



Bus Connects Route 9 Tallaght/Clondalkin to City Centre - Ground Investigation

Client: National Transport Authority (NTA)

Client's Representative: AECOM/Mott MacDonald

Report No.: 20-0399D

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Client:		National Transp	oort Authority (N	ΓΑ)						
Client's Repres	entative:	AECOM/Mott MacDonald								
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The works were conducted in accordance with:

British Standards Institute (2015) BS 5930:2015, Code of practice for site 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, The Code of Practice for Site Investigation.

Abbreviations use	ed 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.
В	Bulk disturbed sample.
LB	Large bulk disturbed sample.
D	Small disturbed sample.
С	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	g to rock core – reference Clause 36.4.4 of BS 5930: 2015
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.



Bus Connects Route 9 Tallaght/Clondalkin to City Centre

1 **AUTHORITY**

On the instructions of AECOM/Mott MacDonald, ("the Client's Representative"), acting on the behalf of National Transport Authority (NTA) ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information to inform the planning stage design and enable the design of Bus Connects Core Bus Corridors.

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 site 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 and rock core sampling, environmental sampling, groundwater 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 along the proposed route from Tallaght in South Dublin to the Walkinstown Roundabout, with most locations undertaken along the Greenhills Road in grass areas, housing estates or industrial areas.





4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 29th September and 29th October 2020, comprised:

- eighteen light cable percussion boreholes
- four boreholes by rotary follow-on methods
- one borehole by dynamic (windowless) sampling methods
- a standpipe installation in eight boreholes
- eleven machine dug trial pits
- indirect CBR tests at ten locations.

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

A total of nineteen boreholes were put down in a minimum diameter of 150mm through soils and rock strata to their completion depths by a combination of methods, including light percussion boring using a Dando Terrier rig, light cable percussion boring using a Dando 2000 rig, and rotary drilling by a truck mounted Beretta T44 rotary drilling rig.

The borehole logs state the methodology and plant used for each location, as well as the appropriate depth ranges.

A summary of the boreholes, subdivided by category in accordance with the methods employed for their completion, is presented in the following sub-sections.

4.2.1 Light cable percussion boreholes

Fourteen boreholes (R9CP01-R9CP13) were put down to completion in minimum 200mm diameter using a Dando 2000 light cable percussion boring rig. All boreholes were terminated either at their scheduled completion depths, or else on encountering virtual refusal. R9CP13A was terminated due to encountering an old tank and removed to a new position at R9CP13.

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 obstruction

Disturbed (bulk and small bag) samples were taken within the encountered strata. Undisturbed (U100) samples were taken where appropriate and as directed within fine soils. Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Standard penetration tests were carried out in accordance with BS EN 22476-3:2005+A1:2011 at standard depth intervals 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 I.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded.

Where water was added to assist with boring, a note has been added to the log to account for same.

Appendix B presents the borehole logs.

4.2.2 Boreholes by combined percussion boring and rotary follow-on drilling

Four boreholes (R9CPGS01-R9CPGS04) were put down by a combination of light cable percussion boring and rotary follow-on drilling techniques using a truck mounted Beretta T44 rotary drilling rig with core recovery in overburden and bedrock.

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.

In the cable percussion section of the boreholes, disturbed (bulk and small bag) samples were taken within the encountered strata. Undisturbed (U100) samples were taken where appropriate and as directed within fine soils. Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded. Where water was added to assist with boring, a note has been added to the log to account for same.

Where the cable percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to bedrock after which rotary coring was employed to recover core samples of the bedrock. Symmetrix cased full-hole drilling was used, with SPTs carried out at standard intervals as required.

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 I.

Where coring was carried out, Geobor S Coring was used. The core was extracted in up to 1.5m lengths using a SK6L core barrel, which produced core of nominal 102mm diameter, and was placed in single channel wooden core boxes.

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

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

4.2.3 Dynamic sampled boreholes

One borehole (R9WS01) was put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig.

A hand dug inspection pit was carried out between ground level and 1.20m depth to ensure the borehole was put down clear of services or subsurface obstructions.

The borehole was taken to a depth of 1.27m where it was terminated on encountering a service which was not picked up during the initial location clearance.

Disturbed (bulk) samples were taken within the encountered strata. Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Appendix B presents the borehole logs.

4.3 Standpipe installations

A groundwater monitoring standpipe was installed in R9CP02, R9CP04, R9CP05, R9CP06, R9CP08, R9CP11, R9CPGS01 and R9CPGS04.

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

4.4 Trial Pits

Eleven trial pits (R9TP01–R9TP11) were excavated using a 3t tracked excavator of JCB3CX fitted with a 600mm wide bucket, to a maximum depth of 4.20m.



Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Disturbed (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.

4.5 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 R6 GPS system employing VRS and real time kinetic (RTK) techniques.

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

4.6 Archaeological monitoring

Archaeological monitoring was conducted by Shanarc Archaeology during the excavation of R9TP01, R9TP02, R9TP04-R9TP07, R9TP10, R9TP11 and during excavation of inspection pits for R9CP03, R9CP04 and R9CP07-R9CP13a.

The findings of the monitoring are presented as a report in Appendix J.

4.7 Groundwater monitoring

Following completion of site works, groundwater monitoring was conducted on one round. Ground water monitoring was carried out using a water interface probe.

The monitoring records are presented in Section 6.3.

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.
- shear strength (total stress): unconsolidated undrained triaxial tests, lab shear vane
- **compaction related:** Moisture Condition Value, California bearing ratio tests
- soil chemistry: pH, water soluble sulphate content, acid soluble sulphate content and total sulphur

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 G.

5.2 Geotechnical laboratory testing of rock

Laboratory testing of rock sub-samples comprised:

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

Test	Test carried out in accordance with												
Point load index	ISRM Suggested Methods (1985) Suggested method for determining point-load												
	trength. Int. J. Rock Mech. Min. Sci. Geomech. Abstr. 22, pp. 53–60												
Uniaxial	ISRM Suggested Methods (1981) Suggested method for determining												
compression	deformability of rock materials in uniaxial compression, Part 2												
strength tests	and												
	ISRM (2007) Ulusay R, Hudson JA (eds) The complete ISRM suggested methods												
	for rock characterization, testing and monitoring, 2007												

The test results are presented in Appendix H.

5.3 Environmental laboratory testing of soils

Environmental testing, as specified by the Client's Representative was conducted on selected environmental soil and water samples by Chemtest at its laboratory in Newmarket, Suffolk.

Soil testing was carried out on a number of samples according to Engineer's Ireland Suite E and Rialta Suite of testing which included testing for a range of determinants:

Metals



- Speciated total petroleum hydrocarbons (TPH)
- Speciated polycyclic aromatic hydrocarbons (PAH)
- Cvanides
- Asbestos screen
- pH
- Waste acceptance criteria (WAC) testing.

Groundwater testing was carried out on a number of samples according to Engineer's Ireland Suite F and additional testing which included testing for a range of determinants:

- Metals
- Speciated total petroleum hydrocarbons (TPH)
- Speciated polycyclic aromatic hydrocarbons (PAH)
- pH

Results of environmental laboratory testing are presented in Appendix H.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise Glacial Till and fluvioglacial sands and gravels. These deposits are underlain by limestones and shales of the Lucan Formation.

6.2 Ground types encountered during investigation of the site

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

- **Paved surface:** R9CP07, R9CP09, R9CP12 and R9CP13 encountered 100-200 of bitmac surfacing while R9CP11 and R9CP13A encountered 100-200mm of concrete surfacing.
- **Made Ground (gravel surfacing):** R9CP06, R9CP08, R9CP10, R9TP03 and R9TP09 encountered gravel surfacing ranging in thickness from 100-200mm.
- **Topsoil:** encountered across the site in all grass area adjacent to Greenhills road ranging in thickness from 100-600mm.
- Made Ground (sub-base): approximately 200-300mm of aggregate fill beneath the paved surface,





topsoil or gravel surfacing at R9CP02, R9CP07, R9CP09, R9CP11, R9CP12, R9CP13, R9TP03 and R9TP09.

- Made Ground (fill): reworked sandy gravelly clay/silt or sandy clayey gravel or gravelly silty sand fill encountered at all locations except R9CP04, R9CP07, R9CP09, R9CP11, R9CP12, R9CPGS01 and R9TP02 to a maximum depth of 6.50m in R9CPGS02. Varying amounts of red brick, wood, plastic, cloth, glass, rubber, carpet, ceramics and concrete were encountered across the site concentrated R9CP05, R9TP05 and R9TP06.
- **Fluvioglacial deposits:** typically medium dense to dense sands and gravels interspersed with layers of sandy gravelly clay or silt encountered predominantly at all locations north of the M50 where the Greenhills Road roughly follows the path of an old glacial river channel.
- **Glacial Till:** sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth.
- **Bedrock (Limestone/Mudstone):** Rockhead was encountered at depths ranging from 10m in R9CPGS03 to 12.95m in R9CPGS02 in the vicinity of where the Greenhills Road crosses the M50.

6.3 Groundwater

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

Groundwater was encountered during percussion boring, rotary drilling and trial pit excavation as groundwater strikes as shown in Table 1 below.

Table 1: Groundwater strikes encountered during the ground investigation

GI Ref	Water Level (mbgl)	Comments
R9CP01	5.00	Slow seepage at 5.00m
R9CP08	4.10	Rose to 4.00m after 20 mins
R9CP13	2.00	Seepage
R9CPGS01	9.00	
R9CPGS02	9.00	
R9CPGS03	9.00	
R9CPGS04	9.00	
R9TP05	1.60	Rapid water strike at 1.60m



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

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

Groundwater was not noted during excavation of any of the other trial pits.

Subsequent groundwater monitoring of the standpipe installations recorded water levels as shown in Table 2.

Table 2: Groundwater monitoring

Date	Water l	evel (mbgl)			Water level (mbgl)												
Date	R9CP02	R9CP04	R9CP05	R9CP06	R9CP08	R9CP11	R9CPGS01	R9CPGS04										
19/11/20	1.16	Bung stuck	Dry	Dry	4.1	3.28	8.00	8.92										

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.





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: 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.

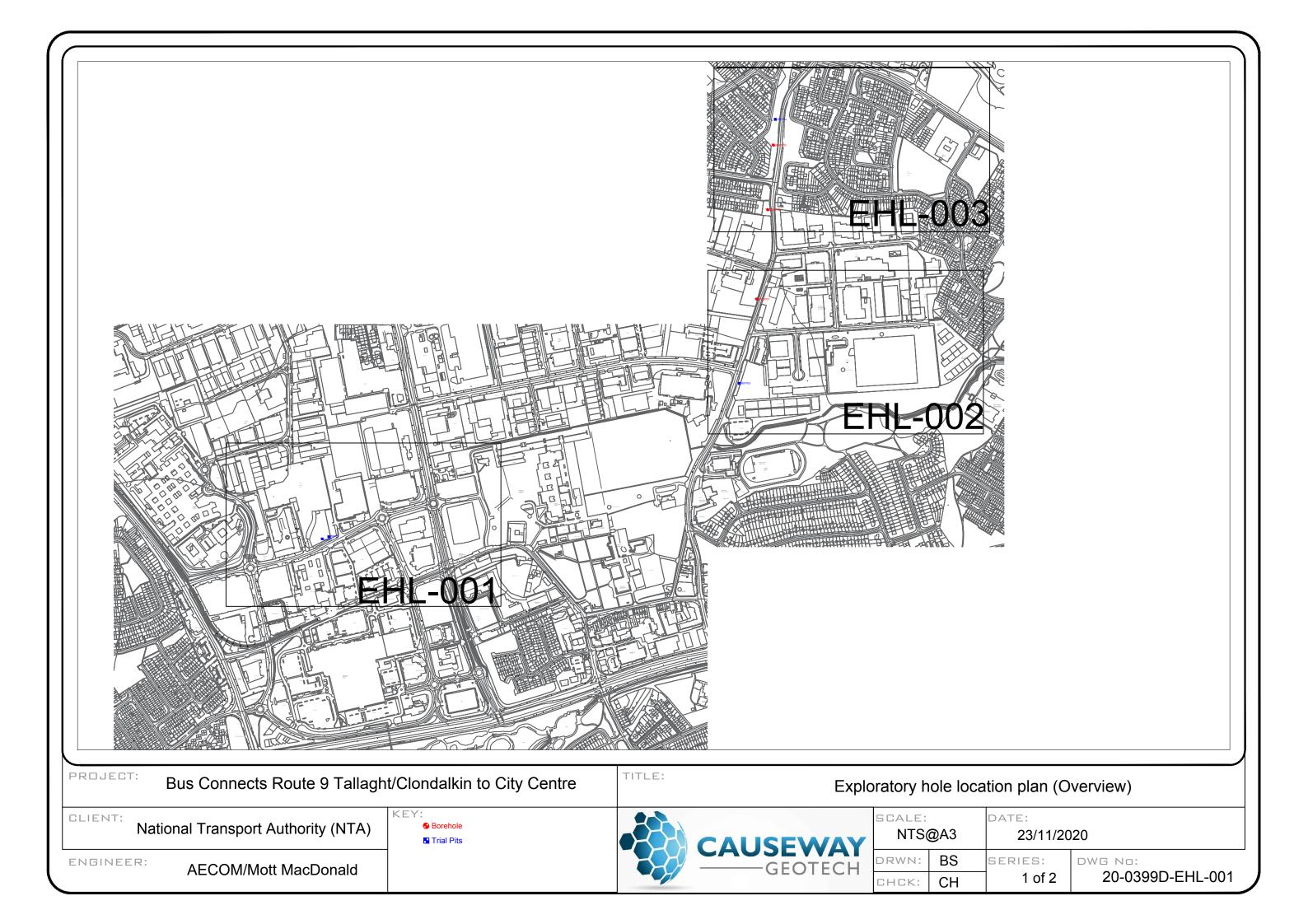
BS EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description.

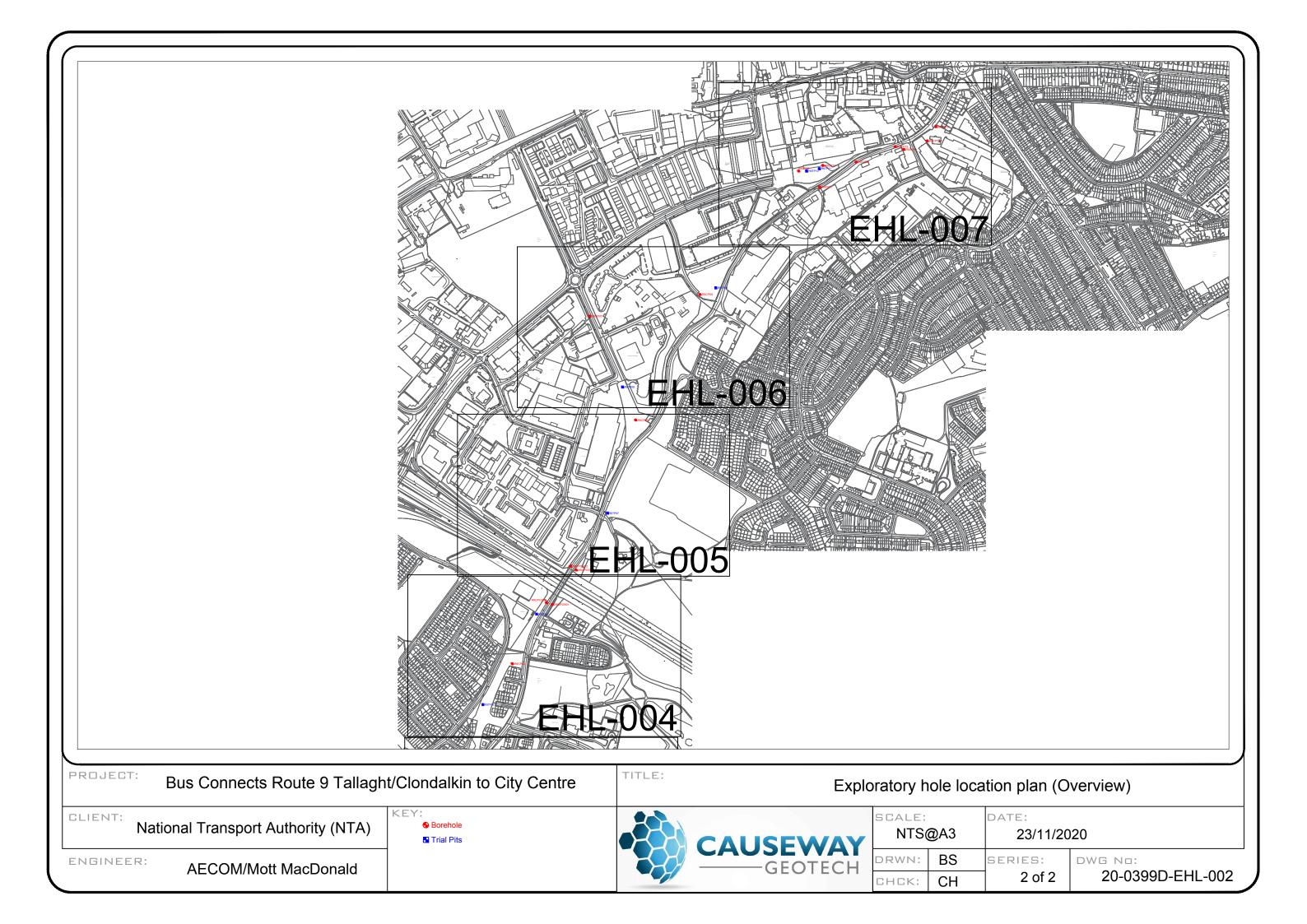
BS EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test.

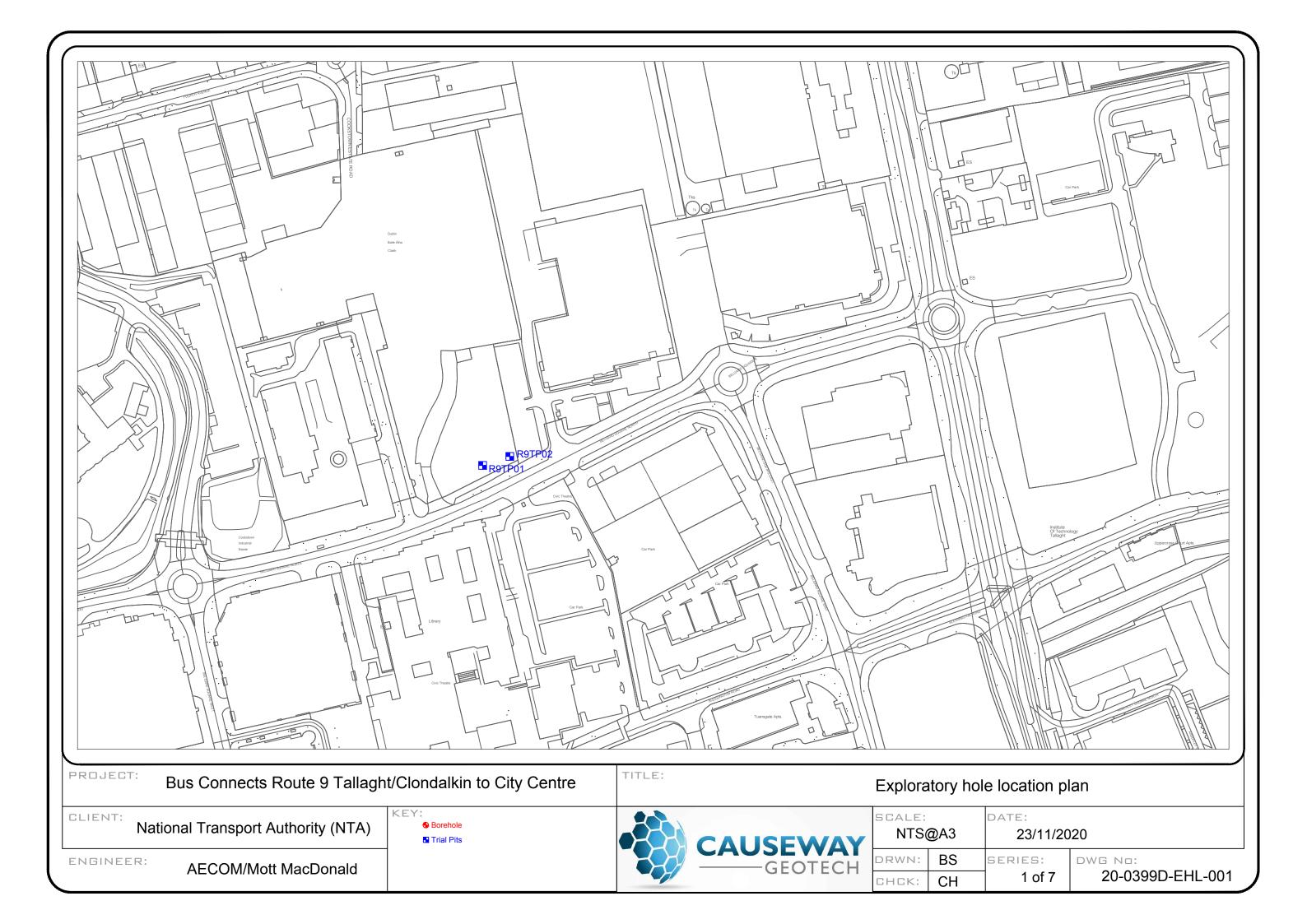


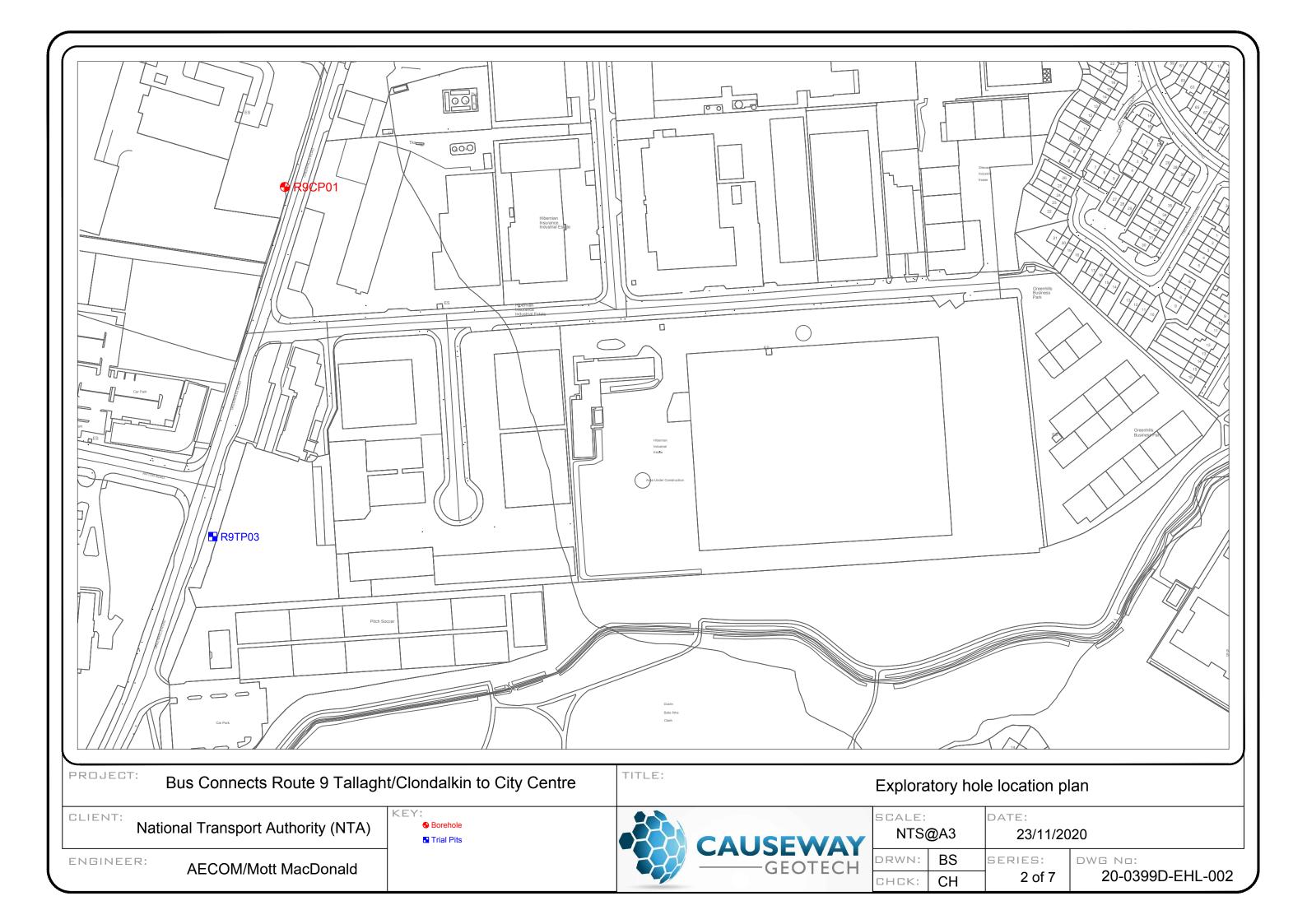
APPENDIX A SITE AND EXPLORATORY HOLE LOCATION PLAN

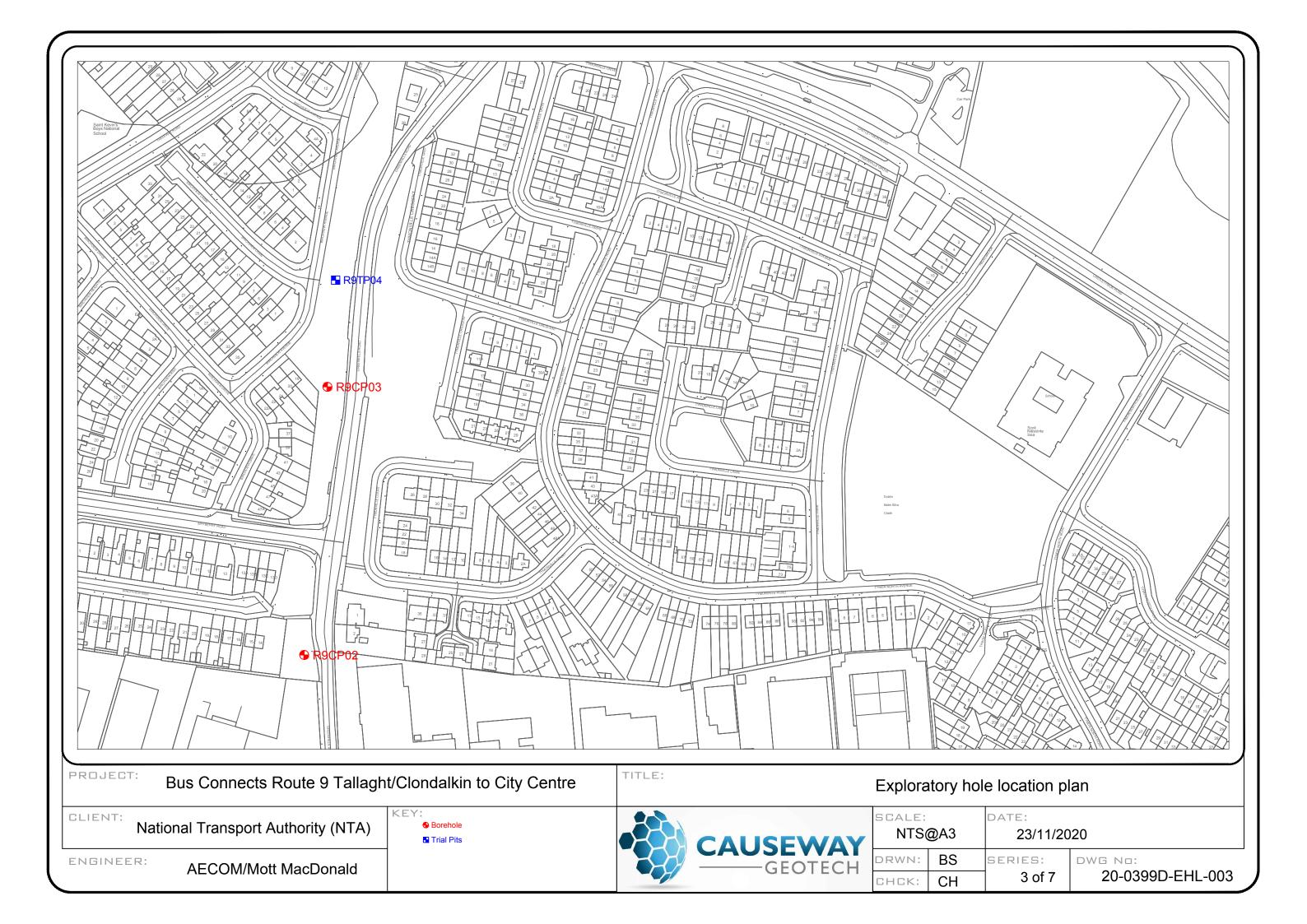


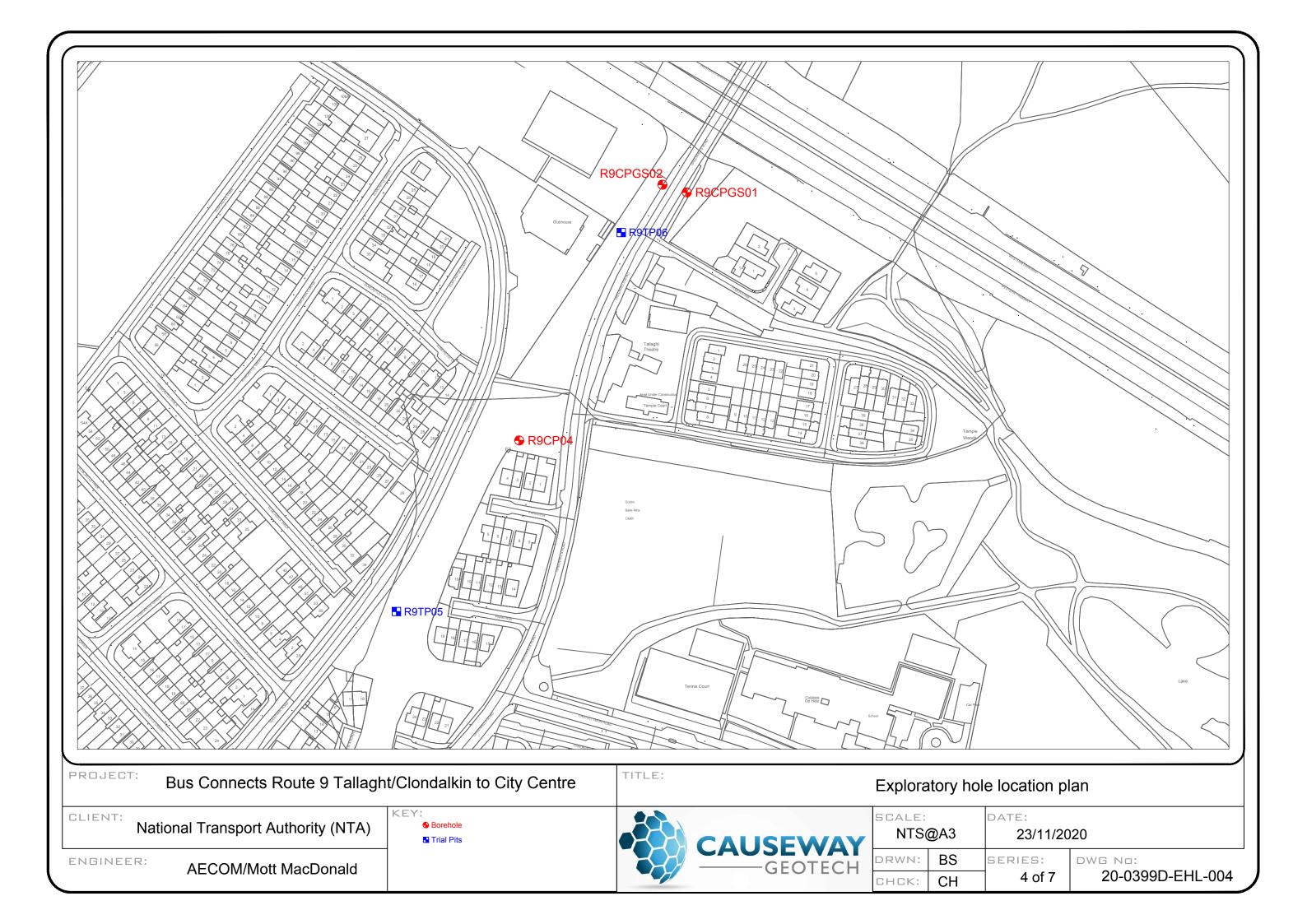


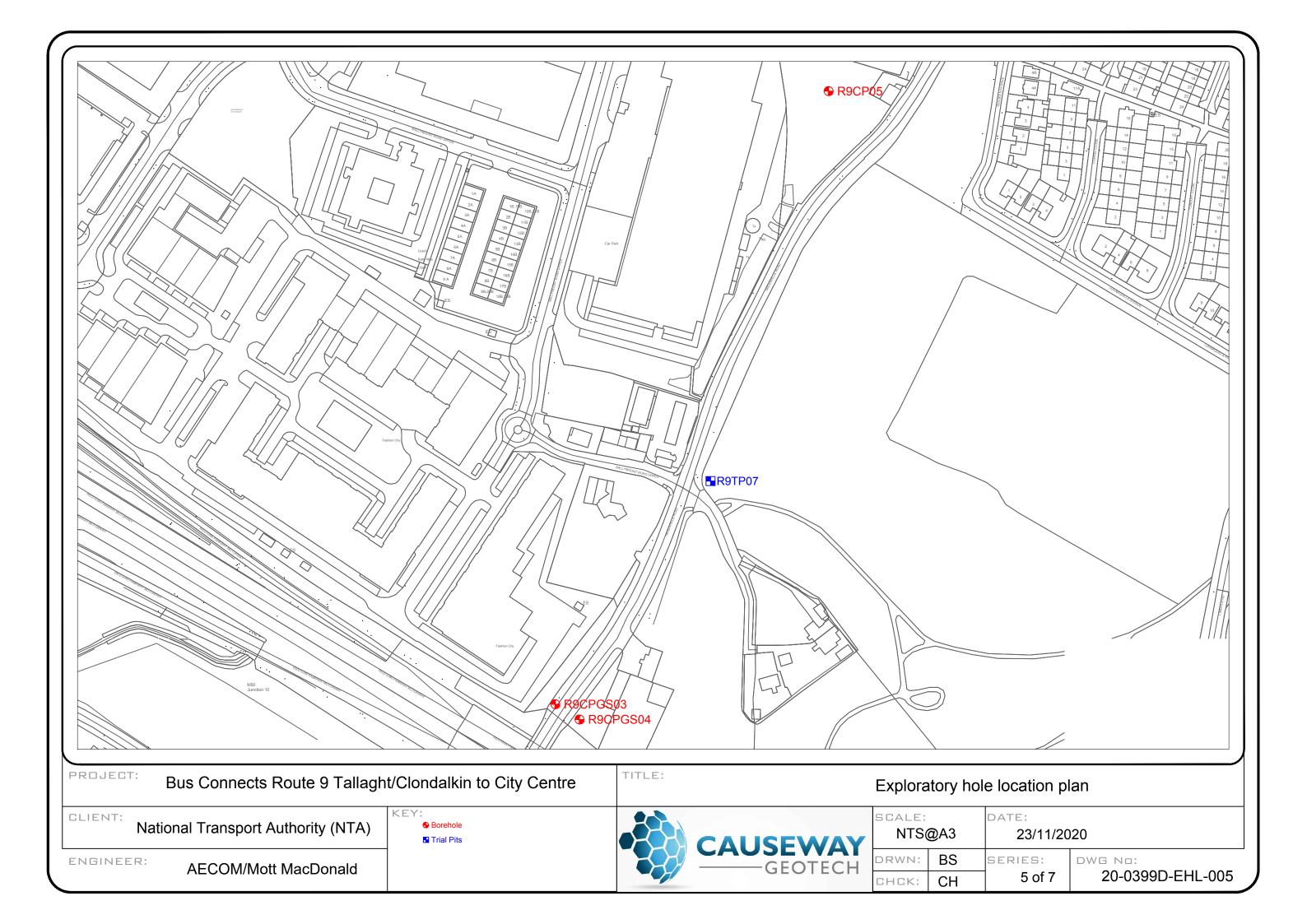


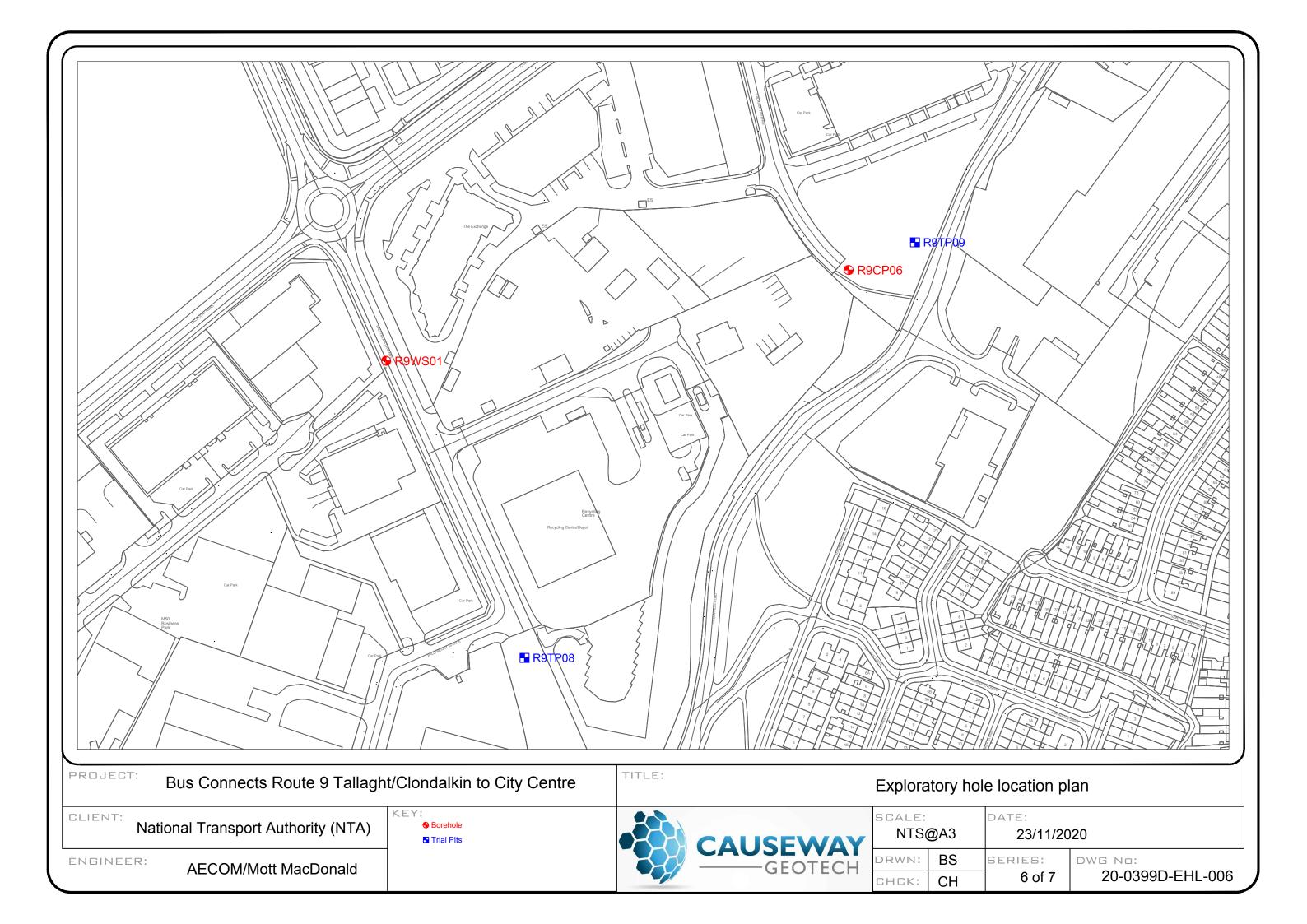


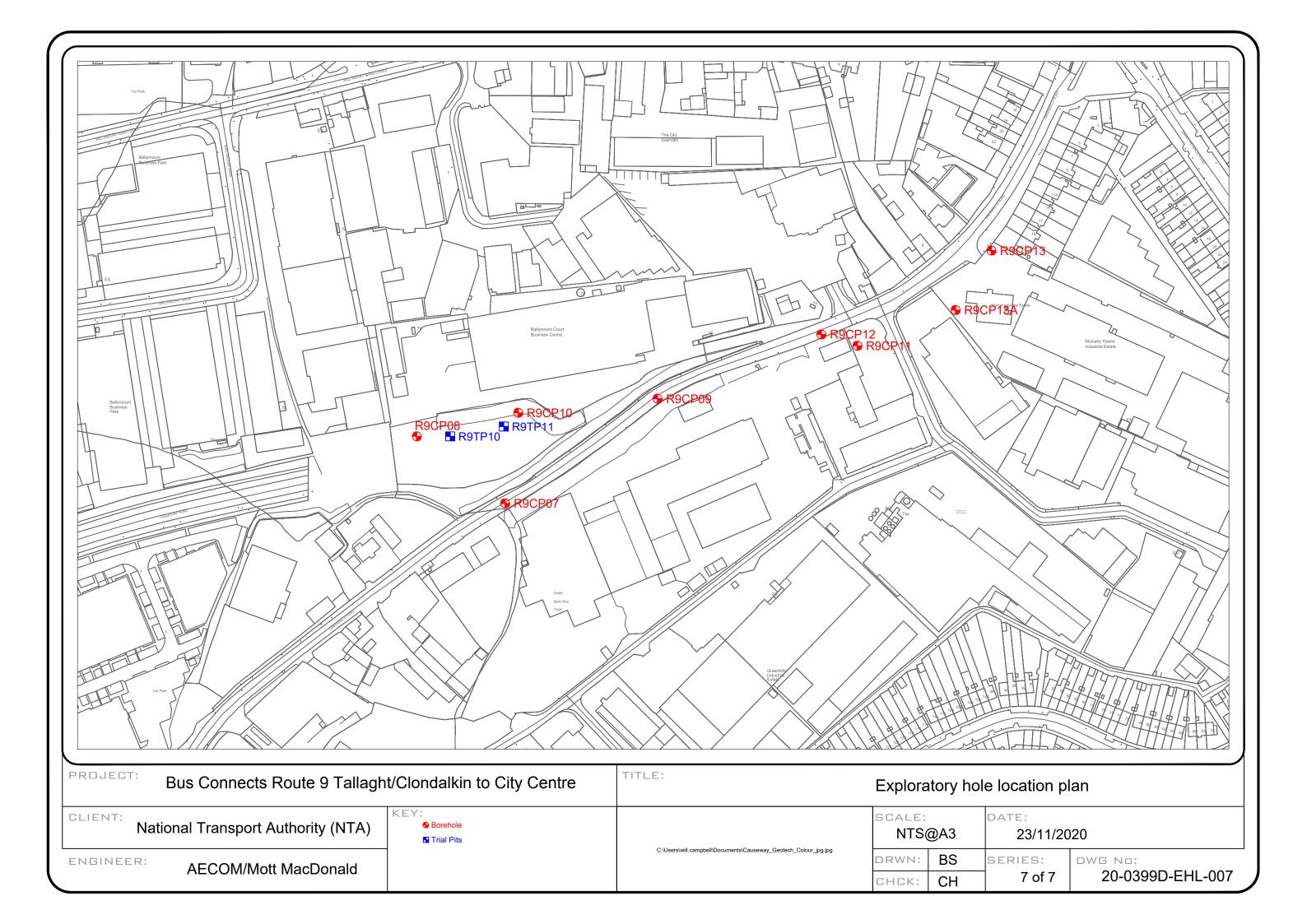














APPENDIX B
BOREHOLE LOGS



		CAUSEW	ECH				ect No. 0399D	Project Client: Client's			Authority (N1		Centre		orehole	
Methoo Cable Percu		Plant Used Dando 2000	Top (m) 0.00	_	e (m) 20	70966	60.16 E 95.79 N	Final De	•		29/09/2020	Driller: Logger:			heet 1 c Scale: 1: FINA	:40
Depth (m)	Sample / Tests	Field Records		Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend		Des	cription	ļ		Water	Backfill	Γ
.50 .50 .00 .00	B5 ES ES1 B6 ES2 ES6 D12					87.49	- 0.40		MADE GROUND: So coarse. Gravel is sul lithologies. Stiff becoming very fine to coarse. Grav mixed lithologies.	bangular to su stiff brown sli	brounded fine t	ndy CLAY.	f mixed Sand is			0.
20 - 1.65	SPT (S) B7 D13 ES3	N=35 (3,3/3,5,12,15) F SN = 0643 N=50 (25 for 75mm/50 25mm) Hammer SN = 0) for	1.50			-									2.2.2.
00 00 00 - 3.45	B8 ES4 U18 D14	Ublow=40 100%		3.00	Dry	84.89	3.00		Stiff locally very stif low cobble content subrounded fine to subrounded of mixe	. Sand is fine medium of m	to coarse. Grave ixed lithologies.	el is subang	gular to			3
		N=40 (12,7/8,10,10,12 SN = 0643	!) Hammer	3.00	Dry		-							•		4
	B10 D16 U19	Ublow=60 100% Slow seepage at 5.00m	n	3.00	5.00		-									5
.00 .00 .00 - 6.14	B11 D17 SPT (S)	N=50 (18 for 100mm/5 35mm) Hammer SN = 0		3.00	5.60	81.89 81.69	6.20		Very stiff brown slig content. Sand is fin fine to coarse of mi lithologies.	e to coarse. Oxed lithologies	Gravel is subang	ular to sub	rounded			6
		r Strikes	m) 5:-			g Details		Remarks								
5.00 Casing De	5.00	Water Added From (m) To (m)		(111)	To (,	ne (hh:mm)	Hand dug ir	nspection pit excavate	ed to 1.20m.						
									on Reason on refusal.			16/12/2		W	AC	_ }

