	B6						
1.50	ES3						
						below 1.60m: no anthropogenic material encountered	
			86.16	2.50		Light brown slightly clayey fine to coarse SAND.	
2.60	B7						
			85.86	2.80		Very stiff brown grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.	
3.00	B8						
			85.46	3.20		End of trial pit at 3.20m	

Water Strikes	
Struck at (m)	Remarks

Depth: 3.20
Width: 0.70
Length: 3.00

Remarks:
No groundwater encountered.

Stability:	Termination Reason	Last Updated
Stable	Terminated on refusal.	04/05/2023

AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations	**Trial Pit ID** WP1_TP06
	Coordinates 720717.93 E 724031.05 N	**Client:** Dublin Array Offshore Windfarm	
Method: Trial Pitting		**Client's Representative:** Gavin and Doherty Geosolutions (GDG)	Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 89.00 mOD	**Date:** 05/10/2022	**Logger:** MMC — FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			88.80	0.20		TOPSOIL	
0.50 0.50	B4 ES1					MADE GROUND: Brown sandy very clayey subangular to subrounded fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded.	
			88.30	0.70		Brown slightly gravelly slightly clayey fine to coarse SAND. Gravel is subangular fine to coarse.	
1.00 1.00	B5 ES2	Slow inflow at 1.30m					▼
1.50 1.50	B6 ES3		87.50	1.50		Firm to stiff brown slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular to subrounded.	
2.20	B7						
			86.50	2.50		Very stiff dark grey slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles are subrounded.	
3.00	B8						
			85.50	3.50		End of trial pit at 3.50m	

Water Strikes	
Struck at (m)	Remarks
1.30	Slow inflow at 1.30m

Depth: 3.50
Width: 0.65
Length: 3.00

Remarks:

Stability: Stable

Termination Reason: Terminated on refusal.

Last Updated: 04/05/2023

AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations	**Trial Pit ID** WP1_TP07
	Coordinates 720902.03 E 724035.31 N	**Client:** Dublin Array Offshore Windfarm	
Method: Trial Pitting		**Client's Representative:** Gavin and Doherty Geosolutions (GDG)	Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 86.56 mOD	**Date:** 07/10/2022 **Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			86.56	0.00		TOPSOIL	
			86.36	0.20		MADE GROUND: Firm brown slightly gravelly sandy CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.	
0.50	B4						
0.50	ES1						
			85.76	0.80		Brown very sandy slightly clayey subrounded fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse. Cobbles are subrounded to rounded.	
1.00	B5						
1.00	ES2						
			85.26	1.30		Firm brown slightly gravelly sandy CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.	
1.50	B6						
1.50	ES3						
			84.16	2.40		Very stiff brown slightly sandy slightly gravelly CLAY with low cobble content and two subangular boulders 0.3m in size. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.	
2.60	B7						
			83.66	2.90		End of trial pit at 2.90m	

Water Strikes	
Struck at (m)	Remarks

Depth: 2.90
Width: 0.70
Length: 3.50

Remarks:
No groundwater encountered.

Stability:
Stable

Termination Reason
Terminated on refusal.

Last Updated
04/05/2023

AGS

CAUSEWAY GEOTECH

Project No. 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations		**Trial Pit ID** WP1_TP08
Coordinates 720942.94 E 724067.07 N	**Client:** Dublin Array Offshore Windfarm		
Method: Trial Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)		Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 83.90 mOD	**Date:** 07/10/2022	**Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			83.80	0.10		TOPSOIL	
			83.60	0.30		MADE GROUND: Grey gravelly slightly clayey fine to coarse SAND. Gravel is subrounded fine to coarse.	
			83.50	0.40		MADE GROUND: Firm orangish brown slightly gravelly sandy CLAY. Sands is fine to coarse. Gravel is subangular fine to coarse.	
0.50	B1					Grey slightly clayey fine to coarse SAND and subrounded fine to coarse GRAVEL.	
0.50	ES1						
			83.10	0.80		Stiff orangish brown slightly sandy slightly gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles are subrounded of limestone.	
1.00	B3						
1.00	ES2						
1.50	B5						
1.50	ES3						
			82.10	1.80		Stiff brown slightly gravelly sandy CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subangular.	
2.50	B7						
3.50	B8						
			79.40	4.50		End of trial pit at 4.50m	

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: 4.50	**Remarks:** No groundwater encountered.
		Width: 0.70	
		Length: 3.50	
		Stability: Stable	**Termination Reason** Terminated at scheduled depth.

Last Updated 04/05/2023

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CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations	**Trial Pit ID** WP1_TP09
	Coordinates 720681.95 E 724016.99 N	**Client:** Dublin Array Offshore Windfarm	
Method: Trial Pitting		**Client's Representative:** Gavin and Doherty Geosolutions (GDG)	Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 89.58 mOD	**Date:** 07/10/2022 **Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			89.48	0.10		TOPSOIL	
0.50 0.50	B1 ES1					MADE GROUND: Stiff brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.	
1.00 1.00	B3 ES2						
1.50 1.50	B5 ES3						
			87.38	2.20		Very stiff dark grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles are subrounded of limestone.	
2.40	B7						
			87.08	2.50		End of trial pit at 2.50m	

Water Strikes	
Struck at (m)	Remarks

Depth: 2.50
Width: 0.70
Length: 3.00

Remarks:
No groundwater encountered.

Stability:	Termination Reason	Last Updated
Stable	Terminated on refusal.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No. 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations		**Trial Pit ID** WP1_TP10
Coordinates 720756.37 E 724007.05 N	**Client:** Dublin Array Offshore Windfarm		
Method: Trail Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)		Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 89.38 mOD	**Date:** 05/10/2022	**Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
						TOPSOIL	
			89.18	0.20		MADE GROUND: Very stiff brownish grey slightly sandy gravelly CLAY with low cobble content, occasional boulders, and pieces of concrete blocks, bricks and plastic. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles and boulders are of limestone.	
0.50	B1						
0.50	ES1						
1.00	B3						
1.00	ES2						
1.50	B5		87.88	1.50		Brown slightly gravelly slightly clayey fine to coarse SAND. Gravel is subangular fine to coarse.	
1.50	ES3						
2.00	B7					*below 2.50m: light grey with pockets of laminated clay*	
		Fast inflow at 2.70m					▼
3.00	B8						
			86.08	3.30		Stiff dark grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.	
3.40	B9						
			85.88	3.50		End of trial pit at 3.50m	

Water Strikes	
Struck at (m)	Remarks
2.70	Fast inflow at 2.70m

Depth: 3.50
Width: 0.70
Length: 3.50

Remarks:

Stability: Unstable

Termination Reason: Terminated due to collapse.

Last Updated: 04/05/2023

AGS

CAUSEWAY GEOTECH

Project No. 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations		**Trial Pit ID** WP1_TP11
Coordinates 720784.89 E 724078.78 N	**Client:** Dublin Array Offshore Windfarm		
Method: Trial Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)		Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 86.40 mOD	**Date:** 04/10/2022	**Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			86.20	0.20		TOPSOIL: Black plastic bag just under topsoil	
0.50	B1					MADE GROUND: Firm brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of limestone.	
0.50 - 0.50	ES1		85.80	0.60			
1.00	B3					Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of limestone.	
1.00	ES2		85.30	1.10			
1.50	B5					Firm light greyish brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse of limestone.	
1.50 - 1.50	ES3		84.70	1.70			
2.40	B7					Stiff brown slightly gravelly sandy CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse of limestone. Cobbles are subrounded of limestone.	
3.40	B8						
			82.70	3.70		End of trial pit at 3.70m	

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes	
Struck at (m)	Remarks
	No groundwater encountered.

Depth: 3.70
Width: 0.70
Length: 3.50

Remarks:
No groundwater encountered.

Stability:	Termination Reason	Last Updated
Stable	Terminated on refusal.	04/05/2023

AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations	**Trial Pit ID** WP1_TP12
	Coordinates 720834.50 E 723991.15 N	**Client:** Dublin Array Offshore Windfarm	
Method: Trial Pitting		**Client's Representative:** Gavin and Doherty Geosolutions (GDG)	Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 89.00 mOD	**Date:** 05/10/2022 **Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			88.90	0.10		TOPSOIL	
						MADE GROUND: Stiff dark grey mottled brown slightly sandy gravelly CLAY with low cobble and boulder content, and pieces of steel, plastic and cloth. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.	
0.50	B1						
0.50	ES1						
0.90	ES2						
1.00	B3						
1.00	ES3						
1.50	B5						
1.50	ES4						
			86.00	3.00		Brown gravelly very clayey fine to coarse SAND with low cobble content. Gravel is subrounded fine to coarse of limestone. Cobbles are subrounded.	
3.20	B7						
			85.30	3.70		Very stiff dark greyish black slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse of limestone. Cobbles are subrounded.	
3.80	B8		85.10	3.90		End of trial pit at 3.90m	

Water Strikes	
Struck at (m)	Remarks
	No groundwater encountered.

Depth: 3.90
Width: 0.70
Length: 3.50

Remarks:
No groundwater encountered.

Stability: Stable

Termination Reason: Terminated on refusal.

Last Updated: 04/05/2023

AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations	**Trial Pit ID** WP1_TP13
	Coordinates 720873.87 E 724049.07 N	**Client:** Dublin Array Offshore Windfarm	
Method: Trial Pitting		**Client's Representative:** Gavin and Doherty Geosolutions (GDG)	Sheet 1 of 1 Scale: 1:25
Plant: 13T Excavator	**Elevation** 85.06 mOD	**Date:** 07/10/2022 **Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			84.76	0.30		TOPSOIL	
0.50 0.50	B1 ES1					MADE GROUND: Firm dark brown slightly sandy slightly gravelly CLAY with a few pieces of timer and plastic. Sand is fine to coarse. Gravel is subrounded fine to coarse of limestone.	
1.00 1.00	B3 ES2						
1.50 1.50	B5 ES3					*Red 5 inch PVC duct encountered at 1.50m.*	
			83.46	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
	No groundwater encountered.

Depth: 1.60
Width: 0.70
Length: 3.50

Remarks:
No groundwater encountered.
Red 5 inch PVC duct encountered at 1.50m running at 115 degrees.

Stability:	**Termination Reason**	**Last Updated**
Stable	Terminated due to services.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No. 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations		**Trial Pit ID** WP2_TP01
Coordinates 725626.31 E 723077.25 N	**Client:** Dublin Array Offshore Windfarm		
Method: Trial Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)		Sheet 1 of 1 Scale: 1:25
Plant: 6T Excavator	**Elevation** 8.78 mOD	**Date:** 03/10/2022	**Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			8.48	0.30		TOPSOIL	
0.50	B4					MADE GROUND: Stiff greyish brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.	
0.50	ES1						
			7.98	0.80		MADE GROUND: Stiff brown slightly sandy slightly gravelly CLAY with low cobble content, two boulders of granite and a few pieces of ceramic pipe. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.	
1.00	B5						
1.00	ES2						
1.50	B6						
1.50	ES3						
			6.88	1.90		Light greyish brown very gravelly slightly clayey fine to coarse SAND and low cobble and boulder content. Gravel is subangular to subrounded fine to coarse. Cobbles and boulders are subrounded.	
2.50	B7						
			5.58	3.20		Light brown slightly clayey fine to coarse SAND and subrounded fine to coarse GRAVEL and low cobble content. Cobbles and boulders are subrounded.	
3.30	B8						
			5.28	3.50		End of trial pit at 3.50m	

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: 3.50
Width: 0.50
Length: 3.50

Remarks:
No groundwater encountered.

Stability:	Termination Reason	Last Updated
Stable	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No. 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations		**Trial Pit ID** WP2_TP03
Coordinates 725866.49 E 723104.95 N	**Client:** Dublin Array Offshore Windfarm		
Method: Trial Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)		Sheet 1 of 1 Scale: 1:25
Plant: 6T Excavator	**Elevation** 10.23 mOD	**Date:** 03/10/2022	**Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			10.03	0.20		TOPSOIL	
0.50	B4					MADE GROUND: Light brownish grey very sandy clayey GRAVEL with fragments of crushed concrete, red brick and one length of 15mm rebar. Sand is fine to coarse.	
0.50	ES1						
			9.53	0.70		Stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.	
1.00	B5						
1.00	ES2						
			8.93	1.30		Stiff grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.	
1.50	B6						
1.50	ES3						
			8.23	2.00		Stiff brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subrounded.	
2.30	B7						
3.20	B8						
			6.73	3.50		End of trial pit at 3.50m	

Water Strikes	
Struck at (m)	Remarks

Depth: 3.50
Width: 0.50
Length: 3.00

Remarks:
No groundwater encountered.

Stability:	Termination Reason	Last Updated
Stable	Terminated at scheduled depth.	04/05/2023

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Trial Pit ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP2_TP04
Coordinates 725890.26 E 723128.75 N	**Client:** Dublin Array Offshore Windfarm	
Method: Trial Pitting	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)	Sheet 1 of 1 Scale: 1:25
Plant: 6T Excavator	**Elevation** 10.86 mOD / **Date:** 03/10/2022 / **Logger:** MMC	FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			10.61	0.25		TOPSOIL	
0.50	B4		10.36	0.50		MADE GROUND: Stiff brown slightly sandy gravelly CLAY with a 0.3m piece of concrete, brick fragments up to 0.4m in size, a few small pieces of plastic and timber. Sand is fine to coarse. Gravel is subangular to rounded fine to coarse.	
0.50	ES1					MADE GROUND: Grey fine to coarse SAND and subangular to subrounded fine to coarse GRAVEL with fragments of brick and concrete.	
1.00	B5		9.86	1.00		MADE GROUND: Grey fine to coarse clayey SAND and subangular to subrounded fine to coarse GRAVEL with fragments of brick and concrete.	
1.00	ES2		9.76	1.10		MADE GROUND: Grey fine to coarse SAND and subangular to subrounded fine to coarse GRAVEL with fragments of brick and concrete.	
			9.56	1.30		Very stiff light brown slightly sandy CLAY. Sand is fine to coarse.	
1.50	B6						
1.50	ES3						
			9.16	1.70		Stiff brown slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular.	
2.30	B7						
			8.26	2.60		Firm to stiff light brown mottled light grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.	
3.20	B8						
			7.46	3.40		End of trial pit at 3.40m	

Water Strikes	
Struck at (m)	Remarks

Depth: 3.40
Width: 0.50
Length: 3.00

Remarks: No groundwater encountered.

Stability:	Termination Reason	Last Updated
Stable	Terminated on refusal.	04/05/2023

AGS

CAUSEWAY GEOTECH

APPENDIX E

TRIAL PIT PHOTOGRAPHS

WP1_TP01

WP1_TP01

WP1_TP01

WP1_TP01

WP1_TP01

WP1_TP01

WP1_TP01

WP1_TP01

WP1_TP02

WP1_TP02

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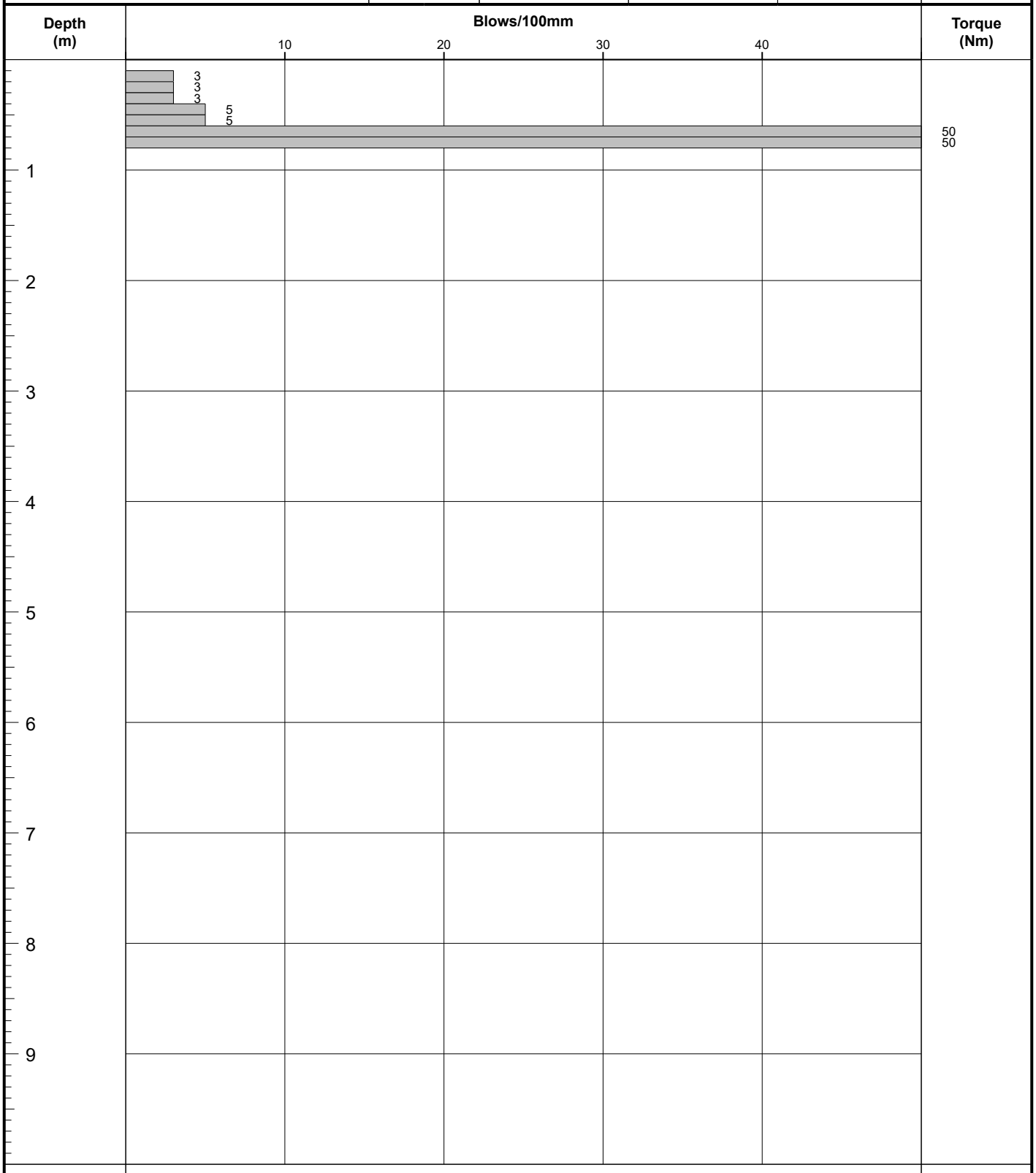
CAUSEWAY GEOTECH

APPENDIX F

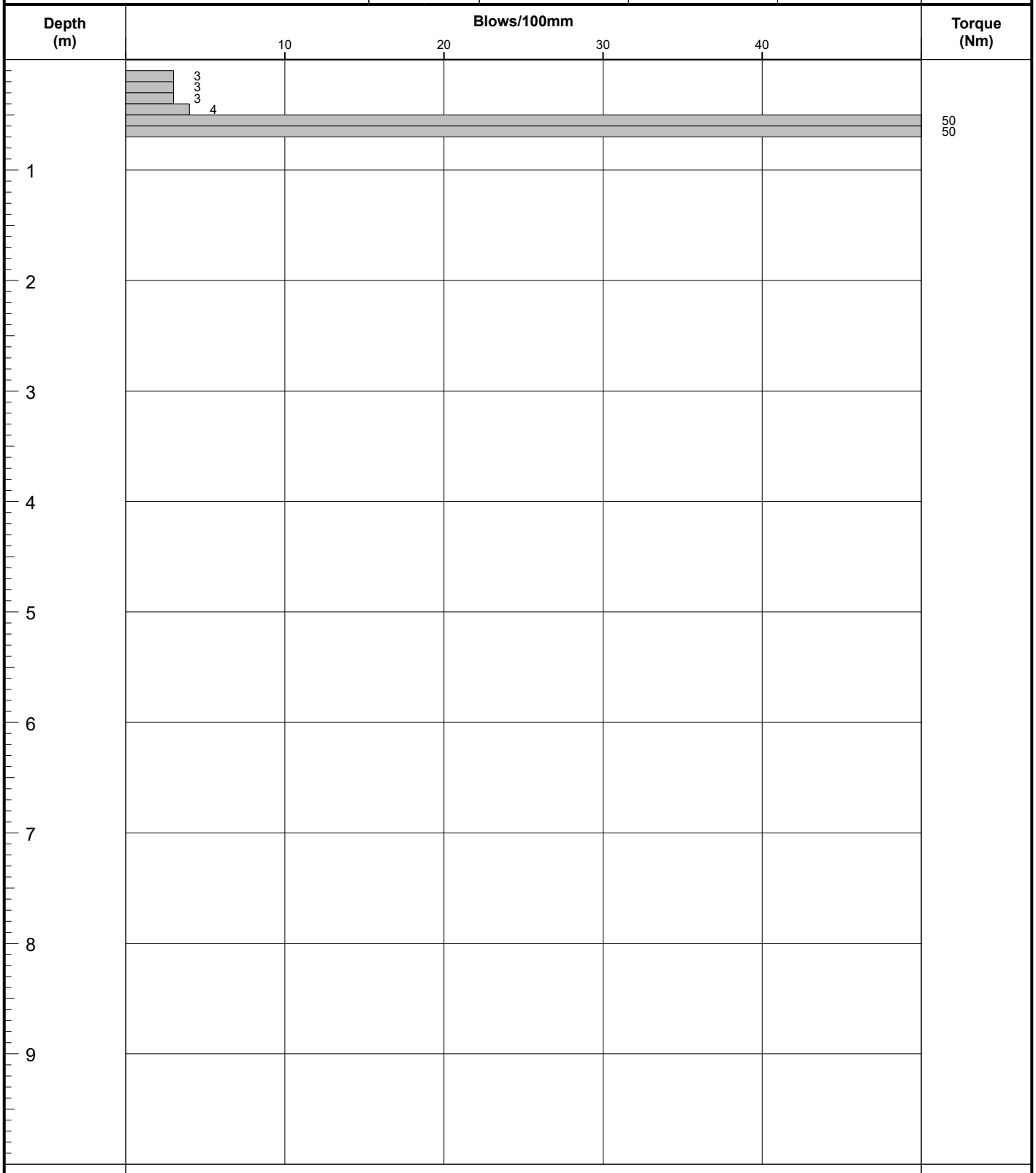
DYNAMIC PROBE LOGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP01 ADP
	Coordinates E N	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing		**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 0.70	**Date:** 26/09/2022	**Operator:** JD	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64.0 kg			
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023	AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP01 DP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 0.60	**Date:** 26/09/2022	**Operator:** JD	FINAL

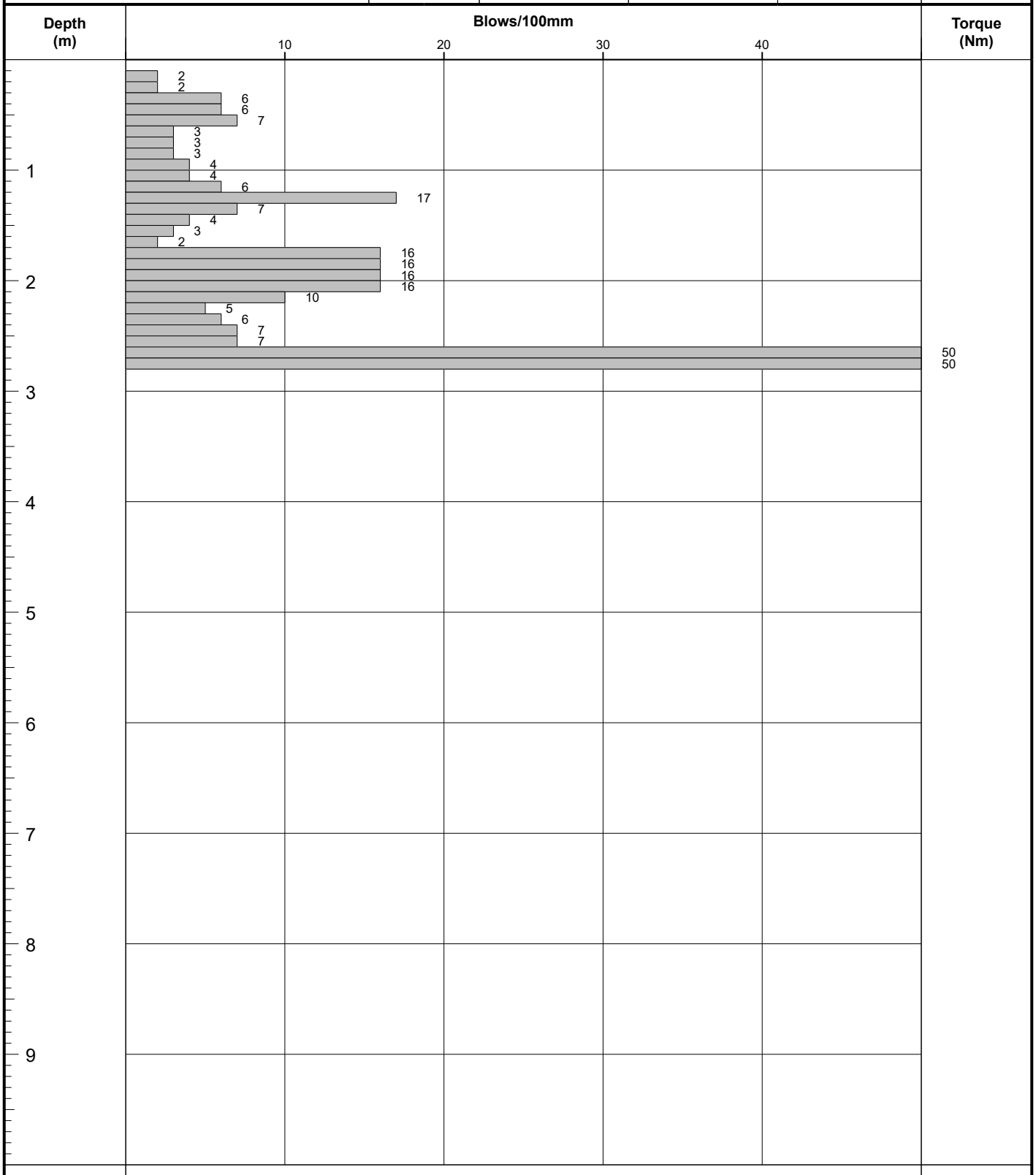


Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64.0 kg			
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023	AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_TP02 DP
Coordinates	**Client:**	
E	Dublin Array Offshore Windfarm	
Method:	**Client's Representative:**	Sheet 1 of 1
Dynamic Probing	N Gavin and Doherty Geosolutions (GDG)	Scale: 1:50

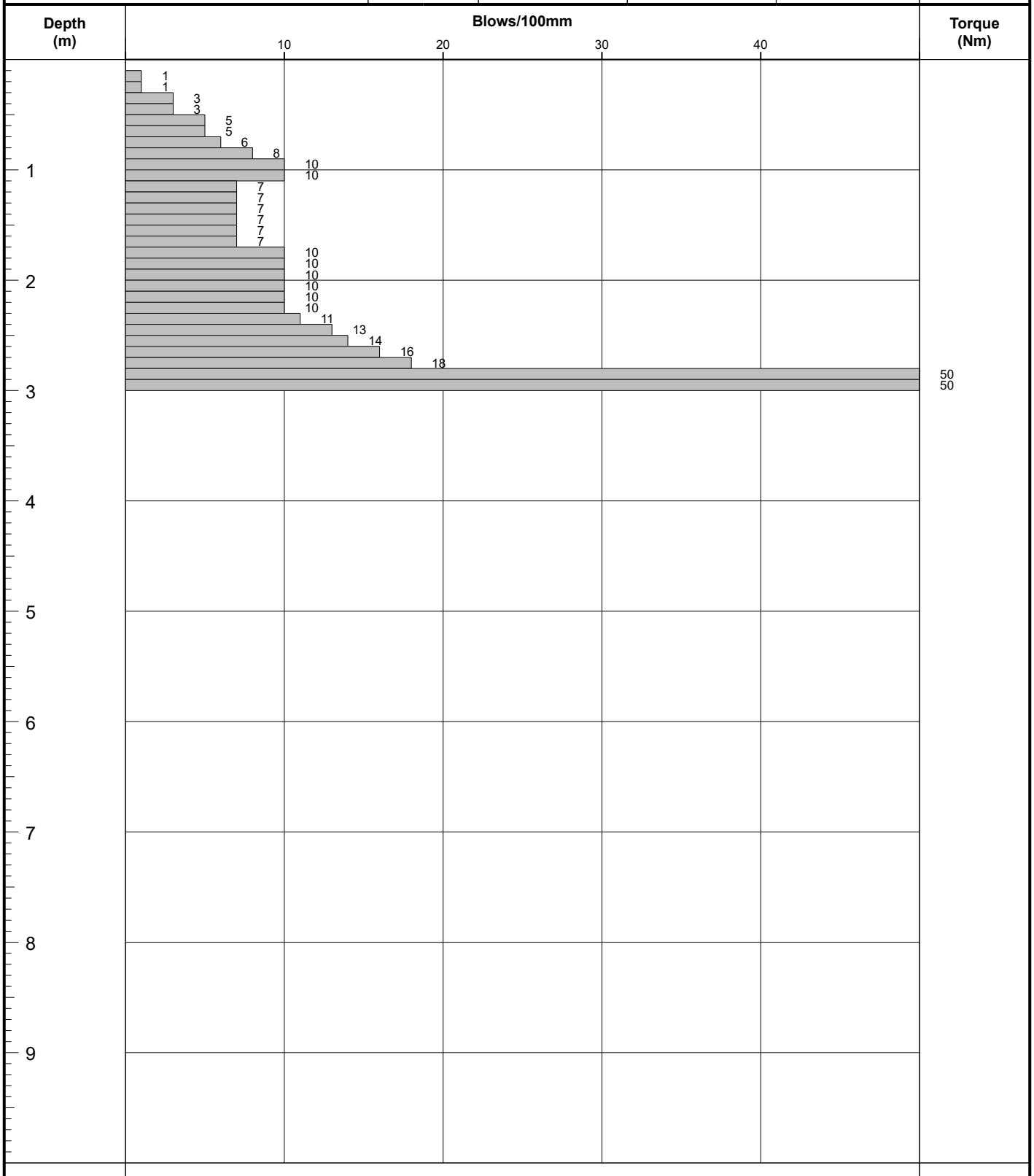
Probe Type:	Elevation	Final Depth:	Date:	Operator:	
DPSH-B	mOD	2.70	26/09/2022	JD	FINAL



Fall Height: 750 mm	Remarks	
Hammer Mass: 64.0 kg		
Cone Diameter: 51.0 mm	Termination Reason	Last Updated 04/05/2023

AGS

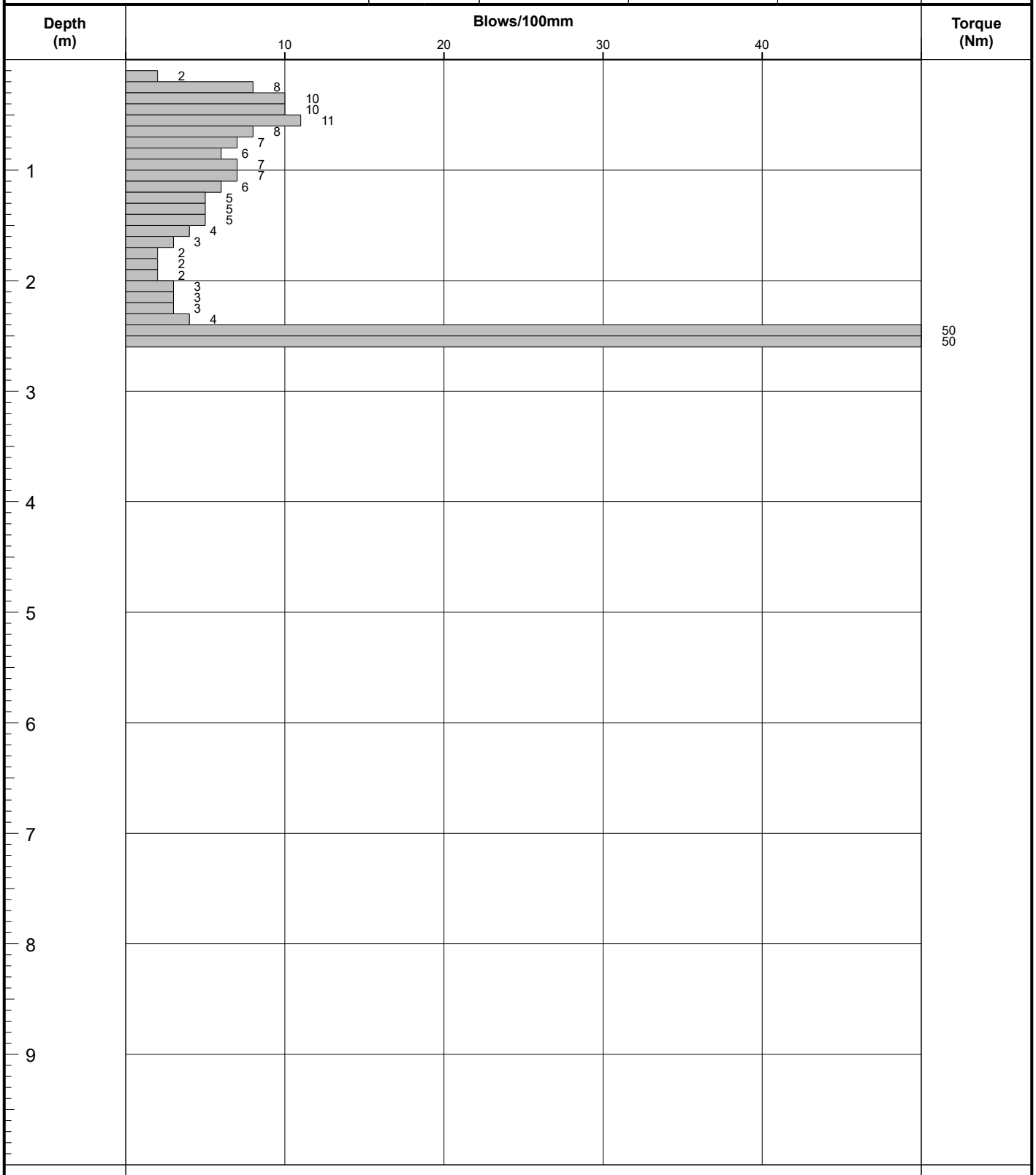
CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP03 DP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 2.90	**Date:** 26/09/2022	**Operator:** JD	FINAL



Fall Height: 750 mm	**Remarks**	
Hammer Mass: 64.0 kg		
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_TP04 DP
Coordinates	**Client:**	
E	Dublin Array Offshore Windfarm	
Method:	**Client's Representative:**	Sheet 1 of 1
Dynamic Probing	N Gavin and Doherty Geosolutions (GDG)	Scale: 1:50
Probe Type:	**Elevation** / **Final Depth:** / **Date:** / **Operator:**	FINAL
DPSH-B	mOD / 2.50 / 26/09/2022 / JD	

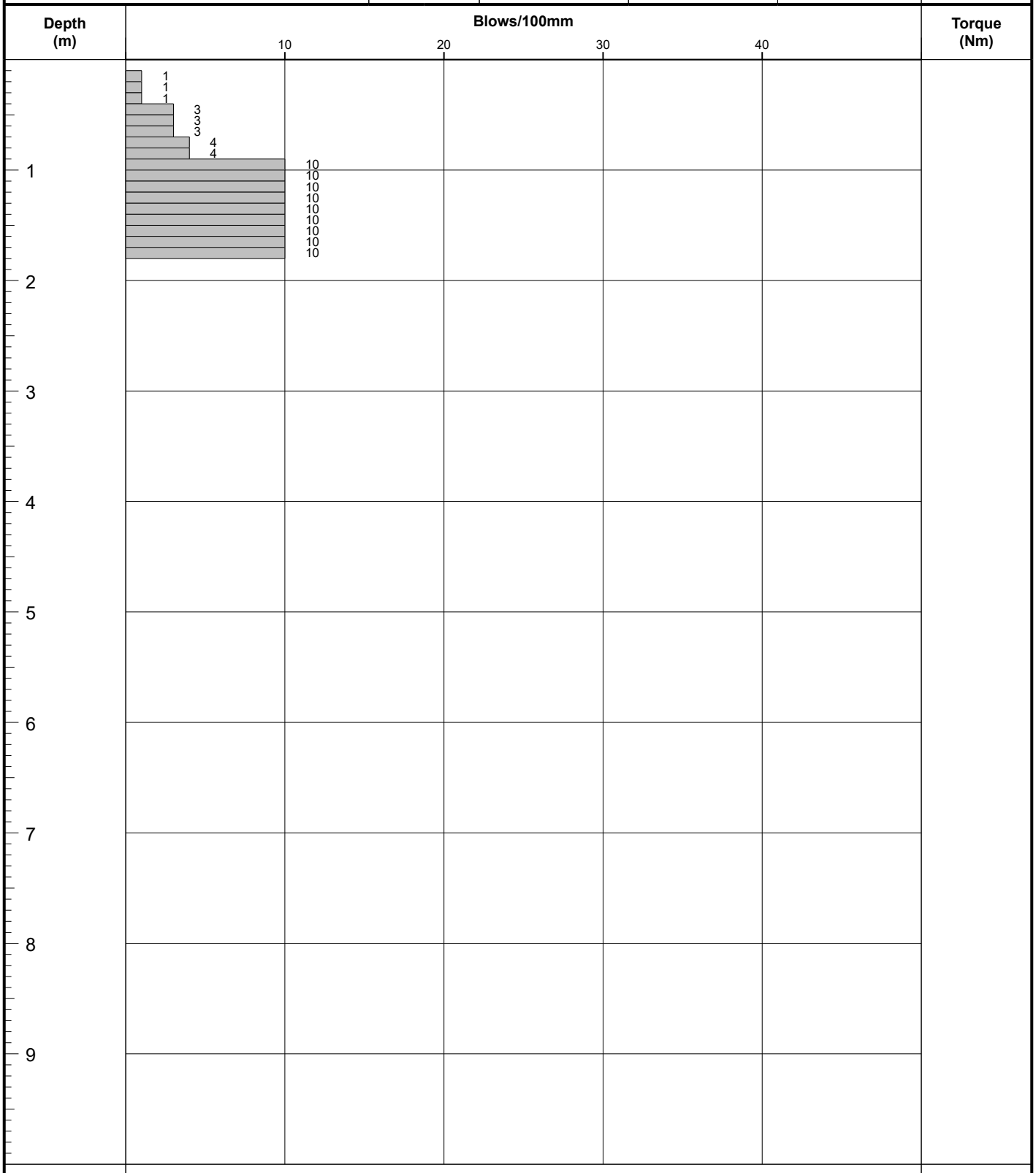


Fall Height:	Remarks
750 mm	
Hammer Mass:	
64.0 kg	
Cone Diameter:	**Termination Reason**
51.0 mm	

Last Updated 04/05/2023

AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP05 ADP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 1.70	**Date:** 26/09/2022	**Operator:** JD	FINAL

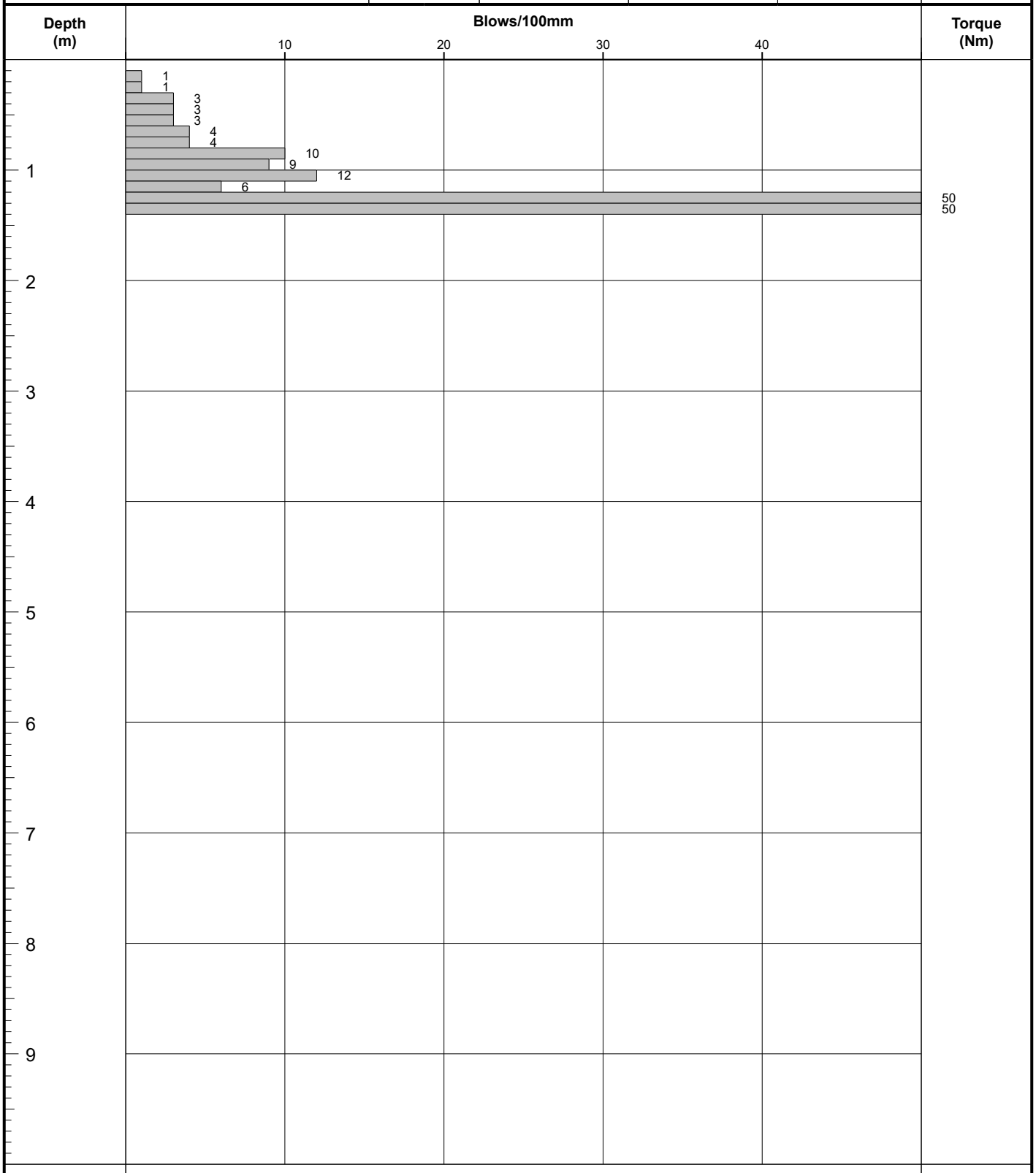


Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64.0 kg			
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023	AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Probe ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_TP05 DP
Coordinates	**Client:**	
E	Dublin Array Offshore Windfarm	
Method:	**Client's Representative:**	Sheet 1 of 1
Dynamic Probing	N Gavin and Doherty Geosolutions (GDG)	Scale: 1:50

Probe Type:	Elevation	Final Depth:	Date:	Operator:	
DPSH-B	mOD	1.30	26/09/2022	JD	FINAL



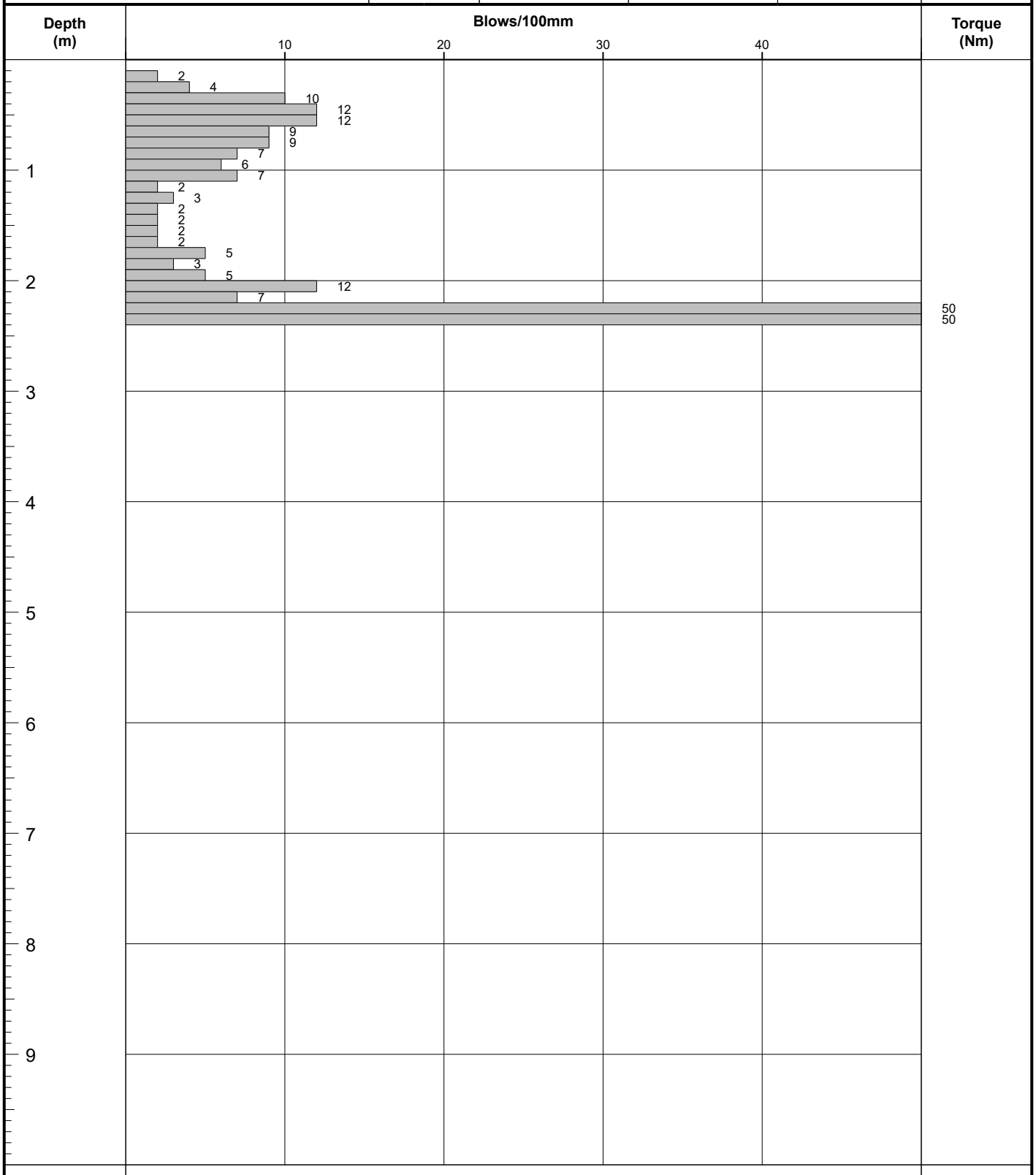
Fall Height:	Remarks
750 mm	
Hammer Mass:	
64.0 kg	
Cone Diameter:	**Termination Reason**
51.0 mm	

Last Updated 04/05/2023

AGS

CAUSEWAY GEOTECH

	Project No. 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP06 DP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 2.30	**Date:** 26/09/2022	**Operator:** JD	FINAL



Fall Height: 750 mm

Hammer Mass: 64.0 kg

Cone Diameter: 51.0 mm

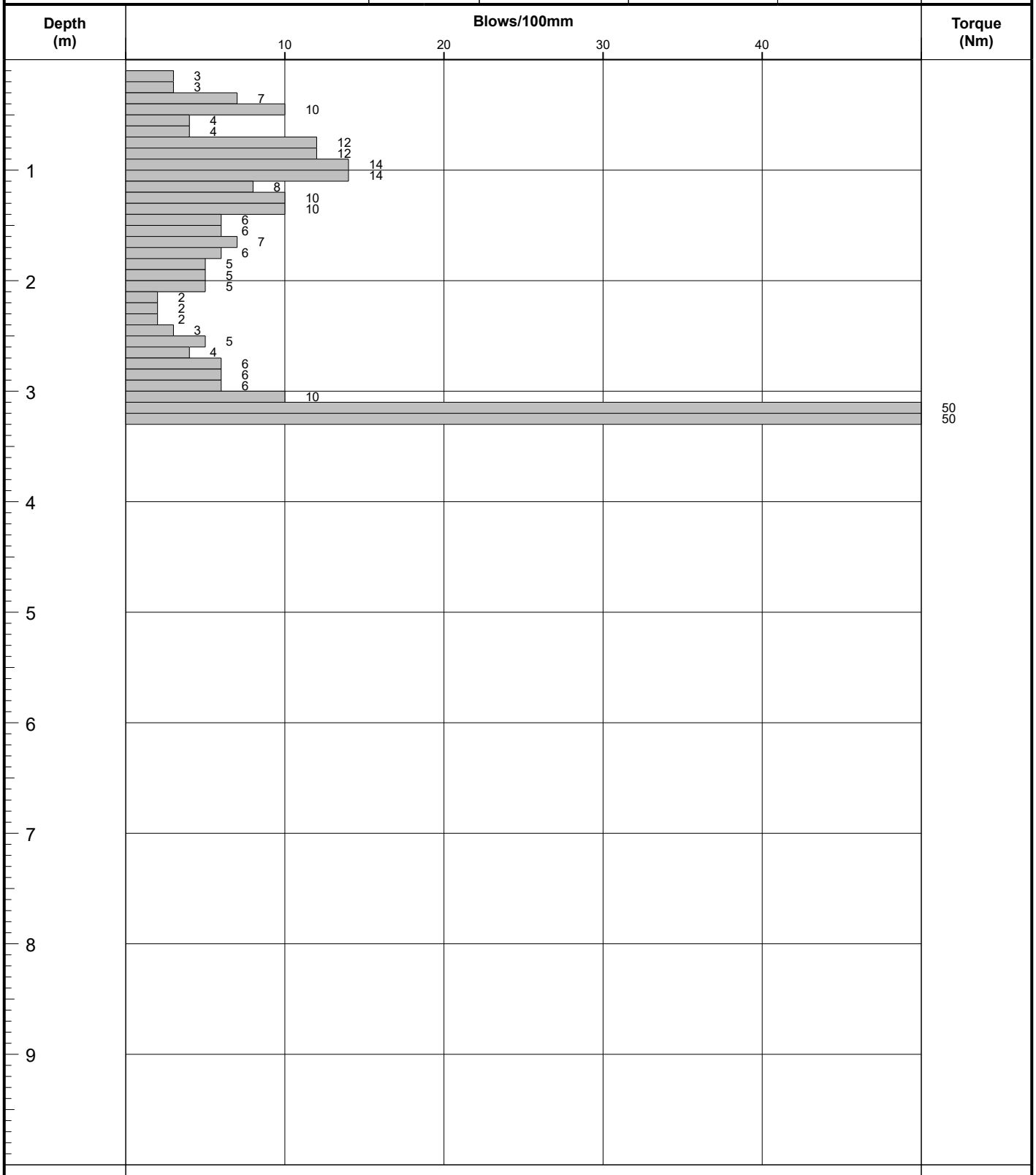
Remarks

Termination Reason

Last Updated 04/05/2023

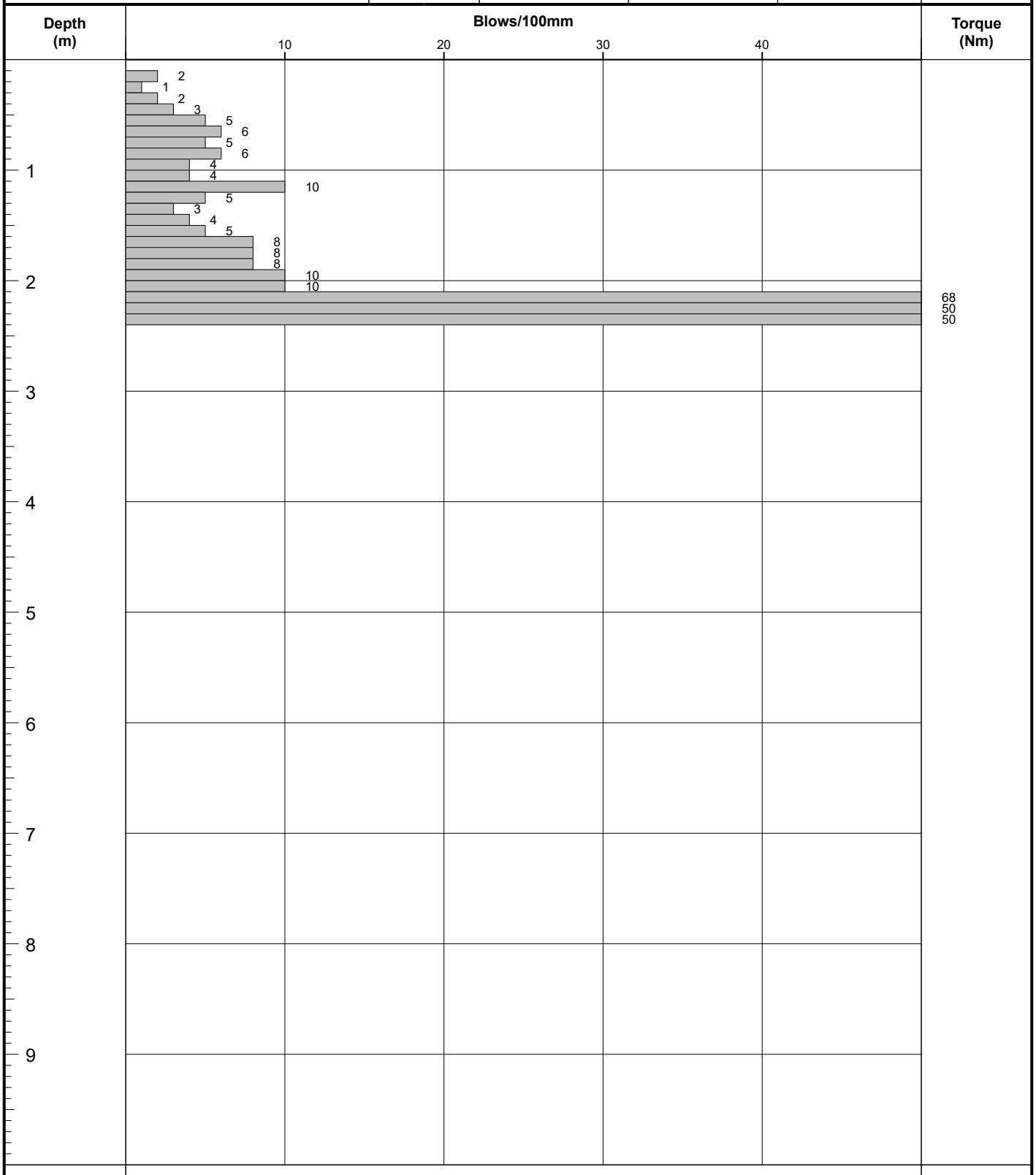
AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP07 DP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 3.20	**Date:** 26/09/2022	**Operator:** JD	FINAL



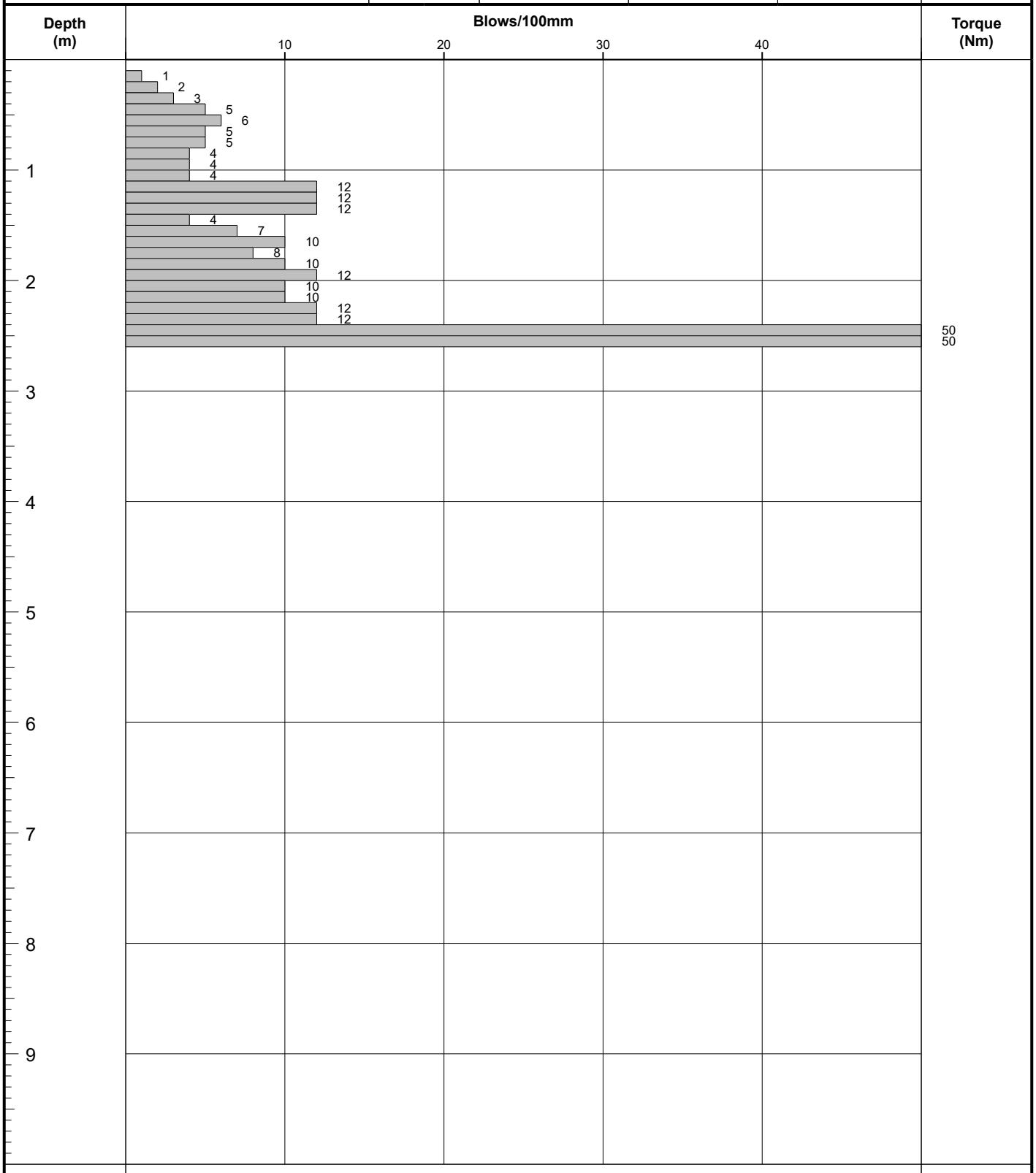
Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64.0 kg			
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023	AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP08 ADP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 2.20	**Date:** 26/09/2022	**Operator:** JD	FINAL



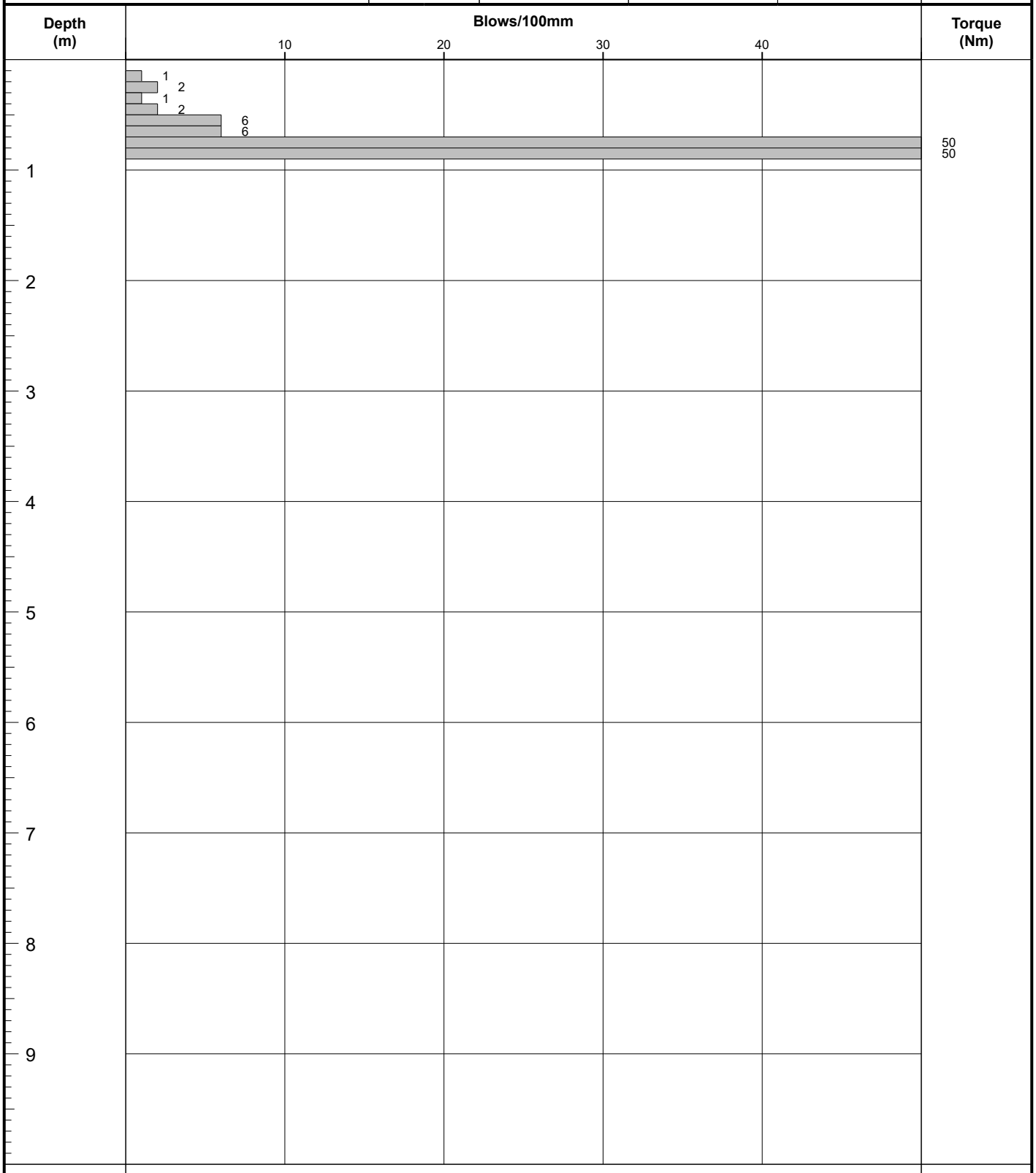
Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64.0 kg			
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023	AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP08 DP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 2.50	**Date:** 26/09/2022	**Operator:** JD	FINAL



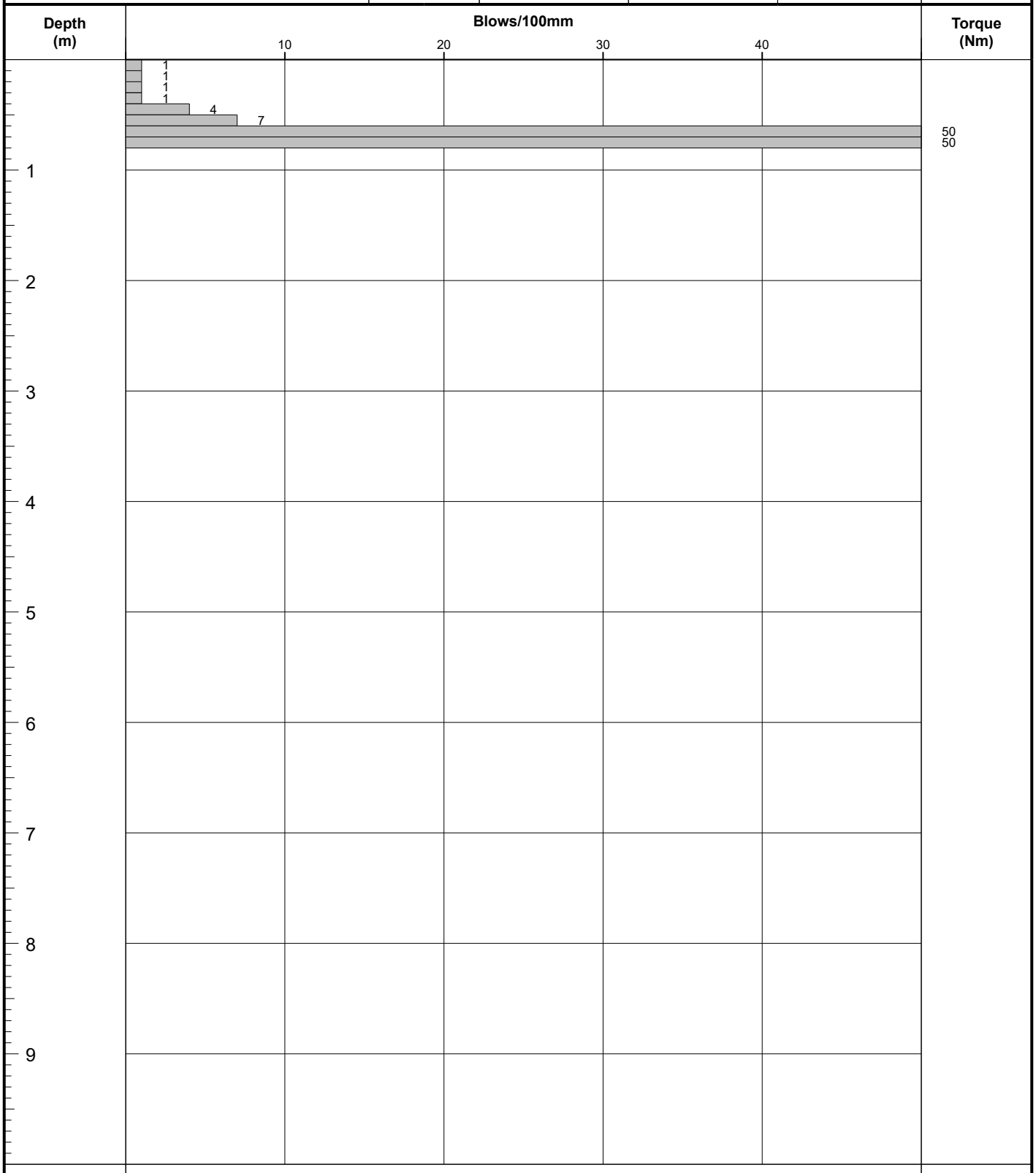
Fall Height: 750 mm	**Remarks**	
Hammer Mass: 64.0 kg		
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP09 ADP
	Coordinates E N	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing		**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 0.80	**Date:** 26/09/2022	**Operator:** JD	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64.0 kg			
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023	AGS

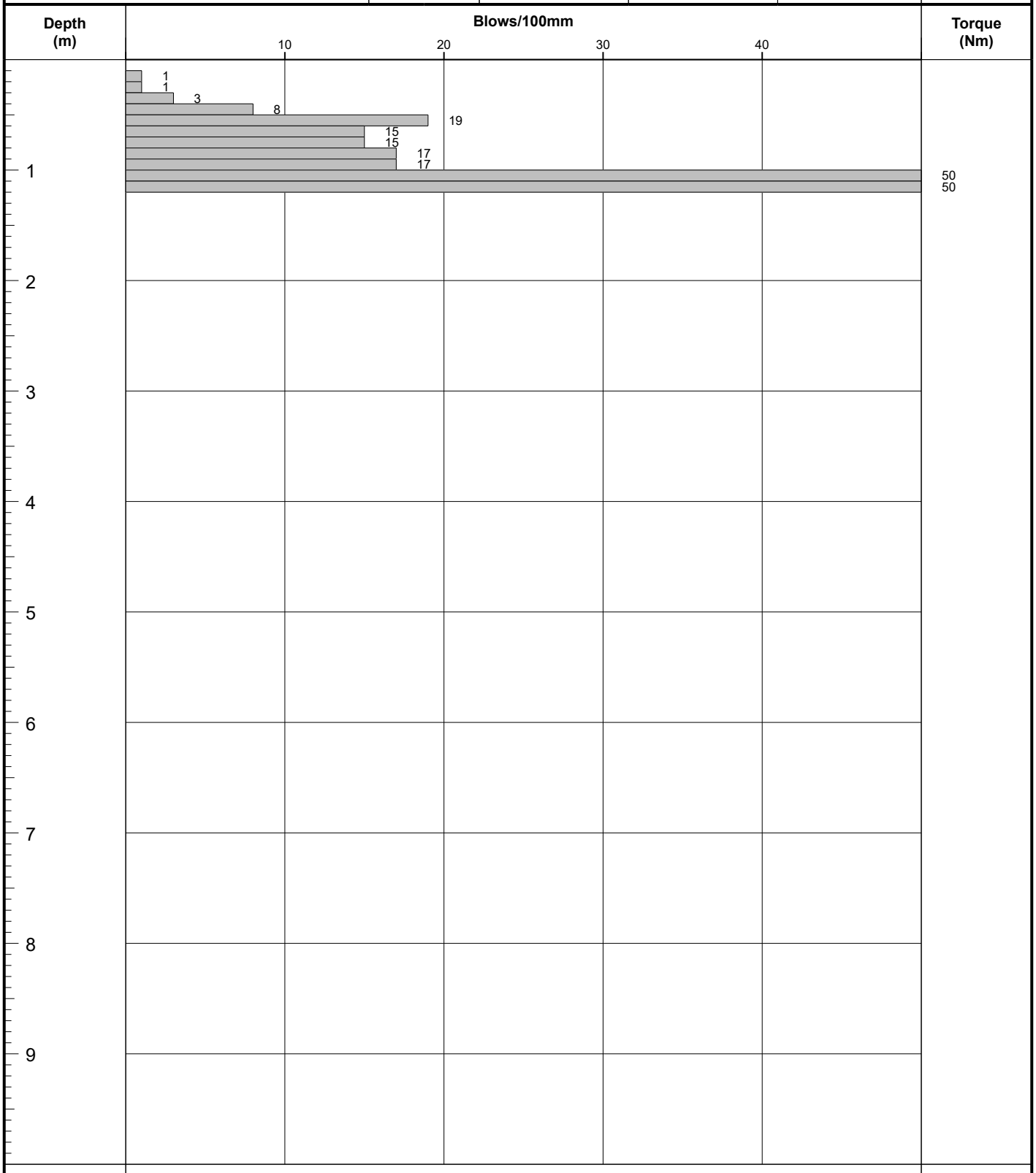
CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP09 DP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 0.80	**Date:** 26/09/2022	**Operator:** JD	FINAL



Fall Height: 750 mm	**Remarks**	
Hammer Mass: 63.5 kg		
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023

CAUSEWAY GEOTECH

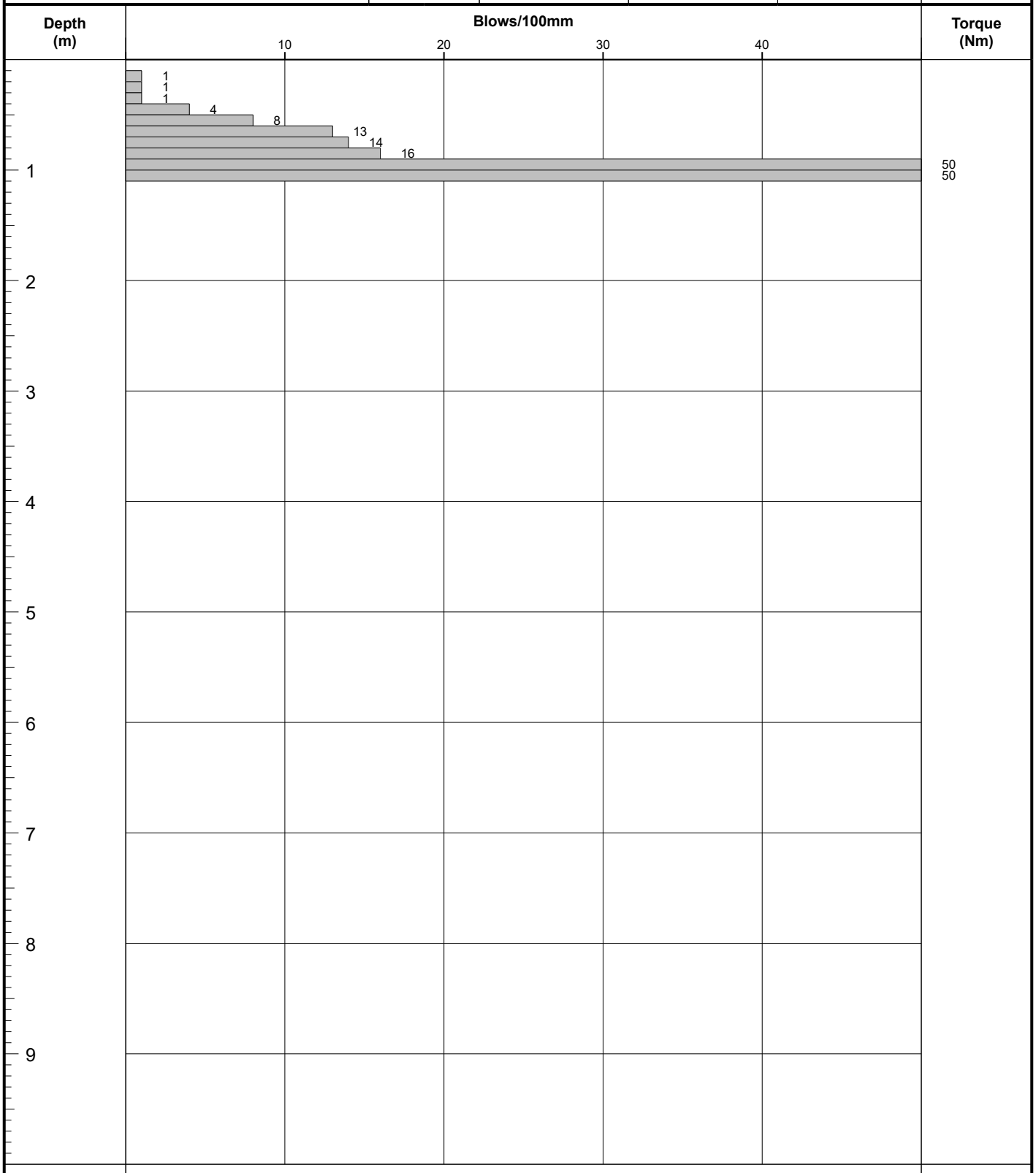
	Project No. 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP10 ADP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 1.10	**Date:** 26/09/2022	**Operator:** JD	FINAL