		CAUSEN	AY ECH				ct No. 399D								
Meth	nod	Plant Used	Top (m)	Base	(m)	Coord	linates	Final De	. 2.10 m	Start Data:	01/10/2020	Driller	DM	S	heet 1 of
Cable Per	cussion	Dando 2000	0.00	3.1	10		39.76 E 36.49 N	Elevation	•	Start Date:		Driller: Logger:		:	Scale: 1:4
Depth (m)	Sample / Tests	Field Records		Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	,	Desc	ription	ļ		Water	Backfill
						85.74	0.10		TOPSOIL MADE GROUND: Gi	rev angular fine	e to coarse GRA	VEL of mix	ed	1	
						85.44	- 0.40		lithologies.						
60 60	B5 ES1						-		MADE GROUND: Br subrounded fine to	coarse GRAVE	L of mixed litho	logies with			
						85.04	0.80		cobble content. Sar subrounded fine to	coarse of mixe					
00	B6						Ė		\subrounded of mixe MADE GROUND: St		ey sandy gravel	ly CLAY. Sa	nd is fine	4	
)0)0	ES2 ES6					84.54	1.30		to coarse. Gravel is	subangular to	subrounded fin	e to coarse	2.		
16 20 - 1.45	EW U12	Ublow=25 100%		1.00	Dry	04.54	1.50		Firm brown slightly is subangular to sub						
0	D9						-					·			
							-								
00 00	B7 D10						-								
00 00 - 2.45	ES3	N=11 (2,2/2,3,3,3) Har	nmer SN -	1 50	Drv										
	3 (3)	0643		50	/		-								
						83.04	- 2.80								
00	B8					03.04	2.80		Very stiff greyish bla cobble content. Sa						
00	D11					82.74	3.10	<u> </u>	subrounded fine to	coarse of mixe					
00 00 - 3.15	ES4 SPT (S)	N=50 (40 for 135mm/5		3.00	Dry		_		(Subrounded of filixe		hole at 3.10m			-	
		15mm) Hammer SN =	0643				-								
							-								
							-								
							-								
							-								
							_								
							-								
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							-								
							-								
							_								
							_								
							-								
		r Strikes				Details		Remarks							
ick at (m)	Casing to (m	n) Time (min) Rose to (m) From 3.0		To (1		e (hh:mm) 01:00		nspection pit excavat water encountered.	ed to 1.20m.					
			5.0		5.1			140 ground	water encountered.						
Casing I	Details	Water Added	\dashv												
Го (m)	Diameter														
3.00	200							Terminati	on Reason			Last Up	dated		
									d on refusal.				2020		AG

		CAUSEV	VA TEC	Y H				ct No. 399D	Project Client: Client's		ects Route 9 Tallaght Transport Autho 'Mott MacDonald	ority (NTA		Centre		rehole	
Meth Cable Per		Plant Used Dando 2000		o (m) E .00	Base 8.0	· +	Coord	linates	Final De	Final Depth: 8.00 m Start Date: 06/10/2020 Driller: B				ВМ		heet 1 o Scale: 1:	
								04.90 E 10.79 N	Elevatio	n: 81.19 mOD	81.19 mOD End Date: 06/10/202			СН		FINAL	
Depth (m)	Sample / Tests	Field Recor	ds		Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend		Description	n			Water	Backfill	
0.50 0.50 1.00 1.00 1.00 1.20	B11 ES1 B12 ES2 ES3 U26	Ublow=20 90%		C	0.00	Dry	80.79	0.40			rm brown sandy grav bangular to subroun						0.5
2.00 2.00 2.00 2.00 2.00 - 2.45	B13 D19 ES4 SPT (S)	N=19 (2,2/2,4,6,7) H 0643	lammer	r SN = (0.00	Dry	79.19	2.00		Stiff brown sandy g subangular to subro				2.0			
3.00 3.00 3.00 3.00 - 3.45 3.50	B14 D20 ES6 SPT (S)	N=29 (4,4/6,7,7,9) H 0643	lammer	r SN = (0.00	Dry		-									3.0 —
4.00 4.00 4.00 4.00 - 4.45	B15 D21 ES8 SPT (S)	N=24 (4,4/5,5,7,7) H 0643	lammer	r SN = (0.00	Dry	77.19	4.00		CLAY with low cobb subangular to subro	stiff greyish black sli le content. Sand is f bunded fine to coars nded of mixed lithol	fine to coar se of mixed	se. Grave	el is			4.0 — - - - 4.5 —
5.00 5.00 5.00 5.00 5.00 5.00 - 5.45	B16 D22 ES22 ES9 SPT (S)	N=30 (4,5/6,7,7,10) = 0643	Hamme	er SN(0.00	Dry		-									5.0 — - - - - 5.5 —
6.00 6.00 6.00 6.00 - 6.45	B17 D23 ES10 SPT (S)	N=38 (5,7/9,9,9,11) = 0643	Hamme	er SN(0.00	Dry		-									6.0 — - - - - 6.5 —
7.00 7.00 - 7.45	D24 SPT (S)	N=38 (5,6/8,8,10,12) SN = 0643) Hamm	ner (0.00	Dry		- - - - -									7.0
struck at (m)		r Strikes n) Time (min) Rose to) (m) F			elling To (r	Details		Remarks	espection nit everyet	ed to 1 20m						
	Casing Details Water Added To (m) Diameter From (m) To (m)								mana aag n	nspection pit excavate vater encountered.	ed to 1.20111.						
										on Reason at scheduled depth.			Last Up		W	AC	iS

		CAUSEV	VAY				ect No. 1399D	Project Client: Client's			Authority (N ⁻		Centre		R9CP03			
Metho Cable Pero		Plant Used Dando 2000	Top (m 0.00	_	e (m) 00	Coor	dinates	Final De	epth: 8.00 m	Start Date:	06/10/2020	Driller:	ВМ		heet 2 c			
cable refe	.0331011	Danuo 2000	0.00	0.			04.90 E 10.79 N	Elevatio		End Date:	06/10/2020	Logger:	СН		FINA			
Depth (m)	Sample / Tests	Field Record	s	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	,	Des	cription	<u>'</u>		Water	Backfill			
.50 .00	B18					73.19	- 8.00		Stiff becoming very CLAY with low cobb subangular to subro Cobbles are subrou	ole content. So ounded fine to unded of mixed	and is fine to co coarse of mixe d lithologies.	arse. Grave	el is			7.5		
ruck at (m) C	Water	r Strikes i) Time (min) Rose to		Chis		g Details m) Tim	ne (hh:mm)		nspection pit excavat water encountered.		ehole at 8.00m					9.5 10.0 - 11.5 12.0 - 13.5 14.0 -		
Casing D	Details Diameter	Water Added From (m) To (m																
								Terminati	on Reason			Last Up	dated					
								Terminated	l at scheduled depth.			16/12/	2020		AC	į		

	CAUSEW	AY ECH			Project 20-03		Project Client: Client's		ects Route 9 Tall Transport Au /Mott MacDo	uthority (NT		Centre		orehole R9CP0	
Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	3.00	7	Coordin '09837 '29319	.71 E	Final De		Start Date: (Driller:			heet 1 c Scale: 1: FINAI	:40
Depth Sample / Tests	Field Records		Depth De	ptn	evel Depth		Legend		Descri	ption		-	Water	Backfill	
(m) Tests .50 B5 .50 ES1 .00 B6 .00 ES2 .00 ES6 .20 D9 .20 - 1.65 SPT (S) .50 ES .50 ES3 .00 B7 .00 D10 .00 ES4 .00 - 2.45 SPT (S) .00 SPT (S) .00 SPT (S)	N=9 (2,2/2,2,2,3) Hami 0643 N=18 (2,2/3,3,5,7) Han 0643 N=50 (25 for 10mm/50 15mm) Hammer SN = 0	mer SN =	0.00 D 0.00 D 0.00 D	rry 7:	1.67	(m) 0.20	Remarks Hand dug i	TOPSOIL Soft becoming firm Gravel is subangula lithologies. Stiff brown sandy g subangular to subre water encountered.	brown sandy gr ir to subrounded gravelly CLAY. Sar bunded fine to c	avelly CLAY. Sa I fine to coarse ond is fine to coa coarse of mixed	of mixed	ıl is		Backfill	0.5 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0 1.0
Casing Details To (m) Diameter	Water Added From (m) To (m)							on Reason			Last Upo		W	AC	35

	CAUSEW	AY ECH			oject No. D-0399D			ects Route 9 Ta Transport A /Mott MacD	authority (NT		entre	Borehole ID R9CP05
Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base (8.00		oordinates	Final De	epth: 8.00 m	Start Date:	12/10/2020	Driller:	вм	Sheet 1 of 2 Scale: 1:40
					.0173.58 E .9983.05 N	Elevatio	levation: 73.20 mOD End Date:		12/10/2020	Logger:	СН	FINAL
Depth Sample / (m) Tests	Field Records		Casing W Depth Do (m) (nter Lev		Legend		Desc	ription			Backfill
0.50 B10 0.50 E51 1.00 B11 1.00 E52 1.20 D19 1.20 - 1.65 SPT (S) 1.50 ES 1.50 ES3 2.00 B12 2.00 D20 2.00 E54 2.00 E54 2.00 - 2.45 SPT (S) 2.50 ES5 3.00 B13 3.00 D21 3.00 SF6 3.00 SPT (S) 4.00 B14 4.00 B14 4.00 B14 4.00 B14	N=8 (2,2/2,2,2,2) Hami 0643 N=9 (2,3/2,2,2,3) Hami 0643 N=11 (2,3/3,2,3,3) Han 0643	mer SN =	0.00 C	гу			MADE GROUND: So fragments of wood coarse. Gravel is su	and pieces of o	loth and plasti	c. Sand is fin		1.5 — 1.5 — 2.0 — 2.5 — 3.0 — 4.0 —
5.00 B15 5.00 D23 5.00 ES8	N=13 (2,3/3,4,3,3) Han 0643 N=18 (2,3/4,4,5,5) Han 0643			68.	40 - 4.80		Medium dense bro fine to coarse GRA\					4.5
6.00 B16 6.00 D24 6.00 E59 6.00 - 6.45 SPT (C)	N=23 (3,4/5,5,6,7)		6.00 D	67.	20 - 6.00	× × × × × × × × × × × × × × × × × × ×	Medium dense bro Gravel is subrounde			ine to coarse	SAND.	6.5
7.00 B17 7.00 D25 7.00 - 7.45 SPT (C)	N=26 (4,5/6,6,7,7) Han 0643	nmer SN =	6.00	66. ry	20 – 7.00 - - -	X X X	Medium dense bro coarse GRAVEL of n				0	7.0
	r Strikes n) Time (min) Rose to (r			ling Det	Time (hh:mm	Remarks	inspection pit excavat	ed to 1 20m				
Casing Details To (m) Diameter 6.00 200	Water Added					No ground	water encountered.	CG tO 1.20III.				
							ion Reason d at scheduled depth.			16/12/20	20 ,	\ \\AGS

	CAUSEN	/AY ECH			ect No. 1399D	Project Client:	Borehole ID R9CP05						
Method Cable Percussion	Plant Used Dando 2000	Top (m) B	ase (m) 8.00	7101	73.58 E	Final De	-		12/10/2020	Driller:		Sheet 2 of Scale: 1:4	10
Depth Sample /		Ca	sing Water	/ 299a	83.05 N Depth	Elevatio	/3.20 mOD		12/10/2020	Logger:	СН	FINAL	
(m) Tests 8.00 B18 8.00 - 8.40 U26 Water truck at (m) Casing to (m	Ublow=30 100% Strikes Time (min) Rose to (i	6	hiselling	mob 65.70 65.40 65.20	(m) - 7.50 - 7.80 - 8.00 - 8.00	mana aag .	Medium dense brocoarse GRAVEL of m Firm brown slightly content. Sand is fin fine to coarse of mi lithologies. Stiff greyish black sl content. Sand is fin fine to coarse of mi lithologies.	wn sandy subinized lithologics sandy slightly se to coarse. (exed lithologies) ightly sandy seed lithologies. End of Bore	es. Sand is fine to gravelly CLAY we Gravel is subangum s. Cobbles are so lightly gravelly C Gravel is subangum	o coarse. ith low cob ular to subr ubrounded LAY with lo ular to subr	oble ounded of mixed w cobble ounded		7.5 8.0 - 8.5 9.0 - 9.5 10.0 - 11.5 12.0 - 13.5 14.0 -
To (m) Diameter	Water Added From (m) To (m)												
6.00 200							on Reason at scheduled depth.			Last Upd	lated	\ \\AG	įS

		CAUSE\ GEO	Field Records													
Method Cable Percu		Plant Used Dando 2000	Т		_		7103	348.72 E								Scale: 1:40
Depth (m)	Sample / Tests	Field Reco	rds		Casing Depth (m)	Water Depth (m)			Legend	,	Des	cription			Nater	Backfill
1.00 1.00 1.00 1.00 1.20	B1 ES7 B2 ES ES8 D14 SPT (S)	N=18 (3,4/5,4,4,5) i 0643	Hamn	ner SN =			66.71	0.10		GRAVEL of mixed lit MADE GROUND: Fir gravelly CLAY. Sand	thologies. San rm becoming s is fine to coar	d is fine to coars stiff dark browni se. Gravel is sub	e. sh black sa	andy		1.0 —
2.00 2.00 2.00 - 2.45	D15 ES9 SPT (S)	N=8 (4,2/2,2,2,2) Hi 0643	amme	er SN =	1.50	Dry	64.81	2.00		coarse. Gravel is su						H
	B3 D16 ES10 SPT (S)	N=8 (2,1/2,2,2,2) Ha 0643	amme	er SN =	3.00	Dry										3.0 -
4.00 4.00 4.00 4.00 - 4.45	B4 D17 ES11 SPT (S)	N=13 (2,2/3,3,3,4) H 0643	Hamn	ner SN =	3.00	Dry	62.81	- 4.00								4.5
5.00 5.00 5.00 5.00 - 5.45	B5 D18 ES12 SPT (S)	N=16 (3,4/4,3,4,5) ł 0643	Hamn	ner SN =	3.00	Dry		-								5.0
6.00 6.00	B6 D19 ES13 SPT (S)	N=18 (4,5/4,4,5,5) H 0643	Hamn	ner SN =	3.00	Dry	60.81	- 6.00			End of Bore	ehole at 6.00m				
Struck at (m) Cas		r Strikes n) Time (min) Rose t	o (m)	From					Hand dug		ed to 1.20m.					
Casing De		Water Added														
To (m) D 3.00	iameter 200	From (m) To (m)							ion Reason			Last Up 16/12/		W	AGS

	CAUSEW	AY ECH		•	ect No. 0399D	Project Name: Bus Connects Route 9 Tallaght/Clondalkin to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald							Borehole ID R9CP07			
Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base (m 6.00	7106	74.83 E 617.42 N	Final De		Start Date:		Driller:			heet 1 c Scale: 1: FINAI	:40		
Depth Sample (m) Tests	/ Field Records		Casing Water Depth Depth (m) (m)	Level mOD	Depth (m)	Legend		Desci	ription			Water	Backfill			
.00 B7 .00 D13 .00 ES3	N=14 (2,3/3,3,4,4) Han 0643				-		BITMAC MADE GROUND: Grithologies. Medium dense broffine to coarse GRAN Sand is fine to coarse	wn sandy slight /EL of mixed lit	ly silty subangu	ular to subr	ounded			1.5		
00 B8 00 D14 00 ES4	N=18 (3,4/5,4,4,5) Han 0643 N=19 (4,5/5,4,5,5) Han 0643			60.72	- 3.00		Medium dense bro subrounded fine to cobble content. Sar	coarse GRAVEI	of mixed litho					3.		
00 B10 00 D16	N=23 (4,5/5,6,6,6) Han 0643 N=23 (4,5/6,5,6,6) Han 0643													4.		
.00 B11 .00 D17 .00 - 6.45 SPT (C)) N=27 (7,9/9,6,6,6) Han 0643	nmer SN =	6.00 3.50	57.72	6.00			End of Borel	nole at 6.00m					6.5		
Casing Details To (m) Diamete		6.00 from (i			me (hh:mm)		nspection pit excavat ble groundwater enco		r added during	drilling.				7.0		
6.00 200	1.20 6.00						on Reason			Last Upd		W	AC			

	CAUSEW	AY ECH				ect No. 1399D	Project Client: Client's		ects Route 9 Tall Transport Al /Mott MacDo	uthority (NT		Centre		orehol	
Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base 5.1		7106	17.34 E 60.94 N	Final De		Start Date:		Driller: Logger:			heet 1 o Scale: 1 FINA	:40
Depth Sample / (m) Tests	Field Records		Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend		Descri	-			Water	Backfill	
.50 B6 ES1 .00 B7 .20 D13 .20 - 1.65 SPT (S) .50 ES .50 ES2 .00 B8 .00 D14 .00 ES3	N=8 (2,2/2,2,2) Hamr 0643 N=6 (2,1/1,2,1,2) Hamr 0643 Ublow=20 100%	0.00	Dry Dry	55.84 53.64 53.04	(m) - 0.20	Tegeno Visit of the control of the c	MADE GROUND: Go MADE GROUND: So to coarse. Gravel is mixed lithologies. Soft brown sandy g subangular to subro Stiff brown sandy g subangular to subro fine to coarse. Grav mixed lithologies.	ravelly silty CLA' ounded fine to co	to coarse GRA n sandy gravell ubrounded fin Y. Sand is fine to coarse of mixed to coarse of mixed dy slightly grave	y CLAY. Sare e to coarse. O coarse. O lithologie	Gravel is ess. Gravel is ess.		Dakilli	0.000	
10 EW 00 B11 00 D17	N=34 (4,5/8,8,9,9) Ham 0643 Slow seepage at 4.10 N=31 (15,25/31 for 75r Hammer SN = 0643		4.50		51.04 50.94	- 5.00		Grey BOULDER of li angular gravel of lin			chiselling a	as grey			5.5.6
						-									7.0
\A/ata	r Strikes		Chic	allina	Details		Remarks								\perp
Casing Details Casing to (m 4.10 4.1	1) Time (min) Rose to (n 20 4.00 Water Added	5.00	(m)	To (r 5.1	n) Tin	ne (hh:mm) 01:00		nspection pit excavat	ed to 1.20m.						
4.50 200								on Reason			Last Up		W	AC	

	CAUSEW	ECH			ect No. 399D	Project Client: Client's		ects Route 9 Talla Transport Au /Mott MacDo	uthority (NT		entre		rehole R9CP0	
Method Cable Percussion	Plant Used Dando 2000	Top (m) I	Base (m) 2.30	71077	73.86 E	Final De		Start Date: 1		Driller:			neet 1 o scale: 1:	40
Doubh Somula /			Casing Water		35.45 N	Elevatio	on: 61.79 mOD	End Date: 1		Logger:	CH	- i	FINAL	-
.50 ES3 .00 B7 .00 D9	N=16 (2,3/3,4,4,5) Har 0643 N=50 (25 for 25mm/50 25mm) Hammer SN =	nmer SN = :	2.00 1.50	Level moD 61.59 61.39	Depth (m) - 0.20 - 0.40	Legend	BITMAC MADE GROUND: Gr lithologies. Medium dense bro is subangular to sub	wn very gravelly	to coarse GRA' silty fine to co coarse of mixe	arse SAND.	Gravel	Water	Backfill	0.5 1.0 1.5 2.0 3.5 4.0 5.5 6.0 7.0
Water	r Strikes		Chiselling	Details	<u> </u>	Remarks								
	Time (min) Rose to (i	m) From (r 2.30		m) Tim	ne (hh:mm) 01:00	Hand dug i	nspection pit excavat ble groundwater enco		added during	drilling.				
200	2.20						on Reason			16/12/20	ated 020	W	AC	ìS

	CAUSEW	AY ECH			roject No. 0-0399D	Project Name: Bus Connects Route 9 Tallaght/Clondalkin to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald	Borehole ID R9CP10
Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base (3.00	7	10683.34 E 30676.26 N	Final Depth: 3.00 m Start Date: 07/10/2020 Driller: BM Elevation: 55.12 mOD End Date: 07/10/2020 Logger: CH	Sheet 1 of 1 Scale: 1:40 FINAL
Depth Sample /	Field Records		Depth D	eptn	evel Depth	Legend Description	हें Backfill
.50 ES3 .00 B8 .00 D11 .00 ES4 .00 - 2.45 SPT (S) .00 B9 .00 D12 .00 ES5	N=9 (2,3/2,3,2,2) Hami 0643 N=6 (1,1/1,1,2,2) Hami 0643	mer SN = mer SN =	O.00 E	54 57 57 57 57 57 57 57 57	op (m) .92 - 0.20 .72 - 1.40 .72 - 2.60 .12 - 3.00	MADE GROUND: Grey angular fine to coarse GRAVEL of mixed lithologies. MADE GROUND: Soft to firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Soft brown sandy gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Grey BOULDER of limestone. Recovered through chiselling as grey angular gravel of limestone. End of Borehole at 3.00m	0.5 0.5 1.0 2.0 2.5 2.5 3.0
							4.0 4.5 5.0 5.5 6.0
	r Strikes n) Time (min) Rose to (r Water Added From (m) To (m)	n) From ((m)	lling De To (m) 3.00	tails Time (hh:mm) 01:00	Remarks Hand dug inspection pit excavated to 1.20m. No groundwater encountered.	
						Termination Reason Last Updated Terminated on refusal. 16/12/2020	\\\AGS

		CAUSEV	VAY				ct No. 399D	Project Client: Client's			Authority (N7		Centre	Borehole I R9CP11
Metho		Plant Used Dando 2000	Top (m) 0.00	Base (Coord	linates	Final De	epth: 4.30 m	Start Date:	30/09/2020	Driller:	ВМ	Sheet 1 of : Scale: 1:40
)3.81 E .9.84 N	Elevatio	on: 54.07 mOD	End Date:	30/09/2020	Logger:	СН	FINAL
Depth (m)	Sample / Tests	Field Record	s	Depth D	Vater Depth (m)	Level mOD	Depth (m)	Legend		Des	cription			Backfill
						53.87	- 0.20		CONCRETE MADE GROUND: G	rov angular fin	o to coarse GPA	V/EI		
50 50 00	B5 ES1 B6 ES2					53.67	0.40		Medium dense bec subrounded fine to cobble content. Sar mixed lithologies.	oming dense I	orown sandy silt EL of mixed litho	y subangul logies with	low	C
20	U12	Ublow=50 0%		1.00 [Dry		- - - -							
00 00 00 00 - 2.45	B7 D10 ES3 SPT (C)	N=18 (2,4/4,4,5,5)		2.00 1	90		-							
00 00 00 00 - 3.45	B8 D11 ES4 SPT (C) EW	N=31 (5,6/6,7,9,9)		3.00 2		50.27		a x a x a x a x a x a x a x a x a x a x						3
00 00 - 4.05	B9 SPT (S)	N=50 (25 for 25mm/5 25mm)	60 for	4.00	Dry	50.37 49.77	3.70		Very stiff greyish bl Gravel is subangula lithologies.		•		oarse.	4.0
ruck at (m) Co		r Strikes) Time (min) Rose to	(m) From (m)	Illing To (m 4.30		e (hh:mm)		nspection pit excavat ble groundwater enc		er added during	drilling.		5 5 6 6
Casing D		Water Added								,	Ü	J		
To (m) 4.00	Diameter 200	From (m) To (m 1.50 3.50							ion Reason			Last Upo		\ \\AG

Second Research Second Res		CAUSEW				20-0	ect No. 0399D	Project Client: Client's		ects Route 9 Tall Transport Al	uthority (NT		entre	ı	orehole R9CP1	2
Surplicy				_		7108	80.38 E		-						Scale: 1:4	40
Social Color	Depth Sample	Field Records		Depth	Depth							100	ı	/ater		
00	.50 B5 .50 E51 .00 B6 .00 E52 .20 D12		nmer SN –			56.79	- 0.20		MADE GROUND: Gr lithologies. Medium dense brov coarse GRAVEL of m	wn sandy silty s	ubangular to su	ubrounded le content.	fine to			0.5
00	00 B7 00 D13 00 ES3	0643 C) N=19 (3,5/4,5,5,5) Har														2.0
D15 SPT (C) N=23 (4,5/5,5,6,7) Hammer SN = 4.00 Dry SPT (S) N=25 (4,5/5,5,6,7) Hammer SN SPT (S) N=10 (3,2/2,3,2,3) Hammer SN SPT (S) N=50 (25 for 50mm/50 for 25mm/50 for 25mm) Hammer SN SPT (S) N=50 (25 for 50mm/50 for 25mm/50 for	00 D14 00 ES4		Dry											3.0		
Note	.00 D15		Dry	52 20	- 470									4.0		
subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies. SPT (S) N=50 (25 for 50mm/50 for 25mm) Hammer SN = 0643 SPT (S) 25mm) Hammer SN = 0643 SPT (S) N=50 (25 for 50mm/50 for 25mm)	.00 D16		mmer SN =	5.00	Dry			× × × × × × × × × × × × × × × × × × ×					vith low			5.0
Water Strikes Chiselling Details ruck at (m) Casing to (m) Time (min) Rose to (m) From (m) To (m) Time (him) Hand dug inspection pit excavated to 1.20m. No noticeable groundwater encountered, water added during drilling. Casing Details Water Added To (m) Diameter From (m) To (m) To (m) 5.50 200 1.20 4.70	5.00 D17			6.00	Dry	50.99	- 6.00		subrounded fine to	coarse of mixed ed lithologies.	d lithologies. C					6.0
Casing Details Water Added To (m) Diameter From (m) To (m) 5.50 200 1.20 4.70 No noticeable groundwater encountered, water added during drilling. No noticeable groundwater encountered, water added during drilling.									nspection pit excavate	ed to 1.20m.						7.0
Terminated on refusal. 16/12/2020 \\AG	Casing Details To (m) Diamet	Water Added er From (m) To (m)	5.80				01:00	No noticea	ble groundwater encc		added during o		ated			

CAL	USEW —GEOTE	ЕСН		20-	ect No. 0399D	Project Client: Client's	Name: Bus Connects Route 9 Tallaght/Clonda National Transport Authority (Name: AECOM/Mott MacDonald		Borehole II
	lant Used ando 2000	Top (m) 0.00	Base (m 2.70	7109	990.93 E 781.72 N	Final De			Sheet 1 of 1 Scale: 1:40 FINAL
Depth Sample /	Field Records		Casing Water Depth Depth	Level	Depth	Legend	Description	100	ਸ਼ੁੱ Backfill
(m) Tests .50 B5 .50 ES1 .00 B6 .00 ES2 .20 D9 .20 - 1.65 SPT (S) N=10 (0643 .50 ES3 .00 D10 .00 ES4 .00 - 2.45 SPT (S) N=10 (0643 Seepai N=50 (25mm Water Strike ruck at (m) Casing to (m) Time 2.00 Time	2,3/2,2,3,3) Ham (1,2/1,2,3,4) Ham ge at 2.00m 25 for 25mm/50) Hammer SN = 0	nmer SN = for 1643	1.00 Dry 1.70 2.00 2.60 1.70	9 49.82 49.52	(m) - 0.10 - 0.30 - 1.20 - 1.50 - 2.40 - 2.70	Remarks	BITMAC MADE GROUND: Grey angular fine to coarse GR [lithologies.] MADE GROUND: Soft to firm brown sandy grave to coarse. Gravel is subangular to subrounded firmixed lithologies. Firm brown sandy gravelly CLAY. Sand is fine to subangular to subrounded fine to coarse of mix Firm brownish grey slightly gravelly sandy silty (coarse. Gravel is subangular to subrounded fine lithologies. Grey BOULDER of limestone. Recovered through angular gravel of limestone. End of Borehole at 2.70m End of Borehole at 2.70m	coarse. Gravel is ed lithologies. CLAY. Sand is fine to to coarse of mixed	2.5 2.6 3.6 3.6 3.6 3.6 3.6 3.7 3.7
To (m) Diameter From 2.60 200	n (m) To (m)						on Reason on refusal.	Last Updated 16/12/2020	\ \\AG\$

							Dro	ject No.	Project	Name: Bus Conne	orts Route a T	allaght/Clondall	rin to City C	entre	D.	orehole	
\Diamond		AUS	FW	ΔΥ				-0399D	Client:			Authority (NT		CHEC		9CP13	
	-	G	EOTE	СН			20	33330			•		~)		'`	.JCI 13	~
Met	hod	Plant U		Гор (m)	Rass	(m)	Con	ordinates	Client's	кер: АЕСОМ/	′Mott Mac[T	onaid				hoct 1	f 1
Cable Pe		Dando 2		0.00	_	e (m) 00			Final De	epth: 2.00 m	Start Date:	08/10/2020	Driller:	ВМ		heet 1 o Scale: 1:4	
								967.63 E 743.05 N	Flavotio	F2 20 m OD	Fred Date:	09/10/2020		CII			
									Elevatio	on: 52.38 MOD	End Date:	08/10/2020	Logger:	СН		FINAL	_
Depth (m)	Sample / Tests	Fiel	ld Records		Casing Depth (m)	Water Depth (m)	Level mOD	(m)	Legend		Des	cription			Water	Backfill	
							52.28	0.10	200000000	CONCRETE Void encountered -	possible old t	ank.			1		-
								-									_
								[0.5 —
								-									-
								-									1.0 —
																	-
								-									1.5
								[]
								8 – 2.00									2.0 —
							50.38	2.50			End of Bore	ehole at 2.00m					-
								-									
								E									2.5 —
								-									3.0 —
								-									
								-									3.5 —
								-									-
								Ŀ									4.0 -
								[4.0
																	-
								-									4.5 —
								-									_
								-									5.0 —
								-									5.5 —
																	-
								-									-
								-									6.0 —
								E									
								-									6.5 —
								-									-
								-									7.0 —
								-									
Struck at (m)		Strikes Time (min)	Rose to (m)	From (elling To (m)		Remarks	intered - possible old	tank						
200. 30 (111)	(111	,	(111)		,	(,	- ,	Moved to r	new position - R9CP13	3.						
Casing To (m)	Details Diameter	Water A	Added To (m)														
10 (111)	Diameter	1.000 (111)	.0 (111)									·					
										on Reason			Last Upd			AG	اء
									Terminated	l on refusal.			16/12/2	020	41		13

		AUSE	W .	AY CH				ct No. 399D	Project Name: Bus Connects Route 9 Tallaght/Clondalkin to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald	Borehole ID R9CPGS01
Method Cable Percu		Plant Used Dando 200		Top (m) 0.00	Base 6.0	_	Coord	dinates	Final Depth: 17.50 m Start Date: 04/10/2020 Driller: BM+GT	Sheet 1 of 2
Rotary Dril Rotary Cor	lling	Beretta T4 Beretta T4	14	6.00 12.00	12. 17.	00		16.53 E 30.52 N	Elevation: 72.60 mOD End Date: 10/10/2020 Logger: CH+RS	Scale: 1:50 FINAL
Depth (m)	Sample / Tests	Field R	Records		Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend Description	Backfill
0.50 1.00 1.00 1.00 1.20 1.20 1.20 - 1.65 2.00 2.00 2.00 2.00 2.00 - 2.45 3.00 3.00 3.00 3.00 3.00 4.00 4.00 4.0	B10 D16 ES10 ES3 SPT (S) B11 D17 ES4 SPT (S) B12 D18 ES12 ES5 SPT (S) B13 D19 ES6 SPT (S) B14 D20 ES7 SPT (C)	N=9 (2,2/2,2,2,3 0643 N=11 (2,3/2,3,3,0643 N=16 (3,4/4,4,4,4,0643 N=18 (4,5/4,5,4,0643 N=27 (7,8/8,6,6,0209 N=50 (25 for 75r,75mm) Hammer Water strike at 9	.3) Hami .4) Hami .5) Hami .7) Hami	mer SN = mer SN = mer SN =	0.00 0.00 0.00 6.50	Dry Dry	72.30 66.60 66.60	e (hh:mm)	Possible MADE GROUND: Firm to stiff brown slightly sandy gravelly SILT with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies. Cobbles are subrounded of mixed lithologies. Stiff brown sandy gravelly CLAY with cobbles and boulders. (Driller's description) Emarks land dug inspection pit excavated to 1.20m. ervices encountered in hand pit.	2.5
Casing De To (m) Dia 8.00	tails am (mm) 200	Water Add	ded To (m)		Barro K6L	el	Flush Polyi		Permination Reason Last Updated erminated at scheduled depth. 16/12/2020	\ \\AGS

		CAUS	E	W ITC	A EC	Y H		:	20-0	399D	Client: Client's		Transport /	Authority (NT. Donald	A)		R	9CPGS0
Meti Cable Per		Plant I Dando				(m)	Base 6.0	• •	Coord	inates	Final De	pth: 17.50 m	Start Date:	04/10/2020	Driller:	BM+GT		heet 2 of
Rotary (Drilling	Beretta Beretta	T44	1	6.	00	12. 17.	00		6.53 E 0.52 N	Elevation			10/10/2020	Logger:	CH+RS	3	Scale: 1:50 FINAL
Depth (m)	Sample / Tests	Fic	eld Re	cords			Casing Depth (m)		Level mOD	Depth (m)	Legend	1	Des	cription			Water	Backfill
0.50 - 9.95 11.00 - 11.4 12.00 - 13.5	-11.45 SPT (C) N=27 (7,8/8,6,6,7) Hammer SN = 11.0 0209 -13.50 C C C C C 100 80 33								52.60 50.60	10.00		Stiff brown sandy gr description) Medium dense browdescription) Medium strong thin Partially weathered	wnish grey sar wnish grey sar say laminated grobably slig	ndy clayey GRAVI	EL. (Driller'	s NE.		
12.55 12.80	C 100 80 22											slightly closer fractu Discontinuities: 1. 0 to 30 degree be planar, smooth.	ure spacing.					12
13.20	C									-		2. 90 degree joint fr	om 12.90m to	o 13.10m, undula	ating, rough	ı.		
13.50 13.75	С											3. 90 degree joint fr						13
14.00	С									-		3 . 3 . 3		,	J 0			14
14.15	С		100	100	46					-								
14.50	С					16				(5.50)								14
15.00										<u> </u>								15
15.35 15.85	С		100	85	49													15
16.50																		16
17.20	100 72 22 C																	17
17.40 17.50	c c							5	55.10	17.50			End of Bore	hole at 17.50m				17
	TCR SCR RQD FI																	18
		r Strikes			Re	mar											Щ	
truck at (m) 9.00	Casing to (n 9.00	n) Time (min)	Rose	e to (r				oection puntered			1.20m.							
Casing To (m) 8.00	Details Diam (mm 200	Water) From (m)		led o (m)														
						Core	Barr K6L	el	Flush Polyr			on Reason at scheduled depth.			16/12/2	dated	11	AG

		CAUS	EOTE	AY CH				ct No. 399D	Project Client: Client's			Authority (NT		Centre		orehole 9CPGS	
Metho Cable Perc		Plant U		Top (m) 0.00	Base 5.0		Coord	linates	Final De	epth: 18.00 m	Start Date:	03/10/2020	Driller:	BM+GT	1	heet 1 c Scale: 1:	
Rotary Dr Rotary Co	_	Beretta Beretta	I	5.00 10.50	10. 18.	50		80.78 E 85.56 N	Elevatio	n: 72.38 mOD	End Date:	09/10/2020	Logger:	CH+RS		FINA	
Depth (m)	Sample / Tests	Fie	eld Records		Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	1	Desc	ription			Water	Backfill	
0.50 0.50 1.00 1.00 1.00	B7 ES1 B8 ES2 ES8						72.18	0.20		TOPSOIL MADE GROUND: Fir is fine to coarse. Gra							0.5 —
1.20 1.20 - 1.65 2.00 2.00	D13	N=12 (2,2/3,: 0643	3,3,3) Ham	mer SN =	0.00	Dry											1.5 —
2.00 2.00 2.00 - 2.45 2.50 3.00	ES3 ES9 U17 D14 B10	Ublow=25 10	00%		0.00	Dry	69.98	2.40		MADE GROUND: Fir SILT. Sand is fine to c coarse of mixed lith	coarse. Gravel						2.5 —
3.00 3.00 3.00 - 3.45		N=14 (3,3/3,3,4,4) Hammer SN = 0.00 Dry 0643															3.5
4.00 4.00 4.00 4.00 - 4.45	B11 D16 ES5 SPT (S)	(S) N=23 (3,4/5,6,6,6) Hammer SN = 0.00 Dry 0643															4.0 —
5.00 5.00 5.00	B12 ES12 ES6						67.38	5.00		MADE GROUND: Fir red brick. (Driller's c		ly gravelly CLAY	with fragm	nents of			5.0 —
6.50 - 6.95	SPT (C)) N=11 (2,2/3,3,3,2) Hammer SN = 6.50 0209					65.88	6.50	2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2	Firm brownish grey description)	sandy gravelly	silty CLAY with	boulders. (Driller's			6.5 — - 7.0 — 7.5 —
8.00 - 8.45	SPT (C)	N=14 (2,2/3, 0209	3,4,4) Ham	mer SN =	8.00		64.38	8.00		Firm brown sandy g	ravelly CLAY w	ith boulders. (D	riller's des	cription)			8.0 —
		Water strike	at 9.00m					-							•		9.0
		r Strikes				elling	Details		Remarks						<u> </u>		
9.00		Time (min)) From (m)	To (ı	m) Tim		Service end	nspection pit excavate ountered at 5.00m 2m for rotary section.							
To (m) D 10.50	etails Diam (mm 200	Water) From (m) 9.00					_				ı						
					Barro K6L	el	Flush Polyr			on Reason at scheduled depth.			16/12/2	2020	W	AC	iS

		AUS	E	W TTC	A	Y			ect No. 399D	Client:		Transport /	Authority (NT		Centre		orehole	
Metho	nd .	Plant U					Base (m	Coor	dinates	Client's	s Rep: AECOM/	/Mott Mac[onald				heet 2 d	
Cable Perci Rotary Dr Rotary Co	ussion illing	Dando Beretta Beretta	2000 a T44)	0. 5.	00 00 .50	5.00 10.50 18.00	70993	30.78 E	Final De			03/10/2020		BM+GT		Scale: 1	:50
	_	Berette	, 1		10	.50			85.56 N	Elevatio	n: /2.38 mOD	End Date:	09/10/2020	Logger:	CH+RS	Ļ	FINA	L —
Depth (m)	Sample / Tests	Fie	eld Re	cords			Casing Wate Depth Depti (m) (m)	Level mOD	Depth (m)	Legend	Firm brown sandy g		cription	rillor's dose	rintion)	Water	Backfill	
.50 - 9.95	SPT (C)	N=13 (2,2/3, 0209	3,3,4) Ham	nmer	SN =	9.50	62.38	10.00		Firm dark grey sand	dy gravelly CLA	Y. (Driller's descr	iption)				9.5
0.50	C11						61.88	(2.45)		Firm brown slightly Gravel is subangula			and is fine t	to coarse.			11.0	
2.00 2.00 2.00 - 13.50	C11 C		100	9	7			59.43	12.95		Medium strong thir Partially weathered							12.5 13.0
3.35 3.50 3.70 3.90 4.10	C C C C 100 100 53										Probably slightly re Discontinuities: 1. 0 to 30 degree be smooth.	duced strengt	h.					13.5
4.65 5.00	c c																	14.5 15.0
5.40 5.70	c c		100	100	47	15			(5.05)									15.5
6.10 6.50	С																	16.0 16.5
6.75 7.05	C C 100 100 35								-									17.0 17.5
8.00								54.38	18.00			End of Bore	hole at 18.00m					18.0
			TCR	SCR	RQD	FI			ŧ							-		18.5
1		r Strikes				emar		•	•							'		
9.00 Casing Do	etails	Water	Add	ed	Se	rvice	encounte	tion pit exc red at 5.00 r rotary sec)m	1.20m.								
To (m) D	iam (mm 200	9.00	8.00		Corr	Barral	El···al-	Tuna	Tormina	on Reason			Lact II.	dated				
							Barrel K6L				on Reason I at scheduled depth.			16/12/2	2020	W	AC	3S

		CAUS	EW EOTE	AY CH				ct No. 399D	Project Client: Client's			authority (NT		Centre		orehole 9CPGS	
Metho Cable Percu Rotary Dri	ussion	Plant Us Dando 20 Beretta	000	Top (m) 0.00 5.00	5.0 10.5	0		5.89 E	Final De	epth: 16.00 m	Start Date:	03/10/2020	Driller:	BM+GT		heet 1 o	
Rotary Co		Beretta 1	T44	10.50	16.0			4.51 N	Elevatio	72.99 mOD	End Date:	11/10/2020	Logger:	CH+RS		FINAL	-
Depth (m)	Sample / Tests	Field	d Records		Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	TOPSOIL	Desc	ription			Water	Backfill	
0.50 0.50 1.00 1.00 1.20 1.20 - 1.65	B6 ES1 B7 ES2 D12 SPT (S)	N=15 (3,3/4,3, 0643	,4,4) Hamr	mer SN =	0.00	Dry	72.79	0.20		MADE GROUND: Fir coarse. Gravel is sub				e to			0.5 —
2.00 2.00 2.00 2.00 2.00 - 2.45		N=20 (4,5/4,5, 0643	,5,6) Hamr	mer SN =	0.00	Dry	70.99	2.00	***** ***** ***** *****	Stiff brown slightly g subangular to subro							2.0 —
3.00 3.00 3.00 - 3.45	B9 ES4 U16	Ublow=25 80%	0.00	Dry	69.79	3.20		Dense brown gravel subangular to subro							3.0 —		
4.00 4.00 4.00 4.00 4.00 - 4.45	B10 D14 ES10 ES5 SPT (S)	N=32 (4,5/6,8, = 0643	0.00	Dry											4.0 —		
5.00 5.00 5.00 - 5.45	B11 D15 SPT (S)	N=32 (4,5/6,8,8,10) Hammer SN					67.99	5.00		Very stiff brown san	dy gravelly CL	AY. (Driller's des	cription)				5.0 —
8.00 - 8.45	Water strike at 9.00						64.99	- 8.00		Medium dense brov description)	wn fine to coar	se SAND and Gi	RAVEL. (Dri	iller's	_		8.0 — 8.0 — 8.5 — 9.0 —
							Details		Remarks								
9.00 Casing De	Casing Details Water Added (m) Diam (mm) From (m) To (m)									nspection pit excavate	ed to 1.20m.	ı	Last Upo	dated			
				2016			Polyr			at scheduled depth.			16/12/2	2020	W	AG	ìS

		CAUS	E	W OT I	A	Y				ct No. 399D	Project Client: Client's			Authority (NT		Centre		orehole	
Metho		Plant U					Base		Coord	inates	Final De	pth: 16.00 m	Start Date:	03/10/2020	Driller:	BM+GT		heet 2 c	
Rotary Dri Rotary Co	lling	Dando 2 Beretta Beretta	T44	ŀ	5.	00 00 .50	5.0 10. 16.	50		5.89 E 4.51 N	Elevatio			11/10/2020		CH+RS		Scale: 1: FINAI	
Depth (m)	Sample / Tests	Fie	ld Re	cords			Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend		Des	cription	ļ		Water	Backfill	
9.50 - 9.95	SPT (S)	N=21 (3,4/4,5 0209	5,5,7) Ham	nmer	SN =	9.50		62.99	- 10.00		Medium dense browdescription) Grey weathered LIM				iller's			9.5
1.50	С		100	100	24				62.49	10.50		Medium, strong thi Partially weathered slightly closer fractu Discontinuities: 1. 0 to 30 degree be planar, smooth.	: probably sligure spacing.	thtly reduced str	ength. Pro	bably			10.5 11.0 -
12.00 12.00 12.40	c c		100	100	12														12.0 - 12.5
12.95 13.50 13.80	С					>20				(5.50)									13.0
14.10 14.55 14.65	c c c		100	100	22														14.0 - 14.5
15.00																			15.0 ·
15.40 15.60	C C		100	100	14														15.5
16.00									56.99	16.00			End of Bore	hole at 16.00m					16.0 - 16.5 17.0 - 18.0 -
			TCR	SCR	Ц—					-									10.3
9.00 Casing De	sing to (m	TStrikes Time (min) Water (a) From (m)	Add			emar and du		oectio	on pit exca	avated to	1.20m.								
10.50	200	9.00		6.00		Core	Barro	el	Flush Polyr			on Reason at scheduled depth.			Last Up 16/12/	dated 2020	W	AC	as

	C	CAUSE	VAY TECH				ect No. 0399D	Project Name: Bus Connects Route 9 Tallaght/Clondalkin to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald	Borehole ID R9CPGS04
Meth Cable Pero Rotary D Rotary C	cussion Frilling	Plant Used Dando 2000 Beretta T44 Beretta T44	0.00 6.00 10.50	6. 10	e (m) 00 .50 .00	7100	11.67 E 74.57 N	Final Depth: 16.00 m Start Date: 02/10/2020 Driller: BM+G Elevation: 73.07 mOD End Date: 08/10/2020 Logger: CH+RS	Sheet 1 of 2 Scale: 1:50 FINAL
Depth (m)	Sample / Tests	Field Reco	ords	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend Description	Backfill
0.50 0.50 1.00 1.00	B6 ES2 B7 ES3					72.97 72.77	0.10	TOPSOIL MADE GROUND: Grey angular fine to coarse GRAVEL of mixed lithologies. MADE GROUND: Firm brownish sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.	0.5 -
1.00 1.20 1.20 - 1.65	ES7 D13 SPT (S)	N=18 (3,3/3,5,5,5) H 0643	Hammer SN =	= 0.00	Dry	71.77	1.30	Stiff to very stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.	1.5
2.00 2.00 2.00 2.00 - 2.45		N=38 (5,6/7,10,10,1 SN = 0643	11) Hammer	0.00	Dry				2.5 -
3.00 3.00 3.00 - 3.45 3.50	B9 ES5 U19 D15	Ublow=25 100%		0.00	Dry	70.07	3.00	Medium dense brown gravelly silty fine to coarse SAND. Gravel is subangular to subrounded fine to coarse of mixed lithologies.	3.0
4.00 4.00 4.00 - 4.45		N=17 (3,4/4,4,4,5) H 0643	Hammer SN =	= 0.00	Dry				4.0 -
5.00 5.00 5.00 5.00 - 5.45		N=18 (4,4/5,5,4,4) H 0643	Hammer SN =	- 0.00	Dry				5.0 -
6.00 6.00 6.00 - 6.45	B12 D18 SPT (C)	N=19 (4,4/4,5,5,5) H 0643	Hammer SN =	= 0.00	Dry	67.07	6.00	Medium dense brown silty SAND and GRAVEL. (Driller's description)	6.5
7.50 - 7.95		N=18 (4,4/4,5,5,4) ł 0209	Hammer SN =	7.50					7.5 -
8.92 9.00 - 9.45	EW SPT (C)	N=20 (4,4/5,5,5,5) H 0209 Water strike at 9.00		9.00					9.0 -
itruck at (m)		r Strikes n) Time (min) Rose t			elling To (g Detail:		Remarks Hand dug inspection pit excavated to 1.20m.	
9.00 Casing C		Water Adde	d m)		- (. 7	335 inspection pit executated to 1/2011.	
20.30	200	5.55		e Barı	rel		Type vmer	Termination Reason Last Updated Terminated at scheduled depth. 16/12/2020	NAGS