Fall Height: 750 mm	**Remarks**	
Hammer Mass: 64.0 kg		
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023

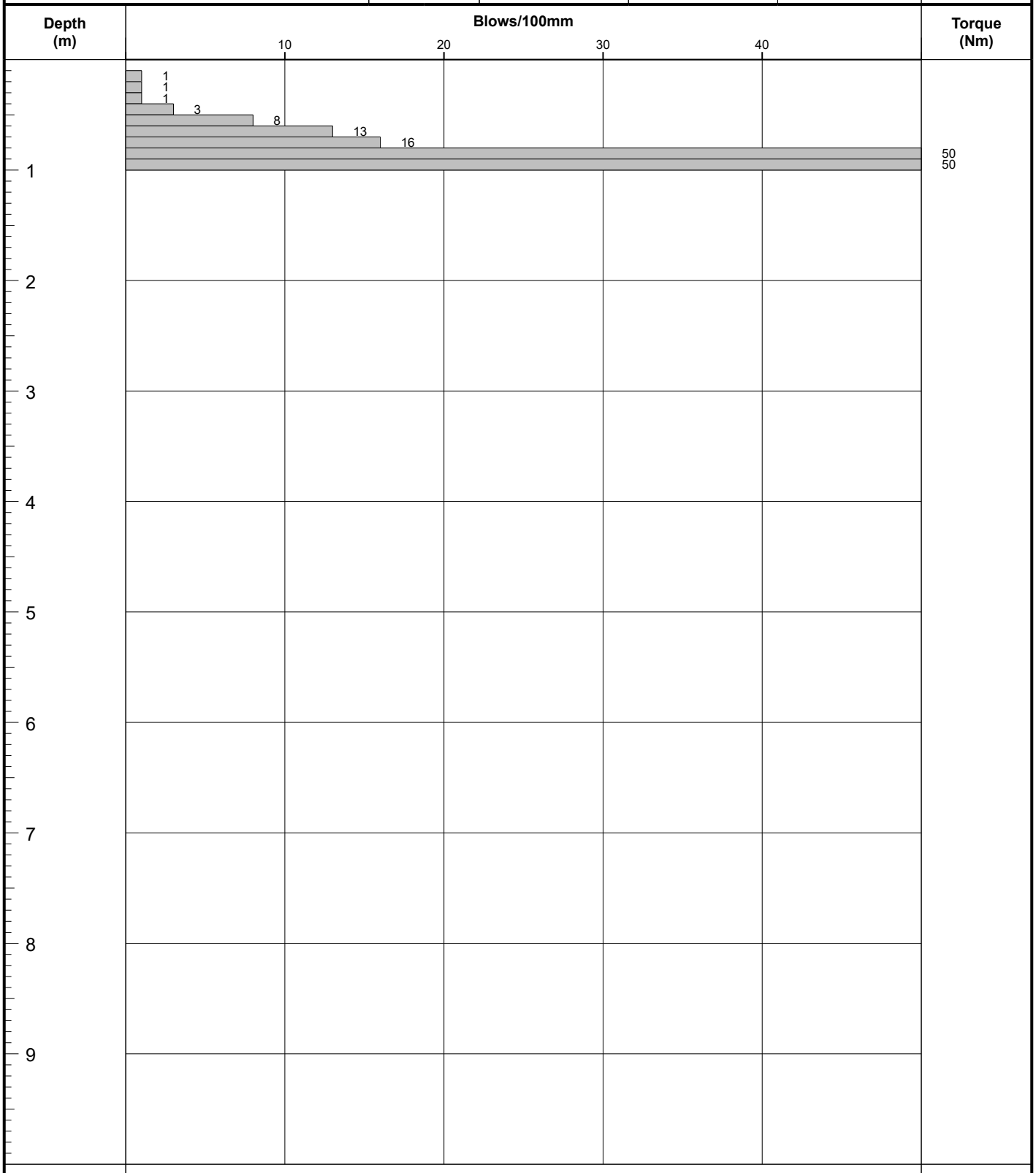
AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP10 BDP
	Coordinates E N	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing		**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 1.00	**Date:** 26/09/2022	**Operator:** JD	FINAL



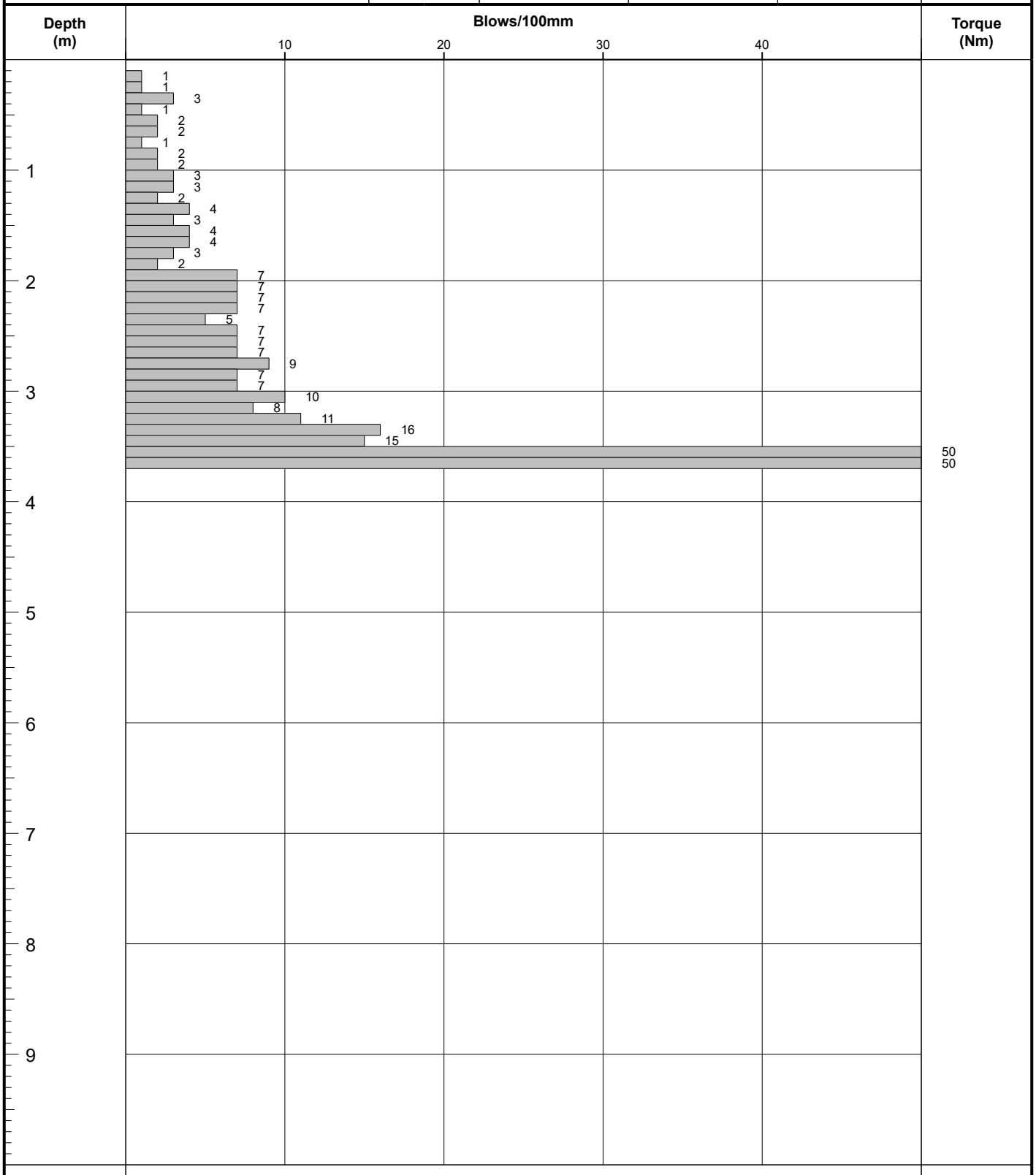
Fall Height: 750 mm	**Remarks**	
Hammer Mass: 64.0 kg		
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP10 DP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 0.90	**Date:** 26/09/2022	**Operator:** JD	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64.0 kg			
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023	AGS

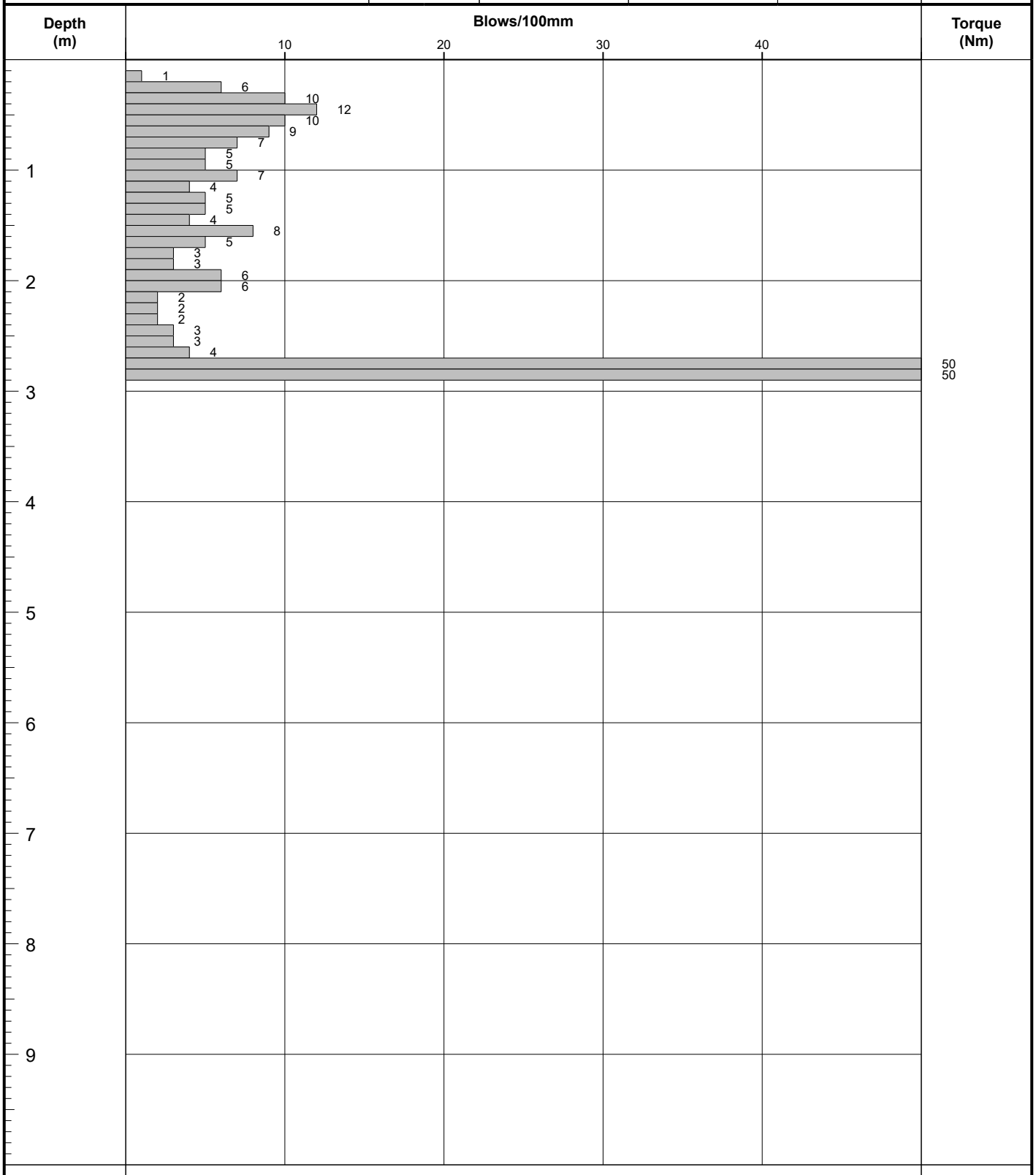
CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP11 DP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 3.60	**Date:** 26/09/2022	**Operator:** JD	FINAL



Fall Height: 750 mm	**Remarks**	
Hammer Mass: 64.0 kg		
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023

CAUSEWAY GEOTECH

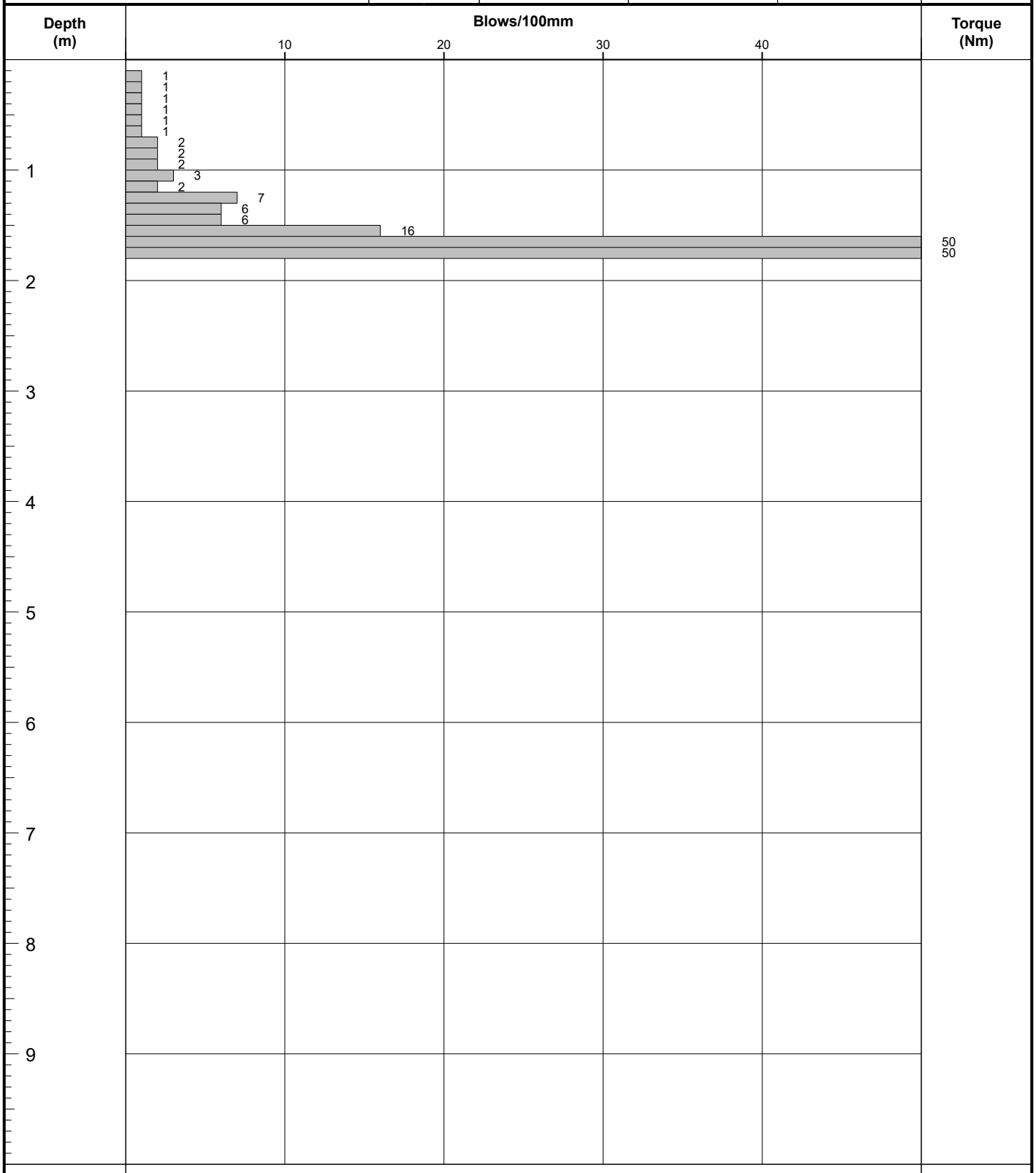
Project No.	Project Name:	Probe ID
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	WP1_TP12 DP
Coordinates	**Client:**	
E	Dublin Array Offshore Windfarm	
Method:	**Client's Representative:**	Sheet 1 of 1
Dynamic Probing	N Gavin and Doherty Geosolutions (GDG)	Scale: 1:50
Probe Type:	**Elevation** / **Final Depth:** / **Date:** / **Operator:**	FINAL
DPSH-B	mOD / 2.80 / 26/09/2022 / JD	



Fall Height: 750 mm	**Remarks**
Hammer Mass: 64.0 kg	
Cone Diameter: 51.0 mm	**Termination Reason**
	Last Updated 04/05/2023

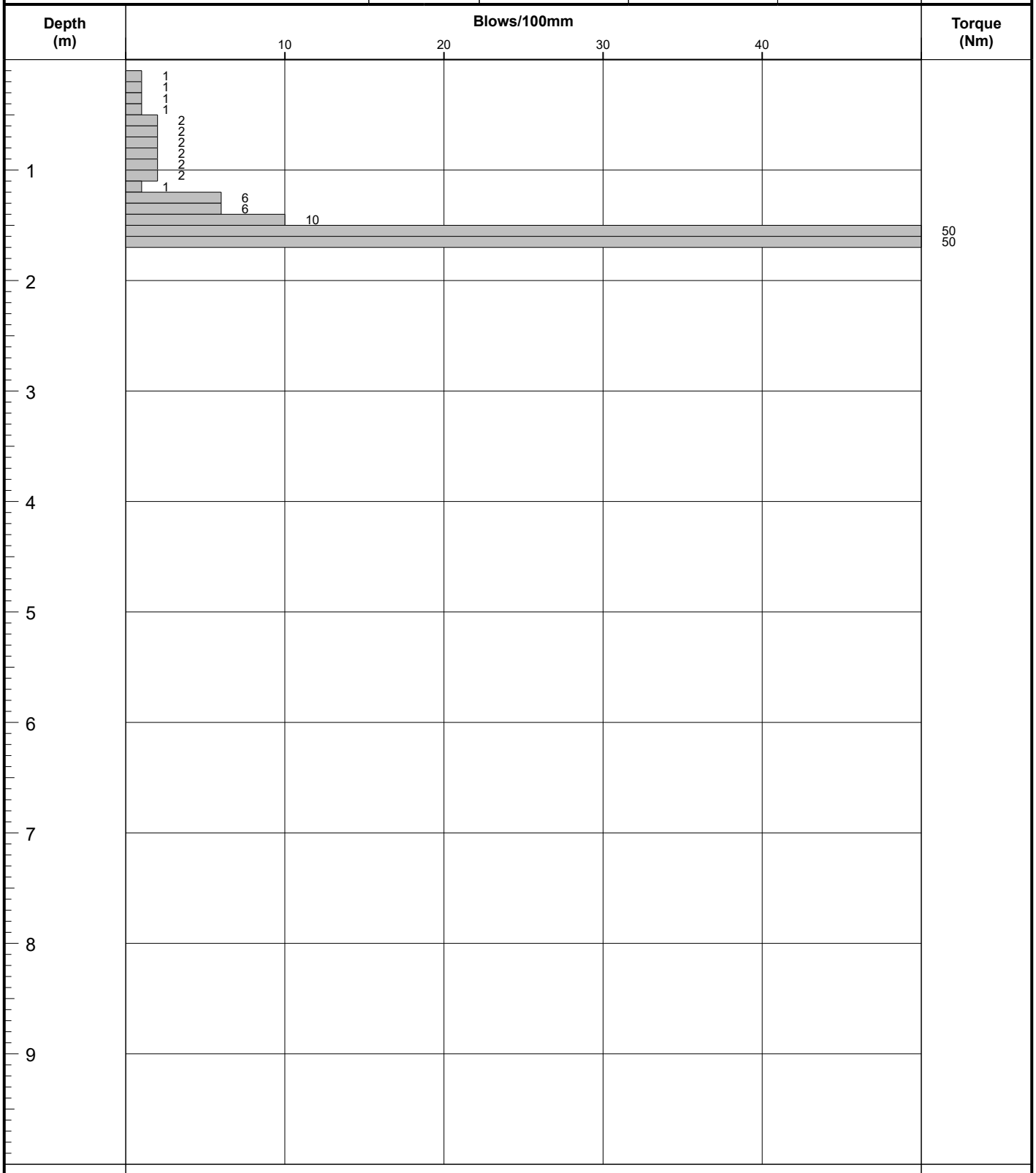
AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP13 ADP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 1.70	**Date:** 26/09/2022	**Operator:** JD	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64.0 kg			
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023	AGS

CAUSEWAY GEOTECH	**Project No.** 21-1443E	**Project Name:** Dublin Array Wind Park - Stage 1 Onshore Site Investigations			**Probe ID** WP1_TP13 DP
	Coordinates E	**Client:** Dublin Array Offshore Windfarm			
Method: Dynamic Probing	N	**Client's Representative:** Gavin and Doherty Geosolutions (GDG)			Sheet 1 of 1 Scale: 1:50
Probe Type: DPSH-B	**Elevation** mOD	**Final Depth:** 1.60	**Date:** 26/09/2022	**Operator:** JD	FINAL



Fall Height: 750 mm	**Remarks**		
Hammer Mass: 64.0 kg			
Cone Diameter: 51.0 mm	**Termination Reason**	**Last Updated** 04/05/2023	AGS

CAUSEWAY GEOTECH

APPENDIX G

SOAKAWAY TEST RESULTS

Soakaway Infiltration Test

Project No.: 21-1443E
Site: DUB ARR Onshore Site Investigations
Test Location: WP1-TP03 (Test 1)
Test Date: 04 October 2022

	width (m)	length (m)
test pit top dimensions	0.75	2.40
test pit base dimensions	0.75	1.30

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

test pit depth (m) 1.70

depth to groundwater before adding water (m) = Dry

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.52	1.18
1	0.56	1.14
2	0.60	1.10
4	0.65	1.05
6	0.70	1.00
8	0.75	0.95
10	0.79	0.91
15	0.90	0.80
20	1.00	0.70
25	1.09	0.61
30	1.17	0.53
40	1.28	0.42
50	1.39	0.31
60	1.51	0.19
120	1.60	0.10

From graph below:

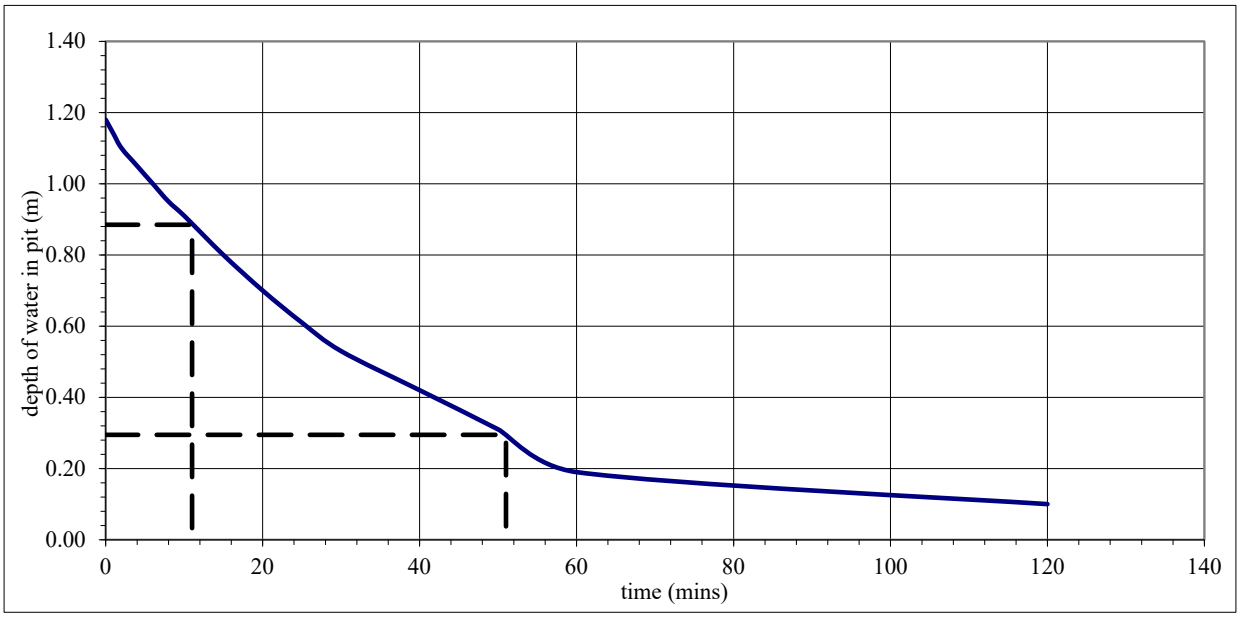
test start - 75% depth at
0.885 m water depth
time is 11.0 minutes

test end - 25% depth at
0.295 m water depth
time is 51.0 minutes

test infiltration rate (q) = 0.304 m/h

*pit collapsed to 1.60m

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
11	0.82	0.885	40	0.74	3.68	5.1E-03	0.304
51	1.41	0.295					



Soakaway Infiltration Test

Project No.: 21-1443E
Site: DUB ARR Onshore Site Investigations
Test Location: WP1-TP03 (Test 2)
Test Date: 04 October 2022

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.75	2.40
test pit base dimensions	0.75	1.30

test pit depth (m) 1.60

depth to groundwater before adding water (m) = Dry

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.65	0.95
1	0.70	0.90
2	0.75	0.85
4	0.83	0.77
6	0.89	0.71
8	0.94	0.66
10	0.99	0.61
15	1.10	0.50
20	1.19	0.41
25	1.28	0.32
30	1.38	0.22
40	1.47	0.13
50	1.55	0.05
60	1.60	0.00

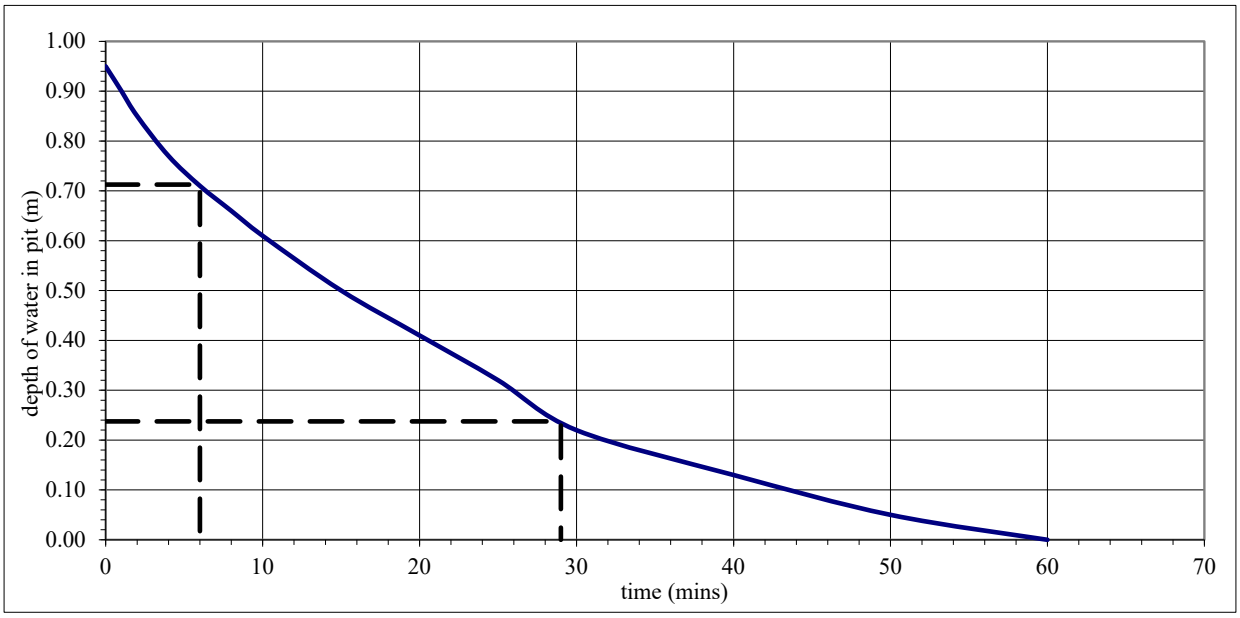
From graph below:

test start - 75% depth at
0.7125 m water depth
time is 6.0 minutes

test end - 25% depth at
0.2375 m water depth
time is 29.0 minutes

test infiltration rate (q) = 0.485 m/h

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
6	0.89	0.7125	23	0.58	3.12	8.1E-03	0.485
29	1.36	0.2375					



Soakaway Infiltration Test

Project No.: 21-1443E
Site: DUB ARR Onshore Site Investigations
Test Location: WP1-TP04 (Test 1)
Test Date: 04 October 2022

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.65	2.40
test pit base dimensions	0.65	1.20

test pit depth (m) 1.50

depth to groundwater before adding water (m) = Dry

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.91	0.59
1	0.96	0.54
2	1.00	0.50
4	1.06	0.44
6	1.09	0.41
8	1.12	0.38
10	1.16	0.34
15	1.21	0.29
20	1.26	0.24
25	1.31	0.19
30	1.36	0.14
40	1.45	0.05
50	1.50	0.00

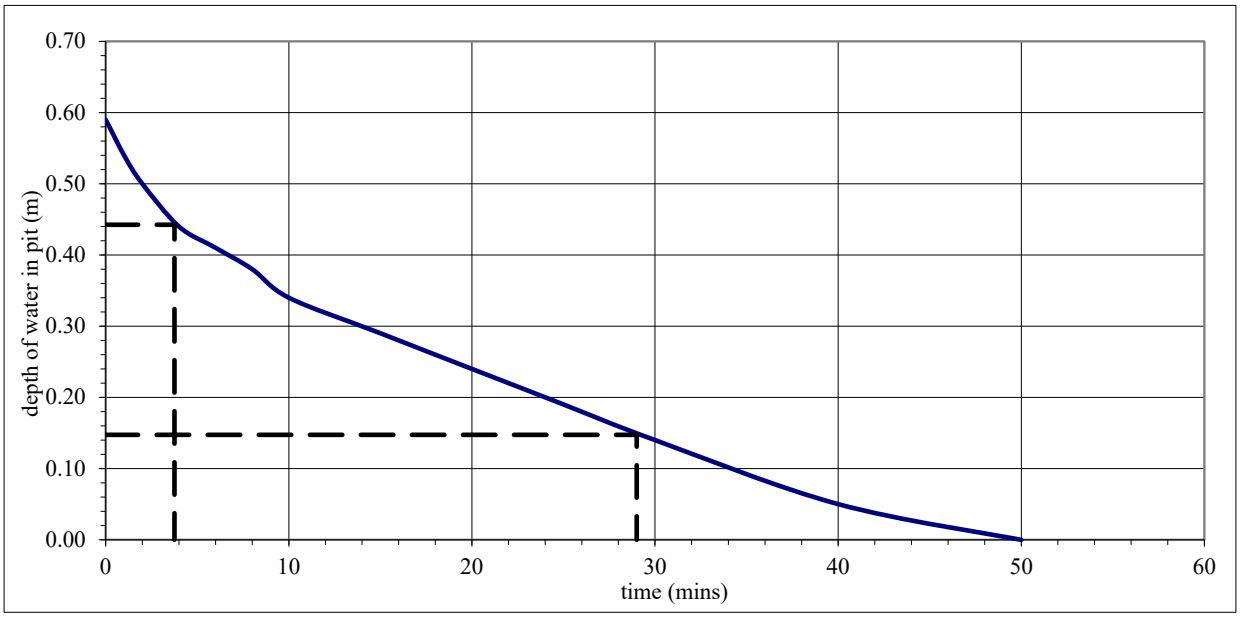
From graph below:

test start - 75% depth at
0.4425 m water depth
time is 3.8 minutes

test end - 25% depth at
0.1475 m water depth
time is 29.0 minutes

test infiltration rate (q) = 0.334 m/h

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
3.75	1.06	0.4425	25.25	0.28	1.96	5.6E-03	0.334
29	1.35	0.1475					



Soakaway Infiltration Test

Project No.: 21-1443E
Site: DUB ARR Onshore Site Investigations
Test Location: WP1-TP04 (Test 2)
Test Date: 04 October 2022

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.65	2.40
test pit base dimensions	0.65	1.20

test pit depth (m) 1.50

depth to groundwater before adding water (m) = Dry

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.85	0.65
1	0.92	0.58
2	0.94	0.56
4	1.02	0.48
6	1.06	0.44
8	1.08	0.42
10	1.10	0.40
15	1.15	0.35
20	1.20	0.30
25	1.24	0.26
30	1.28	0.22
40	1.32	0.18
50	1.38	0.12
60	1.50	0.00

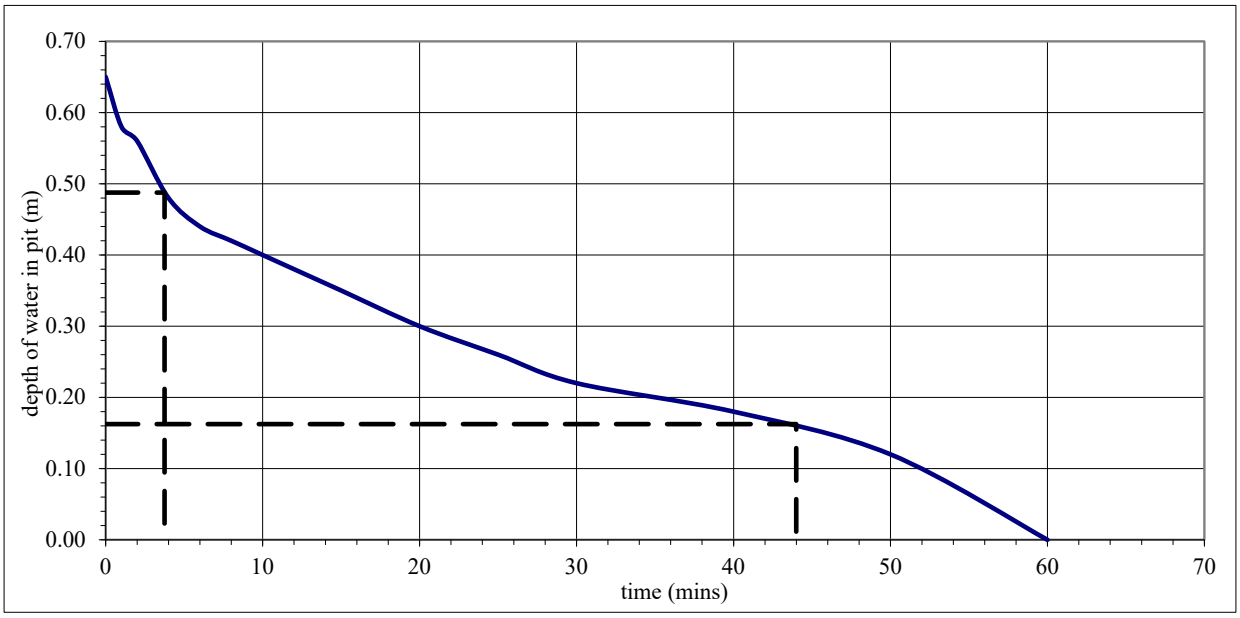
From graph below:

test start - 75% depth at
0.4875 m water depth
time is 3.8 minutes

test end - 25% depth at
0.1625 m water depth
time is 44.0 minutes

test infiltration rate (q) = 0.220 m/h

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
3.75	1.01	0.4875	40.25	0.31	2.09	3.7E-03	0.220
44	1.34	0.1625					



Soakaway Infiltration Test

Project No.: 21-1443E
Site: DUB ARR Onshore Site Investigations
Test Location: WP1-TP06 (Test 1)
Test Date: 05 October 2022

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.75	2.20
test pit base dimensions	0.75	1.50

test pit depth (m) 1.50

depth to groundwater before adding water (m) = Dry

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.36	1.14
1	0.36	1.14
2	0.36	1.14
4	0.36	1.14
6	0.36	1.14
8	0.37	1.13
10	0.37	1.13
15	0.38	1.12
20	0.39	1.11
25	0.41	1.09
30	0.41	1.09
40	0.43	1.07
50	0.45	1.05
60	0.47	1.03
90	0.52	0.98
120	0.55	0.95
180	0.63	0.87
240	0.67	0.83
300	0.71	0.79
360	0.76	0.74

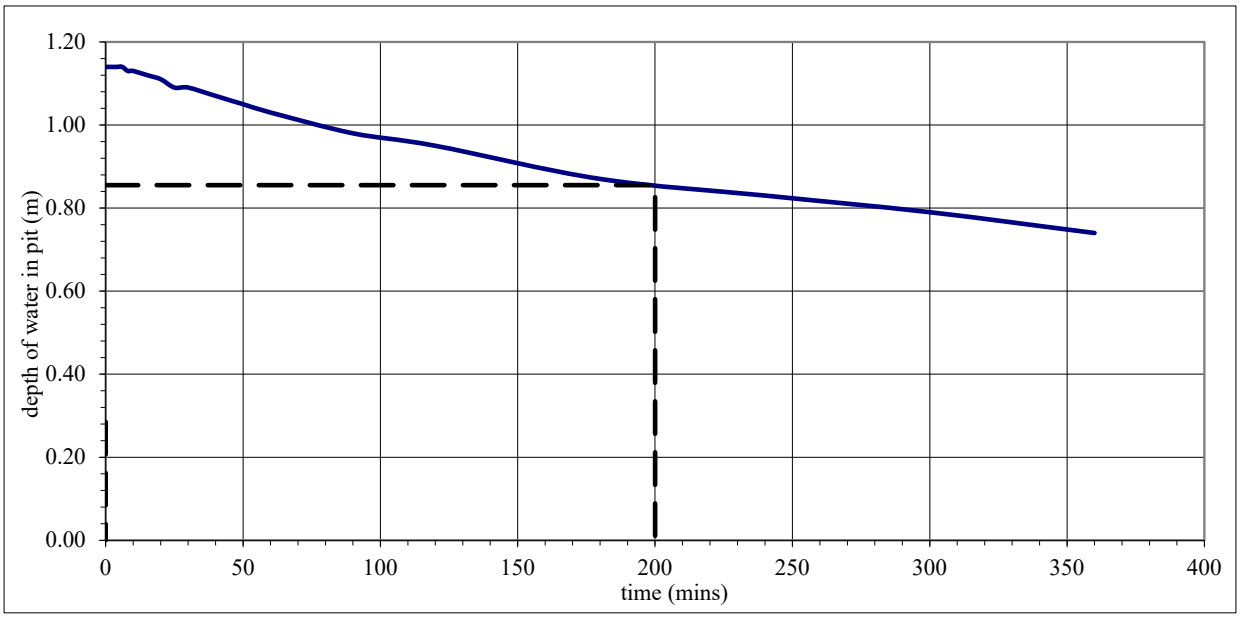
From graph below:

test start - 75% depth at
0.855 m water depth
time is 200.0 minutes

test end - 25% depth at
0.285 m water depth
time is not determined

infiltration rate (q) is very low

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
200	0.65	0.855					
	1.22	0.285					



Soakaway Infiltration Test

Project No.: 21-1443E
Site: DUB ARR Onshore Site Investigations
Test Location: WP1-TP10 (Test 1)
Test Date: 05 October 2022

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.65	2.00
test pit base dimensions	0.65	1.00

test pit depth (m) 1.50

depth to groundwater before adding water (m) = Dry

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.38	1.12
1	0.41	1.09
2	0.44	1.06
4	0.49	1.01
6	0.54	0.96
8	0.60	0.90
10	0.65	0.85
15	0.78	0.72
20	0.91	0.59
25	1.06	0.44
30	1.26	0.24
40	1.32	0.18

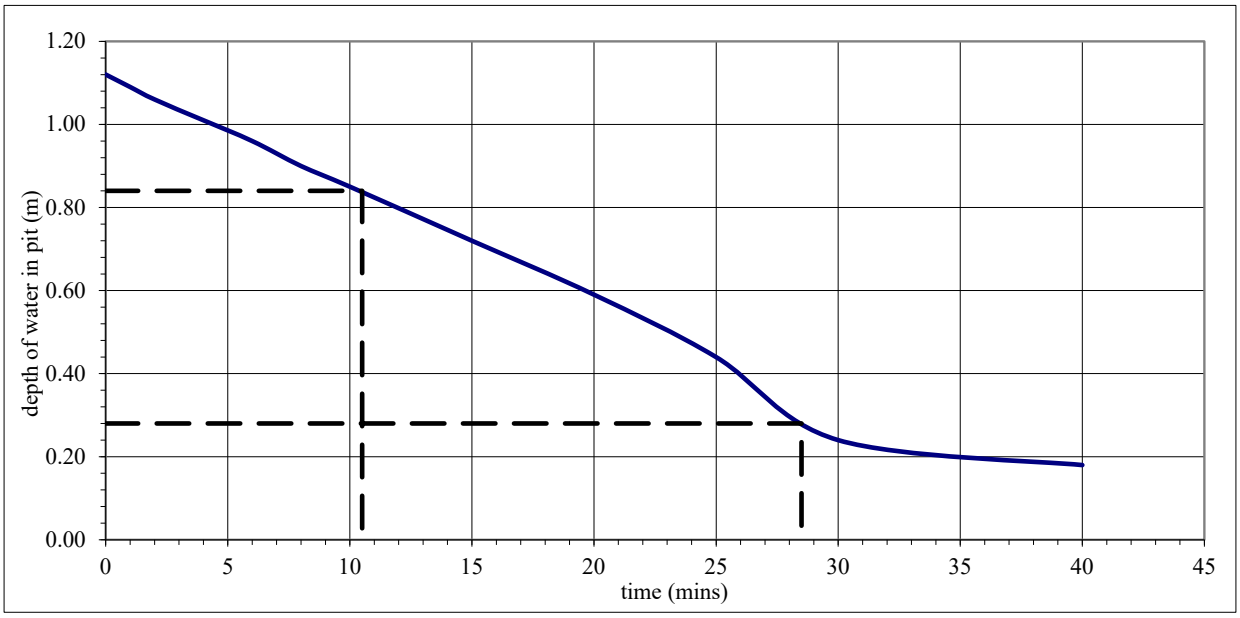
From graph below:
test start - 75% depth at
0.84 m water depth
time is 10.5 minutes

test end - 25% depth at
0.28 m water depth
time is 28.5 minutes

test infiltration rate (q) = 0.604 m/h

*pit collapsed to 1.32m

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
10.5	0.66	0.84	18	0.50	2.76	1.0E-02	0.604
28.5	1.22	0.28					



Soakaway Infiltration Test

Project No.: 21-1443E
Site: DUB ARR Onshore Site Investigations
Test Location: WP1-TP10 (Test 2)
Test Date: 05 October 2022

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.65	2.00
test pit base dimensions	0.65	1.00

test pit depth (m) 1.32

depth to groundwater before adding water (m) = Dry

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.36	0.96
1	0.38	0.94
2	0.40	0.92
4	0.43	0.89
6	0.46	0.86
8	0.49	0.83
10	0.53	0.79
15	0.60	0.72
20	0.68	0.64
25	0.76	0.56
30	0.86	0.46
40	1.01	0.31
50	1.32	0.00

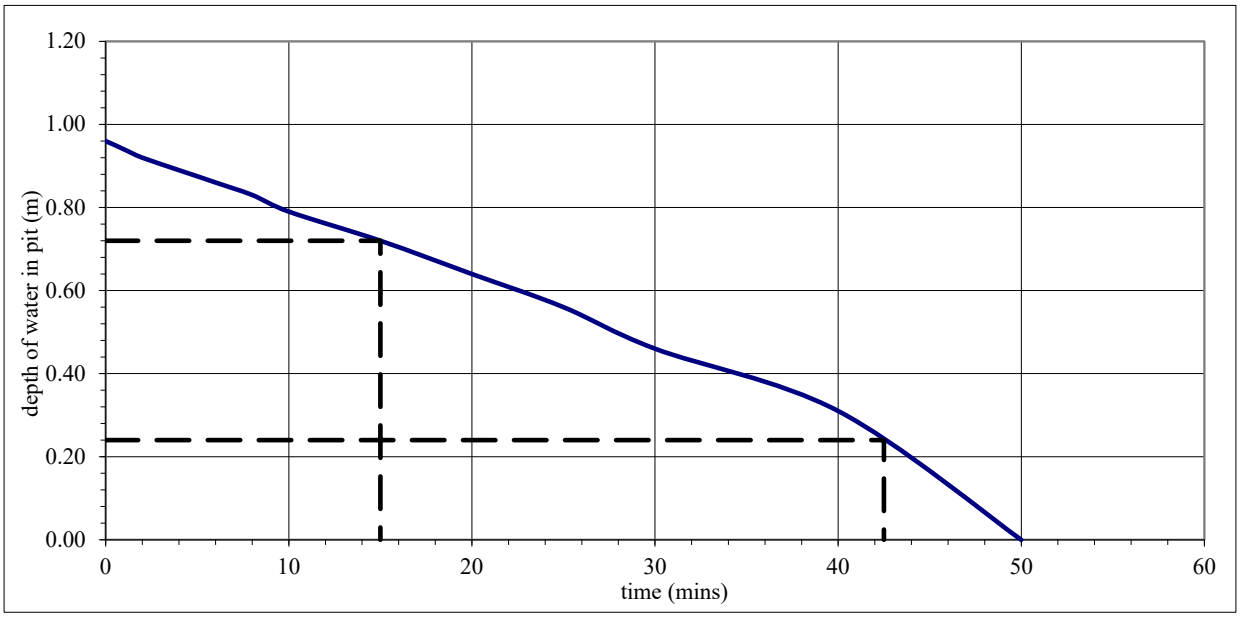
From graph below:

test start - 75% depth at
0.72 m water depth
time is 15.0 minutes

test end - 25% depth at
0.24 m water depth
time is 42.5 minutes

test infiltration rate (q) = 0.379 m/h

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
15	0.60	0.72	27.5	0.43	2.45	6.3E-03	0.379
42.5	1.08	0.24					



Soakaway Infiltration Test

Project No.: 21-1443E
Site: DUB ARR Onshore Site Investigations
Test Location: WP1-TP11 (Test 1)
Test Date: 04 October 2022

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.65	2.40
test pit base dimensions	0.65	1.30

test pit depth (m) 1.70

depth to groundwater before adding water (m) = Dry

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.47	1.23
1	0.49	1.21
2	0.51	1.19
4	0.53	1.17
6	0.55	1.15
8	0.56	1.14
10	0.58	1.12
15	0.61	1.09
20	0.64	1.06
25	0.66	1.04
30	0.68	1.02
40	0.71	0.99
50	0.74	0.96
60	0.77	0.93
90	0.84	0.86
120	0.88	0.82
180	0.96	0.74
240	1.05	0.65

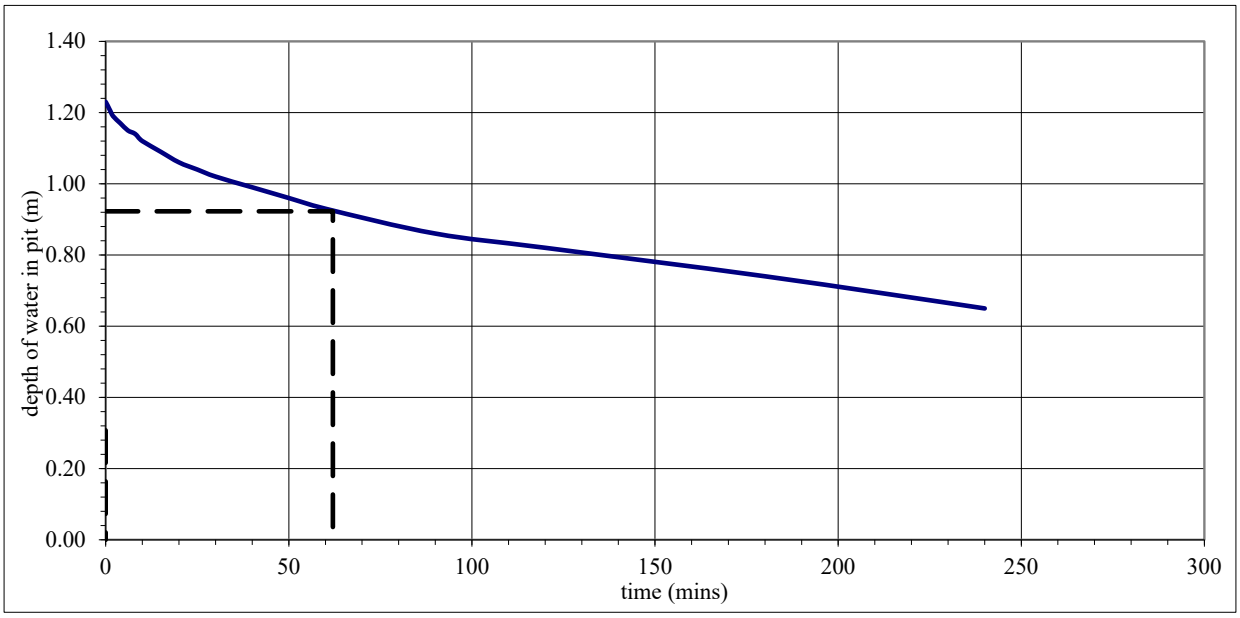
From graph below:

test start - 75% depth at
0.9225 m water depth
time is 62.0 minutes

test end - 25% depth at
0.3075 m water depth
time is not determined

infiltration rate (q) is very low

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
62	0.78	0.9225					
	1.39	0.3075					



Soakaway Infiltration Test

Project No.: 21-1443E
Site: DUB ARR Onshore Site Investigations
Test Location: WP2-TP04 (Test 1)
Test Date: 03 October 2022

Analysis using method as described in BRE Digest 365 and CIRIA Report C697-The SUDS Manual

	width (m)	length (m)
test pit top dimensions	0.50	2.20
test pit base dimensions	0.50	0.80

test pit depth (m) 1.50

depth to groundwater before adding water (m) = Dry

time (mins)	depth to water surface (m)	depth of water in pit (m)
0	0.30	1.20
1	0.31	1.19
2	0.32	1.18
4	0.32	1.18
6	0.34	1.16
8	0.35	1.15
10	0.36	1.14
15	0.38	1.12
20	0.40	1.10
25	0.41	1.09
30	0.42	1.08
40	0.44	1.06
50	0.46	1.04
60	0.48	1.02
90	0.52	0.98
120	0.55	0.95
180	0.60	0.90

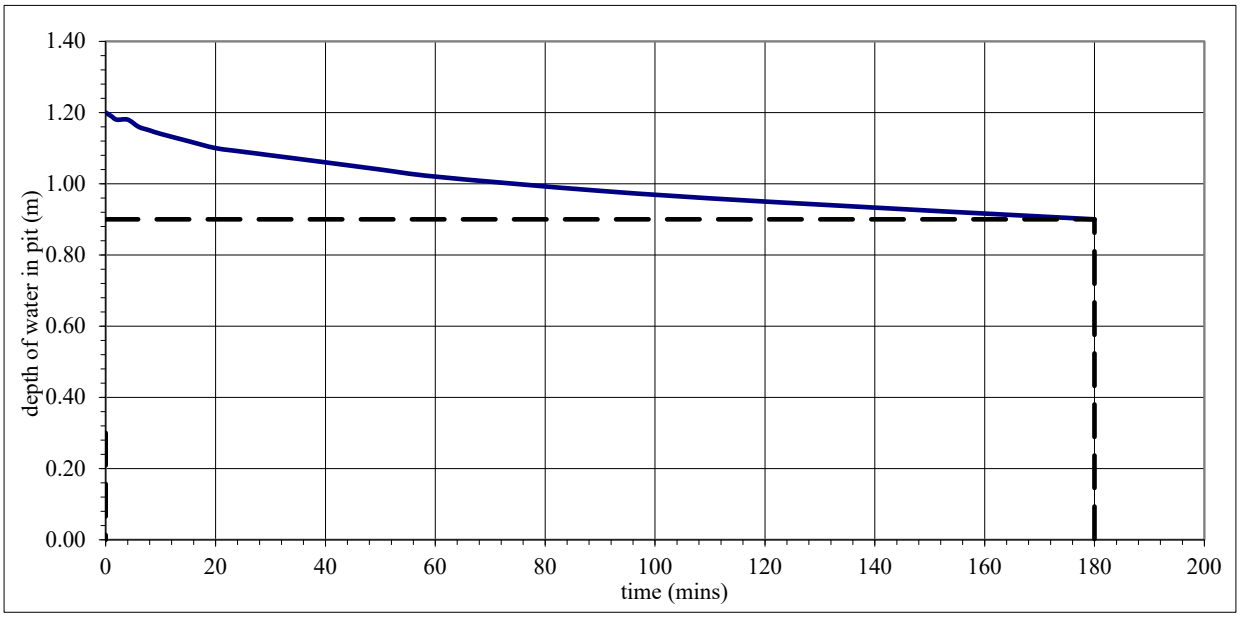
From graph below:

test start - 75% depth at
0.9 m water depth
time is 180.0 minutes

test end - 25% depth at
0.3 m water depth
time is not determined

infiltration rate (q) is very low

time (mins)	depth to water (m)	depth of water in pit (m)	time elapsed (mins)	volume of water lost (m^3)	Area of walls and base at 50% drop (m^2)	q (m/min)	q (m/h)
180	0.60	0.9					
	1.20	0.3					



CAUSEWAY GEOTECH

APPENDIX H

PLATE LOAD TEST RESULTS

CBR TEST REPORT

Analysing
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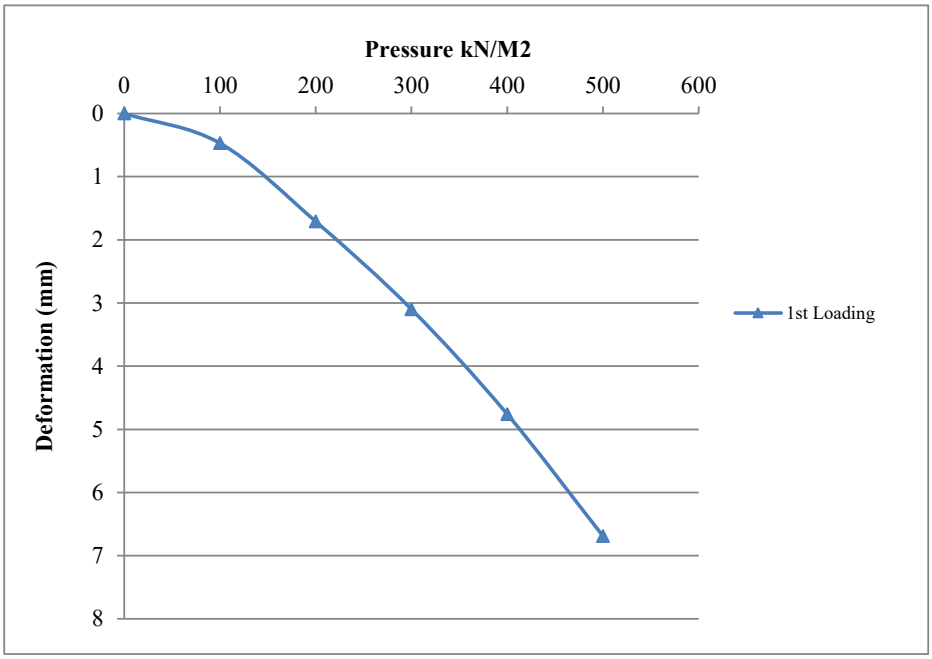
Fax +353 61 455447
E Mail jamespurcell@bhp.ie

Client: Causeway Geotech Ltd
8 Drumahiskey Rd,
Bendooragh,
Ballymoney
Northern Ireland

BHP Ref. No.: 22/10/029-1
Order No.: Not Supplied
Date Tested: 04/10/2022
Test Specification: Client Spec.
Item: Formation

FAO: Mr. Sean Ross

Client Reference: Ballyogan Landfill, Dublin
Location Reference: Site CBR Test Location - WP1 - TP02
Type of Reaction Load: Excavator
Plate Diameter: 450mm
BS 1377:Part 9:1990, Cl.4.1 (Plate Loading Test)



Bearing Pressure kN/m²	Plate Settlement (mm)
0	0
100	0.47
200	1.71
300	3.10
400	4.76
500	6.69

Maximum Applied Pressure (kN/m^2)	500
Maximum Deformation (mm)	6.69
Estimated CBR % @ 1.25mm deformation	20
K= (KN/m^2/m) @ 1.25mm deformation	80848
K= (MN/m^2/m) @ 1.25mm deformation	81

Remarks:
CBR calculated in in accordance with Part 2 DMRB Volume 7 : Part 2 HD 25/94.
Time Recorded at each interval was 2 minutes.

Tony Hehir
Field Testing Services Manager
For and On Behalf of BHP Laboratories

Seamus O' Connell
Laboratory Technical Manager
Issue Date: 05/10/2022

Tested by BHP Laboratories, Limerick (c/o above address) Phone:(061) 455399 Fax:(061) 455447

Where the deformation does not exceed 1.25mm during the test, the CBR and K values have been estimated and are not included under our scope of accreditation.

CBR TEST REPORT

Analysing
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Consulting
Calibrating

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Fax +353 61 455447
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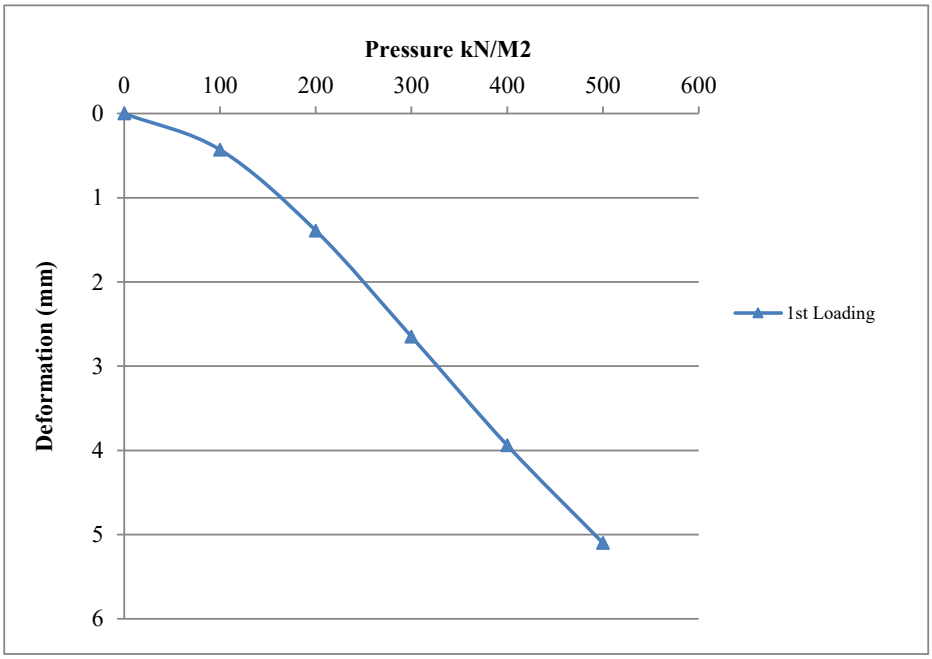
Client: Causeway Geotech Ltd
8 Drumahiskey Rd,
Bendooragh,
Ballymoney
Northern Ireland

BHP Ref. No.: 22/10/029-2
Order No.: Not Supplied
Date Tested: 04/10/2022
Test Specification: Client Spec.
Item: Formation

FAO: Mr. Sean Ross

Client Reference: Ballyogan Landfill, Dublin
Location Reference: Site CBR Test Location - WP1 - TP03
Type of Reaction Load: Excavator
Plate Diameter: 450mm
BS 1377:Part 9:1990, Cl.4.1 (Plate Loading Test)



Bearing Pressure kN/m²	Plate Settlement (mm)
0	0
100	0.43
200	1.39
300	2.65
400	3.94
500	5.10

Maximum Applied Pressure (kN/m^2)	500
Maximum Deformation (mm)	5.10
Estimated CBR % @ 1.25mm deformation	24
K= (KN/m^2/m) @ 1.25mm deformation	91760
K= (MN/m^2/m) @ 1.25mm deformation	92

Remarks:
CBR calculated in in accordance with Part 2 DMRB Volume 7 : Part 2 HD 25/94.
Time Recorded at each interval was 2 minutes.

Tony Hehir
Field Testing Services Manager
For and On Behalf of BHP Laboratories

Seamus O' Connell
Laboratory Technical Manager
Issue Date: 05/10/2022

Tested by BHP Laboratories, Limerick (c/o above address) Phone:(061) 455399 Fax:(061) 455447

Where the deformation does not exceed 1.25mm during the test, the CBR and K values have been estimated and are not included under our scope of accreditation.

CBR TEST REPORT

Analysing
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Fax +353 61 455447
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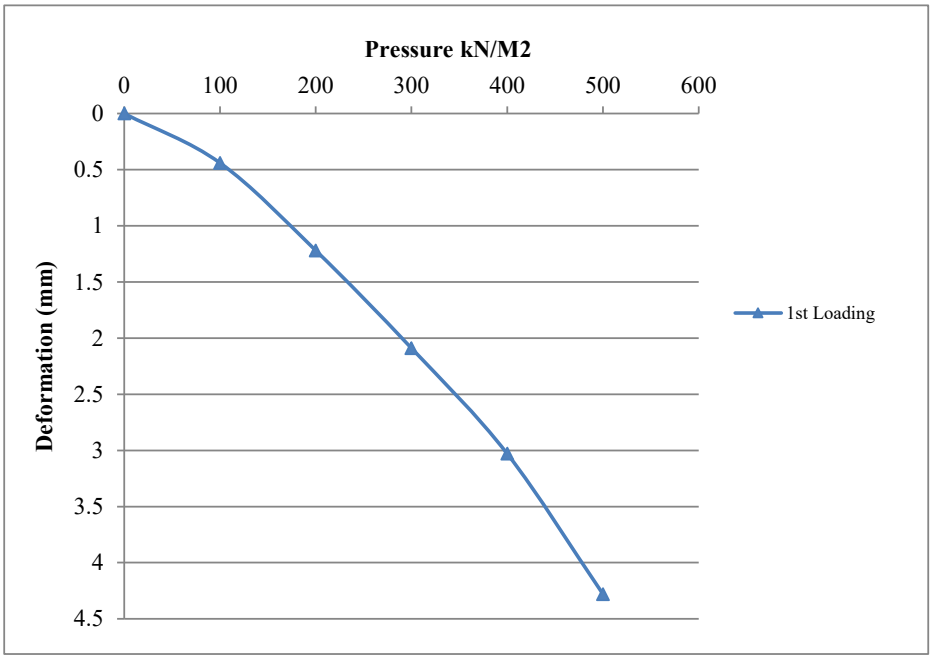
Client: Causeway Geotech Ltd
8 Drumahiskey Rd,
Bendooragh,
Ballymoney
Northern Ireland

BHP Ref. No.: 22/10/029-4
Order No.: Not Supplied
Date Tested: 04/10/2022
Test Specification: Client Spec.
Item: Formation

FAO: Mr. Sean Ross

Client Reference: Ballyogan Landfill, Dublin
Location Reference: Site CBR Test Location - WP1 - TP05
Type of Reaction Load: Excavator
Plate Diameter: 450mm
BS 1377:Part 9:1990, Cl.4.1 (Plate Loading Test)



Bearing Pressure kN/m²	Plate Settlement (mm)
0	0
100	0.44
200	1.22
300	2.09
400	3.03
500	4.28

Maximum Applied Pressure (kN/m^2)	500
Maximum Deformation (mm)	4.28
Estimated CBR % @ 1.25mm deformation	29
K= (KN/m^2/m) @ 1.25mm deformation	100688
K= (MN/m^2/m) @ 1.25mm deformation	101

Remarks:
CBR calculated in in accordance with Part 2 DMRB Volume 7 : Part 2 HD 25/94.
Time Recorded at each interval was 2 minutes.

Tony Hehir
Field Testing Services Manager
For and On Behalf of BHP Laboratories

Seamus O' Connell
Laboratory Technical Manager
Issue Date: 05/10/2022

Tested by BHP Laboratories, Limerick (c/o above address) Phone:(061) 455399 Fax:(061) 455447

Where the deformation does not exceed 1.25mm during the test, the CBR and K values have been estimated and are not included under our scope of accreditation.

CBR TEST REPORT

Analysing
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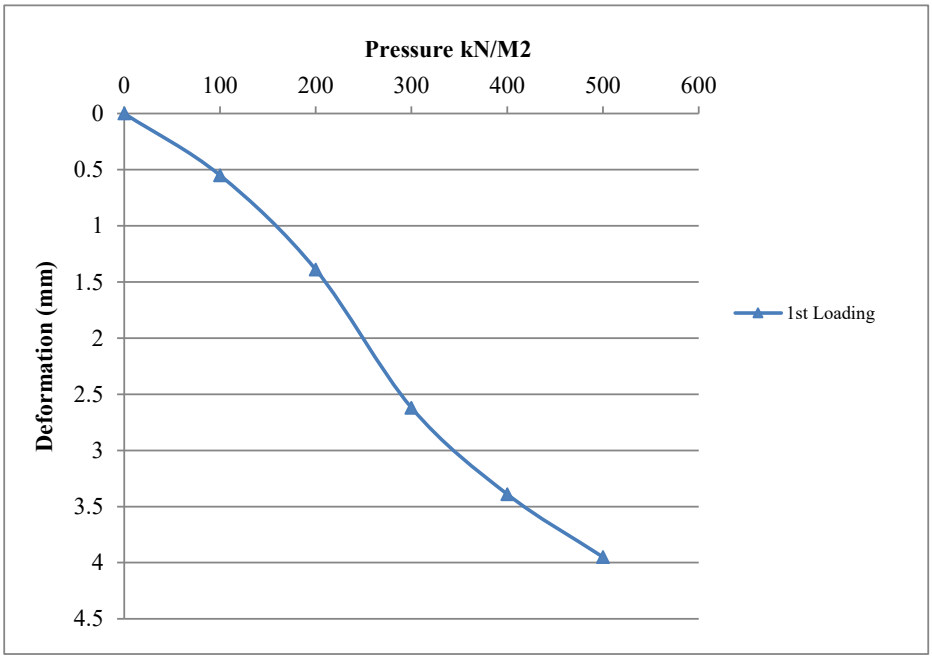
Client: Causeway Geotech Ltd
8 Drumahiskey Rd,
Bendooragh,
Ballymoney
Northern Ireland

BHP Ref. No.: 22/10/029-3
Order No.: Not Supplied
Date Tested: 04/10/2022
Test Specification: Client Spec.
Item: Formation

FAO: Mr. Sean Ross

Client Reference: Ballyogan Landfill, Dublin
Location Reference: Site CBR Test Location - WP1 - TP06
Type of Reaction Load: Excavator
Plate Diameter: 450mm
BS 1377:Part 9:1990, Cl.4.1 (Plate Loading Test)



Bearing Pressure kN/m²	Plate Settlement (mm)
0	0
100	0.55
200	1.39
300	2.62
400	3.39
500	3.95

Maximum Applied Pressure (kN/m^2)	500
Maximum Deformation (mm)	3.95
Estimated CBR % @ 1.25mm deformation	24
K= (KN/m^2/m) @ 1.25mm deformation	90768
K= (MN/m^2/m) @ 1.25mm deformation	91

Remarks:
CBR calculated in in accordance with Part 2 DMRB Volume 7 : Part 2 HD 25/94.
Time Recorded at each interval was 2 minutes.

Tony Hehir
Field Testing Services Manager
For and On Behalf of BHP Laboratories

Seamus O' Connell
Laboratory Technical Manager
Issue Date: 05/10/2022

Tested by BHP Laboratories, Limerick (c/o above address) Phone:(061) 455399 Fax:(061) 455447

Where the deformation does not exceed 1.25mm during the test, the CBR and K values have been estimated and are not included under our scope of accreditation.

CBR TEST REPORT

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Client: Causeway Geotech Ltd
8 Drumahiskey Rd,
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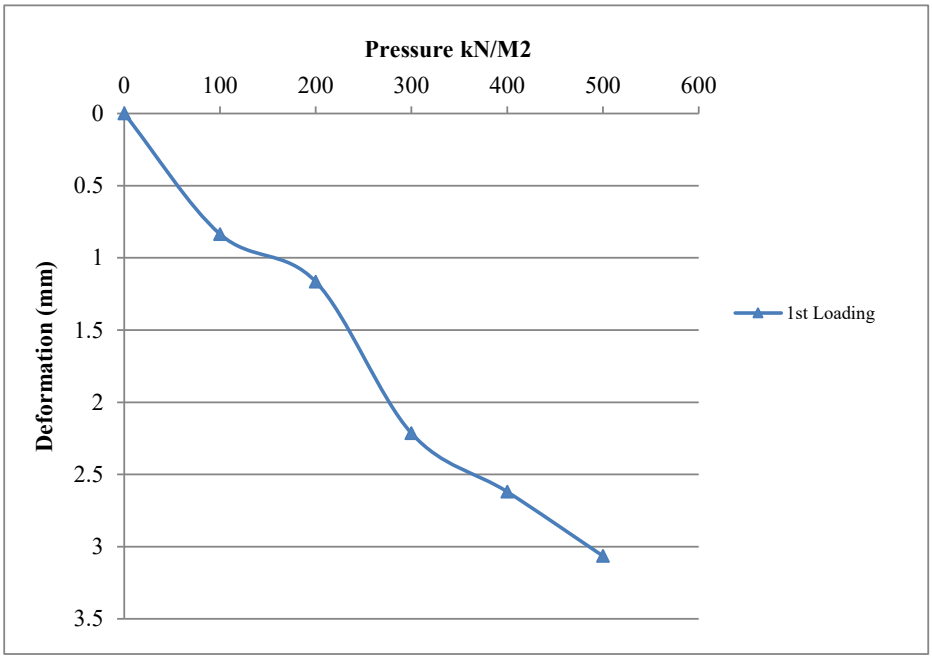
Ballymoney
Northern Ireland

BHP Ref. No.: 22/10/050-1
Order No.: Not Supplied
Date Tested: 05/10/2022
Test Specification: Client Spec.
Item: Clay

FAO: Mr. Sean Ross

Client Reference: Ballyogan Landfill, Dublin
Location Reference: Site CBR Test Location - WP1 - TP9
Type of Reaction Load: Excavator
Plate Diameter: 450mm
BS 1377:Part 9:1990, Cl.4.1 (Plate Loading Test)



Bearing Pressure kN/m²	Plate Settlement (mm)
0	0
100	0.84
200	1.17
300	2.22
400	2.62
500	3.07

Maximum Applied Pressure (kN/m^2)	500
Maximum Deformation (mm)	3.07
Estimated CBR % @ 1.25mm deformation	30
K= (KN/m^2/m) @ 1.25mm deformation	103168
K= (MN/m^2/m) @ 1.25mm deformation	103

Remarks:
CBR calculated in in accordance with Part 2 DMRB Volume 7 : Part 2 HD 25/94.
Time Recorded at each interval was 2 minutes.

Tony Hehir
Field Testing Services Manager
For and On Behalf of BHP Laboratories

Seamus O' Connell
Laboratory Technical Manager
Issue Date: 06/10/2022

Tested by BHP Laboratories, Limerick (c/o above address) Phone:(061) 455399 Fax:(061) 455447

Where the deformation does not exceed 1.25mm during the test, the CBR and K values have been estimated and are not included under our scope of accreditation.