	CAUSEWAY GEOTECH					Proje	ct No. 399D	Project Client:			allaght/Clondalk Authority (NT									
	/ –		SEC	TC	EC	Н					Client's	Rep: AECOM/	Mott MacE	onald						
Metho	od	Plant l	Jsed		Top	(m)	Base	(m)	Coord	inates		•						Shee	et 2 (of 2
Cable Perci	ussion	Dando	2000)	0.	00	6.0	00			Final De	epth: 16.00 m	Start Date:	02/10/2020	Driller:	BM+G		Sca		
Rotary Dr Rotary Co	- 1	Beretta Beretta				.50	10. 16.		71001											
notary co	711116	Derette			10	.50	10.		/295/	4.57 N	Elevatio	n: 73.07 mOD	End Date:	08/10/2020	Logger:	CH+RS		H	NA	L
Depth (m)	Sample / Tests	Fie	eld Re	cords			Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend		Des	cription	*		Water	Ва	ckfill	Τ
	1000						()	(,	63.67	9.40	** : 1 ° * : 1	Medium dense brow					/		Ħ÷,	
										Ē	<u> </u>	Stiff greyish brown	sandy gravelly	CLAY. (Driller's o	description)			H	9.5
											×—								H	.*
										-	× ×								H	* 10.0
										Ē	× × ×								H	
0.50 - 12.00	С						10.5		62.57	10.50	××	Medium dense brow	wn silty gravel	ly fine to coarse	SAND.		-			10.5
0.50 - 10.60	SPT(C) N 80mm/5	l=50 (25 for								(0.55)	××××									.*
		Hammer SN							62.02	11.05	×. ×.			L LANDSTON	5 D .: II			• , °	*.	11.0
l.15	= 0209 C		100	56	7							Medium strong thir weathered: probab					,			
										-		reduced strength.	Ť							11.5
70	С											Discontinuities:								1
2.00						1				/2 2		1 0 to 20 doc '	adding for -t-	as vary alas-l.	03C0d /3/3	5/13F\				12.0
00						20+				(2.00)		1. 0 to 30 degree be planar, smooth.	euuing tractur	es very closely s	paced (2/3	ɔ/ 125),				•
2.50	С																			12.5
2.90	С		100	85	45					Ē										1
.05	C								60.02	13.05		Medium strong ver	thinly bedde	d dark grev argi	laceous LI	MESTONE				13.0
										Ė		with calcite veining	up to 9mm th							
3.50	6					1				<u> </u>		slightly closer fractu	ire spacing.							13.5
3.50	С											Discontinuities:								
3.95	C C											1. 30 to 45 degree b	edding fractu	res closely space	ed (30/110	/350),				14.0
4.05 4.30	C		100	49	29							planar, rough.								
						10				(2.95)										14.5
						10				(2.55)										
5.00																				15.0
5.00										Ē										
			0.5	72	72															45.5
5.65	С		85	72	72															15.5
5.00									57.07	16.00			End of Bore	hole at 16.00m						16.0
																				16.5
										ŧ										
										-										17.0
										-										
										Ē										17.5
										Ē										
																				18.0
										Ė										18.5
			TCR	SCR	RQD	FI														1
		Strikes				emar														
9.00 (m) Ca	asing to (m	Time (min)	Rose	e to (r	n) _{Ha}	and di	ug insp	oectic	on pit exca	vated to	1.20m.									
Casina D	otaile	Water	۱- ۱- ۷	0 d	\dashv															
Casing Do	etalis iam (mm)			ea o (m)																
10.50	200	9.00		6.00																
						Core	Barr	el	Flush	Туре	Terminati	on Reason			Last Up	dated	-			_
								- 1		,				J				1	\	GS

	AUSEW GEOT	ECH	,	Project No 20-0399I	Client'	National	ects Route 9 Tallaght/Clonda Transport Authority (N 'Mott MacDonald T		ı	orehole R9WS0	1
Method Light Percussion	Plant Used Dando Terrier	7 (m) Bas	.20	710048.06	Final De		Start Date: 19/10/2020		- 1	Sheet 1 of Scale: 1:5	50
Double Country		Casin		730265.91		on: 64.16 mOD	End Date: 19/10/2020	Logger: GH	-	FINAL	
Depth Sample / Tests D.50 ES1 D.60 - 1.20 B2 B2 B2 D.60 - 1.20 ES3 D.60 - 1.20 D.60 ES3 D.60 D.6	Field Records	Casin Depth (m)	Depth (m)	Dep (m) 53.56	Legend 0		oft brown sandy gravelly SILT fine to coarse. Gravel is subai	ngular to subrounded	Water		0.5 · · · · · · · · · · · · · · · · · · ·
Water truck at (m) Casing to (m)			Details Diamete		inspection pi struck at 1.27			Last Updated			8.0



APPENDIX C CORE PHOTOGRAPHS





R9-CPGS01 Box 1 12.00-13.50m



R9-CPGS01 Box 2 13.00-15.00m



R9-CPGS01 Box 3 15.00-16.50m



R9-CPGS01 Box 4 16.50-18.00m





R9-CPGS02 Box 1 10.50-12.00m



R9-CPGS02 Box 2 12.00-13.50m



R9-CPGS02 Box 3 13.50-15.00m



R9-CPGS02 Box 4 15.00-16.50m



R9-CPGS02 Box 5 16.50-18.00m





R9-CPGS03 Box 1 10.50-12.00m



R9-CPGS03 Box 2 12.00-13.50m



R9-CPGS03 Box 3 13.50-15.00m



R9-CPGS03 Box 4 15.00-16.00m





R9-CPGS04 Box 1 10.50-12.00m



R9-CPGS04 Box 2 12.00-13.50m



R9-CPGS04 Box 3 13.50-15.00m



R9-CPGS04 Box 4 15.00-16.00m





APPENDIX D
TRIAL PIT LOGS



			Proje	ect No.	Project	Name:		Т	rial Pit ID
RA	CALIS	SEWAY	20-0	0399D	Bus Co	nnects Route 9 Tallaght/Clondalkin to City (Centre		
	CAUS	EWAY GEOTECH	Coor	dinates	Client:				R9TP01
	`	32012011	708/1	88.70 E	1	al Transport Authority (NTA)			
Method:				49.19 N		Representative:			neet 1 of 1
Trial Pitting						I/Mott MacDonald	1.	S	cale: 1:25
Plant:				vation	Date:	2020	Logger:		FINAL
JCB 3CX Depth	Sample /		101.70	Depth	08/10/		RS	5	
(m)	Tests	Field Records	(mOD)	(m)	Legend	Description		Water	
0.50 0.50 0.50 0.50 0.50 1.00 1.00 1.00	ES1 B2 ES3	HVP=108, HVR=17 HVP=115, HVR=17 HVP=161, HVR=26 HVP=275, HVR=9 HVP=201, HVR=29 HVP=201, HVR=80	99.70	2.00		MADE GROUND: Stiff greyish brown slightly sandy gobble content. Sand is fine to coarse. Gravel is sub of limestone. Cobbles are of limestone. End of trial pit at 2.00m	gravelly CLAY with low	,	1.5 —
				-					
				<u>-</u>					4
				-					-
								\pm	
Water		Depth: 2.00	Rema			A consideration of the conside			
Struck at (m)	Remarks	Width: 0.60	No gr	roundwate	r encoun	tered.			
		Length: 3.00							
		Stability:	Torm	ination Re	acon.	7	Last Updated		
		Stable Stable		inated on r			16/12/2020	W	AGS

			Proj	ect No.	Project	Name:		Т	rial Pit ID
(A)	CALIS	EWAY	20-0	0399D	Bus Co	nnects Route 9 Tallaght/Clondalkin to City	Centre		
	CAUS	SEWAY GEOTECH	Coor	dinates	Client:				R9TP02
	`	SECTECIT	7085	06.36 E	1	al Transport Authority (NTA)			
Method:				55.02 N	1	Representative:			neet 1 of 1
Trial Pitting						1/Mott MacDonald	I.	S	cale: 1:25
Plant:				vation	Date:	2020	Logger:		FINAL
JCB 3CX Depth	Sample /		101.68 Level	Depth	08/10/		RS	-	
(m)	Tests	Field Records	(mOD)	(m)	Legend	Description		Water	
0.50 0.50 0.50 1.00 1.00 1.00 1.00 1.00 1.50	E51 B2 E53 E54 B5 E56	HVP=147, HVR=20 HVP=178, HVR=26 HVP=184, HVR=26 HVP=195, HVR=14 HVP=201, HVR=32	99.28	2.40		Stiff brown slightly sandy slightly gravelly CLAY with Sand is fine to coarse. Gravel is subangular fine to cobbles are of limestone. End of trial pit at 2.40m	low cobble content. oarse of limestone.		1.5 — 2.0 — 3.0 — 4.0 — 4.5 —
				-					-
	C+!I.		Rema	arke.					
Water Struck at (m)	Strikes Remarks	Depth: 2.40	1	arks: roundwate	r encoun	tered.			
Juliuck at (III)	nemarks	Width: 0.60	- 3.						
		Length: 3.00							
		Stability:	Term	ination Re	ason:		Last Updated		
		Stable	Term	inated on r	refusal.		16/12/2020		AGS

200			1			Name:	T	rial Pit ID
	CAUS	EWAY	-	0399D		nnects Route 9 Tallaght/Clondalkin to City Centre		DOTDOS
	———G	EOTECH	Coor	dinates	Client:	al Transport Authority (NTA)		R9TP03
/lethod:			7096	13.40 E		s Representative:	SI	neet 1 of 1
rial Pitting			7282	68.52 N		I/Mott MacDonald		cale: 1:25
Plant:			Ele	vation	Date:	Logger:		
CB 3CX				l mOD	09/10/	2020 RS		FINAL
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water	
			87.21	0.10		MADE GROUND: Grey rounded coarse GRAVEL of mixed lithologies. MADE GROUND: Greyish brown very sandy very silty subangular fine to		
				-		coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
			86.96	0.35		MADE GROUND: Dark grey sandy subangular fine to coarse GRAVEL of		
0.50	B2			-		limestone with high cobble content. Sand is fine to coarse. Cobbles are of limestone.	:	0.5 -
).50	ES1			-				
				-				
			86.41	0.90		CONCRETE		
			86.31	1.00	8000000000	End of trial pit at 1.00m		1.0
				-				
				-				
				-				
				-				1.5 =
				-				
				-				
								2.0
				_				
				-				
				-				
				-				2.5 -
				-				
				-				
				-				
				_				3.0
				-				
				-				
				-				
				-				3.5 -
				-				
				-				
				-				4.0 —
				-				4.0
				-				
				-				4.5
				-				
				-				
				-				
	r Strikes	Depth: 1.00	Rema		ronce	torod		
Struck at (m)	Remarks	Width: 0.60	Pote		main bel	ow cement cover		
		Length: 2.50	No h	and vane to	ests poss	ible due to granular material.		
		Stability:	Term	ination Re	ason:	Last Updated		AGS

			Proje	ect No.	Project	Name:		T	rial Pit ID
RA	CALIS	SEWAY	20-0	0399D	Bus Co	nnects Route 9 Tallaght/Clondalkin to City (Centre		
		GEOTECH	Coor	dinates	Client:				R9TP04
		BLOTECH	7097	10.24 E	1	al Transport Authority (NTA)			
Method:				80.16 N	1	s Representative:		Sl	neet 1 of 1
Trial Pitting						1/Mott MacDonald	1.	S	cale: 1:25
Plant:				vation	Date:	2020	Logger:		FINAL
JCB 3CX Depth	Sample /		78.40) mOD Depth	08/10/		RS	<u>.</u>	
(m)	Tests	Field Records	(mOD)	(m)	Legend	Description		Water	
0.50 0.50 1.00 1.00 1.00 1.50 1.50	B2 E52 E53 B4 E5 E55 B6 E57	HVP=201, HVR=29	78.10 77.30 76.40	1.10		MADE GROUND: Stiff brown slightly sandy slightly cobble content and fragments of red brick. Sand is is subangular to subrounded fine to coarse of mixed are of mudstone. MADE GROUND: Stiff yellowish brown slightly sandwith fragments of red brick. Sand is fine to coarse. Of fine to coarse of mudstone. Grey sandy very clayey subrounded fine to coarse. On the coarse of the coarse of the coarse. On the coarse of the coarse of the coarse. On the coarse of the coarse of the coarse. On the coarse of the coarse. On the coarse of the co	fine to coarse. Gravel d lithologies. Cobbles y slightly gravelly CLA' Gravel is subangular	(1.5 — 2.0 — 3.5 — 4.5 — 4.5 — 4.5 —
				-					-
								\pm	
	Strikes	Depth: 2.00	Rema			+d			
Struck at (m)	Remarks	Width: 0.60	No gr	roundwate	r encoun	iterea.			
		Length: 3.00							
		Stability:	Term	ination Re	ason.		Last Updated		
		Stable Stable		inated on i			16/12/2020	W	AGS

	CALIS	SEWAY		ect No. 0399D	Bus Co	: Name: nnects Route 9 Tallaght/Clondalkin to City	Centre	T	rial Pit ID
		SEWAY GEOTECH		rdinates '57.92 E		al Transport Authority (NTA)			R9TP05
Method: Trial Pitting				08.08 N	1	s Representative: 1/Mott MacDonald			neet 1 of 1
Plant:			Ele	vation	Date:	I/ Wort WacDonald	Logger:	3	scale: 1:25
JCB 3CX				0 mOD	08/10/	2020	RS		FINAL
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description		Water	
Struck at (m)	B2 E5 E52 E53 E54	14/2-Jalla . 0.00	73.40	1.80		MADE GROUND: Firm brown slightly sandy slightly medium cobble content and fragments of red brick of rubber and carpet. Sand is fine to coarse. Gravel subrounded fine to medium of mixed lithologies. Clithologies. End of trial pit at 1.80m	and wood and pieces is subangular to		10 — 15 — 20 — 25 — 40 — 45 — 45 — 45 — 4
1.60	Rapid wate strike at 1.6								
		Stability:	Term	nination Re	eason:		Last Updated		AGS

			Proj	ect No.	Project	Name:		Т	rial Pit ID
A H	CALIS	SEWAY	20-	0399D	Bus Coi	nnects Route 9 Tallaght/Clondalkin to City (Centre		
	CAUS	GEOTECH	Coor	dinates	Client:				R9TP06
		BLOTLETT	7000	04.05 E	1	al Transport Authority (NTA)			
Method:				54.47 N	1	Representative:			neet 1 of 1
Trial Pitting						I/Mott MacDonald		S	cale: 1:25
Plant:				vation	Date:	2020	Logger:		FINAL
JCB 3CX Depth	Sample /		Level	B mOD Depth	08/10/	2020	RS		
(m)	Tests	Field Records	(mOD)	(m)	Legend	Description		Water	
0.50 0.50 0.50 0.50 0.50	ES ES1 B2 ES3	HVP=118, HVR=26 HVP=132, HVR=20	70.88 70.78	(m) - 0.10 - 0.20		TOPSOIL MADE GROUND: Firm orangish brown slightly sandy cLAX. Sand is fine to coarse. Gravel is subrounded fivudstone. MADE GROUND: Stiff greyish brown slightly sandy gmedium cobble and boulder content and fragment brick and pieces of rubber tubes. Sand is fine to coasubrounded fine to coarse of predominantly limesto boulders are of limestone. End of trial pit at 1.05m	gravelly CLAY with s of concrete, red arse. Gravel is	<u>w</u>	1.5 — 2.0 — 3.5 — 4.0 — 4.5 —
				-					-
				a ulta:					
Struck at (m)		Depth: 1.05	Rema No g	arks: roundwate	r encoun	tered.			
Struck at (m)	Remarks	Width: 0.60	INO B	Junuwale	. cricouli	terea.			
		Length: 3.00							
		Stability:	Term	ination Re	ason:		Last Updated		
		Unstable		inated on r			16/12/2020	W	AGS

A N			Proi	ect No.	Project	: Name:		Т	rial Pit ID
200				0399D		nnects Route 9 Tallaght/Clondalkin to City	Centre	'	
	CAUS	EWAY GEOTECH		dinates	Client:		-	-	R9TP07
	(GEOTECH			Nation	al Transport Authority (NTA)			
Method:				96.86 E	1	s Representative:		Sł	neet 1 of 1
Trial Pitting			7297	29.58 N	AECOM	1/Mott MacDonald			cale: 1:25
Plant:				vation	Date:		Logger:		FINAL
3T Tracked Ex) mOD	24/10/	2020	GH		FINAL
	Sample / Tests	Field Records	Level (mOD)		Legend	Description		Water	
Depth (m) 0.50 0.50 0.50 0.50 1.00 1.00 2.00 2.00	B1 ES ES4 B2 ES5	Field Records	74.50 73.00 72.80	1.80	Legend	MADE GROUND: Firm brown slightly sandy slightly with medium cobble and boulder content and piec concrete. Sand is fine to coarse. Gravel is subangul to coarse of mixed lithologies. Cobbles and boulde lithologies. Brown gravelly silty fine to coarse SAND. Gravel is smedium. End of trial pit at 2.00m	es of red brick and ar to subrounded fine rs are angular of mixed	Water	1.5 — 2.0 — 3.0 — 3.5 —
									4.5 —
Wat	ter Strikes	Dorth: 3.00	Rema		1	l		1	ı
Struck at (m		Depth: 2.00	Hand	l dug inspe	ction pit	excavated to 1.20m.			
		Width: 0.55 Length: 2.80							
			T	ination P	2000		lock Hudeted		
		Stability:		ination Re			Last Updated		AGS
		Stable	Term	inated on i	instructio	on of engineer.	16/12/2020		MUD

				ect No. 0399D		Name: nnects Route 9 Tallaght/Clondalkin to City Centre		Т	rial Pit ID
	CAUS	EWAY EOTECH	-	dinates	Client:	meets houte 9 ranagm/ ciondaixin to city centre		1	R9TP08
	G	EOTECH				al Transport Authority (NTA)			
Method:				38.06 E 72.84 N	1	Representative:		Sł	neet 1 of 1
Trial Pitting						I/Mott MacDonald		S	cale: 1:25
Plant: ICB 3CX				vation 5 mOD	Date: 08/10/	Logger 2020 RS	:		FINAL
Depth	Sample /	Field Records	Level	Depth	Legend	Description		Water	
(m) 0.50 0.50	Tests ES ES1	Tred Records	(mOD)	(m)		MADE GROUND: Stiff brown slightly sandy gravelly CLAY. Sand is coarse. Gravel is subrounded fine to coarse of limestone. Brown sandy clayey subangular fine to coarse GRAVEL of limes'			- - - - 0.5 —
1.00 1.00	B2 ES3			- - - - - - -		is fine to coarse.	tone. Sand		1.0
				-	-				_
			66.06	1.30		End of trial pit at 1.30m			-
				-					1.5 —
				- - -					-
				-					_
				-					2.0
									_
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				[_
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				-					4.0
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				<u> </u>					-
				-					4.5 —
				-					-
				[_
				<u> </u>					-
	6: "		D	arks:					
Struck at (m)	Remarks	Depth: 1.30 Width: 0.60		roundwate		tered. ible due to granular nature of clay.			
		Length: 2.00	-	inat'- P		1	-l-4		
		Stability: Unstable		ination Reinated on		16/12/	2020	W	AGS

	CAUS	FWΔY	20-0	0399D	IDuc Co	anacte Pouto O Tallaght/Clandalkin to City Contr	Project Name:			
		CAUSEWAY ——GEOTECH		20-0399D		Bus Connects Route 9 Tallaght/Clondalkin to City Centre				
Method: Trial Pitting Plant:				Coordinates		Client: National Transport Authority (NTA)				
				91.88 E	Client's Representative:				neet 1 of 1	
			7303	730342.97 N		AECOM/Mott MacDonald				
			Elevation		Date:		Logger:		FINAL	
CB 3CX Depth	Sample /		69.54 Level	mOD Depth	09/10/			'n	TINAL	
(m)	Tests	Field Records	(mOD)	(m)	Legend	Description MADE GROUND: Grey sandy very silty subangular fine to a	coarse GRAVEL	Water		
			69.39	0.15		of limestone. Sand is fine to coarse. MADE GROUND: Light yellowish brown slightly sandy clay	ey subangular	-	-	
			69.29 69.19	0.25 0.35		fine to coarse GRAVEL of mudstone. Sand is fine to coarse MADE GROUND: Brown very sandy very clayey subangula		1		
			69.09	0.35		subrounded fine to coarse GRAVEL of mixed lithologies. Sa		1	-	
).50	ES1			-		coarse. MADE GROUND: Dark brown very gravelly very silty fine to	to coarse SAND.	/	0.5 —	
						Gravel is subangular fine to coarse of mixed lithologies. MADE GROUND: Greyish brown slightly sandy gravelly CL	AY with high			
				-		cobble content and fragments of glass and red brick. Sand	d is fine to		-	
				-		coarse. Gravel is subangular fine to coarse of mixed lithologies.	ogies. Cobbies		-	
L.00 L.00	B3 ES			-					1.0 —	
00	ES2			-						
				-					-	
50	ES4			-					1.5 —	
				-					-	
				-						
									-	
.00	ES ES5			-					2.0 —	
00	133		67.34	- 2.20					-	
			67.34	- 2.20	a X. , a X. 9	Yellowish brown sandy silty subrounded fine to coarse GR lithologies with low cobble content. Cobbles are subroun				
					a X , a X ,	limestone.	iaca o.		-	
2.50 2.50	B6 ES7			-	** * * * * *				2.5 —	
50	L37				* ,					
			66.79	2.75	, 9 · X.	End of trial pit at 2.75m		1		
				-					-	
				-					3.0 —	
				-					-	
				-					3.5 —	
				-					-	
				-						
				-					4.0 —	
				-					-	
				-						
									-	
				-					4.5 —	
				-						
				-					-	
	er Strikes	Depth: 2.75	Rema No gr	arks: oundwate	er encoun					
Struck at (m)) Remarks	Width: 0.60	1,40 81	_ a.iawatt	c.icouii					
Length: 3.00										
		Length: 3.00								
		Stability:	Term	ination Re	eason:	Las	st Updated		AGS	

			Project No. 20-0399D Coordinates - 710639.12 E 730660.94 N Elevation 56.58 mOD		Project Name: Bus Connects Route 9 Tallaght/Clondalkin to City Centre Client: National Transport Authority (NTA) Client's Representative: AECOM/Mott MacDonald Date: Logger:					
CAUSEWAY GEOTECH Method: Trial Pitting Plant: JCB 3CX										
						2020	Logger: RS		FINAL	
Depth	Sample /	Field Records	Level	Depth	Legend	Description	1.0	Water		
(m) 0.50	Tests ES1	Tied lecolds	(mOD)	(m)	Legend	MADE GROUND: Firm brown slightly sandy slightly fragments of red brick. Sand is fine to coarse. Grave to coarse of mixed lithologies.		W	- - - 0.5 —	
0.50 0.50 0.50		HVP=101, HVR=23 HVP=92, HVR=14 HVP=93, HVR=15	56.02	- 0.55 - -		MADE GROUND: Soft yellowish brown slightly sand CLAY. Sand is fine to coarse. Gravel is subrounded fi mudstone.			-	
0.75 1.00	B2		55.78 0.80 Brown gravelly silty fine to medium of mudstone.		Brown gravelly silty fine to coarse SAND. Gravel is s medium of mudstone.	o coarse SAND. Gravel is subrounded fine to		1.0		
1.00	ES3		55.52	1.05		Brown sandy clayey subrounded fine to coarse GRA low cobble content. Sand is fine to coarse.	VEL of limestone with	1	-	
1.50	ES5			- - - - - - - -					1.5 —	
2.00 2.00	B6 ES7		54.38	2.20		Stiff brown slightly sandy slightly gravelly CLAY. Sand Gravel is subrounded fine to medium of mixed lith Contains occasional lenses of brown fine to mediur	ologies.		2.0 —	
3.00	ES8			-					3.0	
4.00	В9			- - - - - - - - - - - - - - - - - - -					3.5 —	
4.00	ES10		52.38	4.20		End of trial pit at 4.20m			-	
				- - - - - -					4.5 -	
Struck at (m)	er Strikes Remark	Depth: 4.20 Width: 0.60 Length: 4.00	Rem No g	arks: roundwate	er encour	tered.				
		Stability:	Term	ination Re	eason:		Last Updated			
Stability:			Termination Reason:Last UpdatedTerminated on refusal.16/12/2020					W AGS		

200			Proj	ect No.	Project Name:				Trial Pit ID	
CAUSEWAY		20-0	20-0399D		Bus Connects Route 9 Tallaght/Clondalkin to City Centre					
CAUSEWAY ——GEOTECH			Coordinates		Client: National Transport Authority (NTA)				R9TP11	
			710673.95 E		1					
Method:					1	Representative:			neet 1 of 1	
Trial Pitting			730667.32 N		AECOM/Mott MacDonald				cale: 1:25	
Plant:			Elevation		Date:		Logger:		FINAL	
JCB 3CX		56.61 mOD		08/10/	2020	RS		THVAL		
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description		Water		
0.50 0.50 0.50 0.50 0.50 1.00 1.00 1.00	E51 B2 ES ES3 ES4 B5 ES6	HVP=201, HVR=25 HVP=201, HVR=29 HVP=201, HVR=31 HVP=141, HVR=44 HVP=201, HVR=80 HVP=55, HVR=9	55.71	0.90		MADE GROUND: Stiff brown slightly sandy slightly gine to coarse. Gravel is subrounded fine to coarse of the tocoarse. Gravel is subrounded fine to coarse of the tocoarse. Gravel is fine to coarse. Gravel is fine to medium of mudstone. Stiff brown slightly sandy slightly gravelly CLAY. Sand Gravel is subrounded fine of mixed lithologies. Contains occasional lenses of brown fine to medium	of mixed lithologies. y slightly gravelly CLA avel is subangular d is fine to coarse.		1.5 —	
3.00	B7 ES8		53.01	3.60		End of trial pit at 3.60m			3.0 — 3.5 — 4.0 — 4.0	
				-					4.0	
				[
				-]	
				-					-	
				-					4.5 —	
				-					-	
				-					╡	
				E					╡	
	C. "I		Dem	arks:						
	Strikes Remarks	Depth: 3.60	Remarks: No groundwater encountered.							
Struck at (m)	Kernarks	Width: 0.60								
		Length: 3.00								
		Stability:	Torm	ination Re	ason.		Last Updated			
								11	AGS	
	Stable		Term	inated on	Terminated on refusal. 16/12/2020					



APPENDIX E TRIAL PIT PHOTOGRAPHS





R9-TP01





R9-TP01





R9-TP01



R9-TP01





R9-TP01



R9-TP01





R9-TP01



R9-TP01





R9-TP02





R9-TP02





R9-TP02



R9-TP02





R9-TP02



R9-TP02





R9-TP02





R9-TP03





R9-TP03





R9-TP03



R9-TP03





R9-TP03



R9-TP03





R9-TP03





R9-TP04





R9-TP04





R9-TP04



R9-TP04





R9-TP04





R9-TP04



R9-TP04





R9-TP05





R9-TP05



R9-TP05





R9-TP05





R9-TP05



R9-TP05





R9-TP05





R9-TP06





R9-TP06





R9-TP06



R9-TP06



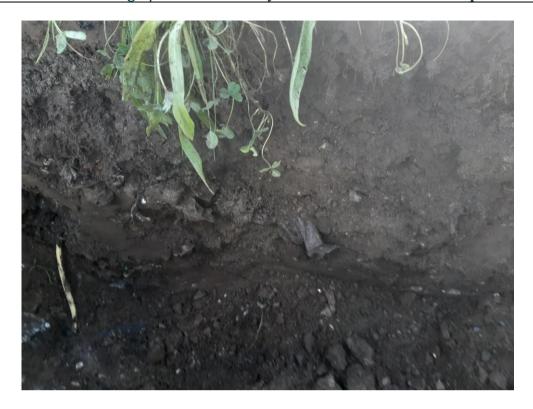


R9-TP06



R9-TP06





R9-TP06



R9-TP06





R9-TP06





R9-TP07





R9-TP07





R9-TP07



R9-TP07





R9-TP07



R9-TP07





R9-TP07





R9-TP08





R9-TP08



R9-TP08





R9-TP08



R9-TP08





R9-TP08



R9-TP08





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R9-TP09





R9-TP09





R9-TP09



R9-TP09





R9-TP09



R9-TP09





R9-TP09





R9-TP10





R9-TP10





R9-TP10



R9-TP10





R9-TP10



R9-TP10





R9-TP10





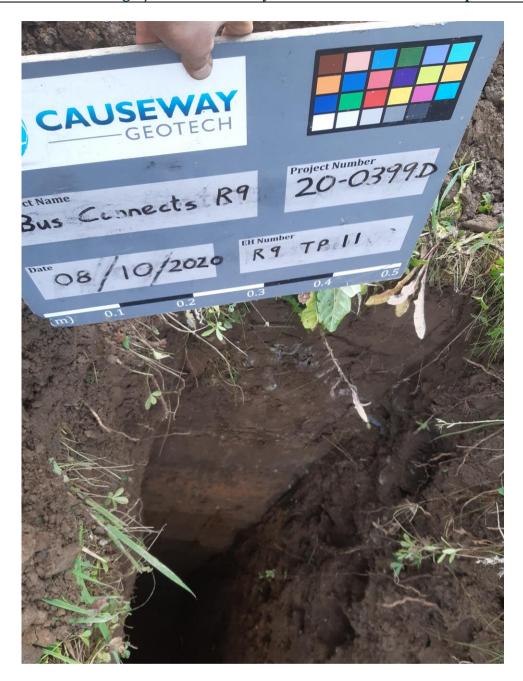
R9-TP11





R9-TP11





R9-TP11





R9-TP11





R9-TP11





R9-TP11





R9-TP11



R9-TP11





APPENDIX F INDIRECT IN-SITU CBR TEST RESULTS



Project Number	20-0399D	
Project Name	Bus Connects Route 9	
Site Location	R9-TP01	



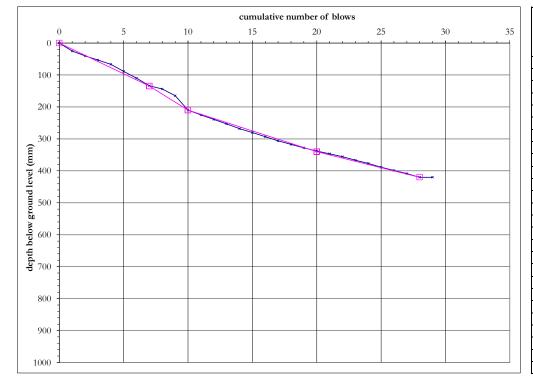
Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020	
Weather	Raining	

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.

CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	Topsoil



top / base of layer (mm)	mm/ blow	CBR (%)
0	19	13
135	19	13
135	25	10
210	23	10
210	13	20
340	15	20
340	10	26
420	10	20
	,	

CBR Range Min: 10 The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None
--------------------------------------	------

Observations and comments

Approved Name and Appointment

Darren O'Mahony Director Jam Or de Mon.



Project Number	20-0399D	
Project Name	Bus Connects Route 9	
Site Location	R9-TP02	



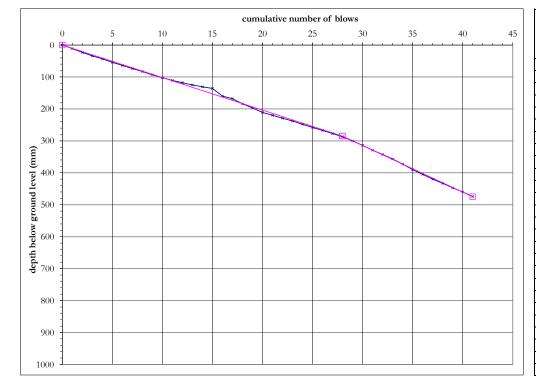
Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020	
Weather	Raining	

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.

CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material	
Natural Ground	Topsoil	



top / base of layer (mm)	mm/ blow	CBR (%)
0	10	26
285	10	26
285	15	10
475	15	18

CBR Range	Min: 18	
	Max: 26	

The selection of layers is based on visual interpretation of the data.

The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None
--------------------------------------	------

Observations and comments

Approved Name and Appointment

Darren O'Mahony Director Jam Or Mus.



Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP04



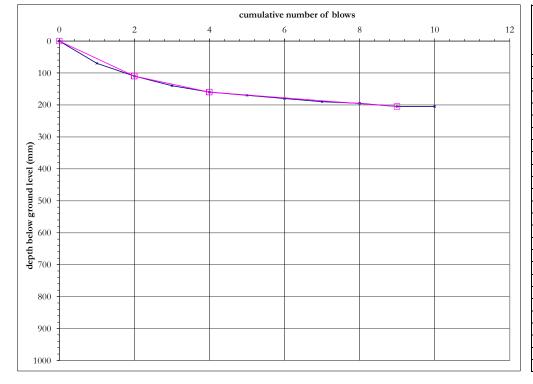
Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.

CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	Topsoil



top / base of layer (mm)	mm/ blow	CBR (%)
0	55	4.4
110	55	4.4
110	25	10
160	25	10
160	9	30
205	,	30
	,	

CBR	Min: 4.4	The selection of layers is based on visual interpretation of the data.
Range	Max: 30	The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None
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Observations and comments	Terminated due to refusal
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Approved Name and Appointment

Darren O'Mahony Director Jam Or Mus.



Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP05



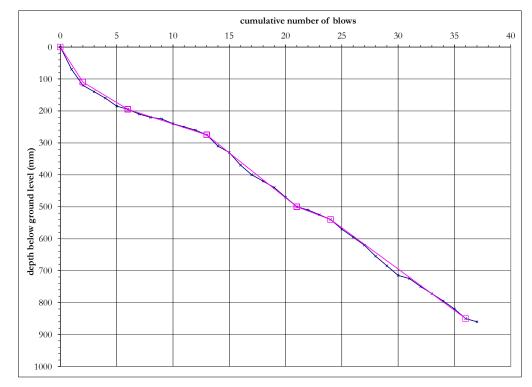
Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.

CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	Topsoil



top / base of layer (mm)	mm/ blow	CBR (%)
0	55	4.4
110	33	4.4
110	21	12
195	21	12
195	11	23
275	11	25
275	28	8.9
500	20	0.7
500	13	20
540	13	20
540	26	9.7
850	20	7.7

CBR	Min: 4.4
Range	Max: 23

The selection of layers is based on visual interpretation of the data.

The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None
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Observations and comments

Approved Name and Appointment

Darren O'Mahony Director Jam O de Mo.



Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP06



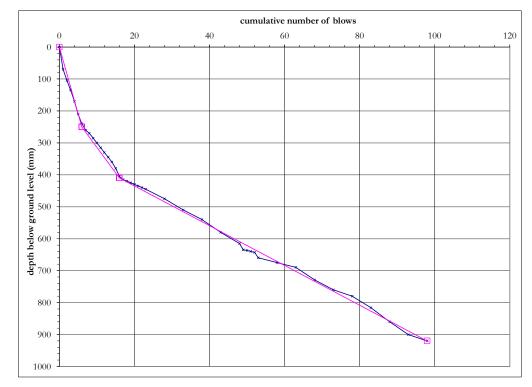
Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.

CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	Topsoil



top / base of layer (mm)	mm/ blow	CBR (%)
0	42	5.9
250	72	3.7
250	16	16
410		
410	6.2	44
920		

CBR	Min: 5.9
Range	Max: 44

The selection of layers is based on visual interpretation of the data.

The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None
--------------------------------------	------

Observations and comments

Approved Name and Appointment

Darren O'Mahony Director Jam Or de Mon.



Project Number	20-0399D	
Project Name	Bus Connects Route 9	
Site Location	R9-TP07	

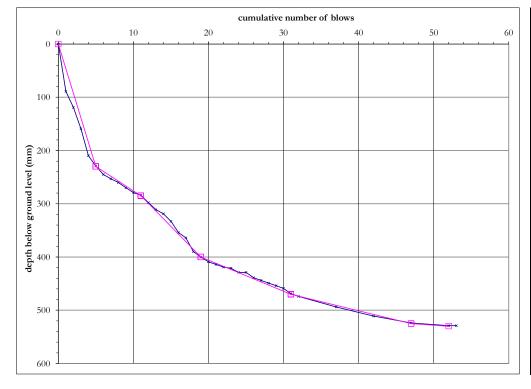


Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4. CBR calculated using the TRL equation: $\log 10(CBR) = 2.48 - 1.057 \times \log 10(mm/blow)$ iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	Topsoil



top / base of layer (mm)	mm/ blow	CBR (%)
0	46	5.3
230	10	5.5
230	9.2	29
285	7.2	2,
285	14	18
400	17	10
400	5.8	47
470	5.0	1,
470	3.4	82
525	5.1	02
525	1	>100
530	•	7 100

CBR Min: 5.3
Range Max: >100

The selection of layers is based on visual interpretation of the data.

The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None
--------------------------------------	------

Observations and comments

Approved Name and Appointment

Darren O'Mahony Director Jam Or de Mo.



Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP08



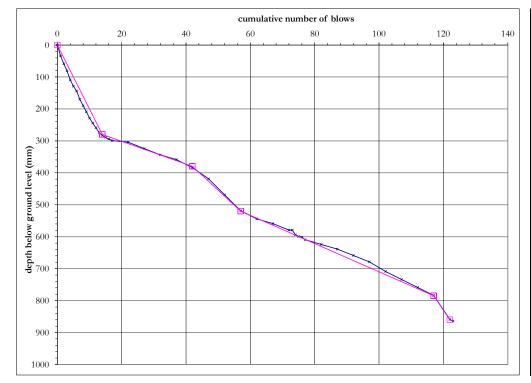
Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.

CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	MADE GROUND: Stiff brown sandy gravelly CLAY



-		
top / base of layer (mm)	mm/ blow	CBR (%)
0	20	13
280		
280	3.6	79
380		
380		
520	9.3	28
520		
520	4.4	63
785	4.4	03
785	15	17
860		

CBR	Min: 13	
Range	Max: 79	

The selection of layers is based on visual interpretation of the data.

The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None
--------------------------------------	------

Observations and comments

Approved Name and Appointment

Darren O'Mahony Director Jam O UNO J.



Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP09



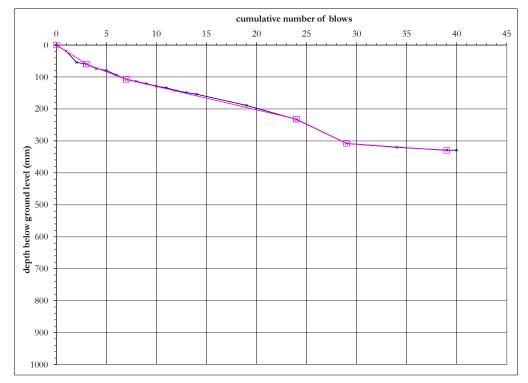
Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.

CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	MADE GROUND: Grey sandy very silty GRAVEL



top / base of layer (mm)	mm/ blow	CBR (%)
0	20	13
60	20	13
60	12	22
108		
108	7.3	37
232		
200		
232	15	17
308		
308		
330	2.2	>100
330		
ĺ		

CBR The insitu DCP reading	Min: 13	The selection of layers is based on visual interpretation of the data. The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing;
	variation in moisture content or other factors may affect the insitu value.	

Deviation(s) from standard procedure	None
--------------------------------------	------

Observations and comments	Terminated due to refusal
---------------------------	---------------------------

Approved Name and Appointment

Darren O'Mahony Director Jam O'dlag.



Project Number	20-0399D
Project Name	Bus Connects Route 9
Site Location	R9-TP10



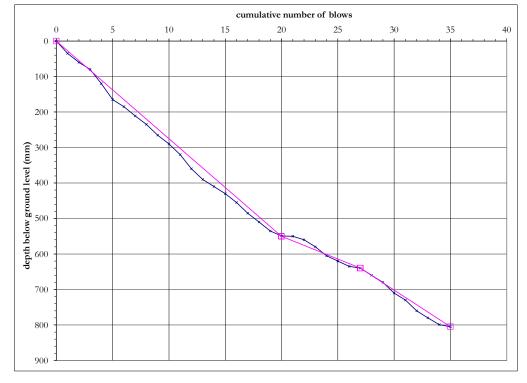
Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.

CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with fragments of red brick



top / base of layer (mm)	mm/ blow	CBR (%)
0	28	9.1
550	20	9.1
550	13	20
640		
640	21	12
805		

CBR	Min: 9.1
Range	Max: 20

The selection of layers is based on visual interpretation of the data.

The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure

Observations and comments

Approved Name and Appointment

Darren O'Mahony Director Jam O de Mon.



Project Number	20-0399d
Project Name	Bus Connects Route 9
Site Location	R9-TP11



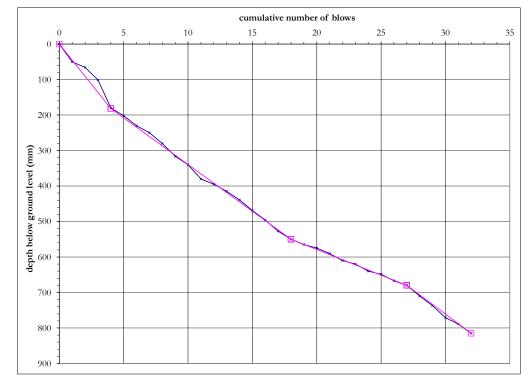
Test Number	1
Depth bgl (m)	0.00

Date Tested	30/10/2020
Weather	Raining

Test conducted in accordance with Documented In-House Technical Procedure IMS TP7-4.

CBR calculated using the TRL equation: log10(CBR) = 2.48 - 1.057 x log10(mm/blow) iaw IAN 73/06 Rev 1 2009.

Surface preparation	Description of surface material
Natural Ground	MADE GROUND: Stiff brown slightly sandy slightly gravelly CLAY



top / base of layer (mm)	mm/ blow	CBR (%)
0	46	5.3
182		0.0
182	26	9.5
550		
550		
680	14	18
680	27	0.2
815	27	9.3

CBR Min: 5	Min: 5.3
Range	Max: 18

The selection of layers is based on visual interpretation of the data.

The insitu DCP reading (mm/blow) and CBR values are valid at the time of testing; variation in moisture content or other factors may affect the insitu value.

Deviation(s) from standard procedure	None
--------------------------------------	------

Observations and comments

Approved Name and Appointment

Darren O'Mahony Director Jam Or de Mo.





APPENDIX G GEOTECHNICAL LABORATORY TEST RESULTS





HEAD OFFICE

Registered in Northern Ireland. Company Number: NI610766

REGIONAL OFFICE Causeway Geotech (IRL) Ltd

Unit 3 Balbriggan Business Park, Balbriggan Co Dublin, Ireland, K32 EH36 ROI: +353 (0)1 526 7465

> Registered in Ireland. Company Number: 633786

www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

20 November 2020

Project Name:	Bus Connects - Route 9 - Tallaght/Clondalkin to City Centre	
Project No.:	20-0399D	
Client:	National Transport Authority (NTA)	
Engineer:	AECOM/Mott MacDonald	

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).

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: Bus Connects - Route 9 – Tallaght/Clondalkin to City Centre

Report Reference: Schedule 1 & 2

The table below details the tests carried out, the specifications used, and the number of tests included in this report.

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. 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	63		
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	30		
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	32		
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	21		
SOIL	Moisture Condition Value at natural moisture content	BS 1377-4: 1990: Cl 5.4	4		
SOIL	California Bearing Ratio (CBR)	BS 1377-4: 1990: Cl 7	2		
SOIL	Laboratory Vane Shear Strength (3 determinations) *	BS 1377-7: 1990: Cl 3	2		
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS 1377-7: 1990: Cl 8	7		
ROCK	Point load index ISRM Commission on Testing Methods. Suggested Method for Determining Point Load Strength 1985		43		
ROCK	Uniaxial Compressive Strength (UCS)*	ISRM Suggested Methods -Rock Characterization Testing and Monitoring, Ed. E T Brown - 1981			

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)	pH Value of Soil		21
SOIL – Subcontracted to Eurofins Chemtest Ltd (UKAS 2183)	Sulphate Content water extract		21
SOIL – Subcontracted to Eurofins Chemtest Ltd (UKAS 2183)	Sulphate Content Acid extract		8
SOIL – Subcontracted to Eurofins Chemtest Ltd (UKAS 2183)	Total Sulphur		8



Summary of Classification Test Results

Project No.

Project Name

20-0399D

Bus Connects Route 9 Tallaght/Clondalkin to City Centre

	Sample					Density	W	Passing	LL	PL	PI	Particle	Casagrande
Hole No.	Ref	Тор	Base	Туре	Soil Description	bulk dr Mg/m3	/	425μm %	%	%	%	density Mg/m3	Classification
R9CP01	5	0.50		В	Brown sandy slightly gravelly silty CLAY.	ing iii	20.0						
R9CP01	12	1.20		D	Brown sandy slightly gravelly silty CLAY.		14.0						
R9CP01	7	2.00		В	Brown sandy slightly gravelly silty CLAY.		11.0	68	31 -1pt	19	12		CL
R9CP01	18	3.00		U	Brown sandy slightly gravelly silty CLAY.		16.0	(
R9CP01	15	4.00		D	Brownish grey sandy slightly gravelly silty CLAY.		22.0	74	35 -1pt	21	14		CL/CI
R9CP01	19	5.00		U	Brownish grey sandy slightly gravelly silty CLAY.		12.0	C					
R9CP02	5	0.50		В	Brownish grey sandy clayey subangular fine to coarse GRAVEL.		5.9	42	33 -1pt	20	13		CL
R9CP02	12	1.20		U	Greyish brown slightly sandy slightly gravelly silty CLAY.		21.0	(-					
R9CP02	10	2.00		D	Brownish grey sandy gravelly silty CLAY.		11.0	47	33 -1pt	20	13		CL
R9CP02	11	3.00		D	Brownish grey sandy gravelly silty CLAY.		13.0						
R9CP03	12	1.00		В	Brownish grey sandy gravelly SILT.		21.0	48	24 -1pt	19	5		ML
R9CP03	26	1.20		U	Brownish grey sandy gravelly SILT.		14.0						

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

LAB 01R Version 4

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

Approved By

20/11/2020



Stephen.Watson



Project No.