CBR TEST REPORT

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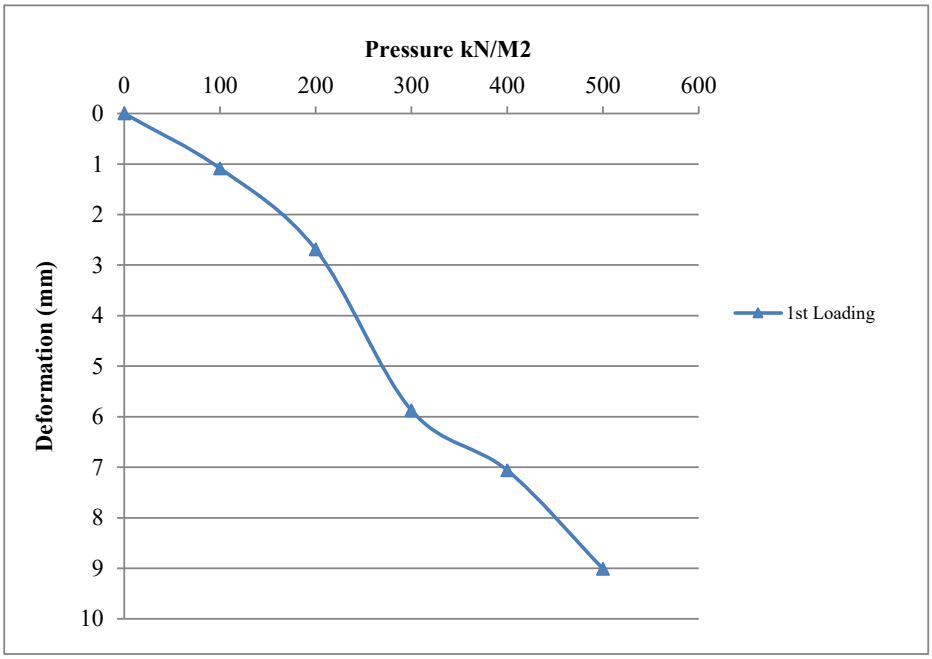
Client: Causeway Geotech Ltd
8 Drumahiskey Rd,
Bendooragh,
Ballymoney
Northern Ireland

BHP Ref. No.: 22/10/050-2
Order No.: Not Supplied
Date Tested: 05/10/2022
Test Specification: Client Spec.
Item: Clay

FAO: Mr. Sean Ross

Client Reference: Ballyogan Landfill, Dublin
Location Reference: Site CBR Test Location - WP1 - TP10
Type of Reaction Load: Excavator
Plate Diameter: 450mm
BS 1377:Part 9:1990, Cl.4.1 (Plate Loading Test)



Bearing Pressure kN/m²	Plate Settlement (mm)
0	0
100	1.09
200	2.69
300	5.88
400	7.06
500	9.01

Maximum Applied Pressure (kN/m^2)	500
Maximum Deformation (mm)	9.01
Estimated CBR % @ 1.25mm deformation	10
K= (KN/m^2/m) @ 1.25mm deformation	54560
K= (MN/m^2/m) @ 1.25mm deformation	55

Remarks:
CBR calculated in in accordance with Part 2 DMRB Volume 7 : Part 2 HD 25/94.
Time Recorded at each interval was 2 minutes.

Tony Hehir
Field Testing Services Manager
For and On Behalf of BHP Laboratories

Seamus O' Connell
Laboratory Technical Manager
Issue Date: 06/10/2022

Tested by BHP Laboratories, Limerick (c/o above address) Phone:(061) 455399 Fax:(061) 455447

Where the deformation does not exceed 1.25mm during the test, the CBR and K values have been estimated and are not included under our scope of accreditation.

CBR TEST REPORT

Analysing
Testing
Consulting
Calibrating

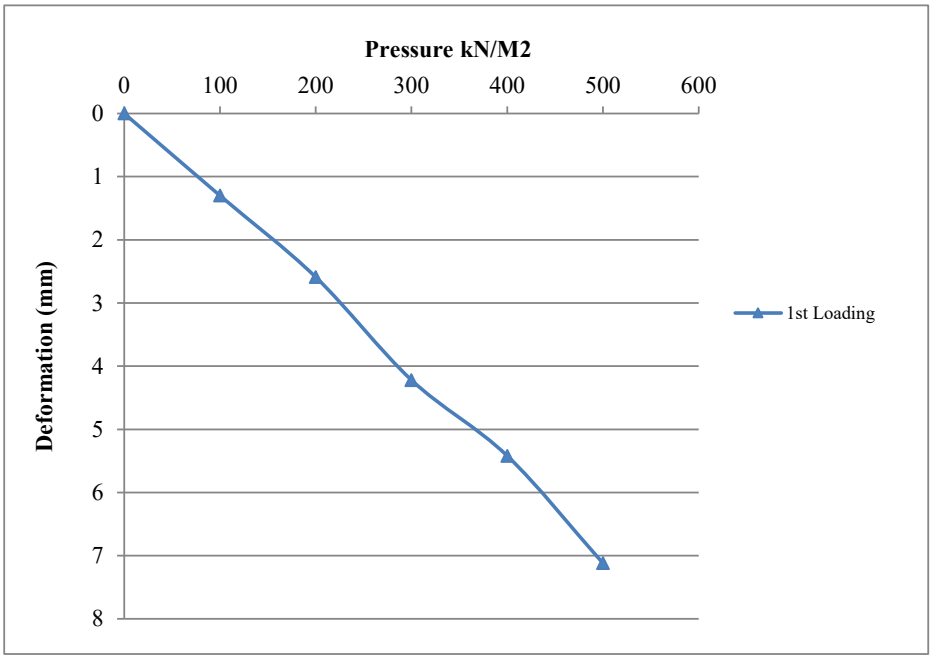
BHP Laboratories Ltd
New Road
Thomondgate
Limerick
Ireland
Tel +353 61 455399
Fax +353 61 455447
E Mail jamespurcell@bhp.ie

Client: Causeway Geotech Ltd
8 Drumahiskey Rd,
Bendooragh,
Ballymoney
Northern Ireland

BHP Ref. No.: 22/10/050-3
Order No.: Not Supplied
Date Tested: 05/10/2022
Test Specification: Client Spec.
Item: Clay

FAO: Mr. Sean Ross

Client Reference: Ballyogan Landfill, Dublin
Location Reference: Site CBR Test Location - WP1 - TP12
Type of Reaction Load: Excavator
Plate Diameter: 450mm
BS 1377:Part 9:1990, Cl.4.1 (Plate Loading Test)



Bearing Pressure kN/m²	Plate Settlement (mm)
0	0
100	1.30
200	2.59
300	4.22
400	5.42
500	7.12

Maximum Applied Pressure (kN/m^2)	500
Maximum Deformation (mm)	7.12
Estimated CBR % @ 1.25mm deformation	8
K= (KN/m^2/m) @ 1.25mm deformation	47616
K= (MN/m^2/m) @ 1.25mm deformation	48

Remarks:
CBR calculated in in accordance with Part 2 DMRB Volume 7 : Part 2 HD 25/94.
Time Recorded at each interval was 2 minutes.

Tony Hehir
Field Testing Services Manager
For and On Behalf of BHP Laboratories

Seamus O' Connell
Laboratory Technical Manager
Issue Date: 06/10/2022

Tested by BHP Laboratories, Limerick (c/o above address) Phone:(061) 455399 Fax:(061) 455447

Where the deformation does not exceed 1.25mm during the test, the CBR and K values have been estimated and are not included under our scope of accreditation.

CBR TEST REPORT

Analysing
Testing
Consulting
Calibrating

BHP Laboratories Ltd
New Road
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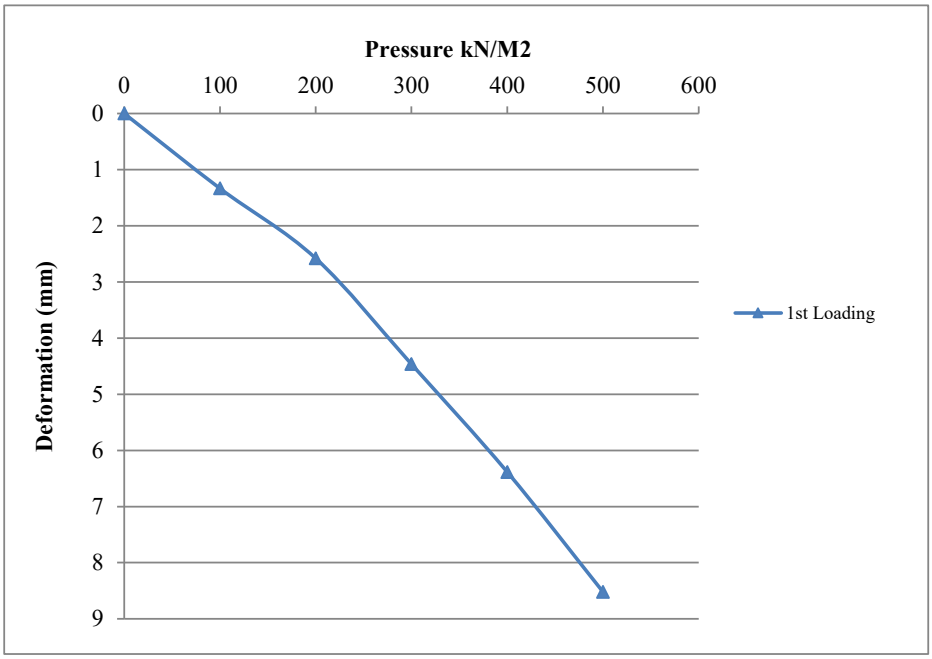
Tel +353 61 455399
Fax +353 61 455447
E Mail jamespurcell@bhp.ie

Client: Causeway Geotech Ltd
8 Drumahiskey Rd,
Bendooragh,
Ballymoney
Northern Ireland

BHP Ref. No.: 22/10/050-4
Order No.: Not Supplied
Date Tested: 05/10/2022
Test Specification: Client Spec.
Item: Clay

FAO: Mr. Sean Ross

Client Reference: Ballyogan Landfill, Dublin
Location Reference: Site CBR Test Location - WP1 - TP13
Type of Reaction Load: Excavator
Plate Diameter: 450mm
BS 1377:Part 9:1990, Cl.4.1 (Plate Loading Test)



Bearing Pressure kN/m²	Plate Settlement (mm)
0	0
100	1.34
200	2.58
300	4.47
400	6.39
500	8.52

Maximum Applied Pressure (kN/m^2)	500
Maximum Deformation (mm)	8.52
Estimated CBR % @ 1.25mm deformation	7
K= (KN/m^2/m) @ 1.25mm deformation	46128
K= (MN/m^2/m) @ 1.25mm deformation	46

Remarks:
CBR calculated in in accordance with Part 2 DMRB Volume 7 : Part 2 HD 25/94.
Time Recorded at each interval was 2 minutes.

Tony Hehir
Field Testing Services Manager
For and On Behalf of BHP Laboratories

Seamus O' Connell
Laboratory Technical Manager
Issue Date: 06/10/2022

Tested by BHP Laboratories, Limerick (c/o above address) Phone:(061) 455399 Fax:(061) 455447

Where the deformation does not exceed 1.25mm during the test, the CBR and K values have been estimated and are not included under our scope of accreditation.

CAUSEWAY GEOTECH

APPENDIX I

GEOTECHNICAL LABORATORY TEST RESULTS

HEAD OFFICE
Causeway Geotech Ltd
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Registered in Northern Ireland.
Company Number: NI610766

REGIONAL OFFICE
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

16 November 2022

Project Name:	Dublin Array Wind Park - Stage 1 Onshore Site Investigations
Project No.:	21-1443E
Client:	Dublin Array Offshore Windfarm
Engineer:	Gavin & Doherty Geosolutions (GDG)

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 30/09/2022 and 24/10/2022.

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: Dublin Array Wind Park - Stage 1 Onshore Site Investigations

Report Reference: Schedule 1 - FINAL

The table below details the tests carried out, the specifications used, and the number of tests included in this report. The results contained in this report relate to the sample(s) as received

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. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	16
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	8
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	8
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	8

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 Eurofins Chemtest Ltd *(UKAS 2183)*	BRE Test - Suite A		3
SOIL – Subcontracted to Celtest Company *(UKAS 0494)*	Determination of Thermal Conductivity by Thermal Needle Probe Procedure *(5 Point method at various Moisture Content).*	ASTM – D5334-14	13

Summary of Classification Test Results

Project No.	Project Name
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations

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										
WP2_BH01	11	6.00		D	Brown sandy slightly gravelly silty CLAY.			57.0	72	32 -1pt	16	16		CL
WP2_BH01	14	7.50		D	Brown sandy slightly gravelly silty CLAY.			10.0						
WP2_BH01	21	10.50		D	Brown sandy slightly gravelly silty CLAY.			10.0						
WP2_BH01	32	16.50		D	Brownish grey sandy slightly gravelly silty CLAY.			8.7	68	29 -1pt	14	15		CL
WP2_BH02	25	6.00		D	Brown slightly gravelly clayey fine to coarse SAND.			16.0						
WP2_BH02	26	9.00		D	Orangish brown sandy slightly gravelly silty CLAY.			20.0	100	37 -1pt	23	14		CI
WP2_BH02	27	10.50		D	Brown sandy gravelly silty CLAY.			12.0						
WP2_BH02	33	18.00	19.50	B	Dark grey sandy gravelly silty CLAY.			7.6	66	26 -1pt	15	11		CL
WP2_BH03	54	4.50		D	Dark brown sandy slightly gravelly silty CLAY.			13.0	93	30 -1pt	14	16		CL
WP2_BH03	55	5.00		D	Dark brown sandy slightly gravelly silty CLAY.			12.0						
WP2_BH03	57	7.50		D	Brown slightly gravelly clayey fine to coarse SAND.			6.2						
WP2_BH03	60	9.50		D	Brown sandy slightly gravelly silty CLAY.			10.0	77	31 -1pt	17	14		CL

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

24/10/2022

Approved By

Stephen Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations

Hole No.	Sample				Specimen Description	Density bulk	Density dry	*w*	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		Mg/m3		%	%	%	%	%	Mg/m3	
WP2_BH04	57	3.00	3.45	D	Brown sandy slightly gravelly silty CLAY.			13.0						
WP2_BH04	3	4.50	4.95	D	Brown sandy slightly gravelly silty CLAY.			14.0	90	29 -1pt	14	15		CL
WP2_BH04	4	6.00	6.45	D	Brown slightly gravelly clayey fine to coarse SAND.			15.0	59	23 -1pt	14	9		CL
WP2_BH04	5	7.50	7.85	D	Brown sandy slightly gravelly silty CLAY.			9.9						

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

24/10/2022

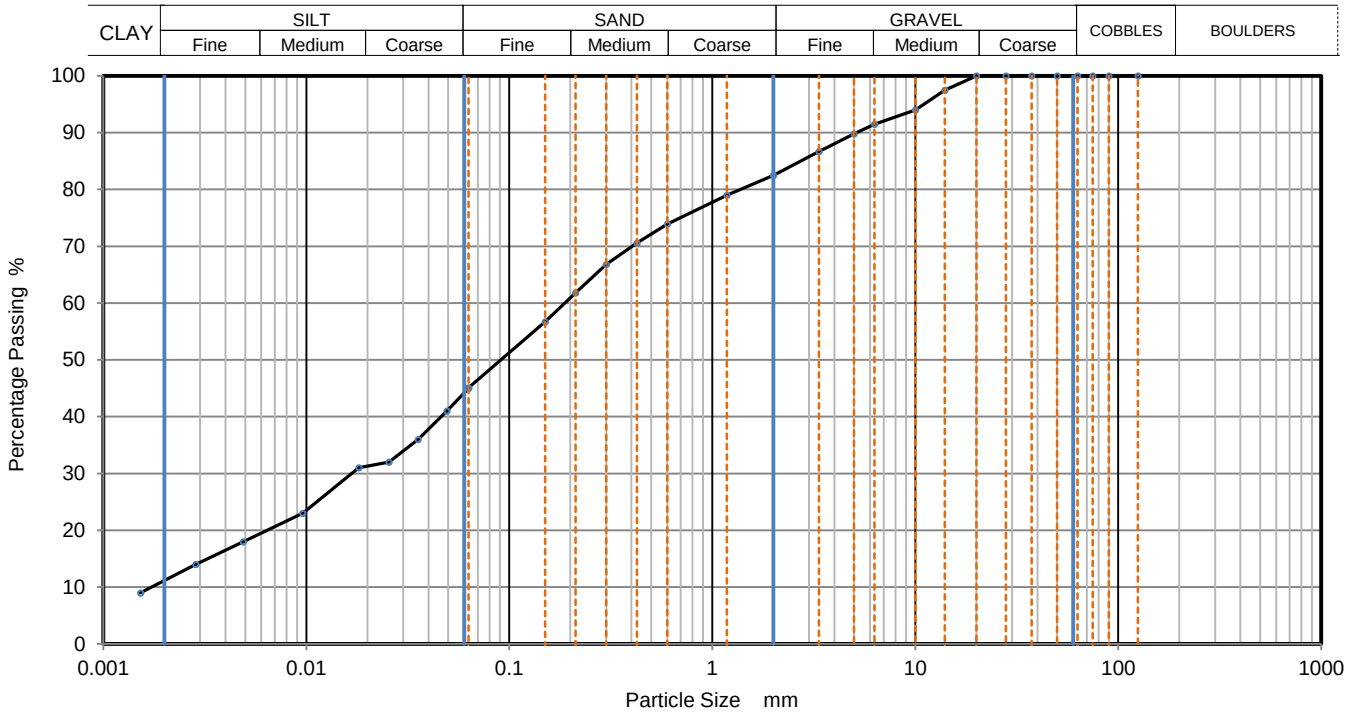
Approved By

Stephen Watson

UKAS TESTING

10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP2_BH01
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		17
Specimen Description	Brown sandy slightly gravelly silty CLAY.			Sample Depth (m)	Top	8.50
					Base	9.50
Specimen Reference	2	Specimen Depth	8.5 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022093055



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	45
90	100	0.04935	41
75	100	0.03559	36
63	100	0.02548	32
50	100	0.01813	31
37.5	100	0.00959	23
28	100	0.00488	18
20	100	0.00285	14
14	98	0.00152	9
10	94		
6.3	92		
5	90		
3.35	87		
2	83		
1.18	79		
0.6	74	Particle density	(assumed)
0.425	71	2.65	Mg/m3
0.3	67		
0.212	62		
0.15	57		
0.063	45		

Dry Mass of sample, g	509

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	17.5
Sand	37.4
Silt	33.7
Clay	11.4

Grading Analysis		
D100	mm	
D60	mm	0.188
D30	mm	0.0171
D10	mm	0.00171
Uniformity Coefficient		110
Curvature Coefficient		0.91

Remarks

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

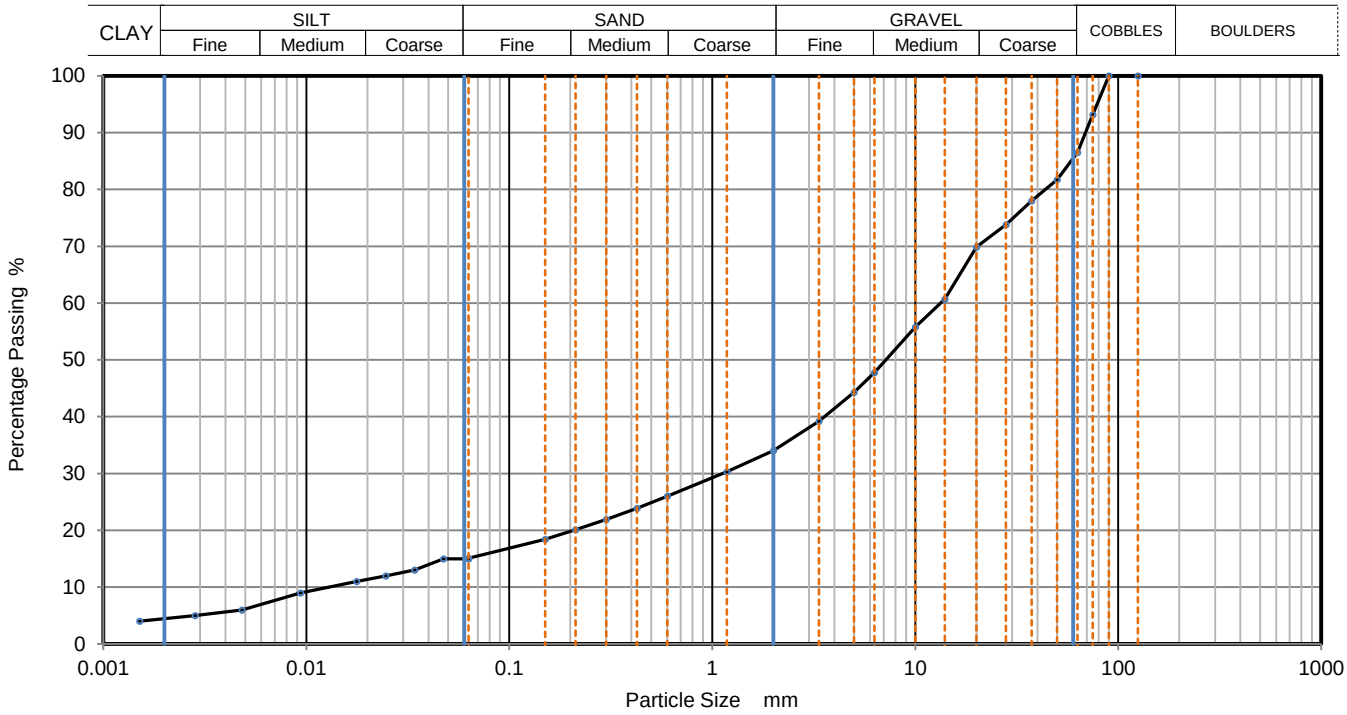
Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING

10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP2_BH01
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		24
Specimen Description	Brown sandy gravelly silty CLAY.				Sample Depth (m)	Top	12.00
						Base	13.30
Specimen Reference	2	Specimen Depth	12	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID		Caus2022093057



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	15
90	100	0.04735	15
75	93	0.03420	13
63	87	0.02468	12
50	82	0.01768	11
37.5	78	0.00936	9
28	74	0.00482	6
20	70	0.00283	5
14	61	0.00151	4
10	56		
6.3	48		
5	44		
3.35	39		
2	34		
1.18	30		
0.6	26	Particle density	(assumed)
0.425	24	2.65	Mg/m3
0.3	22		
0.212	20		
0.15	18		
0.063	15		

Dry Mass of sample, g	13510

Sample Proportions	% dry mass
Cobbles	13.5
Gravel	52.5
Sand	18.9
Silt	11.1
Clay	4.0

Grading Analysis		
D100	mm	
D60	mm	13.3
D30	mm	1.12
D10	mm	0.0148
Uniformity Coefficient		900
Curvature Coefficient		6.4

Remarks

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

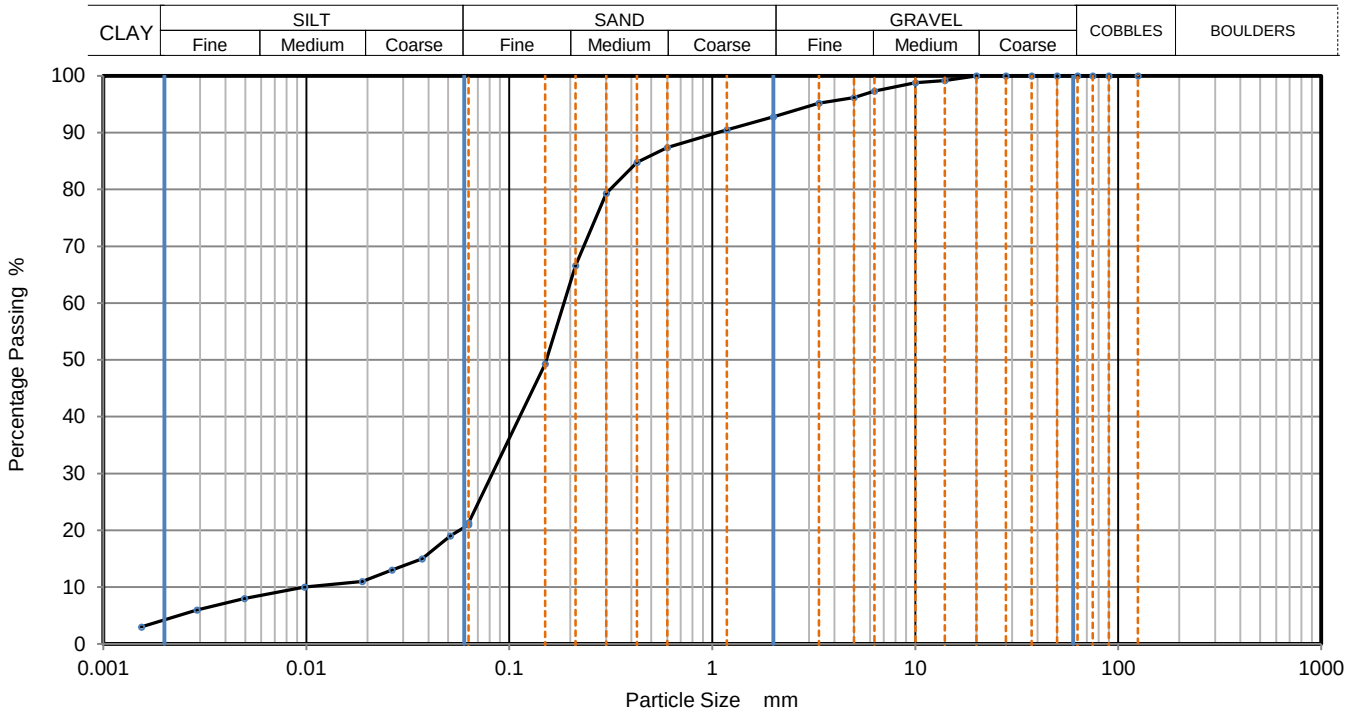
Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING

10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1443E**
				Borehole/Pit No.	WP2_BH02
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.	14
Specimen Description	Brown slightly gravelly clayey fine to coarse SAND.			Sample Depth (m) Top	6.00
				Base	6.50
Specimen Reference	2	Specimen Depth	6 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2022093061



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	21
90	100	0.05128	19
75	100	0.03714	15
63	100	0.02642	13
50	100	0.01889	11
37.5	100	0.00981	10
28	100	0.00496	8
20	100	0.00289	6
14	99	0.00154	3
10	99		
6.3	97		
5	96		
3.35	95		
2	93		
1.18	91		
0.6	87	Particle density	(assumed)
0.425	85	2.65	Mg/m3
0.3	79		
0.212	67		
0.15	49		
0.063	21		

Dry Mass of sample, g: 542

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	7.2
Sand	71.5
Silt	17.0
Clay	4.3

Grading Analysis		
D100	mm	
D60	mm	0.186
D30	mm	0.0826
D10	mm	0.00955
Uniformity Coefficient		19
Curvature Coefficient		3.8

Remarks

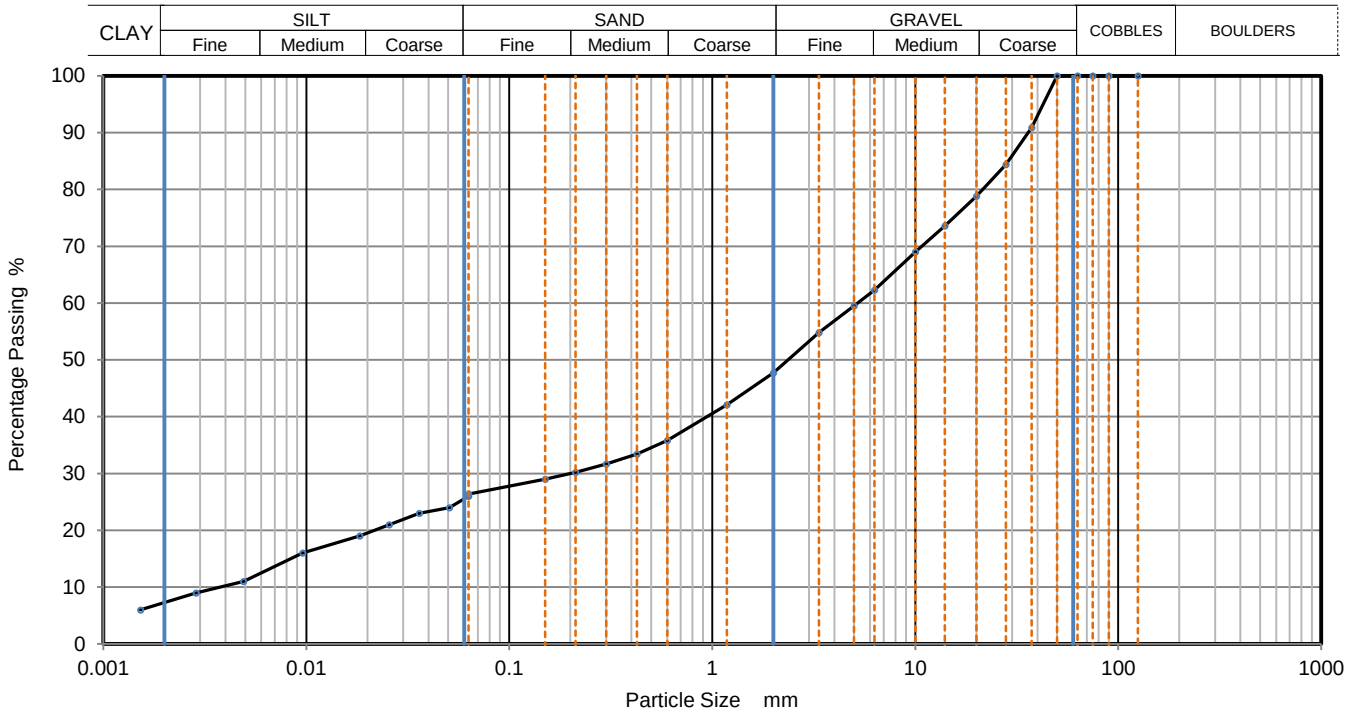
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP2_BH02
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		22
Specimen Description	Brown sandy gravelly silty CLAY.			Sample Depth (m)	Top	10.50
					Base	11.10
Specimen Reference	2	Specimen Depth	10.5 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022093064



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	26
90	100	0.05064	24
75	100	0.03604	23
63	100	0.02564	21
50	100	0.01835	19
37.5	91	0.00959	16
28	84	0.00491	11
20	79	0.00286	9
14	74	0.00152	6
10	69		
6.3	62		
5	60		
3.35	55		
2	48		
1.18	42		
0.6	36	Particle density (assumed)	
0.425	33	2.65 Mg/m3	
0.3	32		
0.212	30		
0.15	29		
0.063	26		

Dry Mass of sample, g: 4409

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	52.3
Sand	21.3
Silt	19.0
Clay	7.4

Grading Analysis		
D100	mm	
D60	mm	5.23
D30	mm	0.201
D10	mm	0.0037
Uniformity Coefficient		1400
Curvature Coefficient		2.1

Remarks

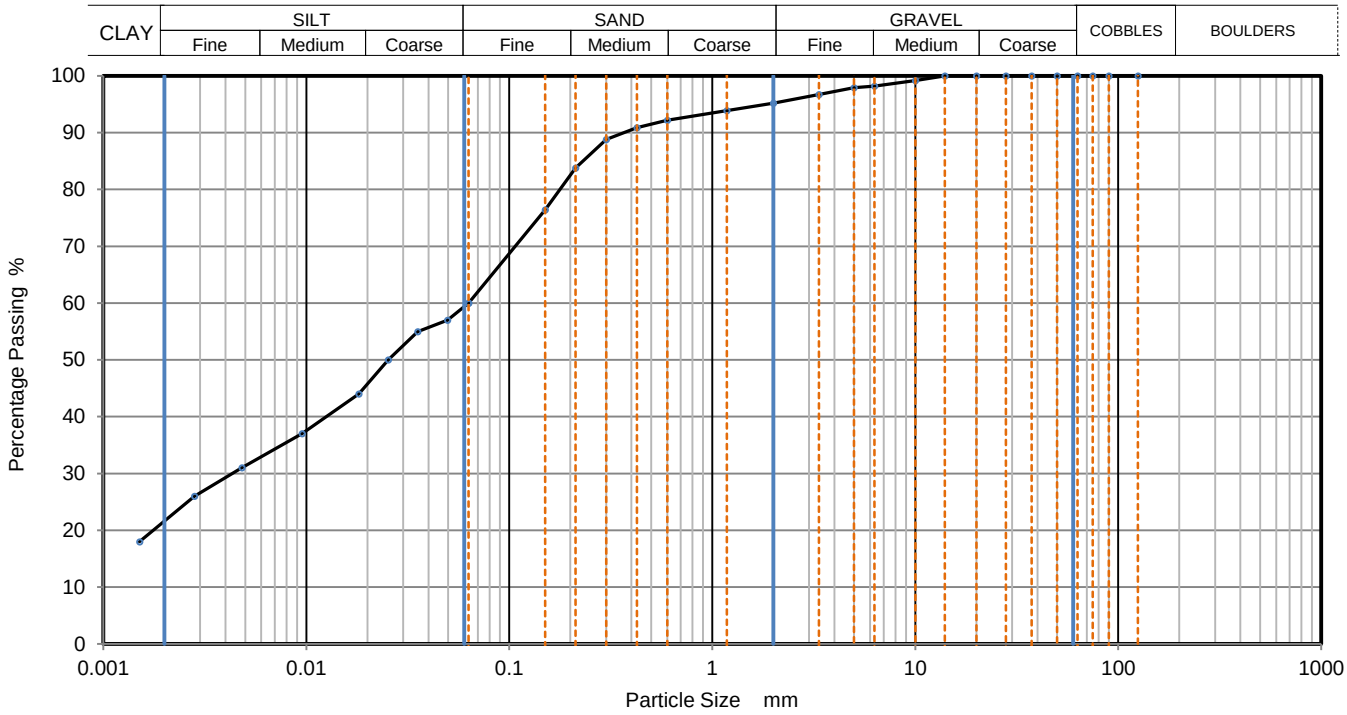
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP2_BH03
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		13
Specimen Description	Dark brown sandy slightly gravelly silty CLAY.			Sample Depth (m)	Top	6.00
					Base	7.50
Specimen Reference	2	Specimen Depth	6 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022093069



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	60
90	100	0.04968	57
75	100	0.03536	55
63	100	0.02532	50
50	100	0.01813	44
37.5	100	0.00953	37
28	100	0.00482	31
20	100	0.00282	26
14	100	0.00151	18
10	99		
6.3	98		
5	98		
3.35	97		
2	95		
1.18	94		
0.6	92	Particle density	(assumed)
0.425	91	2.65	Mg/m3
0.3	89		
0.212	84		
0.15	76		
0.063	60		

Dry Mass of sample, g: 518

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	4.8
Sand	35.3
Silt	38.1
Clay	21.8

Grading Analysis		
D100	mm	
D60	mm	
D30	mm	0.00422
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

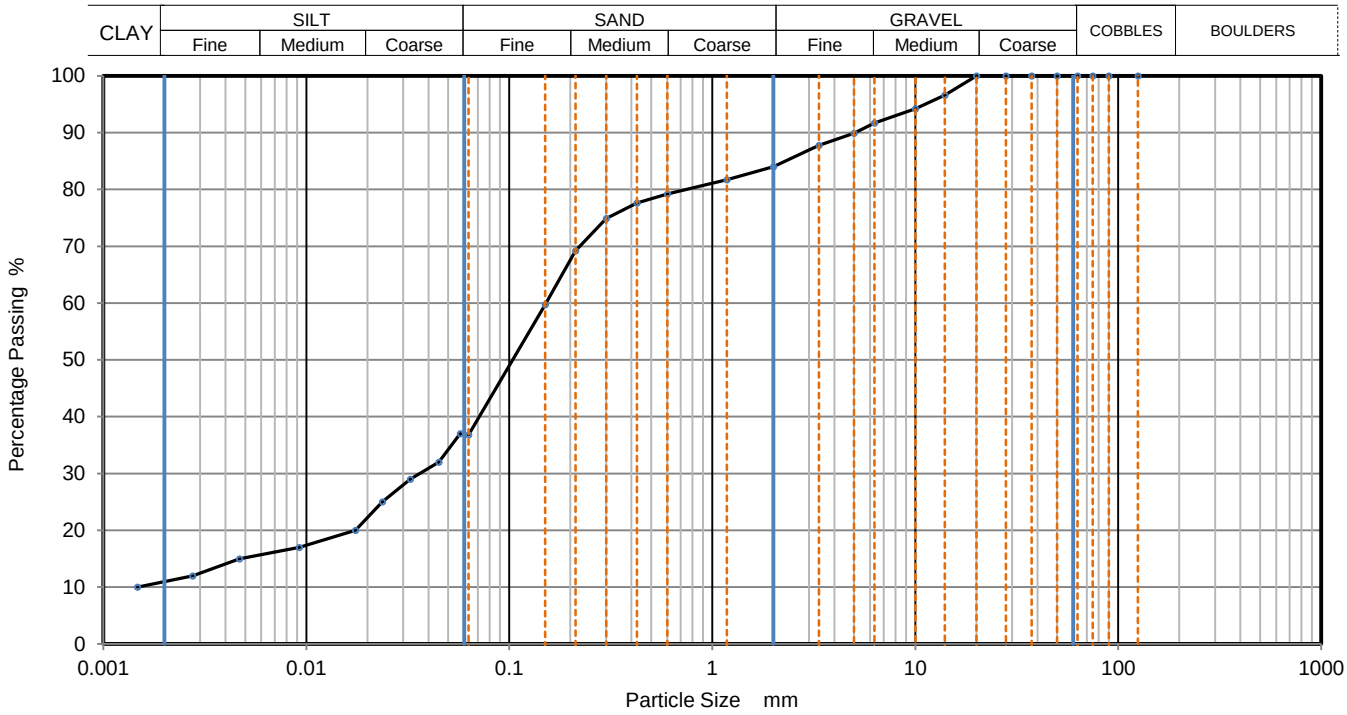
Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING

10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP2_BH03
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		18
Specimen Description	Brown slightly gravelly silty fine to coarse SAND.			Sample Depth (m)	Top	13.50
					Base	15.00
Specimen Reference	2	Specimen Depth	13.5 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022093072



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.05740	37
90	100	0.04490	32
75	100	0.03250	29
63	100	0.02367	25
50	100	0.01745	20
37.5	100	0.00925	17
28	100	0.00468	15
20	100	0.00275	12
14	97	0.00147	10
10	94		
6.3	92		
5	90		
3.35	88		
2	84		
1.18	82		
0.6	79	Particle density	(assumed)
0.425	78	2.65	Mg/m3
0.3	75		
0.212	69		
0.15	60		
0.063	37		

Dry Mass of sample, g	550

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	16.0
Sand	47.2
Silt	25.9
Clay	10.9

Grading Analysis		
D100	mm	
D60	mm	0.152
D30	mm	0.0371
D10	mm	0.00161
Uniformity Coefficient		94
Curvature Coefficient		5.7

Remarks

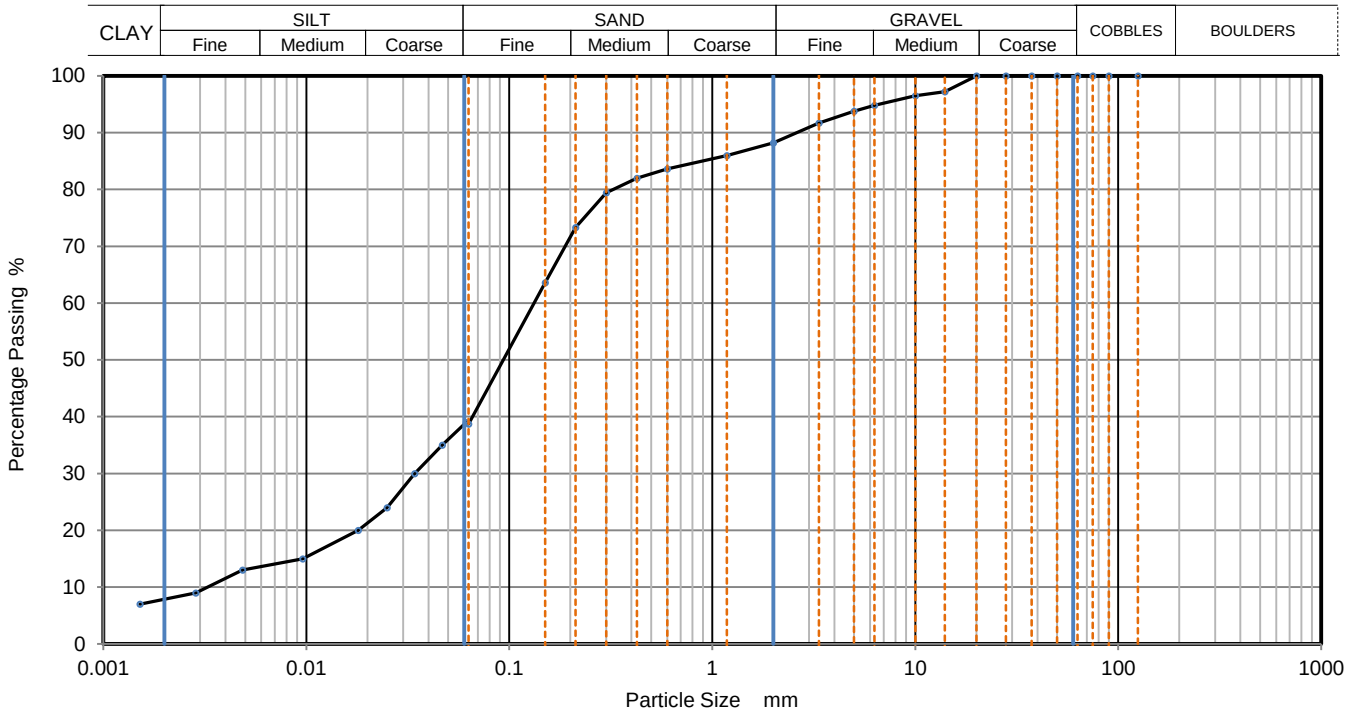
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP2_BH04
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		13
Specimen Description	Brown slightly gravelly clayey fine to coarse SAND.			Sample Depth (m)	Top	6.50
					Base	6.80
Specimen Reference	2	Specimen Depth	6.5 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022093077



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06134	39
90	100	0.04666	35
75	100	0.03420	30
63	100	0.02500	24
50	100	0.01802	20
37.5	100	0.00959	15
28	100	0.00485	13
20	100	0.00285	9
14	97	0.00152	7
10	97		
6.3	95		
5	94		
3.35	92		
2	88		
1.18	86		
0.6	84	Particle density	(assumed)
0.425	82	2.65	Mg/m3
0.3	79		
0.212	73		
0.15	64		
0.063	39		

Dry Mass of sample, g: 579

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	11.8
Sand	49.5
Silt	30.9
Clay	7.8

Grading Analysis		
D100	mm	
D60	mm	0.132
D30	mm	0.035
D10	mm	0.00327
Uniformity Coefficient		40
Curvature Coefficient		2.8

Remarks

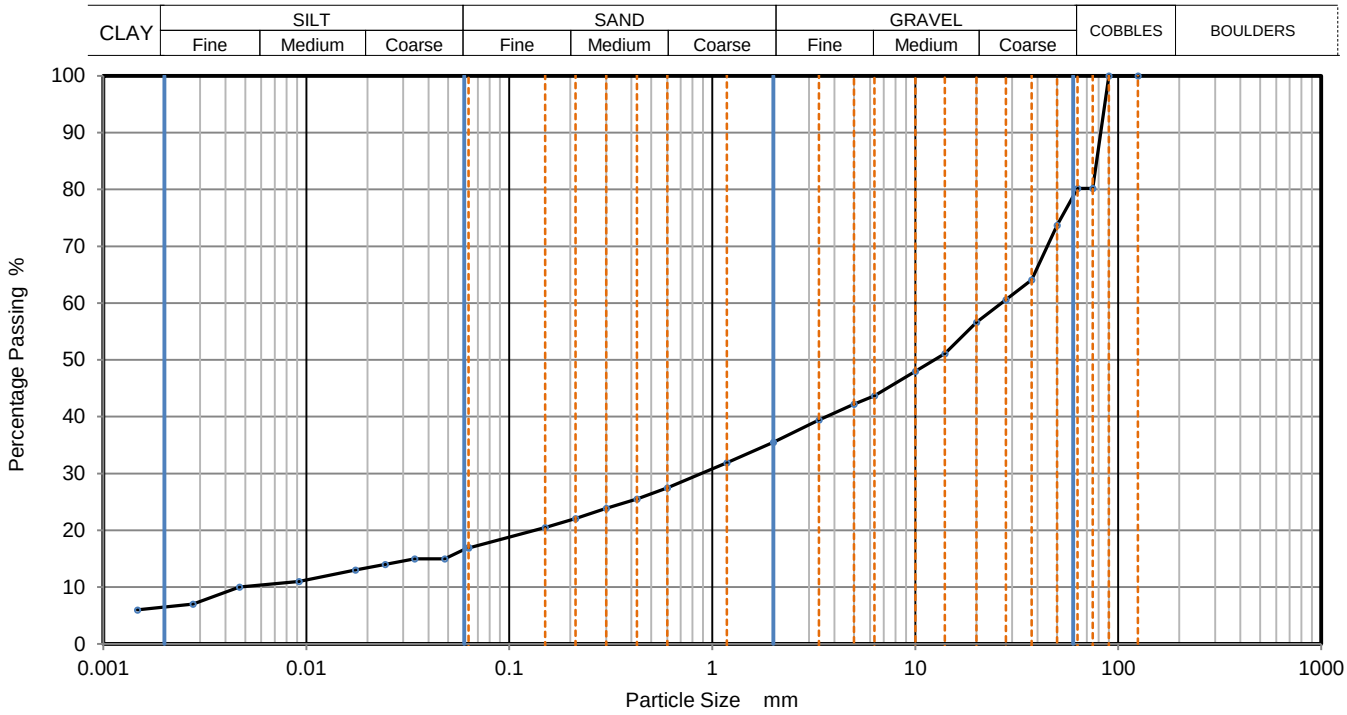
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1443E**
				Borehole/Pit No.	WP2_BH04
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.	31
Specimen Description	Brownish grey sandy gravelly silty CLAY.			Sample Depth (m) Top	13.50
				Base	13.80
Specimen Reference	2	Specimen Depth	13.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2022093079



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	17
90	100	0.04803	15
75	80	0.03420	15
63	80	0.02451	14
50	74	0.01745	13
37.5	64	0.00919	11
28	61	0.00468	10
20	57	0.00277	7
14	51	0.00147	6
10	48		
6.3	44		
5	42		
3.35	39		
2	36		
1.18	32		
0.6	28	Particle density (assumed)	
0.425	26	2.65 Mg/m3	
0.3	24		
0.212	22		
0.15	21		
0.063	17		

Dry Mass of sample, g: 3926

Sample Proportions	% dry mass
Cobbles	19.8
Gravel	44.8
Sand	18.5
Silt	10.2
Clay	6.7

Grading Analysis		
D100	mm	
D60	mm	26.6
D30	mm	0.881
D10	mm	0.00554
Uniformity Coefficient		4800
Curvature Coefficient		5.3

Remarks

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

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914082

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 0.0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.063**
Thermal Resistivity	°C●Cm/W	**48.48**
Thermal Resistivity	°C●m/W	**0.4848**
Moisture Content of Test Specimen	%	**14**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914083

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 0.0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.181**
Thermal Resistivity	°C●Cm/W	**45.66**
Thermal Resistivity	°C●m/W	**0.46**
Moisture Content of Test Specimen	%	**11**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

N. Hughes

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914084

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 0.0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.223**
Thermal Resistivity	°C●Cm/W	**44.99**
Thermal Resistivity	°C●m/W	**0.45**
Moisture Content of Test Specimen	%	**8**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914085

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 0.0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.259**
Thermal Resistivity	°C●Cm/W	**44.27**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**5**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

N. Hughes

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914086

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 0.0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.365**
Thermal Resistivity	°C●Cm/W	**73.27**
Thermal Resistivity	°C●m/W	**0.73**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914087

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 1.5-2.45M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.27**
Thermal Resistivity	°C●Cm/W	**44.06**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**12.6**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914088

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 1.5-2.45M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**3.153**
Thermal Resistivity	°C●Cm/W	**31.71**
Thermal Resistivity	°C●m/W	**0.32**
Moisture Content of Test Specimen	%	**9.6**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914089

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 1.5-2.45M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.153**
Thermal Resistivity	°C●Cm/W	**46.46**
Thermal Resistivity	°C●m/W	**0.46**
Moisture Content of Test Specimen	%	**6.6**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914090

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 1.5-2.45M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.036**
Thermal Resistivity	°C●Cm/W	**44.73**
Thermal Resistivity	°C●m/W	**0.45**
Moisture Content of Test Specimen	%	**3.6**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914091

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 1.5-2.45M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.181**
Thermal Resistivity	°C●Cm/W	**84.7**
Thermal Resistivity	°C●m/W	**0.85**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914092

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.519**
Thermal Resistivity	°C●Cm/W	**39.7**
Thermal Resistivity	°C●m/W	**0.4**
Moisture Content of Test Specimen	%	**10.6**
Dry Density of Test Specimen	Mg/m^3	**1.85**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914093

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.867**
Thermal Resistivity	°C●Cm/W	**34.85**
Thermal Resistivity	°C●m/W	**0.35**
Moisture Content of Test Specimen	%	**7.6**
Dry Density of Test Specimen	Mg/m^3	**1.85**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914094

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.819**
Thermal Resistivity	°C●Cm/W	**54.97**
Thermal Resistivity	°C●m/W	**0.55**
Moisture Content of Test Specimen	%	**4.6**
Dry Density of Test Specimen	Mg/m^3	**1.85**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914095

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.873**
Thermal Resistivity	°C●Cm/W	**53.4**
Thermal Resistivity	°C●m/W	**0.53**
Moisture Content of Test Specimen	%	**1.6**
Dry Density of Test Specimen	Mg/m^3	**1.85**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914096

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.353**
Thermal Resistivity	°C●Cm/W	**73.91**
Thermal Resistivity	°C●m/W	**0.74**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.85**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

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Date: 03 November 2022
Test Report Ref: TR 914097

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-6.0M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.462**
Thermal Resistivity	°C●Cm/W	**40.61**
Thermal Resistivity	°C●m/W	**0.4**
Moisture Content of Test Specimen	%	**13.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
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Date: 03 November 2022
Test Report Ref: TR 914098

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-6.0M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.107**
Thermal Resistivity	°C●Cm/W	**47.46**
Thermal Resistivity	°C●m/W	**0.47**
Moisture Content of Test Specimen	%	**10.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

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Date: 03 November 2022
Test Report Ref: TR 914099

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-6.0M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.258**
Thermal Resistivity	°C●Cm/W	**44.28**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**7.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
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Date: 03 November 2022
Test Report Ref: TR 914100

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-6.0M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.956**
Thermal Resistivity	°C●Cm/W	**51.11**
Thermal Resistivity	°C●m/W	**0.51**
Moisture Content of Test Specimen	%	**4.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

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Date: 03 November 2022
Test Report Ref: TR 914101

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-6.0M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.177**
Thermal Resistivity	°C●Cm/W	**84.94**
Thermal Resistivity	°C●m/W	**0.85**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
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Date: 02 November 2022
Test Report Ref: TR 914102

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 10.5-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.679**
Thermal Resistivity	°C●Cm/W	**59.55**
Thermal Resistivity	°C●m/W	**0.6**
Moisture Content of Test Specimen	%	**15.5**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
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Date: 02 November 2022
Test Report Ref: TR 914103

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 10.5-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.582**
Thermal Resistivity	°C●Cm/W	**60.85**
Thermal Resistivity	°C●m/W	**0.61**
Moisture Content of Test Specimen	%	**12.5**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
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Date: 02 November 2022
Test Report Ref: TR 914104

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 10.5-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.542**
Thermal Resistivity	°C●Cm/W	**64.83**
Thermal Resistivity	°C●m/W	**0.65**
Moisture Content of Test Specimen	%	**9.5**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

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Date: 02 November 2022
Test Report Ref: TR 914105

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 10.5-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.509**
Thermal Resistivity	°C●Cm/W	**66.26**
Thermal Resistivity	°C●m/W	**0.66**
Moisture Content of Test Specimen	%	**6.5**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

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Date: 02 November 2022
Test Report Ref: TR 914106

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 10.5-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**01/11/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.303**
Thermal Resistivity	°C●Cm/W	**76.72**
Thermal Resistivity	°C●m/W	**0.77**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
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Date: 02 November 2022
Test Report Ref: TR 914119

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH02 7.2-7.85M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**3.069**
Thermal Resistivity	°C●Cm/W	**32.59**
Thermal Resistivity	°C●m/W	**0.33**
Moisture Content of Test Specimen	%	**26.8**
Dry Density of Test Specimen	Mg/m^3	**1.76**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

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Date: 02 November 2022
Test Report Ref: TR 914120

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH02 7.2-7.85M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**3.822**
Thermal Resistivity	°C●Cm/W	**26.16**
Thermal Resistivity	°C●m/W	**0.26**
Moisture Content of Test Specimen	%	**23.8**
Dry Density of Test Specimen	Mg/m^3	**1.76**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
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Date: 02 November 2022
Test Report Ref: TR 914121

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH02 7.2-7.85M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.669**
Thermal Resistivity	°C●Cm/W	**37.47**
Thermal Resistivity	°C●m/W	**0.39**
Moisture Content of Test Specimen	%	**20.8**
Dry Density of Test Specimen	Mg/m^3	**1.76**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
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Date: 02 November 2022
Test Report Ref: TR 914122

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH02 7.2-7.85M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.638**
Thermal Resistivity	°C●Cm/W	**37.9**
Thermal Resistivity	°C●m/W	**0.39**
Moisture Content of Test Specimen	%	**17.8**
Dry Density of Test Specimen	Mg/m^3	**1.76**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
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Date: 02 November 2022
Test Report Ref: TR 914123

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH02 7.2-7.85M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.315**
Thermal Resistivity	°C●Cm/W	**76.03**
Thermal Resistivity	°C●m/W	**0.76**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.76**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
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Date: 02 November 2022
Test Report Ref: TR 914134

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0.5-1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.584**
Thermal Resistivity	°C●Cm/W	**63.14**
Thermal Resistivity	°C●m/W	**0.63**
Moisture Content of Test Specimen	%	**20.3**
Dry Density of Test Specimen	Mg/m^3	**1.71**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914135

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0.5-1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.65**
Thermal Resistivity	°C●Cm/W	**65.39**
Thermal Resistivity	°C●m/W	**0.61**
Moisture Content of Test Specimen	%	**17.3**
Dry Density of Test Specimen	Mg/m^3	**1.71**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914136

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0.5-1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.39**
Thermal Resistivity	°C●Cm/W	**72.48**
Thermal Resistivity	°C●m/W	**0.72**
Moisture Content of Test Specimen	%	**14.3**
Dry Density of Test Specimen	Mg/m^3	**1.71**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914137

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0.5-1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.211**
Thermal Resistivity	°C●Cm/W	**82.57**
Thermal Resistivity	°C●m/W	**0.83**
Moisture Content of Test Specimen	%	**11.3**
Dry Density of Test Specimen	Mg/m^3	**1.71**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914138

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0.5-1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.106**
Thermal Resistivity	°C●Cm/W	**90.44**
Thermal Resistivity	°C●m/W	**0.9**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.71**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 03 November 2022
Test Report Ref: TR 914129

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.999**
Thermal Resistivity	°C●Cm/W	**50.03**
Thermal Resistivity	°C●m/W	**0.5**
Moisture Content of Test Specimen	%	**13.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 03 November 2022
Test Report Ref: TR 914130

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.97**
Thermal Resistivity	°C●Cm/W	**50.76**
Thermal Resistivity	°C●m/W	**0.5**
Moisture Content of Test Specimen	%	**10.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

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8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 03 November 2022
Test Report Ref: TR 914131

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.712**
Thermal Resistivity	°C●Cm/W	**58.42**
Thermal Resistivity	°C●m/W	**0.58**
Moisture Content of Test Specimen	%	**7.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

N. Hughes

Neil Hughes
Assistant Aggregate Team Manager

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8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 03 November 2022
Test Report Ref: TR 914132

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.395**
Thermal Resistivity	°C●Cm/W	**71.67**
Thermal Resistivity	°C●m/W	**0.72**
Moisture Content of Test Specimen	%	**4.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 03 November 2022
Test Report Ref: TR 914133

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**0.915**
Thermal Resistivity	°C●Cm/W	**109.2**
Thermal Resistivity	°C●m/W	**1.09**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
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Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914139

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.644**
Thermal Resistivity	°C●Cm/W	**37.83**
Thermal Resistivity	°C●m/W	**0.38**
Moisture Content of Test Specimen	%	**10.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914140

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.474**
Thermal Resistivity	°C●Cm/W	**40.09**
Thermal Resistivity	°C●m/W	**0.4**
Moisture Content of Test Specimen	%	**7.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914141

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.323**
Thermal Resistivity	°C●Cm/W	**43.06**
Thermal Resistivity	°C●m/W	**0.4306**
Moisture Content of Test Specimen	%	**4.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914142

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.625**
Thermal Resistivity	°C●Cm/W	**61.5**
Thermal Resistivity	°C●m/W	**0.62**
Moisture Content of Test Specimen	%	**1.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914143

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.398**
Thermal Resistivity	°C●Cm/W	**71.53**
Thermal Resistivity	°C●m/W	**0.72**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914145

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 10.5-12M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.65**
Thermal Resistivity	°C●Cm/W	**37.74**
Thermal Resistivity	°C●m/W	**0.37**
Moisture Content of Test Specimen	%	**13**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914146

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 10.5-12M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**3.033**
Thermal Resistivity	°C●Cm/W	**31.08**
Thermal Resistivity	°C●m/W	**0.31**
Moisture Content of Test Specimen	%	**10**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

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BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914147

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 10.5-12M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.145**
Thermal Resistivity	°C●Cm/W	**46.61**
Thermal Resistivity	°C●m/W	**0.47**
Moisture Content of Test Specimen	%	**7**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914148

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 10.5-12M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.107**
Thermal Resistivity	°C●Cm/W	**47.47**
Thermal Resistivity	°C●m/W	**0.47**
Moisture Content of Test Specimen	%	**4**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914149

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 10.5-12M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.414**
Thermal Resistivity	°C●Cm/W	**70.95**
Thermal Resistivity	°C●m/W	**0.71**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914152

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 1.1-1.2M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.578**
Thermal Resistivity	°C●Cm/W	**38.78**
Thermal Resistivity	°C●m/W	**0.39**
Moisture Content of Test Specimen	%	**13.2**
Dry Density of Test Specimen	Mg/m^3	**1.73**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

N. Hughes

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914153

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 1.1-1.2M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.766**
Thermal Resistivity	°C●Cm/W	**56.64**
Thermal Resistivity	°C●m/W	**0.57**
Moisture Content of Test Specimen	%	**10.2**
Dry Density of Test Specimen	Mg/m^3	**1.73**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

N. Hughes

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914154

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 1.1-1.2M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.753**
Thermal Resistivity	°C●Cm/W	**57.06**
Thermal Resistivity	°C●m/W	**0.57**
Moisture Content of Test Specimen	%	**7.2**
Dry Density of Test Specimen	Mg/m^3	**1.73**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914155

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 1.1-1.2M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.31**
Thermal Resistivity	°C●Cm/W	**58.93**
Thermal Resistivity	°C●m/W	**0.59**
Moisture Content of Test Specimen	%	**4.2**
Dry Density of Test Specimen	Mg/m^3	**1.73**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914156

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 1.1-1.2M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.414**
Thermal Resistivity	°C●Cm/W	**70.71**
Thermal Resistivity	°C●m/W	**0.71**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.73**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

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8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914157

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 6-6.4M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.367**
Thermal Resistivity	°C●Cm/W	**42.25**
Thermal Resistivity	°C●m/W	**0.42**
Moisture Content of Test Specimen	%	**10.1**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

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8 Drumahiskey Rd
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BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914158

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 6-6.4M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.549**
Thermal Resistivity	°C●Cm/W	**39.23**
Thermal Resistivity	°C●m/W	**0.39**
Moisture Content of Test Specimen	%	**7.1**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914159

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 6-6.4M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.186**
Thermal Resistivity	°C●Cm/W	**45.74**
Thermal Resistivity	°C●m/W	**0.46**
Moisture Content of Test Specimen	%	**4.1**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914160

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 6-6.4M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.828**
Thermal Resistivity	°C●Cm/W	**54.2**
Thermal Resistivity	°C●m/W	**0.54**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914161

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 6-6.4M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.43**
Thermal Resistivity	°C●Cm/W	**69.93**
Thermal Resistivity	°C●m/W	**0.7**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 03 November 2022
Test Report Ref: TR 914162

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 9.74-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.531**
Thermal Resistivity	°C●Cm/W	**65.3**
Thermal Resistivity	°C●m/W	**0.65**
Moisture Content of Test Specimen	%	**19.2**
Dry Density of Test Specimen	Mg/m^3	**1.64**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 03 November 2022
Test Report Ref: TR 914163

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 9.74-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.512**
Thermal Resistivity	°C●Cm/W	**66.12**
Thermal Resistivity	°C●m/W	**0.66**
Moisture Content of Test Specimen	%	**16.2**
Dry Density of Test Specimen	Mg/m^3	**1.64**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 03 November 2022
Test Report Ref: TR 914164

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 9.74-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.452**
Thermal Resistivity	°C●Cm/W	**68.88**
Thermal Resistivity	°C●m/W	**0.69**
Moisture Content of Test Specimen	%	**13.2**
Dry Density of Test Specimen	Mg/m^3	**1.64**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 03 November 2022
Test Report Ref: TR 914165

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 9.74-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.36**
Thermal Resistivity	°C●Cm/W	**73.51**
Thermal Resistivity	°C●m/W	**0.74**
Moisture Content of Test Specimen	%	**10.2**
Dry Density of Test Specimen	Mg/m^3	**1.64**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 03 November 2022
Test Report Ref: TR 914166

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 9.74-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.127**
Thermal Resistivity	°C●Cm/W	**88.73**
Thermal Resistivity	°C●m/W	**0.89**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.64**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

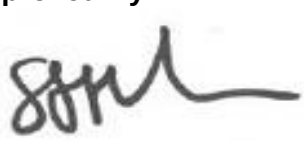
UKAS TESTING
2183

Final Report

Report No.:	22-38401-1
Initial Date of Issue:	11-Oct-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	21-1443E Dublin Array Wind Park

Quotation No.:		**Date Received:**	07-Oct-2022
Order No.:		**Date Instructed:**	07-Oct-2022
No. of Samples:	3		
Turnaround (Wkdays):	7	**Results Due:**	17-Oct-2022
Date Approved:	11-Oct-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E Dublin Array Wind Park

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-38401	22-38401	22-38401
Quotation No.:			**Chemtest Sample ID.:**		1520819	1520820	1520821
Order No.:			Client Sample Ref.:		8	9	56
			Sample Location:		WP2-BH01	WP2-BH02	WP2-BH04
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		3.0	2.1	1.2
			Date Sampled:		06-Oct-2022	06-Oct-2022	06-Oct-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Moisture	N	2030	%	0.020	0.64	5.4	12
pH (2.5:1)	N	2010		4.0	8.8	8.7	8.1
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	0.31

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

LABORATORY RESTRICTION REPORT

Project Reference	21-1143E	To	Sean Ross
Project Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations	Position	Project Manager
TR reference	21-1143E / TR01	From	Stephen Watson
		Position	Laboratory Manager

The following sample(s) and test(s) are restricted as detailed below. Could you please complete the "Required Action" column and return the completed form to the laboratory.

Hole Number	Sample			Test Type	Reason for Restriction	Required Action
	Number	Depth (m)	Type			
WP2_BH01	63	7.5	U	Thermal Resisitvity	Insufficient intact material in U100 (20% recovery In sample tube).	CANCEL
WP2_BH03	5	1.5	D	BRE Suite A	No sample recovery	CANCEL
WP2_BH02	2	0.25	B	Thermal Resisitvity	Material too coarse	CANCEL
WP2_BH02	3	1.25	B	Thermal Resisitvity	Material too coarse	CANCEL
WP2_BH02	44	4.5	U	Thermal Resisitvity	Material too coarse	CANCEL
WP2_BH02	28	12	B	Thermal Resisitvity	Material too coarse	CANCEL
WP2_BH03	28	7.8	B	Thermal Resisitvity	Material too coarse	CANCEL
WP2_BH03	34	8.1	B	Thermal Resisitvity	Material too coarse	CANCEL
WP2_BH03	37	15.5	B	Thermal Resisitvity	Material too coarse	CANCEL
WP2_BH04	32	19.5	B	Thermal Resisitvity	Material too coarse	CANCEL
WP2_BH04	39	13.8	B	Thermal Resisitvity	Material too coarse	CANCEL

For electronic reporting a form of electronic signature or printed name is acceptable

Laboratory Signature Stephen Watson	Project Manager Signature Sean Ross
Date 05 October 2022	Date

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914082a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 0.0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.063**
Thermal Resistivity	°C●Cm/W	**48.48**
Thermal Resistivity	°C●m/W	**0.4848**
Moisture Content of Test Specimen	%	**14**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914083a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 0.0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.181**
Thermal Resistivity	°C●Cm/W	**45.66**
Thermal Resistivity	°C●m/W	**0.46**
Moisture Content of Test Specimen	%	**11**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914084a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 0.0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.223**
Thermal Resistivity	°C●Cm/W	**44.99**
Thermal Resistivity	°C●m/W	**0.45**
Moisture Content of Test Specimen	%	**8**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914085a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 0.0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.259**
Thermal Resistivity	°C●Cm/W	**44.27**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**5**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914086a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 0.0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.365**
Thermal Resistivity	°C●Cm/W	**73.27**
Thermal Resistivity	°C●m/W	**0.73**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914087a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 1.5-2.45M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.27**
Thermal Resistivity	°C●Cm/W	**44.06**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**12.6**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914088a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 1.5-2.45M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**3.153**
Thermal Resistivity	°C●Cm/W	**31.71**
Thermal Resistivity	°C●m/W	**0.32**
Moisture Content of Test Specimen	%	**9.6**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914089a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 1.5-2.45M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.153**
Thermal Resistivity	°C●Cm/W	**46.46**
Thermal Resistivity	°C●m/W	**0.46**
Moisture Content of Test Specimen	%	**6.6**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914090a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 1.5-2.45M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.036**
Thermal Resistivity	°C●Cm/W	**44.73**
Thermal Resistivity	°C●m/W	**0.45**
Moisture Content of Test Specimen	%	**3.6**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914091a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 1.5-2.45M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.181**
Thermal Resistivity	°C●Cm/W	**84.7**
Thermal Resistivity	°C●m/W	**0.85**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914139a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.644**
Thermal Resistivity	°C●Cm/W	**37.83**
Thermal Resistivity	°C●m/W	**0.38**
Moisture Content of Test Specimen	%	**10.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914140a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.474**
Thermal Resistivity	°C●Cm/W	**40.09**
Thermal Resistivity	°C●m/W	**0.4**
Moisture Content of Test Specimen	%	**7.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914141a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.323**
Thermal Resistivity	°C●Cm/W	**43.06**
Thermal Resistivity	°C●m/W	**0.4306**
Moisture Content of Test Specimen	%	**4.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914142a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.625**
Thermal Resistivity	°C●Cm/W	**61.5**
Thermal Resistivity	°C●m/W	**0.62**
Moisture Content of Test Specimen	%	**1.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914143a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.398**
Thermal Resistivity	°C●Cm/W	**71.53**
Thermal Resistivity	°C●m/W	**0.72**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914097a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-6.0M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Slightly Sandy Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.462**
Thermal Resistivity	°C●Cm/W	**40.61**
Thermal Resistivity	°C●m/W	**0.4**
Moisture Content of Test Specimen	%	**13.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
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Date: 22 November 2022
Test Report Ref: TR 914098a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-6.0M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Slightly Sandy Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.107**
Thermal Resistivity	°C●Cm/W	**47.46**
Thermal Resistivity	°C●m/W	**0.47**
Moisture Content of Test Specimen	%	**10.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
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Date: 22 November 2022
Test Report Ref: TR 914099a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-6.0M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Slightly Sandy Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.258**
Thermal Resistivity	°C●Cm/W	**44.28**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**7.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
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Date: 22 November 2022
Test Report Ref: TR 914100a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-6.0M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Slightly Sandy Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.956**
Thermal Resistivity	°C●Cm/W	**51.11**
Thermal Resistivity	°C●m/W	**0.51**
Moisture Content of Test Specimen	%	**4.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914101a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 4.5-6.0M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Slightly Sandy Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.177**
Thermal Resistivity	°C●Cm/W	**84.94**
Thermal Resistivity	°C●m/W	**0.85**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
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Neil Hughes
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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914102a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 10.5-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Very Gravelly Sandy Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.679**
Thermal Resistivity	°C●Cm/W	**59.55**
Thermal Resistivity	°C●m/W	**0.6**
Moisture Content of Test Specimen	%	**15.5**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914103a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 10.5-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Very Gravelly Sandy Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.582**
Thermal Resistivity	°C●Cm/W	**60.85**
Thermal Resistivity	°C●m/W	**0.61**
Moisture Content of Test Specimen	%	**12.5**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914104a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 10.5-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Very Gravelly Sandy Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.542**
Thermal Resistivity	°C●Cm/W	**64.83**
Thermal Resistivity	°C●m/W	**0.65**
Moisture Content of Test Specimen	%	**9.5**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914105a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 10.5-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Very Gravelly Sandy Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.509**
Thermal Resistivity	°C●Cm/W	**66.26**
Thermal Resistivity	°C●m/W	**0.66**
Moisture Content of Test Specimen	%	**6.5**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914106a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH01 10.5-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**01/11/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Very Gravelly Sandy Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.303**
Thermal Resistivity	°C●Cm/W	**76.72**
Thermal Resistivity	°C●m/W	**0.77**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914119a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH02 7.2-7.85M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**3.069**
Thermal Resistivity	°C●Cm/W	**32.59**
Thermal Resistivity	°C●m/W	**0.33**
Moisture Content of Test Specimen	%	**26.8**
Dry Density of Test Specimen	Mg/m^3	**1.76**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
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Date: 22 November 2022
Test Report Ref: TR 914120a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH02 7.2-7.85M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**3.822**
Thermal Resistivity	°C●Cm/W	**26.16**
Thermal Resistivity	°C●m/W	**0.26**
Moisture Content of Test Specimen	%	**23.8**
Dry Density of Test Specimen	Mg/m^3	**1.76**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
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Date: 22 November 2022
Test Report Ref: TR 914121a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH02 7.2-7.85M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.669**
Thermal Resistivity	°C●Cm/W	**37.47**
Thermal Resistivity	°C●m/W	**0.39**
Moisture Content of Test Specimen	%	**20.8**
Dry Density of Test Specimen	Mg/m^3	**1.76**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914122a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH02 7.2-7.85M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.638**
Thermal Resistivity	°C●Cm/W	**37.9**
Thermal Resistivity	°C●m/W	**0.39**
Moisture Content of Test Specimen	%	**17.8**
Dry Density of Test Specimen	Mg/m^3	**1.76**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914123a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH02 7.2-7.85M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.315**
Thermal Resistivity	°C●Cm/W	**76.03**
Thermal Resistivity	°C●m/W	**0.76**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.76**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 21 December 2022
Test Report Ref: TR 928634

Order No: 2210-043

Contract: Dublin Arrray - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0.5-1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**26/11/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TR**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.151**
Thermal Resistivity	°C●Cm/W	**86.88**
Thermal Resistivity	°C●m/W	**0.87**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.94**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

N. Hughes

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914129a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Slightly Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.999**
Thermal Resistivity	°C●Cm/W	**50.03**
Thermal Resistivity	°C●m/W	**0.5**
Moisture Content of Test Specimen	%	**13.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914130a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Slightly Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.97**
Thermal Resistivity	°C●Cm/W	**50.76**
Thermal Resistivity	°C●m/W	**0.5**
Moisture Content of Test Specimen	%	**10.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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County Antrim
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Date: 22 November 2022
Test Report Ref: TR 914131a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Slightly Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.712**
Thermal Resistivity	°C●Cm/W	**58.42**
Thermal Resistivity	°C●m/W	**0.58**
Moisture Content of Test Specimen	%	**7.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914132a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Slightly Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.395**
Thermal Resistivity	°C●Cm/W	**71.67**
Thermal Resistivity	°C●m/W	**0.72**
Moisture Content of Test Specimen	%	**4.3**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914133a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 0-0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Slightly Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**0.915**
Thermal Resistivity	°C●Cm/W	**109.2**
Thermal Resistivity	°C●m/W	**1.09**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914139

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.644**
Thermal Resistivity	°C●Cm/W	**37.83**
Thermal Resistivity	°C●m/W	**0.38**
Moisture Content of Test Specimen	%	**10.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914140

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.474**
Thermal Resistivity	°C●Cm/W	**40.09**
Thermal Resistivity	°C●m/W	**0.4**
Moisture Content of Test Specimen	%	**7.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914141

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.323**
Thermal Resistivity	°C●Cm/W	**43.06**
Thermal Resistivity	°C●m/W	**0.4306**
Moisture Content of Test Specimen	%	**4.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914142

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.625**
Thermal Resistivity	°C●Cm/W	**61.5**
Thermal Resistivity	°C●m/W	**0.62**
Moisture Content of Test Specimen	%	**1.7**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 02 November 2022
Test Report Ref: TR 914143

Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 4.5-5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Clay - Red/Brown**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.398**
Thermal Resistivity	°C●Cm/W	**71.53**
Thermal Resistivity	°C●m/W	**0.72**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**2.04**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914145a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 10.5-12M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.65**
Thermal Resistivity	°C●Cm/W	**37.74**
Thermal Resistivity	°C●m/W	**0.37**
Moisture Content of Test Specimen	%	**13**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914146a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 10.5-12M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**3.033**
Thermal Resistivity	°C●Cm/W	**31.08**
Thermal Resistivity	°C●m/W	**0.31**
Moisture Content of Test Specimen	%	**10**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914147a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 10.5-12M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.145**
Thermal Resistivity	°C●Cm/W	**46.61**
Thermal Resistivity	°C●m/W	**0.47**
Moisture Content of Test Specimen	%	**7**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914148a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 10.5-12M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.107**
Thermal Resistivity	°C●Cm/W	**47.47**
Thermal Resistivity	°C●m/W	**0.47**
Moisture Content of Test Specimen	%	**4**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914149a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH03 10.5-12M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.414**
Thermal Resistivity	°C●Cm/W	**70.95**
Thermal Resistivity	°C●m/W	**0.71**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.93**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914152a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 1.1-1.2M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.578**
Thermal Resistivity	°C●Cm/W	**38.78**
Thermal Resistivity	°C●m/W	**0.39**
Moisture Content of Test Specimen	%	**13.2**
Dry Density of Test Specimen	Mg/m^3	**1.73**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
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8 Drumahiskey Rd
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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914153a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 1.1-1.2M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.766**
Thermal Resistivity	°C●Cm/W	**56.64**
Thermal Resistivity	°C●m/W	**0.57**
Moisture Content of Test Specimen	%	**10.2**
Dry Density of Test Specimen	Mg/m^3	**1.73**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
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Date: 22 November 2022
Test Report Ref: TR 914154a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 1.1-1.2M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.753**
Thermal Resistivity	°C●Cm/W	**57.06**
Thermal Resistivity	°C●m/W	**0.57**
Moisture Content of Test Specimen	%	**7.2**
Dry Density of Test Specimen	Mg/m^3	**1.73**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
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Date: 22 November 2022
Test Report Ref: TR 914155a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 1.1-1.2M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.31**
Thermal Resistivity	°C●Cm/W	**58.93**
Thermal Resistivity	°C●m/W	**0.59**
Moisture Content of Test Specimen	%	**4.2**
Dry Density of Test Specimen	Mg/m^3	**1.73**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
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BT53 7QL

Date: 21 November 2022
Test Report Ref: TR 914156a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 1.1-1.2M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.414**
Thermal Resistivity	°C●Cm/W	**70.71**
Thermal Resistivity	°C●m/W	**0.71**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.73**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
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County Antrim
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Date: 22 November 2022
Test Report Ref: TR 914157a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 6-6.4M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.367**
Thermal Resistivity	°C●Cm/W	**42.25**
Thermal Resistivity	°C●m/W	**0.42**
Moisture Content of Test Specimen	%	**10.1**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
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Neil Hughes
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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914158a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 6-6.4M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.549**
Thermal Resistivity	°C●Cm/W	**39.23**
Thermal Resistivity	°C●m/W	**0.39**
Moisture Content of Test Specimen	%	**7.1**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914159a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 6-6.4M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.186**
Thermal Resistivity	°C●Cm/W	**45.74**
Thermal Resistivity	°C●m/W	**0.46**
Moisture Content of Test Specimen	%	**4.1**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
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County Antrim
BT53 7QL

Date: 21 November 2022
Test Report Ref: TR 914160a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 6-6.4M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Grey Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.828**
Thermal Resistivity	°C●Cm/W	**54.2**
Thermal Resistivity	°C●m/W	**0.54**
Moisture Content of Test Specimen	%	**1.1**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description and moisture content of test specimen corrected.

Report checked and approved by:

Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914161a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 6-6.4M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.43**
Thermal Resistivity	°C●Cm/W	**69.93**
Thermal Resistivity	°C●m/W	**0.7**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914162a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 9.74-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.531**
Thermal Resistivity	°C●Cm/W	**65.3**
Thermal Resistivity	°C●m/W	**0.65**
Moisture Content of Test Specimen	%	**19.2**
Dry Density of Test Specimen	Mg/m^3	**1.64**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

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BT53 7QL

Date: 22 November 2022
Test Report Ref: TR 914163a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 9.74-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**28/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.512**
Thermal Resistivity	°C●Cm/W	**66.12**
Thermal Resistivity	°C●m/W	**0.66**
Moisture Content of Test Specimen	%	**16.2**
Dry Density of Test Specimen	Mg/m^3	**1.64**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
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BT53 7QL

Date: 21 November 2022
Test Report Ref: TR 914164a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 9.74-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.452**
Thermal Resistivity	°C●Cm/W	**68.88**
Thermal Resistivity	°C●m/W	**0.69**
Moisture Content of Test Specimen	%	**13.2**
Dry Density of Test Specimen	Mg/m^3	**1.64**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
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BT53 7QL

Date: 21 November 2022
Test Report Ref: TR 914165a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 9.74-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**29/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.36**
Thermal Resistivity	°C●Cm/W	**73.51**
Thermal Resistivity	°C●m/W	**0.74**
Moisture Content of Test Specimen	%	**10.2**
Dry Density of Test Specimen	Mg/m^3	**1.64**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 21 November 2022
Test Report Ref: TR 914166a
Revision 1
Order No: 2210-043

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S105990**
Client Ref. No:	**WP2_BH04 9.74-10.7**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**10/10/2022**
Date of Start of Test:	**31/10/2022**
Sampling Location:	**Unknown**
Name of Source:	**Unknown**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**TD**
Material Description:	**Brown Gravelly Silty Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.127**
Thermal Resistivity	°C●Cm/W	**88.73**
Thermal Resistivity	°C●m/W	**0.89**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.64**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
Revision 1 -Material description corrected.

Report checked and approved by:
N. Hughes
Neil Hughes
Assistant Aggregate Team Manager

CAUSEWAY GEOTECH

HEAD OFFICE
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Registered in Ireland.
Company Number: 633786

www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

4 November 2022

Project Name:	Dublin Array Wind Park - Stage 1 Onshore Site Investigations
Project No.:	21-1443E
Client:	Dublin Array Offshore Windfarm
Engineer:	Gavin & Doherty Geosolutions (GDG)

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 11/10/2022 and 04/11/2022.

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: Dublin Array Wind Park - Stage 1 Onshore Site Investigations

Report Reference: Schedule 2

The table below details the tests carried out, the specifications used, and the number of tests included in this report. The results contained in this report relate to the sample(s) as received

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. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	16
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	8
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	8
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	8

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 Eurofins Chemtest Ltd *(UKAS 2183)*	BRE Test - Suite C		4

CAUSEWAY GEOTECH

Summary of Classification Test Results

Project No.	Project Name
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations

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										
WP1_BH01	13	3.00		D	Grey sandy slightly gravelly silty CLAY.			8.4						
WP1_BH01	14	4.50		D	Grey sandy slightly gravelly silty CLAY.			8.1	68	24 -1pt	15	9		CL
WP1_BH01	20	9.00		D	Brownish grey sandy gravelly silty CLAY.			10.0	40	32 -1pt	21	11		CL
WP1_BH01	22	10.00		D	Brownish grey slightly gravelly silty fine to coarse SAND.			12.0						
WP1_BH02	11	3.00		D	Brownish grey slightly gravelly silty fine to coarse SAND.			5.3	63	27 -1pt	16	11		CL
WP1_BH02	14	6.00		D	Brownish grey sandy slightly gravelly silty CLAY.			6.7	49	28 -1pt	18	10		CL
WP1_BH02	19	9.00		D	Brownish grey sandy slightly gravelly silty CLAY.			10.0						
WP1_BH02	23	12.00		D	Brownish grey sandy slightly gravelly silty CLAY.			7.6						
WP1_BH03	7	4.50		D	Brownish grey sandy slightly gravelly silty CLAY.			8.3	75	27 -1pt	16	11		CL
WP1_BH03	6	6.00		D	Brownish grey sandy slightly gravelly silty CLAY.			6.7						
WP1_BH03	10	7.50		D	Brownish grey sandy slightly gravelly silty CLAY.			9.2	72	32 -1pt	18	14		CL
WP1_BH03	14	10.50		D	Brownish grey sandy slightly gravelly silty CLAY.			6.0						

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

11/04/2022 00:00

Approved By

Stephen Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations

Hole No.	Sample				Specimen Description	Density bulk	Density dry	*w*	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		Mg/m3		%	%	%	%	%	Mg/m3	
WP1_BH04	12	3.00		D	Brownish grey sandy slightly gravelly silty CLAY.			14.0	46	28 -1pt	17	11		CL
WP1_BH04	14	6.00		D	Brownish grey sandy slightly gravelly silty CLAY.			6.0						
WP1_BH04	21	9.00		D	Brownish grey sandy slightly gravelly silty CLAY.			12.0						
WP1_BH04	25	13.50		D	Brownish grey slightly gravelly slightly silty fine to coarse SAND.			14.0	47	30 -1pt	17	13		CL

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

11/04/2022 00:00

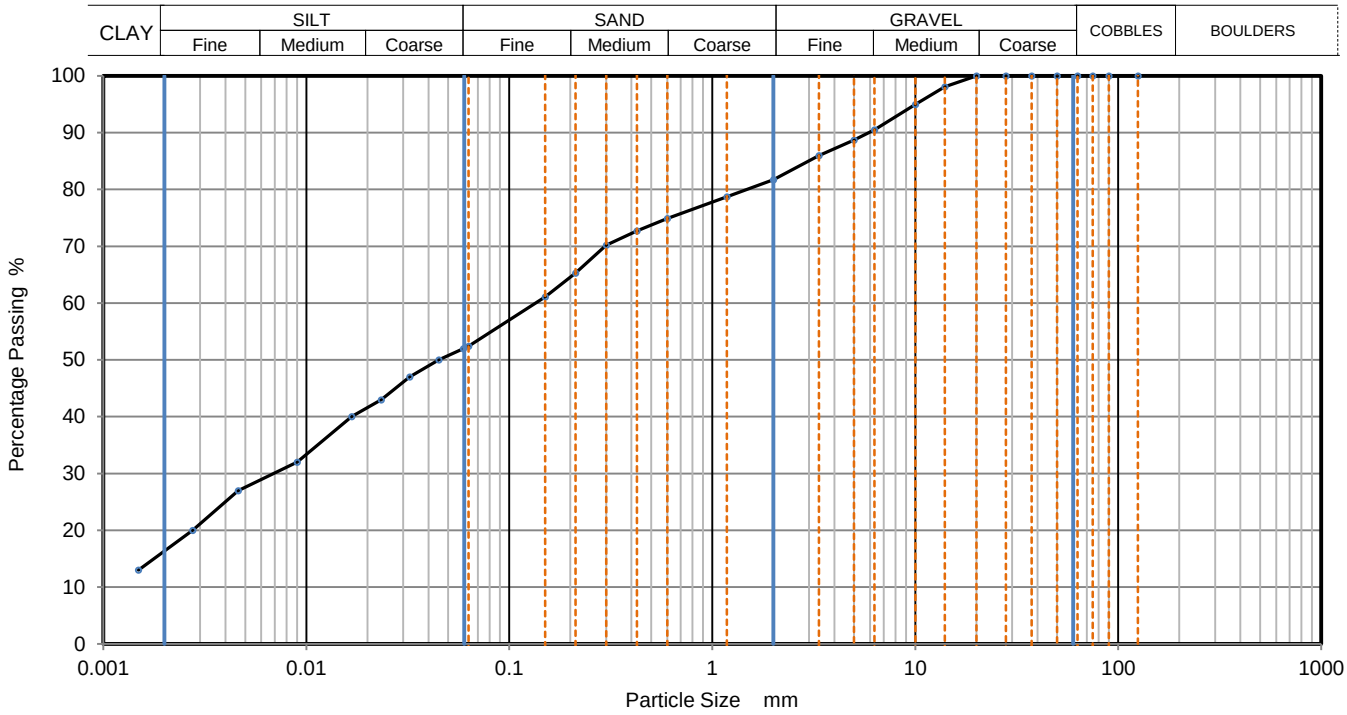
Approved By

Stephen Watson

UKAS TESTING

10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP1_BH01
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		12
Specimen Description	Grey sandy slightly gravelly silty CLAY.			Sample Depth (m)	Top	3.00
					Base	4.50
Specimen Reference	2	Specimen Depth	3 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus202210119



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.05942	52
90	100	0.04491	50
75	100	0.03226	47
63	100	0.02333	43
50	100	0.01674	40
37.5	100	0.00901	32
28	100	0.00462	27
20	100	0.00275	20
14	98	0.00149	13
10	95		
6.3	91		
5	89		
3.35	86		
2	82		
1.18	79		
0.6	75	Particle density (assumed)	
0.425	73	2.65 Mg/m3	
0.3	70		
0.212	65		
0.15	61		
0.063	52		

Dry Mass of sample, g	541

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	18.3
Sand	29.4
Silt	35.6
Clay	16.7

Grading Analysis		
D100	mm	
D60	mm	0.134
D30	mm	0.00682
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

Approved
Stephen Watson

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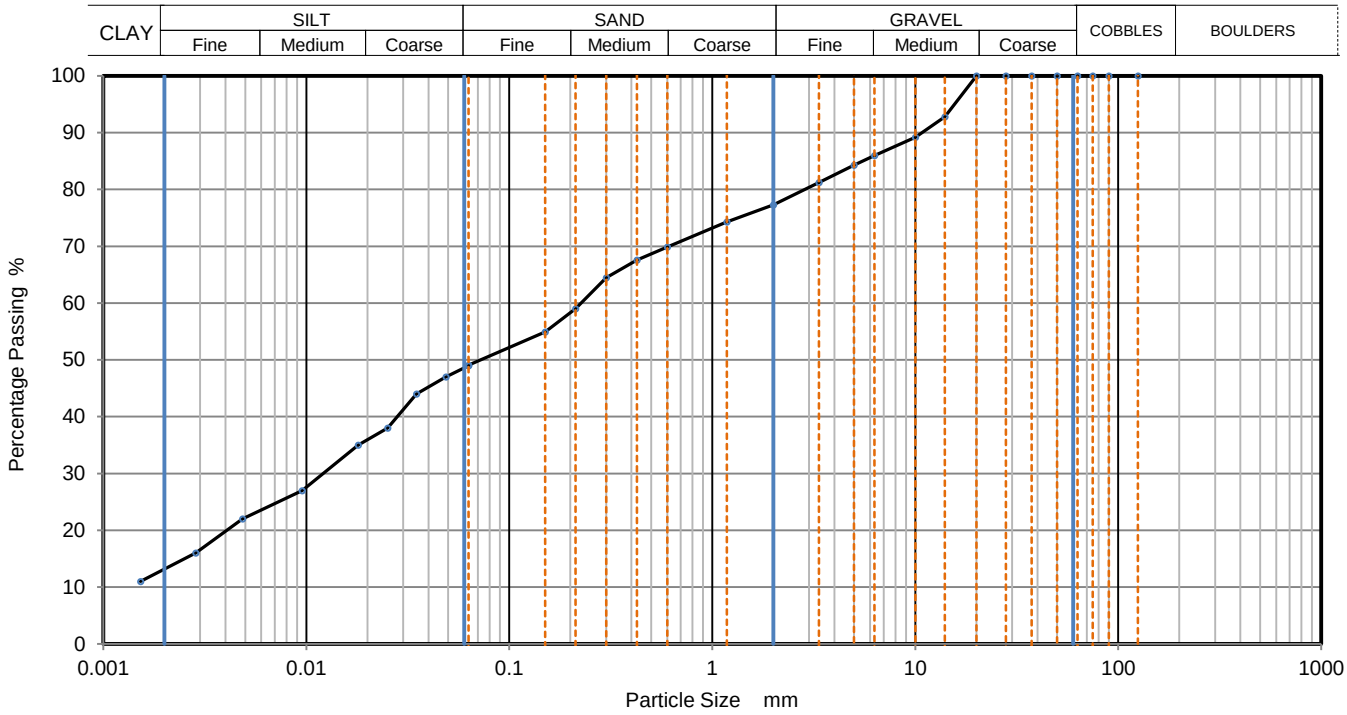
UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP1_BH01
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		17
Specimen Description	Brownish grey sandy slightly gravelly silty CLAY.			Sample Depth (m)	Top	6.00
					Base	7.50
Specimen Reference	2	Specimen Depth	6 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022101112



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	49
90	100	0.04870	47
75	100	0.03490	44
63	100	0.02517	38
50	100	0.01802	35
37.5	100	0.00953	27
28	100	0.00485	22
20	100	0.00285	16
14	93	0.00152	11
10	89		
6.3	86		
5	84		
3.35	81		
2	77		
1.18	74		
0.6	70	Particle density	(assumed)
0.425	68	2.65	Mg/m3
0.3	65		
0.212	59		
0.15	55		
0.063	49		

Dry Mass of sample, g: 542

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	22.7
Sand	28.2
Silt	35.8
Clay	13.3

Grading Analysis		
D100	mm	
D60	mm	0.225
D30	mm	0.0121
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

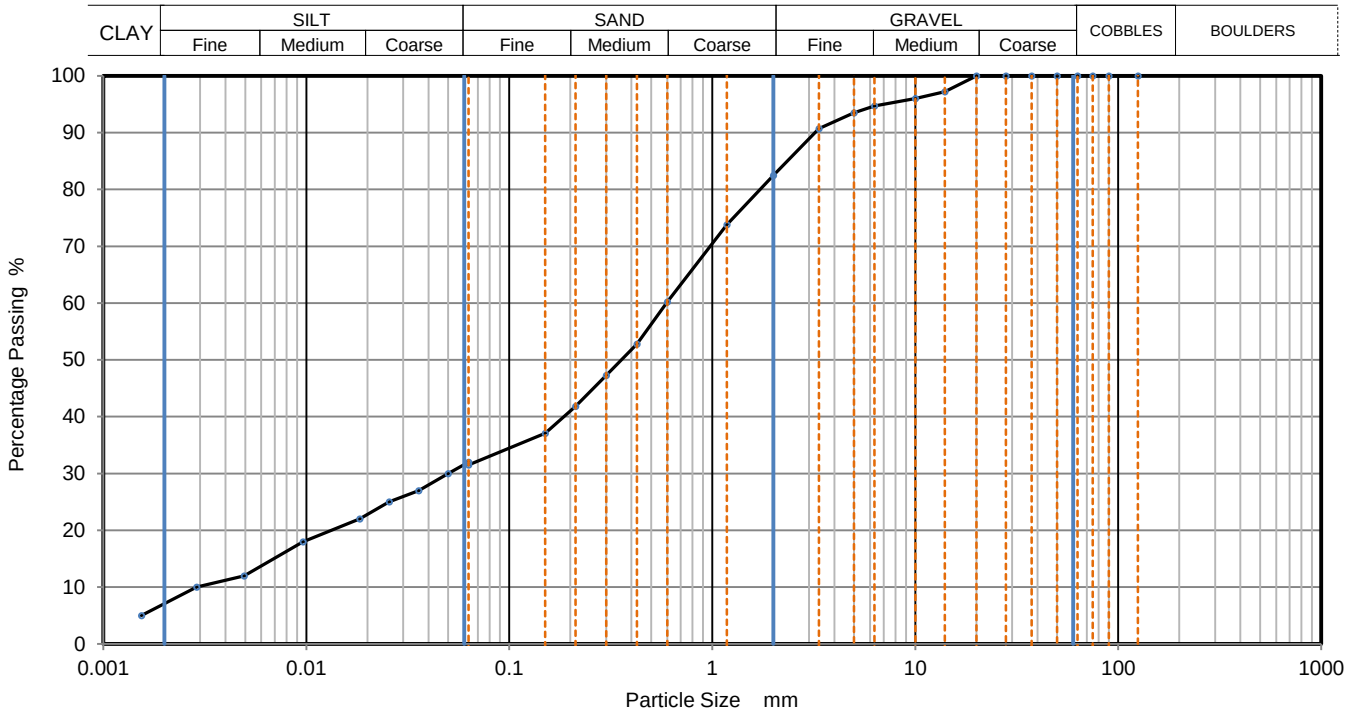
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP1_BH02
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		10
Specimen Description	Brownish grey sandy slightly gravelly silty CLAY.			Sample Depth (m)	Top	3.00
					Base	4.50
Specimen Reference	2	Specimen Depth	3 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022101116



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	32
90	100	0.05001	30
75	100	0.03582	27
63	100	0.02564	25
50	100	0.01835	22
37.5	100	0.00965	18
28	100	0.00493	12
20	100	0.00288	10
14	97	0.00154	5
10	96		
6.3	95		
5	94		
3.35	91		
2	83		
1.18	74		
0.6	60	Particle density	(assumed)
0.425	53	2.65	Mg/m3
0.3	47		
0.212	42		
0.15	37		
0.063	32		

Dry Mass of sample, g: 556

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	17.5
Sand	51.0
Silt	24.3
Clay	7.2

Grading Analysis		
D100	mm	
D60	mm	0.596
D30	mm	0.0492
D10	mm	0.00312
Uniformity Coefficient		190
Curvature Coefficient		1.3

Remarks

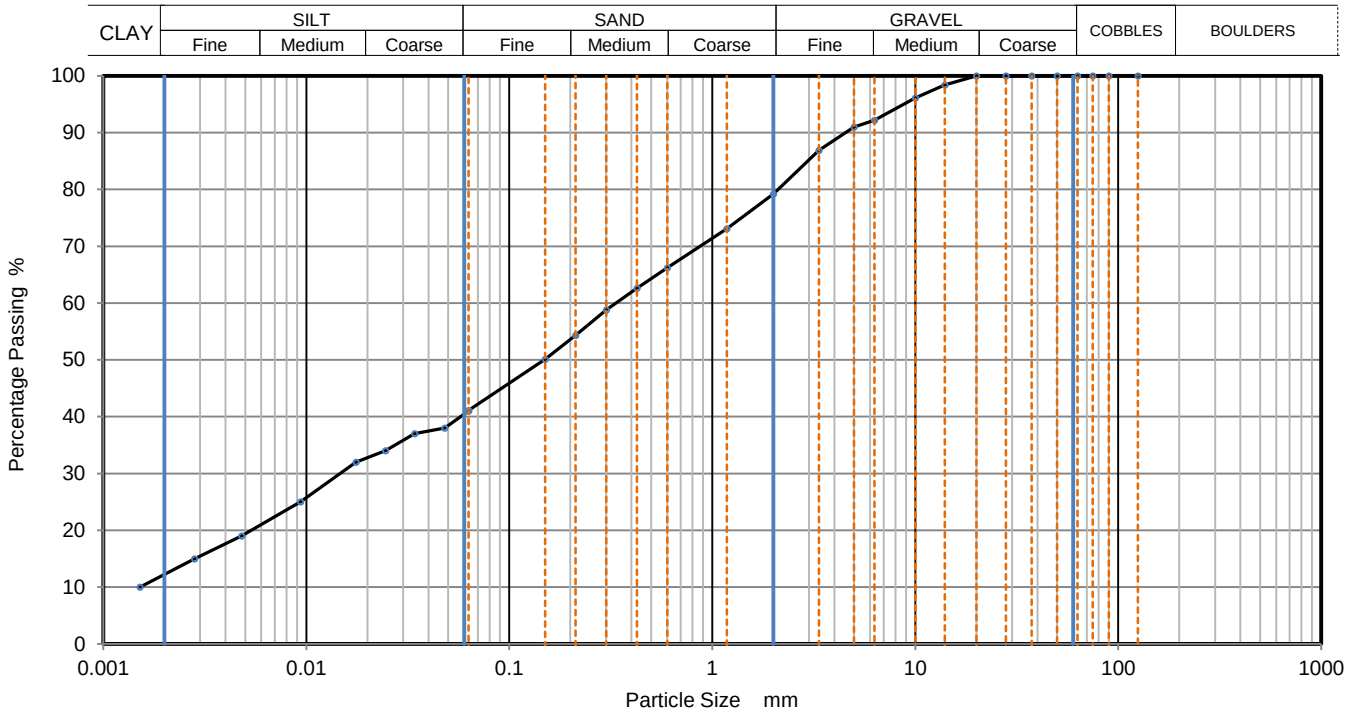
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1443E**
				Borehole/Pit No.	WP1_BH02
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.	17
Specimen Description	Brownish grey sandy slightly gravelly silty CLAY.			Sample Depth (m) Top	8.30
				Base	9.00
Specimen Reference	2	Specimen Depth	8.3 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2022101119



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	41
90	100	0.04803	38
75	100	0.03420	37
63	100	0.02452	34
50	100	0.01757	32
37.5	100	0.00936	25
28	100	0.00480	19
20	100	0.00282	15
14	98	0.00152	10
10	96		
6.3	92		
5	91		
3.35	87		
2	79		
1.18	73		
0.6	66	Particle density	(assumed)
0.425	63	2.65	Mg/m3
0.3	59		
0.212	54		
0.15	50		
0.063	41		

Dry Mass of sample, g: 522

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	20.8
Sand	38.1
Silt	29.1
Clay	12.0

Grading Analysis		
D100	mm	
D60	mm	0.334
D30	mm	0.0153
D10	mm	0.00159
Uniformity Coefficient		210
Curvature Coefficient		0.44

Remarks

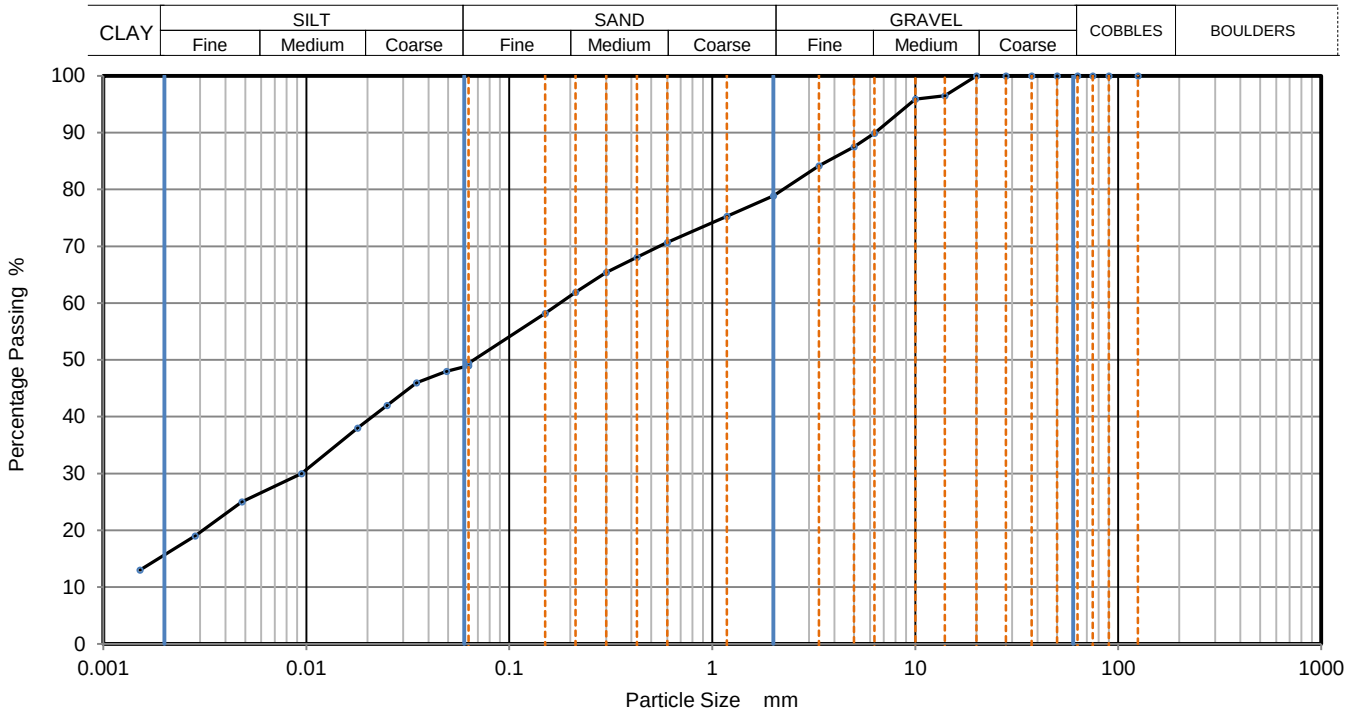
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1443E**
				Borehole/Pit No.	WP1_BH03
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.	5
Specimen Description	Brownish grey sandy slightly gravelly silty CLAY.			Sample Depth (m) Top	4.50
				Base	6.00
Specimen Reference	2	Specimen Depth	4.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2022101124



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	49
90	100	0.04903	48
75	100	0.03490	46
63	100	0.02501	42
50	100	0.01791	38
37.5	100	0.00948	30
28	100	0.00482	25
20	100	0.00283	19
14	97	0.00152	13
10	96		
6.3	90		
5	88		
3.35	84		
2	79		
1.18	75		
0.6	71	Particle density	(assumed)
0.425	68	2.65	Mg/m3
0.3	65		
0.212	62		
0.15	58		
0.063	49		

Dry Mass of sample, g	531

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	21.1
Sand	29.5
Silt	33.6
Clay	15.8

Grading Analysis		
D100	mm	
D60	mm	0.178
D30	mm	0.00904
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

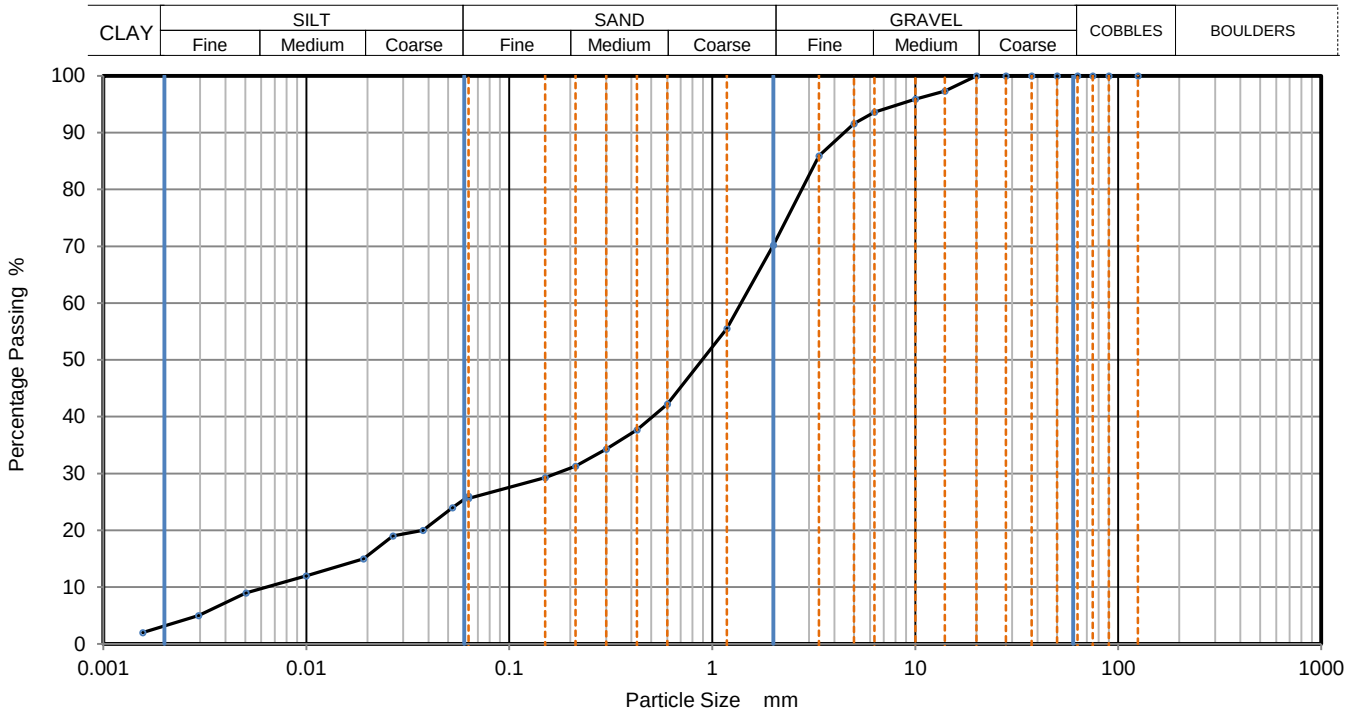
Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING

10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP1_BH03
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		19
Specimen Description	Brownish grey slightly gravelly silty fine to coarse SAND.			Sample Depth (m)	Top	12.00
					Base	13.50
Specimen Reference	2	Specimen Depth	12 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022101128



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	26
90	100	0.05253	24
75	100	0.03758	20
63	100	0.02672	19
50	100	0.01911	15
37.5	100	0.00998	12
28	100	0.00504	9
20	100	0.00294	5
14	97	0.00156	2
10	96		
6.3	94		
5	92		
3.35	86		
2	70		
1.18	56		
0.6	42	Particle density	(assumed)
0.425	38	2.65	Mg/m3
0.3	34		
0.212	31		
0.15	29		
0.063	26		

Dry Mass of sample, g	510

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	29.8
Sand	44.6
Silt	22.6
Clay	3.0

Grading Analysis		
D100	mm	
D60	mm	1.39
D30	mm	0.17
D10	mm	0.00676
Uniformity Coefficient		210
Curvature Coefficient		3.1

Remarks

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

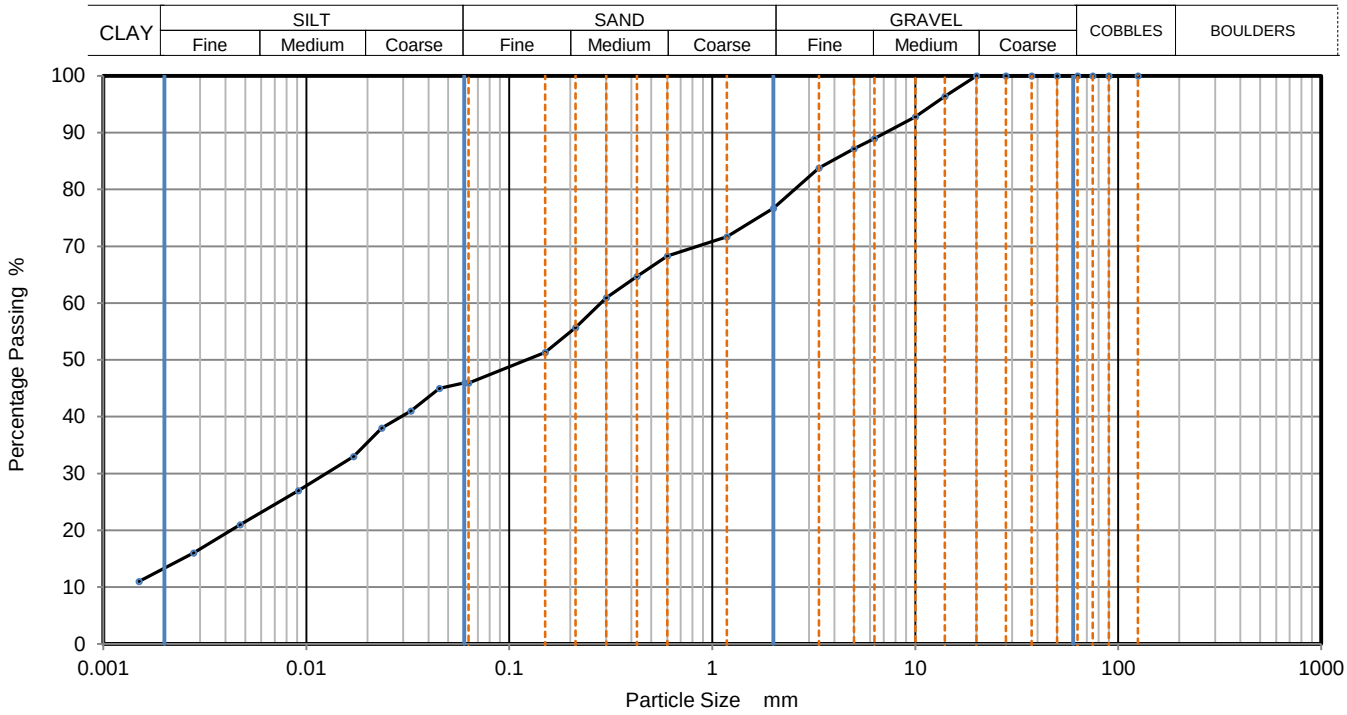
Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING

10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP1_BH04
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		17
Specimen Description	Brownish grey sandy slightly gravelly silty CLAY.			Sample Depth (m)	Top	6.00
					Base	7.50
Specimen Reference	2	Specimen Depth	6 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022101132



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06039	46
90	100	0.04526	45
75	100	0.03276	41
63	100	0.02351	38
50	100	0.01710	33
37.5	100	0.00913	27
28	100	0.00471	21
20	100	0.00278	16
14	96	0.00150	11
10	93		
6.3	89		
5	87		
3.35	84		
2	77		
1.18	72		
0.6	68	Particle density	(assumed)
0.425	65	2.65	Mg/m3
0.3	61		
0.212	56		
0.15	51		
0.063	46		

Dry Mass of sample, g	506

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	23.3
Sand	30.8
Silt	32.4
Clay	13.5

Grading Analysis		
D100	mm	
D60	mm	0.282
D30	mm	0.012
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

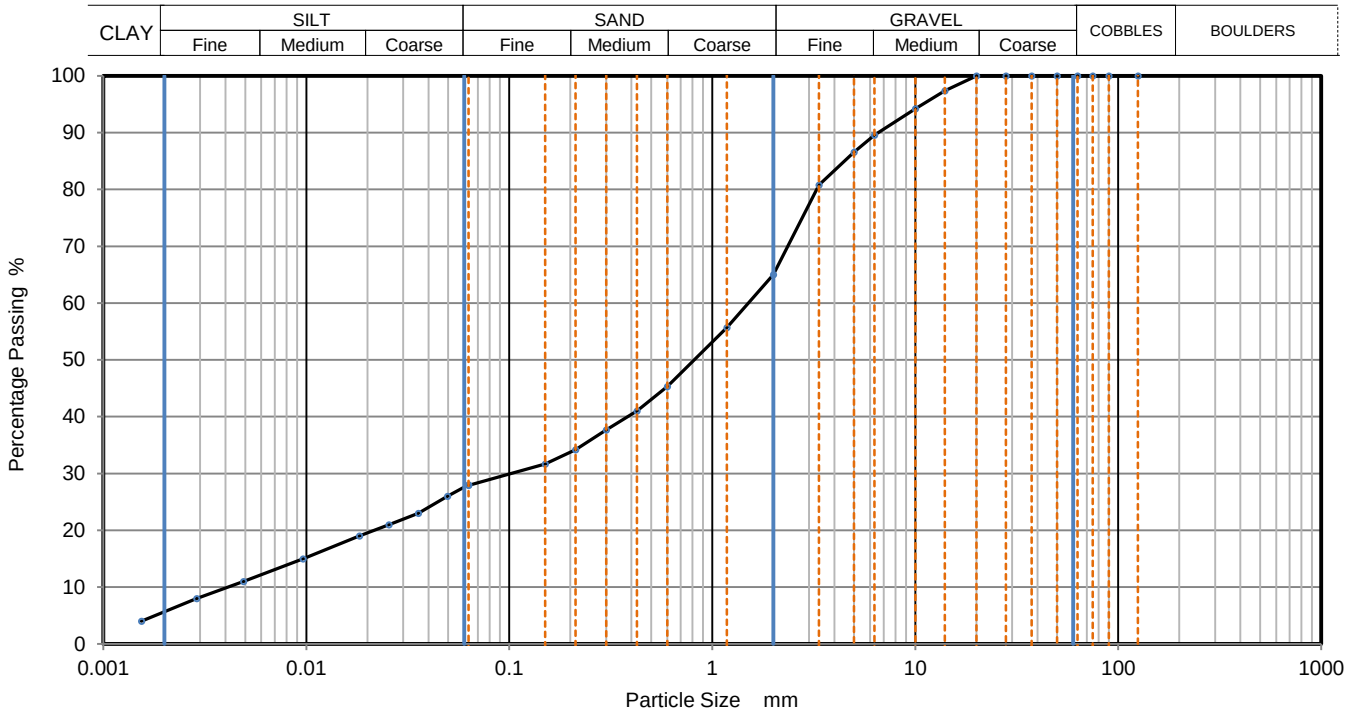
Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING

10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP1_BH04
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		24
Specimen Description	Brownish grey slightly gravelly silty fine to coarse SAND.				Sample Depth (m)	Top	12.70
						Base	15.00
Specimen Reference	2	Specimen Depth	12.7	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID		Caus2022101134



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	28
90	100	0.04969	26
75	100	0.03559	23
63	100	0.02549	21
50	100	0.01824	19
37.5	100	0.00965	15
28	100	0.00491	11
20	100	0.00288	8
14	97	0.00154	4
10	94		
6.3	90		
5	87		
3.35	81		
2	65		
1.18	56		
0.6	45	Particle density	(assumed)
0.425	41	2.65	Mg/m3
0.3	38		
0.212	34		
0.15	32		
0.063	28		

Dry Mass of sample, g	575

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	35.0
Sand	37.1
Silt	22.0
Clay	5.9

Grading Analysis		
D100	mm	
D60	mm	1.5
D30	mm	0.101
D10	mm	0.00408
Uniformity Coefficient		370
Curvature Coefficient		1.7

Remarks

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

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

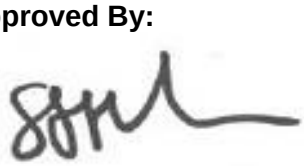
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-40381-1
Initial Date of Issue:	27-Oct-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Carin Cornwall Ciaran Doherty Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Megan Walsh Neil Haggan Paul Dunlop Rachel White Sean Ross Stephen Franey S
Project	21-1443E Dublin Array

Quotation No.:		**Date Received:**	21-Oct-2022
Order No.:		**Date Instructed:**	21-Oct-2022
No. of Samples:	4		
Turnaround (Wkdays):	7	**Results Due:**	31-Oct-2022
Date Approved:	27-Oct-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E Dublin Array

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-40381	22-40381	22-40381	22-40381
Quotation No.:			**Chemtest Sample ID.:**		1529886	1529887	1529888	1529889
Order No.:			Client Sample Ref.:		11	7	3	11
			Sample Location:		WP1_BH01	WP1_BH02	WP1_BH03	WP1_BH04
			Sample Type:		SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.50	1.50	1.50	1.50
			Date Sampled:		20-Oct-2022	20-Oct-2022	20-Oct-2022	20-Oct-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Moisture	N	2030	%	0.020	8.9	1.4	9.7	14
pH (2.5:1)	N	2010		4.0	8.3	9.6	8.1	8.4
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.014	0.013	0.010	0.028

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

HEAD OFFICE
Causeway Geotech Ltd
8 Drumahiskey Road
Ballymoney
Co. Antrim, N. Ireland, BT53 7QL
NI: +44 (0)28 276 66640
Registered in Northern Ireland.
Company Number: NI610766

REGIONAL OFFICE
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

22 November 2022

Project Name:	Dublin Array Wind Park - Stage 1 Onshore Site Investigations
Project No.:	21-1443E
Client:	Dublin Array Offshore Windfarm
Engineer:	Gavin & Doherty Geosolutions (GDG)

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 08/11/2022 and 22/11/2022.

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: Dublin Array Wind Park - Stage 1 Onshore Site Investigations

Report Reference: Schedule 3 - INTERIM

The table below details the tests carried out, the specifications used, and the number of tests included in this report. The results contained in this report relate to the sample(s) as received

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. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	27
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	14
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	16
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	14

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 Eurofins Chemtest Ltd *(UKAS 2183)*	BRE Test - Suite C		8
SOIL – Subcontracted to Celtest Company *(UKAS 0494)*	Determination of Thermal Conductivity by Thermal Needle Probe Procedure *(5 Point method at various Moisture Content).*	ASTM – D5334-14	5
SOIL – Subcontracted to Celtest Company *(UKAS 0494)*	Determination of Thermal Conductivity by Thermal Needle Probe Procedure *(1 Point method at optimum moisture content).*	ASTM – D5334-14	17

CAUSEWAY GEOTECH

Summary of Classification Test Results

Project No.	Project Name
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations

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										
WP1_TP01	5	1.00		B	Brownish grey sandy gravelly silty CLAY.			7.8						
WP1_TP01	6	1.50		B	Brownish grey sandy gravelly silty CLAY.			5.8	61	23 -1pt	14	9		CL
WP1_TP02	7	2.50		B	Brownish grey sandy gravelly silty CLAY.			10	61	24 -1pt	16	8		CL
WP1_TP02	8	3.50		B	Brownish grey sandy gravelly silty CLAY.			7.9						
WP1_TP03	8	3.40		B	Brownish grey sandy gravelly silty CLAY.			8.9	45	25 -1pt	16	9		CL
WP1_TP04	5	1.00		B	Brownish grey gravelly clayey fine to coarse SAND.			10						
WP1_TP04	8	3.30		B	Brownish grey sandy gravelly silty CLAY.			17	73	27 -1pt	16	11		CL
WP1_TP05	8	3.00		B	Brownish grey sandy gravelly silty CLAY.			10	42	29 -1pt	20	9		CL
WP1_TP06	6	1.50		B	Brownish grey slightly gravelly clayey fine to coarse SAND.			17						
WP1_TP06	8	3.00		B	Brownish grey sandy gravelly silty CLAY.			15	74	31 -1pt	19	12		CL
WP1_TP07	7	2.60		B	Brownish grey sandy gravelly silty CLAY.			8.6	37	32 -1pt	19	13		CL
WP1_TP08	8	3.50		B	Brownish grey sandy gravelly silty CLAY.			8.4	45	27 -1pt	17	10		CL

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

22/11/2022

Approved By

Stephen Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations

Hole No.	Sample				Specimen Description	Density bulk / dry		*w*	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		Mg/m3		%	%	%	%	%	Mg/m3	
WP1_TP09	7	2.40		B	Brownish grey sandy gravelly silty CLAY.			7.9						
WP1_TP10	8	3.00		B	Brownish grey slightly gravelly clayey fine to coarse SAND.			20						
WP1_TP10	9	3.40		B	Brownish grey sandy gravelly silty CLAY.			13	56	24 -1pt	16	8		CL
WP1_TP11	3	1.00		B	Brownish grey sandy gravelly silty CLAY.			11						
WP1_TP11	8	3.40		B	Brownish grey sandy gravelly silty CLAY.			8.5	61	30 -1pt	18	12		CL
WP1_TP12	7	3.20		B	Brownish grey gravelly slightly clayey fine to coarse SAND.			10						
WP1_TP12	8	3.80		B	Brownish grey sandy gravelly silty CLAY.			11	56	27 -1pt	15	12		CL
WP1_TP13	1	0.50		B	Brownish grey sandy gravelly silty CLAY.			15						
WP1_TP13	5	1.50		B	Brownish grey sandy gravelly clayey SILT.			10	44	44 -1pt	28	16		MI
WP2_TP01	7	2.50		B	Brownish grey slightly gravelly silty fine to coarse SAND.			11						
WP2_TP01	8	3.30		B	Brownish grey slightly gravelly silty fine to coarse SAND.			4.8						
WP2_TP03	7	2.30		B	Brownish grey sandy slightly gravelly silty CLAY.			15						

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

22/11/2022

Approved By

Stephen Watson

UKAS TESTING

10122

Summary of Classification Test Results

Project No.	Project Name
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations

Hole No.	Sample				Specimen Description	Density bulk	Density dry	*w*	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		Mg/m3		%	%	%	%	%	Mg/m3	
WP2_TP03	8	3.20		B	Brownish grey sandy slightly gravelly silty CLAY.			15	84	35 -1pt	17	18		CL/CI
WP2_TP04	7	2.30		B	Brownish grey sandy slightly gravelly silty CLAY.			16	86	34 -1pt	17	17		CL
WP2_TP04	8	3.20		B	Brownish grey sandy slightly gravelly silty CLAY.			15						

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

22/11/2022

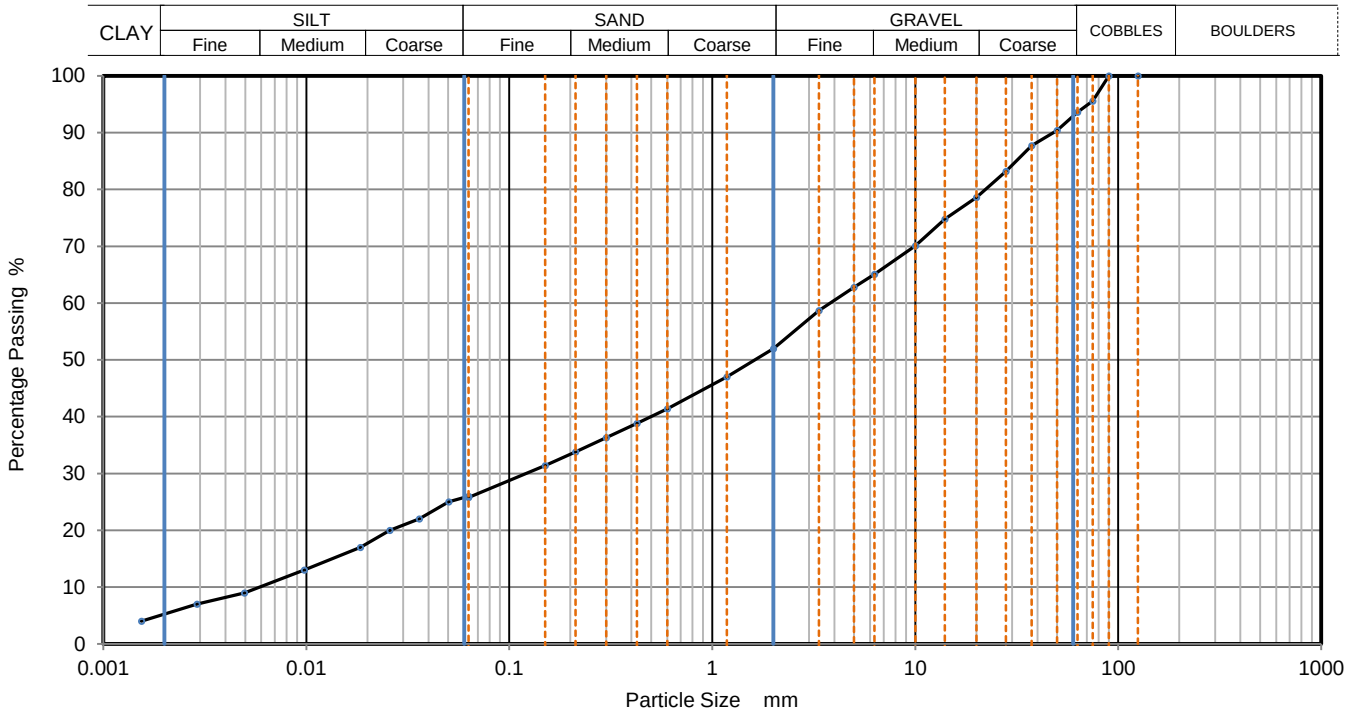
Approved By

Stephen Watson

UKAS TESTING

10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP1_TP01
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		5
Specimen Description	Brownish grey sandy gravelly silty CLAY.			Sample Depth (m)	Top	1.00
					Base	
Specimen Reference	6	Specimen Depth	1 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus202211081



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	26
90	100	0.05032	25
75	96	0.03604	22
63	94	0.02580	20
50	90	0.01846	17
37.5	88	0.00976	13
28	83	0.00496	9
20	79	0.00289	7
14	75	0.00154	4
10	70		
6.3	65		
5	63		
3.35	59		
2	52		
1.18	47		
0.6	41	Particle density (assumed)	
0.425	39	2.65 Mg/m3	
0.3	36		
0.212	34		
0.15	31		
0.063	26		

Dry Mass of sample, g	17716

Sample Proportions	% dry mass
Cobbles	6.4
Gravel	41.6
Sand	26.2
Silt	20.7
Clay	5.1

Grading Analysis		
D100	mm	
D60	mm	3.8
D30	mm	0.121
D10	mm	0.00607
Uniformity Coefficient		630
Curvature Coefficient		0.64

Remarks

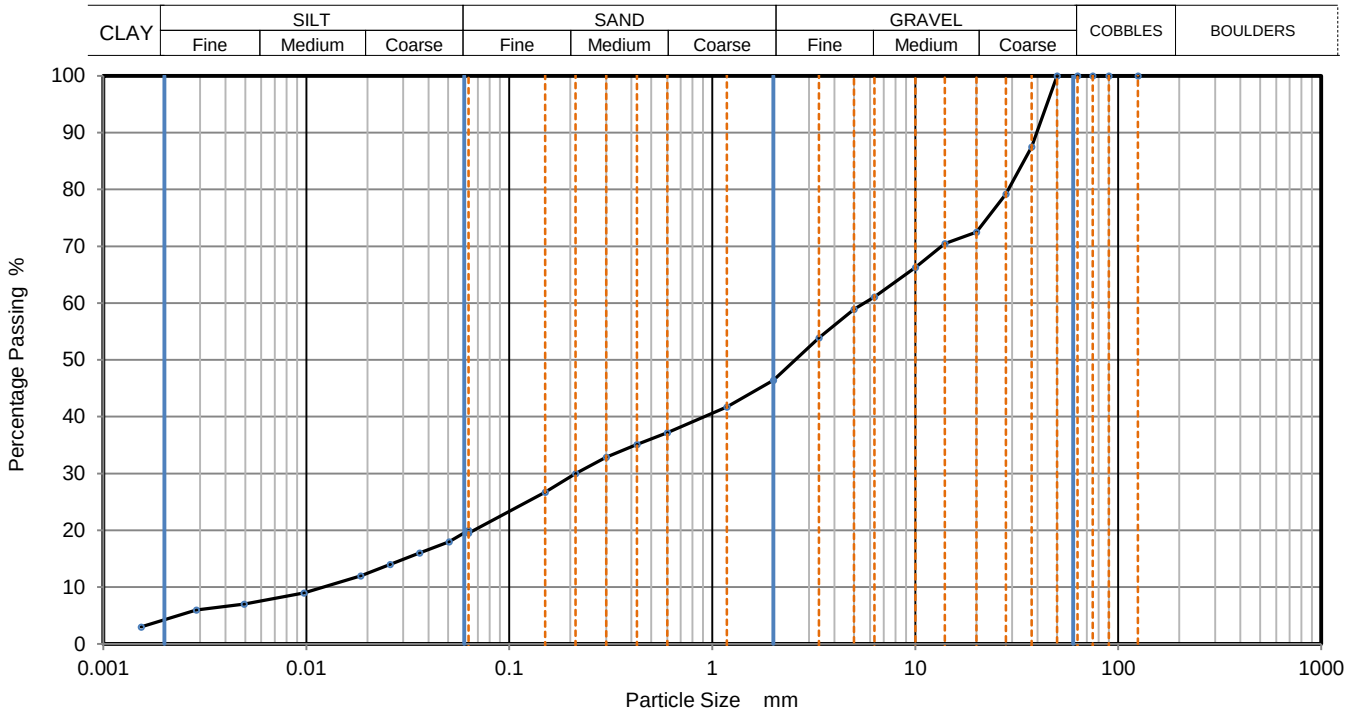
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP1_TP02
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		8
Specimen Description	Brownish grey sandy gravelly silty CLAY.			Sample Depth (m)	Top	3.50
					Base	
Specimen Reference	6	Specimen Depth	3.5 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus202211087



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	20
90	100	0.05048	18
75	100	0.03615	16
63	100	0.02587	14
50	100	0.01851	12
37.5	88	0.00973	9
28	79	0.00495	7
20	73	0.00287	6
14	71	0.00154	3
10	66		
6.3	61		
5	59		
3.35	54		
2	46		
1.18	42		
0.6	37	Particle density	(assumed)
0.425	35	2.65	Mg/m3
0.3	33		
0.212	30		
0.15	27		
0.063	20		

Dry Mass of sample, g	4260

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	53.6
Sand	26.9
Silt	15.5
Clay	4.0

Grading Analysis		
D100	mm	
D60	mm	5.62
D30	mm	0.212
D10	mm	0.0115
Uniformity Coefficient		490
Curvature Coefficient		0.69

Remarks

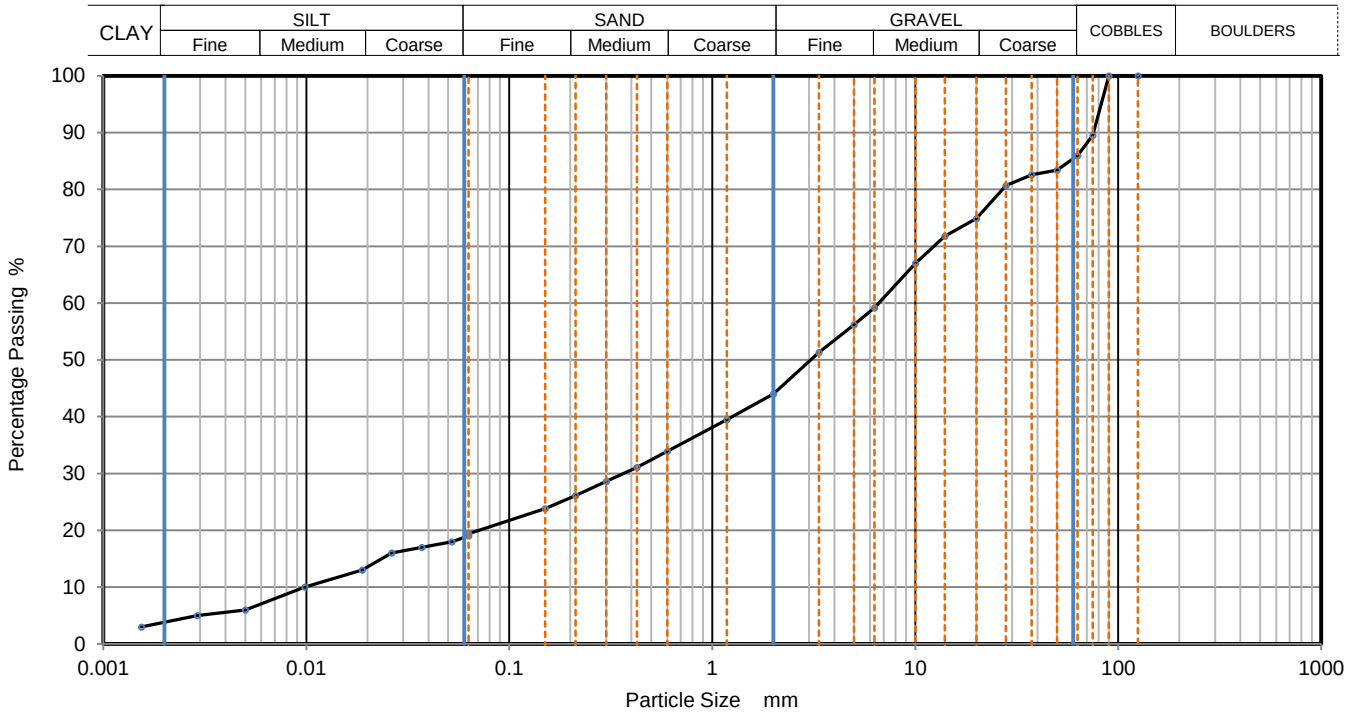
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP1_TP03
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		8
Specimen Description	Brownish grey sandy gravelly silty CLAY.				Sample Depth (m)	Top	3.40
						Base	
Specimen Reference	8	Specimen Depth	3.4	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID		Caus2022110812



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	19
90	100	0.05206	18
75	90	0.03703	17
63	86	0.02634	16
50	83	0.01884	13
37.5	83	0.00984	10
28	81	0.00500	6
20	75	0.00290	5
14	72	0.00154	3
10	67		
6.3	59		
5	56		
3.35	51		
2	44		
1.18	40		
0.6	34	Particle density	(assumed)
0.425	31	2.65	Mg/m3
0.3	29		
0.212	26		
0.15	24		
0.063	19		

Dry Mass of sample, g	10581

Sample Proportions	% dry mass
Cobbles	14.0
Gravel	42.0
Sand	24.6
Silt	15.8
Clay	3.6

Grading Analysis		
D100	mm	
D60	mm	6.6
D30	mm	0.364
D10	mm	0.00926
Uniformity Coefficient		710
Curvature Coefficient		2.2

Remarks

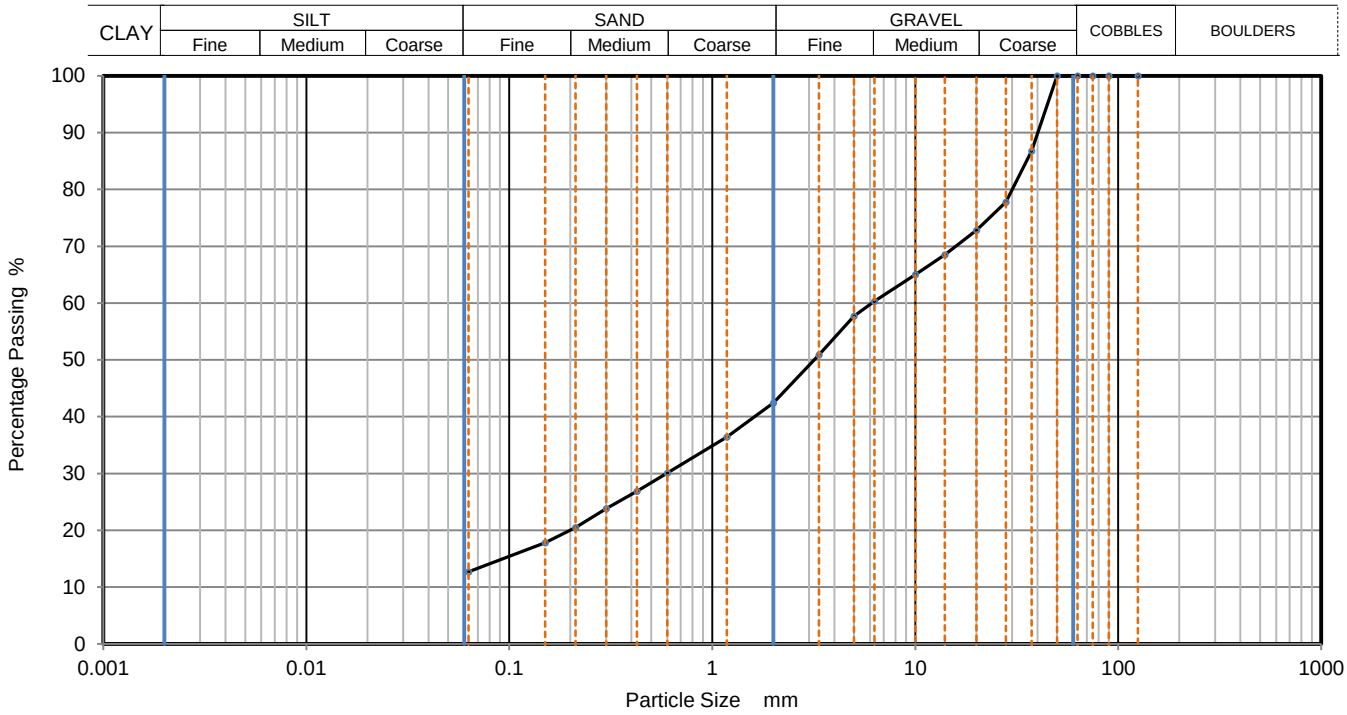
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP1_TP04
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		5
Specimen Description	Brownish grey gravelly clayey fine to coarse SAND.				Sample Depth (m)	Top	1.00
						Base	
Specimen Reference	6	Specimen Depth	1	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clause 9.2				KeyLAB ID		Caus2022110814



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	87		
28	78		
20	73		
14	69		
10	65		
6.3	60		
5	58		
3.35	51		
2	42		
1.18	36		
0.6	30		
0.425	27		
0.3	24		
0.212	21		
0.15	18		
0.063	13		

Dry Mass of sample, g	6787

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	57.6
Sand	29.8
Fines <0.063mm	13.0

Grading Analysis		
D100	mm	
D60	mm	6.12
D30	mm	0.593
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

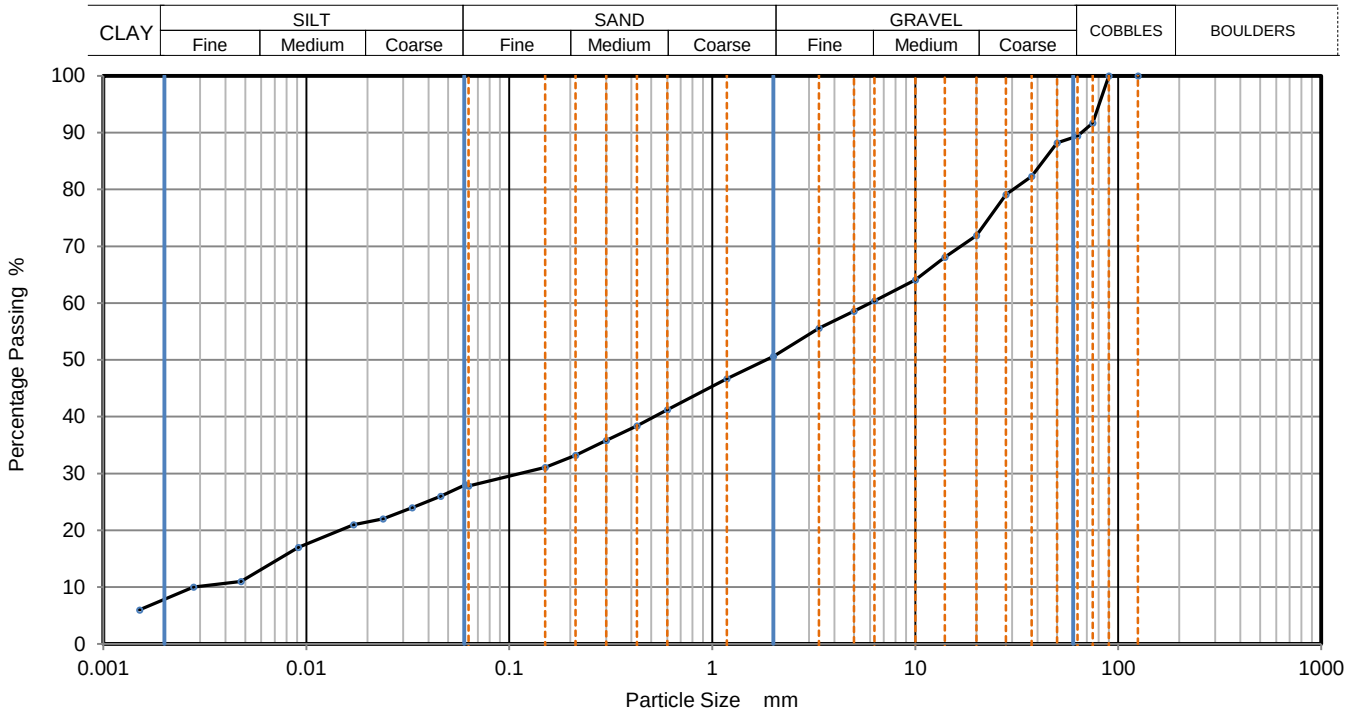
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP1_TP05
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		8
Specimen Description	Brownish grey sandy gravelly silty CLAY.				Sample Depth (m)	Top	3.00
						Base	
Specimen Reference	8	Specimen Depth	3	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID		Caus2022110822



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06086	28
90	100	0.04596	26
75	92	0.03324	24
63	89	0.02384	22
50	88	0.01710	21
37.5	82	0.00913	17
28	79	0.00477	11
20	72	0.00278	10
14	68	0.00151	6
10	64		
6.3	60		
5	59		
3.35	56		
2	51		
1.18	47		
0.6	41	Particle density	(assumed)
0.425	38	2.65	Mg/m3
0.3	36		
0.212	33		
0.15	31		
0.063	28		

Dry Mass of sample, g	17012

Sample Proportions	% dry mass
Cobbles	10.6
Gravel	38.8
Sand	22.8
Silt	20.4
Clay	7.4

Grading Analysis		
D100	mm	
D60	mm	5.96
D30	mm	0.112
D10	mm	0.00326
Uniformity Coefficient		1800
Curvature Coefficient		0.64

Remarks

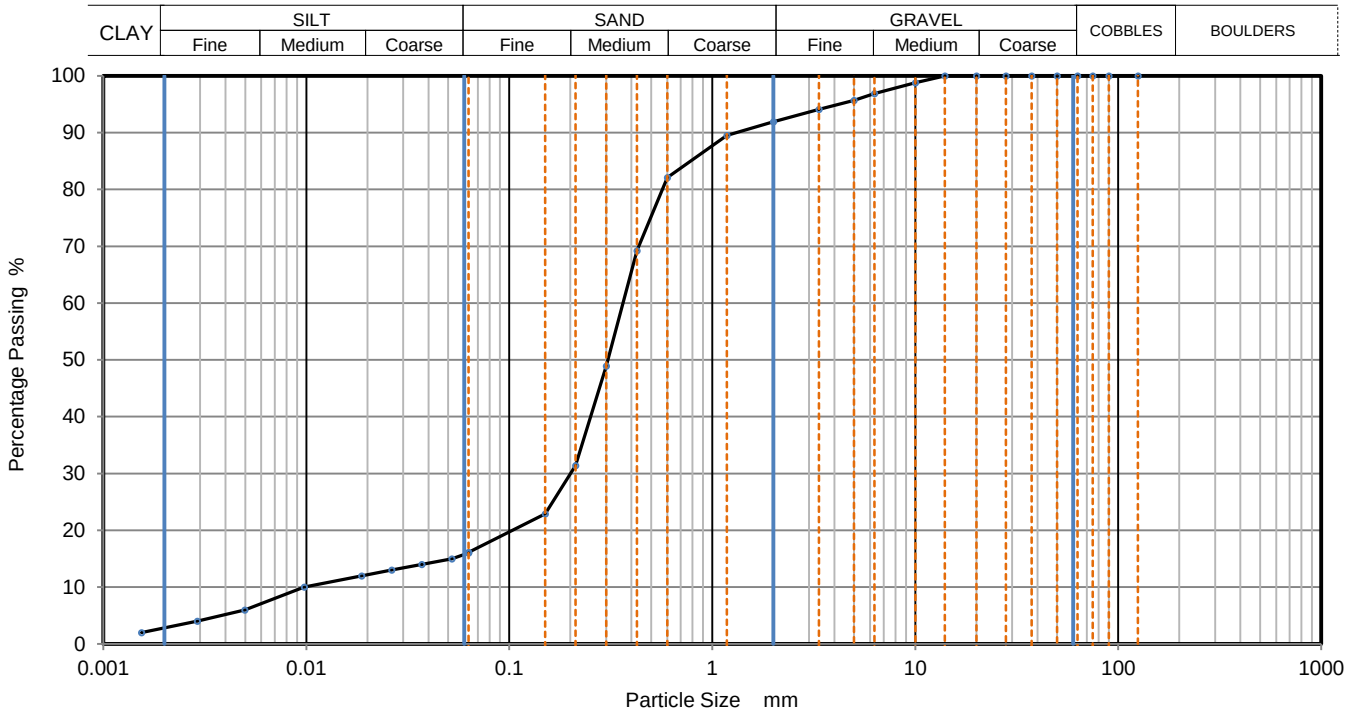
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP1_TP06
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		6
Specimen Description	Brownish grey slightly gravelly clayey fine to coarse SAND.				Sample Depth (m)	Top	1.50
						Base	
Specimen Reference	6	Specimen Depth	1.5	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID		Caus2022110825



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	16
90	100	0.05206	15
75	100	0.03703	14
63	100	0.02634	13
50	100	0.01873	12
37.5	100	0.00978	10
28	100	0.00497	6
20	100	0.00290	4
14	100	0.00154	2
10	99		
6.3	97		
5	96		
3.35	94		
2	92		
1.18	90		
0.6	82	Particle density	(assumed)
0.425	69	2.65	Mg/m3
0.3	49		
0.212	31		
0.15	23		
0.063	16		

Dry Mass of sample, g	508

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	8.1
Sand	75.8
Silt	13.1
Clay	3.0

Grading Analysis		
D100	mm	
D60	mm	0.363
D30	mm	0.201
D10	mm	0.0108
Uniformity Coefficient		33
Curvature Coefficient		10

Remarks

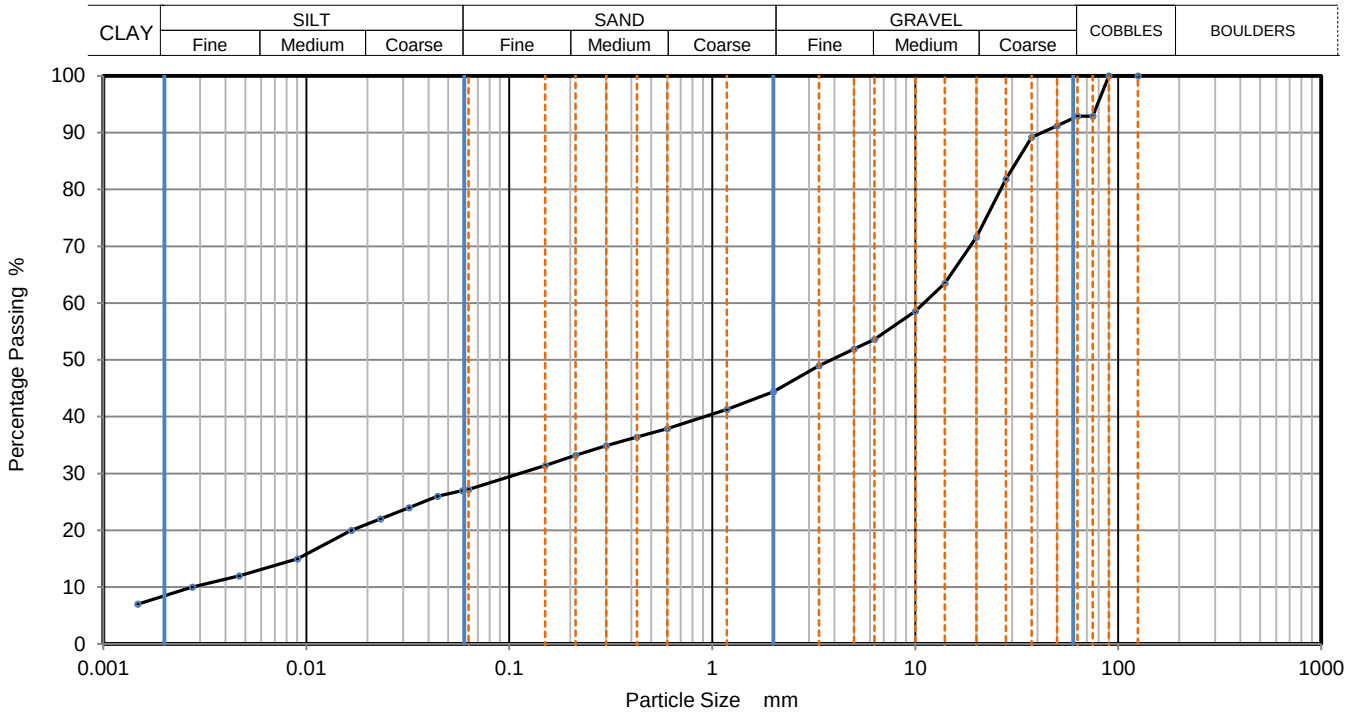
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1443E**
				Borehole/Pit No.	WP1_TP07
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.	7
Specimen Description	Brownish grey sandy gravelly silty CLAY.			Sample Depth (m) Top	2.60
				Sample Depth (m) Base	
Specimen Reference	8	Specimen Depth	2.6 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2022110831