Project Name

20-0399D

Bus Connects Route 9 Tallaght/Clondalkin to City Centre

						I			_	_			I_ 1	
Hole No.	Ref	Sar Top	nple Base	Туре	Soil Description	Dens bulk	dry	W	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
				. 7 [-		Mg/m	3	%	%	%	%	%	Mg/m3	
R9CP03	19	2.00		D	Brownish grey sandy gravelly SILT.			12.0						
R9CP03	20	3.00		D	Brownish grey sandy gravelly silty CLAY.			9.1						
R9CP03	21	4.00		D	Brownish grey sandy gravelly silty CLAY.			11.0						
R9CP03	22	5.00		D	Brownish grey sandy gravelly silty CLAY.			13.0						
R9CP03	23	6.00		D	Brownish grey sandy gravelly silty CLAY.			14.0						
R9CP03	18	7.50		В	Brownish grey sandy gravelly silty CLAY.			15.0	74	30 -1pt	18	12		CL
R9CP03	25	8.00		D	Brownish grey sandy gravelly silty CLAY.			12.0						
R9CP04	9	1.20		D	Brownish grey sandy gravelly silty CLAY.			24.0						
R9CP04	10	2.00			Brownish grey sandy gravelly silty CLAY.			33.0						
R9CP04	11	3.00		D	Brownish grey sandy gravelly silty CLAY.			9.7						
R9CP05	10	0.50		В	Brownish grey sandy gravelly silty CLAY.			14.0						
R9CP05	19	1.20		D	Brownish grey sandy gravelly silty CLAY.			12.0						
													1 1 5	R 01P Version 4

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

LAB 01R Version 4

Key

Density test Liquid Limit Particle density

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

1pt - single point test

wd - water displacement

wi - immersion in water

cas - Casagrande method

gj - gas jar

Date Printed

20/11/2020

Approved By

UKAS
TESTING



Project No.

Project Name

20-0399D

Bus Connects Route 9 Tallaght/Clondalkin to City Centre

													1	
Hole No.	Ref	Sar Top	nple Base	Туре	Soil Description	Densi bulk	dry	W	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
		. 06	2400	.) 0		Mg/m	3	%	%	%	%	%	Mg/m3	
R9CP05	20	2.00		D	Brownish grey sandy gravelly silty CLAY.			14.0	44	31 -1pt	20	11		CL
R9CP05	21	3.00		D	Brownish grey sandy gravelly silty CLAY.			13.0						
R9CP05	22	4.00		D	Brownish grey sandy gravelly silty CLAY.			14.0						
R9CP05	26	8.00		U	Grey sandy slightly gravelly silty CLAY.			9.2						
R9CP06	2	1.00		В	Brownish grey sandy gravelly silty CLAY.			15.0	59	30 -1pt	17	13		CL
R9CP06	3	3.00		В	Brownish grey sandy gravelly silty CLAY.			14.0	63	33 -1pt	14	19		CL
R9CP08	7	1.00		В	Brownish grey sandy gravelly silty CLAY.			15.0						
R9CP08	14	2.00		D	Brownish grey sandy gravelly silty CLAY.			15.0						
R9CP08	18	3.00			Grey slightly sandy slightly gravelly silty CLAY.			14.0						
R9CP08	9	3.00		В	Brownish grey sandy gravelly silty CLAY.			13.0	63	24 -1pt	18	6		ML/CL
R9CP08	16	4.00		D	Brownish grey sandy slightly gravelly silty CLAY.			15.0	46	27 -1pt	19	8		CL
R9CP10	6	0.50		В	Brownish grey sandy gravelly silty CLAY.			17.0						
													LAB	01P Version 4

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

LAB 01R Version 4

Key

Density test Liquid Limit

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

wd - water displacement cas - Casagrande method

wi - immersion in water 1pt - single point test Particle density

gj - gas jar

Date Printed

Approved By

20/11/2020





Project No.

Project Name

20-0399D

Bus Connects Route 9 Tallaght/Clondalkin to City Centre

		Sar	nple			Density	W	Passing	LL	PL	PI	Particle	
Hole No.	Ref	Тор	Base	Туре	Soil Description	bulk dr		425µm	%	%	%	density Mg/m3	Casagrande Classification
R9CP10	10	1.20		D	Brownish grey sandy gravelly silty CLAY.	Mg/III3	21.0	70	76	70	70	Wig/IIIS	
R9CP10	8	2.00		В	Brownish grey sandy gravelly silty CLAY.		15.0	71	43 -1pt	24	19		CI
R9CP11	9	4.00		В	Brownish grey sandy gravelly silty CLAY.		13.0	67	26 -1pt	18	8		CL
R9CP12	10	5.00		В	Brownish grey silty fine to coarse SAND.		24.0	93	26 -1pt	21	5		ML
R9CP12	16	5.00		D	Brownish grey silty fine to coarse SAND.		28.0						
R9CP12	17	6.00		D	Brownish grey sandy clayey subangular fine to coarse GRAVEL.		7.5						
R9CP13	9	1.20		D	Brownish grey sandy slightly gravelly SILT.		12.0						
R9CPGS01	9	1.00		В	Brownish grey sandy gravelly silty CLAY.		21.0	55	28 -1pt	18	10		CL
R9CPGS01	11	3.00		В	Brownish grey gravelly silty fine to coarse SAND.		9.8	40	21 -1pt	17	4		ML
R9CPGS01	13	5.00		В	Brown sandy gravelly SILT.		15.0	54	21 -1pt	20	1		ML
R9CPGS02	17	2.00		U	Greyish brown slightly sandy silty CLAY.		16.0						
R9CPGS02	9	2.00		В	Greyish brown slightly sandy silty CLAY.		12.0	44	33 -1pt	23	10		ML/CL
												1 4 5	01P Version 4

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

4pt cone unless:

LAB 01R Version 4

Key

Density test Liquid Limit Particle density

•

gj - gas jar

sp - small pyknometer

Linear measurement unless:

wd - water displacement cas - Casagrande method

wi - immersion in water 1pt - single point test

Date Printed

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Project No.

Project Name

20-0399D

Bus Connects Route 9 Tallaght/Clondalkin to City Centre

		Sar	nple	ı		Density	W	Passing 425µm	LL	PL	ΡI	Particle	Casagrande
Hole No.	Ref	Тор	Base	Туре	Soil Description	bulk dry	′ %	425μm %	%	%	%	density Mg/m3	Classification
						Mg/m3	/0	/6	/0	/0	/6	IVIG/TITO	
R9CPGS02	11	4.00		В	Greyish brown sandy gravelly silty CLAY.		22.0	60	44 -1pt	29	15		MI
R9CPGS02	11	10.50		С	Greyish brown sandy gravelly silty CLAY.		15.0						
R9CPGS02	11	12.00		С	Greyish brown sandy gravelly silty CLAY.		13.0						
R9CPGS03	13	2.00		D	Greyish brown sandy gravelly silty CLAY.		9.9						
R9CPGS03	9	3.00		В	Greyish brown slightly sandy slightly gravelly silty CLAY.		11.0	67	23 -1pt	17	6		ML/CL
R9CPGS04	14	2.00		D	Greyish brown sandy gravelly silty CLAY.		16.0	97	37 -1pt	20	17		CI
R9TP01	2	1.00		В	Greyish brown slightly sandy slightly gravelly silty CLAY.		12.0	63	29 -1pt	17	12		CL
R9TP02	2	1.00		В	Greyish brown slightly sandy slightly gravelly silty CLAY.		14.0	64	34 -1pt	19	15		CL
R9TP04	2	1.00		В	Brown sandy gravelly silty CLAY.		16.0	73	33 -1pt	16	17		CL
R9TP05	2	1.00		В	Brown sandy gravelly silty CLAY.		14.0	59	23 -1pt	17	6		ML/CL
R9TP06	2	1.00		В	Brown sandy gravelly silty CLAY.		12.0	41	32 -1pt	19	13		CL
R9TP07	1	0.50		В	Brown gravelly clayey fine to coarse SAND.		14.0	49	38 -1pt	20	18		CI

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

LAB 01R Version 4

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

20/11/2020

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TESTING
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Project No. Project Name

20-0399D

Bus Connects Route 9 Tallaght/Clondalkin to City Centre

					1	1								
Hole No.	Ref		nple Base	Туре	Soil Description	Dens bulk	ity dry	W	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	IVEI	ТОР	Dase	туре		Mg/m	13	%	%	%	%	%	Mg/m3	Gracomoanon
R9TP10	9	4.00		В	Brown sandy silty CLAY.			27.0	97	25 -1pt	17	8		CL
R9TP11	2	1.00		В	Brown sandy slightly gravelly silty CLAY.			22.0	77	35 -1pt	22	13		CL/CI
R9TP11	5	2.00		В	Brown slightly sandy silty CLAY.			20.0	97	43 -1pt	20	23		CI
All tests perfor	med i	n accord	ance wit	h RS1	377:1990 unless specified	otherwis	2		<u> </u>	<u> </u>		<u> </u>	LAE	3 01R Version 4

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

Key Density test

Liquid Limit

Particle density

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Linear measurement unless:

4pt cone unless:

sp - small pyknometer

gj - gas jar

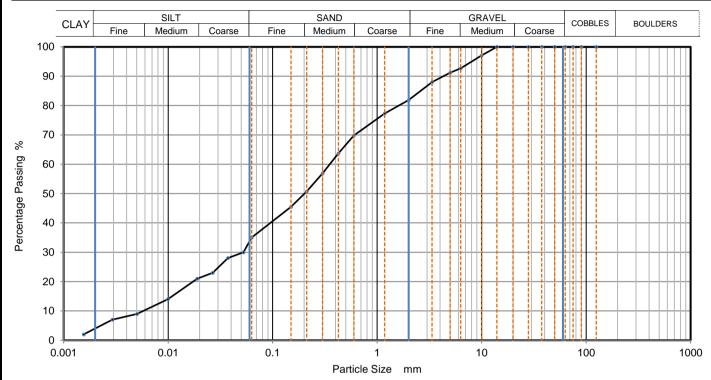
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wd - water displacement wi - immersion in water

cas - Casagrande method 1pt - single point test

CAUSEWAY	DART	ICLE SIZE DIST	FDIDLITION		Job Ref	20-0399D
—— GEOTECH	PANI	ICLE SIZE DIST	IKIBUTION		Borehole/Pit No.	R9CP01
Site Name	Bus Connects Route 9	Tallaght/Clondalk	in to City Centre		Sample No.	7
Soil Description	Brown sandy slightly gra	evelly silty CLAY.			Depth, m	2.00
Specimen Reference	6	Specimen Depth	2	Sample Type	В	
Test Method	BS1377:Part 2:1990, cla	uses 9.2 and 9.5			KeyLAB ID	Caus202010222



Siev	/ing	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	35
90	100	0.05248	30
75	100	0.03732	28
63	100	0.02669	23
50	100	0.01897	21
37.5	100	0.00996	14
28	100	0.00503	9
20	100	0.00292	7
14	100	0.00155	2
10	97		
6.3	93		
5	91		
3.35	88		
2	82		
1.18	77		
0.6	70	Particle density	(assumed)
0.425	64	2.65	Mg/m3
0.3	57		
0.212	51		
0.15	46		
0.063	35		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	18.1
Sand	46.9
Silt	30.8
Clay	4.2

Grading Analysis		
D100	mm	
D60	mm	0.351
D30	mm	0.05
D10	mm	0.00555
Uniformity Coefficient		63
Curvature Coefficient		1.3

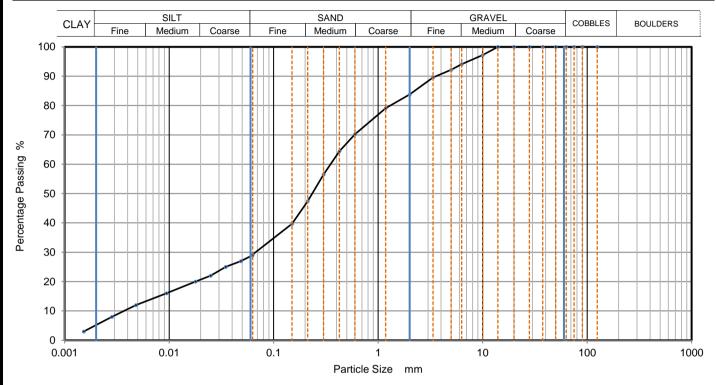
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CAUSEWAY	DART	ICLE SIZE DIST	Job Ref	20-0399D	
GEOTECH	PARI	ICLE SIZE DIST	IKIBOTION	Borehole/Pit No.	R9CP01
Site Name	Bus Connects Route 9	Tallaght/Clondalk	in to City Centre	Sample No.	15
Soil Description	Brownish grey sandy slig	htly gravelly silty CLA	AY.	Depth, m	4.00
Specimen Reference	6	Specimen Depth	4 m	Sample Type	D
Test Method	BS1377:Part 2:1990, cla	uses 9.2 and 9.5	KeyLAB ID	Caus202010224	



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	29
90	100	0.04856	27
75	100	0.03479	25
63	100	0.02492	22
50	100	0.01784	20
37.5	100	0.00944	16
28	100	0.00480	12
20	100	0.00283	8
14	100	0.00152	3
10	97		
6.3	94		
5	92		
3.35	90		
2	84		
1.18	79		
0.6	70	Particle density	(assumed)
0.425	64	2.65	Mg/m3
0.3	57		
0.212	47		
0.15	40		
0.063	29		

Dry Mass of sample, g	519

Sample Proportions	% dry mass		
Cobbles	0.0		
Gravel	16.2		
Sand	54.6		
Silt	23.9		
Clay	5.3		

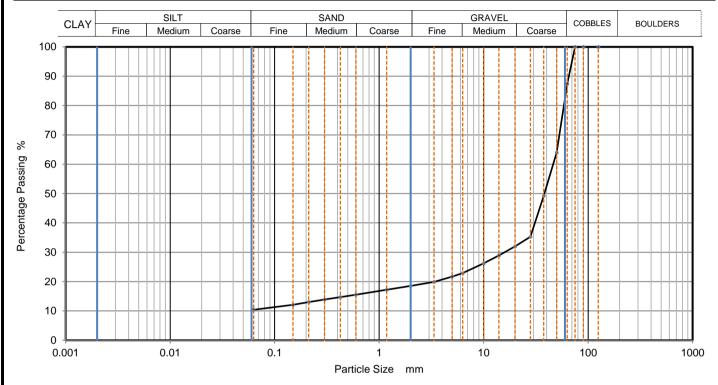
Grading Analysis		
D100	mm	
D60	mm	0.35
D30	mm	0.0673
D10	mm	0.00364
Uniformity Coefficient		96
Curvature Coefficient		3.5

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



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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D		
GEOTECH	PARI	TICLE SIZE DISTRIBUTION		Borehole/Pit No.	R9CP02
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	5
Soil Description	Brownish grey sandy clayey subangular fine to coarse GRAVEL.			Depth, m	0.50
Specimen Reference	6 Specimen 0.5 m			Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus202010226



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100			
90	100			
75	100			
63	87			
50	64			
37.5	49			
28	35			
20	32			
14	29			
10	26			
6.3	23			
5	22			
3.35	20			
2	19			
1.18	17			
0.6	16			
0.425	15	1		
0.3	14			
0.212	13			
0.15	12	1		
0.063	10			

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Dry Mass of sample, g	9739

Sample Proportions	% dry mass
Cobbles	12.6
Gravel	68.9
Sand	8.1
Fines < 0.063 mm	10.0

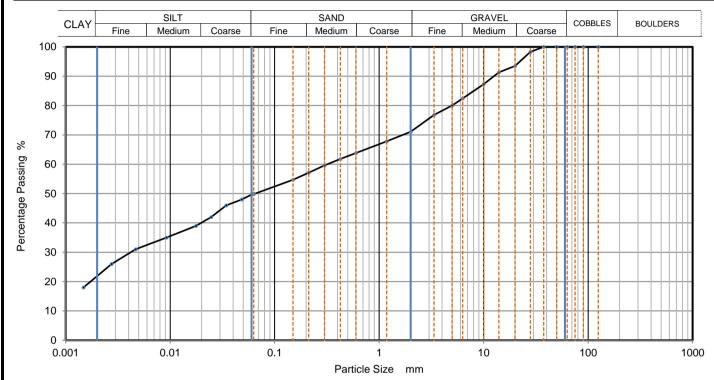
Grading Analysis		
D100	mm	
D60	mm	46.3
D30	mm	16
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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



CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D		
—— GEOTECH	PANI	AKTICLE SIZE DISTRIBUTION		Borehole/Pit No.	R9CP03
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	17
Soil Description	Brownish grey sandy gravelly silty CLAY.			Depth, m	6.00
Specimen Reference	2 Specimen 6 m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102217



Sievi	ng	Sedim	Sedimentation			
Particle Size mm	% Passing	Particle Size mm	% Passing			
125	100	0.06300	50			
90	100	0.04843	48			
75	100	0.03447	46			
63	100	0.02470	42			
50	100	0.01769	39			
37.5	100	0.00925	35			
28	98	0.00468	31			
20	94	0.00275	26			
14	91	0.00148	18			
10	87					
6.3	82					
5	80					
3.35	77					
2	71					
1.18	68					
0.6	64	Particle density	(assumed)			
0.425	62	2.65	Mg/m3			
0.3	60					
0.212	57	1				
0.15	55	1				
0.063	50					

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	28.9
Sand	21.3
Silt	27.8
Clay	22.0

Grading Analysis		
D100	mm	
D60	mm	0.321
D30	mm	0.00411
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

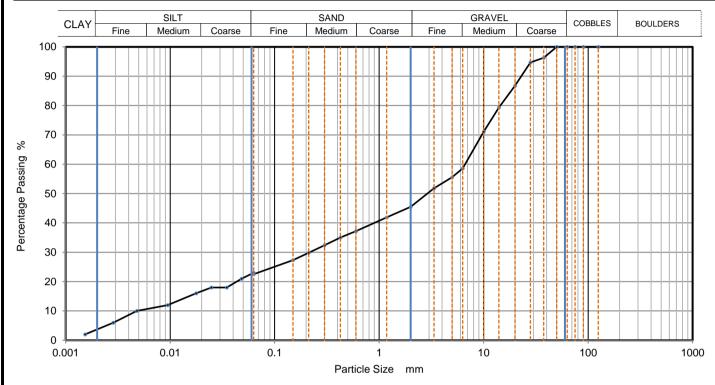
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CAUSEWAY	DART	ARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D	
GEOTECH	PARI			Borehole/Pit No.	R9CP05	
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	15
Soil Description	Brownish grey sandy gravelly silty CLAY.			Depth, m	5.00	
Specimen Reference	2 Specimen 5 m Depth			Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102230	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	23
90	100	0.04830	21
75	100	0.03483	18
63	100	0.02479	18
50	100	0.01775	16
37.5	96	0.00945	12
28	95	0.00481	10
20	87	0.00285	6
14	79	0.00153	2
10	71		
6.3	59		
5	56		
3.35	52		
2	46		
1.18	42		
0.6	37	Particle density	(assumed)
0.425	35	2.65	Mg/m3
0.3	32		
0.212	30		
0.15	27		
0.063	23		

Dry Mass of sample, g	9698
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Sample Proportions	% dry mass
Cobbles	0.0
Gravel	54.5
Sand	23.0
Silt	18.7
Clay	3.8

Grading Analysis		
D100	mm	
D60	mm	6.63
D30	mm	0.219
D10	mm	0.00531
Uniformity Coefficient		1200
Curvature Coefficient		1.4

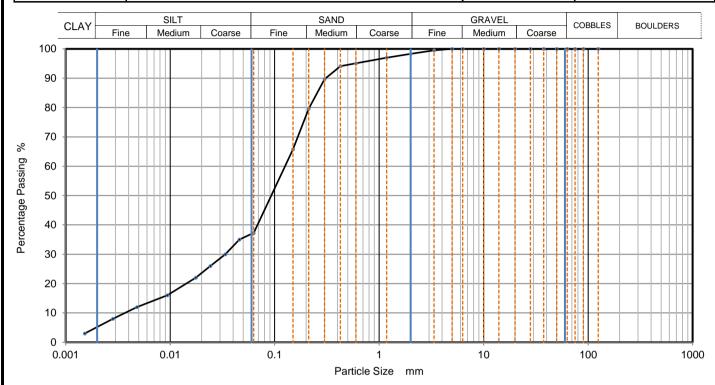
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CAUSEWAY	DARTI	AADTICLE SIZE DISTRIBUITION		Job Ref	20-0399D	
GEOTECH	PARII	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	R9CP05
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	24
Soil Description	Brownish grey silty fine to coarse SAND.			Depth, m	6.00	
Specimen Reference	2 Specimen 6 m Depth			Sample Type	D	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102231	



Sieving		Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06080	37
90	100	0.04590	35
75	100	0.03364	30
63	100	0.02428	26
50	100	0.01762	22
37.5	100	0.00938	16
28	100	0.00480	12
20	100	0.00283	8
14	100	0.00152	3
10	100		
6.3	100		
5	100		
3.35	100		
2	98		
1.18	97		
0.6	95	Particle density	(assumed)
0.425	94	2.65	Mg/m3
0.3	90		
0.212	80		
0.15	66		
0.063	37		

Dry Mass of sample, g	215

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	1.7
Sand	61.1
Silt	32.0
Clay	5.2

Grading Analysis		
D100	mm	
D60	mm	0.126
D30	mm	0.0345
D10	mm	0.00376
Uniformity Coefficient		33
Curvature Coefficient		2.5

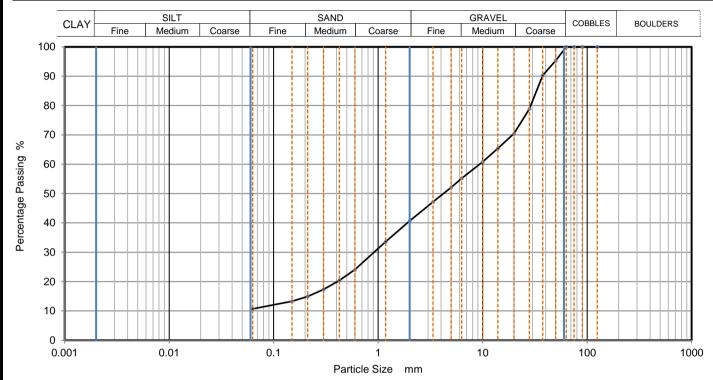
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CAUSEWAY PARTICLE SIZE DISTRIBUTION				Job Ref	20-0399D	
—— GEOTECH	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	R9CP06	
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	5
Soil Description	Brownish grey sandy silty subangular fine to coarse GRAVEL.			Depth, m	5.00	
Specimen Reference	2 Specimen 5 m			Sample Type	В	
Test Method	3S1377:Part 2:1990, clause 9.2				KeyLAB ID	Caus202011032



Siev	ring	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	95		
37.5	90		
28	79		
20	71		
14	65		
10	61		
6.3	55		
5	52		
3.35	47		
2	41		
1.18	34		
0.6	24		
0.425	20	1	
0.3	17		
0.212	15		
0.15	13	1	
0.063	11		

Dry Mass of sample, g	6254

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	59.3
Sand	30.0
Fines < 0.063 mm	11.0

Grading Analysis		
D100	mm	
D60	mm	9.38
D30	mm	0.912
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

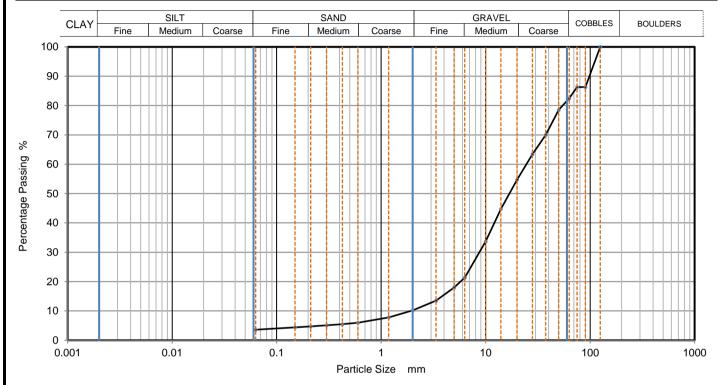
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION -			Job Ref	20-0399D
—— GEOTECH				Borehole/Pit No.	R9CP07
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			5
Soil Description	Brownish grey sandy slightly clayey subangular fine to coarse GRAVEL.			Depth, m	0.50
Specimen Reference	2 Specimen 0.5 m			Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020102233



Siev	/ing	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	86		
75	86		
63	83		
50	79		
37.5	70		
28	63		
20	55		
14	45		
10	34		
6.3	21		
5	18		
3.35	14		
2	10		
1.18	8		
0.6	6		
0.425	6	1	
0.3	5		
0.212	5]	
0.15	4]	
0.063	4		

Sample Proportions	% dry mass		
Cobbles	17.5		
Gravel	72.3		
Sand	6.6		
Fines <0.063mm	4.0		

Grading Analysis		
D100	mm	125
D60	mm	24.5
D30	mm	8.72
D10	mm	1.92
Uniformity Coefficient		13
Curvature Coefficient		1.6

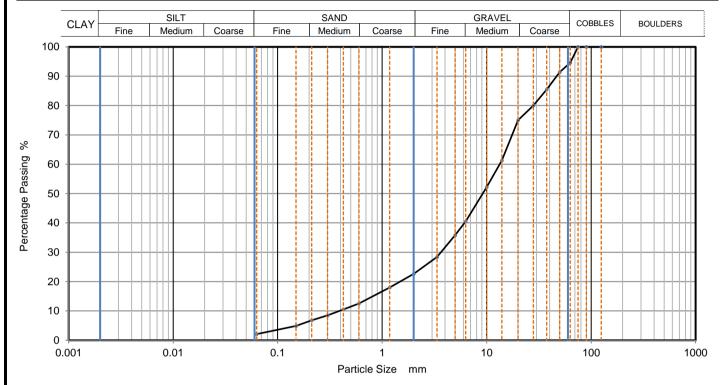
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION -			Job Ref	20-0399D	
—— GEOTECH				Borehole/Pit No.	R9CP07	
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	8
Soil Description	Brownish grey sandy slightly silty subangular fine to coarse GRAVEL.			Depth, m	3.00	
Specimen Reference	2 Specimen 3 m Depth			Sample Type	В	
Test Method	3S1377:Part 2:1990, clause 9.2				KeyLAB ID	Caus2020102234



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	95		
50	91		
37.5	86		
28	80		
20	75		
14	61		
10	52		
6.3	41		
5	36		
3.35	28		
2	23		
1.18	18		
0.6	13		
0.425	11		
0.3	9		
0.212	7		
0.15	5		
0.063	2		

Dry Mass of sample, g	17008
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Sample Proportions	% dry mass
Cobbles	5.4
Gravel	72.0
Sand	20.5
Fines < 0.063mm	2.0

Grading Analysis		
D100	mm	
D60	mm	13.3
D30	mm	3.66
D10	mm	0.39
Uniformity Coefficient		34
Curvature Coefficient		2.6

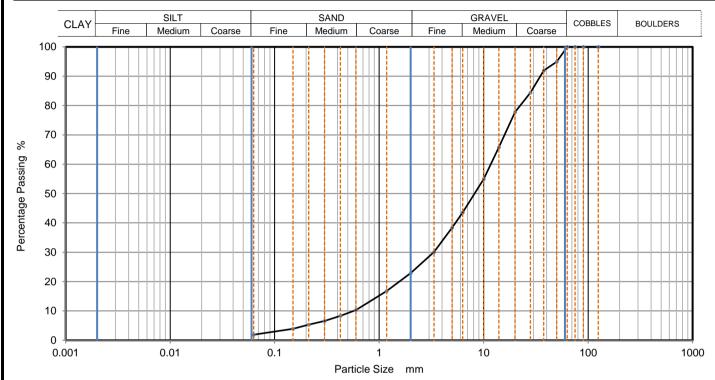
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	20-0399D
—— GEOTECH			Borehole/Pit No.	R9CP07
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre		Sample No.	11
Soil Description	Brownish grey sandy slightly silty subangular fine to coarse GRAVEL.		Depth, m	6.00
Specimen Reference	2 Specimen 6 m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2020102235



Siev	/ing	Sedimer	ıtation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	95		
37.5	92		
28	84		
20	78		
14	66		
10	55		
6.3	44		
5	38		
3.35	30		
2	23		
1.18	17		
0.6	10		
0.425	8		
0.3	7		
0.212	5		
0.15	4		
0.063	2		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	77.1
Sand	21.0
Fines < 0.063mm	2.0

Grading Analysis		
D100	mm	
D60	mm	11.7
D30	mm	3.33
D10	mm	0.569
Uniformity Coefficient		21
Curvature Coefficient		1.7

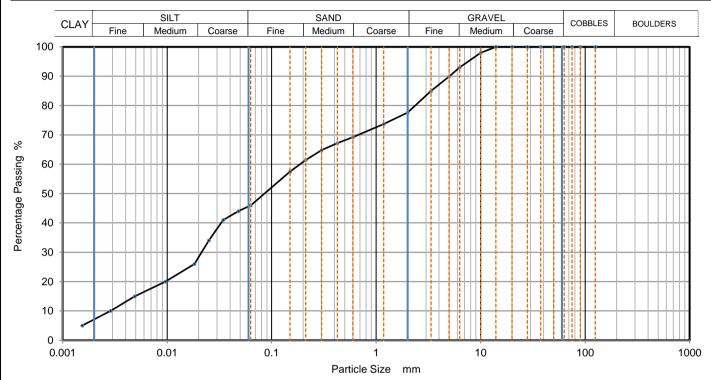
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	20-0399D	
—— GEOTECH			Borehole/Pit No.	R9CP08	
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre		Sample No.	10
Soil Description	Brownish grey sandy slightly gravelly silty CLAY.		Depth, m	4.00	
Specimen Reference	2 Specimen 4 m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102241



Sieving		Sedim	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	46
90	100	0.04810	44
75	100	0.03447	41
63	100	0.02501	34
50	100	0.01823	26
37.5	100	0.00964	20
28	100	0.00490	15
20	100	0.00287	10
14	100	0.00154	5
10	98		
6.3	93		
5	90		
3.35	85		
2	78		
1.18	74		
0.6	69	Particle density	(assumed)
0.425	67	2.65	Mg/m3
0.3	65		
0.212	61	1	
0.15	58	1	
0.063	46		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	22.4
Sand	31.7
Silt	38.9
Clay	7.0

Grading Analysis		
D100	mm	
D60	mm	0.187
D30	mm	0.0211
D10	mm	0.00293
Uniformity Coefficient		64
Curvature Coefficient		0.81

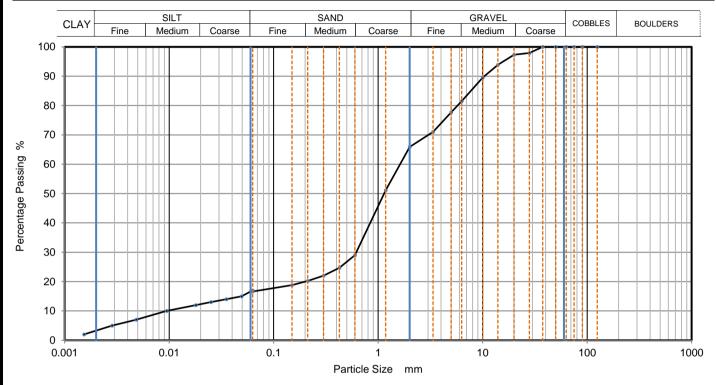
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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D			
GEOTECH	PARI	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	R9CP09	
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	7
Soil Description	Brownish grey gravelly silty fine to coarse SAND.			Depth, m	2.00	
Specimen Reference	2 Specimen 2 m Depth			Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102242	



Sieving		Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	17
90	100	0.04926	15
75	100	0.03528	14
63	100	0.02511	13
50	100	0.01797	12
37.5	100	0.00945	10
28	98	0.00483	7
20	97	0.00284	5
14	94	0.00153	2
10	90		
6.3	82		
5	78		
3.35	71		
2	66		
1.18	51		
0.6	29	Particle density	(assumed)
0.425	25	2.65	Mg/m3
0.3	22		
0.212	20		
0.15	19		
0.063	17		

Dry Mass of sample, g	7046
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Sample Proportions	% dry mass
Cobbles	0.0
Gravel	34.1
Sand	49.3
Silt	13.2
Clay	3.4

Grading Analysis		
D100	mm	
D60	mm	1.62
D30	mm	0.619
D10	mm	0.00957
Uniformity Coefficient		170
Curvature Coefficient		25

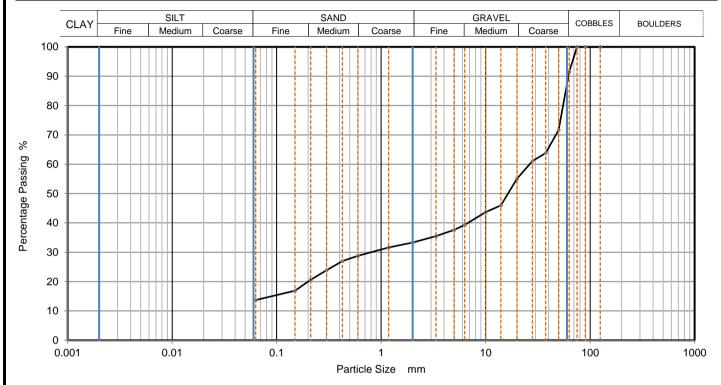
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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D		
—— GEOTECH	PANII	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	R9CP11
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			6
Soil Description	Brownish grey sandy silty subangular fine to coarse GRAVEL.			Depth, m	1.00
Specimen Reference	2 Specimen 1 m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020102246



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	92		
50	72		
37.5	64		
28	61		
20	55		
14	46		
10	44		
6.3	39		
5	38		
3.35	36		
2	33		
1.18	32		
0.6	29		
0.425	27	1	
0.3	24		
0.212	21	1	
0.15	17	1	
0.063	14		

Dry Mass of sample, g	12486

Sample Proportions	% dry mass
Cobbles	8.4
Gravel	58.3
Sand	19.6
Fines < 0.063mm	14.0

Grading Analysis		
D100	mm	
D60	mm	26.3
D30	mm	0.804
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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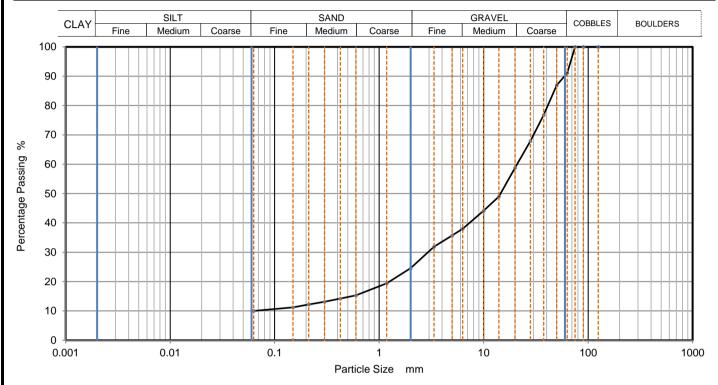


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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D		
—— GEOTECH	PANII	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	R9CP12
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			8
Soil Description	Brownish grey sandy silty subangular fine to coarse GRAVEL.			Depth, m	3.00
Specimen Reference	2 Specimen 3 m			Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020102248



Siev	ving	Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	91		
50	87		
37.5	77		
28	68		
20	59		
14	49		
10	44		
6.3	38		
5	36		
3.35	32		
2	25		
1.18	19		
0.6	15		
0.425	14][
0.3	13		
0.212	12]	
0.15	11]	
0.063	10		

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Dry Mass of sample, g 161	19
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Sample Proportions	% dry mass
Cobbles	8.9
Gravel	66.5
Sand	14.6
Fines < 0.063mm	10.0

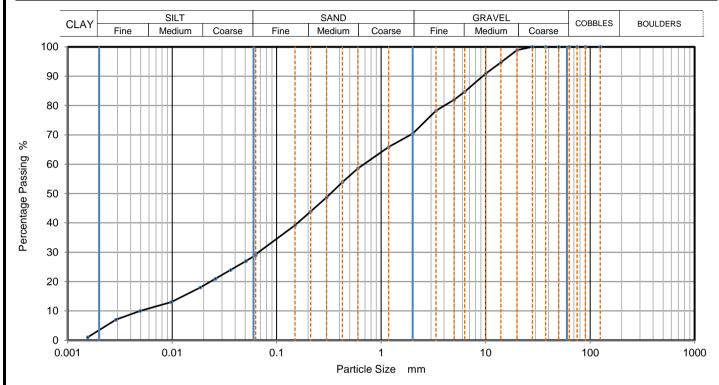
Grading Analysis		
D100	mm	
D60	mm	20.9
D30	mm	2.93
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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



CAUSEWAY	DART	ICLE SIZE DIST	DIDI ITION		Job Ref	20-0399D
—— GEOTECH	PANI	ICLE SIZE DIST	KIBUTION		Borehole/Pit No.	R9CP13
Site Name	Bus Connects Route 9	Tallaght/Clondalk	in to City Centre		Sample No.	7
Soil Description	Brownish grey sandy slig	thtly gravelly SILT.			Depth, m	2.00
Specimen Reference	2	Specimen Depth	2	m	Sample Type	В
Test Method	BS1377:Part 2:1990, cla	uses 9.2 and 9.5			KeyLAB ID	Caus2020102253



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	29
90	100	0.05065	27
75	100	0.03625	24
63	100	0.02594	21
50	100	0.01855	18
37.5	100	0.00980	13
28	100	0.00495	10
20	99	0.00289	7
14	95	0.00155	1
10	91		
6.3	85		
5	82		
3.35	78		
2	70		
1.18	66		
0.6	59	Particle density	(assumed)
0.425	54	2.65	Mg/m3
0.3	49		
0.212	44		
0.15	39		
0.063	29		

Dry Mass of sample, g	2361
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Sample Proportions	% dry mass
Cobbles	0.0
Gravel	29.6
Sand	41.1
Silt	25.6
Clay	3.7

Grading Analysis		
D100	mm	
D60	mm	0.683
D30	mm	0.067
D10	mm	0.00524
Uniformity Coefficient		130
Curvature Coefficient		1.3

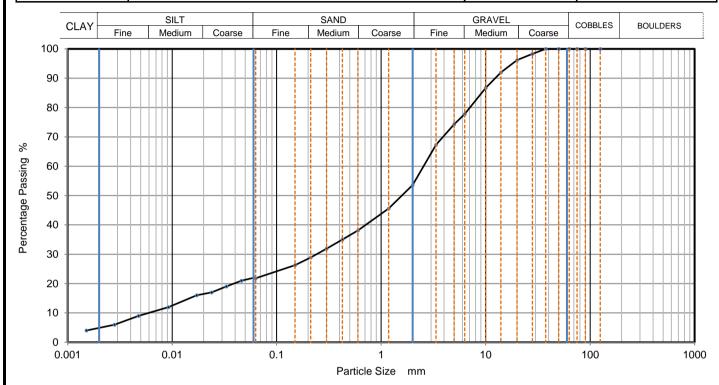
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CAUSEWAY	DARTI	CLE SIZE DIST	PIRITION		Job Ref	20-0399D
—— GEOTECH	PANII	CLE SIZE DIST	KIBOTION		Borehole/Pit No.	R9CPGS01
Site Name	Bus Connects Route 9	Tallaght/Clondalk	in to City Centre		Sample No.	11
Soil Description	Brownish grey gravelly sil	ty fine to coarse SA	ND.		Depth, m	3.00
Specimen Reference	6	Specimen Depth	3	m	Sample Type	В
Test Method	BS1377:Part 2:1990, clau	ses 9.2 and 9.5			KeyLAB ID	Caus2020102255



Sievi	ng	Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06088	22
90	100	0.04596	21
75	100	0.03298	19
63	100	0.02382	17
50	100	0.01719	16
37.5	100	0.00922	12
28	98	0.00475	9
20	96	0.00281	6
14	92	0.00151	4
10	87		
6.3	78		
5	74		
3.35	67		
2	54		
1.18	46		
0.6	38	Particle density	(assumed)
0.425	35	2.65	Mg/m3
0.3	32		
0.212	29	7	
0.15	26	7	
0.063	22]	

Dry Mass of sample, g 2472	g 2472	Dry Mass of sample, g
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Sample Proportions	% dry mass
Cobbles	0.0
Gravel	46.4
Sand	31.8
Silt	16.9
Clay	4.9

Grading Analysis		
D100	mm	
D60	mm	2.54
D30	mm	0.24
D10	mm	0.00624
Uniformity Coefficient		410
Curvature Coefficient		3.6

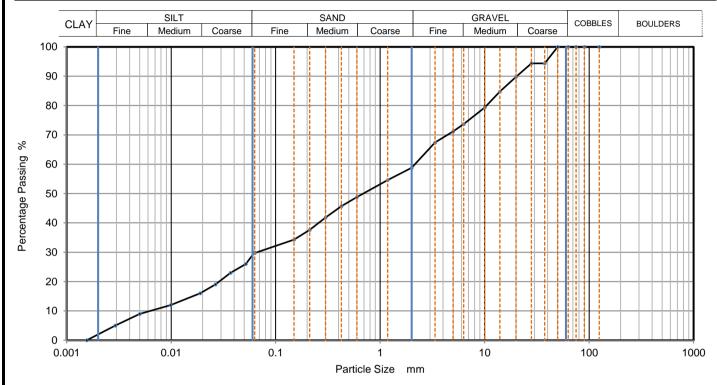
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	20-0399D		
—— GEOTECH	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	R9CPGS01	
Site Name	Bus Connects Route 9	us Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	14
Soil Description	Brown sandy gravelly SILT.			Depth, m	6.00	
Specimen Reference	2 Specimen 6 m			Sample Type	В	
Test Method	3S1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020102257



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.06300	30	
90	100	0.05176	26	
75	100	0.03702	23	
63	100	0.02648	19	
50	100	0.01893	16	
37.5	94	0.00988	12	
28	94	0.00499	9	
20	90	0.00291	5	
14	85	0.00156	0	
10	79			
6.3	74			
5	71			
3.35	67			
2	59			
1.18	55			
0.6	49	Particle density	(assumed)	
0.425	46	2.65	Mg/m3	
0.3	42			
0.212	38			
0.15	34			
0.063	30			

Dry Mass of sample, g 2616	Dry Mass of sample, g	2616
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Sample Proportions	% dry mass
Cobbles	0.0
Gravel	41.2
Sand	29.0
Silt	27.7
Clay	2.1

Grading Analysis		
D100	mm	
D60	mm	2.15
D30	mm	0.0663
D10	mm	0.00639
Uniformity Coefficient		340
Curvature Coefficient		0.32

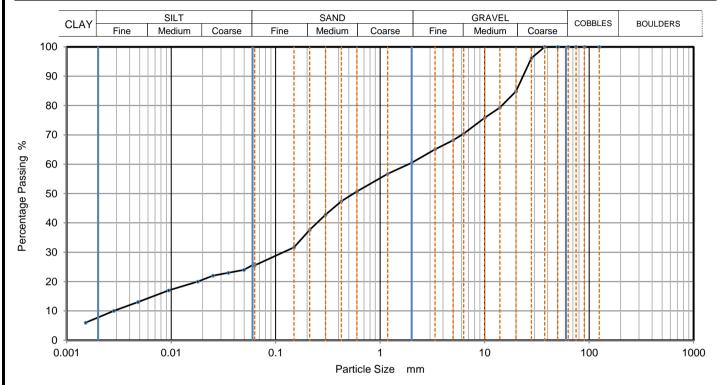
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	20-0399D		
—— GEOTECH			Borehole/Pit No.	R9CPGS02		
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	11
Soil Description	Greyish brown sandy gravelly silty CLAY.			Depth, m	4.00	
Specimen Reference	6 Specimen 4 m Depth			Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020102260



Sieving		Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	26
90	100	0.04958	24
75	100	0.03528	23
63	100	0.02511	22
50	100	0.01797	20
37.5	100	0.00945	17
28	96	0.00481	13
20	85	0.00282	10
14	79	0.00152	6
10	76		
6.3	70		
5	68		
3.35	65		
2	61		
1.18	57		
0.6	51	Particle density	(assumed)
0.425	47	2.65	Mg/m3
0.3	43		
0.212	38		
0.15	32		
0.063	26		

Dry Mass of sample, g 2058	Dry Mass of sample, g	2058
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Sample Proportions	% dry mass
Cobbles	0.0
Gravel	39.5
Sand	35.0
Silt	18.0
Clay	7.5

Grading Analysis		
D100	mm	
D60	mm	1.87
D30	mm	0.119
D10	mm	0.00283
Uniformity Coefficient		660
Curvature Coefficient		2.7

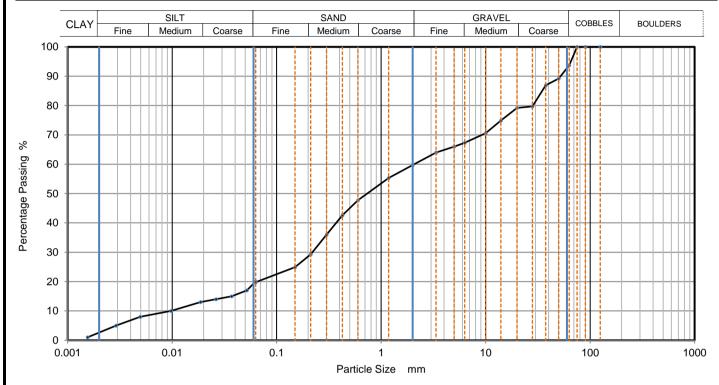
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION -			Job Ref	20-0399D
—— GEOTECH				Borehole/Pit No.	R9CPGS03
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			9
Soil Description	Greyish brown slightly sandy slightly gravelly silty CLAY.			Depth, m	3.00
Specimen Reference	6 Specimen 3 m			Sample Type	В
Test Method	3S1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102264



Siev	/ing	Sedimentation			
Particle Size mm	% Passing	Particle Size mm	% Passing		
125	100	0.06300	20		
90	100	0.05176	17		
75	100	0.03702	15		
63	94	0.02633	14		
50	89	0.01872	13		
37.5	87	0.00978	10		
28	80	0.00494	8		
20	79	0.00290	5		
14	75	0.00155	1		
10	71				
6.3	67				
5	66				
3.35	64				
2	60				
1.18	55				
0.6	48	Particle density	(assumed)		
0.425	43	2.65	Mg/m3		
0.3	36				
0.212	29				
0.15	25				
0.063	20				

Dry Mass of sample, g	13423
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Sample Proportions	% dry mass		
Cobbles	6.3		
Gravel	34.0		
Sand	40.0		
Silt	17.1		
Clay	2.6		

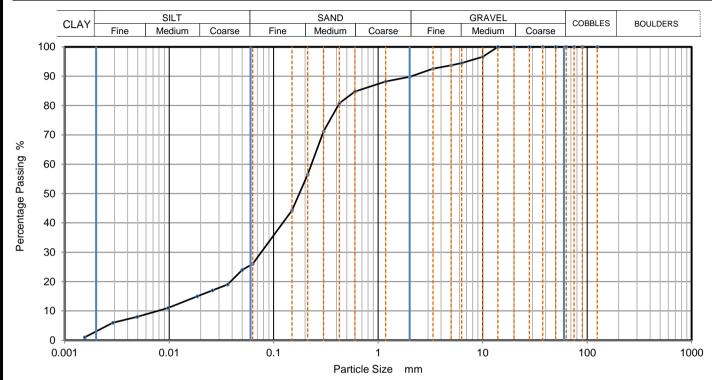
Grading Analysis		
D100	mm	
D60	mm	2.07
D30	mm	0.219
D10	mm	0.00849
Uniformity Coefficient		240
Curvature Coefficient		2.7