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.05866	27
90	100	0.04435	26
75	93	0.03212	24
63	93	0.02324	22
50	91	0.01668	20
37.5	89	0.00904	15
28	82	0.00467	12
20	72	0.00274	10
14	64	0.00148	7
10	59		
6.3	54		
5	52		
3.35	49		
2	44		
1.18	41		
0.6	38	Particle density	(assumed)
0.425	36	2.65	Mg/m3
0.3	35		
0.212	33		
0.15	31		
0.063	27		

Dry Mass of sample, g	13455

Sample Proportions	% dry mass
Cobbles	7.1
Gravel	48.5
Sand	17.2
Silt	18.9
Clay	8.3

Grading Analysis		
D100	mm	
D60	mm	11
D30	mm	0.113
D10	mm	0.00291
Uniformity Coefficient		3800
Curvature Coefficient		0.4

Remarks

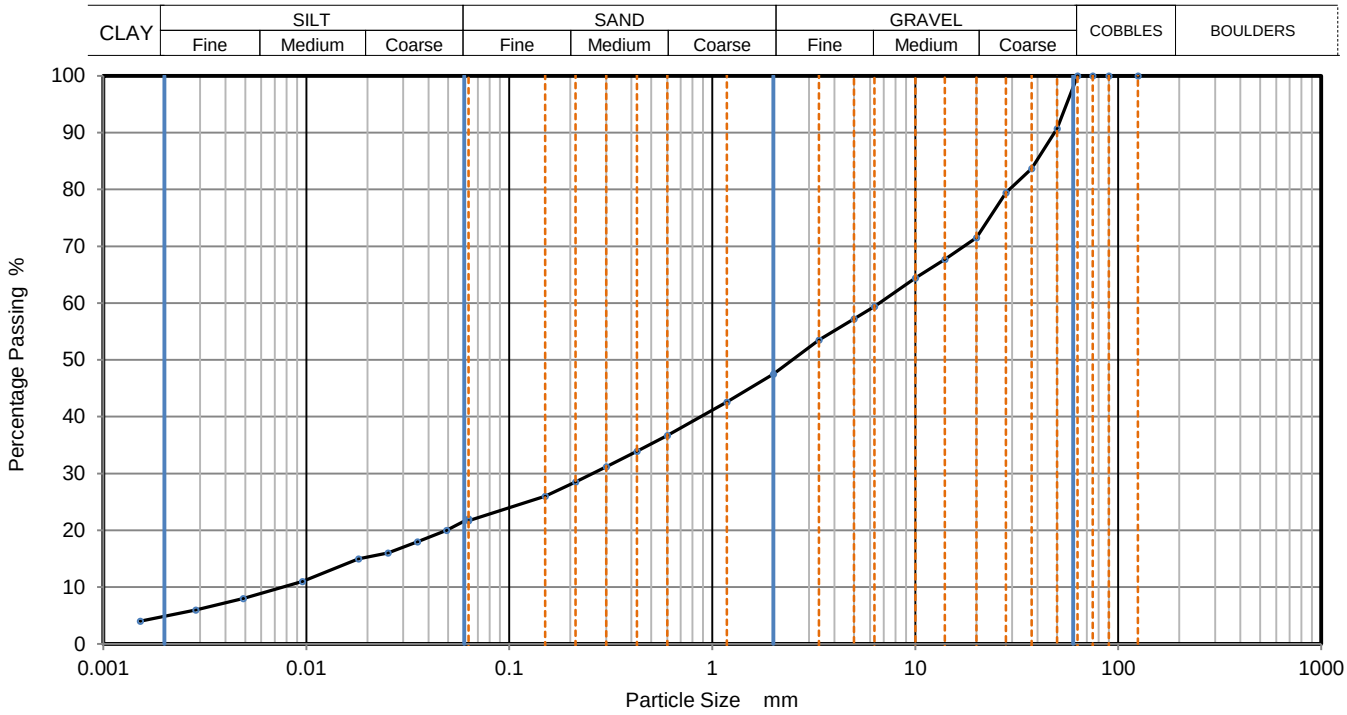
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1443E**
				Borehole/Pit No.	WP1_TP08
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.	8
Specimen Description	Brownish grey sandy gravelly silty CLAY.			Sample Depth (m) Top	3.50
				Sample Depth (m) Base	
Specimen Reference	8	Specimen Depth	3.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2022110836



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	22
90	100	0.04918	20
75	100	0.03524	18
63	100	0.02524	16
50	91	0.01807	15
37.5	84	0.00956	11
28	79	0.00489	8
20	72	0.00286	6
14	68	0.00152	4
10	64		
6.3	59		
5	57		
3.35	54		
2	48		
1.18	43		
0.6	37	Particle density	(assumed)
0.425	34	2.65	Mg/m3
0.3	31		
0.212	29		
0.15	26		
0.063	22		

Dry Mass of sample, g: 12047

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	52.5
Sand	25.8
Silt	16.6
Clay	5.1

Grading Analysis		
D100	mm	
D60	mm	6.65
D30	mm	0.258
D10	mm	0.00746
Uniformity Coefficient		890
Curvature Coefficient		1.3

Remarks

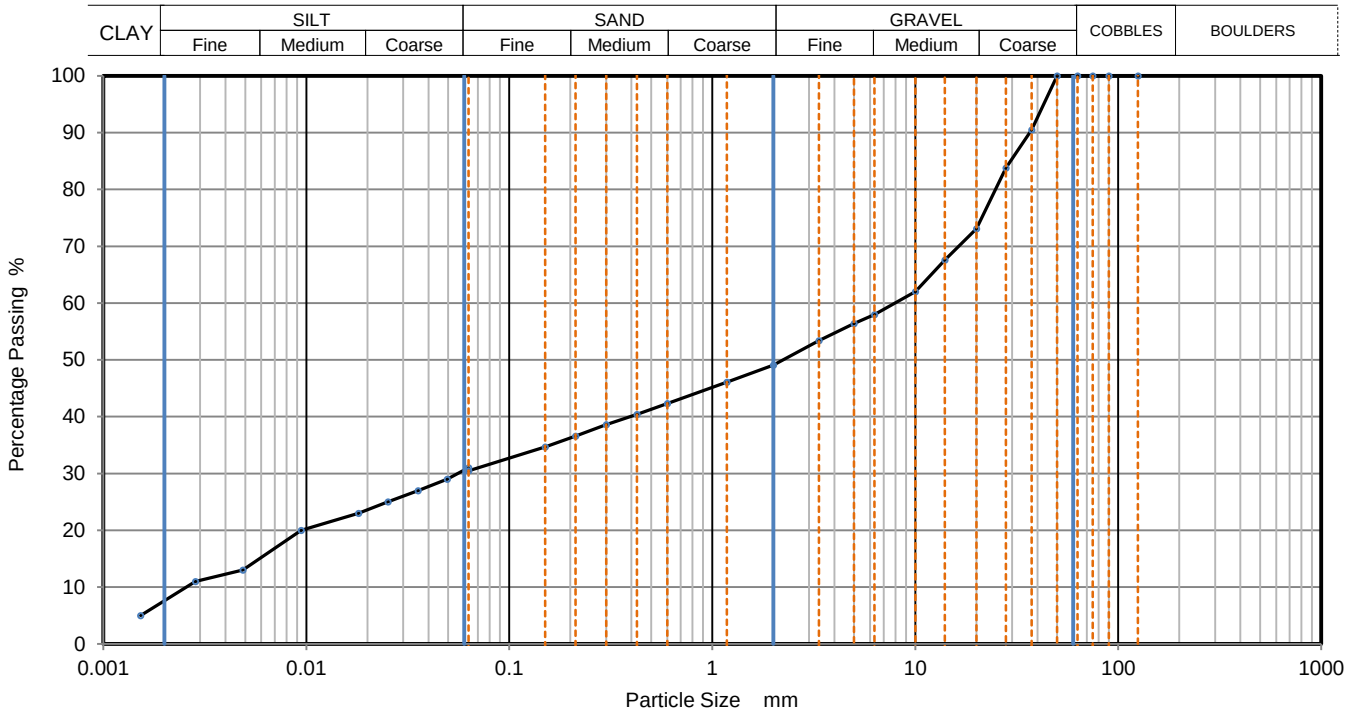
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP1_TP09
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		7
Specimen Description	Brownish grey sandy gravelly silty CLAY.			Sample Depth (m)	Top	2.40
					Base	
Specimen Reference	6	Specimen Depth	2.4 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022110840



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	31
90	100	0.04951	29
75	100	0.03547	27
63	100	0.02524	25
50	100	0.01807	23
37.5	91	0.00945	20
28	84	0.00486	13
20	73	0.00284	11
14	68	0.00153	5
10	62		
6.3	58		
5	56		
3.35	53		
2	49		
1.18	46		
0.6	42	Particle density (assumed)	
0.425	40	2.65 Mg/m3	
0.3	39		
0.212	37		
0.15	35		
0.063	31		

Dry Mass of sample, g: 3141

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	50.9
Sand	18.6
Silt	22.9
Clay	7.6

Grading Analysis		
D100	mm	
D60	mm	7.91
D30	mm	0.0572
D10	mm	0.00264
Uniformity Coefficient		3000
Curvature Coefficient		0.16

Remarks

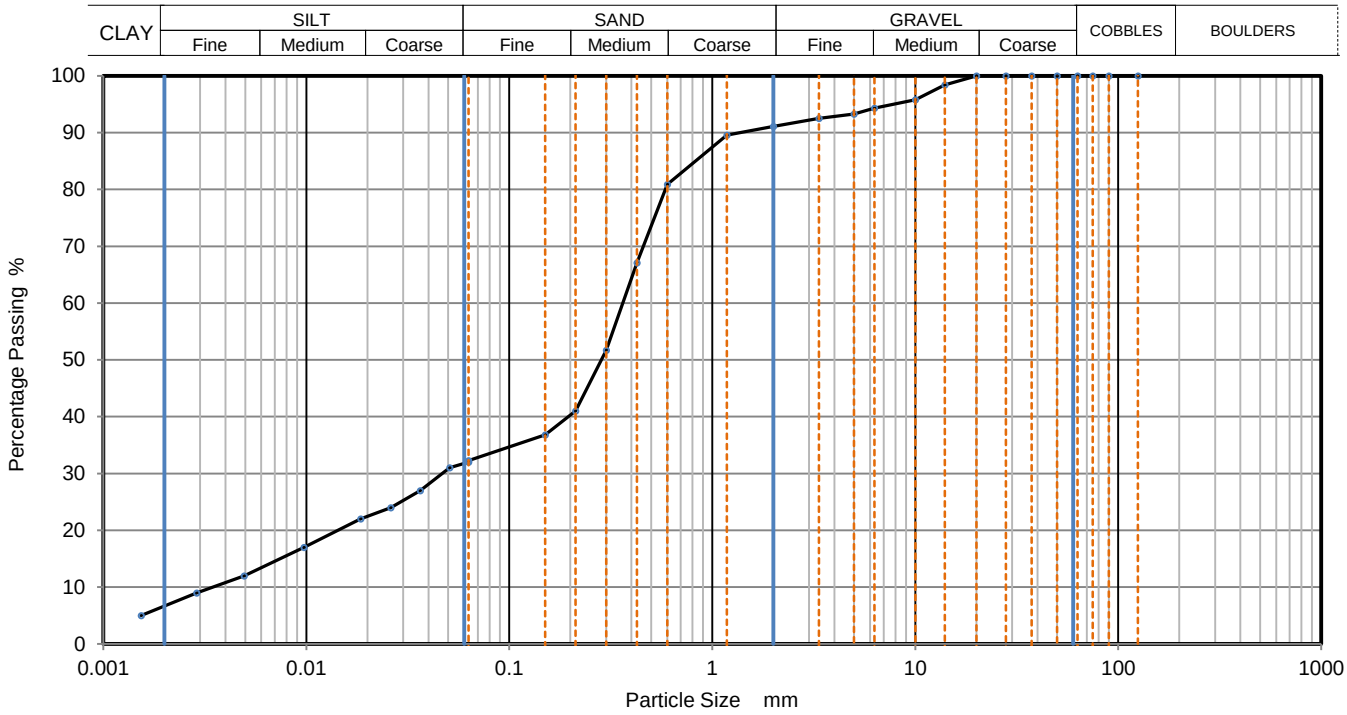
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP1_TP10
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		8
Specimen Description	Brownish grey slightly gravelly clayey fine to coarse SAND.			Sample Depth (m)	Top	3.00
					Base	
Specimen Reference	6	Specimen Depth	3 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022110845



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	32
90	100	0.05080	31
75	100	0.03637	27
63	100	0.02603	24
50	100	0.01851	22
37.5	100	0.00973	17
28	100	0.00495	12
20	100	0.00289	9
14	98	0.00154	5
10	96		
6.3	94		
5	93		
3.35	93		
2	91		
1.18	90		
0.6	81	Particle density	(assumed)
0.425	67	2.65	Mg/m3
0.3	52		
0.212	41		
0.15	37		
0.063	32		

Dry Mass of sample, g	506

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	8.9
Sand	58.8
Silt	25.8
Clay	6.5

Grading Analysis		
D100	mm	
D60	mm	0.362
D30	mm	0.0479
D10	mm	0.00366
Uniformity Coefficient		99
Curvature Coefficient		1.7

Remarks

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

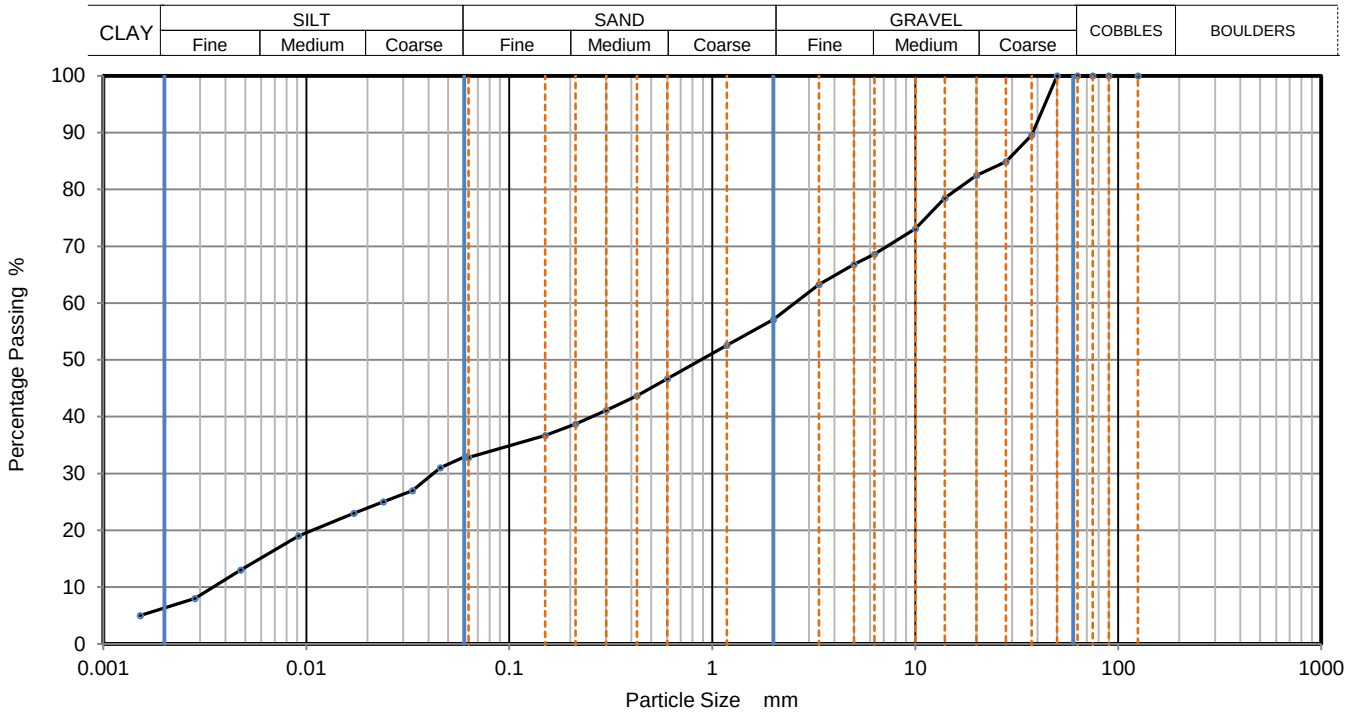
Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING

10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP1_TP11
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		3
Specimen Description	Brownish grey sandy gravelly silty CLAY.				Sample Depth (m)	Top	1.00
						Base	
Specimen Reference	6	Specimen Depth	1	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID		Caus2022110848



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06062	33
90	100	0.04578	31
75	100	0.03336	27
63	100	0.02393	25
50	100	0.01716	23
37.5	90	0.00916	19
28	85	0.00475	13
20	83	0.00282	8
14	79	0.00152	5
10	73		
6.3	69		
5	67		
3.35	63		
2	57		
1.18	53		
0.6	47	Particle density (assumed)	
0.425	44	2.65 Mg/m3	
0.3	41		
0.212	39		
0.15	37		
0.063	33		

Dry Mass of sample, g	3335

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	42.9
Sand	24.3
Silt	26.5
Clay	6.3

Grading Analysis		
D100	mm	
D60	mm	2.55
D30	mm	0.0423
D10	mm	0.00336
Uniformity Coefficient		760
Curvature Coefficient		0.21

Remarks

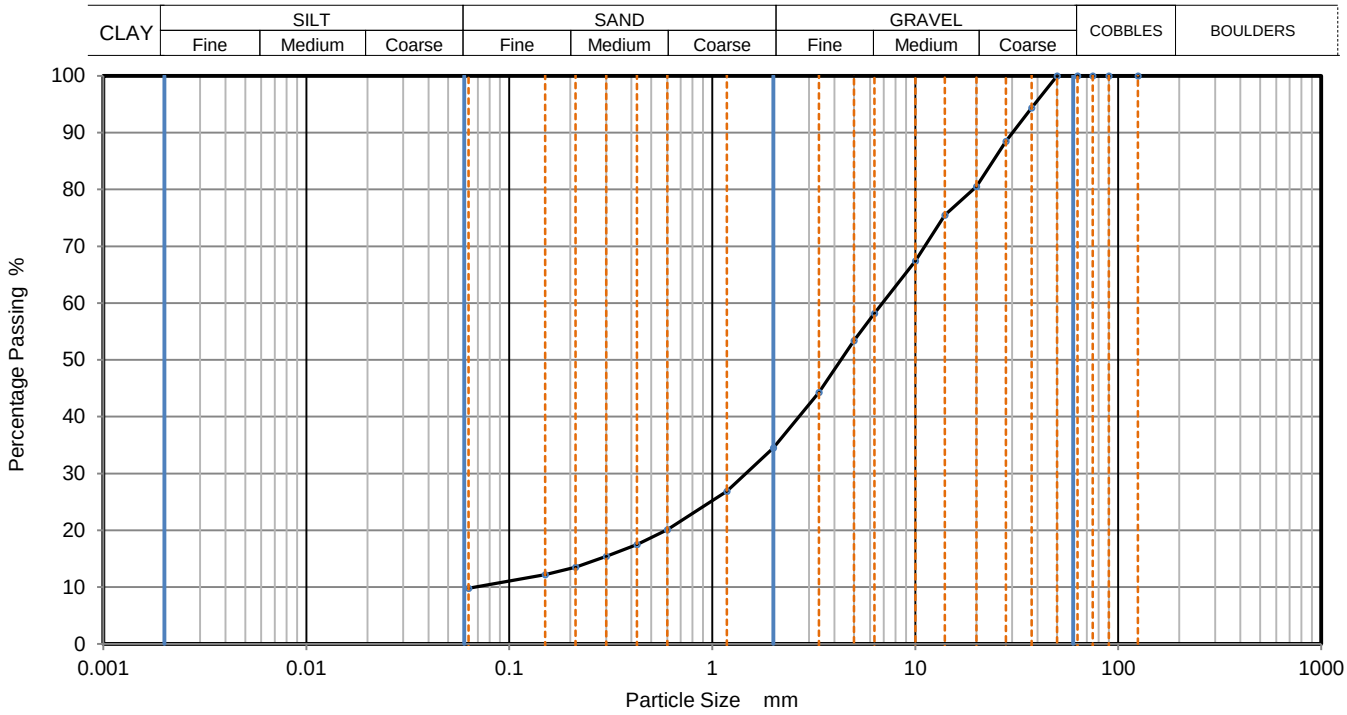
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP1_TP12
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		7
Specimen Description	Brownish grey gravelly slightly clayey fine to coarse SAND.				Sample Depth (m)	Top	3.20
						Base	
Specimen Reference	6	Specimen Depth	3.2	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clause 9.2				KeyLAB ID		Caus2022110855



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	94		
28	89		
20	81		
14	76		
10	67		
6.3	58		
5	53		
3.35	44		
2	35		
1.18	27		
0.6	20		
0.425	18		
0.3	15		
0.212	14		
0.15	12		
0.063	10		

Dry Mass of sample, g	6738

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	65.5
Sand	24.7
Fines <0.063mm	10.0

Grading Analysis		
D100	mm	
D60	mm	6.91
D30	mm	1.46
D10	mm	0.067
Uniformity Coefficient		100
Curvature Coefficient		4.6

Remarks

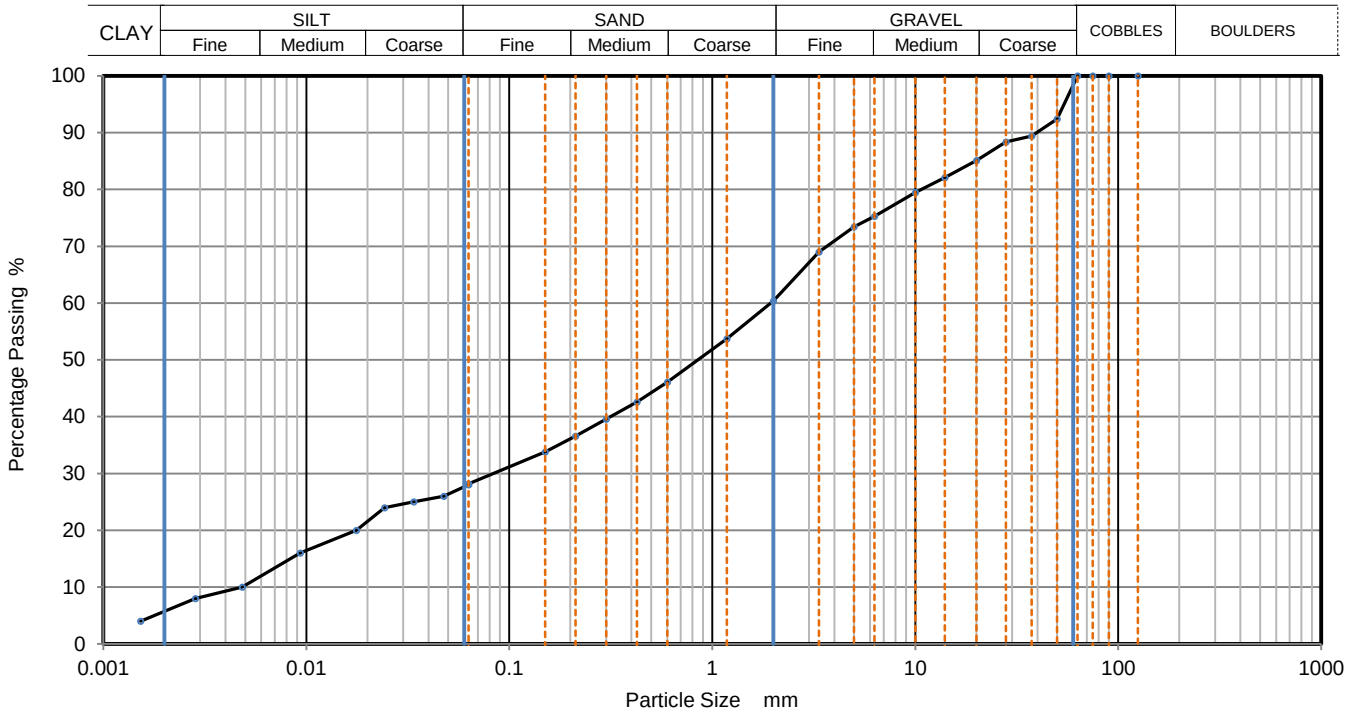
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP1_TP13
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		1
Specimen Description	Brownish grey sandy gravelly silty CLAY.				Sample Depth (m)	Top	0.50
						Base	
Specimen Reference	6	Specimen Depth	0.5	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID		Caus2022110857



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06298	28
90	100	0.04751	26
75	100	0.03384	25
63	100	0.02426	24
50	92	0.01762	20
37.5	89	0.00933	16
28	88	0.00484	10
20	85	0.00284	8
14	82	0.00153	4
10	80		
6.3	75		
5	73		
3.35	69		
2	60		
1.18	54		
0.6	46	Particle density	(assumed)
0.425	43	2.65	Mg/m3
0.3	40		
0.212	37		
0.15	34		
0.063	28		

Dry Mass of sample, g	2881

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	39.6
Sand	32.2
Silt	22.8
Clay	5.4

Grading Analysis		
D100	mm	
D60	mm	1.94
D30	mm	0.0838
D10	mm	0.00454
Uniformity Coefficient		430
Curvature Coefficient		0.8

Remarks

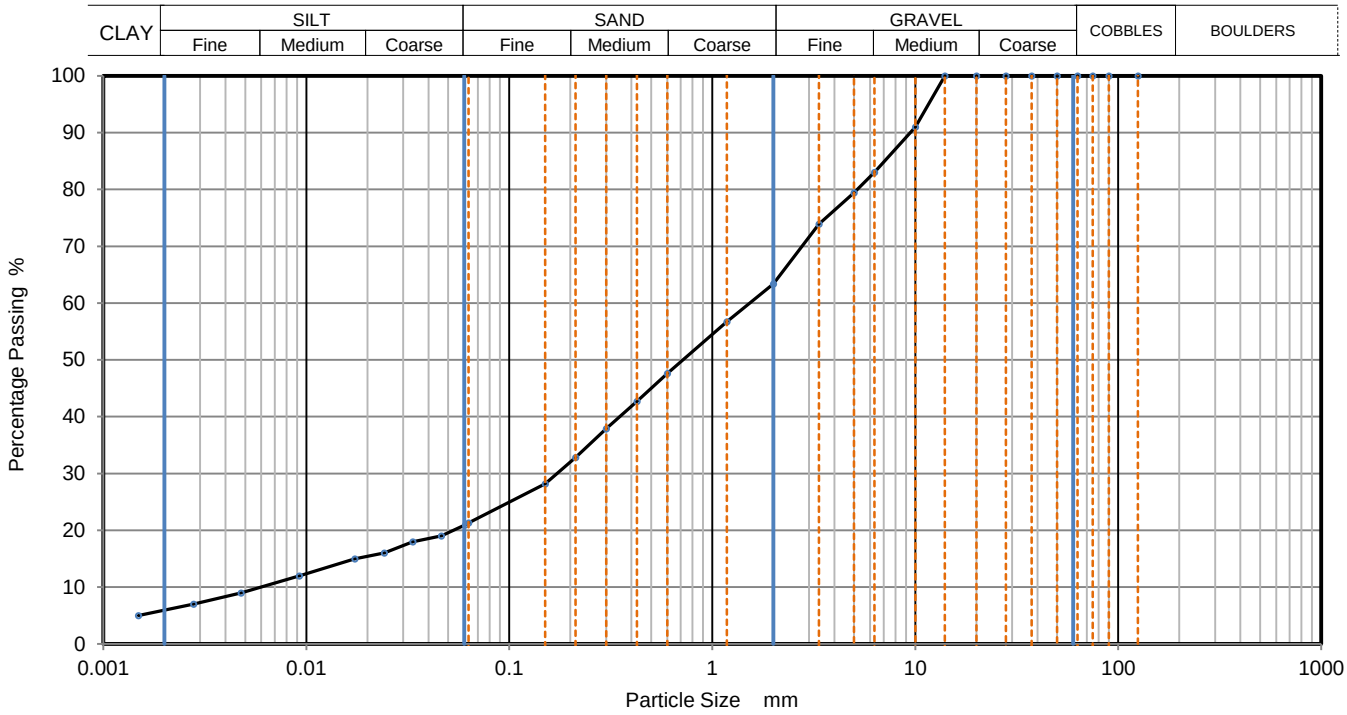
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

LAB 05R - Version 6

UKAS TESTING 10122

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION			Job Ref		21-1443E
				Borehole/Pit No.		WP2_TP01
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.		7
Specimen Description	Brownish grey slightly gravelly silty fine to coarse SAND.			Sample Depth (m)	Top	2.50
					Base	
Specimen Reference	6	Specimen Depth	2.5 m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID		Caus2022110863



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06086	21
90	100	0.04631	19
75	100	0.03348	18
63	100	0.02418	16
50	100	0.01733	15
37.5	100	0.00925	12
28	100	0.00477	9
20	100	0.00278	7
14	100	0.00149	5
10	91		
6.3	83		
5	79		
3.35	74		
2	63		
1.18	57		
0.6	48	Particle density	(assumed)
0.425	43	2.65	Mg/m3
0.3	38		
0.212	33		
0.15	28		
0.063	21		

Dry Mass of sample, g	503

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	36.6
Sand	42.2
Silt	14.9
Clay	6.3

Grading Analysis		
D100	mm	
D60	mm	1.53
D30	mm	0.172
D10	mm	0.00658
Uniformity Coefficient		230
Curvature Coefficient		2.9

Remarks

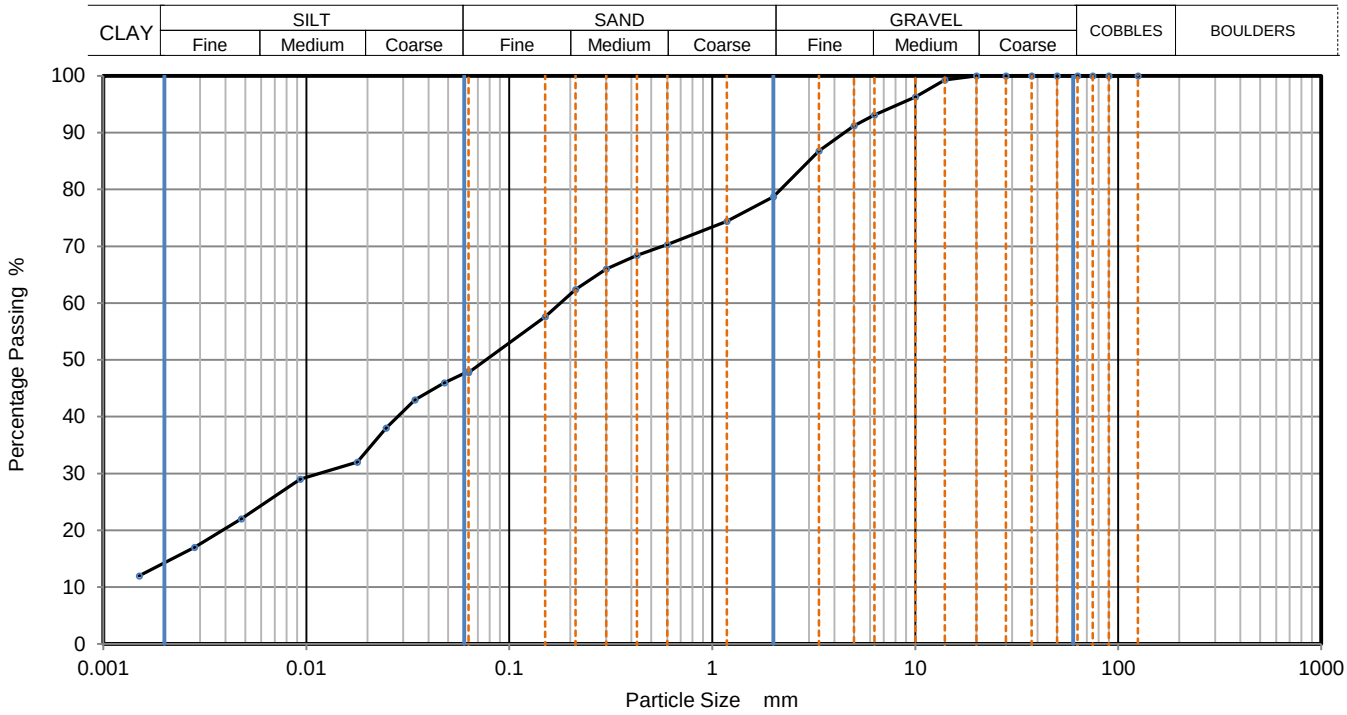
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

Approved
Stephen Watson

UKAS TESTING 10122

LAB 05R - Version 6

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP2_TP03
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		7
Specimen Description	Brownish grey sandy slightly gravelly silty CLAY.				Sample Depth (m)	Top	2.30
						Base	
Specimen Reference	6	Specimen Depth	2.3	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID		Caus2022110868



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	48
90	100	0.04785	46
75	100	0.03431	43
63	100	0.02476	38
50	100	0.01785	32
37.5	100	0.00933	29
28	100	0.00478	22
20	100	0.00281	17
14	99	0.00150	12
10	96		
6.3	93		
5	91		
3.35	87		
2	79		
1.18	74		
0.6	70	Particle density	(assumed)
0.425	68	2.65	Mg/m3
0.3	66		
0.212	62		
0.15	58		
0.063	48		

Dry Mass of sample, g	503

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	21.3
Sand	30.9
Silt	33.5
Clay	14.3

Grading Analysis		
D100	mm	
D60	mm	0.178
D30	mm	0.0112
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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

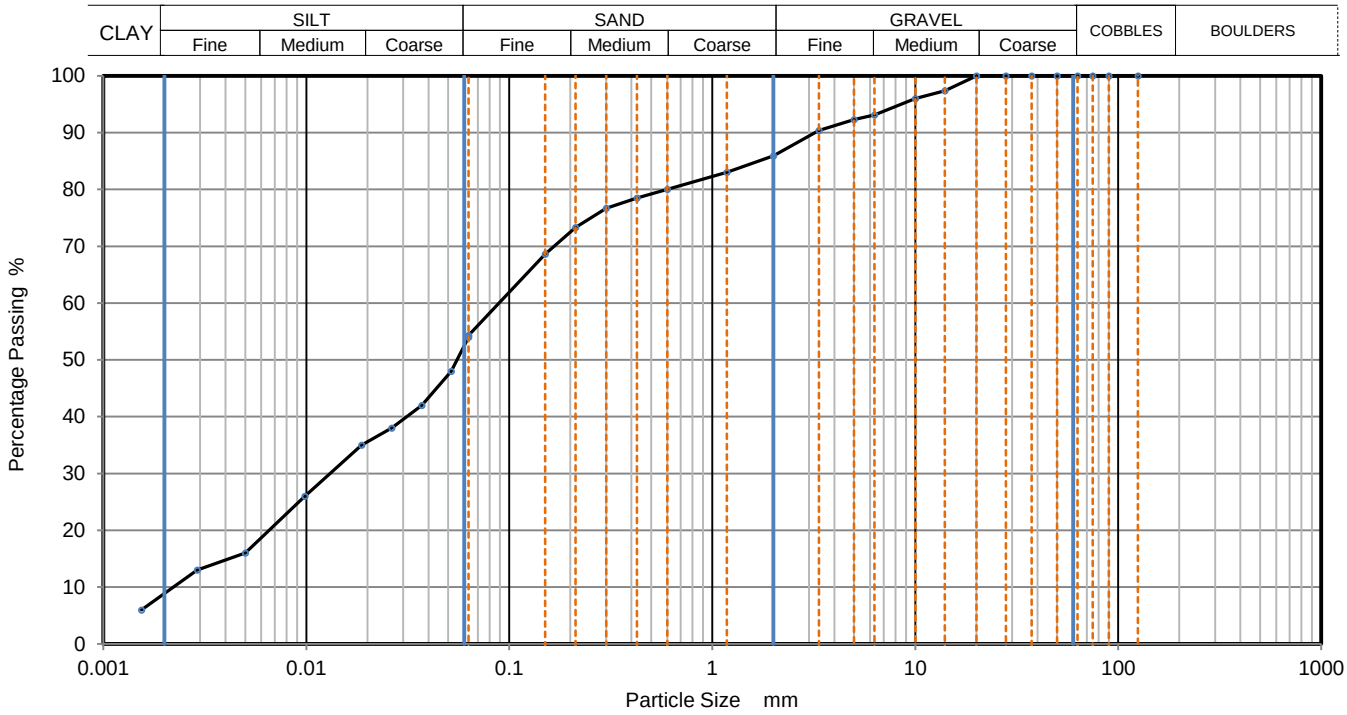
Approved
Stephen Watson

UKAS TESTING

10122

LAB 05R - Version 6

CAUSEWAY GEOTECH	PARTICLE SIZE DISTRIBUTION				Job Ref		21-1443E
					Borehole/Pit No.		WP2_TP04
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations				Sample No.		8
Specimen Description	Brownish grey sandy slightly gravelly silty CLAY.				Sample Depth (m)	Top	3.20
						Base	
Specimen Reference	6	Specimen Depth	3.2	m	Sample Type		B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID		Caus2022110874



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	54
90	100	0.05175	48
75	100	0.03703	42
63	100	0.02634	38
50	100	0.01873	35
37.5	100	0.00984	26
28	100	0.00500	16
20	100	0.00290	13
14	97	0.00154	6
10	96		
6.3	93		
5	92		
3.35	90		
2	86		
1.18	83		
0.6	80	Particle density	(assumed)
0.425	79	2.65	Mg/m3
0.3	77		
0.212	73		
0.15	69		
0.063	54		

Dry Mass of sample, g	512

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	14.1
Sand	31.6
Silt	45.3
Clay	9.0

Grading Analysis		
D100	mm	
D60	mm	0.089
D30	mm	0.0133
D10	mm	0.00221
Uniformity Coefficient		40
Curvature Coefficient		0.9

Remarks

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

Approved
Stephen Watson

UKAS TESTING 10122

LAB 05R - Version 6

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921879

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP02 0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP02 0.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.263**
Thermal Resistivity	°C●Cm/W	**44.2**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**15**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921880

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP02 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP02 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.39**
Thermal Resistivity	°C●Cm/W	**41.84**
Thermal Resistivity	°C●m/W	**0.42**
Moisture Content of Test Specimen	%	**17**
Dry Density of Test Specimen	Mg/m^3	**1.75**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921881

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP02 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP02 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.289**
Thermal Resistivity	°C●Cm/W	**43.68**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**16**
Dry Density of Test Specimen	Mg/m^3	**1.78**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921882

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP03 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP03 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.81**
Thermal Resistivity	°C●Cm/W	**55.25**
Thermal Resistivity	°C●m/W	**0.55**
Moisture Content of Test Specimen	%	**15**
Dry Density of Test Specimen	Mg/m^3	**1.84**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921883

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP03 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP03 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.944**
Thermal Resistivity	°C●Cm/W	**51.43**
Thermal Resistivity	°C●m/W	**0.51**
Moisture Content of Test Specimen	%	**15**
Dry Density of Test Specimen	Mg/m^3	**1.83**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921884

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP07 0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP07 0.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.431**
Thermal Resistivity	°C●Cm/W	**41.14**
Thermal Resistivity	°C●m/W	**0.41**
Moisture Content of Test Specimen	%	**16**
Dry Density of Test Specimen	Mg/m^3	**1.8**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921886

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP07 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP07 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.823**
Thermal Resistivity	°C●Cm/W	**54.86**
Thermal Resistivity	°C●m/W	**0.55**
Moisture Content of Test Specimen	%	**17**
Dry Density of Test Specimen	Mg/m^3	**1.8**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921888

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP08 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP08 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.91**
Thermal Resistivity	°C●Cm/W	**52.34**
Thermal Resistivity	°C●m/W	**0.52**
Moisture Content of Test Specimen	%	**14**
Dry Density of Test Specimen	Mg/m^3	**1.78**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921889

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP08 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP08 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.939**
Thermal Resistivity	°C●Cm/W	**51.57**
Thermal Resistivity	°C●m/W	**0.52**
Moisture Content of Test Specimen	%	**13**
Dry Density of Test Specimen	Mg/m^3	**1.85**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

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8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921890

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP09 0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP09 0.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.272**
Thermal Resistivity	°C●Cm/W	**44.02**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**15**
Dry Density of Test Specimen	Mg/m^3	**1.88**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921891

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP09 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP09 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.96**
Thermal Resistivity	°C●Cm/W	**51.03**
Thermal Resistivity	°C●m/W	**0.51**
Moisture Content of Test Specimen	%	**14**
Dry Density of Test Specimen	Mg/m^3	**1.83**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921892

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP09 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP09 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.152**
Thermal Resistivity	°C●Cm/W	**46.46**
Thermal Resistivity	°C●m/W	**0.46**
Moisture Content of Test Specimen	%	**13**
Dry Density of Test Specimen	Mg/m^3	**1.9**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921893

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP10 0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP10 0.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.062**
Thermal Resistivity	°C●Cm/W	**48.5**
Thermal Resistivity	°C●m/W	**0.49**
Moisture Content of Test Specimen	%	**18**
Dry Density of Test Specimen	Mg/m^3	**1.77**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921894

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP1 TP10 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP1 TP10 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.019**
Thermal Resistivity	°C●Cm/W	**49.53**
Thermal Resistivity	°C●m/W	**0.5**
Moisture Content of Test Specimen	%	**16**
Dry Density of Test Specimen	Mg/m^3	**1.82**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921928

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP1 0.5**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP1 0.5**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.837**
Thermal Resistivity	°C●Cm/W	**54.43**
Thermal Resistivity	°C●m/W	**0.54**
Moisture Content of Test Specimen	%	**20**
Dry Density of Test Specimen	Mg/m^3	**1.68**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921929

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP1 0.5**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP1 0.5**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.183**
Thermal Resistivity	°C●Cm/W	**45.81**
Thermal Resistivity	°C●m/W	**0.46**
Moisture Content of Test Specimen	%	**17**
Dry Density of Test Specimen	Mg/m^3	**1.68**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921930

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP1 0.5**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP1 0.5**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.133**
Thermal Resistivity	°C●Cm/W	**46.88**
Thermal Resistivity	°C●m/W	**0.47**
Moisture Content of Test Specimen	%	**14**
Dry Density of Test Specimen	Mg/m^3	**1.68**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921931

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP1 0.5**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP1 0.5**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.075**
Thermal Resistivity	°C●Cm/W	**48.19**
Thermal Resistivity	°C●m/W	**0.48**
Moisture Content of Test Specimen	%	**11**
Dry Density of Test Specimen	Mg/m^3	**1.68**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921932

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP1 0.5**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP1 0.5**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**0.92**
Thermal Resistivity	°C●Cm/W	**108.7**
Thermal Resistivity	°C●m/W	**1.09**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.68**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921933

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP1 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**07/12/2022**
Sampling Location:	**WP2 TP1 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.617**
Thermal Resistivity	°C●Cm/W	**61.83**
Thermal Resistivity	°C●m/W	**0.62**
Moisture Content of Test Specimen	%	**17.3**
Dry Density of Test Specimen	Mg/m^3	**1.65**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921934

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP1 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP1 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.753**
Thermal Resistivity	°C●Cm/W	**57.05**
Thermal Resistivity	°C●m/W	**0.57**
Moisture Content of Test Specimen	%	**14.3**
Dry Density of Test Specimen	Mg/m^3	**1.65**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921935

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP1 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP1 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.884**
Thermal Resistivity	°C●Cm/W	**53.09**
Thermal Resistivity	°C●m/W	**0.53**
Moisture Content of Test Specimen	%	**11.3**
Dry Density of Test Specimen	Mg/m^3	**1.65**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921936

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP1 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP1 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.686**
Thermal Resistivity	°C●Cm/W	**59.31**
Thermal Resistivity	°C●m/W	**0.59**
Moisture Content of Test Specimen	%	**8.3**
Dry Density of Test Specimen	Mg/m^3	**1.65**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921937

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP1 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP1 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**0.6**
Thermal Resistivity	°C●Cm/W	**166.7**
Thermal Resistivity	°C●m/W	**1.67**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.65**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921938

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP2 TP3 0.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.994**
Thermal Resistivity	°C●Cm/W	**50.16**
Thermal Resistivity	°C●m/W	**0.5**
Moisture Content of Test Specimen	%	**19**
Dry Density of Test Specimen	Mg/m^3	**1.71**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Conten

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
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County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921940

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP3 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.435**
Thermal Resistivity	°C●Cm/W	**41.06**
Thermal Resistivity	°C●m/W	**0.41**
Moisture Content of Test Specimen	%	**13.3**
Dry Density of Test Specimen	Mg/m^3	**1.96**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
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County Antrim
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Date: 20 December 2022
Test Report Ref: TR 921941

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP3 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.741**
Thermal Resistivity	°C●Cm/W	**36.48**
Thermal Resistivity	°C●m/W	**0.36**
Moisture Content of Test Specimen	%	**10.3**
Dry Density of Test Specimen	Mg/m^3	**1.96**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921942

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP3 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.482**
Thermal Resistivity	°C●Cm/W	**40.3**
Thermal Resistivity	°C●m/W	**0.4**
Moisture Content of Test Specimen	%	**7.3**
Dry Density of Test Specimen	Mg/m^3	**1.96**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921943

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP3 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.14**
Thermal Resistivity	°C●Cm/W	**46.72**
Thermal Resistivity	°C●m/W	**0.47**
Moisture Content of Test Specimen	%	**4.3**
Dry Density of Test Specimen	Mg/m^3	**1.96**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921944

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP3 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.237**
Thermal Resistivity	°C●Cm/W	**80.81**
Thermal Resistivity	°C●m/W	**0.81**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.96**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921945

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP3 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.221**
Thermal Resistivity	°C●Cm/W	**45.03**
Thermal Resistivity	°C●m/W	**0.45**
Moisture Content of Test Specimen	%	**12.2**
Dry Density of Test Specimen	Mg/m^3	**1.89**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

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8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921946

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP3 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.448**
Thermal Resistivity	°C●Cm/W	**40.85**
Thermal Resistivity	°C●m/W	**0.41**
Moisture Content of Test Specimen	%	**9.2**
Dry Density of Test Specimen	Mg/m^3	**1.89**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921947

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP3 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.293**
Thermal Resistivity	°C●Cm/W	**43.61**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**6.2**
Dry Density of Test Specimen	Mg/m^3	**1.89**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921948

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP3 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.113**
Thermal Resistivity	°C●Cm/W	**47.33**
Thermal Resistivity	°C●m/W	**0.47**
Moisture Content of Test Specimen	%	**3.2**
Dry Density of Test Specimen	Mg/m^3	**1.89**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
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County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921949

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP3 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP3 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**0.966**
Thermal Resistivity	°C●Cm/W	**103.5**
Thermal Resistivity	°C●m/W	**1.04**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.89**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921950

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP4 0.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP2 TP4 0.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.04**
Thermal Resistivity	°C●Cm/W	**49.01**
Thermal Resistivity	°C●m/W	**0.49**
Moisture Content of Test Specimen	%	**13**
Dry Density of Test Specimen	Mg/m^3	**1.92**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Conten

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 20 December 2022
Test Report Ref: TR 921951

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP4 1M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**15/12/2022**
Sampling Location:	**WP2 TP4 1M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**VY**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.279**
Thermal Resistivity	°C●Cm/W	**43.88**
Thermal Resistivity	°C●m/W	**0.44**
Moisture Content of Test Specimen	%	**13**
Dry Density of Test Specimen	Mg/m^3	**1.94**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Optimum Moisture Content

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921952

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP4 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP4 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.514**
Thermal Resistivity	°C●Cm/W	**39.78**
Thermal Resistivity	°C●m/W	**0.4**
Moisture Content of Test Specimen	%	**12.2**
Dry Density of Test Specimen	Mg/m^3	**1.99**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921953

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP4 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**13/12/2022**
Sampling Location:	**WP2 TP4 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.587**
Thermal Resistivity	°C●Cm/W	**38.65**
Thermal Resistivity	°C●m/W	**0.39**
Moisture Content of Test Specimen	%	**9.2**
Dry Density of Test Specimen	Mg/m^3	**1.99**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921954

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP4 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**13/12/2022**
Sampling Location:	**WP2 TP4 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.521**
Thermal Resistivity	°C●Cm/W	**39.66**
Thermal Resistivity	°C●m/W	**0.4**
Moisture Content of Test Specimen	%	**6.2**
Dry Density of Test Specimen	Mg/m^3	**1.99**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921955

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP4 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP4 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**2.569**
Thermal Resistivity	°C●Cm/W	**38.73**
Thermal Resistivity	°C●m/W	**0.4**
Moisture Content of Test Specimen	%	**3.2**
Dry Density of Test Specimen	Mg/m^3	**1.99**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

Causeway Geotech
8 Drumahiskey Rd
Ballymoney
County Antrim
BT53 7QL

Date: 19 December 2022
Test Report Ref: TR 921956

Contract: Dublin Array - 21-1443E

LABORATORY TEST REPORT

TEST REQUIREMENTS: Determination of Thermal Conductivity / Resistivity by Thermal Needle Probe tested in accordance with **ASTM D5334-14**

SAMPLE DETAILS:

Certificate of sampling received:	**No**
Laboratory Ref. No:	**S106738**
Client Ref. No:	**WP2 TP4 1.5M**
Date and Time of Sampling:	**Unknown**
Date of Receipt at Lab:	**14/11/2022**
Date of Start of Test:	**14/12/2022**
Sampling Location:	**WP2 TP4 1.5M**
Name of Source:	**Site Won**
Method of Sampling:	**Unknown**
Sampled By:	**Client (Test results apply to sample as received)**
Tested By:	**SR**
Material Description:	**Red/Brown Clay**
Target Specification:	**ENA Technical Specification 97-1: Selected Sand Backfill: ≤2.70°C●m/W**

RESULTS:

Test	Units	Result
Thermal Conductivity	W/m●K	**1.326**
Thermal Resistivity	°C●Cm/W	**75.44**
Thermal Resistivity	°C●m/W	**0.75**
Moisture Content of Test Specimen	%	**0**
Dry Density of Test Specimen	Mg/m^3	**1.99**
Method of Compaction		**2.5Kg Rammer**
Compacted at		Natural moisture

These results relate only to the items tested.

Comments:
None

Report checked and approved by:

Chantelle Kopec-Williams
Job Coordinator

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Company Number: 633786

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SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

7 February 2023

Project Name:	Dublin Array Wind Park - Stage 1 Onshore Site Investigations
Project No.:	21-1443E
Client:	Dublin Array Offshore Windfarm
Engineer:	Gavin & Doherty Geosolutions (GDG)

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 25/01/2023 and 07/02/2023.

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: Dublin Array Wind Park - Stage 1 Onshore Site Investigations

Report Reference: Additional Testing

The table below details the tests carried out, the specifications used, and the number of tests included in this report. The results contained in this report relate to the sample(s) as received.

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. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	6
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	1
SOIL	Bulk and dry density by Linear Measurement Method	BS 1377-2: 1990: Cl 7.2	6
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	1
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	1

Summary of Classification Test Results

Project No.	Project Name
21-1443E	Dublin Array Wind Park - Stage 1 Onshore Site Investigations

Hole No.	Sample				Specimen Description	Density bulk Mg/m3	Density dry Mg/m3	w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type										
WP2_BH03	10	3.00	3.45	D	Brown slightly sandy silty CLAY.	2.05	1.82	13						
WP2_BH03	59	8.10		D	Brown slightly sandy silty CLAY.	2.25	1.99	13						
WP2_BH03	51	27.50	28.00	B	Greyish brown slightly sandy slightly gravelly silty CLAY.	2.14	1.96	9.3						
WP2_BH04	3	4.50	4.95	D	Brown slightly sandy silty CLAY.	2.30	2.00	15	93	27 -1pt	13	14		CL
WP2_BH04	5	7.50	7.85	D	Brown slightly sandy slightly gravelly silty CLAY.	2.11	1.94	9						
WP2_BH04	24	11.50	11.95	B	Brown sandy slightly gravelly silty CLAY.	2.05	1.91	7.5						

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

02/07/2023 00:00

Approved By

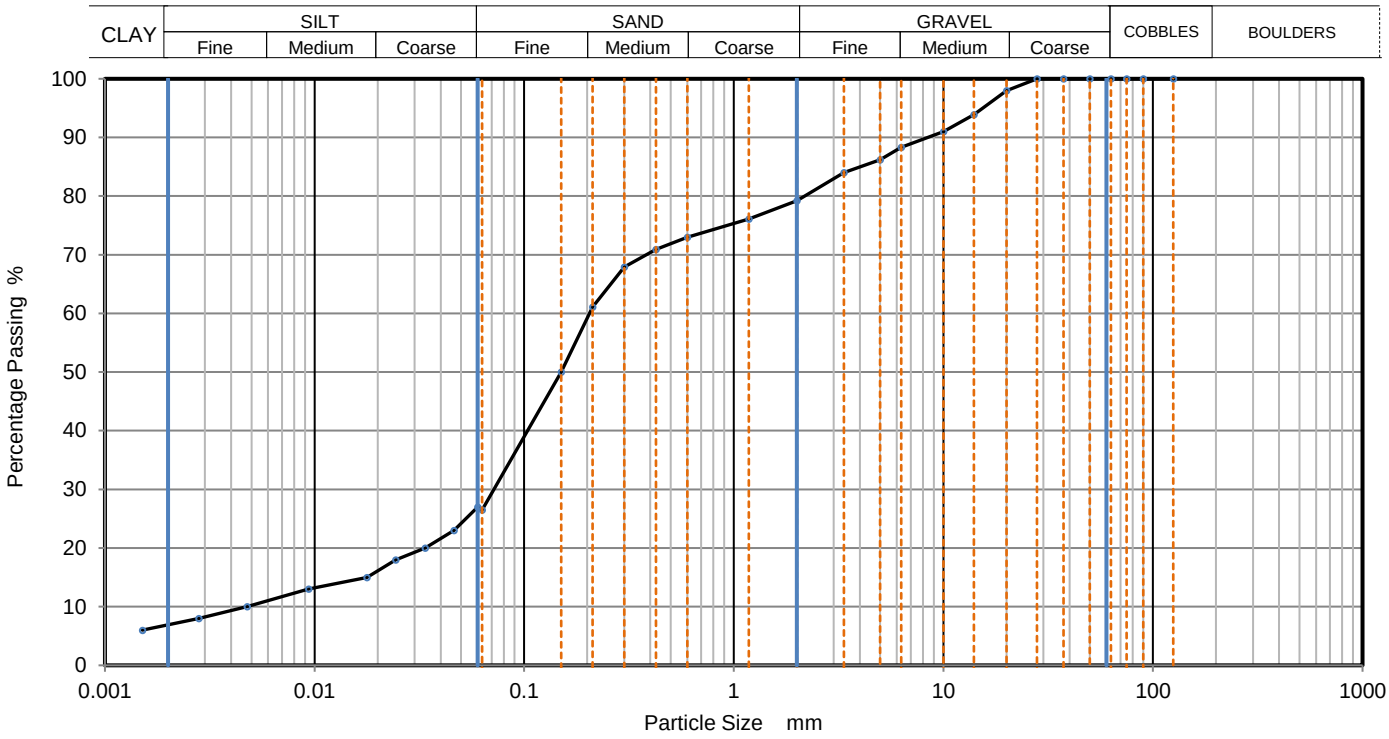
Stephen Watson

UKAS TESTING

10122

PARTICLE SIZE DISTRIBUTION

Job Ref					21-1443E
Borehole/Pit No.					WP2_BH03
Site Name	Dublin Array Wind Park - Stage 1 Onshore Site Investigations			Sample No.	18
Specimen Description	Greyish brown slightly gravelly clayey fine to coarse SAND.			Sample Depth (m) Top	13.50
				Base	15.00
Specimen Reference	4	Specimen Depth	13.5 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2022093072



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.05991	27
90	100	0.04632	23
75	100	0.03373	20
63	100	0.02435	18
50	100	0.01780	15
37.5	100	0.00936	13
28	100	0.00477	10
20	98	0.00280	8
14	94	0.00151	6
10	91		
6.3	88		
5	86		
3.35	84		
2	79		
1.18	76		
0.6	73	Particle density	(assumed)
0.425	71	2.65	Mg/m3
0.3	68		
0.212	61		
0.15	50		
0.063	27		

Dry Mass of sample, g: 1030

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	20.8
Sand	52.8
Silt	19.5
Clay	6.9

Grading Analysis		
D100	mm	
D60	mm	0.205
D30	mm	0.0718
D10	mm	0.00424
Uniformity Coefficient		48
Curvature Coefficient		5.9

Remarks

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

Approved
Stephen Watson

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

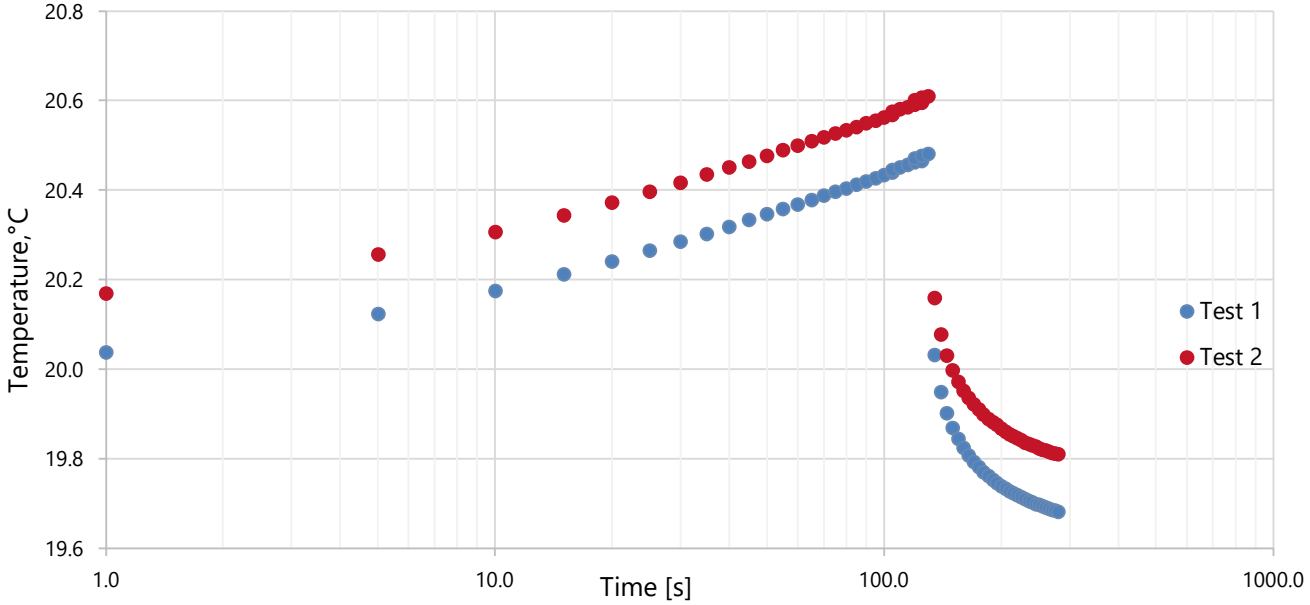
Test Identification			
Borehole	WP2_BH03	Sample Depth [m]	5.00
Sample	25	Test Depth [m]	5.00

Visual Description
Firm, dark greyish brown, sandy, gravelly CLAY. Gravel is subangular to subrounded, fine to medium of various lithologies

Specimen Conditions			
Sample condition	Intact	Water content [%]	12.2
Wet mass [g]	3381.6	Dry density [Mg/m^3]	1.76
Diameter [mm]	107.4	Bulk density [Mg/m^3]	1.97
Length [mm]	188.9	Target density [Mg/m^3]	NA

Test Conditions			
Room Temperature [°C]	19.5	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	2.09	2.10
Sample Temperature [°C]	19.58	19.72
Error	0.001	0.002
Power [W/m]	3.46	3.46



FUGRO

DUBLIN ARRAY WP

230054

Colour Chart #14

Blue Cyan Green Yellow Red Magenta White 3/Color Black

WP2_BH03 03.03.23

5.00–5.50

TOP

10 20 30 40 50 60 70 80 90 cm

LAB

21.1443E
DALP
WP2.BH03
5.00-5.50
25

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

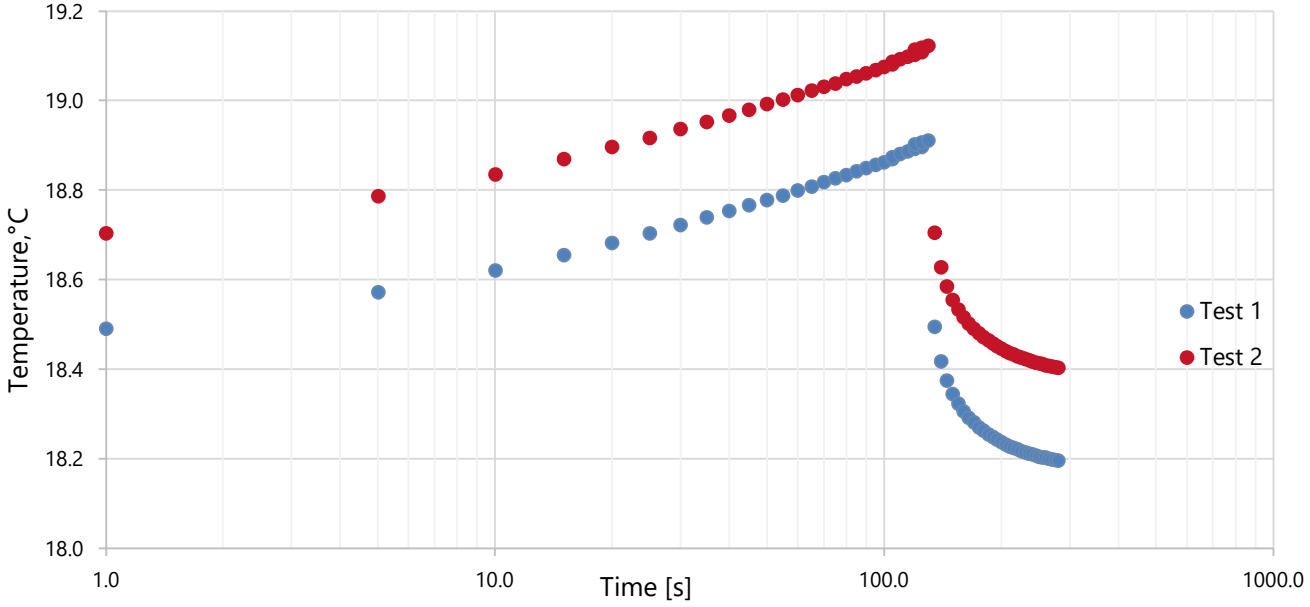
Test Identification			
Borehole	WP2_BH03	Sample Depth [m]	11.00
Sample	31	Test Depth [m]	11.00

Visual Description
Stiff, dark brown, gravelly, sandy CLAY. Gravel is subangular to subrounded, fine to medium of various lithologies

Specimen Conditions			
Sample condition	Intact	Water content [%]	12.0
Wet mass [g]	5513.0	Dry density [Mg/m^3]	1.94
Diameter [mm]	106.2	Bulk density [Mg/m^3]	2.17
Length [mm]	287.3	Target density [Mg/m^3]	NA

Test Conditions			
Room Temperature [°C]	19	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	2.36	2.37
Sample Temperature [°C]	18.07	18.28
Error	0.001	0.001
Power [W/m]	3.52	3.52



Location: Wallingford, UK

Approved by CD 28/02/2023

FUGRO

DUBLIN ARRAY WP

230054

Colour Chart #14

Blue Cyan Green Yellow Red Magenta White 3/Color Black

WP2_BH03 03.03.23

11.00-11.50

TOP

10 20 30 40 50 60 70 80 90 cm

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

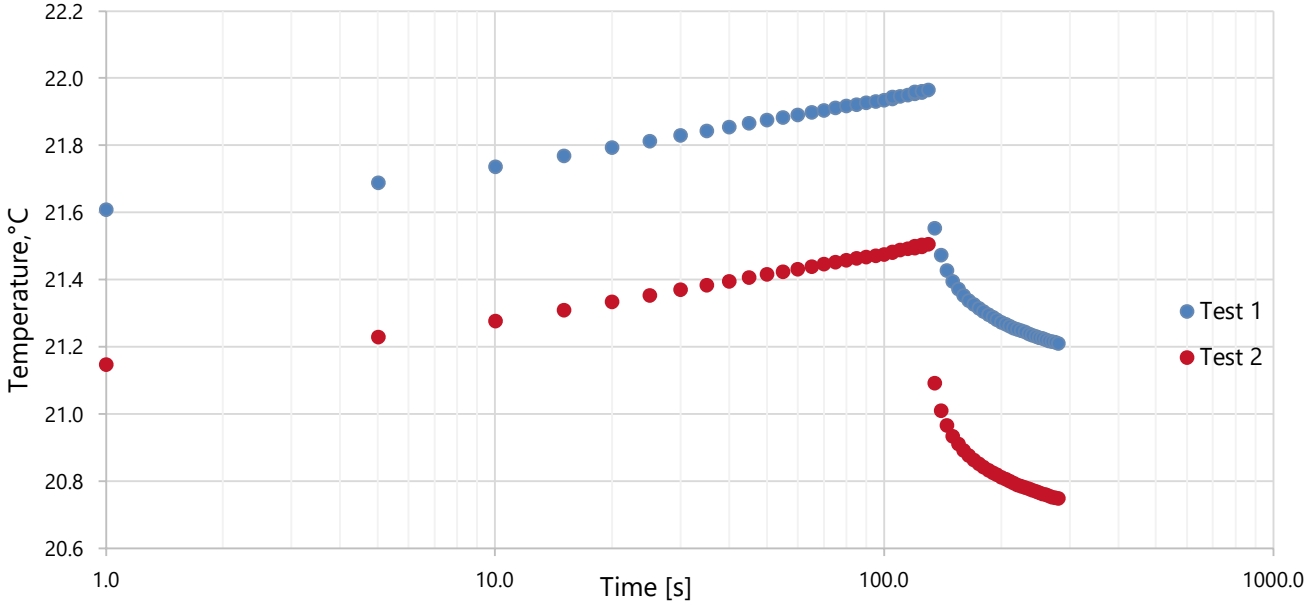
Test Identification			
Borehole	WP2_BH03	Sample Depth [m]	20.00
Sample	46	Test Depth [m]	20.00

Visual Description
Stiff, dark greyish brown, slightly gravelly, slightly sandy CLAY. Gravel is subangular, fine to medium of various lithologies

Specimen Conditions			
Sample condition	Remoulded	Water content [%]	7.8
Wet mass [g]	2542.9	Dry density [Mg/m^3]	2.12
Diameter [mm]	83.5	Bulk density [Mg/m^3]	2.28
Length [mm]	203.5	Target density [Mg/m^3]	2.35

Test Conditions			
Room Temperature [°C]	20	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	2.56	2.56
Sample Temperature [°C]	21.19	20.73
Error	0.001	0.001
Power [W/m]	3.45	3.45



FUGRO

DUBLIN ARRAY WP

230054

Colour Chart #14

Blue Cyan Green Yellow Red Magenta White 3/Color Black

WP2_BH03 03.03.23

20.00-21.00

TOP FUGRO 10 20 30 40 50 60 70 80 90 cm

230054
WP2-BH03
46 20m
Needs approval

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

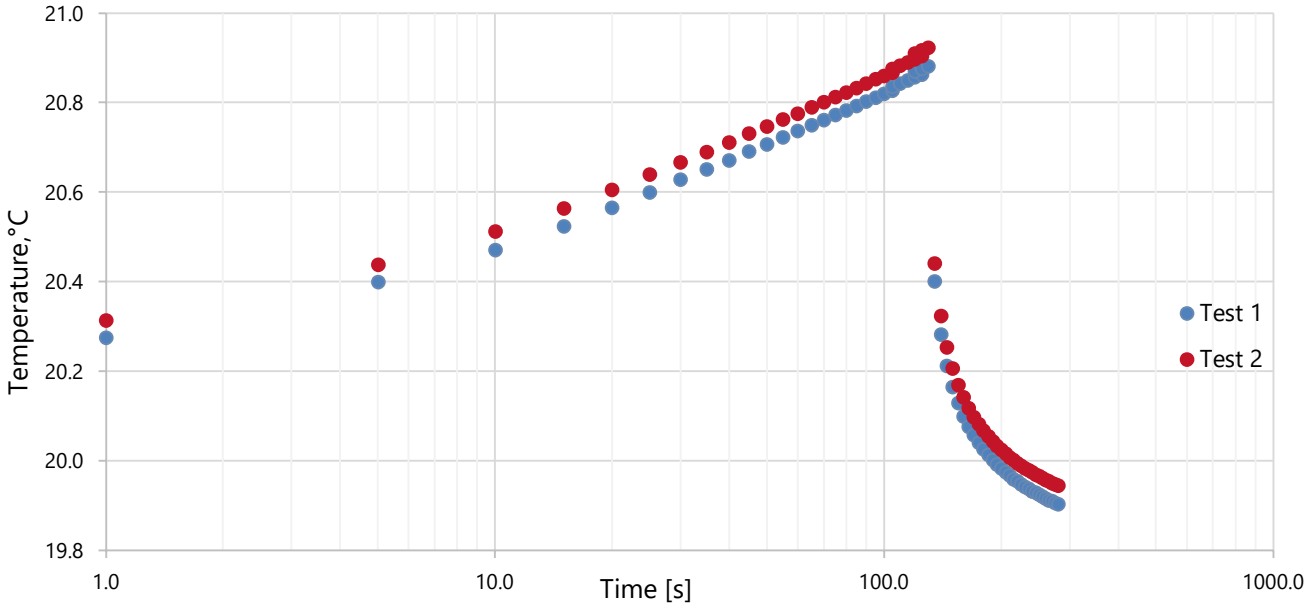
Test Identification			
Borehole	WP2_BH03	Sample Depth [m]	26.00
Sample	50	Test Depth [m]	26.00

Visual Description
Firm to stiff, dark brown, slightly gravelly, slightly sandy CLAY. Gravel is subangular to subrounded, fine of various lithologies

Specimen Conditions			
Sample condition	Remoulded	Water content [%]	8.3
Wet mass [g]	2230.2	Dry density [Mg/m^3]	1.85
Diameter [mm]	84.2	Bulk density [Mg/m^3]	2.00
Length [mm]	200.4	Target density [Mg/m^3]	2.06

Test Conditions			
Room Temperature [°C]	20	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	1.57	1.57
Sample Temperature [°C]	19.79	19.83
Error	0.001	0.001
Power [W/m]	3.45	3.45



FUGRO

DUBLIN ARRAY WP

230054

Colour Chart #14

Blue Cyan Green Yellow Red Magenta White 3/Color Black

WP2_BH03 03.03.23

26.00-26.50

TOP FUGRO 10 20 30 40 50 60 70 80 90 cm

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

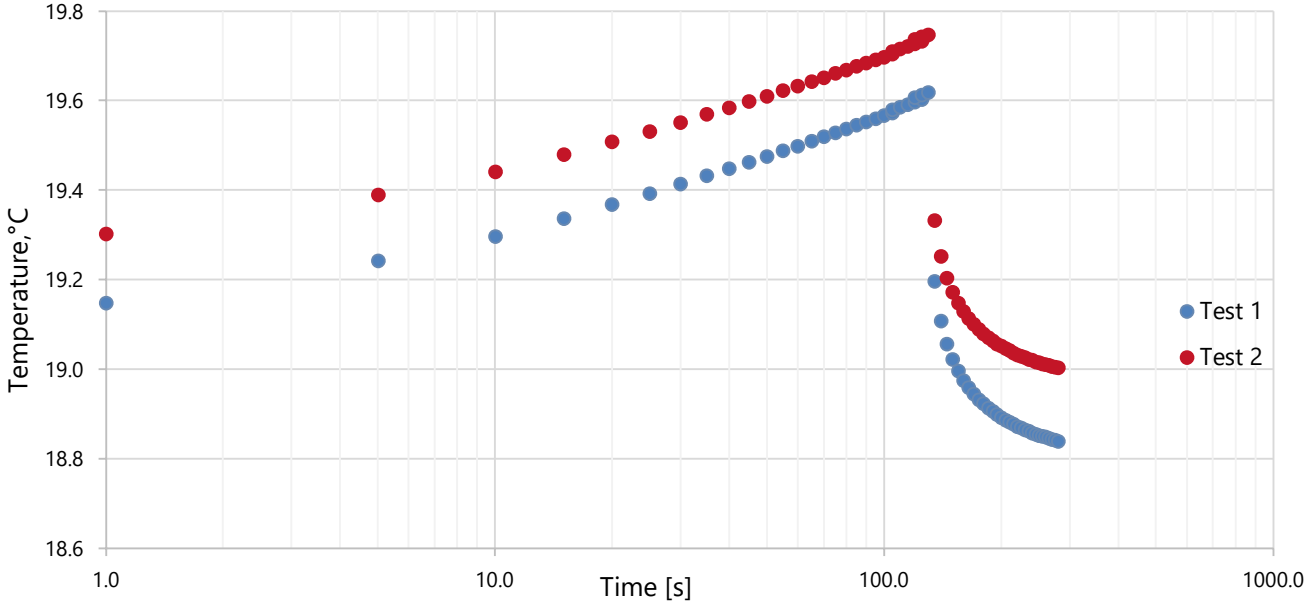
Test Identification			
Borehole	WP2_BH04	Sample Depth [m]	5.30
Sample	11	Test Depth [m]	5.30