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CAUSEWAY PARTICI E SIZE DISTRIBUTU				Job Ref	20-0399D
——— GEOTECH	PARTICLE SIZE DISTRIBUTION -			Borehole/Pit No.	R9CPGS03
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			10
Soil Description	Greyish brown slightly gravelly silty fine to coarse SAND.			Depth, m	4.00
Specimen Reference	2 Specimen 4 m Depth			Sample Type	В
Test Method	3S1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102266



Siev	/ing	Sedimentation			
Particle Size mm	% Passing	Particle Size mm	% Passing		
125	100	0.06300	26		
90	100	0.05002	24		
75	100	0.03625	19		
63	100	0.02594	17		
50	100	0.01855	15		
37.5	100	0.00974	11		
28	100	0.00495	8		
20	100	0.00289	6		
14	100	0.00155	1		
10	97				
6.3	95				
5	94				
3.35	93				
2	90				
1.18	88				
0.6	85	Particle density	(assumed)		
0.425	81	2.65	Mg/m3		
0.3	71				
0.212	57				
0.15	44				
0.063	26				

Dry Mass of sample, g	505

Sample Proportions	% dry mass		
Cobbles	0.0		
Gravel	10.2		
Sand	63.7		
Silt	23.1		
Clay	3.0		

Grading Analysis		
D100	mm	
D60	mm	0.23
D30	mm	0.076
D10	mm	0.00751
Uniformity Coefficient		31
Curvature Coefficient		3.3

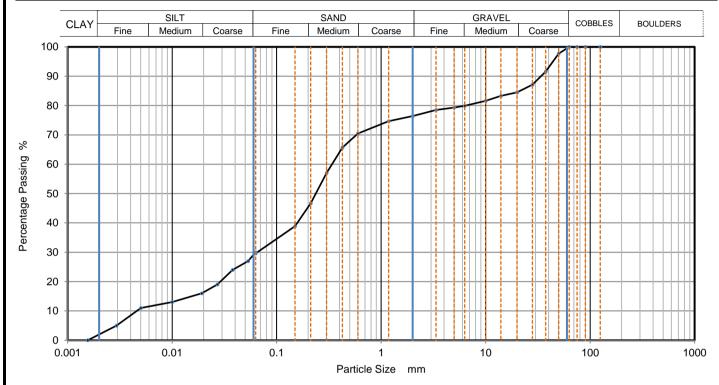
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PARTICLE SIZE DISTRIBUTION			IDIDI ITIONI		Job Ref	20-0399D
				Borehole/Pit No.	R9CPGS04	
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	10
Soil Description	Greyish brown sandy gravelly silty CLAY.				Depth, m	4.00
Specimen Reference	2 Specimen 4 m Depth			n	Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5				KeyLAB ID	Caus2020102268



Sieving		Sedimentation			
Particle Size mm	% Passing	Particle Size mm	% Passing		
125	100	0.06300	30		
90	100	0.05325	27		
75	100	0.03787	24		
63	100	0.02707	19		
50	98	0.01924	16		
37.5	92	0.00999	13		
28	87	0.00502	11		
20	85	0.00293	5		
14	83	0.00156	0		
10	82				
6.3	80				
5	79				
3.35	79				
2	76				
1.18	75				
0.6	71	Particle density	(assumed)		
0.425	66	2.65	Mg/m3		
0.3	57				
0.212	47				
0.15	39				
0.063	30				

Dry Mass of sample, g 14527	
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Sample Proportions	% dry mass
Cobbles	0.0
Gravel	23.6
Sand	46.8
Silt	27.5
Clay	2.1

Grading Analysis		
D100	mm	
D60	mm	0.338
D30	mm	0.0654
D10	mm	0.00465
Uniformity Coefficient		73
Curvature Coefficient		2.7

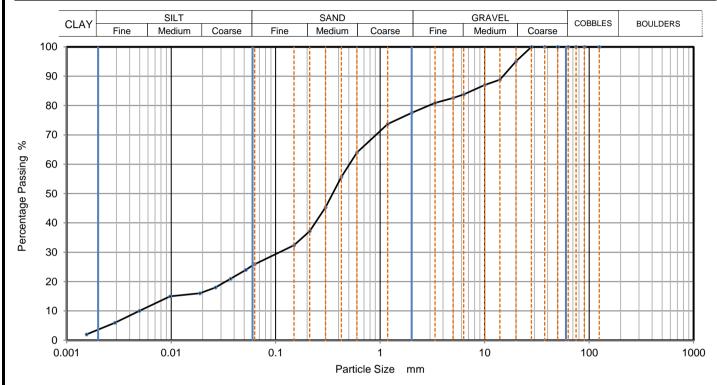
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PARTICLE SIZE DISTRIBUTION			Job Ref	20-0399D	
			Borehole/Pit No.	R9CPGS04	
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	12
Soil Description	Greyish brown sandy gravelly silty CLAY.			Depth, m	6.00
Specimen Reference	2 Specimen 6 m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102269



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.06300	26	
90	100	0.05176	24	
75	100	0.03702	21	
63	100	0.02648	18	
50	100	0.01883	16	
37.5	100	0.00978	15	
28	100	0.00497	10	
20	95	0.00290	6	
14	89	0.00155	2	
10	87			
6.3	84			
5	83			
3.35	81			
2	78			
1.18	74			
0.6	64	Particle density	(assumed)	
0.425	56	2.65	Mg/m3	
0.3	45			
0.212	37			
0.15	32			
0.063	26			

Dry Mass of sample, g	3044
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Sample Proportions	% dry mass		
Cobbles	0.0		
Gravel	22.5		
Sand	51.6		
Silt	22.3		
Clay	3.6		

Grading Analysis		
D100	mm	
D60	mm	0.508
D30	mm	0.109
D10	mm	0.00517
Uniformity Coefficient		98
Curvature Coefficient		4.5

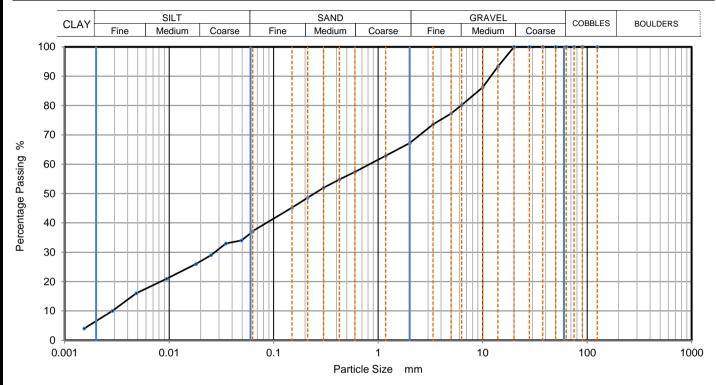
Preparation and testing in accordance with BS1377-2:1990 unless noted below



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Stephen.Watson

PARTICLE SIZE DISTRIBUTION			Job Ref	20-0399D		
			Borehole/Pit No.	R9TP05		
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	2
Soil Description	Brown sandy gravelly silty CLAY.			Depth, m	1.00	
Specimen Reference	6 Specimen 1 m			Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102273	



Sieving		Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	37
90	100	0.04907	34
75	100	0.03492	33
63	100	0.02517	29
50	100	0.01802	26
37.5	100	0.00947	21
28	100	0.00485	16
20	100	0.00286	10
14	93	0.00154	4
10	86		
6.3	80		
5	77		
3.35	74		
2	67		
1.18	63		
0.6	57	Particle density	(assumed)
0.425	55	2.65	Mg/m3
0.3	52		
0.212	49		
0.15	45		
0.063	37		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	32.8
Sand	30.0
Silt	30.5
Clay	6.7

Grading Analysis		
D100	mm	
D60	mm	0.824
D30	mm	0.028
D10	mm	0.00285
Uniformity Coefficient		290
Curvature Coefficient		0.33

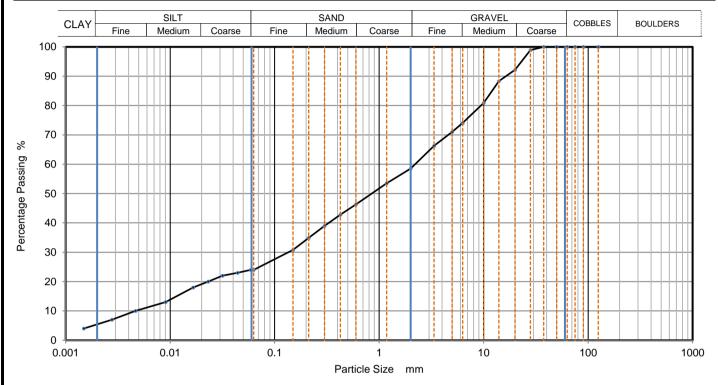
Preparation and testing in accordance with BS1377-2:1990 unless noted below



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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D	
—— GEOTECH	PANI	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	R9TP07
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	1
Soil Description	Brown gravelly clayey fine to coarse SAND.			Depth, m	0.50
Specimen Reference	6 Specimen 0.5 m			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus202011033



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.05889	24	
90	100	0.04415	23	
75	100	0.03172	22	
63	100	0.02312	20	
50	100	0.01659	18	
37.5	100	0.00904	13	
28	99	0.00466	10	
20	92	0.00277	7	
14	88	0.00149	4	
10	81			
6.3	74			
5	71			
3.35	66			
2	59			
1.18	54			
0.6	46	Particle density	(assumed)	
0.425	43	2.65	Mg/m3	
0.3	39			
0.212	35			
0.15	31			
0.063	24			

Dry Mass of sample, g	2464

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	41.5
Sand	34.5
Silt	18.4
Clay	5.6

Grading Analysis		
D100	mm	
D60	mm	2.21
D30	mm	0.135
D10	mm	0.00458
Uniformity Coefficient		480
Curvature Coefficient		1.8

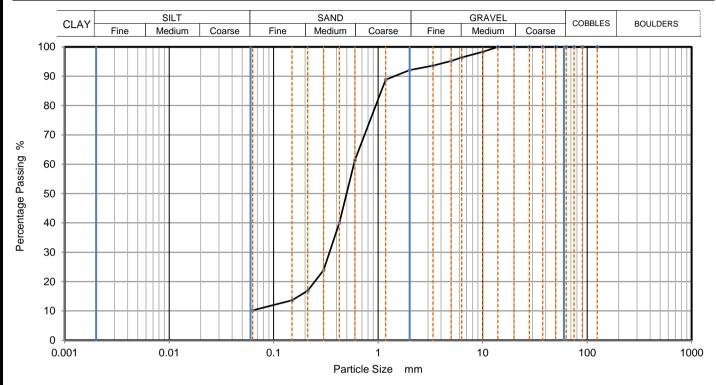
Preparation and testing in accordance with BS1377-2:1990 unless noted below



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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D	
—— GEOTECH	PANII	TICLE SIZE DISTRIBUTION		Borehole/Pit No.	R9TP07
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	3
Soil Description	Brown gravelly slightly clayey fine to coarse SAND.			Depth, m	2.00
Specimen Reference	2 Specimen 2 m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus202011034



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	98		
6.3	96		
5	95		
3.35	94		
2	92		
1.18	89		
0.6	61		
0.425	40		
0.3	24		
0.212	17		
0.15	14		
0.063	10		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	7.9
Sand	81.9
Fines < 0.063 mm	10.0

Grading Analysis		
D100	mm	
D60	mm	0.587
D30	mm	0.342
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

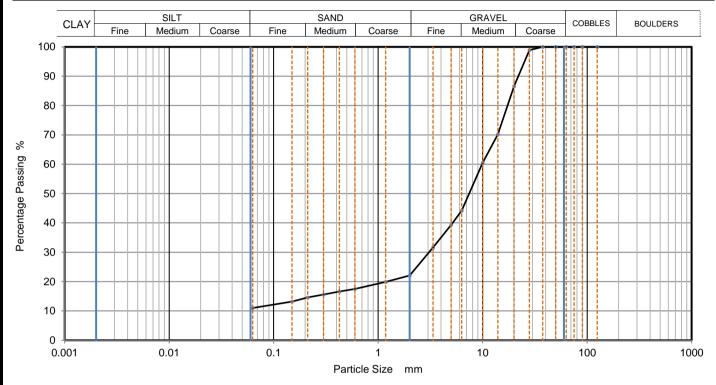
Preparation and testing in accordance with BS1377-2:1990 unless noted below



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CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	20-0399D
—— GEOTECH	PANI	ICLE SIZE DIST	RIBOTION	Borehole/Pit No.	R9TP08
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			2
Soil Description	Brown sandy slightly silty subangular fine to coarse GRAVEL.			Depth, m	1.00
Specimen Reference	4 Specimen 1 m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	use 9.2		KeyLAB ID	Caus2020102275



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	99		
20	87		
14	70		
10	61		
6.3	44		
5	39		
3.35	32		
2	22		
1.18	20		
0.6	18		
0.425	17		
0.3	16		
0.212	15		
0.15	13		
0.063	11		

Dry Mass of sample, g	2621

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	77.9
Sand	11.1
Fines < 0.063mm	11.0

Grading Analysis		
D100	mm	
D60	mm	9.87
D30	mm	3.07
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

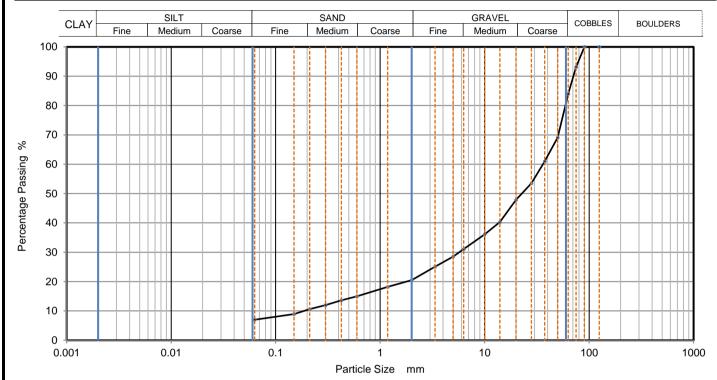
Preparation and testing in accordance with BS1377-2:1990 unless noted below



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CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	20-0399D	
—— GEOTECH	PANI	CLE SIZE DIST	TRIBUTION		Borehole/Pit No.	R9TP09
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	6
Soil Description	Brown sandy slightly silty subangular fine to coarse GRAVEL.			Depth, m	2.50	
Specimen Reference	2 Specimen 2.5 m		Sample Type	В		
Test Method	BS1377:Part 2:1990, clau	ise 9.2			KeyLAB ID	Caus2020102276



Siev	ring	Sedimer	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	93		
63	84		
50	69		
37.5	61		
28	54		
20	48		
14	40		
10	36		
6.3	31		
5	29		
3.35	25		
2	21		
1.18	18		
0.6	15		
0.425	14		
0.3	12		
0.212	11		
0.15	9		
0.063	7	1	

Dry Mass of sample, g	9866

Sample Proportions	% dry mass
Cobbles	16.0
Gravel	63.4
Sand	13.5
Fines < 0.063 mm	7.0

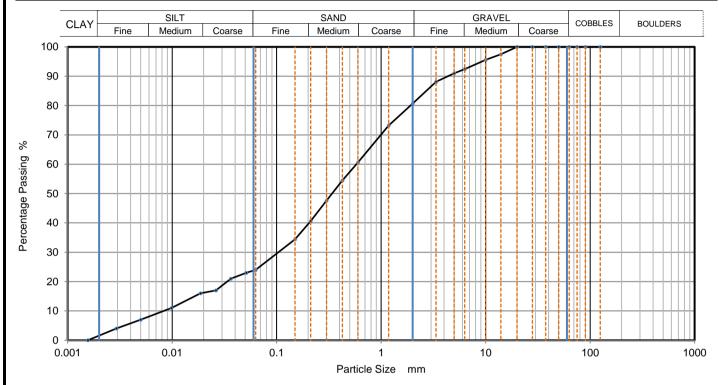
Grading Analysis		
D100	mm	
D60	mm	36.1
D30	mm	5.72
D10	mm	0.186
Uniformity Coefficient		190
Curvature Coefficient		4.9

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



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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D			
GEOTECH	PARI	ICLE SIZE DIST	: SIZE DISTRIBUTION -		Borehole/Pit No.	R9TP10
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	4
Soil Description	Brown silty fine to coarse SAND.			Depth, m	1.00	
Specimen Reference	2 Specimen 1 m		Sample Type	В		
Test Method	BS1377:Part 2:1990, clau	uses 9.2 and 9.5			KeyLAB ID	Caus2020102277



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	24
90	100	0.05127	23
75	100	0.03647	21
63	100	0.02624	17
50	100	0.01866	16
37.5	100	0.00985	11
28	100	0.00501	7
20	100	0.00292	4
14	98	0.00156	0
10	96		
6.3	92		
5	91		
3.35	88		
2	81		
1.18	73		
0.6	61	Particle density	(assumed)
0.425	55	2.65	Mg/m3
0.3	48		
0.212	41		
0.15	34		
0.063	24		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	19.3
Sand	56.8
Silt	22.3
Clay	1.6

Grading Analysis		
D100	mm	
D60	mm	0.58
D30	mm	0.104
D10	mm	0.0088
Uniformity Coefficient		66
Curvature Coefficient		2.1

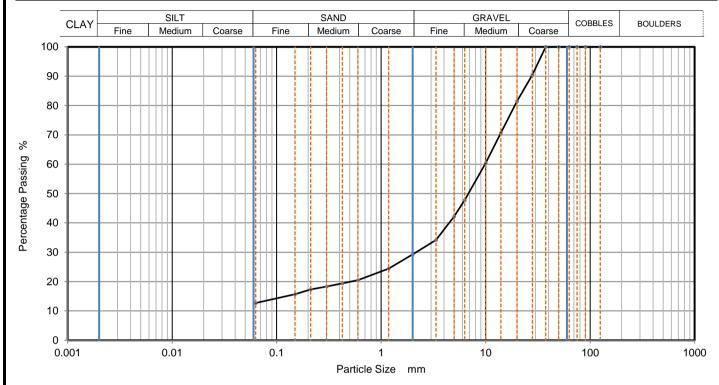
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D	
—— GEOTECH	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	R9TP10
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	6
Soil Description	Brown slightly sandy silty subangular fine to coarse GRAVEL.			Depth, m	2.00
Specimen Reference	2 Specimen 2 m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2020102278



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	91		
20	82		
14	71		
10	60		
6.3	48		
5	42		
3.35	34		
2	29		
1.18	24		
0.6	21		
0.425	19		
0.3	18		
0.212	17		
0.15	16		
0.063	13		

Approved

Dry Mass of sample, g 16682	Dry Mass of sample, g	16682
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Sample Proportions	% dry mass
Cobbles	0.0
Gravel	70.7
Sand	16.6
Fines < 0.063mm	13.0

Grading Analysis		
D100	mm	
D60	mm	9.85
D30	mm	2.16
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

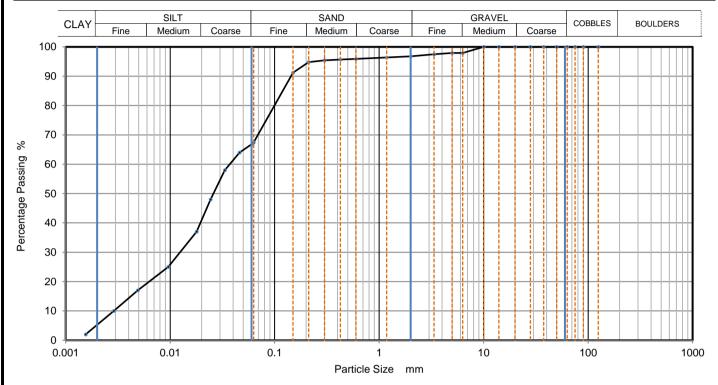
Remarks

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



LAB 05R Version 4 Stephen.Watson

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	20-0399D		
GEOTECH	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	R9TP10	
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	9
Soil Description	Brown sandy silty CLAY.			Depth, m	4.00	
Specimen Reference	6	6 Specimen 4 m Depth			Sample Type	В
Test Method	3S1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102279	



Sie	ving	Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06107	67
90	100	0.04609	64
75	100	0.03331	58
63	100	0.02437	48
50	100	0.01791	37
37.5	100	0.00958	25
28	100	0.00490	17
20	100	0.00289	10
14	100	0.00155	2
10	100		
6.3	98		
5	98		
3.35	98		
2	97		
1.18	96		
0.6	96	Particle density	(assumed)
0.425	96	2.65	Mg/m3
0.3	95		
0.212	95		
0.15	91		
0.063	67		

Dry Mass of sample, g	205

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	3.2
Sand	29.5
Silt	62.2
Clay	5.1

Grading Analysis		
D100	mm	
D60	mm	0.0378
D30	mm	0.0125
D10	mm	0.00296
Uniformity Coefficient		13
Curvature Coefficient		1.4

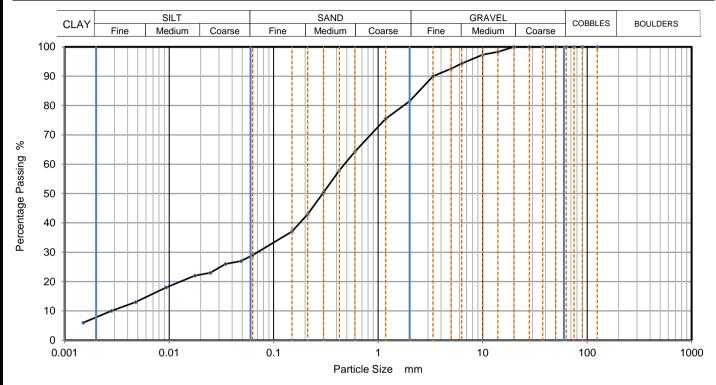
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	20-0399D		
GEOTECH			Borehole/Pit No.	R9TP11		
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	2	
Soil Description	Brown sandy slightly gravelly silty CLAY.			Depth, m	1.00	
Specimen Reference	6	Specimen Depth	1	m	Sample Type	В
Test Method	Method BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102280	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.06300	29	
90	100	0.04856	27	
75	100	0.03457	26	
63	100	0.02476	23	
50	100	0.01762	22	
37.5	100	0.00933	18	
28	100	0.00477	13	
20	100	0.00280	10	
14	98	0.00151	6	
10	97			
6.3	94			
5	93			
3.35	90			
2	82			
1.18	76			
0.6	64	Particle density	(assumed)	
0.425	58	2.65	Mg/m3	
0.3	50			
0.212	43			
0.15	37			
0.063	29			

Dry Mass of sample, g	522

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	18.5
Sand	52.5
Silt	21.4
Clay	7.6

Grading Analysis		
D100	mm	
D60	mm	0.477
D30	mm	0.07
D10	mm	0.00279
Uniformity Coefficient		170
Curvature Coefficient		3.7

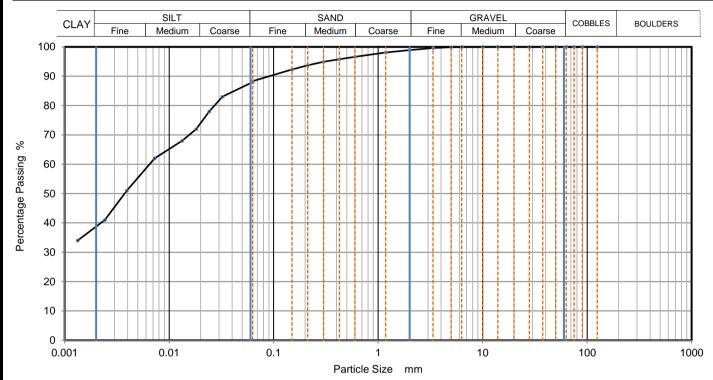
Preparation and testing in accordance with BS1377-2:1990 unless noted below



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PARTICLE SIZE DISTRIBUTION -			Job Ref	20-0399D		
			Borehole/Pit No.	R9TP11		
Site Name	Bus Connects Route 9	Bus Connects Route 9 Tallaght/Clondalkin to City Centre			Sample No.	5
Soil Description	Brown slightly sandy silty CLAY.			Depth, m	2.00	
Specimen Reference	6	Specimen Depth	2	m	Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2020102281	



Siev	/ing	Sedim	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	88
90	100	0.03228	83
75	100	0.02417	78
63	100	0.01820	72
50	100	0.01332	68
37.5	100	0.00725	62
28	100	0.00394	51
20	100	0.00242	41
14	100	0.00133	34
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	98		
0.6	97	Particle density	(assumed)
0.425	96	2.65	Mg/m3
0.3	95		
0.212	94	1	
0.15	92	1	
0.063	88		

Dry Mass of sample, g	213

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	1.1
Sand	10.6
Silt	49.6
Clay	38.7

Grading Analysis		
D100	mm	
D60	mm	0.00644
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Remarks

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



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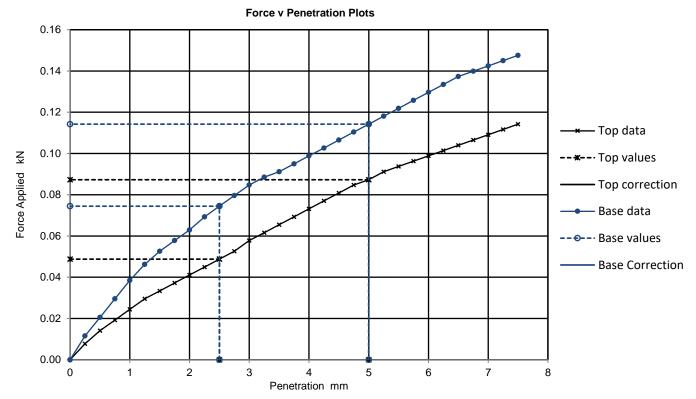
LAB 05R Version 4

CALISEWAY	California Posring Ratio (CRR)		Job Ref	20-0399D
CAUSEWAY California Bearing Ratio (CBR)		Borehole/Pit No.	R9CP01	
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City	Bus Connects Route 9 Tallaght/Clondalkin to City Centre		5
Soil Description	Brown sandy slightly gravelly silty CLAY.		Depth m	0.50
Specimen Reference	Specimen m Depth		Sample Type	В
Specimen Description	Brown sandy slightly gravelly silty CLAY.		KeyLAB ID	Caus202010220
Test Method	BS1377 : Part 4 : 1990, clause 7		CBR Test Number	1

Specimen Preparation

REMOULDED Condition Soaking details Not soaked Details Period of soaking days Recompacted with specified standard effort using 2.5kg rammer Time to surface days Amount of swell recorded mm Material retained on 20mm sieve removed 3 % Dry density after soaking Mg/m3 2.06

Initial Specimen details Bulk density 2.06 Mg/m3 Surcharge applied 4.5 kg
Dry density 1.73 Mg/m3 3 kPa
Moisture content 19.4 %



Results	Curve		CBR Va	lues, %		Moisture
	correction	2.5mm	5mm	Highest	Average	Content
	applied	2.511111	Jillill	riigilest	Average	%
TOP	No	0	0	0		20
BASE	No	1	1	1		19

General remarks	Test specific remarks	Approved	
	Average result may be reported if within 10% of the mean CBR value of top and base.		



CAUSEWAY	California Bearing Ratio (CBR)		Job Ref	20-0399D
GEOTECH Calliornia Bearing Ratio (CBR)			Borehole/Pit No.	R9CP03
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre		Sample No.	11
Soil Description	Brownish grey sandy gravelly silty CLAY.		Depth m	0.50
Specimen Reference	Specimen m Depth		Sample Type	В
Specimen Description	Brownish grey sandy gravelly silty CLAY.		KeyLAB ID	Caus2020102210
Test Method	BS1377 : Part 4 : 1990, clause 7		CBR Test Number	1

Specimen Preparation

Condition REMOULDED Soaking details Not soaked

Details Recompacted with specified standard effort using 2.5kg Period of soaking days rammer Time to surface days

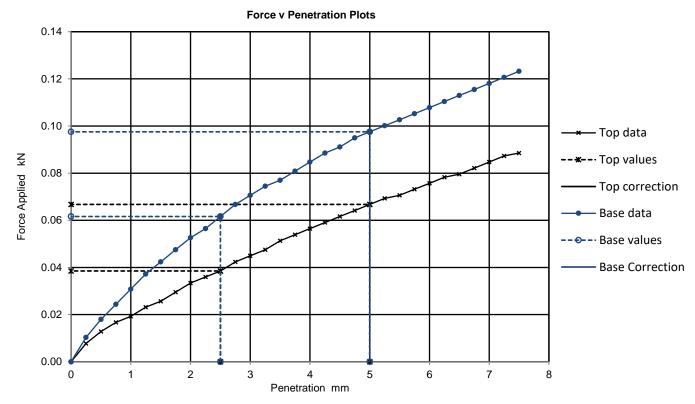
Amount of swell recorded mm

Material retained on 20mm sieve removed 1 % Dry density after soaking Mg/m3

Initial Specimen details Bulk density 2.07 Mg/m3 Surcharge applied 4.5 kg

Dry density 1.40 Mg/m3

Moisture content 48.0 %



TOP BASE

Results

Curve	CBR Values, %					
correction applied	2.5mm	5mm	Highest	Average		
No	0	0	0			
No	0	0	0			

Moisture Content
%
50
46

General remarks	Test specific remarks	Approved
Tested at natural moisture content.	Average result may be reported if within 10% of the mean CBR value of top and	Stephen.Watson
	base.	



kPa



Moisture Condition Value at Natural Moisture Content Summary of Results

Project No.

Project Name

20-0399D

Bus Connects Route 9 Tallaght/Clondalkin to City Centre

						onnects reduc				
Hole No.			nple		Soil Description	Retained on 20mm sieve	Moisture Content <20mm	Moisture Condition Value	Method of Interpretation	Remarks
	Ref	Тор	Base	Туре		%	%			
R9CP01	5	0.50		В	Brown sandy slightly gravelly silty CLAY.	3	20	2.5	Best fit line	
R9CP03	11	0.50		В	Brownish grey sandy gravelly silty CLAY.	1	48	5.7	Best fit line	
R9CP05	11	1.00		В	Brownish grey sandy gravelly silty CLAY.	4	13	10.6	Best fit line	
R9TP08	2	1.00		В	Brown sandy slightly silty subangular fine to coarse GRAVEL.	34	6.3	>18	Best fit line	
									L <i>F</i>	AB 10R Version 5

Key

Test performed in accordance with BS1377:Part4:1990, clause 5.4 unless

annotated otherwise

Date Printed

Approved By

18/11/2020

Stephen.Watson



			ı								
CAU	SEW/ GEOTE			Summary of Laboratory Vane Test Results							
Project No.	000D		Project Name Pun Connecte Boute 9 Tellegat/Clandelkin to City Contro								
20-0	399D	Cov	mnla	Bus Connects Route 9 Tallaght/Clondalkin to City Centre							
Hole No.	Ref	Top	mple Base	Туре	Soil Description at test horizon	Moisture Content %	Vane shea Undisturbed kPa	ar strength Remoulded kPa	Sensitivity	Remarks	
R9CP02	12	1.20		U	Greyish brown slightly sandy slightly gravelly silty CLAY.	21	93				
R9CPGS03	16	3.00		U	Greyish brown slightly sandy slightly gravelly silty CLAY.	11	48				

Notes
Tests performed in accordance with BS 1377:Part 7:clause 3 using 19mm x 30mm vane
Tests carried out in nominally 100mm diameter tube unless noted otherwise
Shear strengths are average of at least 3 tests unless noted otherwise

Date Printed Approved By
18/11/2020

Approved By
Table

1
sheet
Stephen.Watson
1

CALISEWAY	Unconsolidate			Job Ref	20-0399D	
GEOTECH GEOTECH	Compression Test without measurement of pore pressure - single specimen				Borehole/Pit No.	R9CP01
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	18
Soil Description	Brown sandy slightly gravelly silty CLAY.			Depth	3.00	
Specimen Reference	4 Specimen 3.05 m			Sample Type	U	
Specimen Description	Stiff brown sandy slightly gravelly silty CLAY.				KeyLAB ID	Caus202010223
Test Method	BS1377 : Part 7 : 19	90, clause 8, sinç	gle specimen		Date of test	28/10/2020

Rate of Strain Cell Pressure At failure

Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

2.27	Mg/m3
15.6	%
1.96	Mg/m3
	_
2.0	%/min
60	L-D-

mm

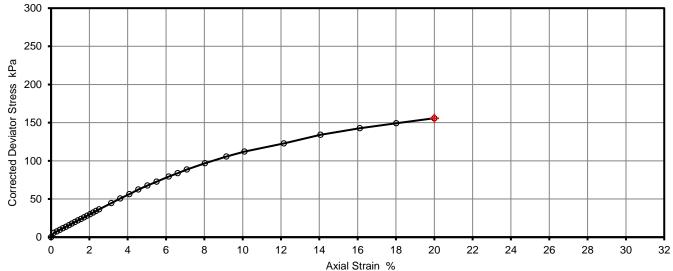
mm

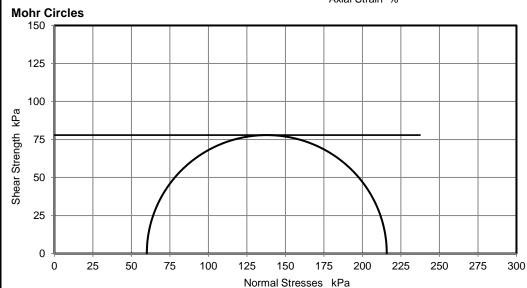
209.9

105.2

2.0	%/min
60	kPa
20.0	%
156	kPa
78	kPa ½(σ1 - σ3)f

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects based on Fig 11 BS1377-7:1990

Mohr circles and their interpretation is not covered by BS1377-7. This is provided for information only.

Remarks

No failure defined. Testing terminated at 20% axial strain.

Approved

Stephen.Watson

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18/11/2020 15:10



10122

CAUSEWAY	Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen				Job Ref	20-0399D
GEOTECH					Borehole/Pit No.	R9CP01
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	19
Soil Description	Brownish grey sandy slightly gravelly silty CLAY.			Depth	5.00	
Specimen Reference	4 Specimen 5.05 m			Sample Type	U	
Specimen Description	Stiff brownish grey sandy slightly gravelly silty CLAY.			KeyLAB ID	Caus202010225	
Test Method	BS1377 : Part 7 : 19	90, clause 8, sing	gle specimen		Date of test	28/10/2020

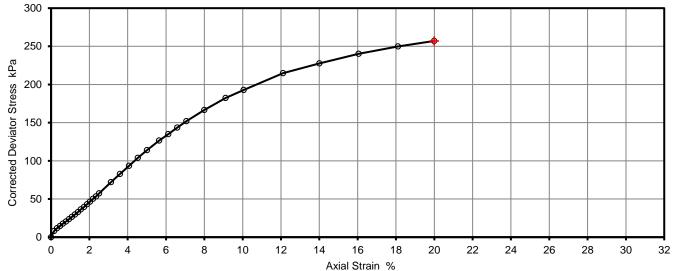
Rate of Strain Cell Pressure At failure

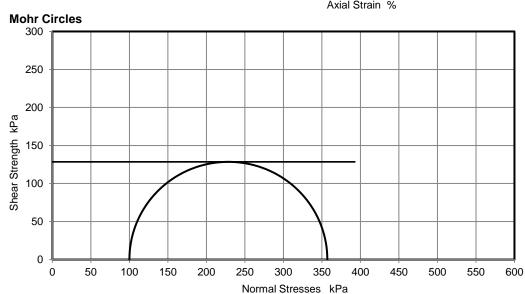
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

1	
210.8	mm
105.1	mm
2.31	Mg/m3
12.0	%
2.07	Mg/m3

2.0	%/min
100	kPa
20.0	%
257	kPa
129	kPa ½(σ1 - σ3)f

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects based on Fig 11 BS1377-7:1990

Mohr circles and their interpretation is not covered by BS1377-7. This is provided for information only.



No failure defined. Testing terminated at 20% axial strain.

Approved

Stephen.Watson

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LAB 15R Version 4



CAUSEWAY	Unconsolidat			Job Ref	20-0399D	
——GEOTECH	Compression Test without measurement of pore pressure - single specimen				Borehole/Pit No.	R9CP03
Site Name	Bus Connects Route 9 Tallaght/Clondalkin to City Centre				Sample No.	26
Soil Description	Brownish grey sandy gravelly SILT.				Depth	1.20
Specimen Reference	4 Specimen 1.25 m			Sample Type	U	
Specimen Description	Firm brownish grey sandy gravelly SILT.			KeyLAB ID	Caus2020102212	
Test Method	BS1377 : Part 7 : 19	990, clause 8, sing	gle specimen		Date of test	29/10/2020

Rate of Strain Cell Pressure

At failure

Axial Strain

Mode of Failure

Deviator Stress, (σ 1 - σ 3)f

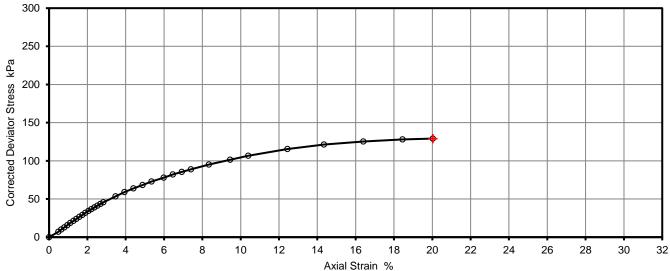
Undrained Shear Strength, cu

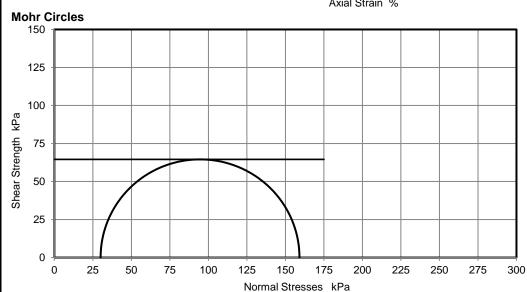
210.7	mm
105.2	mm
2.28	Mg/m3
14.3	%
2.00	Mg/m3
	_

2.0	%/min
30	kPa
20.0	%
129	kPa
65	kPa 1

½(σ1 - σ3)f

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects based on Fig 11 BS1377-7:1990

Mohr circles and their interpretation is not covered by BS1377-7. This is provided for information only.

Remarks

No failure defined. Testing terminated at 20% axial strain.

Approved

Stephen.Watson

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LAB 15R Version 4



CAUSEWAY ——GEOTECH	Unconsolic Compressi					t -	Job Ref	:			20-03	399D				
GEOTECH	of pore pre						Borehol	e/Pit No).		R9C	P05				
Site Name	Bus Connects F	Route 9 Tallagh	ıt/Clondalk	in to City	Centre		Sample	No.			2	6				
Soil Description	Grey sandy slig	htly gravelly sil	ty CLAY.				Depth				8.0	00				
Specimen Reference	4	Specim Depth	nen	8.05		m	Sample	Туре			ι	J				
Specimen Description	Stiff grey sandy	slightly gravell	y silty CLA	AY.			KeyLAE	3 ID		C		0102232	2			
Test Method	BS1377 : Part 7	' : 1990, clause	8, single	specimen			Date of	test			29/10	/2020				
	Length Diameter Bulk Density Moisture Conter Dry Density Rate of Strain Cell Pressure At failure	Diameter 104.0 Bulk Density 2.14 Moisture Content 9.2 Dry Density 1.96 Rate of Strain 2.0 Cell Pressure 150 At failure Axial Strain 17.1 Deviator Stress, (σ1 - σ3)f 235 Undrained Shear Strength, cu 118 Mode of Failure Plastic											mm mm Mg/m3 % Mg/m3 %/min kPa % kPa kPa kPa kPa ½(σ1 - σ3)f			
iator Stress v	Axial Strain															
50					•		,						-			
00			_													
50	P															
00																
50																
0													_			
		0 40	12 1	14 16		2) 22	2 24	4	26	28	30	32			
0 2	4 6	8 10		Axial St	rain %											
0 2 r Circles	4 6	8 10		Axial St	rain %					5						
0 2	4 6	8 10		Axial St	rain %					for are	a chang					
0 2	4 6	8 10		Axial St	rain %					for are	a chang rane eff		ed on			
0 2 r Circles	4 6	8 10		Axial Sti	rain %					for are member Fig 11	a chang rane effo BS1377 circles a	e and ects base 7-7:1990 and their	ed on			
0 2 or Circles 00 00 00 00 00	4 6	8 10		Axial Sti	rain %					for are member Fig 11 Mohr of interpre- by BS3	a chang rane effo BS1377 circles a	le and ects base 7-7:1990 and their s not cov	ed on			
0 2 nr Circles 00 50 50	4 6	8 10		Axial Sti	ain %					for are member Fig 11 Mohr contemporary by BS2 This is	a chang rane effor BS1377 sircles are tation i 1377-7.	ee and ects base 7-7:1990 and their s not covered for	ed on			
0 2 ar Circles 50 50 600	4 6	8 10		Axial Str	—					for are member Fig 11 Mohr contemporary by BS2 This is	a chang rane effor BS1377 circles an etation i 1377-7. provide	ee and ects base 7-7:1990 and their s not covered for	ed on			
0 2 ar Circles 50 50 600	4 6	8 10		Axial Str						for are member Fig 11 Mohr contemporary by BS2 This is	a chang rane effor BS1377 circles an etation i 1377-7. provide	ee and ects base 7-7:1990 and their s not covered for	ed on			
0 2 or Circles 00 50 00 00 00 00 00 00 00 0		200 250	300 3	Axial Str		50	00 55	0 60	000	for are member Fig 11 Mohr contemporary by BS2 This is	a chang rane effor BS1377 circles an etation i 1377-7. provide	ee and ects base 7-7:1990 and their s not covered for	ed on			
0 2 nr Circles 00 50 50 00 50		200 250	al Stresses	350 400 s kPa			00 55	0 60	00	for are member Fig 11 Mohr contemporary by BS2 This is	a chang rane effor BS1377 circles an etation i 1377-7. provide	ee and ects base 7-7:1990 and their s not covered for	ed on			
0 2 ar Circles 00 50 50 00 50 50 50		200 250	al Stresses	350 400	0 450		Printed	0 60		for are member Fig 11 Mohr contemporary by BS2 This is	a chang rane effor BS1377 circles an etation i 1377-7. provide	ee and ects base 7-7:1990 and their s not covered for	ed on			

CALISEWAY	Unconsolidate Compression			nt	Job Ref	20-0399D		
GEOTECH	of pore pressi			111	Borehole/Pit No.	R9CP08		
Site Name	Bus Connects Route	9 Tallaght/Clond	dalkin to City Centre		Sample No.	18		
Soil Description	Grey slightly sandy s	lightly gravelly si	Ity CLAY.		Depth	3.00		
Specimen Reference	4	Specimen Depth	3.05	m	Sample Type	U		
Specimen Description	Stiff grey slightly sar	dy slightly gravel	lly silty CLAY.		KeyLAB ID	Caus2020102239		
Test Method	BS1377 : Part 7 : 19	90, clause 8, sinç	gle specimen		Date of test	29/10/2020		

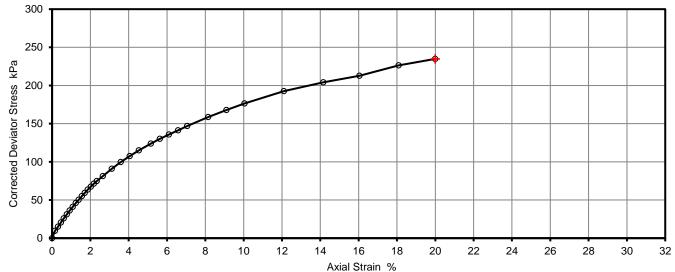
Rate of Strain Cell Pressure At failure

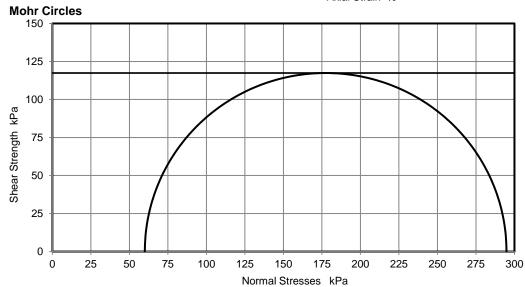
Axial Strain
Deviator Stress, (σ1 - σ3)f
Undrained Shear Strength, cu
Mode of Failure

1	
210.8	mm
104.9	mm
2.22	Mg/m3
14.0	%
1.95	Mg/m3

2.0	%/min
60	kPa
20.0	%
235	kPa
117	kPa ½(σ1 - σ3)f
	1

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects based on Fig 11 BS1377-7:1990

Mohr circles and their interpretation is not covered by BS1377-7. This is provided for information only.



No failure defined. Testing terminated at 20% axial strain.

Approved

Stephen.Watson

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LAB 15R Version 4



CALISEWAY	Unconsolidat		d Triaxial It measureme	nt	Job Ref			20-039	9D			
CAUSEWAY	of pore press				Borehole/I	Pit No.		R9CPG	S02			
Site Name	Bus Connects Rout	e 9 Tallaght/Clond	dalkin to City Centre		Sample N	Ο.		17				
Soil Description	Greyish brown sligh	ntly sandy silty CL	AY.		Depth			2.00)			
Specimen Reference	4	Specimen Depth	2.05	m	Sample Ty	/pe	U					
Specimen Description	Stiff greyish brown	slightly sandy silty	CLAY.		KeyLAB II)	Ca	aus2020	102258			
Test Method	BS1377 : Part 7 : 19	990, clause 8, sing	gle specimen		Date of te	st		29/10/2	020			
	Test Number Length Diameter Bulk Density Moisture Content Dry Density Rate of Strain Cell Pressure At failure	mm mm Mg/m3 % Mg/m3 %/min kPa % kPa kPa kPa kPa kPa kPa										
eviator Stress v	Axial Strain											
300				- +		•						
250										+		
200 · · · · · · · · · · · · · · · · · ·												
150												
100	<u> </u>									+		
50												
0 1	2 3 4	5 6	7 8 9) 1	0 11	12	13	14	15	⊣ 16		
ohr Circles			Axial Strain %									
250		Deviate for area membr Fig 11 Mohr c interpre								on		
							by BS1377-7. This is provided for information only.					
							This is	orovided				
150	100 450 200	250 200	350 400 4	50 5	500 550	600	This is	orovided				
150	100 150 200	250 300 Normal Stres	sses kPa		500 550	600	This is	orovided				
100	100 150 200				500 550 Printed 18/11/202		This is	orovided				

CAUSEWAY	Unconsolidate Compression	Test withou	ıt measuremei	nt	Job Ref	20-0399D
4/	of pore pressu	re - single	specimen	Borehole/Pit No.	R9CPGS02	
Site Name	Bus Connects Route	9 Tallaght/Clond	dalkin to City Centre		Sample No.	11
Soil Description	Greyish brown sandy	gravelly silty CL	AY.		Depth	12.00
Specimen Reference	4	Specimen Depth	12.05	m	Sample Type	С
Specimen Description	Firm greyish brown s	andy gravelly silt	y CLAY.		KeyLAB ID	Caus2020102262
Test Method	BS1377 : Part 7 : 199	00, clause 8, sing	gle specimen		Date of test	28/10/2020

Rate of Strain Cell Pressure At failure

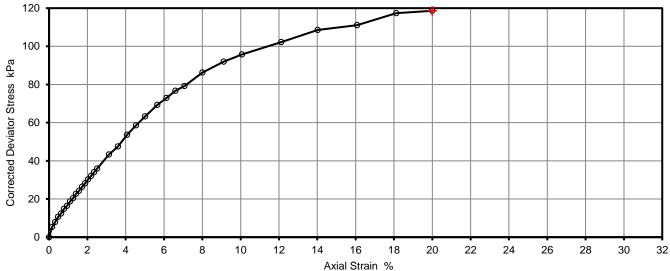
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

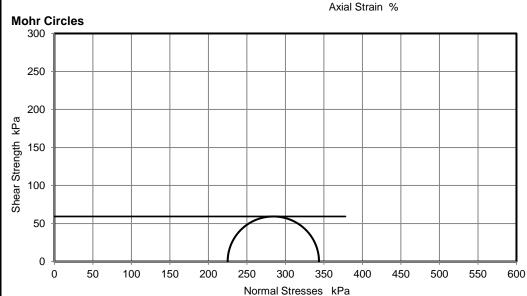
1	
210.7	mm
105.3	mm
2.25	Mg/m3
12.8	%
2.00	Mg/m3

2.0	%/min
225	kPa
20.0	%
119	kPa
59	kPa ⅓

½(σ1 - σ3)f

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects based on Fig 11 BS1377-7:1990

Mohr circles and their interpretation is not covered by BS1377-7. This is provided for information only.

Remarks

No failure defined. Testing terminated at 20% axial strain.

Approved

Stephen.Watson

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18/11/2020 15:10

LAB 15R Version 4



10122

C	AUSEW GEOTE	AY					Po				trenç ary o				its			
Project No.)-0399D			Proje	ct Name	9	В				te 9 Ta				City Co	entre		
Borehole	Sa	ımple		Spe	cimen	Rock Type		Type ISRM			Dime	nsions		Force P	Equivalent diameter, De	Point Load Strength Index		Remarks (including
No.	Depth m	Ref.	Туре	Ref.	Depth m	Nock Type	Type (D, A, I, B)	Direction (L, P or U)	Failure V	Lne	W	Dps	Dps'		a Equiva	Is _{MPa}	Is(5 0) MPa	water content if measured)
R9CPGS01	12.30		С	2	12.30	LIMESTONE	D	U	NO	87.5	101.3	101.3	96.0	8.2	98.6	0.8	1.1	
R9CPGS01	12.55		С	2	12.55	LIMESTONE	Α	U	NO		101.4	68.0	66.0	6.1	92.3	0.7	0.9	
R9CPGS01	12.80		С	2	12.80	LIMESTONE	D	U	NO	81.2	101.4	101.4	98.0	9.6	99.7	1.0	1.3	
R9CPGS01	13.20		С	2	13.20	LIMESTONE	А	U	YES		101.6	57.0	54.0	4.7	83.6	0.7	0.8	
R9CPGS01	13.75		С	2	13.75	LIMESTONE	D	U	NO	79.6	101.3	101.3	98.0	7.5	99.6	0.8	1.0	
R9CPGS01	14.00		С	2	14.00	LIMESTONE	D	U	YES	80.5	101.5	101.5	96.0	9.0	98.7	0.9	1.3	
R9CPGS01	14.15		С	2	14.15	LIMESTONE	А	U	NO		101.9	90.0	88.0	5.8	106.9	0.5	0.7	
R9CPGS01	14.50		С	2	14.50	LIMESTONE	Α	U	NO		101.6	65.0	63.0	2.0	90.3	0.2	0.3	
R9CPGS01	15.35		С	2	15.35	LIMESTONE	D	U	NO	76.6	101.6	101.6	97.0	6.5	99.3	0.7	0.9	
R9CPGS01	15.85		С	2	15.85	LIMESTONE	А	U	NO		101.8	60.0	56.0	4.4	85.2	0.6	0.8	
R9CPGS01	17.20		С	2	17.20	LIMESTONE	D	U	NO	79.2	101.6	101.6	98.0	10.1	99.8	1.0	1.4	
R9CPGS01	17.40		С	2	17.40	LIMESTONE	D	U	NO	88.2	101.4	101.4	98.0	8.6	99.7	0.9	1.2	
R9CPGS02	13.35		С	2	13.35	LIMESTONE	А	U	NO		101.5	51.0	48.0	8.0	78.8	1.3	1.6	
R9CPGS02	13.70		С	2	13.70	LIMESTONE	D	U	YES	75.1	101.4	101.4	94.0	2.4	97.6	0.3	0.3	
R9CPGS02	13.90		С	2	13.90	LIMESTONE	А	U	NO		101.3	47.0	42.0	7.3	73.6	1.3	1.6	
R9CPGS02	14.10		С	2	14.10	LIMESTONE	А	U	NO		101.4	50.0	41.0	5.7	72.8	1.1	1.3	
R9CPGS02	14.65		С	2	14.65	LIMESTONE	D	U	YES	66.3	101.4	101.4	95.0	6.4	98.1	0.7	0.9	
R9CPGS02	15.10		С	2	15.10	LIMESTONE	D	U	NO	88.6	101.6	101.6	96.0	9.2	98.8	0.9	1.3	
Direction L - parallel to plan P - perpendicular t U - unknown or ra Dimensions Dps - Distance be Dps' - at failure (s Lne - Length from	Test Type D - Diametral, A - Axial, I - Irregular Lump, B - Block Direction L - parallel to planes of weakness P - perpendicular to planes of weakness U - unknown or random Dimensions Dps - Distance between platens (platen separation) Dps' - at failure (see ISRM note 6) Lne - Length from platens to nearest free end											Bloo	 		D _{ps}	4	ar lump	P D _{ps}
W - Width of shortest dimension perpendicular to load, P Test performed in accordance with ISRM Suggested Methods: 2007, unless noted otherwise Detailed legend for test and dimensions, based on ISRM, is shown above. Size factor, F = (De/50)0.45 for all tests. LAB 17R Version 4										n 4	Date Printed Approved By 16/11/2020 UKAS TESTING					TESTING		

C	AUSEW GEOTE						Po				Strength Index Tests nary of Results									
Project No.)-0399D			Proje	ect Name	Э	В	us Co	nnect	s Rou	te 9 Ta	llaght/C	Clonda	lkin to (City Ce	entre				
Borehole	Sa	ımple		Spe	ecimen	David Torre		Type ISRM			Dimensions			Force P	Equivalent diameter, De	Point Load Strength Inde		Remarks (including		
No.	Depth m	Ref.	Туре	Ref.	Depth m	Rock Type	Type (D, A, I, B)	Direction (L, P or U)	Failure Va	Lne	W	Dps	Dps'	kN	a Equival	Is MPa	Is(5 0) MPa	water content if measured)		
R9CPGS02	15.40		С	2	15.40	LIMESTONE	D	U	YES	90.2	101.9	101.9	91.0	11.6	96.3	1.3	1.7			
R9CPGS02	15.70		С	2	15.70	LIMESTONE	А	U	NO		101.5	50.0	42.0	4.1	73.7	0.8	0.9			
R9CPGS02	16.10		С	2	16.10	LIMESTONE	А	U	NO		101.8	93.0	74.0	7.4	97.9	0.8	1.0			
R9CPGS02	16.75		С	2	16.75	LIMESTONE	D	U	NO	55.6	101.6	101.6	98.0	6.9	99.8	0.7	0.9			
R9CPGS02	17.05		С	2	17.05	LIMESTONE	D	U	NO	77.2	101.4	101.4	98.0	9.7	99.7	1.0	1.3			
R9CPGS03	11.50		С	3	11.50	LIMESTONE	D	U	YES	92.3	101.3	101.3	89.2	24.6	95.1	2.7	3.6			
R9CPGS03	11.50		С	4	11.55	LIMESTONE	А	U	YES		101.3	57.0	54.0	13.2	83.5	1.9	2.4			
R9CPGS03	12.00		С	2	12.00	LIMESTONE	А	U	NO		101.4	58.0	55.0	11.5	84.3	1.6	2.0			
R9CPGS03	12.40		С	2	12.40	LIMESTONE	Α	U	NO		101.8	71.0	69.0	8.9	94.6	1.0	1.3			
R9CPGS03	12.70		С	2	12.70	LIMESTONE	D	U	YES	85.0	101.6	101.6	97.0	8.5	99.3	0.9	1.2			
R9CPGS03	12.95		С	2	12.95	LIMESTONE	Α	U	YES		101.5	101.5	97.0	5.5	112.0	0.4	0.6			
R9CPGS03	13.80		С	2	13.80	LIMESTONE	D	U	YES	66.0	101.6	101.6	98.0	3.7	99.8	0.4	0.5			
R9CPGS03	14.10		С	2	14.10	LIMESTONE	А	U	NO		101.6	96.0	94.0	0.5	110.3	0.0	0.1			
R9CPGS03	14.55		С	2	14.55	LIMESTONE	Α	U	NO		101.4	101.0	97.2	4.9	112.0	0.4	0.6			
R9CPGS03	14.65		С	2	14.65	LIMESTONE	D	U	YES	81.0	101.6	101.6	91.0	21.4	96.2	2.3	3.1			
R9CPGS03	15.40		С	2	15.40	LIMESTONE	Α	U	YES		101.3	60.0	56.0	9.6	85.0	1.3	1.7			
R9CPGS03	15.60		С	2	15.60	LIMESTONE	D	U	NO	71.0	101.4	101.4	98.0	11.7	99.7	1.2	1.6			
R9CPGS04	11.15		С	2	11.15	LIMESTONE	D	U	NO	85.2	101.6	101.6	99.0	12.1	100.3	1.2	1.6			
Direction L - parallel to pland P - perpendicular t U - unknown or rai Dimensions Dps - Distance bet Dps' - at failure (s Lne - Length from	Test Type D - Diametral, A - Axial, I - Irregular Lump, B - Block Direction L - parallel to planes of weakness U - unknown or random Dimensions Dps - Distance between platens (platen separation) Dps' - at failure (see ISRM note 6) Lne - Length from platens to nearest free end											Bloo	+		D _{ps}	4	ar lump	P D _{ps}		
W - Width of shortest dimension perpendicular to load, P Test performed in accordance with ISRM Suggested Methods: 2007, unless noted otherwise Detailed legend for test and dimensions, based on ISRM, is shown above. Size factor, F = (De/50)0.45 for all tests. LAB 17R Version 4										n 4		Printed 6/11/20	20	Appro		y √atson		JKAS TESTING 10122		

· C	AUSEW GEOTE						Po	oint			treng				its			
Project No.	02000			Proje	ect Nam	е	D	Co	nnoote	. Pour	to 0 Tal	loabt/C	londo	lkin to (City C	antro		
Borehole	0-0399D Sa	ample		Spe	ecimen		Test	Type ISRM		S ROU	Dimensions			Force	Equivalent diameter,	Point Strengt		Remarks (including
No.	Depth	Ref.	Туре	Ref.	Depth	Rock Type	Type (D, A, I, B)	Direction (L, P or U)	Failure Valid (Y/N)	Lne	W	Dps	Dps'		Equivale	Is	Is(5 0)	water content if measured)
DOCDCS04	m			2	m	LIMESTONE			NO	mm	mm	mm	mm	kN	mm	MPa	MPa	
R9CPGS04	11.70		С	2	11.70	LIMESTONE	A	U			103.9	56.0	53.0	9.3	83.7	1.3	1.7	
R9CPGS04	12.50		С	2	12.50		D	U	YES	72.4	101.4	101.4	97.0	8.4	99.2	0.9	1.2	
R9CPGS04	12.90		С	2	12.90	LIMESTONE	Α	U	YES		101.5	64.0	60.0	12.2	88.1	1.6	2.0	
R9CPGS04	13.50		С	2	13.50	LIMESTONE	D	U	YES	77.9	101.4	101.4	97.0	16.9	99.2	1.7	2.3	
R9CPGS04	13.95		С	2	13.95	LIMESTONE	D	U	YES	76.2	101.7	101.7	98.0	14.1	99.8	1.4	1.9	
R9CPGS04	14.05		С	2	14.05	LIMESTONE	А	U	YES		101.6	55.0	52.0	8.2	82.0	1.2	1.5	
R9CPGS04	14.30		С	2	14.30	LIMESTONE	D	U	YES	82.6	101.2	101.1	97.0	21.0	99.1	2.1	2.9	
Test Type D - Diametral, A - Axial, I - Irregular Lump, B - Block Direction L - parallel to planes of weakness P - perpendicular to planes of weakness U - unknown or random Dimensions Dps - Distance between platens (platen separation) Dps' - at failure (see ISRM note 6) Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P											-ne ▲	Bloo	 	•	D _{ps}	4	ar lump	P D _{ps}
Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise Detailed legend for test and dimensions, based on ISRM, is shown above. Size factor, F = (De/50)0.45 for all tests.											Date F	Printed 6/11/20	20	Appro	ved B	у		⇒ ↓ ↓ ↓ KAS
Ì						I	LAB 1	7R V	ersio	า 4	4 Stephen Watson 101					10122		



UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Project No.

Project Name

20-0399D

Bus Connects Route 9 Tallaght/Clondalkin to City Centre

		Sample				Dii	Specime mensior	n is2	Bulk	Water Content		al Compre	ssion3	
Hole No.	Ref	Тор	Base	Туре	Rock Type	Dia. mm	Length mm	H/D	Density2 Mg/m3	1 %	Condition	Mode of failure	UCS MPa	Remarks
R9CPGS04		13.05		С	LIMESTONE	101.2	256.8	2.5	2.69	1.0	as received	F	75.6	
R9CPGS04		15.65		С	LIMESTONE	101.2	257.5	2.5	2.68	1.0	as received	F	39.0	

- 2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density
- $3\,$ ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials

above notes apply unless annotated otherwise in the remarks

S - Single shear

MS - multiple shear

AC - Axial cleavage

F - Fragmented

Test Specification	Date Printed	Approved By	Table	
International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007	16/11/2020		sheet	1
		Stephen.Watson		1



eurofins Chemtest

Eurofins Chemtest Ltd
Depot Road
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CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-29098-1

Initial Date of Issue: 02-Nov-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 McAllis

Project 20-0399D Bus Connects Route 9

Tallaght/Clondalkin to City Centre

Quotation No.: Date Received: 28-Oct-2020

Order No.: Date Instructed: 28-Oct-2020

No. of Samples: 16

Turnaround (Wkdays): 5 Results Due: 03-Nov-2020

Date Approved: 02-Nov-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Results - Soil

Project: 20-0399D Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Client: Causeway Geotech Ltd		Cher	ntest Jo	ob No.:	20-29098	20-29098	20-29098	20-29098	20-29098	20-29098	20-29098	20-29098	20-29098
Quotation No.:	(Chemte	st Sam	ple ID.:	1087486	1087487	1087488	1087489	1087490	1087491	1087492	1087493	1087494
Order No.:		Clier	nt Samp	le Ref.:	6	6	22	6	20	10	12	8	9
	Sample Location:		R9CP01	R9CP02	R9CP03	R9CP04	R9CP05	R9CPGS01	R9CPGS01	R9CPGS02	R9CPGS02		
	Sample Type:		SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL		
	Top Depth (m):		1.00	1.00	5.00	1.00	2.00	2.00	4.00	1.00	2.00		
			Date Sa	ampled:	27-Oct-2020								
Determinand	Accred.	SOP	Units	LOD									
Moisture	N	2030	%	0.020	11	16	9.5	13	16	12	14	11	8.4
рН	J	2010		4.0	8.6	8.5	8.6	8.6	8.4	8.8	8.8	8.7	8.4
Sulphate (2:1 Water Soluble) as SO4	J	2120	g/l	0.010	0.12	< 0.010	0.057	< 0.010	1.5	< 0.010	< 0.010	< 0.010	0.12
Total Sulphur	U	2175	%	0.010					0.77	0.030		0.041	
Sulphate (Acid Soluble)	U	2430	%	0.010					1.9	0.050		0.039	

Results - Soil

Project: 20-0399D Bus Connects Route 9 Tallaght/Clondalkin to City Centre

Client: Causeway Geotech Ltd		Che	mtest J	ob No.:	20-29098	20-29098	20-29098	20-29098	20-29098	20-29098	20-29098
Quotation No.:		Chemte	st Sam	ple ID.:	1087495	1087496	1087497	1087498	1087499	1087500	1087501
Order No.:		Clie	nt Samp	le Ref.:	12	8	10	7	11	2	2
		Sa	ample Lo	ocation:	R9CPGS02	R9CPGS03	R9CPGS03	R9CPGS04	R9CPGS04	R9TP04	R9TP05
			Sampl	е Туре:	SOIL						
			Top De	pth (m):	5.00	2.00	4.00	1.00	5.00	1.00	1.00
			Date Sa	ampled:	27-Oct-2020						
Determinand	Accred.	SOP	Units	LOD							
Moisture	N	2030	%	0.020	5.5	10	12	13	6.7	13	10
рН	U	2010		4.0	11.3	10.1	8.7	9.1	9.0	8.7	8.5
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.65	0.010	< 0.010	0.013	< 0.010	< 0.010	0.095
Total Sulphur	U	2175	%	0.010		0.065		0.013		0.028	0.25
Sulphate (Acid Soluble)	U	2430	%	0.010		0.055		0.041		0.067	0.087

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	рН	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
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by 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"

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 45 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: <u>customerservices@chemtest.com</u>



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Chemtest
Eurofins Chemtest Ltd
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Newmarket
CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-30004-1

Initial Date of Issue: 10-Nov-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 McAllis

Project 20-0399D Bus Connects Route 9

Quotation No.: Date Received: 05-Nov-2020

Order No.: Date Instructed: 05-Nov-2020

No. of Samples: 4

Turnaround (Wkdays): 5 Results Due: 11-Nov-2020

Date Approved: 10-Nov-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Results - Soil

Project: 20-0399D Bus Connects Route 9

Client: Causeway Geotech Ltd		Cher	ntest Jo	ob No.:	20-30004	20-30004	20-30004	20-30004
Quotation No.:	Chemtest Sample ID.:		1092175	1092176	1092177	1092178		
		Sa	ample Lo	ocation:	R9CPGS01	R9CPGS02	R9CPGS03	R9CPGS04
	Sample Type:			SOIL	SOIL	SOIL	SOIL	
	Top Depth (m):			12.0	12.0	10.5	10.5	
	Bottom Depth (m):		13.5	13.5	12.0	12.0		
			Date Sa	ampled:	04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020
Determinand	Accred.	SOP	Units	LOD				
Moisture	N	2030	%	0.020	3.7	2.0	1.7	2.0
рН	U	2010		4.0	9.1	8.9	9.2	8.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	0.090

Test Methods

SOP	Title	Parameters included	Method summary			
2010	pH Value of Soils	рН	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

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- N Unaccredited
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- 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"

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 45 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: <u>customerservices@chemtest.com</u>



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Eurofins Chemtest Ltd
Depot Road
Newmarket
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Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-30603-1

Initial Date of Issue: 16-Nov-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 Franey
Stephen McCracken
Stephen Watson
Stuart Abraham
Thomas McAllis

Project 20-0399D ROUTE 9 Tallaght/

Clondalkin to City Centre

Quotation No.: Date Received: 11-Nov-2020

Order No.: Date Instructed: 11-Nov-2020

No. of Samples: 1

Turnaround (Wkdays): 5 Results Due: 17-Nov-2020

Date Approved: 16-Nov-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Results - Soil

Project: 20-0399D ROUTE 9 Tallaght/Clondalkin to City Centre

Client: Causeway Geotech Ltd		Che	mtest Jo	ob No.:	20-30603
Quotation No.:	(Chemtest Sample ID.: 1095			
Order No.:		Client Sample Ref.: 2			
		Sa	ample Lo	ocation:	R9CP06
		е Туре:	SOIL		
		oth (m):	1.00		
		Date Sampled:			09-Nov-2020
Determinand	Accred.	SOP	Units	LOD	
Moisture	N	2030	%	0.020	11
рН	U	2010		4.0	8.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010
Total Sulphur	U	2175	%	0.010	0.024
Sulphate (Acid Soluble)	U	2430	%	0.010	0.019

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	рН	pH Meter
	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
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by 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"

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 45 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: <u>customerservices@chemtest.com</u>



LABORATORY RESTRICTION REPORT

Projec	t Referenc	се			20-0	399D	То	Sean Ross
Project Name Bus Connects			Conne	ects Route 9 - Talla	aght/Clondalkin to City Centre	Position	Project Manager	
TD			20-0399D	/ G01	From	Joseph Nicholl		
						Position	Laboratory Quality Manage	
ne followi rm to the	ng sample(s laboratory.	s) and	l test(s	s) are re	stricted as detailed be	elow. Could you please complete the "	'Required Action"	column and return the completed
Hole		Samp			Test	December Dectrication		Degration d Action
lumber	Number	ber Dep		Туре	Туре	Reason for Restriction	on	Required Action
R9CP GS02			.50	С	UU Triaxial	Insufficient intact material to specimen	obtain test	CANCEL
or electi	onic repor	ting f	a forn	n of		Laboratory Signatur Joseph Nicholl	re	Project Manager Signature Sean Ross

IMSF57 Version 2 Password Access Controlled

acceptable

electronic signature or printed name is

Page 1 of 1 UNCONTROLLED COPY WHEN PRINTED

Date

04 November 2020

Date



APPENDIX H ENVIRONMENTAL LABORATORY TEST RESULTS





eurofins Chemtest

Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-26467-1

Initial Date of Issue: 12-Oct-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 McAllis

Project 20-0399D Bus Connects-Greenhills

Quotation No.: Q20-21063 Date Received: 01-Oct-2020

Order No.: Date Instructed: 05-Oct-2020

No. of Samples: 1

Turnaround (Wkdays): 5 Results Due: 09-Oct-2020

Date Approved: 12-Oct-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070

Results - Leachate

Client: Causeway Geotech Ltd			Che	mtest Jo	ob No.:	20-26467
Quotation No.: Q20-21063	Chemtest Sample ID.					1073480
	Sample Location:					R9CP01
	Sample Type:				e Type:	SOIL
	Top Depth (m):					0.50
				Date Sa	ampled:	29-Sep-2020
Determinand	Accred.	SOP	Type	Units	LOD	
Ammonium	U	1220	10:1	mg/l	0.050	0.071
Ammonium	N	1220	10:1	mg/kg	0.10	0.74

Client: Causeway Geotech Ltd			mtest Jo		
Quotation No.: Q20-21063	(st Sam		1073480
		Sa	ample Lo		R9CP01
				e Type:	SOIL
			Top Dep		0.50
			Date Sa	ampled:	29-Sep-2020 COVENTRY
		Asbestos Lab			
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	=
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	10
pН	М	2010		4.0	8.9
Boron (Hot Water Soluble)	М		mg/kg	0.40	< 0.40
Sulphur (Elemental)	М		mg/kg	1.0	1.5
Cyanide (Total)	М		mg/kg	0.50	< 0.50
Sulphide (Easily Liberatable)	N		mg/kg	0.50	8.7
Sulphate (Total)	M	2430	%	0.010	0.024
Arsenic	М	2450	mg/kg	1.0	5.4
Barium	М		mg/kg	10	22
Cadmium	М		mg/kg	0.10	0.85
Chromium	М		mg/kg	1.0	7.1
Molybdenum	М		mg/kg	2.0	< 2.0
Antimony	N		mg/kg	2.0	< 2.0
Copper	М		mg/kg	0.50	12
Mercury	М		mg/kg	0.10	< 0.10
Nickel	М		mg/kg	0.50	20
Lead	М		mg/kg		8.7
Selenium	М		mg/kg	0.20	0.22
Zinc	М		mg/kg	0.50	35
Chromium (Trivalent)	N		mg/kg	1.0	7.1
Chromium (Hexavalent)	N		mg/kg	0.50	< 0.50
Total Organic Carbon	М	2625	%	0.20	0.49
Mineral Oil	N	2670	mg/kg	10	< 10
Aliphatic TPH >C5-C6	N		mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N		mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	М		mg/kg	1.0	< 1.0
Aliphatic TPH >C10-C12	М		mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	М	2680		1.0	< 1.0
Aliphatic TPH >C16-C21	М		mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	М		mg/kg	1.0	< 1.0
Aliphatic TPH >C35-C44	N		mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	N		mg/kg	5.0	< 5.0
Aromatic TPH >C5-C7	N		mg/kg	1.0	< 1.0
Aromatic TPH >C7-C8	N		mg/kg	1.0	< 1.0
Aromatic TPH >C8-C10	М		mg/kg	1.0	< 1.0

Client: Causeway Geotech Ltd			mtest Jo		
Quotation No.: Q20-21063			st Sam		1073480
		Sa	ample Lo		R9CP01
				e Type:	SOIL
			Top Dep		0.50
			Date Sa	mpled:	29-Sep-2020
		Asbestos Lab			
Determinand	Accred.	SOP	Units	LOD	
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		mg/kg	10.0	< 10
Benzene	M	2760	μg/kg	1.0	< 1.0
Toluene	М	2760	μg/kg	1.0	< 1.0
Ethylbenzene	М	2760		1.0	< 1.0
m & p-Xylene	М	2760		1.0	< 1.0
o-Xylene	М	2760		1.0	< 1.0
Methyl Tert-Butyl Ether	М		μg/kg	1.0	< 1.0
Naphthalene	М		mg/kg	0.10	< 0.10
Acenaphthylene	N	-	mg/kg	0.10	< 0.10
Acenaphthene	М		mg/kg	0.10	< 0.10
Fluorene	М		mg/kg	0.10	< 0.10
Phenanthrene	M		mg/kg	0.10	< 0.10
Anthracene	M		mg/kg	0.10	< 0.10
Fluoranthene	М		mg/kg	0.10	< 0.10
Pyrene	М	-	mg/kg	0.10	< 0.10
Benzo[a]anthracene	М		mg/kg	0.10	< 0.10
Chrysene	M		mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	M		mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	М		mg/kg	0.10	< 0.10
Benzo[a]pyrene	М		mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M		mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	N		mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	M		mg/kg	0.10	< 0.10
Coronene	N N		mg/kg	0.10	< 0.10
Total Of 17 PAH's	N		mg/kg	2.0	< 2.0
PCB 28	Ü		mg/kg		< 0.010
PCB 52	Ü		mg/kg	0.010	< 0.010
PCB 90+101	Ü		mg/kg	0.010	< 0.010
PCB 118	Ü		mg/kg		< 0.010
PCB 153	Ü		mg/kg		< 0.010
PCB 138	U		mg/kg		< 0.010
PCB 180	U		mg/kg		< 0.010
1 00 100	U		mg/kg		< 0.010

Client: Causeway Geotech Ltd		Che	mtest Jo	ob No.:	20-26467
Quotation No.: Q20-21063	(Chemte	ple ID.:	1073480	
		Sa	R9CP01		
		Sample Type:			
	Top Depth (m):				0.50
		Date Sampled:			
		Asbestos Lab:			
Determinand	Accred.	SOP	Units	LOD	
Total Phenols	М	2920	mg/kg	0.30	< 0.30

Results - Single Stage WAC

Project: 20-0399D Bus Connects-Greenhills

<u>Greennilis</u>						
20-26467				Landfill \	Naste Acceptanc	e Criteria
1073480					Limits	
					Stable, Non-	
					reactive	
R9CP01					hazardous	Hazardous
0.50				Inert Waste	waste in non-	Waste
				Landfill	hazardous	Landfill
29-Sep-2020					Landfill	
SOP	Accred.	Units				
2625	M	%	0.49	3	5	6
2610	М	%	2.7			10
2760	M	mg/kg	< 0.010	6		
2815	М	mg/kg	< 0.10	1		
2670	M	mg/kg	< 10	500		
2800	N	mg/kg	< 2.0	100		
2010	M		8.9		>6	
2015	N	mol/kg	0.13		To evaluate	To evaluate
		10:1 Eluate	10:1 Eluate	Limit values	for compliance I	eaching test
		mg/l	mg/kg	using B	S EN 12457 at L/S	3 10 l/kg
1450	U	< 0.0010	< 0.050	0.5	2	25
1450	U	0.0054	< 0.50	20	100	300
1450	U	< 0.00010	< 0.010	0.04	1	5
1450	U	< 0.0010	< 0.050	0.5	10	70
1450	U	< 0.0010	< 0.050	2	50	100
1450	U	< 0.00050	< 0.0050	0.01	0.2	2
1450	U	0.0036	< 0.050	0.5	10	30
1450	U	< 0.0010	< 0.050	0.4	10	40
1450	U	< 0.0010	< 0.010	0.5	10	50
1450	U	< 0.0010	< 0.010	0.06	0.7	5
1450	U	< 0.0010	< 0.010	0.1	0.5	7
1450	U	< 0.0010	< 0.50	4	50	200
1220	U	< 1.0	< 10	800	15000	25000
1220	U	< 0.050	< 1.0	10	150	500
1220	U	< 1.0	< 10	1000	20000	50000
1020	N	290	2900	4000	60000	100000
1920	U	< 0.030	< 0.30	1	-	-
	20-26467 1073480 R9CP01 0.50 29-Sep-2020 SOP 2625 2610 2760 2815 2670 2800 2010 2015 1450 1450 1450 1450 1450 1450 1450	20-26467 1073480 R9CP01 0.50 29-Sep-2020 SOP Accred. 2625 M 2610 M 2760 M 2815 M 2670 M 2800 N 2010 M 2015 N 1450 U	20-26467 1073480 R9CP01 0.50 29-Sep-2020 SOP Accred. Units 2625 M % 2610 M % 2760 M mg/kg 2815 M mg/kg 2815 M mg/kg 2800 N mg/kg 2010 M 2015 N mol/kg 10:1 Eluate mg/l 1450 U < 0.0010 1450 U < 0.00050 1450 U < 0.00010 1450 U < 0.00010 1450 U < 0.0010	R9CP01	Record	Control Cont

Solid Information				
Dry mass of test portion/kg	0.090			
Moisture (%)	10			

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	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.
1450	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
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
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.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N–dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	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
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

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- < "less than"
- > "greater than"

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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 45 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: <u>customerservices@chemtest.com</u>



eurofins

Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Chemtest

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-26886-1

Initial Date of Issue: 14-Oct-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 Franey
Stephen McCracken
Stephen Watson
Stuart Abraham
Thomas McAllis

Project 20-0399D Bus Connects Route 9

Quotation No.: Q20-21063 Date Received: 06-Oct-2020

Order No.: Date Instructed: 08-Oct-2020

No. of Samples: 1

Turnaround (Wkdays): 5 Results Due: 14-Oct-2020

Date Approved: 14-Oct-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070

Email: info@chemtest.com

Client: Causeway Geotech Ltd		Chemtest Job N			20-26886
Quotation No.: Q20-21063	(st Sam		1075650
		Sa	ample Lo		R9-CPGS02
				e Type:	SOIL 2.00
		Top Depth (m)			
			Date Sa	ampled:	03-Oct-2020
			Asbest	os Lab:	COVENTRY
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	9.9
pH	U	2010		4.0	8.6
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	< 0.010
Cyanide (Total)	U	2300		0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	24
Cadmium	U	2450	mg/kg	0.10	1.7
Chromium	U	2450	mg/kg	1.0	15
Copper	U	2450	mg/kg	0.50	25
Mercury	U	2450	mg/kg	0.10	0.22
Nickel	U	2450	mg/kg	0.50	60
Lead	U	2450	mg/kg	0.50	37
Zinc	U	2450	mg/kg	0.50	83
Organic Matter	U	2625	%	0.40	< 0.40
Total TPH >C6-C40	U	2670		10	< 10
Naphthalene	U	2700		0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10
Phenanthrene	U	2700	9	0.10	< 0.10
Anthracene	U	2700	0	0.10	< 0.10
Fluoranthene	U	2700	0	0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	U	2700	0	0.10	< 0.10
Benzo[k]fluoranthene	U	2700	0	0.10	< 0.10
Benzo[a]pyrene	U	2700		0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700)	0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	U	2700) י	0.10	< 0.10
Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700		2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	рН	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
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.
2450	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.
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
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)
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
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- I/S Insufficient Sample
- U/S Unsuitable Sample
- N/E not evaluated
 - < "less than"
 - > "greater than"

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 45 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: <u>customerservices@chemtest.com</u>



eurofins Chemtest

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-27122-1

Initial Date of Issue: 15-Oct-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

Colm Hurley
Darren O'Mahony
Gabriella Horan
Joe Gervin
John Cameron
Lucy Newland
Martin Gardiner
Matthew Gilbert
Neil Haggan
Paul Dunlop
Sean Ross
Stephen Francy

Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis

Project 20-0399D Bus Connects Route 9

Quotation No.: Q20-21063 Date Received: 08-Oct-2020

Order No.: Date Instructed: 09-Oct-2020

No. of Samples: 1

Turnaround (Wkdays): 5 Results Due: 15-Oct-2020

Date Approved: 15-Oct-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070

Email: info@chemtest.com

Client: Causeway Geotech Ltd	Chemtest Job No			ob No.:	20-27122
Quotation No.: Q20-21063		Chemte	st Sam	ple ID.:	1077012
		Sa	ample Lo	cation:	R9-CP04
			Sample	е Туре:	SOIL
	Top Depth (m)			oth (m):	1.50
			Date Sa	impled:	05-Oct-2020
			Asbest	os Lab:	COVENTRY
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	19
pH	U	2010		4.0	8.3
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	1.2
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.10
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	25
Cadmium	U	2450	mg/kg	0.10	1.8
Chromium	U	2450	mg/kg	1.0	23
Copper	U	2450	mg/kg	0.50	65
Mercury	U	2450	mg/kg	0.10	0.24
Nickel	U	2450	mg/kg	0.50	60
Lead	U	2450	mg/kg	0.50	87
Zinc	U	2450	mg/kg	0.50	140
Organic Matter	U	2625	%	0.40	2.2
Total TPH >C6-C40	U	2670	mg/kg	10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10
Pyrene	U	2700)	0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10
Chrysene	U	2700	0	0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]pyrene	U	2700	,	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700)	0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700		0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10
Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700)	2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	рН	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
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.
2450	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.
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
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)
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.

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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 45 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: <u>customerservices@chemtest.com</u>



eurofins Chemtest

Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-27377-1

Initial Date of Issue: 19-Oct-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 Franey
Stephen McCracken
Stephen Watson
Stuart Abraham
Thomas McAllis

Project 20-0399D Bus Connects Route 9

Quotation No.: Q20-21063 Date Received: 09-Oct-2020

Order No.: Date Instructed: 13-Oct-2020

No. of Samples: 1

Turnaround (Wkdays): 5 Results Due: 19-Oct-2020

Date Approved: 19-Oct-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070

Email: info@chemtest.com

Client: Causeway Geotech Ltd		Che	mtest Jo	ob No.:	20-27377
Quotation No.: Q20-21063		Chemte	st Sam	ple ID.:	1078413
		Sa	ample Lo	cation:	R9-CP08
			Sample	е Туре:	SOIL
			Top Dep	oth (m):	1.50
			Date Sa	impled:	07-Oct-2020
			Asbest	os Lab:	COVENTRY
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	11
pH	U	2010		4.0	8.6
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	1.7
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.13
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	25
Cadmium	U	2450	mg/kg	0.10	2.5
Chromium	U	2450	mg/kg	1.0	19
Copper	U	2450	mg/kg	0.50	32
Mercury	U	2450	mg/kg	0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	60
Lead	U	2450	mg/kg	0.50	54
Zinc	U	2450	mg/kg	0.50	86
Organic Matter	U	2625	%	0.40	0.67
Total TPH >C6-C40	U	2670	mg/kg	10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10
Pyrene	U	2700)	0.10	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10
Chrysene	U	2700	0	0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10
Benzo[a]pyrene	U	2700	,	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700)	0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700		0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10
Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700)	2.0	< 2.0
Total Phenols	U	2920	mg/kg	0.30	< 0.30

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	рН	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
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.
2450	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.
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
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)
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"

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

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eurofins Chemtest

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-27524-1

Initial Date of Issue: 19-Oct-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 McAllis

Project 20-0399D Bus Connects Route 9

Quotation No.: Q20-21063 Date Received: 12-Oct-2020

Order No.: Date Instructed: 13-Oct-2020

No. of Samples: 6

Turnaround (Wkdays): 5 Results Due: 19-Oct-2020

Date Approved: 19-Oct-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Results - Leachate

Client: Causeway Geotech Ltd		Chemtest Job No.:			20-27524	20-27524	
Quotation No.: Q20-21063		Chemtest Sample ID.:					1079230
		Sample Location:					TP09
		Sample Type:					SOIL
		Top Depth (m):					1.00
				Date Sa	ampled:	08-Oct-2020	09-Oct-2020
Determinand	Accred.	Accred. SOP Type Units LOD					
Ammonium	U	U 1220 10:1 mg/l 0.050					0.066
Ammonium	N	N 1220 10:1 mg/kg 0.10					0.78

Client: Causeway Geotech Ltd			mtest Jo		20-27524	20-27524	20-27524	20-27524	20-27524	20-27524
Quotation No.: Q20-21063			est Sam	•	1079222	1079225	1079227	1079230	1079232	1079240
		Sa	ample Lo	ocation:	TP04	TP05	TP06	TP09	TP09	TP11
				e Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Dep	oth (m):	1.50	1.00	0.50	1.00	2.00	1.00
			Date Sa	ampled:	08-Oct-2020	08-Oct-2020	08-Oct-2020	09-Oct-2020	09-Oct-2020	08-Oct-202
			Asbest	os Lab:	COVENTRY	COVENTRY	COVENTRY	DURHAM	COVENTRY	COVENTR'
Determinand	Accred.	SOP	Units	LOD						
ACM Type	U	2192		N/A	-	-	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbesto Detected				
ACM Detection Stage	U	2192		N/A	-	-	-	-	-	-
Moisture	N	2030	%	0.020	10	13	9.5	10	23	13
На	М	2010		4.0	8.7	8.6	8.5	8.8	8.3	8.7
Boron (Hot Water Soluble)	М	2120	mg/kg	0.40	0.67	0.44	0.48	0.72	1.5	0.84
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010		0.13		0.24	< 0.010
Sulphur (Elemental)	M	2180	mg/kg	1.0		3.7	21.0	7.3		
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50		13		9.9		
Sulphate (Total)	M	2430	%	0.010		0.071		0.13		
Arsenic	M	2450	mg/kg	1.0	14	18	35	25	86	21
Barium	M	2450	mg/kg	10	1-7	80	- 00	350	00	
Cadmium	M	2450	mg/kg	0.10	2.2	1.4	1.8	1.4	1.2	1.9
Chromium	M	2450	mg/kg	1.0	18	17	21	17	81	1.0
Molybdenum	M	2450	mg/kg	2.0	10	2.1	21	4.6	01	15
Antimony	N	2450	mg/kg	2.0		< 2.0		3.8		
Copper	M	2450	mg/kg	0.50	25	30	38	61	280	47
Mercury	M	2450	mg/kg	0.10	< 0.10	0.20	0.25	0.43	0.51	0.37
Nickel	M	2450	mg/kg	0.50	40	37	46	44	120	43
Lead	M	2450	mg/kg	0.50	36	92	90	130	710	120
Selenium	M	2450	mg/kg	0.20	30	0.36	90	0.34	710	120
Zinc	M	2450	mg/kg	0.50	95	85	280	340	570	120
Chromium (Trivalent)	N	2490		1.0	95	17	200	17	370	120
Chromium (Hexavalent)	N	2490	mg/kg mg/kg	0.50		< 0.50		< 0.50		
Organic Matter	M	2625	%	0.40	1.7	₹ 0.50	2.8	< 0.50	19	4.1
Total Organic Carbon	M	2625	%	0.40	1.7	1.9	2.0	3.3	19	4.1
<u> </u>	N			10		< 10		3.3 24		
Mineral Oil Total TPH >C6-C40	M	2670 2670	mg/kg	10	- 10	< 10	55	24	960	60
Aliphatic TPH >C5-C6	N N		mg/kg		< 10	- 10	55	-110	860	62
•	N N	2680	mg/kg	1.0		< 1.0		< 1.0		
Aliphatic TPH > C6-C8		2680	mg/kg	1.0		< 1.0		< 1.0		
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0		< 1.0		6.2		
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0		< 1.0		2.3		
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0		< 1.0		1.4		
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0		< 1.0		1.2		
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0		< 1.0		11		
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0		< 1.0		1.9		
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0		< 5.0		24		

Client: Causeway Geotech Ltd			mtest Jo		20-27524	20-27524	20-27524	20-27524	20-27524	20-27524
Quotation No.: Q20-21063	(Chemte	est Sam	ple ID.:	1079222	1079225	1079227	1079230	1079232	1079240
		Sa	ample Lo		TP04	TP05	TP06	TP09	TP09	TP11
				e Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Dep	oth (m):	1.50	1.00	0.50	1.00	2.00	1.00
			Date Sa	ampled:	08-Oct-2020	08-Oct-2020	08-Oct-2020	09-Oct-2020	09-Oct-2020	08-Oct-2020
			Asbest	os Lab:	COVENTRY	COVENTRY	COVENTRY	DURHAM	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD						
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		
Aromatic TPH >C8-C10	М	2680	mg/kg	1.0		< 1.0		1.2		
Aromatic TPH >C10-C12	М	2680	mg/kg	1.0		< 1.0		1.3		
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0		< 1.0		2.2		
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0		< 1.0		5.3		
Aromatic TPH >C21-C35	М	2680	mg/kg	1.0		< 1.0		57		
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0		< 1.0		3.7		
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0		< 5.0		71		
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0		< 10		94		
Naphthalene	М	2700	mg/kg	0.10	< 0.10		0.32		< 0.10	< 0.10
Acenaphthylene	М	2700	mg/kg	0.10	< 0.10		0.33		< 0.10	< 0.10
Acenaphthene	М	2700	mg/kg	0.10	< 0.10		1.3		< 0.10	< 0.10
Fluorene	М	2700	mg/kg	0.10	< 0.10		1.4		< 0.10	< 0.10
Phenanthrene	М	2700	mg/kg	0.10	< 0.10		7.7		< 0.10	0.88
Anthracene	М	2700	mg/kg	0.10	< 0.10		2.7		< 0.10	0.17
Fluoranthene	М	2700	mg/kg	0.10	< 0.10		11		1.6	1.6
Pyrene	М	2700	mg/kg	0.10	< 0.10		10		2.8	1.9
Benzo[a]anthracene	М	2700	mg/kg	0.10	< 0.10		4.9		1.6	0.97
Chrysene	М	2700	mg/kg	0.10	< 0.10		4.3		1.5	0.87
Benzo[b]fluoranthene	М	2700	mg/kg	0.10	< 0.10		6.2		3.7	1.6
Benzo[k]fluoranthene	М	2700	mg/kg	0.10	< 0.10		2.8		1.8	0.71
Benzo[a]pyrene	М	2700	mg/kg	0.10	< 0.10		5.3		3.0	1.2
Indeno(1,2,3-c,d)Pyrene	М	2700	mg/kg	0.10	< 0.10		3.1		2.2	0.78
Dibenz(a,h)Anthracene	М	2700	mg/kg	0.10	< 0.10		1.9		1.9	0.50
Benzo[g,h,i]perylene	М	2700	mg/kg	0.10	< 0.10		3.1		2.6	0.81
Coronene	N	2700	mg/kg	0.10	< 0.10		< 0.10		< 0.10	< 0.10
Total Of 17 PAH's	N	2700	mg/kg	2.0	< 2.0		66		23	12
Benzene	М	2760	μg/kg	1.0		< 1.0		< 1.0		
Toluene	М	2760	μg/kg	1.0		< 1.0		< 1.0		
Ethylbenzene	М	2760	μg/kg	1.0		< 1.0		< 1.0		
m & p-Xylene	М	2760	µg/kg	1.0		< 1.0		< 1.0		
o-Xylene	М	2760	μg/kg	1.0		< 1.0		< 1.0		
Methyl Tert-Butyl Ether	М	2760	μg/kg	1.0		< 1.0		< 1.0		
Naphthalene	M	2800	mg/kg	0.10		< 0.10		0.16		
Acenaphthylene	N	2800	mg/kg	0.10		< 0.10		0.10		
Acenaphthene	M	2800	mg/kg	0.10		< 0.10		0.11		
Fluorene	M	2800	mg/kg	0.10		< 0.10		0.13		
Phenanthrene	M	2800	mg/kg	0.10		< 0.10		1.4		

Client: Causeway Geotech Ltd		Che	mtest Jo	ob No.:	20-27524	20-27524	20-27524	20-27524	20-27524	20-27524
Quotation No.: Q20-21063	(Chemte	st Sam	ple ID.:	1079222	1079225	1079227	1079230	1079232	1079240
		Sa	ample Lo	ocation:	TP04	TP05	TP06	TP09	TP09	TP11
			Sampl	е Туре:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
			Top Dep	oth (m):	1.50	1.00	0.50	1.00	2.00	1.00
			Date Sa	ampled:	08-Oct-2020	08-Oct-2020	08-Oct-2020	09-Oct-2020	09-Oct-2020	08-Oct-2020
			Asbest	os Lab:	COVENTRY	COVENTRY	COVENTRY	DURHAM	COVENTRY	COVENTRY
Determinand	Accred.	SOP	Units	LOD						
Anthracene	M	2800	mg/kg	0.10		< 0.10		0.34		
Fluoranthene	M	2800	mg/kg	0.10		0.19		3.7		
Pyrene	M	2800	mg/kg	0.10		0.17		3.3		
Benzo[a]anthracene	M	2800	mg/kg	0.10		0.18		2.4		
Chrysene	M	2800	mg/kg	0.10		0.18		2.1		
Benzo[b]fluoranthene	M		mg/kg	0.10		0.27		3.3		
Benzo[k]fluoranthene	M	2800	mg/kg	0.10		0.19		1.4		
Benzo[a]pyrene	M	2800	mg/kg	0.10		0.26		3.2		
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10		0.43		3.2		
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10		0.41		0.67		
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10		0.43		2.6		
Coronene	N	2800	mg/kg	0.10		< 0.10		< 0.10		
Total Of 17 PAH's	N	2800	mg/kg	2.0		2.7		28		
PCB 28	U	2815	mg/kg	0.010		< 0.010		< 0.010		
PCB 52	U	2815	mg/kg	0.010		< 0.010		< 0.010		
PCB 90+101	U		mg/kg			< 0.010		< 0.010		
PCB 118	U	2815	mg/kg	0.010		< 0.010		< 0.010		
PCB 153	U		mg/kg			< 0.010		< 0.010		
PCB 138	U		mg/kg			< 0.010		< 0.010		
PCB 180	U	2815	mg/kg	0.010		< 0.010		< 0.010		
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10		< 0.10		< 0.10		
Total Phenols	M	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