Visual Description
Firm to stiff, brown, gravelly, sandy CLAY. Gravel is subangular to subrounded, fine to coarse of various lithologies

Specimen Conditions			
Sample condition	Intact	Water content [%]	12.2
Wet mass [g]	4550.3	Dry density [Mg/m^3]	1.89
Diameter [mm]	107.0	Bulk density [Mg/m^3]	2.12
Length [mm]	239.0	Target density [Mg/m^3]	NA

Test Conditions			
Room Temperature [°C]	19.5	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	2.11	2.23
Sample Temperature [°C]	18.72	18.88
Error	0.001	0.001
Power [W/m]	3.52	3.52



FUGRO

DUBLIN ARRAY WP

230054

WP2_BH04 03.03.23

5.30-5.70

Colour Chart #14

Blue Cyan Green Yellow Red Magenta White 3/Color Black

TOP FUGRO 10 20 30 40 50 60 70 80 90 cm

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

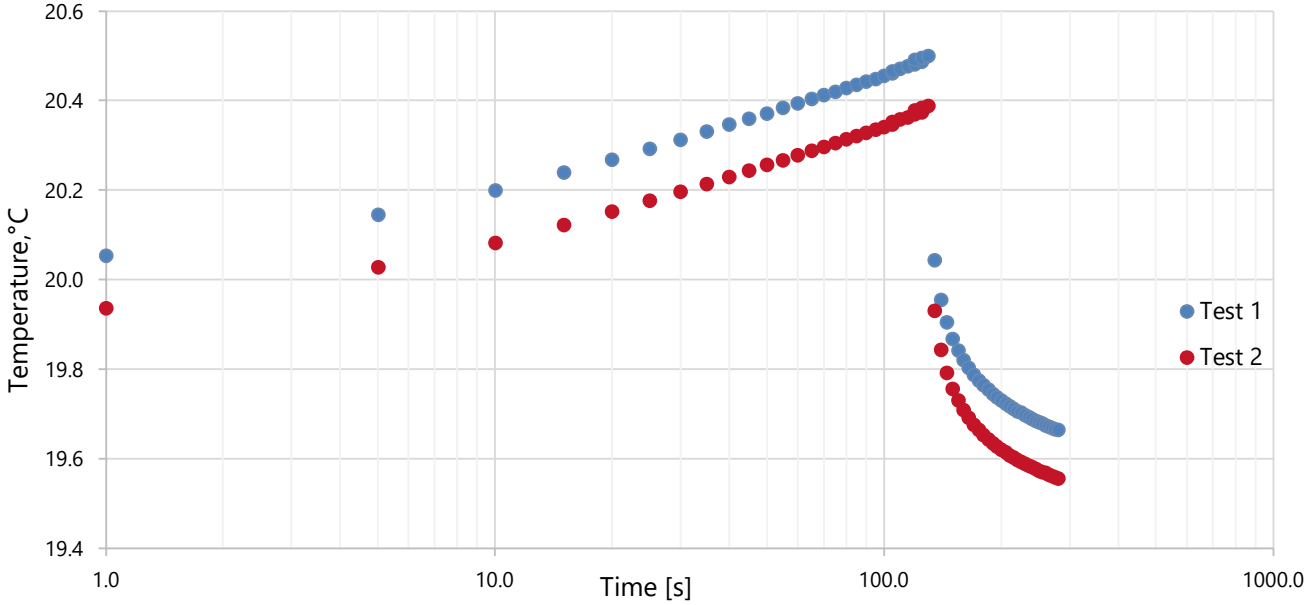
Test Identification			
Borehole	WP2-BH04	Sample Depth [m]	9.25
Sample	21	Test Depth [m]	9.25

Visual Description
Olive brown silty fine to medium SAND

Specimen Conditions			
Sample condition	Reconstituted	Water content [%]	21.4
Wet mass [g]	1478.1	Dry density [Mg/m^3]	1.65
Diameter [mm]	70.3	Bulk density [Mg/m^3]	2.00
Length [mm]	190.6	Target density [Mg/m^3]	1.73

Test Conditions			
Room Temperature [°C]	19	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	2.04	2.04
Sample Temperature [°C]	19.59	19.48
Error	0.001	0.001
Power [W/m]	3.44	3.44



FUGRO

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

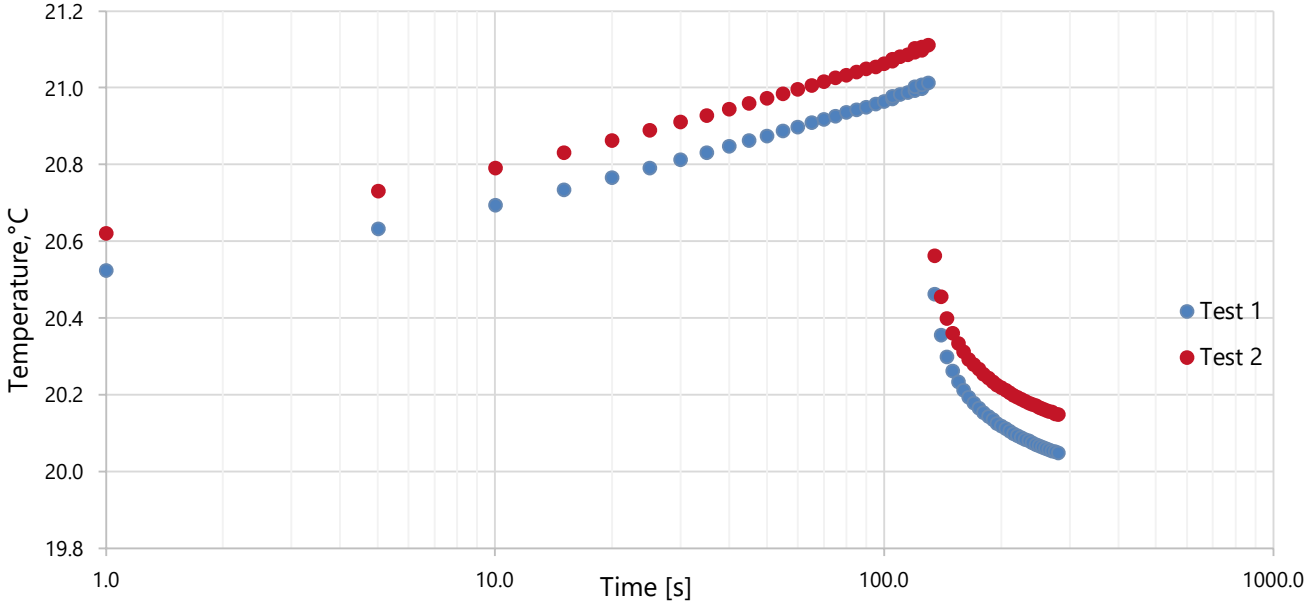
Test Identification			
Borehole	WP2_BH03	Sample Depth [m]	9.50
Sample	30	Test Depth [m]	9.50

Visual Description
Stiff, yellowish brown, slightly gravelly, slightly sandy CLAY. Gravel is subangular to subrounded, fine of various lithologies

Specimen Conditions			
Sample condition	Remoulded	Water content [%]	9.2
Wet mass [g]	2229.1	Dry density [Mg/m^3]	1.80
Diameter [mm]	83.4	Bulk density [Mg/m^3]	1.97
Length [mm]	207.3	Target density [Mg/m^3]	2.06

Test Conditions			
Room Temperature [°C]	19	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	1.92	1.92
Sample Temperature [°C]	19.97	20.07
Error	0.002	0.001
Power [W/m]	3.46	3.46



FUGRO

DUBLIN ARRAY WP

230054

Colour Chart #14

Blue Cyan Green Yellow Red Magenta White 3/Color Black

WP2_BH03

9.50-10.00

10.03.23

TOP FUGRO 10 20 30 40 50 60 70 80 90 cm

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

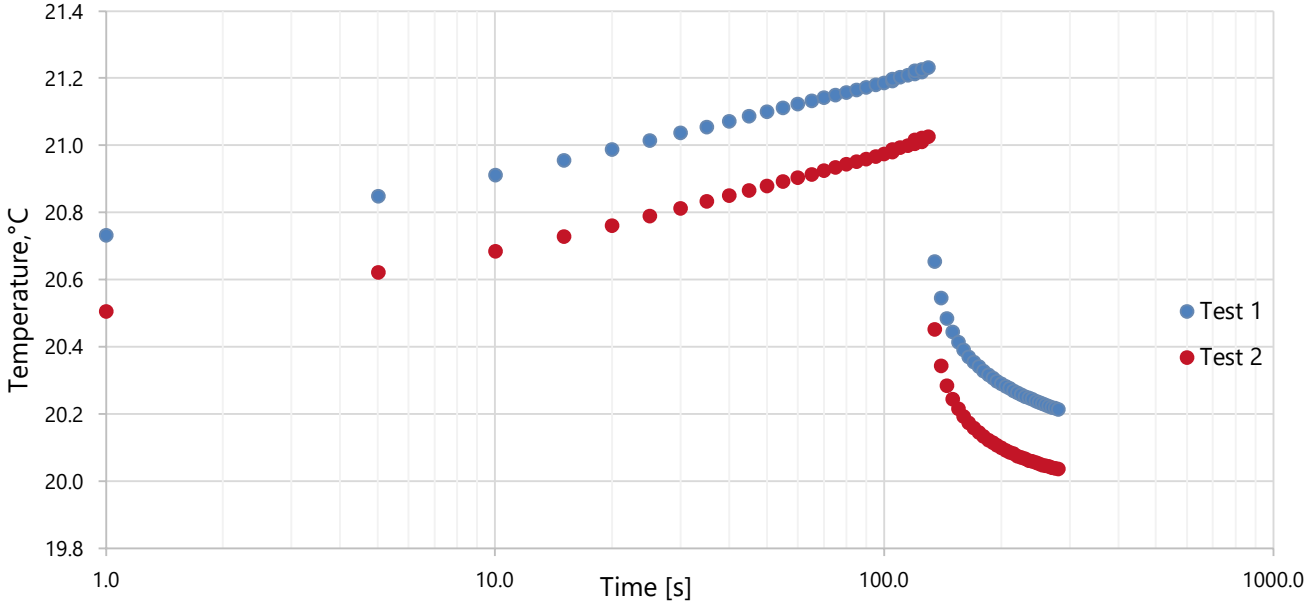
Test Identification			
Borehole	WP2_BH03	Sample Depth [m]	23.00
Sample	48	Test Depth [m]	23.00

Visual Description
Very stiff, very dark greyish brown, gravelly, slightly sandy CLAY. Gravel is subangular to subrounded, fine to medium of various lithologies

Specimen Conditions			
Sample condition	Remoulded	Water content [%]	7.5
Wet mass [g]	2250.4	Dry density [Mg/m^3]	1.93
Diameter [mm]	83.0	Bulk density [Mg/m^3]	2.08
Length [mm]	200.3	Target density [Mg/m^3]	2.08

Test Conditions			
Room Temperature [°C]	19	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	1.89	1.90
Sample Temperature [°C]	20.16	19.93
Error	0.001	0.002
Power [W/m]	3.43	3.43



FUGRO

DUBLIN ARRAY WP

230054

Colour Chart #14

Blue Cyan Green Yellow Red Magenta White 3/Color Black

WP2_BH03

23.00–23.50

10.03.23

TOP FUGRO 10 20 30 40 50 60 70 80 90 cm

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

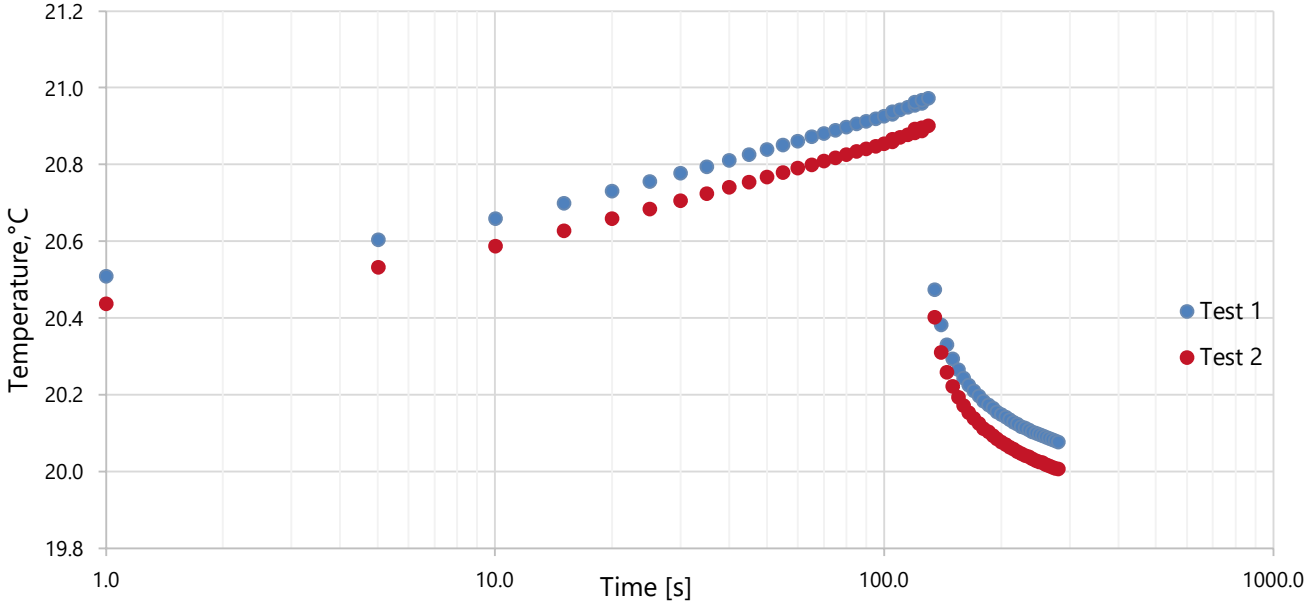
Test Identification			
Borehole	WP2_BH04	Sample Depth [m]	4.50
Sample	10	Test Depth [m]	4.50

Visual Description
Firm, brown, slightly gravelly, slightly sandy CLAY with rare coarse sand-size to fine gravel-size shell fragments. Gravel is subangular to subrounded, fine of various lithologies

Specimen Conditions			
Sample condition	Remoulded	Water content [%]	13.6
Wet mass [g]	2348.3	Dry density [Mg/m^3]	1.89
Diameter [mm]	83.1	Bulk density [Mg/m^3]	2.14
Length [mm]	201.7	Target density [Mg/m^3]	2.17

Test Conditions			
Room Temperature [°C]	19	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	2.01	2.00
Sample Temperature [°C]	20.01	19.94
Error	0.001	0.001
Power [W/m]	3.56	3.56



FUGRO

DUBLIN ARRAY WP

230054

Colour Chart #14

Blue Cyan Green Yellow Red Magenta White 3/Color Black

WP2_BH04

4.50-4.80

10.03.23

TOP FUGRO 10 20 30 40 50 60 70 80 90 cm

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

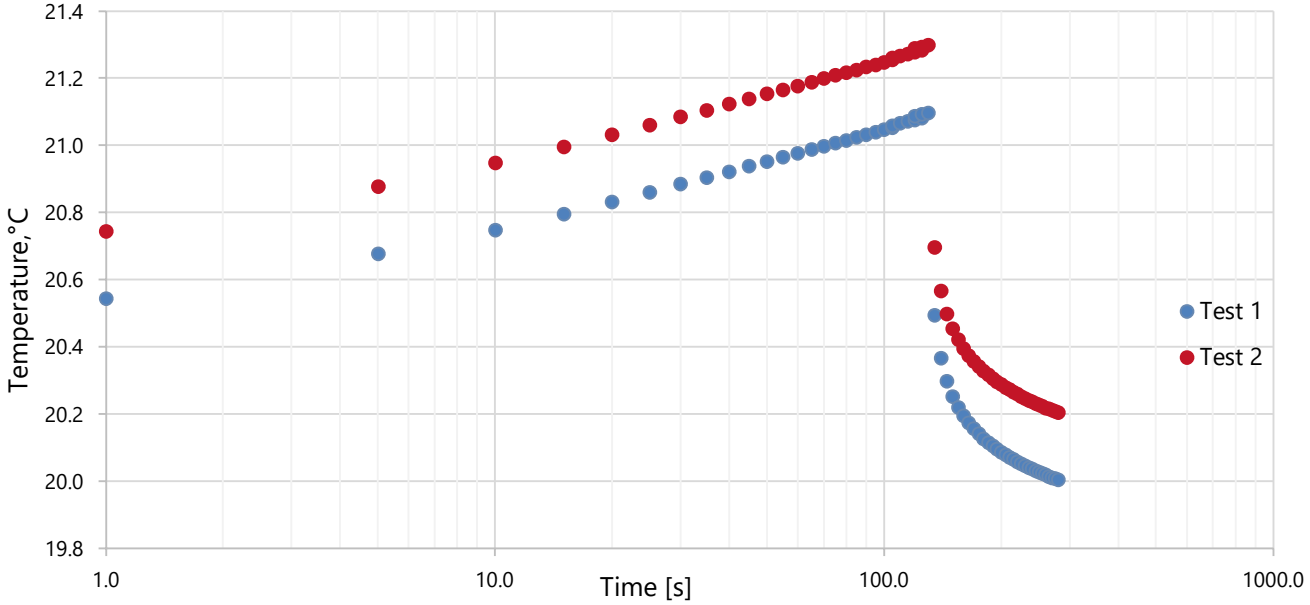
Test Identification			
Borehole	WP2_BH04	Sample Depth [m]	26.10
Sample	55	Test Depth [m]	26.10

Visual Description
Stiff, dark greyish brown, gravelly, slightly sandy CLAY. Gravel is subangular to subrounded fine to medium of various lithologies

Specimen Conditions			
Sample condition	Remoulded	Water content [%]	6.3
Wet mass [g]	2527.8	Dry density [Mg/m^3]	2.06
Diameter [mm]	84.0	Bulk density [Mg/m^3]	2.19
Length [mm]	208.0	Target density [Mg/m^3]	2.29

Test Conditions			
Room Temperature [°C]	19	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	1.74	1.74
Sample Temperature [°C]	19.94	20.14
Error	0.001	0.001
Power [W/m]	3.46	3.46



Project: 230054
Test Page 1/1

Location: Wallingford, UK

Approved by VH 07/03/2023

FUGRO

DUBLIN ARRAY WP

230054

Colour Chart #14

Blue Cyan Green Yellow Red Magenta White 3/Color Black

WP2_BH04

26.10-27.00

10.03.23

TOP

FUGRO

10 20 30 40 50 60 70 80 90 cm

Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

Test Identification			
Borehole	WP2_BH04	Sample Depth [m]	5.30
Sample	11	Test Depth [m]	5.30

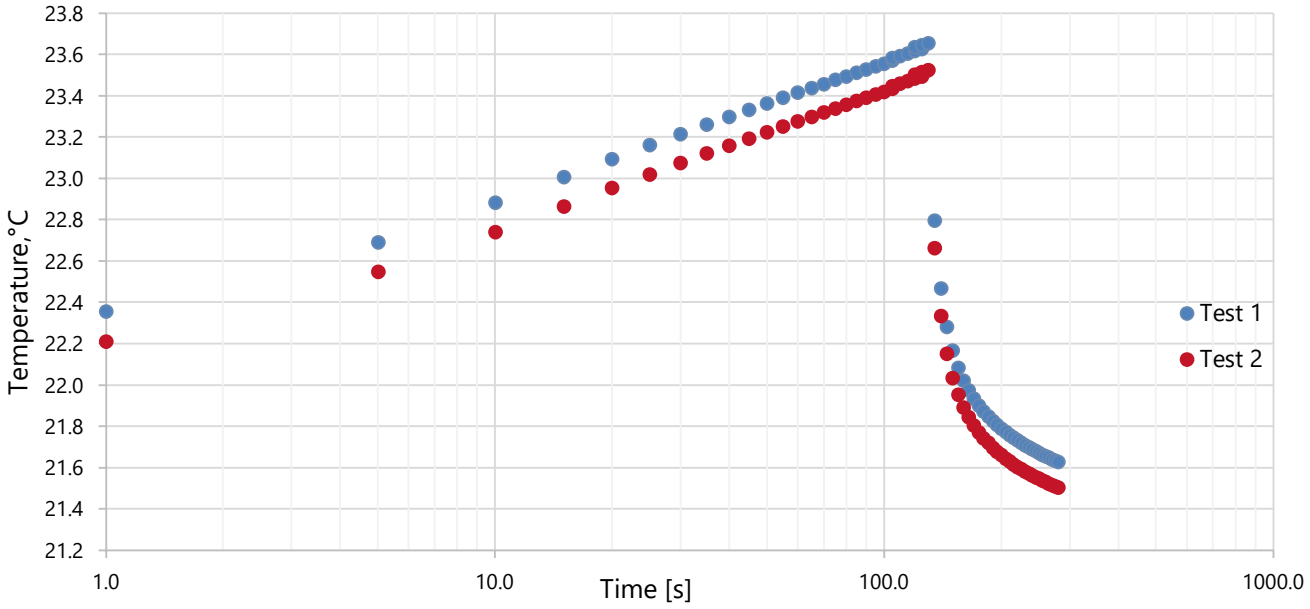
Visual Description

Firm to stiff brown gravelly sandy CLAY. Gravel is subangular to subrounded fine to coarse of various lithologies.

Specimen Conditions			
Sample condition	Intact	Water content [%]	0.8
Wet mass [g]	3871.2	Dry density [Mg/m^3]	2.01
Diameter [mm]	102.0	Bulk density [Mg/m^3]	2.03
Length [mm]	233.2	Target density [Mg/m^3]	NA

Test Conditions			
Room Temperature [°C]	20	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	0.87	0.87
Sample Temperature [°C]	21.49	21.34
Error	0.003	0.003
Power [W/m]	3.44	3.44



Test Report

Thermal Conductivity by Thermal Needle Probe

ASTM D5334-22

UKAS TESTING 0919

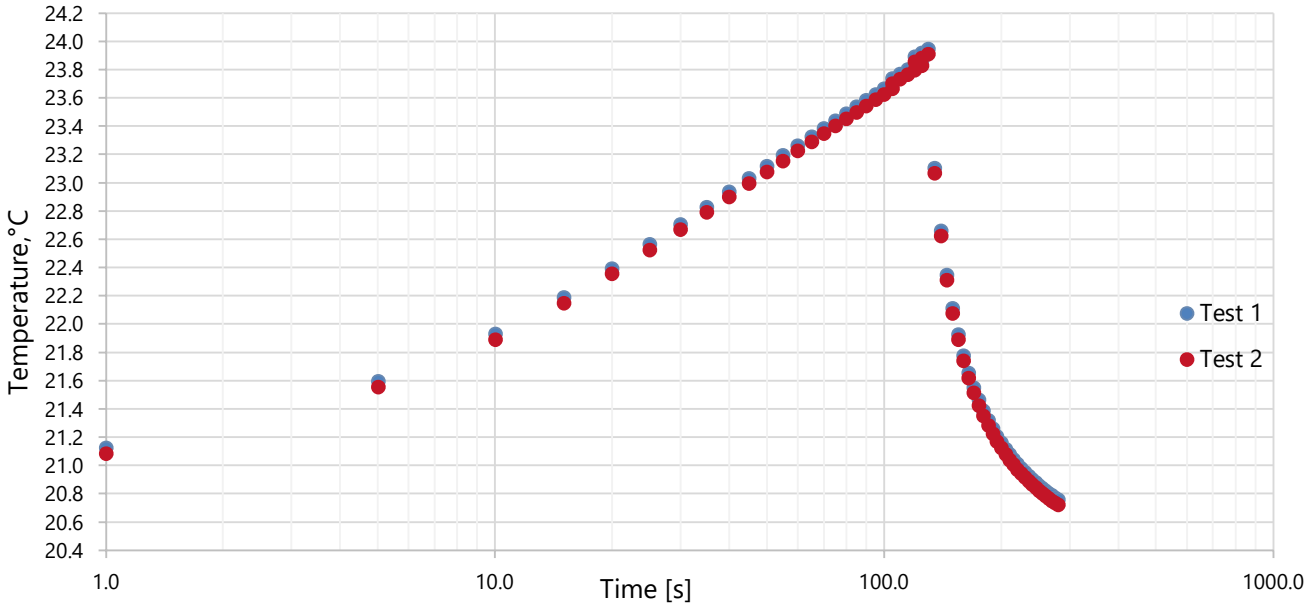
Test Identification			
Borehole	WP2_BH04	Sample Depth [m]	9.25
Sample	21	Test Depth [m]	9.25

Visual Description
Olive brown silty fine to medium SAND

Specimen Conditions			
Sample condition	Reconstituted	Water content [%]	0.1
Wet mass [g]	1197.6	Dry density [Mg/m^3]	1.72
Diameter [mm]	70.5	Bulk density [Mg/m^3]	1.72
Length [mm]	178.7	Target density [Mg/m^3]	1.73

Test Conditions			
Room Temperature [°C]	19.5	Needle diameter [mm]	2.4
Needle	TR-3	Needle length [mm]	100
Heating time [min]	2.5	Insertion type	Pushed
Cooling time [min]	2.5	Calculation method	Inbuilt

Test Results	Test 1	Test 2
Thermal Conductivity [W/mK]	0.32	0.32
Sample Temperature [°C]	20.26	20.22
Error	0.014	0.014
Power [W/m]	3.45	3.45



FUGRO

Checked by: LB
Approved by: PH

Date: 13/04/2023
Date: 14/04/2023

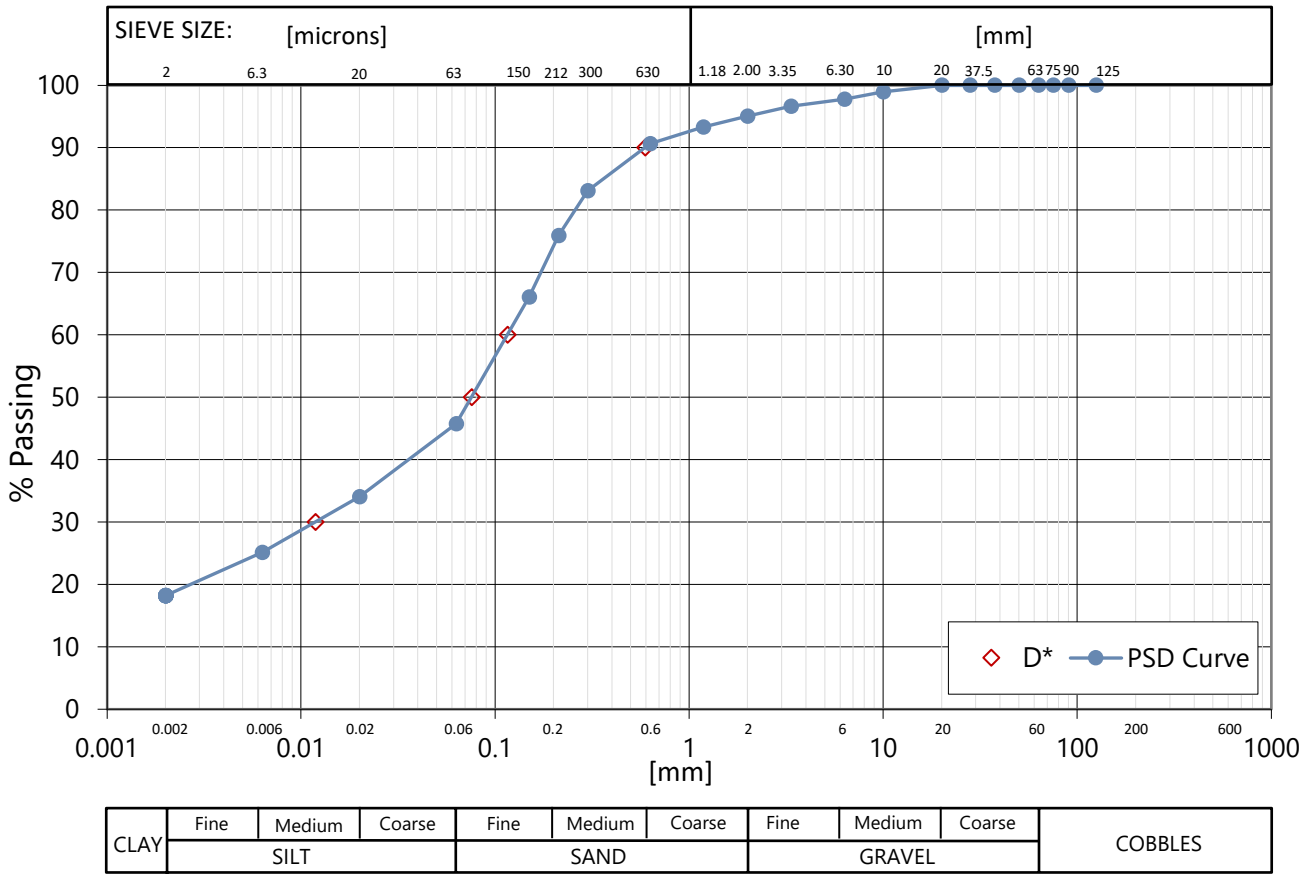
Template Issue: 5.0
Filename: 230054 / Labdata / Class / PSD / WP2_BH03_25_ps.XLS

Drawn by: LB
Date: 13/04/2023

% Passing	Particle Size (mm)	
100	125	Sieving
100	90.0	
100	75.0	
100	63.0	
100	50.0	
100	37.5	
100	28.0	
100	20.0	
99	10.0	
98	6.30	
97	3.35	
95	2.00	
93	1.18	
91	0.630	
83	0.300	
76	0.212	
66	0.150	
46	0.0630	
34	0.0200	Sedimen-tation
25	0.00630	
18	0.00200	

Sieving:	
Initial dry mass of sample - sieve [g]	449.63
Sedimentation:	
Mass retained on 63µm sieve [g]	9.79
Particle density for sedimentation (Assumed)	2.70
Grading Analysis	

D_{90}	0.5930	[mm]
D_{60}	0.1158	[mm]
D_{50}	0.0756	[mm]
D_{30}	0.0119	[mm]
D_{10}	-	[mm]



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

Borehole	Sample	Depth [m]	Percentage soil types				
			Clay	Silt **	Sand	Gravel	Cobbles
WP2_BH03	25.00	5.00	18	28	49	5	0

** Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Description	Remarks
Greyish brown slightly gravelly sandy CLAY	

Tested in accordance with ISO 17892-4: 2016 - 5.2 & 5.4 - Sieving & Sedimentation by pipette method

Checked by: LB
Approved by: PH

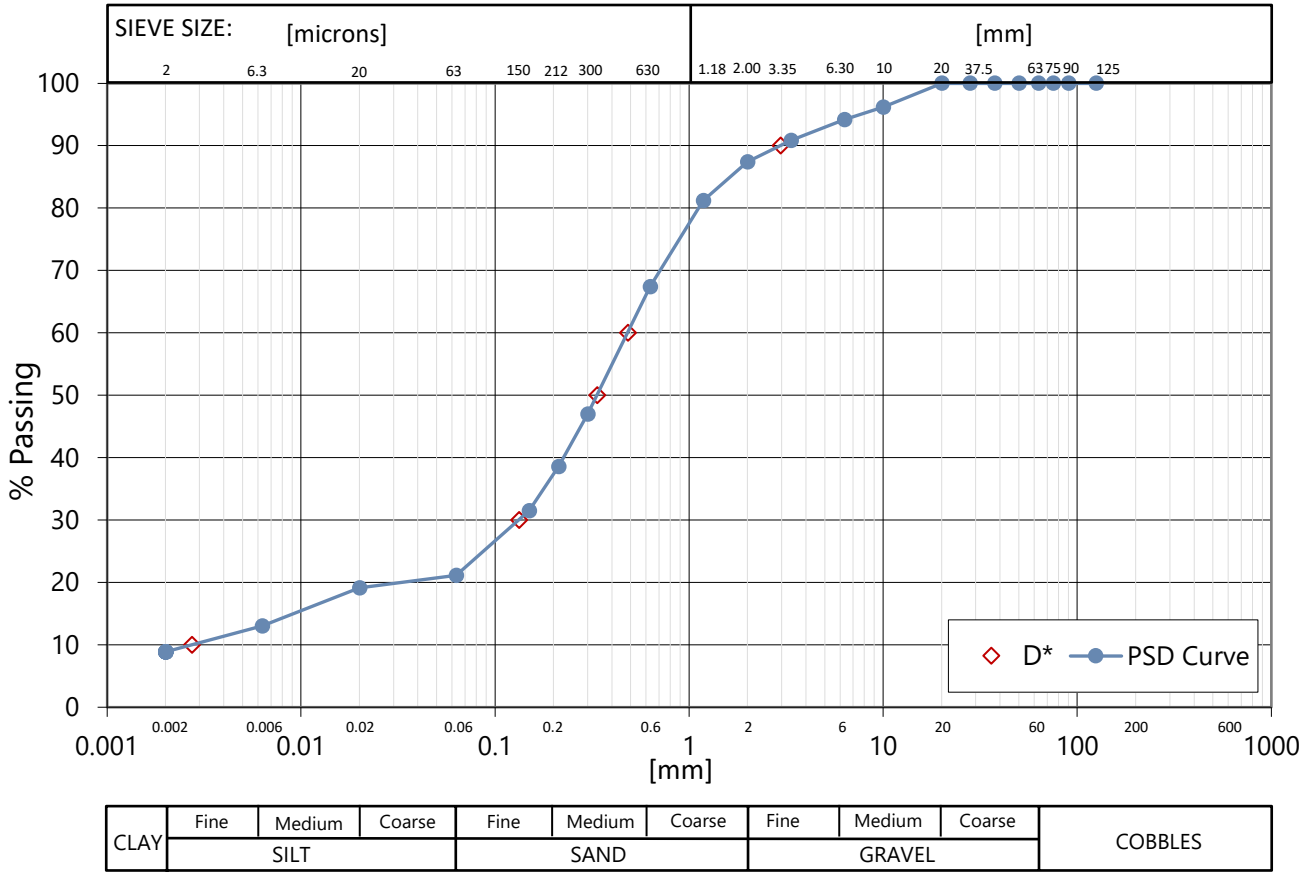
Date: 13/04/2023
Date: 14/04/2023

Template Issue: 5.0
Filename: 230054 / Labdata / Class / PSD / WP2_BH03_30_ps.XLS

Drawn by: LB
Date: 13/04/2023

% Passing	Particle Size (mm)	
100	125	Sieving
100	90.0	
100	75.0	
100	63.0	
100	50.0	
100	37.5	
100	28.0	
100	20.0	
96	10.0	
94	6.30	
91	3.35	
87	2.00	
81	1.18	
67	0.630	
47	0.300	
39	0.212	
31	0.150	
21	0.0630	
19	0.0200	Sedimen-tation
13	0.00630	
9	0.00200	

Sieving:		
Initial dry mass of sample - sieve [g]	#####	
Sedimentation:		
Mass retained on 63µm sieve [g]	13.59	
Particle density for sedimentation (Assumed)	2.70	
Grading Analysis		
D_{90}	2.9576	[mm]
D_{60}	0.4816	[mm]
D_{50}	0.3347	[mm]
D_{30}	0.1327	[mm]
D_{10}	0.0027	[mm]



Borehole	Sample	Depth [m]	Percentage soil types				
			Clay	Silt **	Sand	Gravel	Cobbles
WP2_BH03	30.00	9.50	9	12	66	13	0

** Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Description	Remarks
Yellowish brown gravelly silty SAND. Gravel is fine to medium	

Tested in accordance with ISO 17892-4: 2016 - 5.2 & 5.4 - Sieving & Sedimentation by pipette method

Checked by: LB
Approved by: PH

Date: 13/04/2023
Date: 14/04/2023

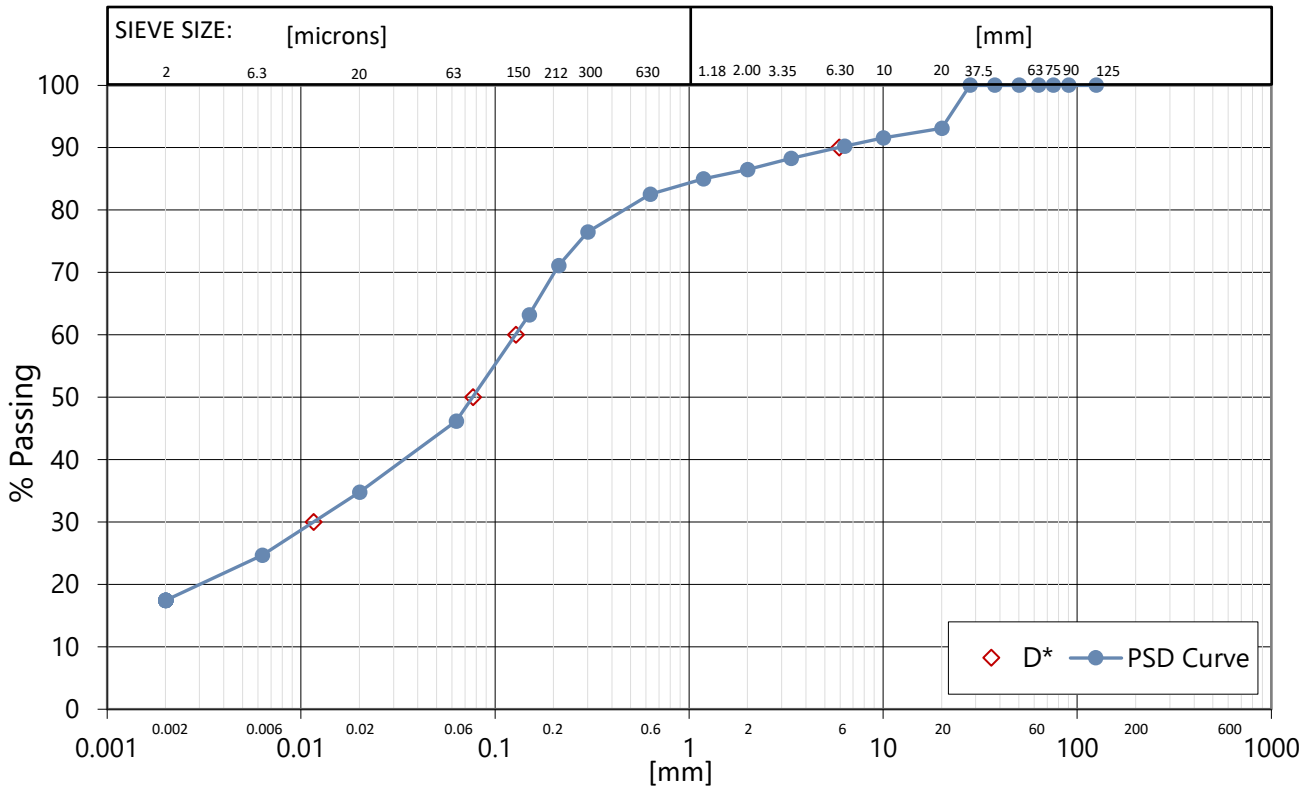
Template Issue: 5.0
Filename: 230054 / Labdata / Class / PSD / WP2_BH03_31_ps.XLS

Drawn by: LB
Date: 13/04/2023

% Passing	Particle Size (mm)	
100	125	Sieving
100	90.0	
100	75.0	
100	63.0	
100	50.0	
100	37.5	
100	28.0	
93	20.0	
92	10.0	
90	6.30	
88	3.35	
86	2.00	
85	1.18	
83	0.630	
76	0.300	
71	0.212	
63	0.150	
46	0.0630	
35	0.0200	Sedimen-tation
25	0.00630	
17	0.00200	

Sieving:	
Initial dry mass of sample - sieve [g]	740.44
Sedimentation:	
Mass retained on 63µm sieve [g]	8.68
Particle density for sedimentation (Assumed)	2.70
Grading Analysis	

D_{90}	5.9076	[mm]
D_{60}	0.1277	[mm]
D_{50}	0.0767	[mm]
D_{30}	0.0116	[mm]
D_{10}	-	[mm]



CLAY	Fine	Medium	Coarse	Fine	Medium	Coarse	Fine	Medium	Coarse	COBBLES
	SILT			SAND			GRAVEL			

Borehole	Sample	Depth [m]	Percentage soil types				
			Clay	Silt **	Sand	Gravel	Cobbles
WP2_BH03	31.00	11.00	17	29	40	14	0

** Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Description	Remarks
Light brown slightly gravelly sandy CLAY. Gravel is fine to medium	

Tested in accordance with ISO 17892-4: 2016 - 5.2 & 5.4 - Sieving & Sedimentation by pipette method

Checked by: LB
Approved by: PH

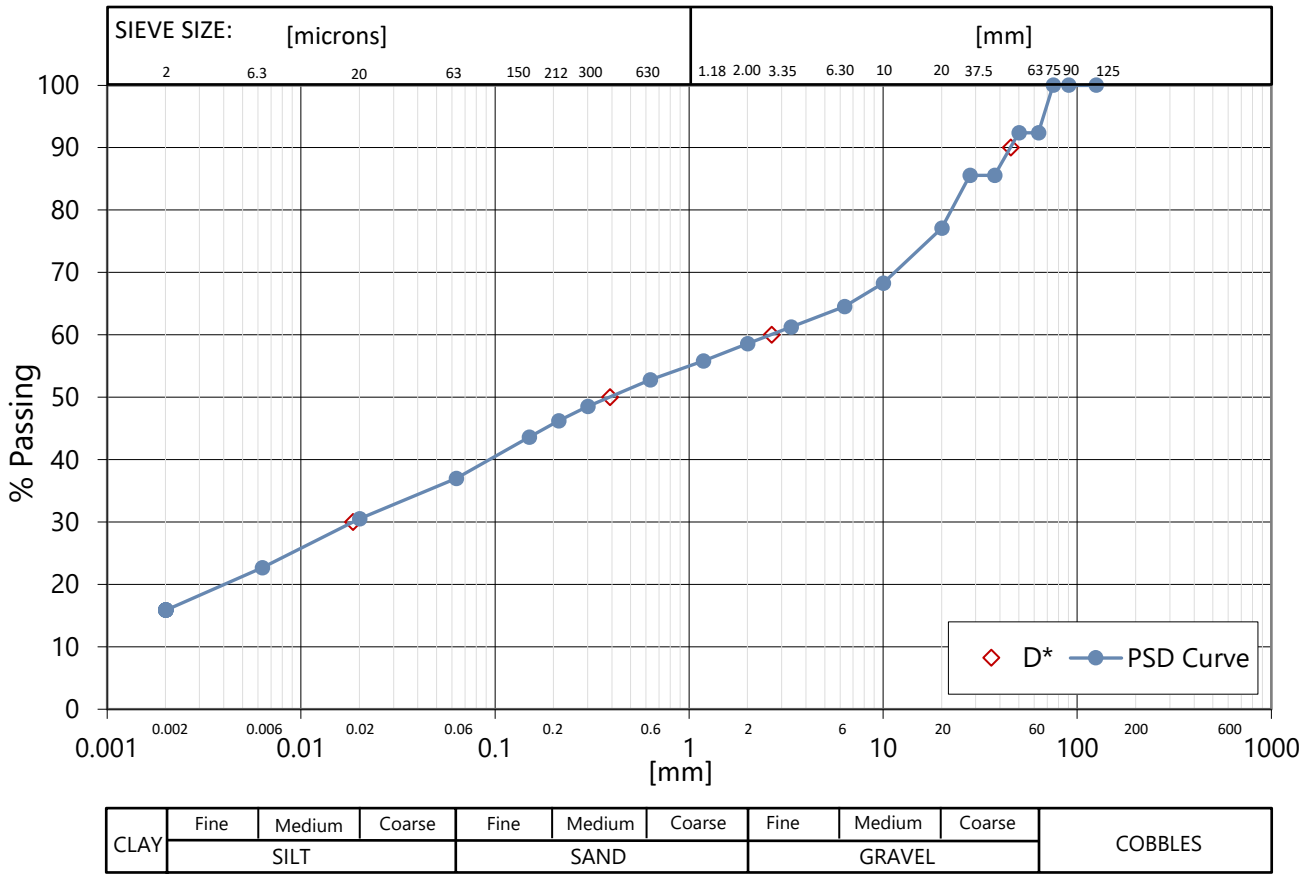
Date: 13/04/2023
Date: 14/04/2023

Template Issue: 5.0
Filename: 230054 / Labdata / Class / PSD / WP2_BH03_48_ps.XLS

Drawn by: LB
Date: 13/04/2023

% Passing	Particle Size (mm)	
100	125	Sieving
100	90.0	
100	75.0	
92	63.0	
92	50.0	
86	37.5	
86	28.0	
77	20.0	
68	10.0	
65	6.30	
61	3.35	
59	2.00	
56	1.18	
53	0.630	
48	0.300	
46	0.212	
44	0.150	
37	0.0630	
31	0.0200	Sedimen-tation
23	0.00630	
16	0.00200	

Sieving:		
Initial dry mass of sample - sieve [g]	#####	
Sedimentation:		
Mass retained on 63µm sieve [g]	8.80	
Particle density for sedimentation (Assumed)	2.70	
Grading Analysis		
D_{90}	45.2459	[mm]
D_{60}	2.6498	[mm]
D_{50}	0.3893	[mm]
D_{30}	0.0185	[mm]
D_{10}	-	[mm]



Borehole	Sample	Depth [m]	Percentage soil types				
			Clay	Silt **	Sand	Gravel	Cobbles
WP2_BH03	48.00	23.00	16	21	22	33	8

** Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Description	Remarks
Dark grey slightly gravelly slightly sandy CLAY. Gravel is fine to coarse	

Tested in accordance with ISO 17892-4: 2016 - 5.2 & 5.4 - Sieving & Sedimentation by pipette method

Checked by: LB
Approved by: PH

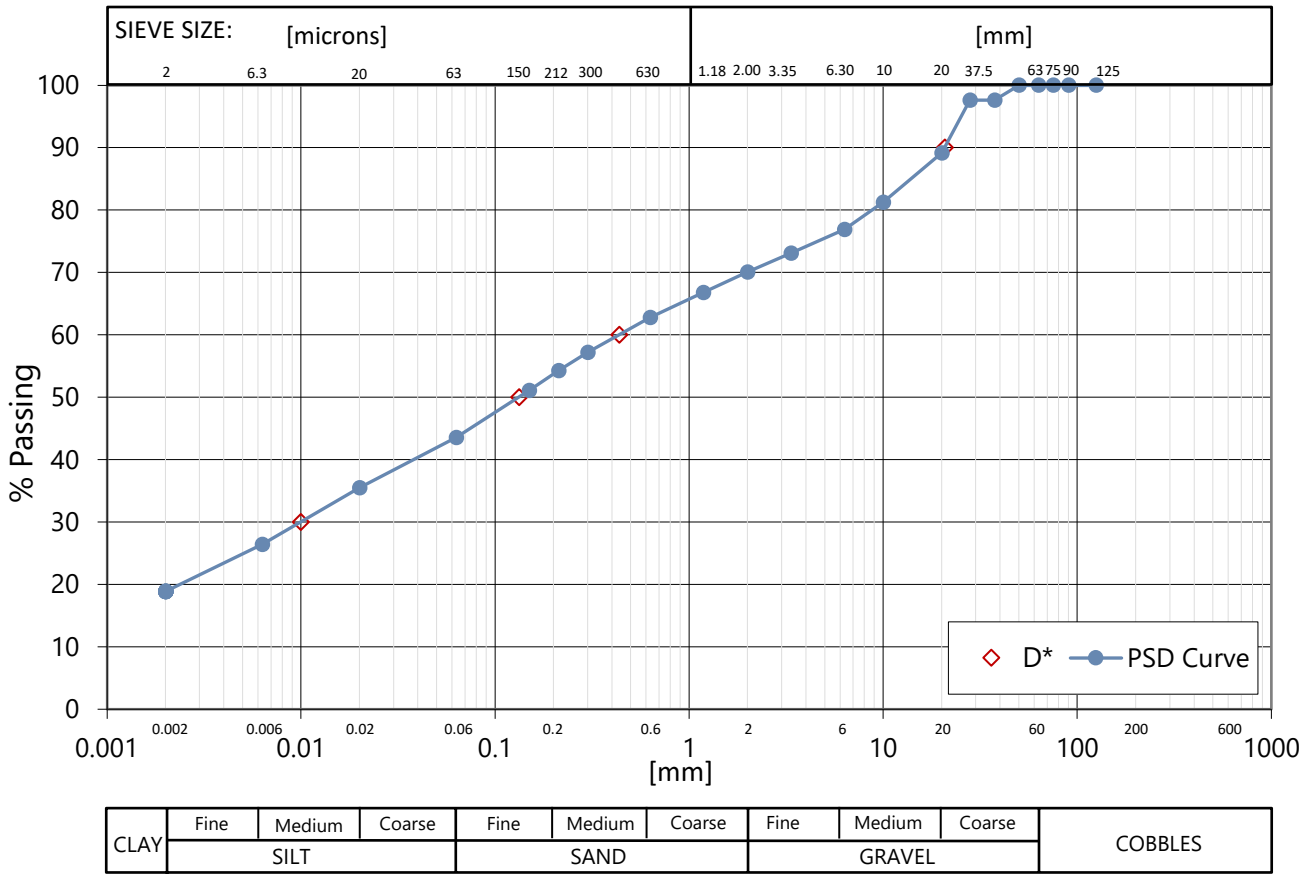
Date: 13/04/2023
Date: 14/04/2023

Template Issue: 5.0
Filename: 230054 / Labdata / Class / PSD / WP2_BH03_50_ps.XLS

Drawn by: LB
Date: 13/04/2023

% Passing	Particle Size (mm)	
100	125	Sieving
100	90.0	
100	75.0	
100	63.0	
100	50.0	
98	37.5	
98	28.0	
89	20.0	
81	10.0	
77	6.30	
73	3.35	
70	2.00	
67	1.18	
63	0.630	
57	0.300	
54	0.212	
51	0.150	
44	0.0630	
35	0.0200	Sedimen-tation
26	0.00630	
19	0.00200	

Sieving:		
Initial dry mass of sample - sieve [g]		#####
Sedimentation:		
Mass retained on 63µm sieve [g]		8.60
Particle density for sedimentation (Assumed)		2.70
Grading Analysis		
D_{90}	20.7116	[mm]
D_{60}	0.4355	[mm]
D_{50}	0.1326	[mm]
D_{30}	0.0100	[mm]
D_{10}	-	[mm]



Borehole	Sample	Depth [m]	Percentage soil types				
			Clay	Silt **	Sand	Gravel	Cobbles
WP2_BH03	50.00	26.00	19	25	26	30	0

** Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Description	Remarks
Dark grey slightly gravelly slightly sandy CLAY. Gravel is fine to medium	

Tested in accordance with ISO 17892-4: 2016 - 5.2 & 5.4 - Sieving & Sedimentation by pipette method

Checked by: LB
Approved by: PH

Date: 13/04/2023
Date: 14/04/2023

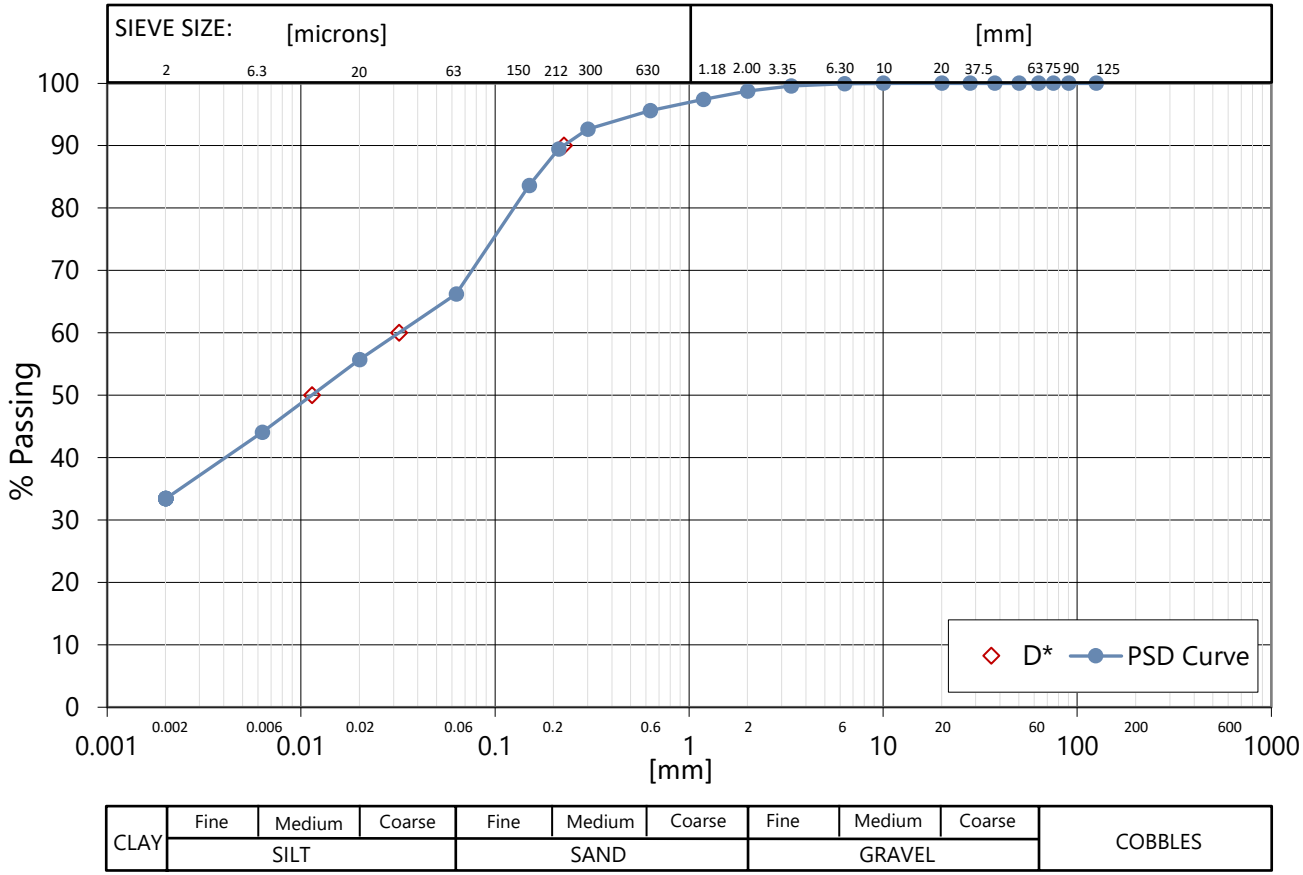
Template Issue: 5.0
Filename: 230054 / Labdata / Class / PSD / WP2_BH04_10_ps.XLS

Drawn by: JC
Date: 03/04/2023

% Passing	Particle Size (mm)	
100	125	Sieving
100	90.0	
100	75.0	
100	63.0	
100	50.0	
100	37.5	
100	28.0	
100	20.0	
100	10.0	
100	6.30	
100	3.35	
99	2.00	
97	1.18	
96	0.630	
93	0.300	
89	0.212	
84	0.150	
66	0.0630	
56	0.0200	Sedimen-tation
44	0.00630	
33	0.00200	

Sieving:	
Initial dry mass of sample - sieve [g]	448.54
Sedimentation:	
Mass retained on 63µm sieve [g]	7.61
Particle density for sedimentation (Assumed)	2.70

Grading Analysis		
D_{90}	0.2252	[mm]
D_{60}	0.0320	[mm]
D_{50}	0.0114	[mm]
D_{30}	-	[mm]
D_{10}	-	[mm]



Borehole	Sample	Depth [m]	Percentage soil types				
			Clay	Silt **	Sand	Gravel	Cobbles
WP2_BH04	10.00	4.50	33	33	33	1	0

** Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Description	Remarks
Light brown slightly gravelly slightly sandy CLAY	

Tested in accordance with ISO 17892-4: 2016 - 5.2 & 5.4 - Sieving & Sedimentation by pipette method

Checked by: LB
Approved by: PH

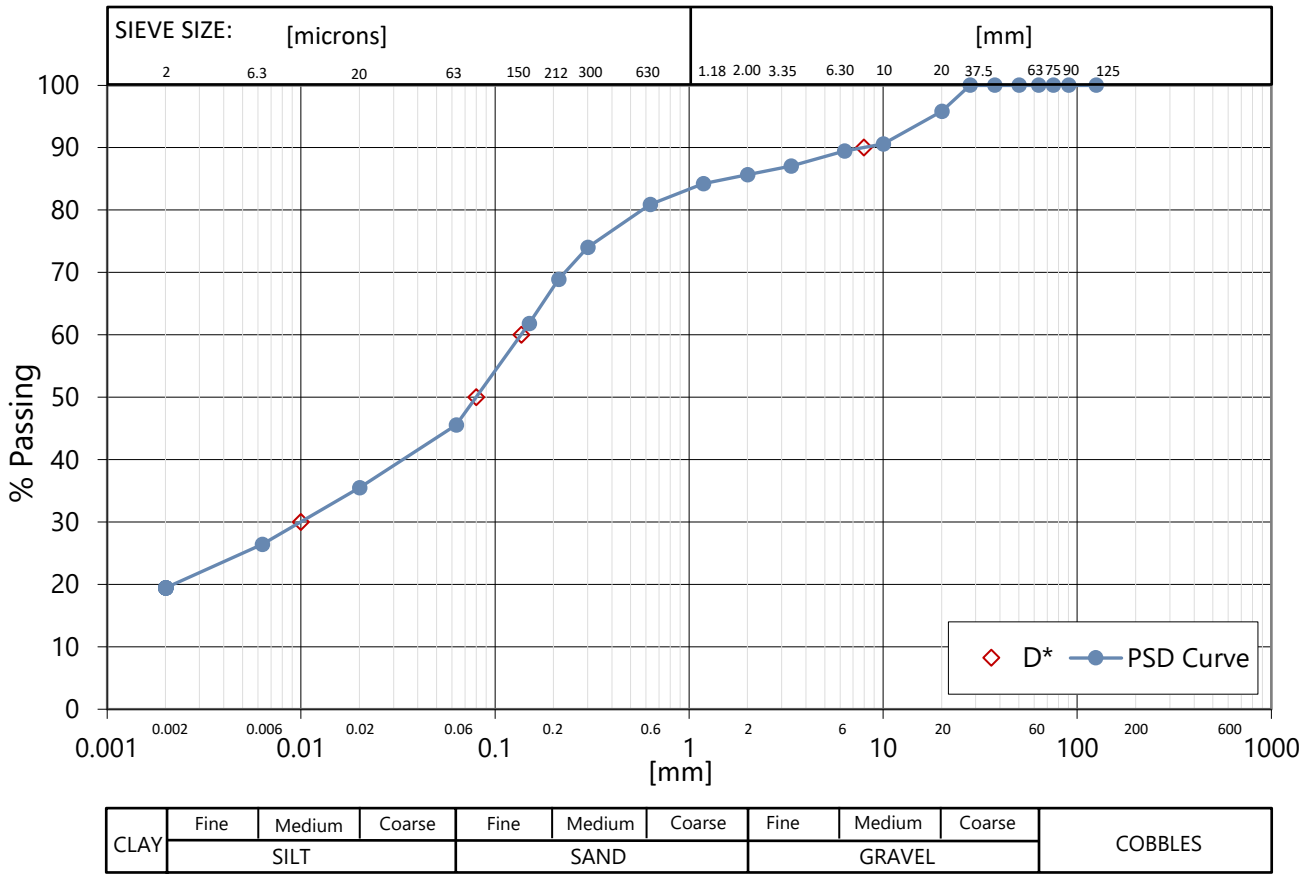
Date: 13/04/2023
Date: 14/04/2023

Template Issue: 5.0
Filename: 230054 / Labdata / Class / PSD / WP2_BH04_11_ps.XLS

Drawn by: LB
Date: 13/04/2023

% Passing	Particle Size (mm)	
100	125	Sieving
100	90.0	
100	75.0	
100	63.0	
100	50.0	
100	37.5	
100	28.0	
96	20.0	
91	10.0	
89	6.30	
87	3.35	
86	2.00	
84	1.18	
81	0.630	
74	0.300	
69	0.212	
62	0.150	
46	0.0630	
36	0.0200	Sedimen-tation
26	0.00630	
19	0.00200	

Sieving:		
Initial dry mass of sample - sieve [g]	#####	
Sedimentation:		
Mass retained on 63µm sieve [g]	7.98	
Particle density for sedimentation (Assumed)	2.70	
Grading Analysis		
D_{90}	7.9253	[mm]
D_{60}	0.1362	[mm]
D_{50}	0.0799	[mm]
D_{30}	0.0099	[mm]
D_{10}	-	[mm]



Borehole	Sample	Depth [m]	Percentage soil types				
			Clay	Silt **	Sand	Gravel	Cobbles
WP2_BH04	11.00	5.30	19	27	40	14	0

** Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Description	Remarks
Brown slightly gravelly sandy CLAY. Gravel is fine to medium	

Tested in accordance with ISO 17892-4: 2016 - 5.2 & 5.4 - Sieving & Sedimentation by pipette method

Checked by: GRM
Approved by: PH

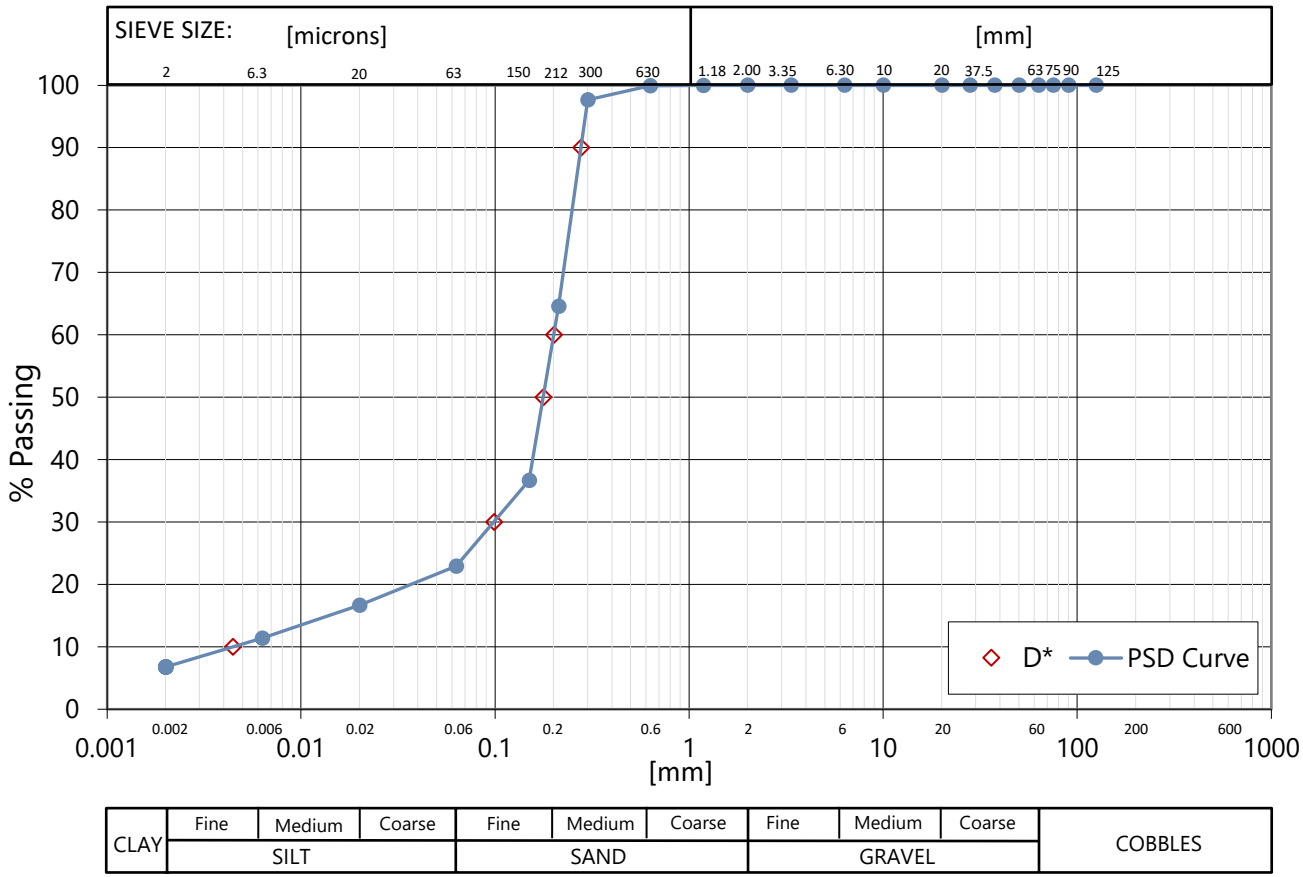
Date: 10/03/2023
Date: 14/04/2023

Template Issue: 5.0
Filename: 230054 / Labdata / Class / PSD / WP2_BH04_21_ps.XLS

Drawn by: JK
Date: 07/03/2023

% Passing	Particle Size (mm)	
100	125	Sieving
100	90.0	
100	75.0	
100	63.0	
100	50.0	
100	37.5	
100	28.0	
100	20.0	
100	10.0	
100	6.30	
100	3.35	
100	2.00	
100	1.18	
100	0.630	
98	0.300	
65	0.212	
37	0.150	
23	0.0630	
17	0.0200	Sedimen-tation
11	0.00630	
7	0.00200	

Sieving:		
Initial dry mass of sample - sieve [g]	324.96	
Sedimentation:		
Mass retained on 63µm sieve [g]	55.83	
Particle density for sedimentation (Assumed)	2.70	
Grading Analysis		
D_{90}	0.2768	[mm]
D_{60}	0.2004	[mm]
D_{50}	0.1770	[mm]
D_{30}	0.0984	[mm]
D_{10}	0.0045	[mm]



Borehole	Sample	Depth [m]	Percentage soil types				
			Clay	Silt **	Sand	Gravel	Cobbles
WP2_BH04	21.00	9.25	7	16	77	0	0

** Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Description	Remarks
Yellow silty fine to medium SAND	

Tested in accordance with ISO 17892-4: 2016 - 5.2 & 5.4 - Sieving & Sedimentation by pipette method

Checked by: LB
Approved by: PH

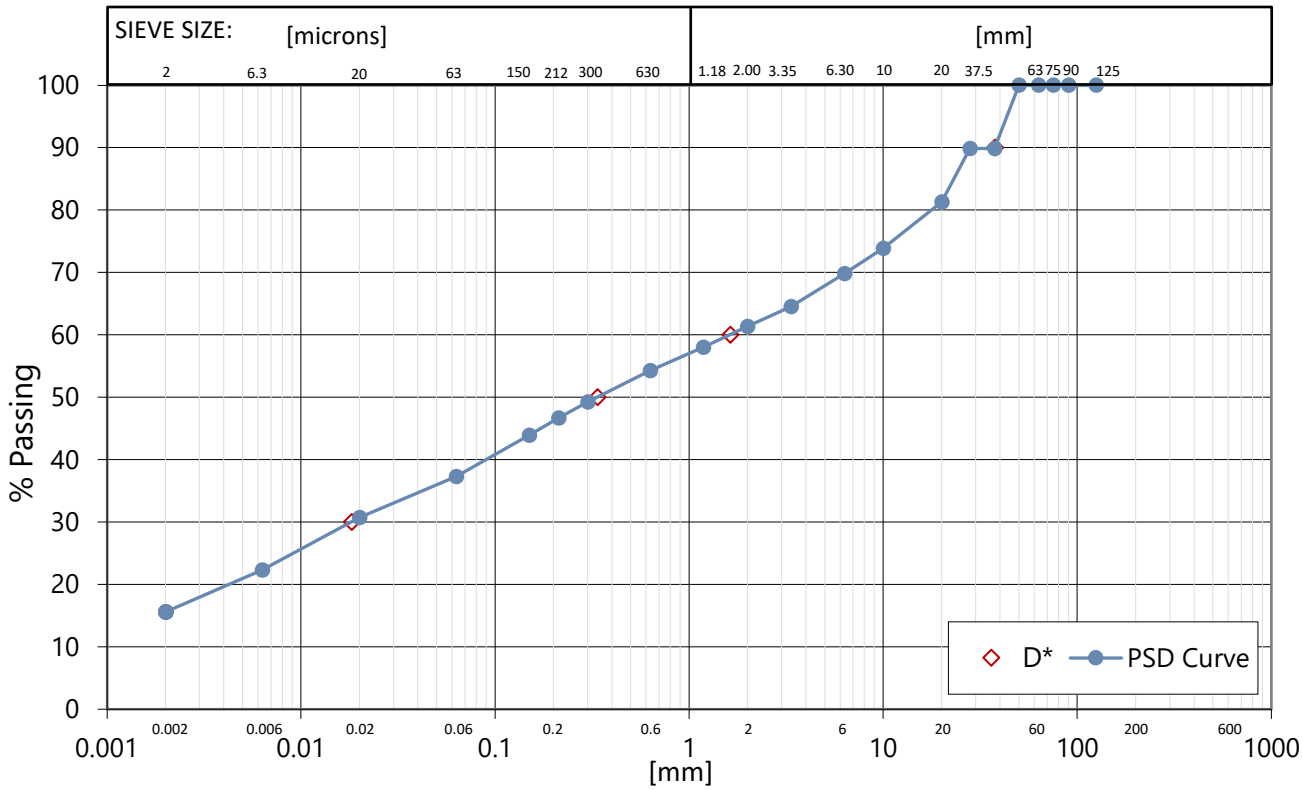
Date: 13/04/2023
Date: 14/04/2023

Template Issue: 5.0
Filename: 230054 / Labdata / Class / PSD / WP2_BH04_55_ps.XLS

Drawn by: LB
Date: 13/04/2023

% Passing	Particle Size (mm)	
100	125	Sieving
100	90.0	
100	75.0	
100	63.0	
100	50.0	
90	37.5	
90	28.0	
81	20.0	
74	10.0	
70	6.30	
65	3.35	
61	2.00	
58	1.18	
54	0.630	
49	0.300	
47	0.212	
44	0.150	
37	0.0630	
31	0.0200	Sedimen-tation
22	0.00630	
16	0.00200	

Sieving:		
Initial dry mass of sample - sieve [g]	#####	
Sedimentation:		
Mass retained on 63µm sieve [g]	9.15	
Particle density for sedimentation (Assumed)	2.70	
Grading Analysis		
D_{90}	37.6774	[mm]
D_{60}	1.6235	[mm]
D_{50}	0.3359	[mm]
D_{30}	0.0182	[mm]
D_{10}	-	[mm]



Borehole	Sample	Depth [m]	Percentage soil types				
			Clay	Silt **	Sand	Gravel	Cobbles
WP2_BH04	55.00	26.10	16	21	24	39	0

** Note: Where a sedimentation test was not carried out, this figure represents total fines, i.e., particles of diameter less than 63 microns

Description	Remarks
Grey gravelly slightly sandy CLAY. Gravel is fine to coarse	

Tested in accordance with ISO 17892-4: 2016 - 5.2 & 5.4 - Sieving & Sedimentation by pipette method

Checked by: PH Date: 22/02/2023 Template Issue: 3 Drawn by: TM Date: 20/02/2023

Approved by: PH Date: 22/02/2023 Filename: / Labdata / Class / MM /_mm list (JIP).XLS

SUMMARY OF MINIMUM AND MAXIMUM DENSITY TEST RESULTS

Minimum and maximum density determination based on the GeoLabs - Norwegian Geotechical Institute method

Borehole	Sample	Depth [m]	Maximum Dry Density [Mg/m^3]				Minimum Dry Density [Mg/m^3]	
			Before surcharge 1	Before surcharge 2	After surcharge 1	After surcharge 2		
WP2_BH04	21	9.25	1.76	1.78	1.81	1.81	1.30	*

* *Test performed is out of specification as fines content is 12-20%. Results are only indicative.*

Soil Environment Services Ltd

Soil Survey 25 years
Thermal Testing 15 years

LABORATORY TEST CERTIFICATE

Client:

Causeway Geotech Limited
Unit 1 Fingal House,
Stephenstown Industrial Estate,
Balbriggan,
Co Dublin,
K32 VR66

Contact: Sean Ross

Client Job Ref.: 21-1443E Dublin Array

Samples Received: 24/01/2023

Analysis Completed: 01/03/2023

Certificate Issued: 02/03/2023

Material: Natural Soils/ rocks

Tests: Thermal Resistivity – BS8990 hotbox

Notes:

1. Bulk samples disposed of 28 days from date of receipt unless otherwise instructed.
2. Unless otherwise stated, Soil Environment Services Ltd was not responsible for sampling.
3. This report shall not be reproduced, except in full, without written approval of Soil Environment Services Ltd.
4. Results reported relate only to the samples supplied.