Results - Single Stage WAC

Project: 20-0399D Bus Connects Route 9

Chemtest Job No:	20-27524				l andfill \	Waste Acceptanc	o Critoria
Chemtest Sample ID:	1079225				Landilli	Limits	e Ontena
Sample Ref:	1073223					Stable, Non-	
Sample ID:						reactive	
Sample Location:	TP05					hazardous	Hazardous
Top Depth(m):	1.00				Inert Waste	waste in non-	Waste
Bottom Depth(m):	1.00				Landfill	hazardous	Landfill
Sampling Date:	08-Oct-2020				Lanum	Landfill	Lanum
Determinand	SOP	Accred.	Units			Lanum	
Total Organic Carbon	2625	M	%	1.9	3	5	6
ž .	2610	M	%	5.3			10
Loss On Ignition Total BTEX	2760	M		< 0.010	6		
			mg/kg		1		
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	·		
TPH Total WAC (Mineral Oil)	2670	M	mg/kg	< 10	500		
Total (Of 17) PAH's	2800	N	mg/kg	2.7	100		
pH	2010	M		8.6		>6	
Acid Neutralisation Capacity	2015	N	mol/kg	0.018		To evaluate	To evaluate
Eluate Analysis			10:1 Eluate	10:1 Eluate		for compliance I	•
			mg/l	mg/kg		S EN 12457 at L/S	
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0082	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	0.0014	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0021	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.29	2.9	10	150	500
Sulphate	1220	U	3.1	31	1000	20000	50000
Total Dissolved Solids	1020	N	150	1500	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	6.2	62	500	800	1000

Solid Information						
Dry mass of test portion/kg	0.090					
Moisture (%)	13					

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 - Single Stage WAC

Project: 20-0399D Bus Connects Route 9

Chemtest Job No:	20-27524				L andfill \	Naste Acceptanc	o Critoria
Chemtest Sample ID:	1079230				Landilli	Limits	e Ontena
Sample Ref:	1073230					Stable, Non-	
Sample ID:						reactive	
Sample Location:	TP09					hazardous	Hazardous
Top Depth(m):	1.00				Inert Waste	waste in non-	Waste
Bottom Depth(m):	1.00				Landfill	hazardous	Landfill
Sampling Date:	09-Oct-2020				Lanum	Landfill	Lanum
Determinand	SOP	Accred.	Units			Landini	
Total Organic Carbon	2625	M	%	3.3	3	5	6
Loss On Ignition	2610	M	%	6.4			10
Total BTEX	2760	M	mg/kg	< 0.010	6		
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1		
TPH Total WAC (Mineral Oil)	2670	M	mg/kg	94	500		
1	2800	N		28	100		
Total (Of 17) PAH's pH	2010	M	mg/kg	8.8		 >6	
		***	1.0				
Acid Neutralisation Capacity	2015	N	mol/kg	0.012		To evaluate	To evaluate
Eluate Analysis			10:1 Eluate	10:1 Eluate		for compliance I	•
			mg/l	mg/kg		S EN 12457 at L/S	
Arsenic	1450	U	0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.033	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	0.0013	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.012	0.12	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	0.0019	0.019	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0067	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.28	2.8	10	150	500
Sulphate	1220	U	5.6	56	1000	20000	50000
Total Dissolved Solids	1020	N	150	1500	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	4.4	< 50	500	800	1000

Solid Information						
Dry mass of test portion/kg	0.090					
Moisture (%)	10					

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	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.
1450	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
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
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.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N–dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	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

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"

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 45 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: <u>customerservices@chemtest.com</u>



eurofins Chemtest

Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-27739-1

Initial Date of Issue: 02-Nov-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey

Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis

Project 20-0399D Bus Connects Route 9

Quotation No.: Q20-21063 Date Received: 14-Oct-2020

Order No.: R8765/0005 **Date Instructed:** 28-Oct-2020

No. of Samples: 1

Turnaround (Wkdays): 5 Results Due: 03-Nov-2020

Date Approved: 02-Nov-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Results - Leachate

Client: Causeway Geotech Ltd			Che	mtest Jo	ob No.:	20-27739
Quotation No.: Q20-21063		Chemtest Sample ID.:				
		Sample Location:				
		Sample Type:				
		Top Depth (m):				
				Date Sa	ampled:	12-Oct-2020
Determinand	Accred.	SOP	Туре	Units	LOD	
Ammonium	U	1220	10:1	mg/l	0.050	< 0.050
Ammonium	N	1220	10:1	mg/kg	0.10	0.41

Client: Causeway Geotech Ltd		Chemtest Job No.:					
Quotation No.: Q20-21063		Chemtest Sample ID.:					
		Sample Location:					
				e Type:	SOIL		
			Top Dep	oth (m):	1.50		
			Date Sa	ampled:	12-Oct-2020		
			Asbest	os Lab:	COVENTRY		
Determinand	Accred.	SOP	Units	LOD			
ACM Type	U	2192		N/A	-		
Asbestos Identification	U	2192		N/A	No Asbestos Detected		
ACM Detection Stage	U	2192		N/A	-		
Moisture	N	2030	%	0.020	11		
рН	M	2010		4.0	9.3		
Boron (Hot Water Soluble)	М		mg/kg	0.40	0.42		
Sulphur (Elemental)	М	2180		1.0	1.9		
Cyanide (Total)	М	2300		0.50	[B] < 0.50		
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	7.9		
Sulphate (Total)	М	2430	%	0.010	0.089		
Arsenic	М	2450	mg/kg	1.0	20		
Barium	М	2450	,	10	53		
Cadmium	M		mg/kg	0.10	1.9		
Chromium	M		mg/kg	1.0	15		
Molybdenum	M	2450	J	2.0	3.6		
Antimony	N	2450			< 2.0		
Copper	M	2450		0.50	28		
Mercury	M	2450	mg/kg	0.10	< 0.10		
Nickel	M	2450		0.50	48		
Lead	M	2450			19		
Selenium	M		mg/kg	0.20	0.41		
Zinc	M		mg/kg	0.50	76		
Chromium (Trivalent)	N	2490		1.0	15		
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50		
Total Organic Carbon	M	2625	111g/kg %	0.20	0.51		
Mineral Oil	N	2670	mg/kg	10	< 10		
Aliphatic TPH >C5-C6	N	2680		1.0	[B] < 1.0		
Aliphatic TPH >C6-C8	N	2680)	1.0	[B] < 1.0		
Aliphatic TPH >C8-C10	M		mg/kg	1.0	[B] < 1.0		
Aliphatic TPH >C10-C12	M		mg/kg	1.0	[B] < 1.0		
Aliphatic TPH >C12-C16	M		mg/kg	1.0	[B] < 1.0		
Aliphatic TPH >C16-C21	M	2680		1.0	[B] < 1.0		
Aliphatic TPH >C21-C35	M		mg/kg	1.0	[B] < 1.0		
Aliphatic TPH >C35-C44	N	2680		1.0	[B] < 1.0		
Total Aliphatic Hydrocarbons	N	2680		5.0	[B] < 1.0		
Aromatic TPH >C5-C7	N	2680		1.0	[B] < 5.0		
Aromatic TPH >C5-C7 Aromatic TPH >C7-C8	N N			1.0	[B] < 1.0		
		2680)				
Aromatic TPH >C8-C10	M	∠ხ80	mg/kg	1.0	[B] < 1.0		

Client: Causeway Geotech Ltd		Chemtest Job No.:					
Quotation No.: Q20-21063		Chemtest Sample ID.:					
		Sample Location:					
				e Type:	SOIL		
			Top Dep		1.50		
			Date Sa	mpled:	12-Oct-2020		
				os Lab:	COVENTRY		
Determinand	Accred.	SOP	Units	LOD			
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	[B] < 1.0		
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	[B] < 1.0		
Aromatic TPH >C16-C21	U		mg/kg	1.0	[B] < 1.0		
Aromatic TPH >C21-C35	М	2680	mg/kg	1.0	[B] < 1.0		
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	[B] < 1.0		
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	[B] < 5.0		
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	[B] < 10		
Benzene	M	2760	μg/kg	1.0	[B] < 1.0		
Toluene	M	2760	μg/kg	1.0	[B] < 1.0		
Ethylbenzene	M	2760		1.0	[B] < 1.0		
m & p-Xylene	М	2760		1.0	[B] < 1.0		
o-Xylene	М	2760		1.0	[B] < 1.0		
Methyl Tert-Butyl Ether	М		μg/kg	1.0	[B] < 1.0		
Naphthalene	М		mg/kg	0.10	< 0.10		
Acenaphthylene	N		mg/kg	0.10	< 0.10		
Acenaphthene	М		mg/kg	0.10	< 0.10		
Fluorene	М		mg/kg	0.10	< 0.10		
Phenanthrene	М		mg/kg	0.10	< 0.10		
Anthracene	М		mg/kg	0.10	< 0.10		
Fluoranthene	М		mg/kg	0.10	< 0.10		
Pyrene	М		mg/kg	0.10	< 0.10		
Benzo[a]anthracene	М		mg/kg	0.10	< 0.10		
Chrysene	М		mg/kg	0.10	< 0.10		
Benzo[b]fluoranthene	М		mg/kg	0.10	< 0.10		
Benzo[k]fluoranthene	М		mg/kg	0.10	< 0.10		
Benzo[a]pyrene	М		mg/kg	0.10	< 0.10		
Indeno(1,2,3-c,d)Pyrene	М		mg/kg	0.10	< 0.10		
Dibenz(a,h)Anthracene	N		mg/kg	0.10	< 0.10		
Benzo[g,h,i]perylene	M		mg/kg	0.10	< 0.10		
Coronene	N		mg/kg	0.10	< 0.10		
Total Of 17 PAH's	N		mg/kg	2.0	< 2.0		
PCB 28	U		mg/kg		< 0.010		
PCB 52	U		mg/kg	0.010	< 0.010		
PCB 90+101	Ü		mg/kg	0.010	< 0.010		
PCB 118	Ü		mg/kg		< 0.010		
PCB 153	Ü		mg/kg		< 0.010		
PCB 138	Ü		mg/kg		< 0.010		
PCB 180	U		mg/kg		< 0.010		
Total PCBs (7 Congeners)	U		mg/kg		< 0.10		

Client: Causeway Geotech Ltd		Che	mtest Jo	b No.:	20-27739		
Quotation No.: Q20-21063	(Chemtest Sample ID.:					
		Sample Location:					
		Sample Type:					
		Top Depth (m):					
		Date Sampled:					
			Asbest	os Lab:	COVENTRY		
Determinand	Accred.	SOP	Units	LOD			
Total Phenols	М	2920	mg/kg	0.30	< 0.30		

Results - Single Stage WAC

Project: 20-0399D Bus Connects Route 9

Chemtest Job No:	20-27739				Landfill \	Waste Acceptanc	e Criteria	
Chemtest Sample ID:	1080543				Limits			
Sample Ref:						Stable, Non-		
Sample ID:						reactive		
Sample Location:	R9-CP05					hazardous	Hazardous	
Top Depth(m):	1.50				Inert Waste	waste in non-	Waste	
Bottom Depth(m):					Landfill	hazardous	Landfill	
Sampling Date:	12-Oct-2020					Landfill		
Determinand	SOP	Accred.	Units					
Total Organic Carbon	2625	М	%	0.51	3	5	6	
Loss On Ignition	2610	М	%	2.1			10	
Total BTEX	2760	М	mg/kg	[B] < 0.010	6			
Total PCBs (7 Congeners)	2815	М	mg/kg	< 0.10	1			
TPH Total WAC (Mineral Oil)	2670	М	mg/kg	[B] < 10	500			
Total (Of 17) PAH's	2800	N	mg/kg	< 2.0	100			
pH	2010	М		9.3		>6		
Acid Neutralisation Capacity	2015	N	mol/kg	0.049		To evaluate	To evaluate	
Eluate Analysis			10:1 Eluate	10:1 Eluate	Limit values	for compliance I	eaching test	
			mg/l	mg/kg	using B	S EN 12457 at L/S	6 10 l/kg	
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25	
Barium	1450	U	0.0010	< 0.50	20	100	300	
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5	
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70	
Copper	1450	U	< 0.0010	< 0.050	2	50	100	
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2	
Molybdenum	1450	U	0.0057	0.057	0.5	10	30	
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40	
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50	
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5	
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7	
Zinc	1450	U	< 0.0010	< 0.50	4	50	200	
Chloride	1220	U	< 1.0	< 10	800	15000	25000	
Fluoride	1220	U	0.32	3.2	10	150	500	
Sulphate	1220	U	11	110	1000	20000	50000	
Total Dissolved Solids	1020	N	72	710	4000	60000	100000	
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-	
Dissolved Organic Carbon	1610	U	4.2	< 50	500	800	1000	

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	11

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.

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1080543			R9-CP05	12-Oct-2020	В	Amber Glass 250ml
1080543			R9-CP05	12-Oct-2020	В	Amber Glass 60ml
1080543			R9-CP05	12-Oct-2020	В	Plastic Tub 500g

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	pH	pH Meter
1020	Electrical Conductivity and	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.
1450	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
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
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.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N–dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	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	
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	

Report Information

Key

- U UKAS accredited
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- 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"

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 45 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: <u>customerservices@chemtest.com</u>



eurofins

Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Chemtest

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-27893-1

Initial Date of Issue: 20-Oct-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 McAllis

Project 20-0399D Bus Connects Route 9

Quotation No.: Q20-21063 Date Received: 15-Oct-2020

Order No.: Date Instructed: 15-Oct-2020

No. of Samples: 1

Turnaround (Wkdays): 5 Results Due: 21-Oct-2020

Date Approved: 20-Oct-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070

Email: info@chemtest.com

Client: Causeway Geotech Ltd		20-27893				
Quotation No.: Q20-21063		Chemte	st Sam	ple ID.:	1081298	
		Sample Location:				
			Sampl	е Туре:	SOIL	
			Top Dep	oth (m):	0.50	
			Date Sa	ampled:	08-Oct-2020	
			Asbest	os Lab:	COVENTRY	
Determinand	Accred.	SOP	Units	LOD		
ACM Type	U	2192		N/A	-	
Asbestos Identification	U	2192		N/A	No Asbestos Detected	
ACM Detection Stage	U	2192		N/A	-	
Moisture	N	2030	%	0.020	7.1	
рН	U	2010		4.0	8.8	
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.52	
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	
Arsenic	U	2450	mg/kg	1.0	23	
Cadmium	U	2450	mg/kg	0.10	1.3	
Chromium	U	2450	mg/kg	1.0	30	
Copper	U	2450	mg/kg	0.50	36	
Mercury	U	2450	mg/kg	0.10	< 0.10	
Nickel	U	2450	mg/kg	0.50	47	
Lead	U	2450	mg/kg	0.50	51	
Zinc	U	2450)	0.50	110	
Organic Matter	U	2625	%	0.40	1.0	
Total TPH >C6-C40	U	2670	mg/kg	10	< 10	
Naphthalene	U	2700	mg/kg	0.10	< 0.10	
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	
Acenaphthene	U	2700)	0.10	< 0.10	
Fluorene	U	2700	mg/kg	0.10	< 0.10	
Phenanthrene	U	2700	ֹ	0.10	< 0.10	
Anthracene	U	2700	mg/kg	0.10	< 0.10	
Fluoranthene	U	2700	mg/kg	0.10	0.28	
Pyrene	U	2700)	0.10	0.31	
Benzo[a]anthracene	U	2700		0.10	< 0.10	
Chrysene	U	2700	0	0.10	< 0.10	
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	
Benzo[a]pyrene	U	2700	,	0.10	< 0.10	
Indeno(1,2,3-c,d)Pyrene	U	2700	,	0.10	< 0.10	
Dibenz(a,h)Anthracene	U	2700	0	0.10	< 0.10	
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	
Coronene	N	2700	mg/kg	0.10	< 0.10	
Total Of 17 PAH's	N	2700)	2.0	< 2.0	
Total Phenols	U	2920	mg/kg	0.30	< 0.30	

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	рН	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
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.
2450	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.
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
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)
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.

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 - > "greater than"

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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

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eurofins Chemtest

Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-29281-1

Initial Date of Issue: 04-Nov-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

Colm Hurley
Darren O'Mahony
Gabriella Horan
Joe Gervin
John Cameron
Lucy Newland
Martin Gardiner
Matthew Gilbert
Neil Haggan
Paul Dunlop
Sean Ross
Stephen Francy

Stephen Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis

Project 20-0399D Bus Connects Route 9

Quotation No.: Q20-21063 Date Received: 29-Oct-2020

Order No.: Date Instructed: 29-Oct-2020

No. of Samples: 1

Turnaround (Wkdays): 5 Results Due: 04-Nov-2020

Date Approved: 04-Nov-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Results - Leachate

Client: Causeway Geotech Ltd			Che	mtest Jo	ob No.:	20-29281
Quotation No.: Q20-21063		Chemtest Sample ID.:				
		Sample Location:				
		Sample Type:				
		Top Depth (m):				
				Date Sa	ampled:	26-Oct-2020
Determinand	Accred.	SOP	Type	Units	LOD	
Ammonium	U	1220	10:1	mg/l	0.050	0.051
Ammonium	N	1220	10:1	mg/kg	0.10	0.65

Client: Causeway Geotech Ltd		Chemtest Job No.:						
Quotation No.: Q20-21063		Chemtest Sample ID.:						
		Sample Location:						
				e Type:	SOIL			
			Top Dep	oth (m):	0.50			
			Date Sa	mpled:	26-Oct-2020			
			Asbest	os Lab:	COVENTRY			
Determinand	Accred.	SOP	Units	LOD				
ACM Type	U	2192		N/A	=			
Asbestos Identification	U	2192		N/A	No Asbestos Detected			
ACM Detection Stage	U	2192		N/A	-			
Moisture	N	2030	%	0.020	8.5			
рН	М	2010		4.0	8.9			
Boron (Hot Water Soluble)	М		mg/kg	0.40	0.62			
Sulphur (Elemental)	М	2180		1.0	6.0			
Cyanide (Total)	М	2300		0.50	< 0.50			
Sulphide (Easily Liberatable)	N	2325		0.50	12			
Sulphate (Total)	М	2430	%	0.010	0.22			
Arsenic	М	2450	mg/kg	1.0	19			
Barium	М	2450	,	10	88			
Cadmium	M		mg/kg	0.10	1.4			
Chromium	M		mg/kg	1.0	16			
Molybdenum	M	2450)	2.0	3.4			
Antimony	N		mg/kg	2.0	2.4			
Copper	M		mg/kg	0.50	44			
Mercury	M	2450	mg/kg	0.10	0.27			
Nickel	M	2450		0.50	38			
Lead	M	2450		0.50	110			
Selenium	M		mg/kg	0.20	0.54			
Zinc	М		mg/kg	0.50	120			
Chromium (Trivalent)	N	2490		1.0	16			
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50			
Total Organic Carbon	M	2625	%	0.20	1.6			
Mineral Oil	N	2670	mg/kg	10	< 10			
Aliphatic TPH >C5-C6	N	2680		1.0	< 1.0			
Aliphatic TPH >C6-C8	N	2680)	1.0	< 1.0			
Aliphatic TPH >C8-C10	M		mg/kg	1.0	< 1.0			
Aliphatic TPH >C10-C12	M		mg/kg	1.0	< 1.0			
Aliphatic TPH >C12-C16	M		mg/kg	1.0	< 1.0			
Aliphatic TPH >C16-C21	M	2680		1.0	< 1.0			
Aliphatic TPH >C21-C35	M		mg/kg	1.0	< 1.0			
Aliphatic TPH >C35-C44	N	2680		1.0	< 1.0			
Total Aliphatic Hydrocarbons	N	2680		5.0	< 5.0			
Aromatic TPH >C5-C7	N	2680		1.0	< 1.0			
				1.0	< 1.0			
Aromatic TPH >C7-C8	N	2680	[[]()/K()	1.0				

Client: Causeway Geotech Ltd		Chemtest Job No.:						
Quotation No.: Q20-21063		Chemtest Sample ID.:						
		Sample Location:						
		Sample Type:						
			Top Dep		0.50			
			Date Sa	ampled:	26-Oct-2020			
			Asbest	os Lab:	COVENTRY			
Determinand	Accred.	SOP	Units	LOD				
Aromatic TPH >C10-C12	М	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	М	2680	mg/kg	1.0	< 1.0			
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0			
Total Aromatic Hydrocarbons	N	2680		5.0	< 5.0			
Total Petroleum Hydrocarbons	N		mg/kg		< 10			
Benzene	М	2760)	1.0	< 1.0			
Toluene	М	2760		1.0	< 1.0			
Ethylbenzene	М	2760		1.0	< 1.0			
m & p-Xylene	М	2760	μg/kg	1.0	< 1.0			
o-Xylene	М	2760		1.0	< 1.0			
Methyl Tert-Butyl Ether	M	2760		1.0	< 1.0			
Naphthalene	M		mg/kg		< 0.10			
Acenaphthylene	N		mg/kg		< 0.10			
Acenaphthene	M		mg/kg		< 0.10			
Fluorene	M		mg/kg		< 0.10			
Phenanthrene	M	2800			0.64			
Anthracene	M	2800			0.13			
Fluoranthene	M	2800			1.5			
Pyrene	M		mg/kg		1.3			
Benzo[a]anthracene	M		mg/kg		< 0.10			
Chrysene	M		mg/kg		< 0.10			
Benzo[b]fluoranthene	M	2800			< 0.10			
Benzo[k]fluoranthene	M		mg/kg		< 0.10			
Benzo[a]pyrene	M		mg/kg		< 0.10			
Indeno(1,2,3-c,d)Pyrene	M	2800			< 0.10			
Dibenz(a,h)Anthracene	N	2800			< 0.10			
Benzo[g,h,i]perylene	M		mg/kg	0.10	< 0.10			
Coronene	N N		mg/kg		< 0.10			
Total Of 17 PAH's	N N	2800			3.6			
PCB 28	U		mg/kg		< 0.010			
PCB 52	U		mg/kg		< 0.010			
PCB 90+101	U		mg/kg					
PCB 118	U		mg/kg		< 0.010 < 0.010			
PCB 118								
PCB 138	U		mg/kg		< 0.010			
			mg/kg		< 0.010			
PCB 180	U		mg/kg		< 0.010			
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10			

Client: Causeway Geotech Ltd		Che	mtest Jo	ob No.:	20-29281			
Quotation No.: Q20-21063	(Chemtest Sample ID.:						
		Sample Location:						
		Sample Type:						
			Top Dep	oth (m):	0.50			
			Date Sa	ampled:	26-Oct-2020			
			Asbest	os Lab:	COVENTRY			
Determinand	Accred.							
Total Phenols	М	M 2920 mg/kg 0.30 < 0.3						

Results - Single Stage WAC

Project: 20-0399D Bus Connects Route 9

Project: 20-0399D Bus Connects I					1leur v	N1- A	- Oultania
Chemtest Job No:	20-29281				Landilli	Waste Acceptanc	e Criteria
Chemtest Sample ID:	1088392					Limits	1
Sample Ref:						Stable, Non-	
Sample ID:	TDOT					reactive	
Sample Location:	TP07					hazardous	Hazardous
Top Depth(m):	0.50				Inert Waste	waste in non-	Waste
Bottom Depth(m):					Landfill	hazardous	Landfill
Sampling Date:	26-Oct-2020					Landfill	
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	1.6	3	5	6
Loss On Ignition	2610	M	%	3.9			10
Total BTEX	2760	M	mg/kg	< 0.010	6		
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1		
TPH Total WAC (Mineral Oil)	2670	M	mg/kg	< 10	500		
Total (Of 17) PAH's	2800	N	mg/kg	3.6	100		
рН	2010	М		8.9		>6	
Acid Neutralisation Capacity	2015	N	mol/kg	0.042		To evaluate	To evaluate
Eluate Analysis			10:1 Eluate	10:1 Eluate	Limit values	for compliance l	eaching test
•			mg/l	mg/kg	using B	S EN 12457 at L/	S 10 I/kg
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.010	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.050	0.5	10	70
Copper	1450	U	< 0.0010	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.010	0.10	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.34	3.4	10	150	500
Sulphate	1220	U	3.9	39	1000	20000	50000
Total Dissolved Solids	1020	N	91	910	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	5.5	55	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	8.5

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	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.
1450	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
2180	Sulphur (Elemental) in Soils by HPLC	Sulphur	Dichloromethane extraction / HPLC with UV detection
2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
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.
2325	Sulphide in Soils	Sulphide	Steam distillation with sulphuric acid / analysis by 'Aquakem 600' Discrete Analyser, using N,N–dimethyl-p-phenylenediamine.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.
2450	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
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

Report Information

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
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- 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"

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 45 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: <u>customerservices@chemtest.com</u>



eurofins Chemtest

Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-29604-1

Initial Date of Issue: 06-Nov-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

Colm Hurley
Darren O'Mahony
Gabriella Horan
Joe Gervin
John Cameron
Lucy Newland
Martin Gardiner
Matthew Gilbert
Neil Haggan
Paul Dunlop
Sean Ross
Stephen Francy

Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis

Project

Quotation No.: Q20-21063 Date Received: 02-Nov-2020

Order No.: 20-0399D Bus Connects Route 9 Date Instructed: 02-Nov-2020

No. of Samples: 1

Turnaround (Wkdays): 5 Results Due: 06-Nov-2020

Date Approved: 06-Nov-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070

Email: info@chemtest.com

Project:

Client: Causeway Geotech Ltd		Chemtest Job No.: Chemtest Sample ID.:				
Quotation No.: Q20-21063	(1090019				
		Sample Location:				
		Sample Type:				
			Top Dep		1.00	
			Date Sa	mpled:	29-Oct-2020	
			Asbest	os Lab:	LIVERPOOL	
Determinand	Accred.	SOP	Units	LOD		
ACM Type	U	2192		N/A	1	
Asbestos Identification	U	2192		N/A	No Asbestos Detected	
ACM Detection Stage	U	2192		N/A	-	
Moisture	N	2030	%	0.020	6.5	
рН	U	2010		4.0	8.2	
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	1.2	
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	
Arsenic	U	2450	mg/kg	1.0	20	
Cadmium	U	2450	mg/kg	0.10	0.68	
Chromium	U	2450	mg/kg	1.0	6.8	
Copper	U	2450	mg/kg	0.50	17	
Mercury	U	2450	mg/kg	0.10	< 0.10	
Nickel	U	2450	mg/kg	0.50	27	
Lead	U	2450	mg/kg	0.50	24	
Zinc	U	2450	mg/kg	0.50	49	
Organic Matter	U	2625	%	0.40	2.4	
Total TPH >C6-C40	U	2670	mg/kg	10	< 10	
Naphthalene	U	2700	mg/kg	0.10	< 0.10	
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	
Fluorene	U	2700	mg/kg	0.10	< 0.10	
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	
Anthracene	U	2700	mg/kg	0.10	< 0.10	
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	
Pyrene	U	2700	mg/kg	0.10	< 0.10	
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	
Chrysene	U	2700	mg/kg	0.10	< 0.10	
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	
Benzo[g,h,i]perylene	U	2700		0.10	< 0.10	
Coronene	N	2700		0.10	< 0.10	
Total Of 17 PAH's	N	2700	mg/kg	2.0	< 2.0	
Total Phenols	U	2920	mg/kg	0.30	< 0.30	

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	рН	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.
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2192	Asbestos	Asbestos	Polarised light microscopy / Gravimetry
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.
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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
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)
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.

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- M MCERTS and UKAS accredited
- N Unaccredited
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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

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All water samples will be retained for 14 days from the date of receipt

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If you require extended retention of samples, please email your requirements to: <u>customerservices@chemtest.com</u>



eurofins Chemtest

Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-31991-1

Initial Date of Issue: 30-Nov-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 Franey
Stephen McCracken
Stephen Watson
Stuart Abraham
Thomas McAllis

Project 20-0399D Bus Connects Route 9

Quotation No.: Q20-21063 Date Received: 23-Nov-2020

Order No.: Date Instructed: 24-Nov-2020

No. of Samples: 5

Turnaround (Wkdays): 5 Results Due: 30-Nov-2020

Date Approved: 30-Nov-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL Tel: 01638 606070

Email: info@chemtest.com

Results - Water

Client: Causeway Geotech Ltd			mtest J		20-31991	20-31991	20-31991	20-31991	20-31991
Quotation No.: Q20-21063	(Chemte	est Sam	ple ID.:	1101918	1101919	1101920	1101921	1101922
		S	ample Lo		R9-CP02	R9-CP08	R9-CP11	R9-CPGS01	R9-CPGS04
				е Туре:	WATER	WATER	WATER	WATER	WATER
			Date Sa	ampled:	19-Nov-2020	19-Nov-2020	19-Nov-2020	19-Nov-2020	19-Nov-202
Determinand	Accred.	SOP	Units	LOD					
рН	U	1010		N/A	8.2	7.6	7.7	7.6	7.7
Electrical Conductivity	U	1020	μS/cm	1.0	640	1200	720	960	880
Ammonia (Free) as N	U	1220	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Nitrite as N	U	1220	mg/l	0.010	< 0.010	0.028	0.025	0.30	0.016
Nitrate as N	U	1220	mg/l	0.50	< 0.50	8.3	< 0.50	3.3	3.6
Phosphorus (Total)	N	1220	mg/l	0.020	< 0.020	< 0.020	< 0.020	< 0.020	< 0.020
Phosphate as P	U	1220	mg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Nitrogen (Total)	N	1340	mg/l	5.0	< 5.0	16	< 5.0	9.0	6.8
Calcium	U	1415	mg/l	5.0	73	160	83	120	110
Magnesium	U	1415	mg/l	0.50	17	29	7.7	19	9.4
Sodium	U	1415	mg/l	0.50	33	34	25	56	37
Total Hardness as CaCO3	U	1270	mg/l	15	250	520	240	370	310
Arsenic (Dissolved)	U	1450	μg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Boron (Dissolved)	U	1450	μg/l	20	23	170	29	69	27
Barium (Dissolved)	U	1450	μg/l	5.0	73	64	66	68	61
Cadmium (Dissolved)	U	1450	μg/l	0.080	< 0.080	< 0.080	0.32	< 0.080	0.13
Copper (Dissolved)	U	1450	μg/l	1.0	1.4	1.9	2.3	< 1.0	1.0
Iron (Dissolved)	N	1450	μg/l	20	310	500	340	290	330
Mercury (Dissolved)	U	1450	μg/l	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Manganese (Dissolved)	U	1450	μg/l	1.0	24	18	170	300	9.4
Molybdenum (Dissolved)	U	1450	μg/l	1.0	1.2	1.1	2.6	3.6	1.8
Nickel (Dissolved)	U	1450	μg/l	1.0	< 1.0	6.3	14	6.1	2.1
Lead (Dissolved)	U	1450	μg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Antimony (Dissolved)	U	1450	µg/l	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Selenium (Dissolved)	U	1450	μg/l	1.0	11	6.1	< 1.0	3.7	4.3
Zinc (Dissolved)	U	1450	μg/l	1.0	2.3	5.8	7.4	8.1	4.7
Chromium (Trivalent)	N	1490	µg/l	20	[B] < 20	[B] < 20	[B] < 20	[B] < 20	[B] < 20
Chromium (Hexavalent)	U	1490	µg/l	20	[B] < 20	[B] < 20	[B] < 20	[B] < 20	[B] < 20
Total Organic Carbon	U	1610	mg/l	2.0	85	120	89	94	88
Mineral Oil	N	1670	μg/l	10	< 10	< 10	< 10	< 10	< 10
Total TPH >C6-C40	U	1670	μg/l	10	< 10	< 10	< 10	< 10	< 10
Naphthalene	Ü	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	Ü	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
,	U	1800		0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	U		μg/l						
Chrysene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Water

Client: Causeway Geotech Ltd		Che	mtest Jo	ob No.:	20-31991	20-31991	20-31991	20-31991	20-31991
Quotation No.: Q20-21063	(Chemte	est Sam	ple ID.:	1101918	1101919	1101920	1101921	1101922
		S	ample Lo	ocation:	R9-CP02	R9-CP08	R9-CP11	R9-CPGS01	R9-CPGS04
				e Type:	WATER	WATER	WATER	WATER	WATER
			Date Sa	ampled:	19-Nov-2020	19-Nov-2020	19-Nov-2020	19-Nov-2020	19-Nov-2020
Determinand	Accred.	SOP	Units	LOD					
Benzo[b]fluoranthene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	1800	μg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	1800	μg/l	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0

Deviations

In accordance with UKAS Policy on Deviating Samples TPS 63. Chemtest have a procedure to ensure 'upon receipt of each sample a competent laboratory shall assess whether the sample is suitable with regard to the requested test(s)'. This policy and the respective holding times applied, can be supplied upon request. The reason a sample is declared as deviating is detailed below. Where applicable the analysis remains UKAS/MCERTs accredited but the results may be compromised.

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1101918			R9-CP02	19-Nov-2020	В	Coloured Winchester 1000ml
1101918			R9-CP02	19-Nov-2020	В	EPA Vial 40ml
1101918			R9-CP02	19-Nov-2020	В	Plastic Bottle 1000ml
1101919			R9-CP08	19-Nov-2020	В	Coloured Winchester 1000ml
1101919			R9-CP08	19-Nov-2020	В	EPA Vial 40ml
1101919			R9-CP08	19-Nov-2020	В	Plastic Bottle 1000ml
1101920			R9-CP11	19-Nov-2020	В	Coloured Winchester 1000ml
1101920			R9-CP11	19-Nov-2020	В	EPA Vial 40ml
1101920			R9-CP11	19-Nov-2020	В	Plastic Bottle 1000ml
1101921			R9-CPGS01	19-Nov-2020	В	Coloured Winchester 1000ml
1101921			R9-CPGS01	19-Nov-2020	В	EPA Vial 40ml
1101921			R9-CPGS01	19-Nov-2020	В	Plastic Bottle 1000ml
1101922			R9-CPGS04	19-Nov-2020	В	Coloured Winchester 1000ml
1101922			R9-CPGS04	19-Nov-2020	В	EPA Vial 40ml
1101922			R9-CPGS04	19-Nov-2020	В	Plastic Bottle 1000ml

Test Methods

SOP	Title	Parameters included	Method summary
1010	pH Value of Waters	рН	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.
1270	Total Hardness of Waters	Total hardness	Calculation applied to calcium and magnesium results, expressed as mg l-1 CaCO3 equivalent.
1340	Total Nitrogen in Waters	Total Nitrogen and organic Nitrogen	Persulphate digestion followed by colorimetry.
1415	Cations in Waters by ICP-MS	Sodium; Potassium; Calcium; Magnesium	Direct determination by inductively coupled plasma - mass spectrometry (ICP-MS).
1450	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
1670	Total Petroleum Hydrocarbons (TPH) in Waters by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO	Pentane extraction / GC FID detection
1800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Waters 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	Pentane extraction / GCMS detection

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- 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"

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 45 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: <u>customerservices@chemtest.com</u>



APPENDIX I SPT HAMMER ENERGY MEASUREMENT REPORT





SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing Keeble House Stuart Way East Grinstead

West Sussex RH19 4QA SPT Hammer Ref:

.0643

Test Date:

22/02/2020

Report Date:

03/03/2020

File Name:

.0643.spt

Test Operator:

NPB

Instrumented Rod Data

Diameter d_r (mm):

54

Wall Thickness t_r (mm):

6.0

Assumed Modulus Ea (GPa): 200

0.0

Accelerometer No.1:

6458

Accelerometer No.2:

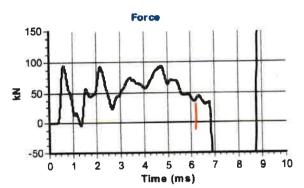
9607

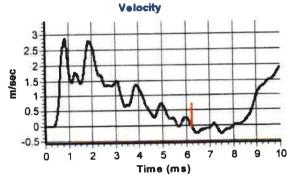
SPT Hammer Information

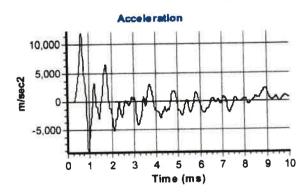
Hammer Mass m (kg): 63.5 Falling Height h (mm): 760 SPT String Length L (m): 10.0

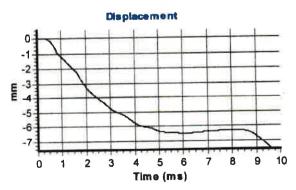
Comments / Location

BALLEYMONEY









Calculations

Area of Rod A (mm2):

905

Theoretical Energy E_{theor} (J):

473

Measured Energy E_{meas} (J):

400

Energy Ratio E , (%):

85

Signed: Neil Burrows

Title:

Field Operations Manager

The recommended calibration interval is 12 months



SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing Keeble House Stuart Way East Grinstead West Sussex

RH19 4QA

SPT Hammer Ref:

.17

Test Date:

22/02/2020

Report Date:

03/03/2020

File Name:

.T7.spt

Test Operator:

NPB

Instrumented Rod Data

Diameter d_r (mm):

54

Wall Thickness t_r (mm):

6.0

Assumed Modulus Ea (GPa): 200

Accelerometer No.1:

6458

Accelerometer No.2:

9607

SPT Hammer Information

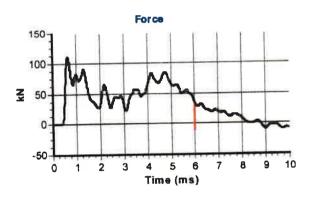
Hammer Mass m (kg):

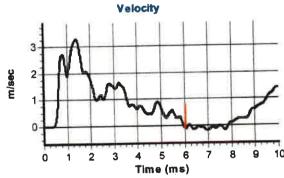
Falling Height h (mm): 760

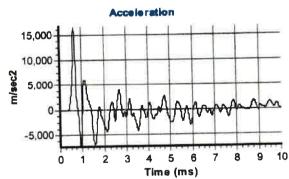
SPT String Length L (m): 10.0

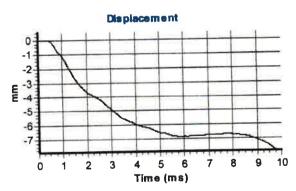
Comments / Location

BALLEYMONEY









Calculations

Area of Rod A (mm2):

905

Theoretical Energy E_{theor} (J):

473

Measured Energy E_{meas} (J):

399

Energy Ratio E_r (%):

84

Signed: **Neil Burrows**

Title:

Field Operations Manager

The recommended calibration interval is 12 months



APPENDIX J ARCHAEOLGY REPORT



Report on Archaeological Monitoring BusConnects Infrastructure Dublin Detailed Ground Investigation Stage 1

Licence No. 20E0622

Client: Causeway Geotech Limited

Issue date: December 2020

Licensee: Grace Fegan

Prepared by: Thaddeus Breen, Marion Sutton and Grace Fegan, Shanarc

Archaeology Ltd.



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Lic Fig	ence N ure 8 L	o. EN 0077920)
		RMP sites (<i>red dots</i>) and Zones of Archaeological Potential (<i>shaded pink</i>) are No. EN 0077920)9

Executive Summary

Archaeological monitoring of Stage 1 detailed ground investigations relating to the National Transport Authority's BusConnects Infrastructure Dublin project was carried out by Shanarc Archaeology Ltd. under licence 20E0622.

The works, carried out in September and October 2020, were split over three routes, namely Route 02: Swords to City Centre, Route 09: Greenhills to City Centre and Route 13: Bray to City Centre.

A total of 22 ground investigation locations were subject to archaeological monitoring, due to their proximity to either a Recorded Monument and Place, other area of archaeological or cultural heritage potential, or as requested by Causeway Geotech Limited.

The works generally comprised the excavation of trial pits that ranged from 1.60m to 2.40m long x 0.60m wide and 1.0m to 4.2m deep, and cable percussion cores that ranged from 0.23m to 8m deep.

No archaeological features or deposits were identified during monitoring. An Irish halfpenny of George II, dated 1742, was recovered during monitoring on Route 13: Bray to City Centre, in Bray, Co. Wicklow.

1. Introduction

This report describes the results of archaeological monitoring of Stage 1 detailed ground investigations relating to the National Transport Authority's BusConnects Infrastructure Dublin project. The planning stage/Stage 1 detailed ground/geotechnical investigations were carried out on five routes, namely Route 02: Swords to City Centre Route, 06: Lucan to City Centre, Route 08: Clondalkin to Drimnagh, Route 09: Greenhills to City Centre and Route 13: Bray to City Centre (Figure 1).

Detailed ground investigation is being carried out in accordance with the BusConnects Detailed Ground Investigation Contract: Stage 1 tendered by the National Transport Authority.

Only specified investigations on identified sections of the Stage 1 routes were subject to archaeological monitoring; the specified investigations were identified following a review by Shanarc Archaeology Ltd. of the proposed investigation locations.

Proposed investigation locations were reviewed by Shanarc Archaeology Ltd. to identify (1) whether proposed works fall with the historic core of Dublin (DU019-020), (2) whether proposed works fall within the Zone of Archaeological Potential associated with an individual recorded monument and (3) whether proposed works fall within an area of identified archaeological or cultural heritage potential.

21 no. ground investigation locations were identified for archaeological monitoring, on three routes, Route 02: Swords to City Centre, Route 09: Greenhills to City Centre and Route 13: Bray to City Centre, with Route 09: Greenhills to City Centre investigations forming the focus of archaeological monitoring. The identified locations are listed in Appendix 1.

Following modifications to Stage 1 detailed ground/geotechnical investigations at the construction stage, a total of 22 ground investigations locations were subject to archaeological monitoring. The monitored locations are listed in Appendix 2.

1.1 Location Description

The BusConnect routes are on existing main commuter routes into Dublin City Centre. Although some of the routes are partly within the Zone of Archaeological Potential of Dublin city (DU018-020), the areas covered by the BusConnects Detailed Ground Investigation Contract: Stage 1 are not.

The Route 02: Swords to City Centre bus corridor commences on the Swords Road at the Pinnock Hill junction and is routed along Swords Road, Drumcondra Road Upper & Lower and Dorset Street to the junction with North Frederick Street. The ground investigation location monitored on Route 02 was located to the south side of the Tolka River at Drumcondra Bridge, on the R132 (Drumcondra Road Upper and Lower).

The Route 09: Greenhills core bus corridor commences on Belgard Square West, at the junction with Cookstown Way, Tallaght, routed along Belgard Square North and Belgard Square East towards the Blessington Road, continuing to Greenhills Road (R819), and along Ballymount Avenue, Calmount Road and Walkinstown Road (R819) to the junction with the Long Mile Road (R110). 20 ground investigation locations were monitored on this section of Route 09, beginning on Belgard Square North and located on, or in proximity of Greenhills Road (R819) to both sides of the M50 as far as Walkinstown.

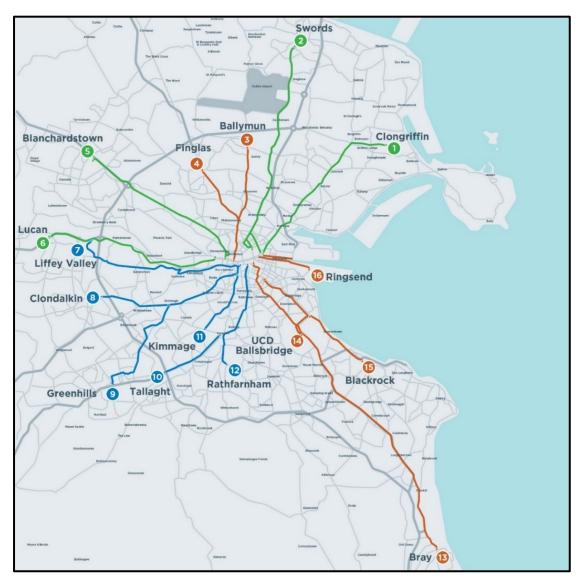


Figure 1 BusConnects Corridor Map.

The Route 13: Bray to City Centre bus corridor commences at the Dargle River crossing, in Bray town, and is routed northwards along the Dublin Road (R119) to Loughlinstown roundabout, along Bray Road and Stillorgan Road (N11, R138), and via Donnybrook Road and Morehampton Road toward Dublin city centre, to the junction of Leeson Street Lower and St. Stephen's Green. One ground investigation location was monitored on Route 13, to the north of Bray town.

1.1 Project Description

BusConnects is the National Transport Authority's programme to greatly improve bus services in Dublin city. The ground/geotechnical investigation works will be variously in public areas, on land under control of a Local Authority and on private land, and are required to determine the condition and properties of the ground to inform the planning stage design of BusConnects core bus corridors. The investigation works provides for trial pits, slit trenches, cable percussion drilling (minimum diameter 200mm) and window samples, which may be associated with pitting and trenching up to 1.2m below the surface to locate and avoid underground services.

2. Receiving Environment

2.1 Route 2: Swords to City Centre

The ground investigation location, R2-SLT02, monitored on Route 02 was located to the south side of the Tolka River at Drumcondra Bridge, west of the R123, in Clonliffe West townland, within 380m of DU018-012001, the site of a 16th-17th century house incorporated into St. Patrick's Teacher Training College, 480m of DU018-011, a holy well, and 480m of DU018-013001 and DU018-013002, the church of St. John the Baptist (1734) and associated graveyard on the grounds of All Hallows College, which was built on a medieval foundation associated with the Prior of All Saints (Figure 2). In 1756, John Rocque records a terrace of buildings facing south onto Botanic Avenue, now the site of our Lady's Park. A terrace of buildings were still present on the first edition 6-inch Ordnance Survey map (1837-1843; Figure 3), known as Tolka Cottages, which appear to have been removed at some point in the 20th century. While no stray finds are provenance to Clonliffe West townland, the Topographical files at the National Museum of Ireland record a number of stray finds to Drisoge (1 x copper alloy coin) and Drumcondra (3 x flint scrapers; 1 x bone ring) townlands to the north of the Tolka River, highlighting the settlement potential in the catchment of the Tolka River.