Tested on behalf of ***Soil Environment Services*** by:

Dr Robin S Davies BSc PhD (Soil Physics) FISoilSci
Managing Director

Quality and Standards

We test to the requirements of the following specifications.

ENA TS 97-1, Issue 2 2016
ASTM D5334 - 14
IEEE Std 442 – 2017
National Grid TS 3.05.07
BS 1377

All test equipment is calibrated to manufacturer's requirements.

Soil Environment Services Ltd

Unit 8, Stocksfield Hall, Stocksfield,
Northumberland, NE43 7TN
Tel: 01661 844827
www.soilenvironmentservices.co.uk
Email: rd@soilenvironmentservices.co.uk

Company Registration Number 4538894 England and Wales
Directors: Dr R S Davies BSc PhD MISoilSci. Dr M T Davies BSc PhD MA

Thermal Properties - Test Data									
Laboratory sample ref:	Sample moisture status	Thermal resistivity (Km/W) Test 1	Test 2	Test 3	Average Resistivity (Km/W)	Test moisture (% w/w)	Porosity (% v/v)	Dry bulk density ($Mg/m^{3)}$	Strata Description
WP2_BH03 12.0-13.5 m 17	Saturated	0.544	0.549	0.543	0.545	18.010	**0.320**	1.794	Brown fine sandy/clayey coarse micaceous GRAVEL
	Zero m.c.	4.666	4.655	4.647	4.656	0.000			
WP2_BH04 15.0-16.5 m 36	Saturated	0.718	0.702	0.711	0.710	14.677	**0.280**	1.908	Brown fine sandy/clayey coarse GRAVEL
	Zero m.c.	5.071	5.055	5.064	5.063	0.000			
WP2_BH04 19.5-21.0 m 40	Saturated	0.520	0.528	0.551	0.533	17.766	**0.319**	1.805	Brown fine sandy/clayey coarse GRAVEL
	Zero m.c.	4.003	3.904	3.823	3.910	0.000			

Notes

1 Hotbox operates with a sample block of 18 cm x 18 cm x 9 cm depth.
2 The sample was oven dried at 105C and compacted dry to achieve a typical field density
2 A temperature difference was created fluctuating around 20C from the hot to the cool side.
3 The equilibrium period is two hours followed by three two hour test periods with readings taken every 10 seconds.
4 Calibration is undertaken with Standard BS4550 density sand at 2.63 Mg/m3. TR dry = 3.979 Km/W and saturated = 0.428 Km/W.
5 A standard heat transfer equation is used to calculate the TR.

A Test specifications

1. Determination of steady-state thermal transmission properties. Calibrated and guarded hot box - *European Standards. Standard number: BS EN ISO 8990:1996*
2. Thermal test method: *Standard Test Method for Determination of Thermal Conductivity of Soil and Soft Rock by Thermal Needle Probe Procedure. ASTM Designation D5334-14, 2015.*

B Test equipment

1. BS 8990 Hotbox
2. TEMPOS or KD2 Thermal analyser.
3. RK1 4 dia mm rock probe with a 0.5 mm copper sheath
4. ELE Proctor ~1 litre mould with an ELE 4.5 kg hammer. Or ~80 mm dia aluminium cores.
5. Impact Test Equipment soil drying oven set at 105°C.

CAUSEWAY GEOTECH

APPENDIX J

ENVIRONMENTAL LABORATORY TEST RESULTS

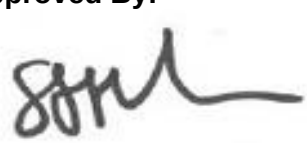
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-34352-1
Initial Date of Issue:	19-Sep-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllister Ciaran Dohert
Project	21-1443E Dub ARR Onshore Site Investigation

Quotation No.:	Q22-28722	**Date Received:**	08-Sep-2022
Order No.:		**Date Instructed:**	09-Sep-2022
No. of Samples:	1		
Turnaround (Wkdays):	7	**Results Due:**	20-Sep-2022
Date Approved:	19-Sep-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E Dub ARR Onshore Site Investigation

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-34352
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1502763
Order No.:			Client Sample Ref.:		2
			Sample Location:		WP2-BH04
			Sample Type:		SOIL
			Top Depth (m):		1.00
			Date Sampled:		06-Sep-2022
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
Moisture	N	2030	%	0.020	6.7
Alkali Reserve	N		g NaOH eq	0.010	< 0.010
pH	U	2010		4.0	8.4
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.42
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.036
Chloride (Water Soluble)	U	2220	g/l	0.010	0.48
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2455	mg/kg	0.5	5.0
Barium	U	2455	mg/kg	0	68
Beryllium	U	2455	mg/kg	0.5	< 0.5
Cadmium	U	2455	mg/kg	0.10	0.21
Chromium	U	2455	mg/kg	0.5	20
Molybdenum	U	2455	mg/kg	0.5	0.8
Antimony	N	2455	mg/kg	2.0	< 2.0
Copper	U	2455	mg/kg	0.50	23
Mercury	U	2455	mg/kg	0.05	< 0.05
Nickel	U	2455	mg/kg	0.50	22
Lead	U	2455	mg/kg	0.50	9.2
Selenium	U	2455	mg/kg	0.25	0.41
Zinc	U	2455	mg/kg	0.50	34
Chromium (Trivalent)	N	2490	mg/kg	1.0	20
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Organic Matter	U	2625	%	0.40	2.4
Total Organic Carbon	U	2625	%	0.20	1.4
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0

Results - Soil

Project: 21-1443E Dub ARR Onshore Site Investigation

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-34352
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1502763
Order No.:			Client Sample Ref.:		2
			Sample Location:		WP2-BH04
			Sample Type:		SOIL
			Top Depth (m):		1.00
			Date Sampled:		06-Sep-2022
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	0.80
Pyrene	U	2800	mg/kg	0.10	0.73
Benzo[a]anthracene	U	2800	mg/kg	0.10	0.32
Chrysene	U	2800	mg/kg	0.10	0.21
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	0.64
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	0.15
Benzo[a]pyrene	U	2800	mg/kg	0.10	0.38
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	3.2
Total Phenols	U	2920	mg/kg	0.10	< 0.10

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

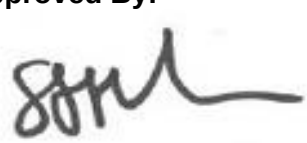
eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-34767-1
Initial Date of Issue:	22-Sep-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllister Ciaran Dohert
Project	21-1443E Dub ARR Onshore Site Investigation

Quotation No.:	Q22-28722	**Date Received:**	12-Sep-2022
Order No.:		**Date Instructed:**	12-Sep-2022
No. of Samples:	1		
Turnaround (Wkdays):	7	**Results Due:**	21-Sep-2022
Date Approved:	22-Sep-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E Dub ARR Onshore Site Investigation

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-34767
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1504701
Order No.:			Client Sample Ref.:		3
			Sample Location:		WP2_BH03
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		08-Sep-2022
			Asbestos Lab:		DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
Moisture	N	2030	%	0.020	6.3
Alkali Reserve	N		g NaOH eq	0.010	< 0.010
pH	M	2010		4.0	9.1
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010
Chloride (Water Soluble)	M	2220	g/l	0.010	< 0.010
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50
Arsenic	M	2455	mg/kg	0.5	7.4
Barium	M	2455	mg/kg	0	35
Beryllium	U	2455	mg/kg	0.5	< 0.5
Cadmium	M	2455	mg/kg	0.10	0.55
Chromium	M	2455	mg/kg	0.5	13
Molybdenum	M	2455	mg/kg	0.5	0.7
Antimony	N	2455	mg/kg	2.0	< 2.0
Copper	M	2455	mg/kg	0.50	17
Mercury	M	2455	mg/kg	0.05	0.14
Nickel	M	2455	mg/kg	0.50	15
Lead	M	2455	mg/kg	0.50	22
Selenium	M	2455	mg/kg	0.25	< 0.25
Zinc	M	2455	mg/kg	0.50	48
Chromium (Trivalent)	N	2490	mg/kg	1.0	13
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Organic Matter	M	2625	%	0.40	1.2
Total Organic Carbon	M	2625	%	0.20	0.69
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0

Results - Soil

Project: 21-1443E Dub ARR Onshore Site Investigation

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-34767
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1504701
Order No.:			Client Sample Ref.:		3
			Sample Location:		WP2_BH03
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		08-Sep-2022
			Asbestos Lab:		DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10
Benzene	M	2760	µg/kg	1.0	< 1.0
Toluene	M	2760	µg/kg	1.0	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0	< 1.0
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0
Naphthalene	M	2800	mg/kg	0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	< 0.10
Anthracene	M	2800	mg/kg	0.10	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	0.14
Pyrene	M	2800	mg/kg	0.10	0.15
Benzo[a]anthracene	M	2800	mg/kg	0.10	< 0.10
Chrysene	M	2800	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0
Total Phenols	M	2920	mg/kg	0.10	< 0.10

Results - 2 Stage WAC

Project: 21-1443E Dub ARR Onshore Site Investigation

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-34767								
Chemtest Sample ID:	1504701								
Sample Ref:	3						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:									
Sample Location:	WP2_BH03								
Top Depth(m):	0.50								
Bottom Depth(m):									
Sampling Date:	08-Sep-2022								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	M	%			0.69	3	5	6
Loss On Ignition	2610	M	%			2.3	--	--	10
Total BTEX	2760	M	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	M	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	M				9.1	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.0090	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0025	0.0014	0.0050	0.015	0.5	2	25
Barium	1455	U	0.009	< 0.005	0.018	0.014	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.015	0.0010	0.030	0.033	0.5	10	70
Copper	1455	U	0.0087	0.0016	0.017	0.014	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0073	0.0028	0.015	0.035	0.5	10	30
Nickel	1455	U	0.0007	< 0.0005	0.0013	0.0011	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0020	0.0008	0.0039	0.010	0.06	0.7	5
Selenium	1455	U	0.0018	0.0006	0.0037	0.0083	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	< 0.003	< 0.003	4	50	200
Chloride	1220	U	7.3	< 1.0	15	12	800	15000	25000
Fluoride	1220	U	0.34	0.18	< 1.0	2.1	10	150	500
Sulphate	1220	U	44	9.1	88	150	1000	20000	50000
Total Dissolved Solids	1020	N	160	95	320	1100	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	6.6	10	< 50	95	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	6.3

Leachate Test Information	
Leachant volume 1st extract/l	0.338
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.280

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)

Test Methods

SOP	Title	Parameters included	Method summary
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge
650	Characterisation of Waste (Leaching WAC)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

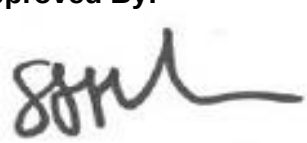
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-35424-1
Initial Date of Issue:	26-Sep-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	21-1443E DUB ARR Onshore Site Investigations

Quotation No.:	Q22-28722	**Date Received:**	15-Sep-2022
Order No.:		**Date Instructed:**	15-Sep-2022
No. of Samples:	1		
Turnaround (Wkdays):	7	**Results Due:**	26-Sep-2022
Date Approved:	26-Sep-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-35424
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1507438
Order No.:			Client Sample Ref.:		1
			Sample Location:		WP2_BH02
			Sample Type:		SOIL
			Top Depth (m):		0.5
			Date Sampled:		13-Sep-2022
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
Moisture	N	2030	%	0.020	14
Alkali Reserve	N		g NaOH eq	0.010	< 0.010
pH	U	2010		4.0	8.8
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.54
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	0.80
Arsenic	U	2455	mg/kg	0.5	8.3
Barium	U	2455	mg/kg	0	29
Beryllium	U	2455	mg/kg	0.5	0.6
Cadmium	U	2455	mg/kg	0.10	0.50
Chromium	U	2455	mg/kg	0.5	12
Molybdenum	U	2455	mg/kg	0.5	0.8
Antimony	N	2455	mg/kg	2.0	< 2.0
Copper	U	2455	mg/kg	0.50	12
Mercury	U	2455	mg/kg	0.05	< 0.05
Nickel	U	2455	mg/kg	0.50	16
Lead	U	2455	mg/kg	0.50	15
Selenium	U	2455	mg/kg	0.25	0.57
Zinc	U	2455	mg/kg	0.50	40
Chromium (Trivalent)	N	2490	mg/kg	1.0	12
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Organic Matter	U	2625	%	0.40	4.1
Total Organic Carbon	U	2625	%	0.20	2.4
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-35424
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1507438
Order No.:			Client Sample Ref.:		1
			Sample Location:		WP2_BH02
			Sample Type:		SOIL
			Top Depth (m):		0.5
			Date Sampled:		13-Sep-2022
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

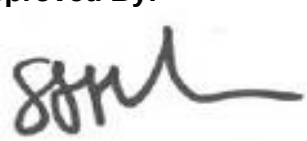
If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-36038-1
Initial Date of Issue:	30-Sep-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	21-1443E DUB ARR Onshore Site Investigations
Quotation No.:	Q22-28722
Order No.:	
No. of Samples:	1
Turnaround (Wkdays):	7
Date Approved:	30-Sep-2022
Approved By:	
Details:	Stuart Henderson, Technical Manager

Date Received:	21-Sep-2022
Date Instructed:	22-Sep-2022
Results Due:	30-Sep-2022



Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-36038
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1510111
Order No.:			Client Sample Ref.:		5
			Sample Location:		WP2-BH01
			Sample Type:		SOIL
			Top Depth (m):		1.5
			Date Sampled:		19-Sep-2022
			Asbestos Lab:		NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
Moisture	N	2030	%	0.020	7.3
Alkali Reserve	N		g NaOH eq	0.010	< 0.010
pH	U	2010		4.0	9.2
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.020
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2455	mg/kg	0.5	6.7
Barium	U	2455	mg/kg	0	23
Beryllium	U	2455	mg/kg	0.5	0.6
Cadmium	U	2455	mg/kg	0.10	0.63
Chromium	U	2455	mg/kg	0.5	6.8
Molybdenum	U	2455	mg/kg	0.5	0.8
Antimony	N	2455	mg/kg	2.0	< 2.0
Copper	U	2455	mg/kg	0.50	9.4
Mercury	U	2455	mg/kg	0.05	< 0.05
Nickel	U	2455	mg/kg	0.50	14
Lead	U	2455	mg/kg	0.50	10
Selenium	U	2455	mg/kg	0.25	0.50
Zinc	U	2455	mg/kg	0.50	28
Chromium (Trivalent)	N	2490	mg/kg	1.0	6.8
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
Organic Matter	U	2625	%	0.40	< 0.40
Total Organic Carbon	U	2625	%	0.20	< 0.20
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-36038
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1510111
Order No.:			Client Sample Ref.:		5
			Sample Location:		WP2-BH01
			Sample Type:		SOIL
			Top Depth (m):		1.5
			Date Sampled:		19-Sep-2022
			Asbestos Lab:		NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.

Report Information

Key

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I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

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Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

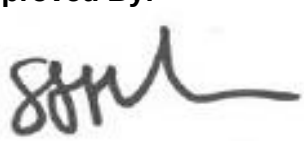
eurofins | Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-36636-1
Initial Date of Issue:	11-Oct-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	21-1443E DUB APR Onshore Site Investigations

Quotation No.:	Q22-28722	**Date Received:**	26-Sep-2022
Order No.:		**Date Instructed:**	29-Sep-2022
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	07-Oct-2022
Date Approved:	11-Oct-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E DUB APR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-36636	22-36636
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1512924	1512926
			Client Sample ID.:		1	1
			Sample Location:		WP1_BH01	WP1_BH01
			Sample Type:		SOIL	SOIL
			Top Depth (m):		1	2
			Date Sampled:		22-Sep-2022	22-Sep-2022
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	9.2	3.1
Alkali Reserve	N		g NaOH eq	0.010	< 0.010	< 0.010
pH	U	2010		4.0	8.7	9.0
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	0.021
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50
Arsenic	U	2455	mg/kg	0.5	6.8	6.5
Barium	U	2455	mg/kg	0	24	45
Beryllium	U	2455	mg/kg	0.5	< 0.5	< 0.5
Cadmium	U	2455	mg/kg	0.10	1.2	0.72
Chromium	U	2455	mg/kg	0.5	9.0	11
Molybdenum	U	2455	mg/kg	0.5	1.7	1.4
Antimony	N	2455	mg/kg	2.0	< 2.0	< 2.0
Copper	U	2455	mg/kg	0.50	18	11
Mercury	U	2455	mg/kg	0.05	< 0.05	< 0.05
Nickel	U	2455	mg/kg	0.50	27	18
Lead	U	2455	mg/kg	0.50	19	13
Selenium	U	2455	mg/kg	0.25	0.72	1.1
Zinc	U	2455	mg/kg	0.50	58	41
Chromium (Trivalent)	N	2490	mg/kg	1.0	9.0	11
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	0.47	0.52
Total Organic Carbon	U	2625	%	0.20	0.27	0.30
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1443E DUB APR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-36636	22-36636
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1512924	1512926
			Client Sample ID.:		1	1
			Sample Location:		WP1_BH01	WP1_BH01
			Sample Type:		SOIL	SOIL
			Top Depth (m):		1	2
			Date Sampled:		22-Sep-2022	22-Sep-2022
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10

Results - 2 Stage WAC

Project: 21-1443E DUB APR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-36636								
Chemtest Sample ID:	1512924								
Sample Ref:							**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:	1								
Sample Location:	WP1_BH01								
Top Depth(m):	1								
Bottom Depth(m):									
Sampling Date:	22-Sep-2022								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.27	3	5	6
Loss On Ignition	2610	U	%			2.0	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0004	0.0003	0.0007	0.0029	0.5	2	25
Barium	1455	U	< 0.005	< 0.005	< 0.0005	< 0.0005	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	0.0008	< 0.0005	0.0016	0.0007	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0054	0.0028	0.011	0.030	0.5	10	30
Nickel	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	0.0008	< 0.0005	0.0015	0.0006	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	< 0.003	< 0.003	4	50	200
Chloride	1220	U	3.7	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.37	0.20	< 1.0	2.1	10	150	500
Sulphate	1220	U	5.9	1.1	12	15	1000	20000	50000
Total Dissolved Solids	1020	N	1100	70	2200	1500	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	4.7	6.4	< 50	63	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	9.2

Leachate Test Information	
Leachant volume 1st extract/l	0.332
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.139

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)

Test Methods

SOP	Title	Parameters included	Method summary
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge
650	Characterisation of Waste (Leaching WAC)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

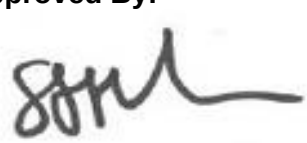
If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-37039-1
Initial Date of Issue:	12-Oct-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	21-1443E DUB ARR Onshore Site Investigations
Quotation No.:	Q22-28722
Order No.:	
No. of Samples:	4
Turnaround (Wkdays):	7
Date Approved:	12-Oct-2022
Approved By:	
Details:	Stuart Henderson, Technical Manager

Date Received:	28-Sep-2022
Date Instructed:	30-Sep-2022
Results Due:	10-Oct-2022



Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-37039	22-37039	22-37039
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1514516	1514518	1514523
Order No.:			Client Sample Ref.:		1	3	2
			Sample Location:		WP1_BH06	WP1_BH06	WP1_BH02
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.5	1.5	1.0
			Date Sampled:		26-Sep-2022	26-Sep-2022	26-Sep-2022
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	8.2	7.2	5.9
Alkali Reserve	N		g NaOH eq	0.010	< 0.010	< 0.010	< 0.010
pH	U	2010		4.0	9.0	9.1	9.0
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	< 0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Arsenic	U	2455	mg/kg	0.5	8.8	5.5	13
Barium	U	2455	mg/kg	0	36	20	23
Beryllium	U	2455	mg/kg	0.5	< 0.5	< 0.5	< 0.5
Cadmium	U	2455	mg/kg	0.10	0.63	0.85	0.98
Chromium	U	2455	mg/kg	0.5	13	7.1	8.7
Molybdenum	U	2455	mg/kg	0.5	0.9	1.5	0.8
Antimony	N	2455	mg/kg	2.0	< 2.0	< 2.0	< 2.0
Copper	U	2455	mg/kg	0.50	20	11	12
Mercury	U	2455	mg/kg	0.05	< 0.05	< 0.05	< 0.05
Nickel	U	2455	mg/kg	0.50	19	19	16
Lead	U	2455	mg/kg	0.50	15	12	14
Selenium	U	2455	mg/kg	0.25	0.57	2.2	0.63
Zinc	U	2455	mg/kg	0.50	48	44	55
Chromium (Trivalent)	N	2490	mg/kg	1.0	13	7.1	8.7
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	1.0	< 0.40	< 0.40
Total Organic Carbon	U	2625	%	0.20	0.59	< 0.20	< 0.20
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-37039	22-37039	22-37039
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1514516	1514518	1514523
Order No.:			Client Sample Ref.:		1	3	2
			Sample Location:		WP1_BH06	WP1_BH06	WP1_BH02
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.5	1.5	1.0
			Date Sampled:		26-Sep-2022	26-Sep-2022	26-Sep-2022
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	0.13	< 0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	0.13	< 0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10

Results - 2 Stage WAC

Project: 21-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-37039								
Chemtest Sample ID:	1514516								
Sample Ref:	1								
Sample ID:									
Sample Location:	WP1_BH06								
Top Depth(m):	0.5								
Bottom Depth(m):									
Sampling Date:	26-Sep-2022						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.59	3	5	6
Loss On Ignition	2610	U	%			1.8	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				9.0	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0008	0.0009	0.0015	0.0088	0.5	2	25
Barium	1455	U	0.023	0.008	0.046	0.095	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0026	0.0026	0.0052	0.026	0.5	10	70
Copper	1455	U	0.0032	0.0027	0.0065	0.0030	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0048	0.0049	0.0096	0.049	0.5	10	30
Nickel	1455	U	0.0020	0.0017	0.0039	0.017	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0005	< 0.0005	0.0011	< 0.0005	0.06	0.7	5
Selenium	1455	U	0.0017	0.0010	0.0033	0.011	0.1	0.5	7
Zinc	1455	U	0.004	0.003	0.007	0.032	4	50	200
Chloride	1220	U	3.6	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.46	0.37	< 1.0	3.8	10	150	500
Sulphate	1220	U	23	3.6	46	54	1000	20000	50000
Total Dissolved Solids	1020	N	190	86	380	950	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	5.0	3.3	< 50	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	8.2

Leachate Test Information	
Leachant volume 1st extract/l	0.334
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.163

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - 2 Stage WAC

Project: 21-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-37039								
Chemtest Sample ID:	1514522								
Sample Ref:	1								
Sample ID:									
Sample Location:	WP1_BH02								
Top Depth(m):	0.5								
Bottom Depth(m):									
Sampling Date:	26-Sep-2022						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			1.0	3	5	6
Loss On Ignition	2610	U	%			1.9	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.9	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0008	0.0017	0.0015	0.016	0.5	2	25
Barium	1455	U	0.016	0.007	0.032	0.077	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0034	0.0032	0.0067	0.032	0.5	10	70
Copper	1455	U	0.0023	0.0027	0.0046	0.0026	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0045	0.0029	0.0089	0.031	0.5	10	30
Nickel	1455	U	0.0015	0.0022	0.0029	0.021	0.4	10	40
Lead	1455	U	< 0.0005	0.0011	< 0.0005	0.0097	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	0.0012	< 0.0005	0.0024	0.0013	0.1	0.5	7
Zinc	1455	U	< 0.003	0.005	< 0.003	0.046	4	50	200
Chloride	1220	U	3.3	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.45	0.27	< 1.0	2.9	10	150	500
Sulphate	1220	U	25	2.9	50	54	1000	20000	50000
Total Dissolved Solids	1020	N	170	68	350	800	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	3.2	2.8	< 50	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	6.1

Leachate Test Information	
Leachant volume 1st extract/l	0.339
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.197

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)

Test Methods

SOP	Title	Parameters included	Method summary
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge
650	Characterisation of Waste (Leaching WAC)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

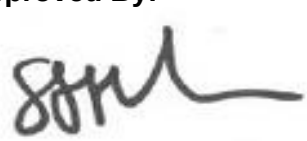
If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-37229-1
Initial Date of Issue:	12-Oct-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	21-1443E DUB ARR Onshore Site Investigation
Quotation No.:	Q22-28722
Order No.:	
No. of Samples:	3
Turnaround (Wkdays):	7
Date Approved:	12-Oct-2022
Approved By:	
Details:	Stuart Henderson, Technical Manager

Date Received:	29-Sep-2022
Date Instructed:	30-Sep-2022
Results Due:	10-Oct-2022



Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigation

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-37229	22-37229	22-37229
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1515444	1515446	1515448
Order No.:			Client Sample Ref.:		6	4	9
			Sample Location:		WP1_BH02	WP1_BH10	WP1_BH10
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		2.50	1.00	3.00
			Date Sampled:		26-Sep-2022	27-Sep-2022	27-Sep-2022
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	6.0	5.5	10
Alkali Reserve	N		g NaOH eq	0.010	< 0.010	< 0.010	< 0.010
pH	U	2010		4.0	9.2	8.5	8.9
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	< 0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	1.5	< 0.50
Arsenic	U	2455	mg/kg	0.5	8.6	8.4	8.2
Barium	U	2455	mg/kg	0	20	32	31
Beryllium	U	2455	mg/kg	0.5	< 0.5	< 0.5	< 0.5
Cadmium	U	2455	mg/kg	0.10	0.61	1.5	1.7
Chromium	U	2455	mg/kg	0.5	8.2	8.9	10
Molybdenum	U	2455	mg/kg	0.5	0.7	1.1	2.3
Antimony	N	2455	mg/kg	2.0	< 2.0	< 2.0	< 2.0
Copper	U	2455	mg/kg	0.50	11	13	25
Mercury	U	2455	mg/kg	0.05	< 0.05	< 0.05	0.06
Nickel	U	2455	mg/kg	0.50	13	17	35
Lead	U	2455	mg/kg	0.50	9.3	11	12
Selenium	U	2455	mg/kg	0.25	0.46	0.59	0.94
Zinc	U	2455	mg/kg	0.50	39	60	71
Chromium (Trivalent)	N	2490	mg/kg	1.0	8.2	8.9	10
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	0.71	0.91	0.43
Total Organic Carbon	U	2625	%	0.20	0.41	0.53	0.25
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigation

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-37229	22-37229	22-37229
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1515444	1515446	1515448
Order No.:			Client Sample Ref.:		6	4	9
			Sample Location:		WP1_BH02	WP1_BH10	WP1_BH10
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		2.50	1.00	3.00
			Date Sampled:		26-Sep-2022	27-Sep-2022	27-Sep-2022
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10

Results - 2 Stage WAC

Project: 21-1443E DUB ARR Onshore Site Investigation

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-37229								
Chemtest Sample ID:	1515446								
Sample Ref:	4								
Sample ID:							**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample Location:	WP1_BH10								
Top Depth(m):	1.00								
Bottom Depth(m):									
Sampling Date:	27-Sep-2022								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.53	3	5	6
Loss On Ignition	2610	U	%			1.3	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0005	0.0002	0.0009	0.0027	0.5	2	25
Barium	1455	U	0.013	< 0.005	0.026	0.015	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0032	0.0036	0.0065	0.036	0.5	10	70
Copper	1455	U	0.0020	0.0019	0.0040	0.0023	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0015	0.0034	0.0030	0.032	0.5	10	30
Nickel	1455	U	0.0013	0.0015	0.0025	0.014	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.06	0.7	5
Selenium	1455	U	0.0013	< 0.0005	0.0025	0.0015	0.1	0.5	7
Zinc	1455	U	0.003	0.003	0.005	0.026	4	50	200
Chloride	1220	U	4.1	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.31	0.24	< 1.0	2.5	10	150	500
Sulphate	1220	U	22	2.8	44	51	1000	20000	50000
Total Dissolved Solids	1020	N	160	71	320	820	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	3.2	2.6	< 50	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	5.5

Leachate Test Information	
Leachant volume 1st extract/l	0.340
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.206

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)

Test Methods

SOP	Title	Parameters included	Method summary
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge
650	Characterisation of Waste (Leaching WAC)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

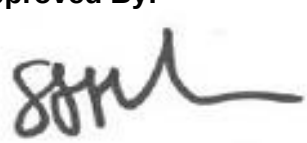
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-37976-1
Initial Date of Issue:	18-Oct-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	21-1443E DUB AEE onshore Site Investigations

Quotation No.:	Q22-28722	**Date Received:**	05-Oct-2022
Order No.:		**Date Instructed:**	06-Oct-2022
No. of Samples:	6		
Turnaround (Wkdays):	7	**Results Due:**	14-Oct-2022
Date Approved:	18-Oct-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Leachate

Project: 21-1443E DUB AEE onshore Site Investigations

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		22-37976	22-37976
Quotation No.: Q22-28722				**Chemtest Sample ID.:**		1518775	1518788
Order No.:				Client Sample Ref.:		6	14
				Sample Location:		WP1_BH04	WP1_BH08
				Sample Type:		SOIL	SOIL
				Top Depth (m):		1.0	1.5
				Date Sampled:		29-Sep-2022	01-Oct-2022
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**		
pH	U	1010	10:1		N/A	8.7	9.2
Chloride	U	1220	10:1	mg/l	1.0	< 1.0	< 1.0
Ammoniacal Nitrogen	U	1220	10:1	mg/l	0.050	< 0.050	< 0.050
Sulphate	U	1220	10:1	mg/l	1.0	3.1	< 1.0
Cyanide (Total)	U	1300	10:1	mg/l	0.050	< 0.050	0.060
Sulphide	U	1325	10:1	mg/l	0.050	< 0.050	< 0.050
Calcium	U	1455	10:1	mg/l	2.00	13	5.2
Hardness	U	1415	10:1	mg/l	15	36	< 15
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	4.4	0.76
Boron (Dissolved)	U	1455	10:1	µg/l	10.0	< 10	< 10
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11	< 0.11
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	2.1	< 0.50
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	5.9	< 0.50
Mercury (Dissolved)	U	1455	10:1	µg/l	0.05	< 0.05	< 0.05
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	4.2	< 0.50
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	2.5	< 0.50
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	0.80	< 0.50
Vanadium (Dissolved)	U	1455	10:1	µg/l	0.50	4.0	< 0.50
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	15	< 2.5
Zinc (Total)	N	1455	10:1	µg/l	2.5	15	< 2.5
Chromium (Hexavalent)	U	1490	10:1	µg/l	20	< 20	< 20
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030	< 0.030

Results - Soil

Project: 21-1443E DUB AEE onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-37976	22-37976	22-37976	22-37976	22-37976	22-37976
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1518775	1518778	1518780	1518783	1518786	1518788
Order No.:			Client Sample Ref.:		6	10	22	27	12	14
			Sample Location:		WP1_BH04	WP1_BH04	WP1_BH03	WP1_BH03	WP1_BH08	WP1_BH08
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.0	3.0	0.5	3.0	0.5	1.5
			Date Sampled:		29-Sep-2022	29-Sep-2022	01-Oct-2022	01-Oct-2022	01-Oct-2022	01-Oct-2022
			Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type	U	2192		N/A	-	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	11	8.0	12	11	9.5	3.3
Alkali Reserve	N		g NaOH eq	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
pH	U	2010		4.0	8.6	8.6	8.7	8.7	8.5	8.2
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40	< 0.40	< 0.40	1.1	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.059	0.027
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.95	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.60
Arsenic	U	2455	mg/kg	0.5	11	12	9.1	13	13	28
Barium	U	2455	mg/kg	0	27	27	30	29	460	56
Beryllium	U	2455	mg/kg	0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
Cadmium	U	2455	mg/kg	0.10	0.86	0.93	0.73	0.98	2.9	0.91
Chromium	U	2455	mg/kg	0.5	13	12	22	15	31	16
Molybdenum	U	2455	mg/kg	0.5	2.3	2.8	1.8	3.5	9.5	3.4
Antimony	N	2455	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	53	< 2.0
Copper	U	2455	mg/kg	0.50	22	24	16	26	810	25
Mercury	U	2455	mg/kg	0.05	< 0.05	< 0.05	< 0.05	< 0.05	1.7	0.06
Nickel	U	2455	mg/kg	0.50	25	26	22	28	32	27
Lead	U	2455	mg/kg	0.50	16	15	11	18	1200	21
Selenium	U	2455	mg/kg	0.25	1.2	1.5	0.86	1.4	0.36	2.8
Zinc	U	2455	mg/kg	0.50	47	41	36	47	750	44
Chromium (Trivalent)	N	2490	mg/kg	1.0	13	12	22	15	31	16
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	0.79	0.82	4.3	0.98	1.9	1.2
Total Organic Carbon	U	2625	%	0.20	0.46	0.48	2.5	0.57	1.1	0.67
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1443E DUB AEE onshore Site Investigations

Client: Causeway Geotech Ltd			Chemtest Job No.:		22-37976	22-37976	22-37976	22-37976	22-37976	22-37976
Quotation No.: Q22-28722			Chemtest Sample ID.:		1518775	1518778	1518780	1518783	1518786	1518788
Order No.:			Client Sample Ref.:		6	10	22	27	12	14
			Sample Location:		WP1_BH04	WP1_BH04	WP1_BH03	WP1_BH03	WP1_BH08	WP1_BH08
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.0	3.0	0.5	3.0	0.5	1.5
			Date Sampled:		29-Sep-2022	29-Sep-2022	01-Oct-2022	01-Oct-2022	01-Oct-2022	01-Oct-2022
			Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	2.0	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.38	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	0.22	0.19	< 0.10	< 0.10	3.3	< 0.10
Pyrene	U	2800	mg/kg	0.10	0.29	0.16	< 0.10	< 0.10	2.8	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	2.0	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	2.1	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	3.1	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	1.1	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	2.6	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	1.9	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.38	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	1.9	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	24	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.
1325	Sulphide in Waters	Sulphides	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using N,N–dimethyl-pphenylenediamine.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1490	Hexavalent Chromium in Waters	Chromium [VI]	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measurememrnt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.

Test Methods

SOP	Title	Parameters included	Method summary
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

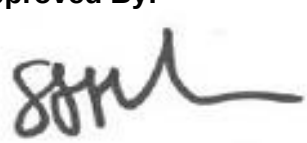
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-38435-1
Initial Date of Issue:	21-Oct-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	21-1443E DUB ARR Onshore Site Investigations

Quotation No.:	Q22-28722	**Date Received:**	07-Oct-2022
Order No.:		**Date Instructed:**	10-Oct-2022
No. of Samples:	3		
Turnaround (Wkdays):	7	**Results Due:**	18-Oct-2022
Date Approved:	21-Oct-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-38435	22-38435	22-38435
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1520937	1520938	1520941
			Client Sample ID.:		3	1	1
			Sample Location:		WP2_TP01	WP2_TP03	WP2_TP04
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		1.5	0.5	0.5
			Date Sampled:		03-Oct-2022	03-Oct-2022	03-Oct-2022
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	13	7.3	6.6
Alkali Reserve	N		g NaOH eq	0.010	< 0.010	< 0.010	< 0.010
pH	U	2010		4.0	7.7	9.0	8.7
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.40	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.017	0.023	< 0.010
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	< 0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Arsenic	U	2455	mg/kg	0.5	9.0	5.5	11
Barium	U	2455	mg/kg	0	42	49	42
Beryllium	U	2455	mg/kg	0.5	0.7	< 0.5	0.6
Cadmium	U	2455	mg/kg	0.10	0.76	0.46	0.51
Chromium	U	2455	mg/kg	0.5	12	11	20
Molybdenum	U	2455	mg/kg	0.5	2.3	0.5	0.9
Antimony	N	2455	mg/kg	2.0	< 2.0	< 2.0	< 2.0
Copper	U	2455	mg/kg	0.50	12	11	15
Mercury	U	2455	mg/kg	0.05	< 0.05	< 0.05	< 0.05
Nickel	U	2455	mg/kg	0.50	16	15	20
Lead	U	2455	mg/kg	0.50	23	14	19
Selenium	U	2455	mg/kg	0.25	0.66	0.36	0.52
Zinc	U	2455	mg/kg	0.50	55	39	65
Chromium (Trivalent)	N	2490	mg/kg	1.0	12	11	20
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	1.7	1.1	1.9
Total Organic Carbon	U	2625	%	0.20	1.0	0.63	1.1
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			Chemtest Job No.:		22-38435	22-38435	22-38435
Quotation No.: Q22-28722			Chemtest Sample ID.:		1520937	1520938	1520941
			Client Sample ID.:		3	1	1
			Sample Location:		WP2_TP01	WP2_TP03	WP2_TP04
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		1.5	0.5	0.5
			Date Sampled:		03-Oct-2022	03-Oct-2022	03-Oct-2022
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10	0.14	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10	0.13	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10

Results - 2 Stage WAC

Project: 21-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-38435								
Chemtest Sample ID:	1520937								
Sample Ref:									
Sample ID:	3								
Sample Location:	WP2_TP01								
Top Depth(m):	1.5								
Bottom Depth(m):									
Sampling Date:	03-Oct-2022								
Determinand	**SOP**	**Accred.**	**Units**				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%			1.0	3	5	6
Loss On Ignition	2610	U	%			3.3	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				7.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0039	0.0004	0.0077	0.0067	0.5	2	25
Barium	1455	U	0.020	< 0.005	0.040	0.018	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	0.0050	< 0.0005	0.010	0.0043	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0077	0.0031	0.015	0.035	0.5	10	30
Nickel	1455	U	0.0024	< 0.0005	0.0047	0.0021	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0025	< 0.0005	0.0050	0.0022	0.06	0.7	5
Selenium	1455	U	0.0022	< 0.0005	0.0044	0.0019	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	< 0.003	< 0.003	4	50	200
Chloride	1220	U	1.5	1.0	< 10	10	800	15000	25000
Fluoride	1220	U	0.41	0.35	< 1.0	3.5	10	150	500
Sulphate	1220	U	28	5.2	55	72	1000	20000	50000
Total Dissolved Solids	1020	N	150	89	310	950	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	16	9.2	< 50	97	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	13

Leachate Test Information	
Leachant volume 1st extract/l	0.323
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.151

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - 2 Stage WAC

Project: 21-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-38435								
Chemtest Sample ID:	1520941								
Sample Ref:									
Sample ID:	1								
Sample Location:	WP2_TP04								
Top Depth(m):	0.5								
Bottom Depth(m):									
Sampling Date:	03-Oct-2022								
Determinand	**SOP**	**Accred.**	**Units**				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%			1.1	3	5	6
Loss On Ignition	2610	U	%			1.6	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0077	0.0031	0.015	0.035	0.5	2	25
Barium	1455	U	0.008	0.010	0.016	0.098	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0050	0.0072	0.0099	0.071	0.5	10	70
Copper	1455	U	0.0055	0.021	0.011	0.0050	2	50	100
Mercury	1455	U	< 0.00005	0.00007	< 0.00005	0.00063	0.01	0.2	2
Molybdenum	1455	U	0.016	0.0070	0.032	0.077	0.5	10	30
Nickel	1455	U	0.0013	0.0030	0.0025	0.029	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0018	0.0067	0.0035	0.063	0.06	0.7	5
Selenium	1455	U	0.0028	0.0026	0.0056	0.026	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	< 0.003	< 0.003	4	50	200
Chloride	1220	U	9.2	5.0	18	53	800	15000	25000
Fluoride	1220	U	0.66	0.21	1.3	2.5	10	150	500
Sulphate	1220	U	47	59	94	580	1000	20000	50000
Total Dissolved Solids	1020	N	160	250	320	2400	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	11	8.5	< 50	87	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	6.6

Leachate Test Information	
Leachant volume 1st extract/l	0.338
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.140

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection

Test Methods

SOP	Title	Parameters included	Method summary
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge
650	Characterisation of Waste (Leaching WAC)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

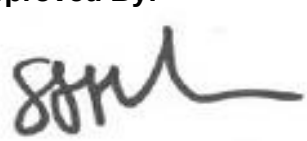
If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-38437-1
Initial Date of Issue:	25-Oct-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	22-1443E DUB ARR Onshore Site Investigations
Quotation No.:	Q22-28722
Order No.:	
No. of Samples:	6
Turnaround (Wkdays):	7
Date Approved:	25-Oct-2022
Approved By:	

Date Received:	07-Oct-2022
Date Instructed:	11-Oct-2022
Results Due:	19-Oct-2022



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Leachate

Project: 22-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		22-38437
Quotation No.: Q22-28722				**Chemtest Sample ID.:**		1520946
Order No.:				Client Sample Ref.:		2
				Sample Location:		WP1_TP05
				Sample Type:		SOIL
				Top Depth (m):		1.0
				Date Sampled:		05-Oct-2022
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**	
pH	U	1010	10:1		N/A	10.0
Chloride	U	1220	10:1	mg/l	1.0	6.3
Ammoniacal Nitrogen	U	1220	10:1	mg/l	0.050	< 0.050
Sulphate	U	1220	10:1	mg/l	1.0	19
Cyanide (Total)	U	1300	10:1	mg/l	0.050	< 0.050
Sulphide	U	1325	10:1	mg/l	0.050	< 0.050
Calcium	U	1455	10:1	mg/l	2.00	28
Hardness	U	1415	10:1	mg/l	15	71
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	8.5
Boron (Dissolved)	U	1455	10:1	µg/l	10.0	37
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	1.9
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	10
Mercury (Dissolved)	U	1455	10:1	µg/l	0.05	< 0.05
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	1.2
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	1.5
Vanadium (Dissolved)	U	1455	10:1	µg/l	0.50	15
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	< 2.5
Zinc (Total)	N	1455	10:1	µg/l	2.5	< 2.5
Chromium (Hexavalent)	U	1490	10:1	µg/l	20	< 20
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030

Results - Soil

Project: 22-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-38437	22-38437	22-38437	22-38437	22-38437	22-38437
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1520946	1520947	1520948	1520950	1520952	1520953
Order No.:			Client Sample Ref.:		2	3	1	3	2	3
			Sample Location:		WP1_TP05	WP1_TP05	WP1_TP06	WP1_TP06	WP1_TP10	WP1_TP10
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.0	1.5	0.5	1.5	1.0	1.5
			Date Sampled:		05-Oct-2022	05-Oct-2022	05-Oct-2022	05-Oct-2022	05-Oct-2022	05-Oct-2022
			Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
ACM Type	U	2192		N/A	-	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	9.0	17	8.0	16	7.7	9.4
Alkali Reserve	N		g NaOH eq	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
pH	U	2010		4.0	8.3	8.3	8.3	8.8	8.8	8.7
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.88	< 0.40	0.48	< 0.40	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.061	0.020	0.023	< 0.010	0.025	0.038
Chloride (Water Soluble)	U	2220	g/l	0.010	0.016	0.015	0.016	< 0.010	< 0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	U	2455	mg/kg	0.5	7.5	7.2	7.2	9.4	10	7.6
Barium	U	2455	mg/kg	0	42	20	22	18	34	29
Beryllium	U	2455	mg/kg	0.5	0.7	< 0.5	< 0.5	< 0.5	0.5	< 0.5
Cadmium	U	2455	mg/kg	0.10	0.90	0.69	0.73	0.91	0.86	0.70
Chromium	U	2455	mg/kg	0.5	8.2	6.9	7.2	7.2	10	7.8
Molybdenum	U	2455	mg/kg	0.5	1.2	0.8	0.7	0.8	1.4	1.0
Antimony	N	2455	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Copper	U	2455	mg/kg	0.50	16	8.9	9.2	9.0	14	12
Mercury	U	2455	mg/kg	0.05	0.15	< 0.05	< 0.05	< 0.05	0.05	< 0.05
Nickel	U	2455	mg/kg	0.50	17	14	14	15	20	17
Lead	U	2455	mg/kg	0.50	43	12	13	9.9	21	22
Selenium	U	2455	mg/kg	0.25	0.74	0.35	0.47	0.36	0.69	0.65
Zinc	U	2455	mg/kg	0.50	58	38	38	39	52	47
Chromium (Trivalent)	N	2490	mg/kg	1.0	8.2	6.9	7.2	7.2	10	7.8
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	2.8	0.71	1.6	< 0.40	0.64	0.45
Total Organic Carbon	U	2625	%	0.20	1.6	0.41	0.91	< 0.20	0.37	0.26
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 22-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-38437	22-38437	22-38437	22-38437	22-38437	22-38437
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1520946	1520947	1520948	1520950	1520952	1520953
Order No.:			Client Sample Ref.:		2	3	1	3	2	3
			Sample Location:		WP1_TP05	WP1_TP05	WP1_TP06	WP1_TP06	WP1_TP10	WP1_TP10
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.0	1.5	0.5	1.5	1.0	1.5
			Date Sampled:		05-Oct-2022	05-Oct-2022	05-Oct-2022	05-Oct-2022	05-Oct-2022	05-Oct-2022
			Asbestos Lab:		DURHAM	DURHAM	DURHAM	DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	3.9	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	1.6	5.9	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	2.4	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	0.27	< 0.10	0.26	0.23
Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	0.18	< 0.10	0.24	0.26
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - 2 Stage WAC

Project: 22-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-38437								
Chemtest Sample ID:	1520947								
Sample Ref:	3								
Sample ID:							**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample Location:	WP1_TP05								
Top Depth(m):	1.5								
Bottom Depth(m):									
Sampling Date:	05-Oct-2022								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.41	3	5	6
Loss On Ignition	2610	U	%			2.2	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.3	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.033	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0027	0.0033	0.0054	0.032	0.5	2	25
Barium	1455	U	0.027	0.011	0.054	0.14	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	< 0.0005	0.0006	< 0.0005	0.0049	0.5	10	70
Copper	1455	U	0.0041	0.0024	0.0081	0.0058	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.20	0.060	0.38	0.79	0.5	10	30
Nickel	1455	U	0.0011	< 0.0005	0.0021	0.0015	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0033	0.0032	0.0064	0.032	0.06	0.7	5
Selenium	1455	U	0.0033	0.0017	0.0064	0.019	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	< 0.003	< 0.003	4	50	200
Chloride	1220	U	13	1.2	26	28	800	15000	25000
Fluoride	1220	U	1.6	0.70	3.1	8.2	10	150	500
Sulphate	1220	U	110	15	210	280	1000	20000	50000
Total Dissolved Solids	1020	N	210	67	420	870	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	5.2	4.3	< 50	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	17

Leachate Test Information	
Leachant volume 1st extract/l	0.315
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.245

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - 2 Stage WAC

Project: 22-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-38437								
Chemtest Sample ID:	1520950								
Sample Ref:	3								
Sample ID:									
Sample Location:	WP1_TP06								
Top Depth(m):	1.5								
Bottom Depth(m):									
Sampling Date:	05-Oct-2022						**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			< 0.20	3	5	6
Loss On Ignition	2610	U	%			1.1	--	--	10
Total BTEX	2760	U	mg/kg			0.012	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.8	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.0090	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.012	0.012	0.024	0.12	0.5	2	25
Barium	1455	U	0.041	0.012	0.081	0.17	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0023	0.0020	0.0045	0.021	0.5	10	70
Copper	1455	U	0.028	0.0089	0.055	0.042	2	50	100
Mercury	1455	U	0.00014	0.00007	0.00028	0.00080	0.01	0.2	2
Molybdenum	1455	U	0.025	0.0078	0.049	0.10	0.5	10	30
Nickel	1455	U	0.0019	0.0008	0.0037	0.0094	0.4	10	40
Lead	1455	U	< 0.0005	0.0026	< 0.0005	0.022	0.5	10	50
Antimony	1455	U	0.0093	0.0026	0.018	0.036	0.06	0.7	5
Selenium	1455	U	0.0026	0.0012	0.0051	0.014	0.1	0.5	7
Zinc	1455	U	< 0.003	< 0.003	< 0.003	< 0.003	4	50	200
Chloride	1220	U	16	1.8	32	39	800	15000	25000
Fluoride	1220	U	0.93	0.26	1.8	3.6	10	150	500
Sulphate	1220	U	110	12	210	260	1000	20000	50000
Total Dissolved Solids	1020	N	210	64	410	850	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	10	6.1	< 50	67	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	16

Leachate Test Information	
Leachant volume 1st extract/l	0.317
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.259

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.
1325	Sulphide in Waters	Sulphides	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using N,N–dimethyl-pphenylenediamine.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1490	Hexavalent Chromium in Waters	Chromium [VI]	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID

Test Methods

SOP	Title	Parameters included	Method summary
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge
650	Characterisation of Waste (Leaching WAC)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

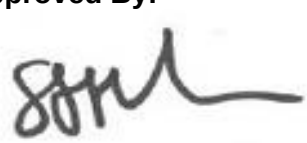
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-38438-1
Initial Date of Issue:	23-Oct-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	21-1443E DUB ARR Onshore Site Investigations

Quotation No.:	Q22-28722	**Date Received:**	07-Oct-2022
Order No.:		**Date Instructed:**	11-Oct-2022
No. of Samples:	5		
Turnaround (Wkdays):	7	**Results Due:**	19-Oct-2022
Date Approved:	23-Oct-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-38438	22-38438	22-38438	22-38438	22-38438
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1520955	1520956	1520958	1520960	1520962
			Client Sample ID.:		2	3	2	1	3
			Sample Location:		WP1_TP03	WP1_TP03	WP1_TP04	WP1_TP11	WP1_TP11
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL
			Bottom Depth (m):		1.0	1.5	1.0	0.5	1.5
			Date Sampled:		04-Oct-2022	04-Oct-2022	04-Oct-2022	04-Oct-2022	04-Oct-2022
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
ACM Type	U	2192		N/A	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	7.7	8.6	7.7	13	9.7
Alkali Reserve	N		g NaOH eq	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
pH	U	2010		4.0	8.5	8.6	8.5	8.2	8.5
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.43	< 0.40	0.56	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	U	2455	mg/kg	0.5	9.8	8.1	8.9	10	9.2
Barium	U	2455	mg/kg	0	35	28	38	46	24
Beryllium	U	2455	mg/kg	0.5	0.6	< 0.5	< 0.5	0.8	0.6
Cadmium	U	2455	mg/kg	0.10	1.2	0.77	0.85	1.1	1.3
Chromium	U	2455	mg/kg	0.5	11	8.1	7.9	8.8	10
Molybdenum	U	2455	mg/kg	0.5	1.5	1.0	0.9	1.2	1.7
Antimony	N	2455	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Copper	U	2455	mg/kg	0.50	15	11	11	11	16
Mercury	U	2455	mg/kg	0.05	0.05	< 0.05	0.05	0.06	< 0.05
Nickel	U	2455	mg/kg	0.50	23	16	15	18	28
Lead	U	2455	mg/kg	0.50	33	23	21	12	16
Selenium	U	2455	mg/kg	0.25	1.1	0.55	0.52	0.75	0.75
Zinc	U	2455	mg/kg	0.50	69	56	42	45	62
Chromium (Trivalent)	N	2490	mg/kg	1.0	11	8.1	7.9	8.8	10
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	3.4	1.5	3.3	1.0	0.62
Total Organic Carbon	U	2625	%	0.20	2.0	0.84	1.9	0.58	0.36
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-38438	22-38438	22-38438	22-38438	22-38438
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1520955	1520956	1520958	1520960	1520962
			Client Sample ID.:		2	3	2	1	3
			Sample Location:		WP1_TP03	WP1_TP03	WP1_TP04	WP1_TP11	WP1_TP11
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL
			Bottom Depth (m):		1.0	1.5	1.0	0.5	1.5
			Date Sampled:		04-Oct-2022	04-Oct-2022	04-Oct-2022	04-Oct-2022	04-Oct-2022
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**					
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - 2 Stage WAC

Project: 21-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-38438								
Chemtest Sample ID:	1520958								
Sample Ref:									
Sample ID:	2								
Sample Location:	WP1_TP04								
Top Depth(m):									
Bottom Depth(m):	1.0								
Sampling Date:	04-Oct-2022								
Determinand	**SOP**	**Accred.**	**Units**				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%			1.9	3	5	6
Loss On Ignition	2610	U	%			3.7	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.5	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.0050	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0029	0.0013	0.0057	0.015	0.5	2	25
Barium	1455	U	0.041	0.036	0.082	0.37	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0021	0.0009	0.0042	0.010	0.5	10	70
Copper	1455	U	0.0033	0.0013	0.0066	0.0041	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.012	0.0056	0.023	0.064	0.5	10	30
Nickel	1455	U	0.0011	< 0.0005	0.0022	0.0014	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0020	0.0010	0.0041	0.012	0.06	0.7	5
Selenium	1455	U	0.0020	0.0015	0.0040	0.015	0.1	0.5	7
Zinc	1455	U	0.006	< 0.003	0.013	0.008	4	50	200
Chloride	1220	U	13	< 1.0	26	16	800	15000	25000
Fluoride	1220	U	0.27	0.28	< 1.0	2.8	10	150	500
Sulphate	1220	U	1500	510	3100	6400	1000	20000	50000
Total Dissolved Solids	1020	N	1400	630	2800	7300	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	9.2	3.6	< 50	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	7.7

Leachate Test Information	
Leachant volume 1st extract/l	0.335
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.216

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection

Test Methods

SOP	Title	Parameters included	Method summary
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge
650	Characterisation of Waste (Leaching WAC)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

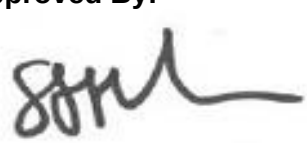
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Final Report

Report No.:	22-38975-1
Initial Date of Issue:	26-Oct-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Alistair McQuat Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAlli
Project	21-1443E Codling Wind Park - Poolbeg

Quotation No.:	Q22-28722	**Date Received:**	12-Oct-2022
Order No.:		**Date Instructed:**	13-Oct-2022
No. of Samples:	10		
Turnaround (Wkdays):	10	**Results Due:**	26-Oct-2022
Date Approved:	26-Oct-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070
Email: info@chemtest.com

Results - Leachate

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		22-38975	22-38975	22-38975
Quotation No.: Q22-28722				**Chemtest Sample ID.:**		1523407	1523409	1523415
				Sample Location:		WP1 TP07	WP1 TP12	WP1 TP01
				Sample Type:		SOIL	SOIL	SOIL
				Top Depth (m):		1.00	0.50	0.50
				Date Sampled:		10-Oct-2022	10-Oct-2022	10-Oct-2022
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**			
pH	U	1010	10:1		N/A	8.0	8.2	6.6
Chloride	U	1220	10:1	mg/l	1.0	< 1.0	< 1.0	< 1.0
Ammoniacal Nitrogen	U	1220	10:1	mg/l	0.050	0.071	0.49	< 0.050
Sulphate	U	1220	10:1	mg/l	1.0	< 1.0	21	< 1.0
Cyanide (Total)	U	1300	10:1	mg/l	0.050	0.060	0.050	0.050
Sulphide	U	1325	10:1	mg/l	0.050	< 0.050	< 0.050	< 0.050
Calcium	U	1455	10:1	mg/l	2.00	18	39	19
Hardness	U	1415	10:1	mg/l	15	48	110	50
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	0.59	1.6	0.56
Boron (Dissolved)	U	1455	10:1	µg/l	10.0	< 10	20	< 10
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11	< 0.11	< 0.11
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	< 0.50	< 0.50
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	1.6	2.6	0.96
Mercury (Dissolved)	U	1455	10:1	µg/l	0.05	< 0.05	< 0.05	< 0.05
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	0.71	2.6	< 0.50
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	< 0.50	< 0.50
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	1.2	1.1
Vanadium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	0.81	< 0.50
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	22	22	< 2.5
Zinc (Total)	N	1455	10:1	µg/l	2.5	22	23	< 2.5
Chromium (Hexavalent)	U	1490	10:1	µg/l	20	< 20	< 20	< 20
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030	< 0.030	< 0.030

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-38975	22-38975	22-38975	22-38975	22-38975	22-38975	22-38975	22-38975
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1523401	1523402	1523404	1523407	1523409	1523410	1523413	1523415
			Sample Location:		WP1 TP13	WP1 TP13	WP1 TP08	WP1 TP07	WP1 TP12	WP1 TP12	WP1 TP09	WP1 TP01
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.00	1.50	1.00	1.00	0.50	1.00	1.00	0.50
			Date Sampled:		10-Oct-2022	10-Oct-2022	10-Oct-2022	10-Oct-2022	10-Oct-2022	10-Oct-2022	10-Oct-2022	10-Oct-2022
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
ACM Type	U	2192		N/A	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	12	13	7.8	6.9	9.2	5.9	7.5	7.6
Alkali Reserve	N		g NaOH eq	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
pH	U	2010		4.0	8.2	8.2	8.6	8.6	8.4	8.4	8.7	8.7
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40	3.5	< 0.40	0.55	0.54	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.047	0.098	< 0.010	0.025
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.010	< 0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Arsenic	U	2455	mg/kg	0.5	10	7.7	8.4	9.7	8.8	8.7	5.4	6.1
Barium	U	2455	mg/kg	0	41	28	20	16	38	35	15	18
Beryllium	U	2455	mg/kg	0.5	0.6	< 0.5	< 0.5	< 0.5	0.5	< 0.5	< 0.5	< 0.5
Cadmium	U	2455	mg/kg	0.10	1.0	0.76	0.77	0.62	0.91	0.73	0.97	1.2
Chromium	U	2455	mg/kg	0.5	10	9.0	8.8	6.8	8.9	8.2	5.8	6.3
Molybdenum	U	2455	mg/kg	0.5	1.3	0.8	1.1	1.0	1.3	1.2	1.1	1.2
Antimony	N	2455	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Copper	U	2455	mg/kg	0.50	15	8.8	12	10	16	14	11	12
Mercury	U	2455	mg/kg	0.05	0.05	< 0.05	< 0.05	< 0.05	0.06	0.06	< 0.05	< 0.05
Nickel	U	2455	mg/kg	0.50	19	12	21	16	19	17	17	19
Lead	U	2455	mg/kg	0.50	26	22	13	12	29	25	8.6	9.5
Selenium	U	2455	mg/kg	0.25	0.83	0.57	0.45	0.50	0.87	0.64	0.52	0.60
Zinc	U	2455	mg/kg	0.50	60	43	48	38	60	51	40	45
Chromium (Trivalent)	N	2490	mg/kg	1.0	10	9.0	8.7	6.8	8.9	8.2	5.8	6.3
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	4.5	3.0	0.92	1.2	2.1	2.1	1.3	0.64
Total Organic Carbon	U	2625	%	0.20	2.6	1.7	0.53	0.67	1.2	1.2	0.76	0.37
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-38975	22-38975	22-38975	22-38975	22-38975	22-38975	22-38975	22-38975
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1523401	1523402	1523404	1523407	1523409	1523410	1523413	1523415
			Sample Location:		WP1 TP13	WP1 TP13	WP1 TP08	WP1 TP07	WP1 TP12	WP1 TP12	WP1 TP09	WP1 TP01
			Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		1.00	1.50	1.00	1.00	0.50	1.00	1.00	0.50
			Date Sampled:		10-Oct-2022	10-Oct-2022	10-Oct-2022	10-Oct-2022	10-Oct-2022	10-Oct-2022	10-Oct-2022	10-Oct-2022
			Asbestos Lab:		COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.33	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.14	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.39	0.56	< 0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.29	0.47	< 0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.33	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.21	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-38975	22-38975
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1523418	1523419
			Sample Location:		WP1 TP02	WP1 TP02
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		10-Oct-2022	10-Oct-2022
			Asbestos Lab:		COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	8.6	11
Alkali Reserve	N		g NaOH eq	0.010	< 0.010	< 0.010
pH	U	2010		4.0	8.7	8.7
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	1.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010
Chloride (Water Soluble)	U	2220	g/l	0.010	< 0.010	< 0.010
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50
Arsenic	U	2455	mg/kg	0.5	6.9	9.5
Barium	U	2455	mg/kg	0	19	27
Beryllium	U	2455	mg/kg	0.5	< 0.5	0.6
Cadmium	U	2455	mg/kg	0.10	1.1	1.4
Chromium	U	2455	mg/kg	0.5	8.2	12
Molybdenum	U	2455	mg/kg	0.5	1.3	1.9
Antimony	N	2455	mg/kg	2.0	< 2.0	< 2.0
Copper	U	2455	mg/kg	0.50	14	20
Mercury	U	2455	mg/kg	0.05	< 0.05	0.05
Nickel	U	2455	mg/kg	0.50	24	34
Lead	U	2455	mg/kg	0.50	12	17
Selenium	U	2455	mg/kg	0.25	0.54	0.73
Zinc	U	2455	mg/kg	0.50	50	72
Chromium (Trivalent)	N	2490	mg/kg	1.0	8.2	12
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	0.80	0.58
Total Organic Carbon	U	2625	%	0.20	0.47	0.34
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1443E DUB ARR Onshore Site Investigations

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-38975	22-38975
Quotation No.: Q22-28722			**Chemtest Sample ID.:**		1523418	1523419
			Sample Location:		WP1 TP02	WP1 TP02
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		10-Oct-2022	10-Oct-2022
			Asbestos Lab:		COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Methyl Tert-Butyl Ether	U	2760	µg/kg	1.0	< 1.0	< 1.0
Naphthalene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Fluorene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]anthracene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Chrysene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2800	mg/kg	0.10	< 0.10	< 0.10
Total Of 16 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.10	< 0.10	< 0.10

Results - 2 Stage WAC

Project: 21-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-38975								
Chemtest Sample ID:	1523402								
Sample Ref:							**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:									
Sample Location:	WP1 TP13								
Top Depth(m):	1.50								
Bottom Depth(m):									
Sampling Date:	10-Oct-2022								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			1.7	3	5	6
Loss On Ignition	2610	U	%			0.77	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.2	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.035	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0011	0.0011	0.0021	0.011	0.5	2	25
Barium	1455	U	0.015	0.006	0.031	0.068	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0005	0.0011	0.0010	0.010	0.5	10	70
Copper	1455	U	0.0029	0.0019	0.0058	0.0035	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0038	0.0037	0.0075	0.037	0.5	10	30
Nickel	1455	U	0.0013	0.0009	0.0026	0.0095	0.4	10	40
Lead	1455	U	< 0.0005	0.0005	< 0.0005	0.0047	0.5	10	50
Antimony	1455	U	0.0021	0.0014	0.0041	0.015	0.06	0.7	5
Selenium	1455	U	0.0026	0.0015	0.0052	0.016	0.1	0.5	7
Zinc	1455	U	0.011	0.012	0.022	0.12	4	50	200
Chloride	1220	U	1.8	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.34	0.30	< 1.0	3.0	10	150	500
Sulphate	1220	U	21	4.1	42	61	1000	20000	50000
Total Dissolved Solids	1020	N	250	200	490	2000	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	12	17	< 50	160	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	13

Leachate Test Information	
Leachant volume 1st extract/l	0.325
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.210

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - 2 Stage WAC

Project: 21-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-38975								
Chemtest Sample ID:	1523410								
Sample Ref:							**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:									
Sample Location:	WP1 TP12								
Top Depth(m):	1.00								
Bottom Depth(m):									
Sampling Date:	10-Oct-2022								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			1.2	3	5	6
Loss On Ignition	2610	U	%			8.0	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			2.5	100	--	--
pH	2010	U				8.4	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.025	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0049	0.0024	0.0098	0.026	0.5	2	25
Barium	1455	U	0.18	0.062	0.36	0.72	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	0.0029	0.0025	0.0058	0.0025	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.039	0.024	0.079	0.25	0.5	10	30
Nickel	1455	U	0.0069	0.0034	0.014	0.037	0.4	10	40
Lead	1455	U	0.0005	< 0.0005	0.0010	< 0.0005	0.5	10	50
Antimony	1455	U	0.0042	0.0062	0.0083	0.060	0.06	0.7	5
Selenium	1455	U	0.0027	0.0018	0.0055	0.019	0.1	0.5	7
Zinc	1455	U	0.011	0.021	0.023	0.20	4	50	200
Chloride	1220	U	10	1.9	20	26	800	15000	25000
Fluoride	1220	U	0.33	0.36	< 1.0	3.6	10	150	500
Sulphate	1220	U	110	33	210	390	1000	20000	50000
Total Dissolved Solids	1020	N	410	240	810	2500	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	18	7.7	< 50	86	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	5.9

Leachate Test Information	
Leachant volume 1st extract/l	0.339
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.152

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - 2 Stage WAC

Project: 21-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-38975								
Chemtest Sample ID:	1523413								
Sample Ref:							**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Sample ID:									
Sample Location:	WP1 TP09								
Top Depth(m):	1.00								
Bottom Depth(m):									
Sampling Date:	10-Oct-2022								
Determinand	**SOP**	**Accred.**	**Units**						
Total Organic Carbon	2625	U	%			0.76	3	5	6
Loss On Ignition	2610	U	%			3.8	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0003	0.0002	0.0006	0.0023	0.5	2	25
Barium	1455	U	0.013	< 0.005	0.027	0.015	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	70
Copper	1455	U	0.0008	< 0.0005	0.0017	0.0009	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.010	0.011	0.021	0.10	0.5	10	30
Nickel	1455	U	0.0006	< 0.0005	0.0012	0.0006	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0010	0.0007	0.0019	0.0071	0.06	0.7	5
Selenium	1455	U	0.0011	0.0008	0.0023	0.0085	0.1	0.5	7
Zinc	1455	U	0.010	0.010	0.020	0.10	4	50	200
Chloride	1220	U	3.4	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.25	0.21	< 1.0	2.1	10	150	500
Sulphate	1220	U	32	5.0	64	80	1000	20000	50000
Total Dissolved Solids	1020	N	150	76	290	840	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	5.9	5.1	< 50	52	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	7.5

Leachate Test Information	
Leachant volume 1st extract/l	0.336
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.192

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Results - 2 Stage WAC

Project: 21-1443E DUB ARR Onshore Site Investigations

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	22-38975								
Chemtest Sample ID:	1523419								
Sample Ref:									
Sample ID:									
Sample Location:	WP1 TP02								
Top Depth(m):	1.00								
Bottom Depth(m):									
Sampling Date:	10-Oct-2022								
Determinand	**SOP**	**Accred.**	**Units**				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%			0.34	3	5	6
Loss On Ignition	2610	U	%			8.5	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				8.7	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			0.0030	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1455	U	0.0004	0.0003	0.0008	0.0035	0.5	2	25
Barium	1455	U	0.011	< 0.005	0.023	0.012	20	100	300
Cadmium	1455	U	< 0.00011	< 0.00011	< 0.00011	< 0.00011	0.04	1	5
Chromium	1455	U	0.0013	< 0.0005	0.0026	0.0014	0.5	10	70
Copper	1455	U	0.0013	0.0010	0.0026	0.0014	2	50	100
Mercury	1455	U	< 0.00005	< 0.00005	< 0.00005	< 0.00005	0.01	0.2	2
Molybdenum	1455	U	0.0045	0.0052	0.0089	0.052	0.5	10	30
Nickel	1455	U	0.0006	< 0.0005	0.0013	0.0007	0.4	10	40
Lead	1455	U	< 0.0005	< 0.0005	< 0.0005	< 0.0005	0.5	10	50
Antimony	1455	U	0.0007	< 0.0005	0.0015	0.0008	0.06	0.7	5
Selenium	1455	U	0.0015	0.0010	0.0031	0.011	0.1	0.5	7
Zinc	1455	U	0.012	0.009	0.024	0.091	4	50	200
Chloride	1220	U	2.9	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.29	0.23	< 1.0	2.4	10	150	500
Sulphate	1220	U	23	3.8	46	59	1000	20000	50000
Total Dissolved Solids	1020	N	150	81	310	890	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	5.8	5.3	< 50	53	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	11

Leachate Test Information	
Leachant volume 1st extract/l	0.329
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.189

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1300	Cyanides & Thiocyanate in Waters	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Continuous Flow Analysis.
1325	Sulphide in Waters	Sulphides	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using N,N–dimethyl-pphenylenediamine.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1490	Hexavalent Chromium in Waters	Chromium [VI]	Automated colorimetric analysis by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
2220	Water soluble Chloride in Soils	Chloride	Aqueous extraction and measuremernt by 'Aquakem 600' Discrete Analyser using ferric nitrate / mercuric thiocyanate.
2300	Cyanides & Thiocyanate in Soils	Free (or easy liberatable) Cyanide; total Cyanide; complex Cyanide; Thiocyanate	Allkaline extraction followed by colorimetric determination using Automated Flow Injection Analyser.
2455	Acid Soluble Metals in Soils	Metals, including: Arsenic; Barium; Beryllium; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Vanadium; Zinc	Acid digestion followed by determination of metals in extract by ICP-MS.
2490	Hexavalent Chromium in Soils	Chromium [VI]	Soil extracts are prepared by extracting dried and ground soil samples into boiling water. Chromium [VI] is determined by 'Aquakem 600' Discrete Analyser using 1,5-diphenylcarbazide.
2610	Loss on Ignition	loss on ignition (LOI)	Determination of the proportion by mass that is lost from a soil by ignition at 550°C.
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2670	Total Petroleum Hydrocarbons (TPH) in Soils by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO*TPH C8–C40	Dichloromethane extraction / GC-FID

Test Methods

SOP	Title	Parameters included	Method summary
2680	TPH A/A Split	Aliphatics: >C5–C6, >C6–C8,>C8–C10, >C10–C12, >C12–C16, >C16–C21, >C21–C35, >C35– C44Aromatics: >C5–C7, >C7–C8, >C8– C10, >C10–C12, >C12–C16, >C16– C21, >C21– C35, >C35– C44	Dichloromethane extraction / GCxGC FID detection
2700	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-FID	Acenaphthene; Acenaphthylene; Anthracene; Benzo[a]Anthracene; Benzo[a]Pyrene; Benzo[b]Fluoranthene; Benzo[ghi]Perylene; Benzo[k]Fluoranthene; Chrysene; Dibenz[ah]Anthracene; Fluoranthene; Fluorene; Indeno[123cd]Pyrene; Naphthalene; Phenanthrene; Pyrene	Dichloromethane extraction / GC-FID (GC-FID detection is non-selective and can be subject to interference from co-eluting compounds)
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge
650	Characterisation of Waste (Leaching WAC)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

A - Date of sampling not supplied
B - Sample age exceeds stability time (sampling to extraction)
C - Sample not received in appropriate containers
D - Broken Container
E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

CAUSEWAY GEOTECH

APPENDIX K

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:	RR14.
Test Date:	01/08/2022
Report Date:	02/08/2022
File Name:	RR14..spt
Test Operator:	NPB

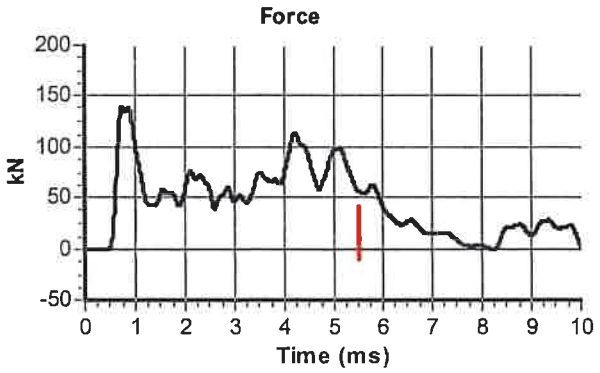
Instrumented Rod Data

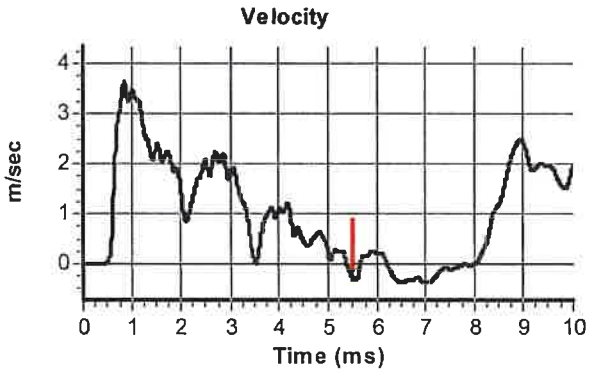
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.7
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	64786
Accelerometer No.2:	64789

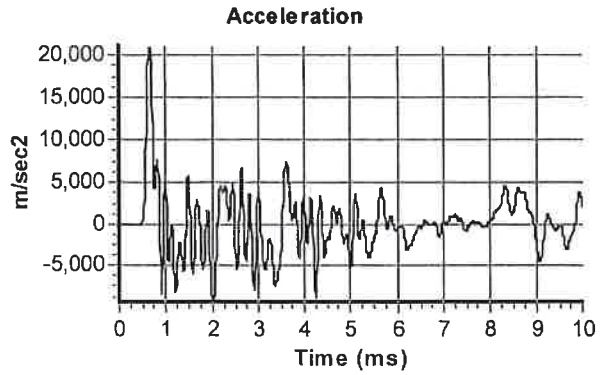
SPT Hammer Information

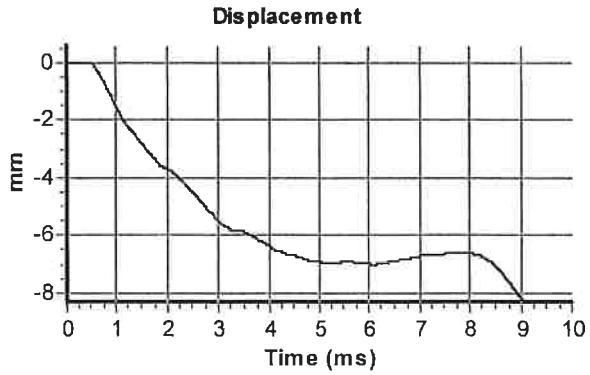
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	11.0

Comments / Location
CAUSEWAY









Calculations

Area of Rod A (mm2):	996
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	509

Energy Ratio E_r (%): 108

The recommended calibration interval is 12 months

N P Burrows

Signed: N P Burrows
Title: Field Operations Manager

CAUSEWAY GEOTECH

APPENDIX L

GROUND WATER AND GAS MONITORING RECORDS

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	17/11/2022
Weather:	Dry
Engineer:	RW

Equipment:		Geotechnical Instruments GA5000				
Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
Before:	986	0.1	0.2	21.1	0	0
After:	999	0.0	0.0	21.2	0	0

WP2-BH01	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.1	0.6	18.9	9	0
60	0.1	0.4	19.7	7	0
90	0.0	0.4	20.1	6	0
120	0.0	0.3	20.2	5	0
150	0.0	0.3	20.2	4	0
180	0.0	0.3	20.3	4	0
240	0.0	0.3	20.3	4	0
300	0.0	0.3	20.4	3	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.2

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.70
Sample collected (Y/N)	N
Sample depth	n/a
Depth of GW in deep standpipe	plug stuck

WP2-BH02	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.9	18.7	0	0
60	0.0	0.9	18.7	0	0
90	0.0	0.9	18.7	0	0
120	0.0	0.9	18.7	0	0
150	0.0	0.8	18.6	0	0
180	0.0	0.8	18.6	0	0
240	0.0	0.8	18.6	0	0
300	0.0	0.8	18.6	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.2
60	0.2
90	0.2
120	0.2
150	0.2
180	0.2
240	0.2
300	0.2

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.05
Sample collected (Y/N)	N
Sample depth	n/a
Depth of GW in deep standpipe	9.50

WP2-BH03	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.3	18.0	0.0	0.0
60	0.0	0.3	20.4	0.0	0.0
90	0.0	0.3	20.4	0.0	0.0
120	0.0	0.3	20.4	0.0	0.0
150	0.0	0.4	20.4	0.0	0.0
180	0.0	0.4	20.4	0.0	0.0
240	0.0	0.4	20.4	0.0	0.0
300	0.0	0.5	20.1	0.0	0.0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	2.05
Depth to bottom of BH	2.95
Sample collected (Y/N)	N
Sample depth	n/a
Depth of GW in deep standpipe	6.89

WP2-BH04	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.1	0.3	12.9	0.0	0.0
60	0.1	0.3	9.3	0.0	0.0
90	0.1	0.3	8.7	0.0	0.0
120	0.1	0.3	8.6	0.0	0.0
150	0.1	0.4	8.6	0.0	0.0
180	0.0	0.4	8.5	0.0	0.0
240	0.0	0.4	8.5	0.0	0.0
300	0.0	0.5	8.5	0.0	0.0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.2
120	0.2
150	0.2
180	0.2
240	0.3
300	0.3

Groundwater monitoring	mbgl
Depth to top of water	1.20
Depth to bottom of BH	2.20
Sample collected (Y/N)	N
Sample depth	n/a
Depth of GW in deep standpipe	1.20

WP1_BH01	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.1	0.3	20.9	0.0	0.0
60	0.1	0.3	20.9	0.0	0.0
90	0.1	0.3	20.9	0.0	0.0
120	0.1	0.2	20.9	0.0	0.0
150	0.1	0.2	20.9	0.0	0.0
180	0.0	0.2	20.9	0.0	0.0
240	0.0	0.2	20.9	0.0	0.0
300	0.0	0.2	20.9	0.0	0.0

Flow rates	
Time (sec)	Flow (l/h)
30	-1.8
60	-0.6
90	0.1
120	0.2
150	0.3
180	0.3
240	0.3
300	0.3

Groundwater monitoring	mbgl
Depth to top of water	2.05
Depth to bottom of BH	2.95
Sample collected (Y/N)	N
Sample depth	n/a

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	17/11/2022
Weather:	Dry
Engineer:	RW

Equipment:		Geotechnical Instruments GA5000				
Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
Before:	986	0.1	0.2	21.1	0	0
After:	999	0.0	0.0	21.2	0	0

WP1_BH03	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.4	19.9	0	0
60	0.0	0.4	20.7	0	0
90	0.0	0.2	21.0	0	0
120	0.0	0.3	21.0	0	0
150	0.0	0.2	21.1	0	0
180	0.0	0.2	21.1	0	0
240	0.0	0.2	21.1	0	0
300	0.0	0.2	21.2	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	
Depth to bottom of BH	
Sample collected (Y/N)	N
Sample depth	n/a

WP1_BH06	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.1	1.8	1.6	3	0
60	0.1	1.8	0.7	3	0
90	0.1	1.8	0.5	3	0
120	0.1	1.8	0.5	3	0
150	0.1	1.8	0.5	3	0
180	0.1	1.8	0.5	3	0
240	0.1	1.7	0.4	3	0
300	0.0	1.7	0.4	3	0

Flow rates	
Time (sec)	Flow (l/h)
30	11.2
60	13.2
90	14.6
120	15.2
150	15.6
180	15.8
240	16.0
300	16.1

Groundwater monitoring	mbgl
Depth to top of water	0.83
Depth to bottom of BH	2.30
Sample collected (Y/N)	N
Sample depth	n/a

WP1_BH08	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	3.6	3.8	0	0
60	0.0	3.6	3.4	0	0
90	0.0	3.6	3.3	0	0
120	0.0	3.6	3.2	0	0
150	0.0	3.6	3.1	0	0
180	0.0	3.7	3.1	0	0
240	0.0	3.7	3.1	0	0
300	0.0	3.7	3.0	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.2
90	0.2
120	0.2
150	0.2
180	0.2
240	0.2
300	0.2

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.18
Sample collected (Y/N)	N
Sample depth	n/a

WP1_BH10	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	2.0	14.8	0	0
60	0.0	2.0	15.0	0	0
90	0.0	2.0	15.2	0	0
120	0.0	1.9	15.5	0	0
150	0.0	1.9	15.7	0	0
180	0.0	1.9	15.8	0	0
240	0.0	1.8	16.0	0	0
300	0.0	1.8	16.1	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	1.91
Sample collected (Y/N)	N
Sample depth	n/a

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	04/01/2023
Weather:	Dry
Engineer:	MRG

Equipment:		Geotechnical Instruments GA5000				
Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
Before:	1004	0.0	0.2	20.0	1	0
After:	1004	0.0	0.2	20.0	1	0

WP2-BH01	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.7	20.7	4	0
60	0.0	0.7	20.7	4	0
90	0.0	0.8	20.6	3	0
120	0.0	0.8	20.7	3	0
150	0.0	0.8	20.4	3	0
180	0.0	0.8	20.4	3	0
240	0.0	0.8	20.4	3	0
300	0.0	0.8	20.4	2	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.2
60	0.2
90	0.2
120	0.2
150	0.2
180	0.2
240	0.2
300	0.2

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.70
Sample collected (Y/N)	N
Sample depth	n/a
Depth of GW in deep standpipe	6.48

WP2-BH03	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.2	20.6	0	0
60	0.0	0.2	20.6	0	0
90	0.0	0.2	20.6	0	0
120	0.0	0.3	20.7	0	0
150	0.0	0.3	20.8	0	0
180	0.0	0.3	20.8	0	0
240	0.0	0.3	20.8	0	0
300	0.0	0.3	20.8	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.2
90	0.2
120	0.2
150	0.2
180	0.2
240	0.2
300	0.2

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.05
Sample collected (Y/N)	N
Sample depth	n/a
Depth of GW in deep standpipe	6.22

WP2_BH02 and WP2_BH04 standpipes were removed in December 2022

WP1_BH01	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.1	20.5	1.0	0.0
60	0.0	0.3	20.5	1.0	0.0
90	0.0	0.3	20.5	1.0	0.0
120	0.0	0.2	20.5	1.0	1.0
150	0.0	0.2	20.5	1.0	1.0
180	0.0	0.2	20.5	1.0	1.0
240	0.0	0.2	20.5	1.0	0.0
300	0.0	0.2	20.5	1.0	0.0

Flow rates	
Time (sec)	Flow (l/h)
30	2.8
60	2.7
90	1.2
120	1.0
150	1.0
180	1.0
240	1.0
300	1.0

Groundwater monitoring	mbgl
Depth to top of water	0.63
Depth to bottom of BH	2.22
Sample collected (Y/N)	N
Sample depth	n/a

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	04/01/2023
Weather:	Dry
Engineer:	MRG

Equipment:		Geotechnical Instruments GA5000				
Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
Before:	1004	0.0	0.2	20.0	1	0
After:	1004	0.0	0.2	20.0	1	0

WP1_BH03	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.1	18.9	0	0
60	0.0	0.4	20.4	0	0
90	0.0	0.4	20.4	0	0
120	0.0	0.6	20.1	0	0
150	0.0	0.8	19.6	0	0
180	0.0	1.0	19.4	0	0
240	0.0	1.0	19.4	0	0
300	0.0	1.0	19.4	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	2.21
Depth to bottom of BH	2.30
Sample collected (Y/N)	N
Sample depth	n/a

WP1_BH06	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	1.3	14.0	3	0
60	0.0	1.3	13.9	3	0
90	0.0	1.3	13.9	3	0
120	0.0	1.3	13.8	3	0
150	0.0	1.3	13.8	3	0
180	0.0	1.3	13.8	3	0
240	0.0	1.3	13.7	3	0
300	0.0	1.3	13.7	3	0

Flow rates	
Time (sec)	Flow (l/h)
30	-15.6
60	-10.1
90	-8.2
120	-4.2
150	-4.0
180	-4.0
240	-4.0
300	-4.0

Groundwater monitoring	mbgl
Depth to top of water	0.72
Depth to bottom of BH	2.30
Sample collected (Y/N)	N
Sample depth	n/a

WP1_BH08	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	6.4	4.4	0	0
60	0.0	6.4	4.3	0	0
90	0.0	6.4	4.3	0	0
120	0.0	6.4	4.2	0	0
150	0.0	6.5	4.1	0	0
180	0.0	6.5	4.1	0	0
240	0.0	6.5	4.1	0	0
300	0.0	6.5	4.1	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	-0.1
60	0.0
90	0.0
120	0.0
150	0.0
180	0.0
240	0.0
300	0.0

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.18
Sample collected (Y/N)	N
Sample depth	n/a

WP1_BH10	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.8	20.3	0	0
60	0.0	0.8	20.2	0	0
90	0.0	0.8	20.2	0	0
120	0.0	0.8	20.2	0	0
150	0.0	0.8	20.2	0	0
180	0.0	0.8	20.2	0	0
240	0.0	0.8	20.2	0	0
300	0.0	0.8	20.2	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	1.91
Sample collected (Y/N)	N
Sample depth	n/a

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	08/02/2023
Weather:	Dry
Engineer:	RW

Equipment:		Geotechnical Instruments GA5000				
Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
Before:	1024	0.0	0.2	21.7	0	0
After:	1024	0.0	0.3	22.0	0	0

Shanganagh Cliffs

WP2-BH01	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.4	21.5	0	0
60	0.0	0.3	21.5	0	0
90	0.0	0.3	21.5	0	0
120	0.0	0.3	21.6	0	0
150	0.0	0.3	21.6	0	0
180	0.0	0.2	21.6	0	0
240	0.0	0.2	21.6	0	0
300	0.0	0.2	21.6	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.0
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water shallow well	No Access
Depth to bottom of BH shallow well	No Access
Install from Log	2.0
Depth to top of water shallow well	3.03
Depth to bottom of BH shallow well	7.20
Install from Log	7.5

WP2-BH03	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	1.3	20.4	0	0
60	0.0	1.3	20.4	0	0
90	0.0	1.4	20.3	0	0
120	0.0	1.6	20.1	0	0
150	0.0	1.7	20.0	0	0
180	0.0	1.9	19.8	0	0
240	0.0	2.3	19.4	0	0
300	0.0	2.5	19.2	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water shallow well	Dry
Depth to bottom of BH shallow well	3.00
Install from Log	3.0
Depth to top of water shallow well	7.10
Depth to bottom of BH shallow well	12.00
Install from Log	12.0

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	08/02/2023
Weather:	Dry
Engineer:	RW

Equipment:		Geotechnical Instruments GA5000				
Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
Before:	1024	0.0	0.2	21.7	0	0
After:	1024	0.0	0.3	22.0	0	0

Ballyogan Landfill

WP1_BH01	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.2	21.7	0	0
60	0.0	0.2	21.7	0	0
90	0.0	0.2	21.7	0	0
120	0.0	0.2	21.7	0	0
150	0.0	0.2	21.7	0	0
180	0.0	0.2	21.7	0	0
240	0.0	0.2	21.7	0	0
300	0.0	0.2	21.7	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	1.5
Depth to bottom of BH	2.2
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH03	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	3.9	12.2	0	0
60	0.0	2.5	16.2	0	0
90	0.0	4.3	12.9	0	0
120	0.0	3.8	13.6	0	0
150	0.0	2.8	15.9	0	0
180	0.0	3.0	14.7	0	0
240	0.0	3.6	13.0	0	0
300	0.0	5.7	9.9	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH06	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	2.9	4.0	0	0
60	0.0	2.9	2.7	0	0
90	0.0	2.9	2.5	0	0
120	0.0	2.9	2.4	0	0
150	0.0	2.9	2.2	0	0
180	0.0	2.9	2.0	0	0
240	0.0	3.0	1.9	0	0
300	0.0	3.0	1.6	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	2.1
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH08	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	6.1	11.6	0	0
60	0.0	6.1	10.8	0	0
90	0.0	6.2	10.7	0	0
120	0.0	6.2	10.6	0	0
150	0.0	6.2	10.5	0	0
180	0.0	6.2	10.4	0	0
240	0.0	6.3	10.3	0	0
300	0.0	6.3	10.2	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.2
150	0.2
180	0.2
240	0.2
300	0.2

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.2
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH10	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.8	21.1	0	0
60	0.0	0.8	21.1	0	0
90	0.0	0.8	21.0	0	0
120	0.0	0.8	21.0	0	0
150	0.0	0.8	21.0	0	0
180	0.0	0.8	21.0	0	0
240	0.0	0.8	21.0	0	0
300	0.0	0.8	20.9	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	09/03/2023
Weather:	Dry
Engineer:	RW

Equipment:		**Geotechnical Instruments GA5000**				
Ambient Conditions	**Barometric Pressure**	**CH_4 (%)**	**CO_2 (%)**	**O_2 (%)**	**CO (ppm)**	**H_2S (ppm)**
Before:	994	0.0	0.1	19.3	0.1	0
After:	994	0.0	0.1	19.3	0.0	0

Shanganagh Cliffs

WP2-BH01	**Gas readings**				
Time (sec)	**CH_4 (%)**	**CO_2 (%)**	**O_2 (%)**	**CO (ppm)**	**H_2S (ppm)**
30	0.0	0.6	20.4	4.3	0.0
60	0.0	0.5	20.6	3.7	0.0
90	0.0	0.5	20.7	3.0	0.0
120	0.0	0.5	20.8	2.7	0.0
150	0.0	0.5	20.7	2.3	0.0
180	0.0	0.4	20.8	2.3	0.0
240	0.0	0.4	20.8	2.3	0.0
300	0.0	0.4	20.8	1.7	0.0

Flow rates	
Time (sec)	**Flow (l/h)**
30	0.1
60	0.2
90	0.2
120	0.2
150	0.2
180	0.2
240	0.2
300	0.2

Groundwater monitoring	**mbgl**
Depth to top of water shallow well	No Access
Depth to bottom of BH shallow well	No Access
Install from Log	2.0
Depth to top of water deep well	2.98
Depth to bottom of BH deep well	7.14
Install from Log	7.5

WP2-BH03	**Gas readings**				
Time (sec)	**CH_4 (%)**	**CO_2 (%)**	**O_2 (%)**	**CO (ppm)**	**H_2S (ppm)**
30	0.0	0.6	19.7	0.0	0.0
60	0.0	0.6	20.5	0.0	0.0
90	0.0	0.6	20.4	0.0	0.0
120	0.0	0.7	20.4	0.0	0.0
150	0.0	0.8	20.4	0.0	0.0
180	0.0	0.9	20.3	0.0	0.0
240	0.0	1.0	20.2	0.0	0.0
300	0.0	1.1	20.0	0.0	0.0

Flow rates	
Time (sec)	**Flow (l/h)**
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	**mbgl**
Depth to top of water shallow well	Dry
Depth to bottom of BH shallow well	3.00
Install from Log	3.0
Depth to top of water shallow well	6.92
Depth to bottom of BH shallow well	12.00
Install from Log	12.0

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	09/03/2023
Weather:	Dry
Engineer:	RW

Equipment:		Geotechnical Instruments GA5000				
Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
Before:	994	0.0	0.1	19.3	0.1	0
After:	994	0.0	0.1	19.3	0.0	0

Ballyogan Landfill

WP1_BH01	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.2	21.0	0.3	0.0
60	0.0	0.3	21.0	0.3	0.0
90	0.0	0.3	21.0	0.3	0.0
120	0.0	0.2	21.0	0.3	0.3
150	0.0	0.2	21.0	0.3	0.3
180	0.0	0.2	21.0	0.3	0.3
240	0.0	0.2	21.0	0.3	0.0
300	0.0	0.2	21.0	0.3	0.0

Flow rates	
Time (sec)	Flow (l/h)
30	-4.2
60	-1.0
90	-0.4
120	-0.2
150	0.0
180	0.0
240	0.0
300	0.0

Groundwater monitoring	mbgl
Depth to top of water	1.3
Depth to bottom of BH	2.2
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH03	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	1.5	17.0	0	0
60	0.0	1.1	19.1	0	0
90	0.0	1.6	18.1	0	0
120	0.0	1.6	18.2	0	0
150	0.0	1.3	18.9	0	0
180	0.0	1.4	18.4	0	0
240	0.0	1.6	17.8	0	0
300	0.0	2.3	16.8	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH06	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	2.0	6.5	2	0
60	0.0	2.0	5.8	2	0
90	0.0	2.0	5.6	2	0
120	0.0	2.0	5.6	2	0
150	0.0	2.0	5.5	2	0
180	0.0	2.0	5.4	2	0
240	0.0	2.0	5.3	2	0
300	0.0	2.0	5.2	2	0

Flow rates	
Time (sec)	Flow (l/h)
30	-5.4
60	-4.8
90	-3.1
120	-2.5
150	-1.5
180	-1.0
240	-0.5
300	-0.5

Groundwater monitoring	mbgl
Depth to top of water	1.3
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH08	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0	5.4	6.6	0	0
60	0	5.4	6.2	0	0
90	0	5.4	6.1	0	0
120	0	5.4	6.0	0	0
150	0	5.4	5.9	0	0
180	0	5.5	5.9	0	0
240	0	5.5	5.8	0	0
300	0	5.5	5.8	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.2
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH10	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0	1.2	18.7	0	0
60	0	1.2	18.8	0	0
90	0	1.2	18.8	0	0
120	0	1.2	18.9	0	0
150	0	1.2	19.0	0	0
180	0	1.2	19.0	0	0
240	0	1.1	19.1	0	0
300	0	1.1	19.1	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	06/04/2023
Weather:	Dry
Engineer:	RW

Equipment:		**Geotechnical Instruments GA5000**				
Ambient Conditions	**Barometric Pressure**	**CH_4 (%)**	**CO_2 (%)**	**O_2 (%)**	**CO (ppm)**	**H_2S (ppm)**
Before:	1001	0.0	0.2	20.1	0	0
After:	1001	0.0	0.2	20.1	0	0

Shanganagh Cliffs

WP2-BH01	**Gas readings**				
Time (sec)	**CH_4 (%)**	**CO_2 (%)**	**O_2 (%)**	**CO (ppm)**	**H_2S (ppm)**
30	0.0	1.3	18.9	3.7	0.0
60	0.0	1.2	19.1	3.1	0.0
90	0.0	1.3	19.2	2.6	0.0
120	0.0	1.3	19.2	2.3	0.0
150	0.0	1.4	19.0	2.1	0.0
180	0.0	1.3	19.1	2.1	0.0
240	0.0	1.3	19.1	2.1	0.0
300	0.0	1.3	19.1	1.5	0.0

Flow rates	
Time (sec)	**Flow (l/h)**
30	0.1
60	0.2
90	0.2
120	0.2
150	0.2
180	0.2
240	0.2
300	0.2

Groundwater monitoring	**mbgl**
Depth to top of water shallow well	No Access
Depth to bottom of BH shallow well	No Access
Install from Log	2.0
Depth to top of water deep well	2.98
Depth to bottom of BH deep well	7.14
Install from Log	7.5

WP2-BH03	**Gas readings**				
Time (sec)	**CH_4 (%)**	**CO_2 (%)**	**O_2 (%)**	**CO (ppm)**	**H_2S (ppm)**
30	0.0	1.5	18.5	0.0	0.0
60	0.0	1.5	19.1	0.0	0.0
90	0.0	1.6	18.9	0.0	0.0
120	0.0	1.6	19.0	0.0	0.0
150	0.0	1.7	19.0	0.0	0.0
180	0.0	1.8	18.9	0.0	0.0
240	0.0	1.9	18.8	0.0	0.0
300	0.0	1.9	18.7	0.0	0.0

Flow rates	
Time (sec)	**Flow (l/h)**
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	**mbgl**
Depth to top of water shallow well	Dry
Depth to bottom of BH shallow well	3.00
Install from Log	3.0
Depth to top of water shallow well	6.40
Depth to bottom of BH shallow well	12.00
Install from Log	12.0

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	06/04/2023
Weather:	Dry
Engineer:	RW

Equipment:		Geotechnical Instruments GA5000				
Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
Before:	1001	0.0	0.2	20.1	0	0
After:	1001	0.0	0.2	20.1	0	0

Ballyogan Landfill

WP1_BH01	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.2	20.8	0.3	0.0
60	0.0	0.2	20.8	0.3	0.0
90	0.0	0.2	20.8	0.3	0.0
120	0.0	0.2	20.8	0.3	0.3
150	0.0	0.2	20.8	0.3	0.3
180	0.0	0.2	20.8	0.3	0.3
240	0.0	0.2	20.8	0.3	0.0
300	0.0	0.2	20.8	0.3	0.0

Flow rates	
Time (sec)	Flow (l/h)
30	-4.2
60	-1.0
90	-0.4
120	-0.2
150	0.0
180	0.0
240	0.0
300	0.0

Groundwater monitoring	mbgl
Depth to top of water	1.3
Depth to bottom of BH	2.2
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH03	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	1.2	17.5	0.0	0.0
60	0.0	0.9	19.2	0.0	0.0
90	0.0	1.3	18.5	0.0	0.0
120	0.0	1.3	18.6	0.0	0.0
150	0.0	1.1	19.1	0.0	0.0
180	0.0	1.2	18.7	0.0	0.0
240	0.0	1.3	18.2	0.0	0.0
300	0.0	1.9	17.4	0.0	0.0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH06	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	2.2	5.5	1.6	0.0
60	0.0	2.2	4.8	1.6	0.0
90	0.0	2.2	4.7	1.6	0.0
120	0.0	2.2	4.7	1.6	0.0
150	0.0	2.2	4.6	1.6	0.0
180	0.0	2.2	4.5	1.6	0.0
240	0.0	2.2	4.5	1.6	0.0
300	0.0	2.2	4.4	1.6	0.0

Flow rates	
Time (sec)	Flow (l/h)
30	-5.4
60	-4.8
90	-3.1
120	-2.5
150	-1.5
180	-1.0
240	-0.5
300	-0.5

Groundwater monitoring	mbgl
Depth to top of water	0.8
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH08	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	5.0	6.5	0.0	0.0
60	0.0	5.0	6.0	0.0	0.0
90	0.0	5.0	5.7	0.0	0.0
120	0.0	5.0	5.4	0.0	0.0
150	0.0	5.0	5.3	0.0	0.0
180	0.0	5.1	5.2	0.0	0.0
240	0.0	5.1	5.2	0.0	0.0
300	0.0	5.1	5.2	0.0	0.0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.2
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH10	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	1.0	18.7	0.0	0.0
60	0.0	1.0	18.8	0.0	0.0
90	0.0	1.0	18.8	0.0	0.0
120	0.0	1.0	18.9	0.0	0.0
150	0.0	1.0	18.9	0.0	0.0
180	0.0	1.0	18.9	0.0	0.0
240	0.0	1.0	19.0	0.0	0.0
300	0.0	1.0	19.0	0.0	0.0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	05/05/2023
Weather:	Dry
Engineer:	MRG

Equipment:		**Geotechnical Instruments GA5000**				
Ambient Conditions	**Barometric Pressure**	**CH_4 (%)**	**CO_2 (%)**	**O_2 (%)**	**CO (ppm)**	**H_2S (ppm)**
Before:	1007	0.0	0.1	19.8	1	0
After:	1007	0.0	0.1	19.8	0	0

Shanganagh Cliffs

WP2-BH01	**Gas readings**				
Time (sec)	**CH_4 (%)**	**CO_2 (%)**	**O_2 (%)**	**CO (ppm)**	**H_2S (ppm)**
30	0.0	4.2	13.2	1	0
60	0.0	4.3	13.0	1	0
90	0.0	4.4	12.9	1	0
120	0.0	4.5	12.5	1	0
150	0.0	4.9	12.3	1	0
180	0.0	5.0	12.4	1	0
240	0.0	5.0	12.4	1	0
300	0.0	5.0	12.4	1	0

Flow rates	
Time (sec)	**Flow (l/h)**
30	0.1
60	0.2
90	0.2
120	0.2
150	0.2
180	0.2
240	0.2
300	0.2

Groundwater monitoring	**mbgl**
Depth to top of water shallow well	No Access
Depth to bottom of BH shallow well	No Access
Install from Log	2.0
Depth to top of water deep well	2.46
Depth to bottom of BH deep well	7.14
Install from Log	7.5

WP2-BH03	**Gas readings**				
Time (sec)	**CH_4 (%)**	**CO_2 (%)**	**O_2 (%)**	**CO (ppm)**	**H_2S (ppm)**
30	0.0	5.2	13.6	0	0
60	0.0	5.3	13.4	0	0
90	0.0	5.3	13.0	0	0
120	0.0	5.3	13.4	0	0
150	0.0	5.3	13.4	0	0
180	0.0	5.3	13.4	0	0
240	0.0	5.3	13.4	0	0
300	0.0	5.3	13.4	0	0

Flow rates	
Time (sec)	**Flow (l/h)**
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	**mbgl**
Depth to top of water shallow well	Dry
Depth to bottom of BH shallow well	3.00
Install from Log	3.0
Depth to top of water shallow well	6.33
Depth to bottom of BH shallow well	12.00
Install from Log	12.0

Groundwater Ground Gas Monitoring

Site:	Dublin Array Onshore GI
Project No.:	21-1443E
Date:	05/05/2023
Weather:	Dry
Engineer:	MRG

Equipment:		Geotechnical Instruments GA5000				
Ambient Conditions	Barometric Pressure	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
Before:	1007	0.0	0.1	19.8	1	0
After:	1007	0.0	0.1	19.8	0	0

Ballyogan Landfill

WP1_BH01	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.1	20.1	0	0
60	0.0	0.1	20.1	0	0
90	0.0	0.1	20.1	0	0
120	0.0	0.1	20.1	0	0
150	0.0	0.1	20.1	0	0
180	0.0	0.1	20.1	0	0
240	0.0	0.1	20.1	0	0
300	0.0	0.1	20.1	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	-4.2
60	-1.0
90	-0.4
120	-0.2
150	0.0
180	0.0
240	0.0
300	0.0

Groundwater monitoring	mbgl
Depth to top of water	0.7
Depth to bottom of BH	2.2
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH03	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.3	19.5	0	0
60	0.0	0.2	19.8	0	0
90	0.0	0.2	19.9	0	0
120	0.0	0.2	20.1	0	0
150	0.0	0.2	20.0	0	0
180	0.0	0.2	20.0	0	0
240	0.0	0.2	19.9	0	0
300	0.0	0.2	19.9	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH06	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	2.8	1.2	0	0
60	0.0	2.8	1.0	0	0
90	0.0	2.8	1.0	0	0
120	0.0	2.8	1.0	0	0
150	0.0	2.8	1.0	0	0
180	0.0	2.8	1.0	0	0
240	0.0	2.8	1.0	0	0
300	0.0	2.8	1.0	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	-5.4
60	-4.8
90	-3.1
120	-2.5
150	-1.5
180	-1.0
240	-0.5
300	-0.5

Groundwater monitoring	mbgl
Depth to top of water	0.7
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH08	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	3.5	6.0	0	0
60	0.0	3.5	5.5	0	0
90	0.0	3.5	4.1	0	0
120	0.0	3.5	3.1	0	0
150	0.0	3.5	2.8	0	0
180	0.0	3.5	2.7	0	0
240	0.0	3.5	2.7	0	0
300	0.0	3.5	2.7	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.2
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

WP1_BH10	Gas readings				
Time (sec)	CH_4 (%)	CO_2 (%)	O_2 (%)	CO (ppm)	H_2S (ppm)
30	0.0	0.4	18.7	0	0
60	0.0	0.4	18.7	0	0
90	0.0	0.4	18.7	0	0
120	0.0	0.4	18.7	0	0
150	0.0	0.4	18.7	0	0
180	0.0	0.4	18.7	0	0
240	0.0	0.4	18.7	0	0
300	0.0	0.4	18.7	0	0

Flow rates	
Time (sec)	Flow (l/h)
30	0.1
60	0.1
90	0.1
120	0.1
150	0.1
180	0.1
240	0.1
300	0.1

Groundwater monitoring	mbgl
Depth to top of water	Dry
Depth to bottom of BH	2.1
Install from Log	2.0
Sample collected (Y/N)	N
Sample depth	-

CAUSEWAY GEOTECH

APPENDIX M

VARIABLE HEAD TESTING

VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 22/09/2022

Borehole No.: WP1-BH01
Test No.: 1
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	1.00m
Depth to bottom of casing below ground level:	2.50m
Depth to bottom of borehole below ground level:	3.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	1.90m

DATUM: Water level measured from top of casing, i.e. SWL is 2.90m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.82	2.08	1.00
1	0.82	2.08	1.00
2	0.82	2.08	1.00
3	0.93	1.97	0.95
5	0.94	1.96	0.94
7	0.96	1.94	0.93
10	0.99	1.91	0.92
15	1.00	1.90	0.91
20	1.01	1.89	0.91
25	1.02	1.88	0.90
30	1.03	1.87	0.90
40	1.04	1.86	0.89
50	1.06	1.84	0.88
60	1.06	1.84	0.88

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

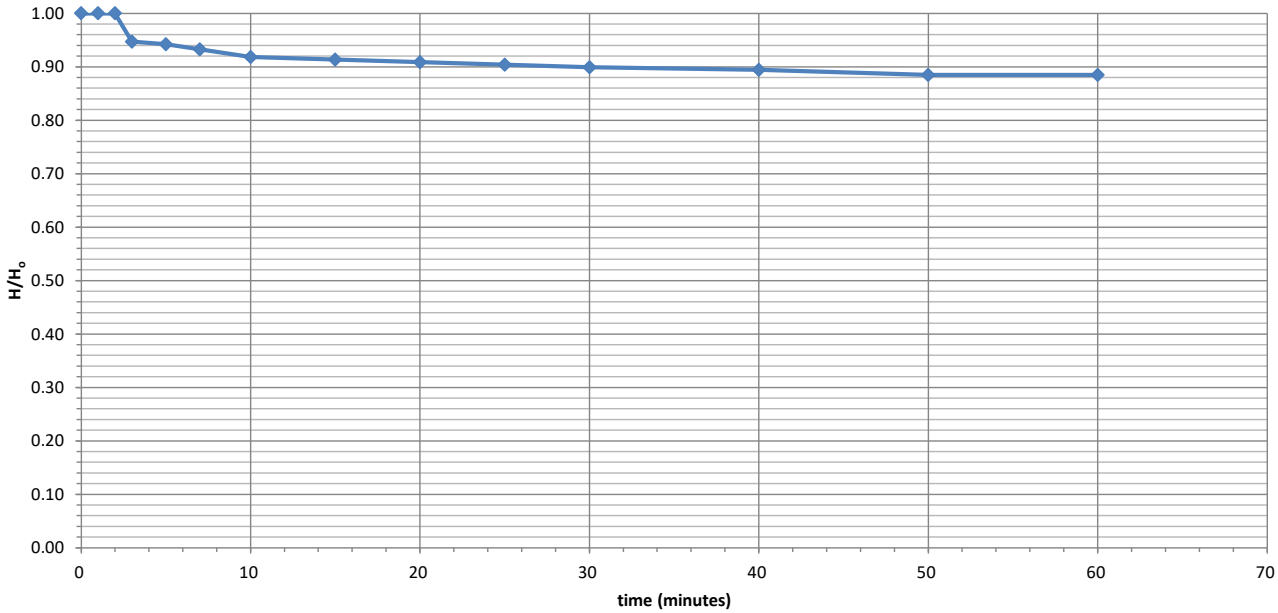
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

$F=(2*\pi*L)/(LN((L/D)+\sqrt{((L/D)^2)+1}))$

i.e.	F =	1.78 (m)
	A =	0.025 (m^2)
	h_1 =	2.08 (m)
	h_2 =	0.77 (m)
	t_1 =	0 (s)
	t_2 =	N/A (s)

Permeability unable to be calculated due to water not dropping to 37% of initial Head



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 22/09/2022

Borehole No.: WP1-BH01
Test No.: 2
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	0.50m
Depth to bottom of casing below ground level:	7.50m
Depth to bottom of borehole below ground level:	8.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	Dry

DATUM: Water level measured from top of casing, i.e. SWL is 8.50m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.25	8.25	1.00
1	0.25	8.25	1.00
2	0.26	8.24	1.00
3	0.27	8.23	1.00
5	0.28	8.22	1.00
7	0.30	8.20	0.99
10	0.33	8.17	0.99
15	0.38	8.12	0.98
20	0.43	8.07	0.98
25	0.48	8.02	0.97
30	0.53	7.97	0.97
40	0.63	7.87	0.95
50	0.73	7.77	0.94
60	0.83	7.67	0.93
80	1.03	7.47	0.91
100	1.23	7.27	0.88
120	1.43	7.07	0.86

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

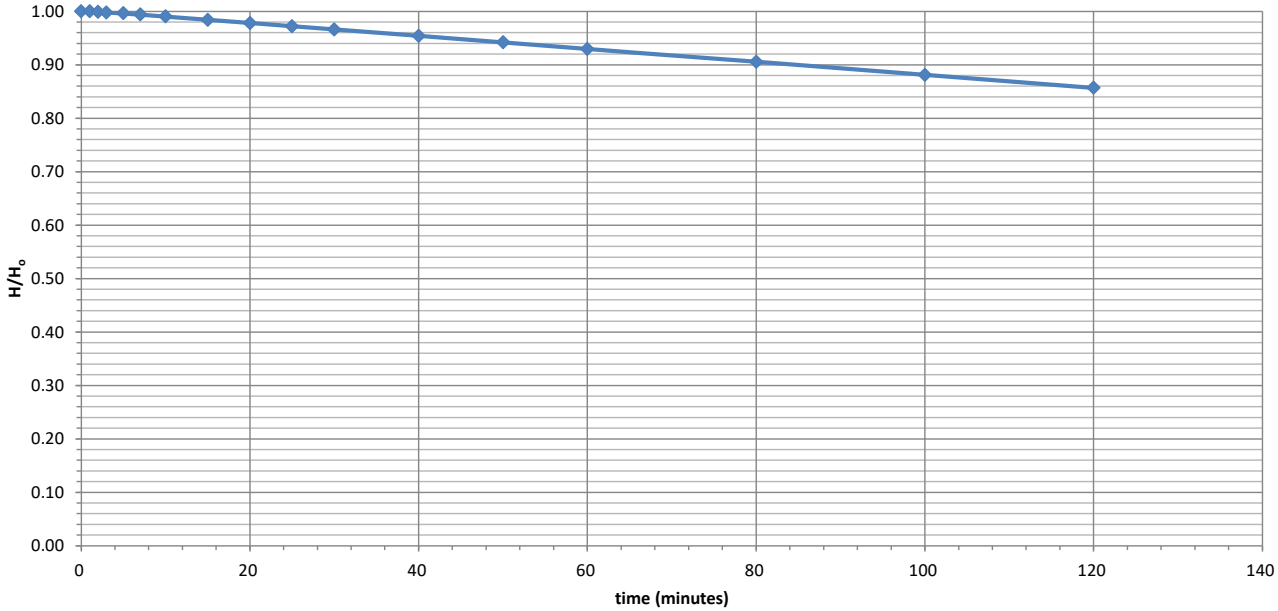
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

$F=(2*\pi*L)/(LN((L/D)+\sqrt{((L/D)^2)+1}))$

i.e.	F =	1.78 (m)
	A =	0.025 (m^2)
	h_1 =	8.25 (m)
	h_2 =	3.05 (m)
	t_1 =	0 (s)
	t_2 =	N/A (s)

Permeability unable to be calculated due to water not dropping to 37% of initial Head



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 30/09/2022

Borehole No.: WP1-BH03
Test No.: 1
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	1.00m
Depth to bottom of casing below ground level:	2.50m
Depth to bottom of borehole below ground level:	3.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	1.20m

DATUM: Water level measured from top of casing, i.e. SWL is 2.20m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.50	1.70	1.00
1	0.51	1.69	0.99
2	0.51	1.69	0.99
3	0.51	1.69	0.99
5	0.51	1.69	0.99
7	0.51	1.69	0.99
10	0.51	1.69	0.99
15	0.51	1.69	0.99
20	0.51	1.69	0.99
25	0.51	1.69	0.99
30	0.51	1.69	0.99
40	0.51	1.69	0.99
50	0.51	1.69	0.99
60	0.51	1.69	0.99

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

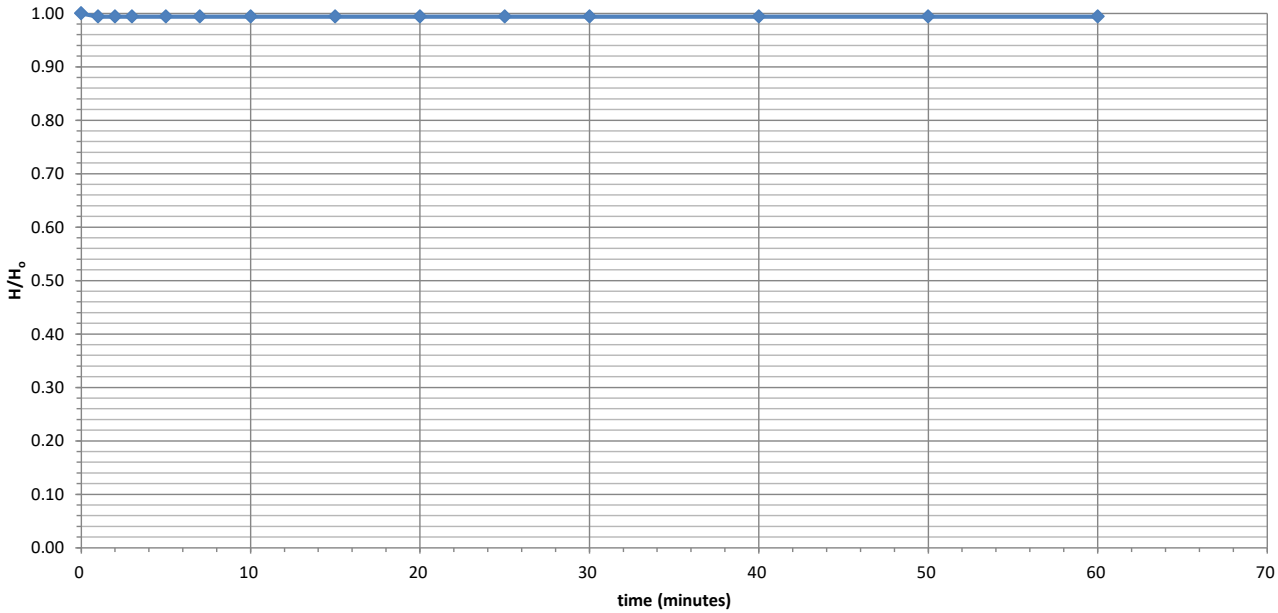
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

$F=(2*\pi*L)/(LN((L/D)+\sqrt{((L/D)^2)+1}))$

i.e.	F =	1.78 (m)
	A =	0.025 (m^2)
	h_1 =	1.70 (m)
	h_2 =	0.63 (m)
	t_1 =	0 (s)
	t_2 =	N/A (s)

Permeability unable to be calculated due to water not dropping to 37% of initial Head



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 30/09/2022

Borehole No.: WP1-BH03
Test No.: 2
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	0.50m
Depth to bottom of casing below ground level:	7.50m
Depth to bottom of borehole below ground level:	8.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	0.10m

DATUM: Water level measured from top of casing, i.e. SWL is 0.60m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.42	0.18	1.00
1	0.42	0.18	1.00
2	0.42	0.18	1.00
3	0.45	0.15	0.83
5	0.45	0.15	0.83
7	0.45	0.15	0.83
10	0.45	0.15	0.83
15	0.45	0.15	0.83
20	0.45	0.15	0.83
25	0.45	0.15	0.83
30	0.45	0.15	0.83
40	0.45	0.15	0.83
50	0.45	0.15	0.83
60	0.45	0.15	0.83

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

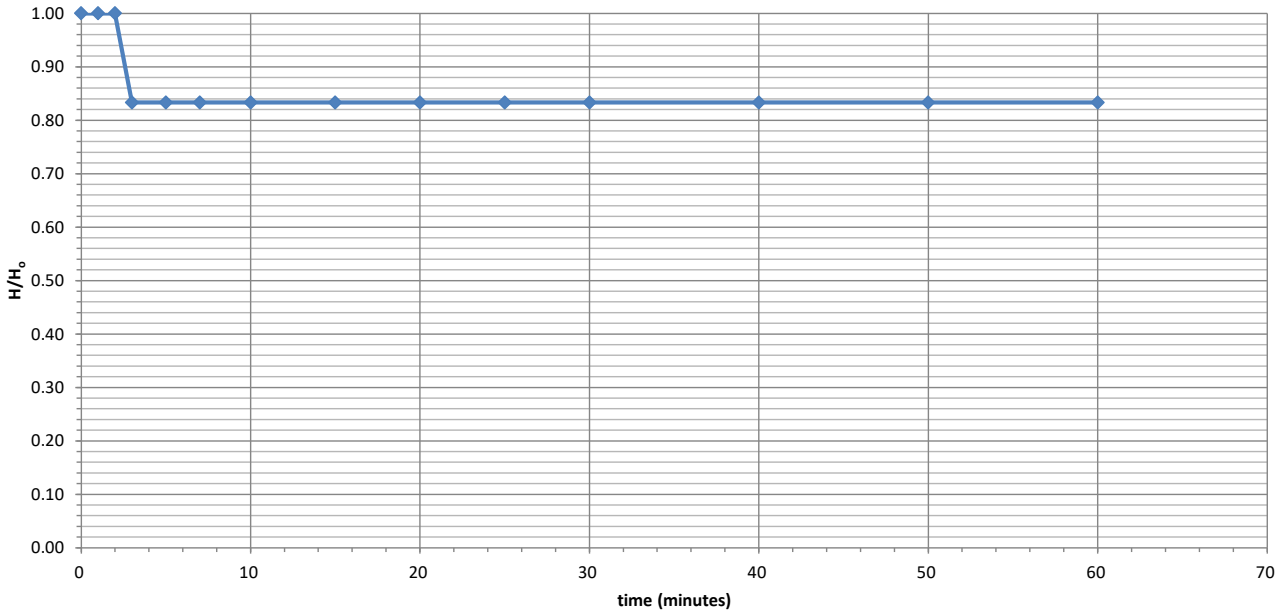
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

$F=(2*\pi*L)/(LN((L/D)+\sqrt{((L/D)^2)+1}))$

i.e. F = 1.78 (m)
A = 0.025 (m^2)
h_1 = 0.18 (m)
h_2 = 0.07 (m)
t_1 = 0 (s)
t_2 = N/A (s)

Permeability unable to be calculated due to water not dropping to 37% of initial Head



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 19/09/2022

Borehole No.: WP2-BH01
Test No.: 1
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	1.00m
Depth to bottom of casing below ground level:	2.50m
Depth to bottom of borehole below ground level:	3.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	1.30m

DATUM: Water level measured from top of casing, i.e. SWL is 2.30m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.95	1.35	1.00
1	0.97	1.33	0.99
2	0.99	1.31	0.97
3	1.03	1.27	0.94
5	1.08	1.22	0.90
7	1.14	1.16	0.86
10	1.26	1.04	0.77
15	1.37	0.93	0.69
20	1.48	0.82	0.61
25	1.58	0.72	0.53
30	1.68	0.62	0.46
35	1.78	0.52	0.39
40	1.98	0.32	0.24
50	2.19	0.11	0.08
60	2.30	0.00	0.00

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

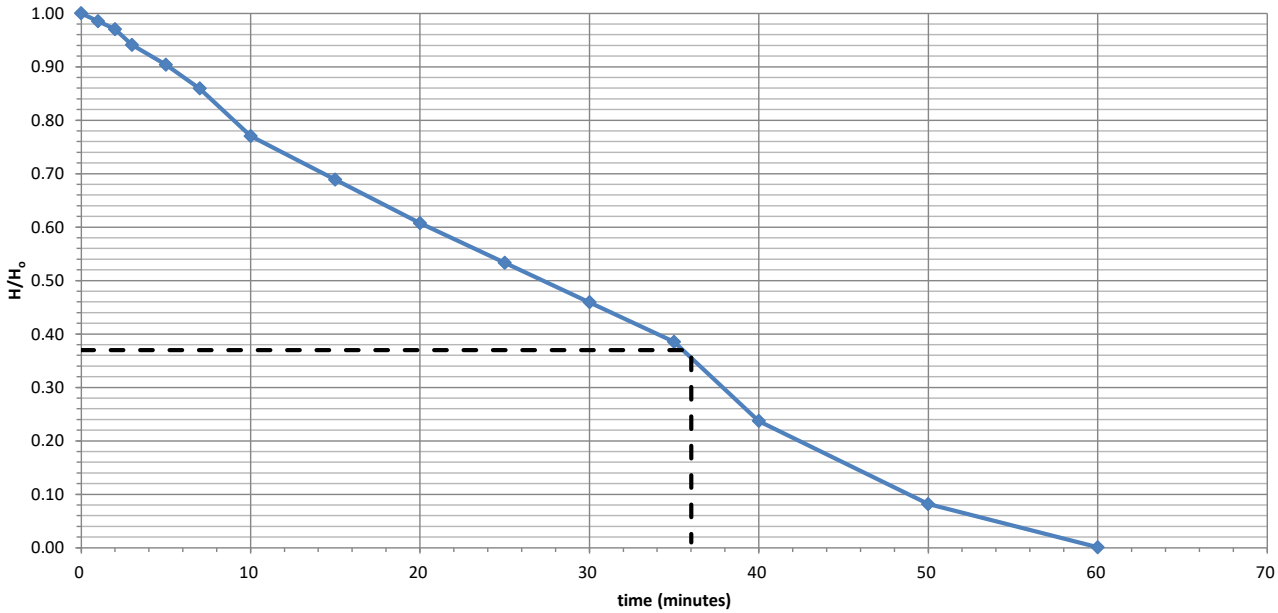
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

*F=(2*π*L)/(LN((L/D)+√((L/D)^2)+1))*

i.e. F =	1.78	(m)
A =	0.025	(m^2)
h_1 =	1.35	(m)
h_2 =	0.50	(m)
t_1 =	0	(s)
t_2 =	2160	(s)

hence, k = 6.34E-06 m/s



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 19/09/2022

Borehole No.: WP2-BH01
Test No.: 2
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	0.50m
Depth to bottom of casing below ground level:	7.50m
Depth to bottom of borehole below ground level:	8.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	2.62m

DATUM: Water level measured from top of casing, i.e. SWL is 3.12m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.34	2.78	1.00
1	0.34	2.78	1.00
2	0.54	2.58	0.93
3	0.74	2.38	0.86
5	1.04	2.08	0.75
7	1.29	1.83	0.66
10	1.65	1.47	0.53
15	1.98	1.14	0.41
20	2.25	0.87	0.31
25	2.45	0.67	0.24
30	2.58	0.54	0.19
35	2.65	0.47	0.17
40	2.74	0.38	0.14
50	2.84	0.28	0.10
60	2.94	0.18	0.06
80	3.12	0.00	0.00

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

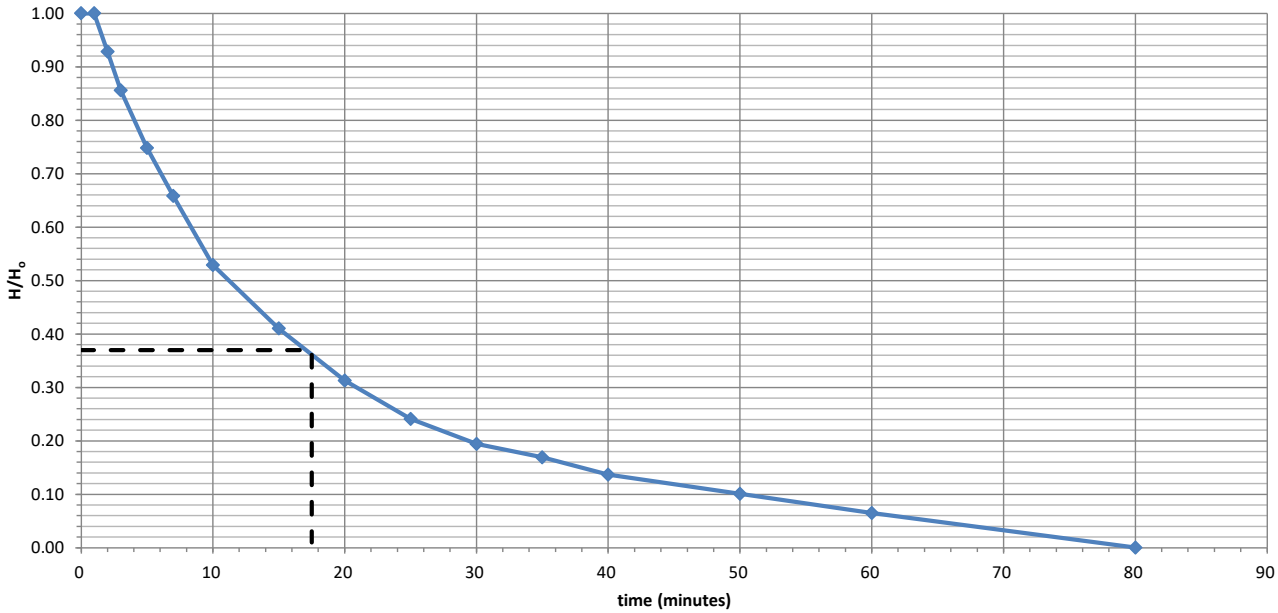
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

*F=(2*π*L)/(LN((L/D)+√((L/D)^2)+1))*

i.e. F = 1.78 (m)
A = 0.025 (m^2)
h_1 = 2.78 (m)
h_2 = 1.03 (m)
t_1 = 0 (s)
t_2 = 1050 (s)

hence, k = 1.30E-05 m/s



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 19/09/2022

Borehole No.: WP2-BH01
Test No.: 3
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	0.50m
Depth to bottom of casing below ground level:	13.50m
Depth to bottom of borehole below ground level:	14.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	4.13m

DATUM: Water level measured from top of casing, i.e. SWL is 4.63m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.74	3.89	1.00
1	0.74	3.89	1.00
2	1.14	3.49	0.90
3	1.46	3.17	0.81
5	1.95	2.68	0.69
7	2.37	2.26	0.58
10	2.75	1.88	0.48
15	3.30	1.33	0.34
20	3.74	0.89	0.23
25	4.01	0.62	0.16
30	4.24	0.39	0.10
35	4.44	0.19	0.05
40	4.55	0.08	0.02
50	4.63	0.00	0.00
60	4.63	0.00	0.00

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

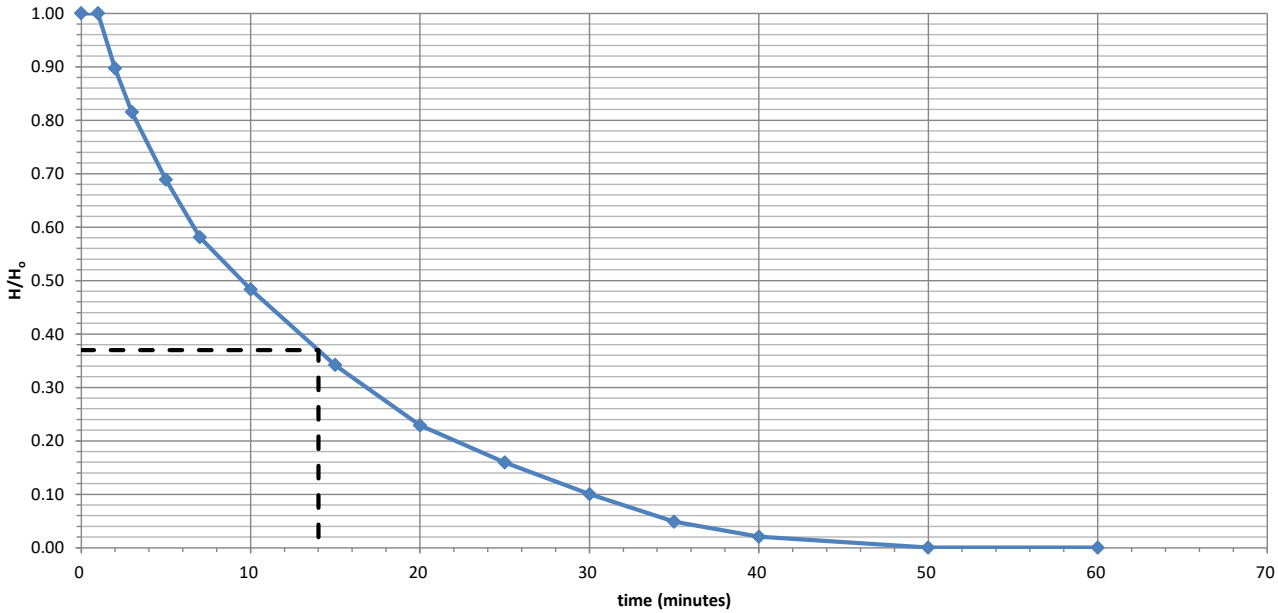
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

*F=(2*π*L)/(LN((L/D)+√((L/D)^2)+1))*

i.e. F = 1.78 (m)
A = 0.025 (m^2)
h_1 = 3.89 (m)
h_2 = 1.44 (m)
t_1 = 0 (s)
t_2 = 840 (s)

hence, k = 1.63E-05 m/s



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 13/09/2022

Borehole No.: WP2-BH02
Test No.: 1
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	1.00m
Depth to bottom of casing below ground level:	2.50m
Depth to bottom of borehole below ground level:	3.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	3.35m

DATUM: Water level measured from top of casing, i.e. SWL is 4.35m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	1.00	3.35	1.00
1	1.50	2.85	0.85
2	2.20	2.15	0.64
3	2.60	1.75	0.52
5	3.10	1.25	0.37
7	3.25	1.10	0.33
10	3.35	1.00	0.30
15	3.35	1.00	0.30

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

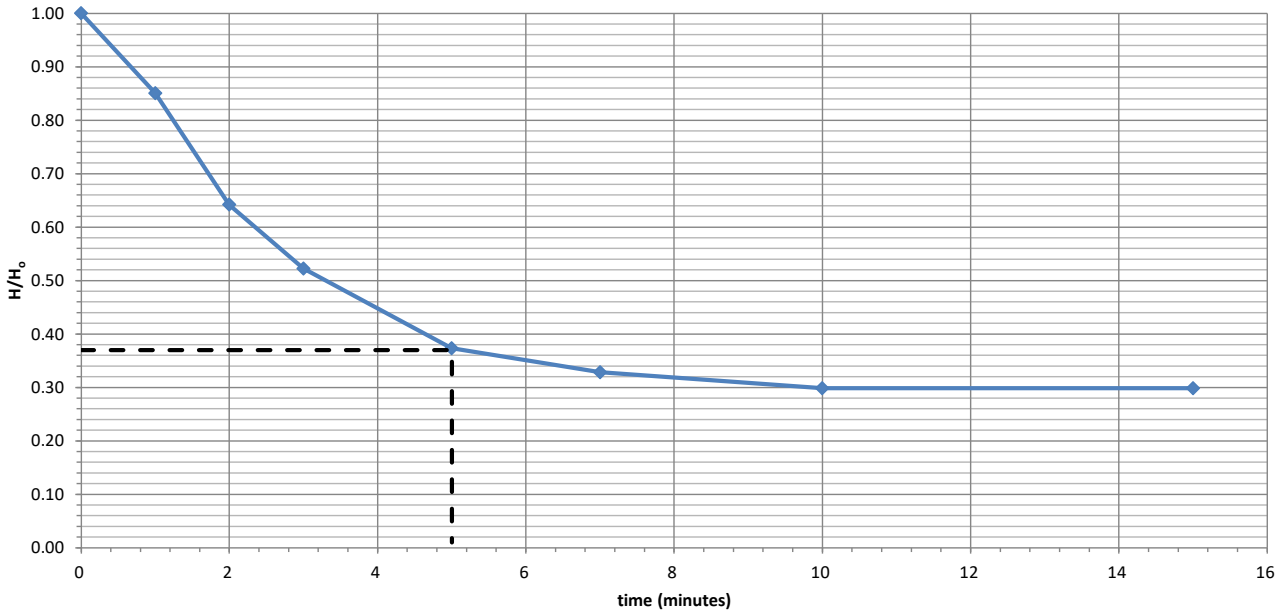
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

*F=(2*π*L)/(LN((L/D)+√((L/D)^2)+1))*

i.e. F = 1.78 (m)
A = 0.025 (m^2)
h_1 = 3.35 (m)
h_2 = 1.24 (m)
t_1 = 0 (s)
t_2 = 300 (s)

hence, k = 4.57E-05 m/s



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 13/09/2022

Borehole No.: WP2-BH02
Test No.: 2
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	0.50m
Depth to bottom of casing below ground level:	7.50m
Depth to bottom of borehole below ground level:	8.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	2.88m

DATUM: Water level measured from top of casing, i.e. SWL is 3.38m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	1.58	1.80	1.00
2	2.17	1.21	0.67
3	2.47	0.91	0.51
5	2.88	0.50	0.28
7	3.01	0.37	0.21
10	3.07	0.31	0.17
15	3.11	0.27	0.15
20	3.16	0.22	0.12
25	3.20	0.18	0.10
30	3.25	0.13	0.07
35	3.30	0.08	0.04
40	3.38	0.00	0.00
50	3.38	0.00	0.00

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

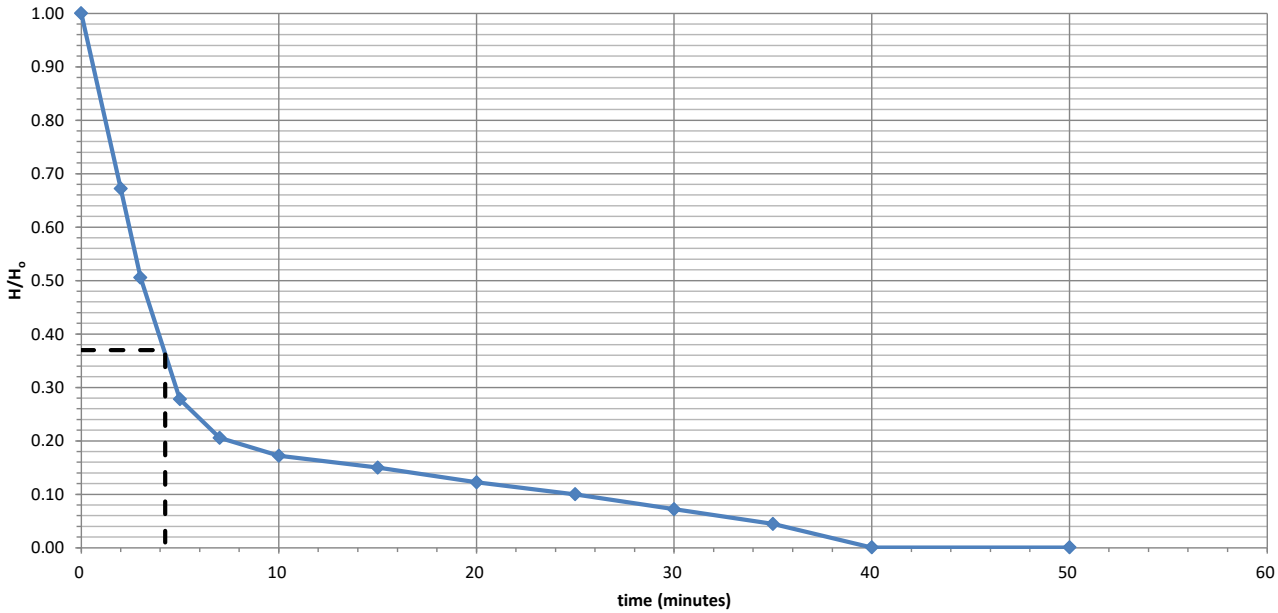
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

*F=(2*π*L)/(LN((L/D)+√((L/D)^2)+1))*

i.e. F = 1.78 (m)
A = 0.025 (m^2)
h_1 = 1.80 (m)
h_2 = 0.67 (m)
t_1 = 0 (s)
t_2 = 255 (s)

hence, k = 5.37E-05 m/s



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 09/09/2022

Borehole No.: WP2-BH03
Test No.: 1
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	0.50m
Depth to bottom of casing below ground level:	19.50m
Depth to bottom of borehole below ground level:	20.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	7.85m

DATUM: Water level measured from top of casing, i.e. SWL is 8.35m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.00	8.35	1.00
1	0.46	7.89	0.94
2	0.90	7.45	0.89
3	1.32	7.03	0.84
5	2.09	6.26	0.75
7	2.82	5.53	0.66
10	3.78	4.57	0.55
15	5.25	3.10	0.37
20	6.61	1.74	0.21
25	7.90	0.45	0.05
30	8.34	0.01	0.00
40	8.35	0.00	0.00
50	8.35	0.00	0.00
60	8.35	0.00	0.00
75	8.35	0.00	0.00
90	8.36	0.01	0.00
120	8.36	0.01	0.00

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

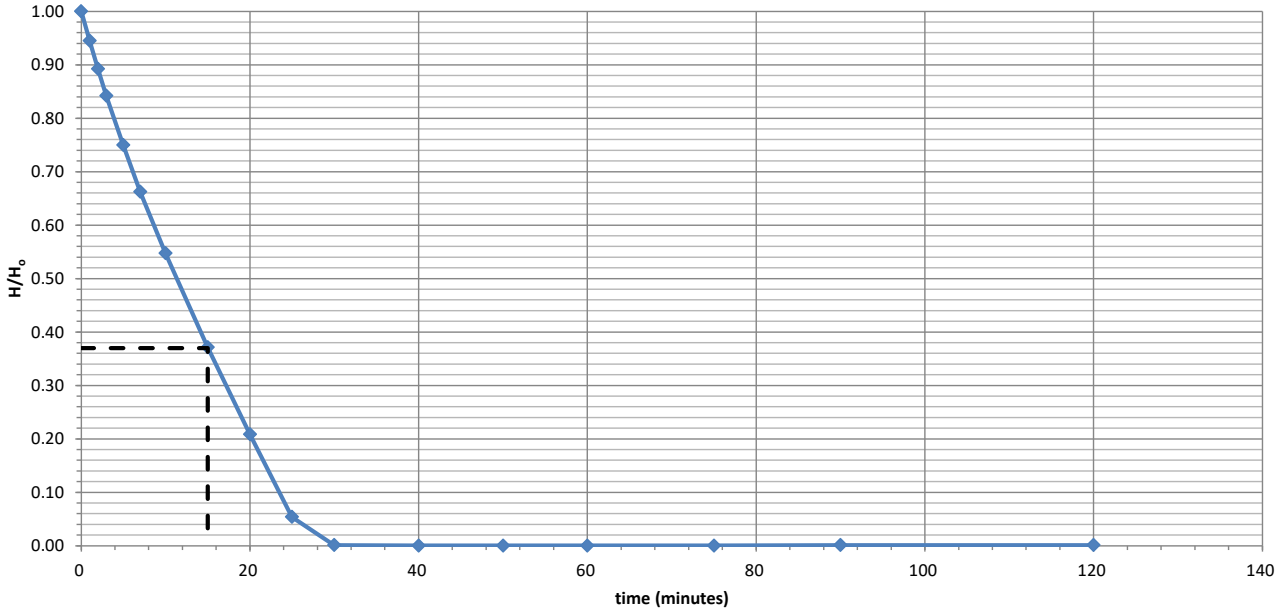
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

*F=(2*π*L)/(LN((L/D)+√((L/D)^2)+1))*

i.e.	F =	1.78 (m)
	A =	0.025 (m^2)
	h_1 =	8.35 (m)
	h_2 =	3.09 (m)
	t_1 =	0 (s)
	t_2 =	900 (s)

hence, k = 1.52E-05 m/s



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 06/09/2022

Borehole No.: WP2-BH04
Test No.: 1
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	1.00m
Depth to bottom of casing below ground level:	2.50m
Depth to bottom of borehole below ground level:	3.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	1.22m

DATUM: Water level measured from top of casing, i.e. SWL is 2.22m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.00	2.22	1.00
1	0.72	1.50	0.68
2	0.90	1.32	0.59
3	0.91	1.31	0.59
5	1.04	1.18	0.53
7	1.07	1.15	0.52
10	1.10	1.12	0.50
15	1.13	1.09	0.49
20	1.16	1.06	0.48
30	1.20	1.02	0.46
35	1.22	1.00	0.45
40	1.24	0.98	0.44
50	1.27	0.95	0.43
60	1.33	0.89	0.40
80	1.40	0.82	0.37
100	1.47	0.75	0.34
120	1.52	0.70	0.32

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

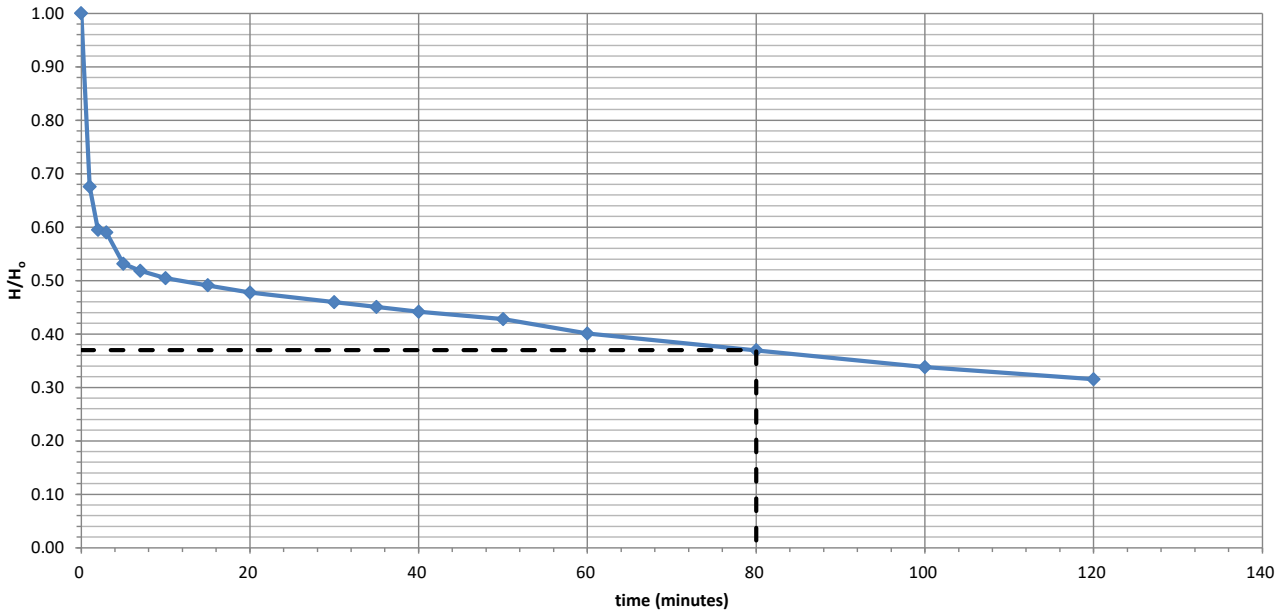
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

*F=(2*π*L)/(LN((L/D)+√((L/D)^2)+1))*

i.e.	F =	1.78 (m)
	A =	0.025 (m^2)
	h_1 =	2.22 (m)
	h_2 =	0.82 (m)
	t_1 =	0 (s)
	t_2 =	4800 (s)

hence, k = 2.85E-06 m/s



VARIABLE HEAD PERMEABILITY TEST (BOREHOLE)

Project Name: DUB ARR
Project No.: 21-1443E
Test Date: 06/09/2022

Borehole No.: WP2-BH04
Test No.: 2
Type of test: Falling Head

Diameter of casing (D):	0.18m
Height of top of casing above ground level:	0.50m
Depth to bottom of casing below ground level:	7.50m
Depth to bottom of borehole below ground level:	8.00m
Length of the test section (L):	0.50m
Standing ground water level (SWL) below ground level:	2.65m

DATUM: Water level measured from top of casing, i.e. SWL is 3.15m below datum

TIME ELAPSED (mins)	WATER LEVEL (m)	HEAD H (m)	HEAD RATIO H/Ho
0	0.00	3.15	1.00
1	0.37	2.78	0.88
2	0.47	2.68	0.85
3	0.52	2.63	0.83
5	0.58	2.57	0.82
7	0.61	2.54	0.81
10	0.64	2.51	0.80
15	0.70	2.45	0.78
20	0.72	2.43	0.77
25	0.76	2.39	0.76
30	0.78	2.37	0.75
35	0.82	2.33	0.74
40	0.84	2.31	0.73
50	0.89	2.26	0.72
60	0.89	2.26	0.72

CALCULATION OF PERMEABILITY:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where: k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t1 (start of test) and t2 (0.37 head reached)

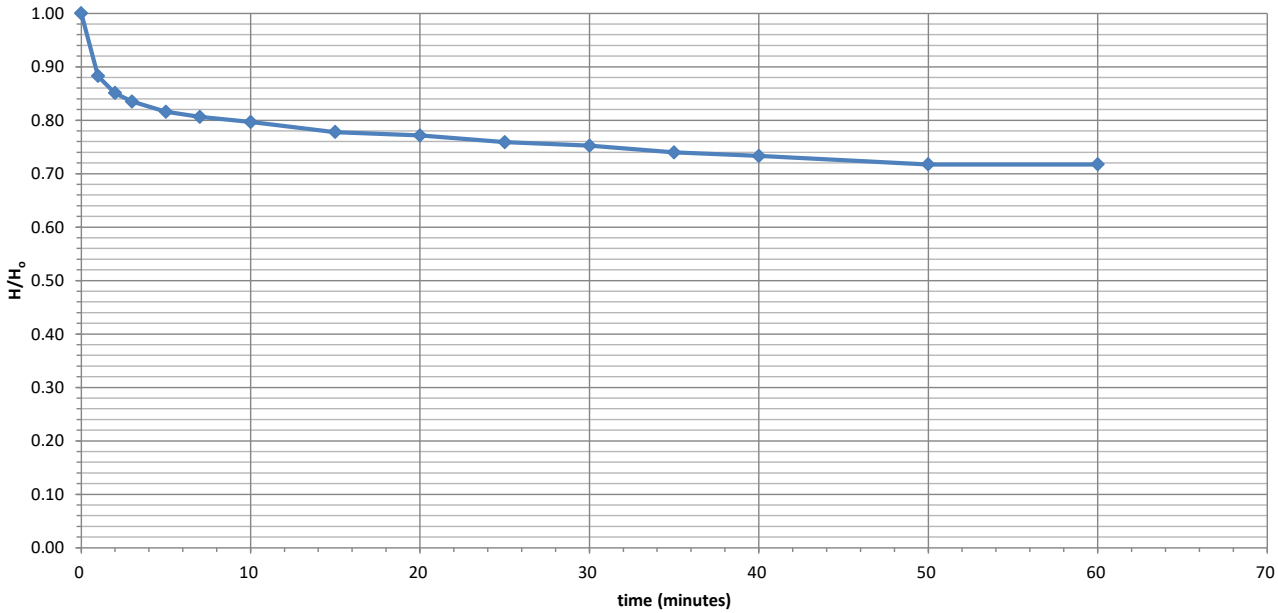
Values for the shape factor (F) are given for various conditions (cases A-E) in Annex B of BS EN ISO 22282-1:2012

L/D is 2.8, so Case D is assumed, therefore:

$F=(2*\pi*L)/(LN((L/D)+\sqrt{((L/D)^2)+1}))$

i.e. F = 1.78 (m)
A = 0.025 (m^2)
h_1 = 3.15 (m)
h_2 = 1.17 (m)
t_1 = 0 (s)
t_2 = N/A (s)

Permeability unable to be calculated due to water not dropping to 37% of initial Head



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