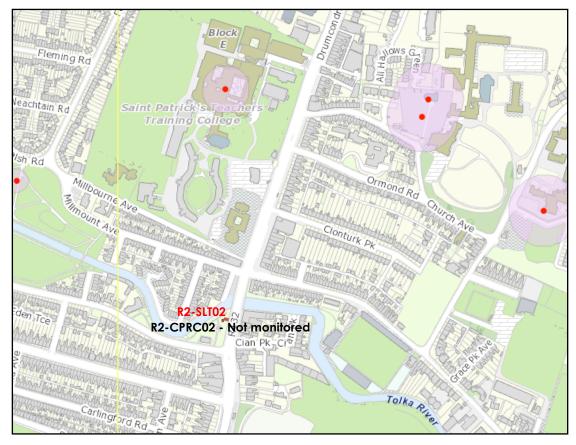


Figure 2 Location of R2-SLT02 (in red) next to R2-CPRC02, in relation to RMP sites (red dots) and Zones of Archaeological Potential (shaded pink) (OSi Licence No. EN 0077920).

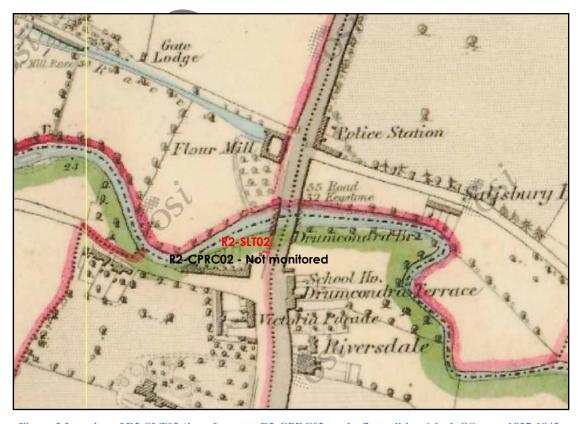


Figure 3 Location of R2-SLT02 (in red) next to R2-CPRC02 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

2.2 Route 9: Greenhills to City Centre

The majority of ground investigation locations were monitored on Route 09, 20 sites in total, in Tallaght, Tymon North, Kilnamanagh and Greenhills townlands. The Greenhills route is situated in a landscape in which archaeological remains are well represented, which include Bronze Age (c. 2400-500 BC) burials in Greenhills townland, stray finds indicating early occupation from the Bancroft and Dodder River areas at Tallaght Village (Bolger 2010; NMI Topographical Files), which include a number of bronze axeheads from a sandpit in Tallaght, and well represented early and later medieval remains, the monastery at Tallaght being founded in the mid-8th century. With the arrival of the Anglo-Normans in 1169, the monastery passed to the control of the archbishop of Dublin, becoming a manor with borough status.

R9-TP01 and R9-TP02 are sited to the north side of Belgrade Square North, a short distance east of the entry to Tallaght General Hospital, 500m from the historic town and ecclesiastical manor at Tallaght (DU021-037) (Figure 4), on land that was formerly within the grounds of the Glebe House, later St. Maelruen's. The Glebe grounds were located within the wider Tallaght townland (Figure 5). R9-TP03, on the Greenhills Road (R819), is sited approximately 540m to the north-north-east of the historic town, which in addition to DU021-037003 and DU021-037004, Tallaght church and graveyard, comprises DU021-037012, a holy well, and two castles, DU021-037020 and DU022-018001 (Figure 6).

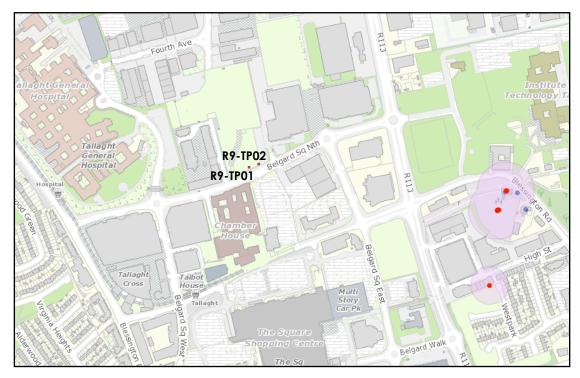


Figure 4 Locations of R9-TP01 and R9-TP02 in relation to RMP sites (*red dots*) and Zones of Archaeological Potential (*shaded pink*) (OSi Licence No. EN 0077920).

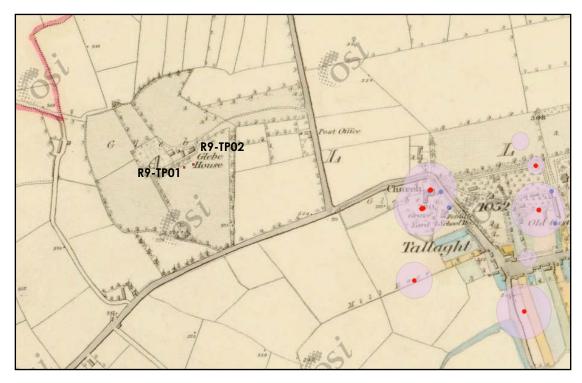


Figure 5 Locations of R9-TP01 and R9-TP02 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

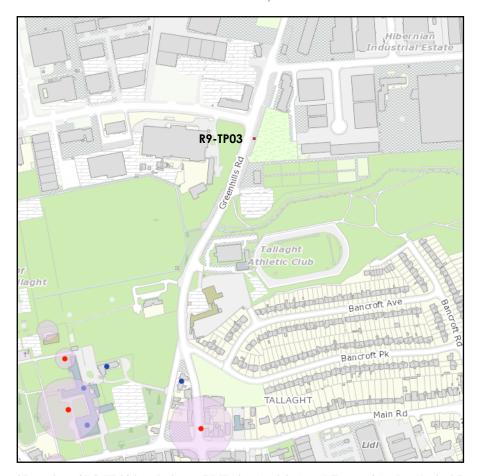


Figure 6 Location of R9-TP03 in relation to RMP sites (red dots) and Zones of Archaeological Potential (shaded pink) (OSi Licence No. EN 0077920).

A programme of archaeological monitoring of utility trenches along the route of Metro West in the vicinity of Tallaght was carried out in October 2010 in accordance with licence numbers 10E0309, 10E0415, 10E0416 and 10E0417. No archaeological features or deposits were found (Bolger 2010). John Rocque's 1760 map presents a rural landscape in the hinterland of the historic Tallaght village, with enclosed fields and sporadic dwellings largely fronting the mid-18th century road network, which included the precursors of the Old Blessington Road and the Greenhills Road. R9-TP03 is depicted positioned on the Greenhills Road on the first edition 6-inch Ordnance Survey map (Figure 7).

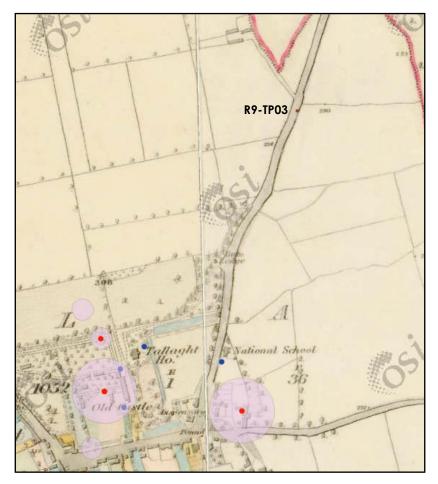


Figure 7 Location of R9-TP03 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

R9-CP03, R9-TP04, R9-TP05, R9-CP04 and R9-TP06 are all situated within 380m of a complex of medieval monuments at Kilnamanagh, a developed area with no visible surface remains (Figure 8). The complex incorporates DU022-005005, an ecclesiastical enclosure, bi-sected by Treepark Road - R9-TP05 is sited within the Zone of Archaeological Potential of the enclosure. The complex also includes DU022-005002, a church, DU022-005003, a graveyard, DU022-005004, a holy well, and DU022-005009 and DU022-005008, an earthwork and bawn enclosing Kilnamanagh Castle, DU022-005001.

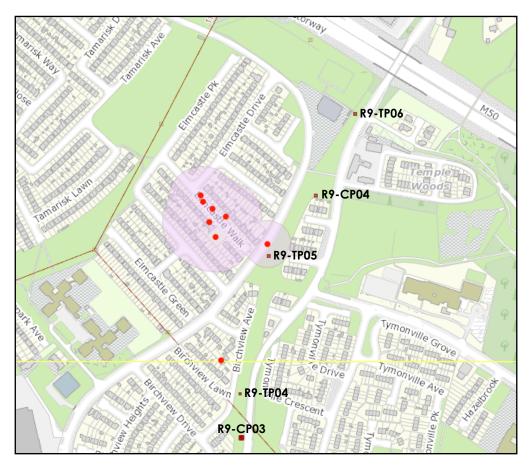


Figure 8 Locations of R9-CP03, R9-TP04, R9-TP05, R9-CP04 and R9-TP06 in relation to RMP sites (red dots) and Zones of Archaeological Potential (shaded pink) (OSi Licence No. EN 0077920).

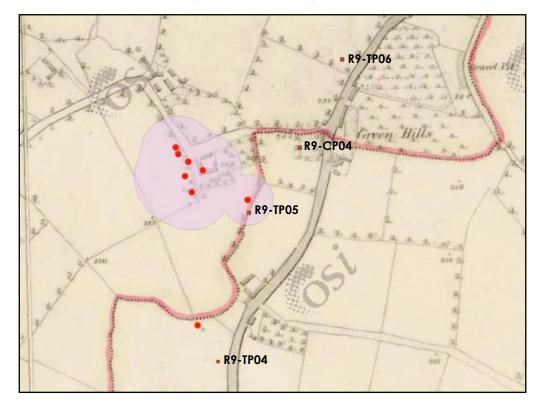


Figure 9 Locations of R9-TP04, R9-TP05, R9-CP04 and R9-TP06 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

Both Rocque, in 1760, and the Ordnance Survey (1837-1843) show the rural nature of the Kilnamanagh area, with a number of structures concentrated on the Greenhills Road in this area (Figure 9); with Rocque showing a spring to the east side of the precursor of the Greenhills Road. The National Museum of Ireland provenance a large number of stray finds to Kilnamanagh and Greenhills townlands, reflecting settlement in this area in prehistory and during the medieval and post medieval periods.

R9-CP05, R9-TP08, R9-WS01 and R9-TP09 are ground investigation locations situated peripheral to the medieval Kilnamanagh complex (Figure 10 and Figure 11).

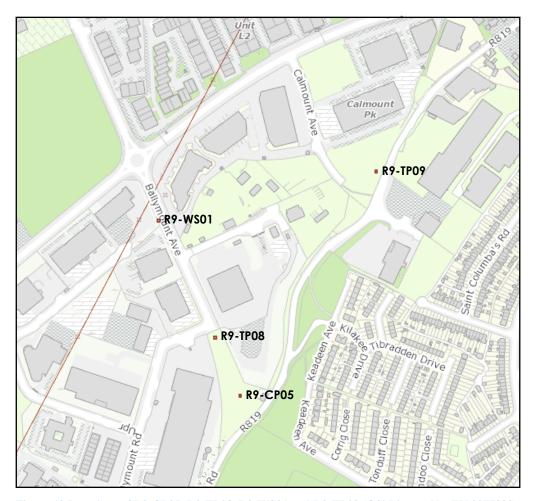


Figure 10 Locations of R9-CP05, R9-TP08, R9-WS01 and R9-TP02 (OSi Licence No. EN 0077920).

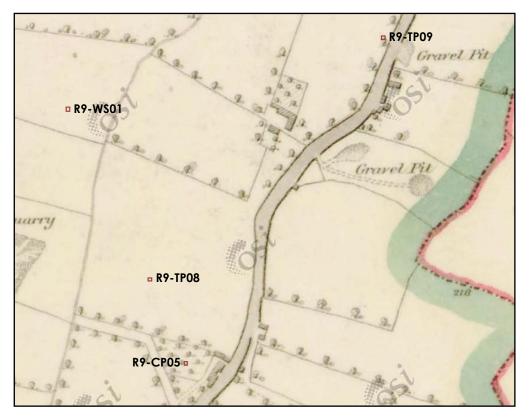


Figure 11 Locations of R9-CP05, R9-TP08, R9-WS01 and R9-TP02 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

R9-CP08, R9-TP10, R9-TP11, R9-CP10, R9-CP07, R9-CP09, R9-CP12 and R9-CP13 are sited on, or in proximity of Greenhills Road (R819) near Walkinstown, between Greenhills Industrial Estate and Ballymount Court Business Centre (Figure 12). The investigation locations are within 95m-400m of DU022-002, a Bronze Age flat cemetery, and 330m-480m of DU022-001, a holy well. R9-CP12 is sited closest to the DU022-002, flat cemetery, just west of the designated Zone of Archaeological Potential. This area, to either side of the Greenhills Road was the focus of gravel extraction, at least from the 19th century, and the flat cemetery was first uncovered during the quarrying of a sand and gravel ridge in 1892. A spot height shown on the first edition 6-inch Ordnance Survey map (1837-1943) to the south-west of the cemetery site overlooked the locations of R9-CP09, R9-CP12 and R9-CP13.

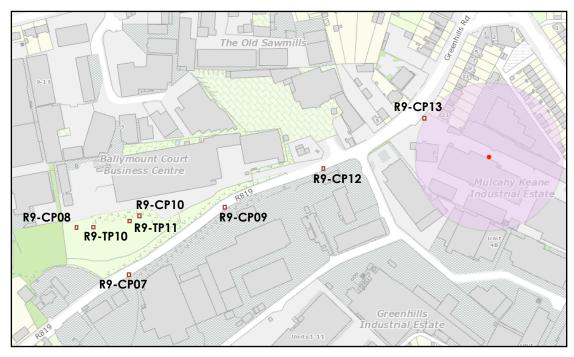


Figure 12 Locations of R9-CP08, R9-TP10, R9-TP11, R9-CP10, R9-CP07, R9-CP09, R9-CP12 and R9-CP13 in relation to RMP sites (red dots) and Zones of Archaeological Potential (shaded pink) (OSi Licence No. EN 0077920).

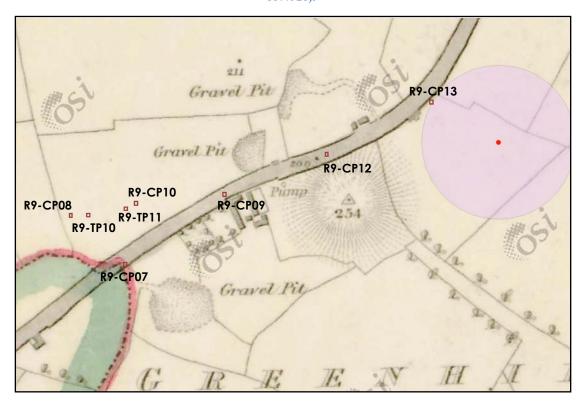


Figure 13 Locations of R9-CP08, R9-TP10, R9-TP11, R9-CP10, R9-CP07, R9-CP09, R9-CP12 and R9-CP13 on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

2.3 Route 13: Bray to City Centre

The ground investigation location, R13-WS01, monitored on Route 13 was located in Ravenswell townland, to the east of the Dublin Road (R716) in the grounds of Saint Philomena's Primary School, situated outside, and to the north of the Zone of Archaeological Potential for the historic town at Bray (W1004-001). The window sample, approximately 120m north-west of the historic town, was sited 95m from W1004-001006, the findspot of a cross-slab, and 185m of W1004-001006, a castle site forming a sub-element of the historic town (Figure 14). A timber pier excavated on the Dargle River (W1004-006; Excavation Licence No. 95E0004), in Killarney townland, upriver of the town, has been radiocarbon dated to 4661-4360 BC, indicating Neolithic activity in the Dargle River and Bray area.

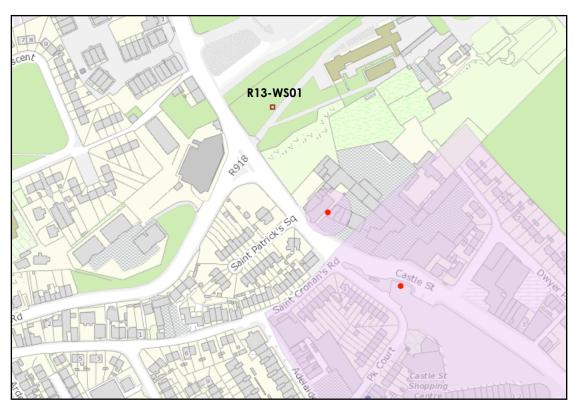


Figure 14 Location of R13-WS01 outside Bray (OSi Licence No. EN 0077920).

The first edition 6-inch Ordnance Survey map (1837-1843; Figure 15) shows the location of the window sample sited to the townland boundary between Ravenswell and Cork Great, to the north of Little Bray and the Dargle River. A grant of lands in the town of Little Bray in 1636 mentioned the castle, sited on Castle Street, along with six houses and gardens, orchards, the commons and fishing in the Dargle. The grounds of Ravenswell House, the residence of de Butt Esq., are now substantially developed as part of the Bray Golf Club, which has operated a course at Ravenswell since 1897.

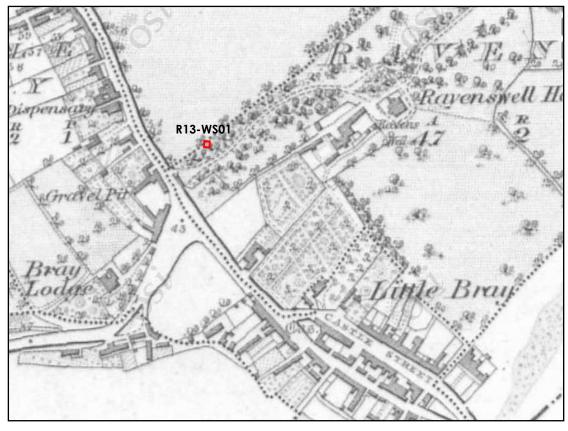


Figure 15 Location of R13-WS01, outside Bray, on the first edition 6-inch OS map, 1837-1843 (OSi Licence No. EN 0077920).

3. Methodology

The objective of the programme of archaeological monitoring was to provide a watching brief of excavation and drilling associated with the of ground/geotechnical investigations for the purpose of identifying any archaeological features, deposits or finds that might be present and subject to potential development impacts.

Ground/geotechnical investigations comprised a combination of trial pits (TP), cable percussion cores (CP), slit trenches (SLT), and window samples (WS).

It was originally proposed that archaeological monitoring would occur at 21 locations (listed in Appendix 1). However, as a result of changes at the construction phase, investigation locations were subject to name changes, with some cancellations (i.e. R2-CPRC01) and with some additions (e.g. R2-SLT02). Changes to the construction programme also resulted in a number of investigation locations being excavated in the absence of an archaeologist i.e. R2-CPRC02, R13-CP01, R13-CP02 and R13-CP03. Although in the case of R2-CPRC02, an added slit trench R2-SLT02 in very close proximity was monitored, while R13-WS01 was monitored in the general proximity of R13-CP03. Ultimately, 22 locations were monitored (listed in Appendix 2), including a number of locations more peripheral to identified areas of archaeological potential that were monitored at the request of Causeway Geotech Limited.

4. Results of monitoring

The following tables provide details of the location and stratigraphy of each of the Stage I archaeologically monitored ground/geotechnical investigation locations. Relevant plates are provided in Section 7.

4.1 Results of Monitoring

Route 2: Swords to City Centre

Slit Trench	R2-SLT02
Location	Drumcondra, in a small park, Our Lady's Park, immediately south of
Location	the River Tolka
Date	29 September 2020
Туре	Slit trench, 7m long, 0.40m wide
Depth	Description
0m-0.20m	Mid-brown loose topsoil with roots
0.20m-0.50m	Mid-brown stony soil with modern potsherds, F#'s 1-8 listed in
	Appendix 3
0.50m-1.30m	Very hard, compact, stony soil with brick and roof-tile fragments
1.30m-	Some pea gravel present at 1.13m, then mid-brown gravelly clay
1.60m+	continuing, still with fragments of brick, ceramic, glass and even
	plastic

Comments: Modern disturbance throughout the trench. Natural not reached. No archaeological significance. **Plate 1**

Location Plan showing R2-SLT02:

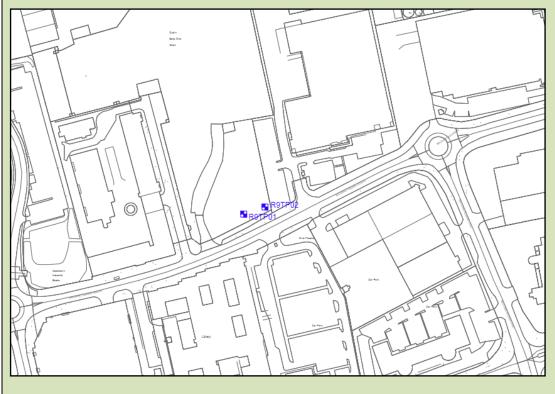


Route 9: Greenhills to City Centre

Trial Pit	R9-TP01	
Location	Tallaght, on waste ground near centre	
Date	8 October 2020	
Туре	Machine-dug trial pit, 2.30m x 0.60m	
Depth	Description	
0m-0.30m	Mid-grey-brown topsoil	
0.30m-2.00m+	Stiff greyish-brown sandy gravelly clay	
Comments: Former garicultural field. No grahgeological cignificance. Plate 2		

Comments: Former agricultural field. No archaeological significance. Plate 2

Location Plan showing R9-TP01 and R9-TP02:



Trial Pit	R9-TP02
Location	Tallaght, waste ground near centre
Date	8 October 2020
Туре	Machine-dug trial pit, 2.30m x 0.60m
Depth	Description
0m-0.10m	Dark brown topsoil
0.10m-0.23m	Very stony, gravelly soil, dark brown
0.30m-0.65m	Lighter mid-brown material
1.50m-2.40m+	Similar to above but more stony

Comments: Former agricultural field. No archaeological significance. Plate 3

Location Plan showing R9-TP02:

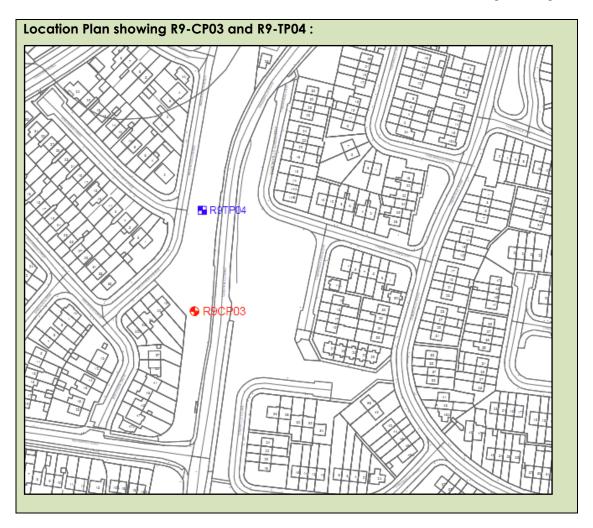
See R9-TP01 above.

Trial Pit	R9-TP03
Location	Greenhills Road: gravelled margin beside main road
Date	9 Oct 2020
Туре	Machine-dug trial pit, 1.50m x 0.60m

Depth	Description		
0m-0.20m	Compacted gravel laid on geotextile		
0.20m-0.85m	Hardcore		
0.85m+	Leanmix, probably protecting services		
significance. Plate	Comments: Pit abandoned because of probable services. No archaeological significance. Plate 4 Location Plan showing R9-TP03:		
	R9CP01		

Cable Percussion	R9-CP03
Location	Kilnamanagh, on ornamental grassland in a housing estate
Date	6 October 2020
Туре	Cable percussion, no hand-digging
Depth	Description
0m-1.00m	Mid-brown topsoil; sherd of sewer pipe
1.00m-1.50m	Similar material, but somewhat lighter in colour
1.50m-8.00m	Light yellow-brown natural
8.00m	Hard boulder clay; refusal

Comments: Made ground to a depth of 1.50m. No archaeological significance. **Plate 5**



Trial Pit	R9-TP04	
Location	Kilnamanagh, on ornamental grassland in a housing estate	
Date	8 Oct 2020	
Туре	Machine-dug trial pit, 2.40m x 0.60m	
Depth	Description	
0m-0.20m	Loose dark brown topsoil with plastic and other modern refuse; modern potsherds and a clay pipe stem mixed in, F#'s 9-11 listed in Appendix 3	
0.20m-0.80m	Mid-brown clayey soil	
0.80m-2.00m+	Darker brown stony soil	
Comments: Ornamental grassland in a housing estate. No archaeological		

Comments: Ornamental grassland in a housing estate. No archaeologica significance. **Plate 6**

Location Plan showing R9-TP04:

See R9-CP03 above.

Trial Pit	R9-TP05
Location	Kilnamanagh, on ornamental grassland in a housing estate
Date	8 Oct 2020
Туре	Machine-dug trial pit, 2.40m x 0.60m
Depth	Description
0m-0.15m	Loose mid-brown sod layer
0.15m-2.00m+	Loose mid-brown soil with concrete blocks, fabric, plastic; larger stones at about 1.80m, and water coming in.

Comments: Higher than the level of the surrounding roads. Evidently used as a dump before being grassed over. No archaeological significance. Plate 7 Location Plan showing R9-TP05, R9-CP04 and R9-TP06:

Pit/Cable	R9-CP04
Percussion	
Location	Kilnamanagh, on ornamental grassland in a housing estate
Date	5 October 2020
Туре	Hand-dug inspection pit followed by cable percussion
Depth	Description
0m-2.00m	Mid-brown soil with stones and coarse modern refuse including
	a carpet
2.00m-3.00m	Gravelly brown natural; refusal at about 3.00m: probably
	boulder clay

Comments: Higher than the level of the surrounding roads. Evidently used as a dump before being grassed over. No archaeological significance. **Plate 8**

Location Plan showing R9-CP04:

See R9-TP05 above.

Trial pit	R9-TP06
Location	Greenhills Road, on ornamental grassland beside main road
Date	8 Oct 2020
Туре	Machine-dug trial pit, 2.00m x 0.60m
Depth	Description
0m-0.30m	Mid-brown sod layer
0.30m-0.40m	Gravelly soil with beer cans
0.40m-0.95m	Hard stony clay with some brick fragments, wire, metal debris
0.95m-1.00m+	Similar material, but with boulders

Comments: Used as a dump before landscaping. No archaeological significance.

Plate 9

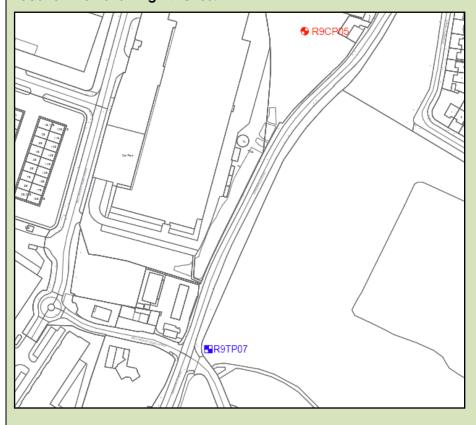
Location Plan showing R9-TP06:

See R9-TP05 above.

Cable Percussion	R9-CP05
Location	Narrow strip of waste land in an industrial estate/business park
Date	12 Oct 2020
Туре	Cable percussion, no hand-digging
Depth	Description
0m-0.20m	Loose mid grey-brown soil with some fabric and plastic
0.20m-1.50m	Mid-grey-brown soil mixed with rubbish
1.50m-4.80m	Very clayey, but still with rubbish and stones; roofing felt at
	4.00m
4.80m-5.00+	Natural gravel

Comments: Worked-out gravel pit used as a dump. No archaeological significance. Plate 10

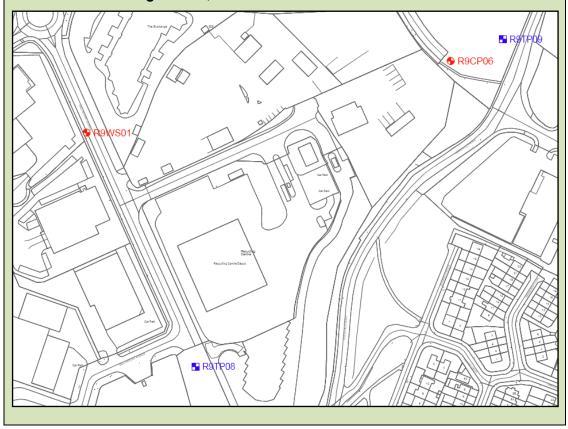
Location Plan showing R9-CP05:



Trial Pit	R9-TP08
Location	Narrow strip of waste land in an industrial estate/business park
Date	8 October 2020
Туре	Machine-dug trial pit, 1.70m x 0.50m
Depth	Description
0-0.55m	Loose mid-brown topsoil
0.55-1.00m	Gravel
1.00m+	Clayey gravel, boulders by 1.30m

Comments: Formerly in the middle of a field. Cartographic sources suggest that, unlike much of the land adjoining Greenhills Road, it was never quarried for gravel. Nothing of archaeological significance. **Plate 11**

Location Plan showing R9-TP08, R9-WS01 and R9-TP09:



Window Sample	R9-WS01
Location	Grass verge beside road in an industrial estate/business park
Date	19 Oct 2020
Туре	Hand-dug inspection pit to 1.20m, then window sample drill
Depth	Description
0m-1.00m	Mid-brown gravelly soil, a lot of roots from adjoining tree
c. 1.10m	Electricity cable

Comments: Pit abandoned after electric cable cut. Plate 12

Location Plan showing R9-WS01:

See R9-TP08 above.

Trial Pit	R9-TP09
Location	Waste ground on the edge of an industrial estate
Date	9 Oct 2020
Туре	Machine-dug trial pit 1.60m x 0.60m
Depth	Description
0m-0.30m	Hardcore
0.30m-0.48m	Clay with lumps of concrete
0.48m-0.53m	Loose dark-brown soil
0.53m-1.00m	Black burnt layer
1.00m-2.5mm	Stony loose soil with rubble and domestic refuse (bottles, etc.)
2.50m-2.75m+	Gravel mixed with refuse and rubble

Comments: Worked-out gravel pit used as a dump. Nothing of archaeological significance. **Plate 13**

Location Plan showing R9-TP09:

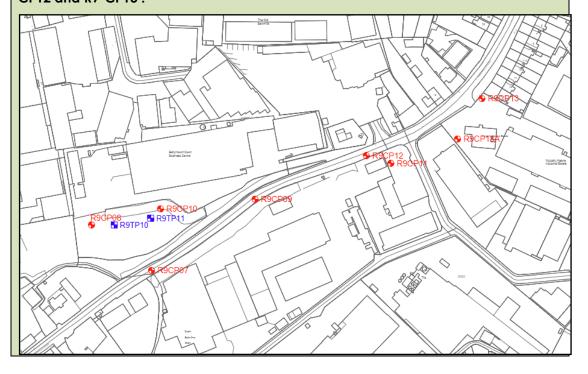
See R9-TP08 above.

Cable Percussion	R9-CP08
Location	Grounds of DPD premises, Greenhills. Raised area near car park.
Date	7 October 2020
Туре	Cable percussion; no hand-digging
Depth	Description
0-0.20m	Gravel
0.20-0.50m	Light reddish-brown soil
0.50-2.00m	Stony/gravelly soil, lighter in colour but less red: tending to grey
2.00m+	Sticky clay with natural banding.

Comments: This is the edge of a worked-out gravel pit. Nothing of archaeological significance. **Plate 14**

Location Plan showing R9-CP08, R9-TP10, R9-TP11, R9-CP10, R9-CP07, R9-CP09, R9-

CP12 and R9-CP13:



Trial Pit	R9-TP10
Location	Grounds of DPD premises, Greenhills; cut into bank next to
	raised area.
Date	8 Oct 2020
Туре	Machine-dug trial trench, 2.00m x 0.60m
Depth	Description
0m-0.30m	Loose mid-brown sod layer
0.30m-0.55m	Silty yellow-brown clayey layer
0.55m-0.80m	Soft yellow-brown sandy gravelly clay
0.80m-2.20m	Yellow-brown clayey gravelly sand
2.20m-4.20m+	Silt, banded

Comments: Cutting into glacial deposits at the edge of a worked-out gravel pit. Nothing of archaeological significance. **Plate 15**

Location Plan showing R9-TP10:

See R9-CP08 above.

Trial Pit	R9-TP11
Location	Grounds of DPD premises, Greenhills; cut into bank next to raised area
Date	8 Oct 2020
Туре	Machine-dug trial trench, 2.00m x 0.60m
Depth	Description
0m-0.90m	Loose dark-brown topsoil
0.90m-1.60m	Lighter yellow-brown silty soil
1.60m-3.00m	Very mixed silty material
3.00m-3.60m+	Silt

Comments: Cutting into glacial deposits at the edge of a worked-out gravel pit. Nothing of archaeological significance. **Plate 16**

Location Plan showing R9-TP11:

See R9-CP08 above.

Cable Percussion	R9-CP10
Location	Grounds of DPD premises, Greenhills. Raised area near car
	park.
Date	7 October 2020
Туре	Cable percussion, no hand-digging
Depth	Description
БСРШ	Description
0m-0.20m	Gravel
	•
0m-0.20m	Gravel
0m-0.20m 0.20m-0.50m	Gravel Very stony soil

Comments: This is the edge of a worked-out gravel pit. Nothing of archaeological significance. **Plate 17**

Location Plan showing R9-CP10:

See R9-CP08 above.

Cable Percussion	R9-CP07
Location	Greenhills Road; road surface
Date	10 Oct 2020
Туре	Cable percussion, no hand-digging

Depth	Description
0m-0.02m	Tarmacadam
0.02m-0.05m	Dense stone fill
0.05m-6.00m+	Dense brown gravel

Comments: Modern road surface overlying natural. No archaeological significance.

Location Plan showing R9-CP07:

See R9-CP08 above.

Cable Percussion	R9-CP09
Location	Greenhills Road; road surface
Date	10 Oct 2020
Туре	Cable percussion, no hand-digging
Depth	Description
0m-0.02m	Tarmacadam
0.02m-0.04m	Dense stone fill
0.04m-0.23m	Dense brown sand and gravel

Comments: Modern road surface. No archaeological significance.

Location Plan showing R9-CP09:

See R9-CP08 above.

Cable Percussion	R9-CP12
Location	Greenhills Road; road surface
Date	10 Oct 2020
Туре	Cable percussion, no hand-digging
Depth	Description
0m-0.02m	Tarmacadam
0.02m-0.05m	Dense stone fill
0.05m-0.4.70m	Dense brown gravel
4.70m-5.50m	Soft brown silty clay
5.50m-6.00m	Dark brown boulder clay

Comments: Modern road surface overlying natural. No archaeological significance.

Location Plan showing R9-CP12:

See R9-CP08 above.

Cable Percussion	R9-CP13
Location	Mulcahy Keane industrial estate, Greenhills; corner of car park
Date	8 October 2020
Туре	Cable percussion, no hand-digging.
Depth	Description
0m-0.08m	Tarmacadam
0.08m-0.50m	Very stony dark brown gritty soil
0.50m-0.80m	Grey-brown sandy soil with few stones, sherd of flowerpot
0.80m+	Yellow-brown silty soil

Comments: Former garden soil to about 0.80m. Nothing of archaeological significance. **Plate 18**

Location Plan showing R9-CP13:

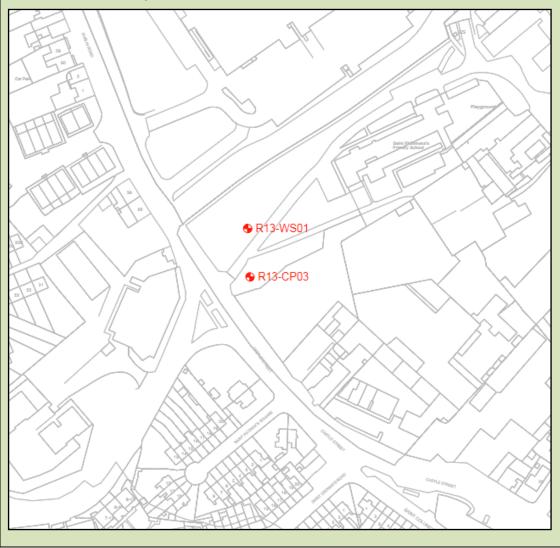
See R9-CP08 above.

Route 13: Bray to City Centre

Window Sample	R13-WS01
Location	Bray, in ornamental grassland beside a driveway
Date	19 Oct 2020
Туре	Hand-dug inspection pit to 1.20m, then window sample drill
Depth	Description
0m-0.40m	Mid-brown garden soil with roots of nearby shrubs
0.40m-1.50m	Lighter brown soil; 1742 coin found in this layer, F#12 listed in
	Appendix 3
1.50m+	Lighter still, natural

Comments: Irish halfpenny of George II, 1742, recovered.

Location Plan showing R13-WS01:



4.2 Review of Finds

Artefacts were recovered from R2-SL02, R9-TP04 and R13-WS01.

The finds recovered from R2-SL02 consist of potsherds (F#'s 1-8 listed in Appendix 3), and include transfer-printed ware, polychrome ware, Willow Pattern, part of the handle of a white stoneware vessel and part of a whisky jar with the inscription:

...t Blak..

[Spir]it Merch[ant]

[Du]blin

There was also a piece of fairly coarse red ware with a pale green glaze, of possible 16th-17th century date.

This assemblage, from a slit trench beside the River Tolka, suggests that either the area behind the wall alongside the river was used as a dump, or that material dredged from the river could have been deposited there. The area is also sited in proximity of a terrace of cottages, Tolka Cottages, recorded in the mid-18th century but now demolished.

The finds from R9-TP04 comprised part of a pipe stem with spur and two potsherds, one of them with a gilt shamrock of fairly modern appearance (F#'s 9-11 listed in Appendix 3). These were mixed with undoubtedly modern refuse, but the clay pipe fragment shows that residual material from the agricultural soil was mixed in.

A copper coin from R13-WS01 was recovered from garden soil beside the driveway into Ravenswell House (F# 12 listed in Appendix 3). The coin comprises an Irish halfpenny depicted on the obverse side with the head of George II and on the reverse with Hibernia 1742 (Plate 20).

5. Conclusions

The stratigraphy revealed in the detailed ground/geotechnical investigations reflected mostly a landscape changed by modern industrial activities and development. A number of the sites in Greenhills were on the edges of worked-out sandpits, once a common feature of the area – the 'green hills' which gave the area its name were long ago removed in the course of sand-winning.

Other sites showed how ornamental grassland around housing developments were often used as a dump for building waste and general refuse before being landscaped.

No trace was found of any archaeological stratigraphy, even in Kilnamanagh, where there had been a group of medieval sites.

Finds retrieved during archaeological monitoring were mostly relatively recent, and reflected disposal of refuse. An 18th-century coin found during window sampling at Bray was a fortuitous find from garden soil.

6. References

Bolger, T., 2010. Archaeological Monitoring of utility slit trenching along the proposed route of Metro West, Co. Dublin. Unpublished report.

National Museum of Ireland Topographical Files

Cartographic Sources

John Rocque's map of Dublin city, 1757 John Rocque's map of County Dublin, 1760 1837-43, first edition 6-inch OS map 1908-13, 25" edition OS map

Cassini c. 1940s edition OS map

Electronic sources

www.excavations.ie Summary accounts of archaeological investigations

www.archaeology.ie Website listing RMP and NIAH sites

www.heritagemaps.ie Heritage Council website

http://digital.ucd.ie Historic OS maps

www.dublinhistoric maps.ie 17th and 18th century historic maps of Dublin

www.stpetersparishbray.com Bray history

7. Monitoring Plates



Plate 1 Slit trench R2-SLT02



Plate 2 Trial pit R9-TP01



Plate 3 Trial pit R9-TP02



Plate 4 Trial pit R9-TP03



Plate 5 Cable percussion R9-CP03



Plate 6 Trial pit R9-TP04



Plate 7 Trial pit R9-TP05

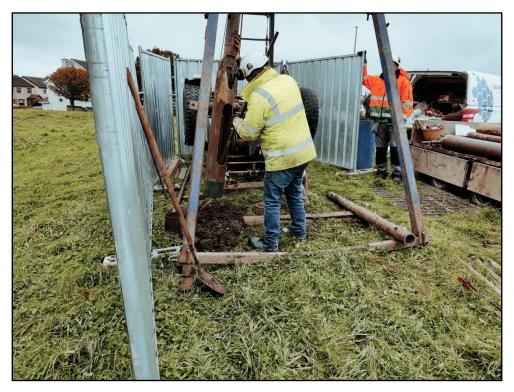


Plate 8 Cable percussion R9-CP04



Plate 9 Trial pit R9-TP06



Plate 10 Cable percussion, R9-CP05



Plate 11 Trial pit R9-TP08



Plate 12 Window sample R9-WS01



Plate 13 Trial pit R9-TP09



Plate 14 Cable percussion R9-CP08



Plate 15 Trial pit R9-TP10



Plate 16 Trial pit R9-TP11



Plate 17 Cable percussion R9-CP10



Plate 18 Cable percussion R9-CP13



Plate 19 Window sample R13-WS01



Plate 20 R13-WS01, Irish halfpenny of George II, 1742

8. Appendix 1 Identified Investigation Locations

Route	Investigation Ref.	Townland, County	Monitoring proposed
CBC02 – Swords to City Centre	R2-CPRC01	Drishoge, Dublin	Yes
CBC02 – Swords to City Centre	R2-CPRC02	Clonliff West, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M09-BH-01	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M10-BH-01	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M16-BH-04	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M16-BH-05	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-01	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-02	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-04	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-06	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-07	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M17-BH-08	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M03-TP-01	Tallaght, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M03-TP-02	Tallaght, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M09-TP-03	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M10-TP-01	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M10-TP-04	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-M11-TP-02	Kilmnamanagh, Dublin	Yes
CBC13 – Bray to City Centre	R13-CP01 unmonitored	Woodland, Dublin	Yes
CBC13 – Bray to City Centre	R13-CP02 unmonitored	Foxrock, Dublin	Yes
CBC13 – Bray to City Centre	R13-CP03	Ravenswell, Wicklow	Yes

9. Appendix 2 Monitored Investigation Locations

Route	Borehole Ref.	Townland, County	Archaeological Monitoring Completed
CBC02 – Swords to City Centre	R2-SLT02	Clonliff West, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP01	Tallaght, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP02	Tallaght, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP03	Tallaght, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP03	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP04	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP05	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP04	Tymon North, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP06	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP05	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP08	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-WS01	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP09	Kilnamanagh, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP08	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP10	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-TP11	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP10	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP07	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP09	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP12	Greenhills, Dublin	Yes
CBC09 – Greenhills to City Centre	R9-CP13	Greenhills, Dublin	Yes
CBC13 – Bray to City Centre	R13-WS01	Ravenswell, Bray, Wicklow	Yes

10. Appendix 3 Register of Finds

Licence #	Find#	Туре	Description	Date	Investigation Location	Townland
20E0622	1	Potsherd	Rim of large transfer-printed plate	29-Sep-20	R02-SLT02	Clonliff West
20E0622	2	Potsherd	Handle of white stoneware vessel	29-Sep-20	R02-SLT02	Clonliff West
20E0622	3	Potsherd	Fragment of transfer-printed plate	29-Sep-20	R02-SLT02	Clonliff West
20E0622	4	Potsherd	Rim of transfer-printed cup	29-Sep-20	R02-SLT02	Clonliff West
20E0622	5	Potsherd	Base of hand-painted cup	29-Sep-20	R02-SLT02	Clonliff West
20E0622	6	Potsherd	Base of Willow Pattern plate '[S]TONE W[]'	29-Sep-20	R02-SLT02	Clonliff West
20E0622	7	Potsherd	Part of plate with red fabric and light green glaze	29-Sep-20	R02-SLT02	Clonliff West
20E0622	8	Potsherd	Part of stoneware vessel with brown glaze. 't Blak[e, Spir]it Merch[ant Du]blin'	29-Sep-20	R02-SLT02	Clonliff West
20E0622	9	Potsherd	Part of cup with shamrock decoration	08-Oct-20	R09-TP04	Kilnamanagh
20E0622	10	Potsherd	Piece of transfer-printed ware	08-Oct-20	R09-TP04	Kilnamanagh
20E0622	11	Clay-pipe	Part of stem with spur	08-Oct-20	R09-TP04	Kilnamanagh
20E0622	12	Coin	Irish halfpenny of George II, 1742	19-Oct-20	R13-WS01	Ravenswell



Bus Connects Route 8 Tallaght/Clondalkin to City Centre – Ground Investigation

Client: National Transport Authority (NTA)

Client's Representative: AECOM/Mott MacDonald

Report No.: 20-0399C

Date: December 2020

Status: Final for Issue





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APPENDICES

Appendix A	Site and e	exploratory l	hole loca	ition plans
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Appendix B Borehole logs

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Appendix F SPT hammer energy measurement report





Document Control Sheet

Report No.:		20-0399C							
Project Title:		Bus Connects Ro	oute 8 Tallaght/C	londalkin to City (Centre				
Client:		National Transp	oort Authority (N	ΓA)					
Client's Repres	entative:	AECOM/Mott M	acDonald						
Revision:	Bus Connects Route 8 Tallaght/Clondalkin to City Centre National Transport Authority (NTA) Security: AECOM/Mott MacDonald Status: Final for Issue Issue Date: 14th Decem 2020 Reviewed by: Approved by: Colm Hurley Darren O'Mahony								
Prepared by:		Reviewed by:		Approved by:					
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Sean Ross BSc MSc MIEI		Colm Hurley BSc FGS PGeo		Darren O'Mahor BSc MSc MIEI Et					

The works were conducted in accordance with:

British Standards Institute (2015) BS 5930:2015, Code of practice for site 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, The Code of Practice for Site Investigation.

Abbreviations use	ed 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.
В	Bulk disturbed sample.
LB	Large bulk disturbed sample.
D	Small disturbed sample.
С	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.
$\overline{}$	Water strike: initial depth of strike.
T	Water strike: depth water rose to.
Abbreviations relating	g to rock core – reference Clause 36.4.4 of BS 5930: 2015
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.





Bus Connects Route 8 Tallaght/Clondalkin to City Centre

1 **AUTHORITY**

On the instructions of AECOM/Mott MacDonald, ("the Client's Representative"), acting on the behalf of National Transport Authority (NTA) ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information to inform the planning stage design and enable the design of Bus Connects Core Bus Corridors.

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 site 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, soil and rock core sampling, environmental sampling, groundwater 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 from north west to north east across the junction of the Long Mile Road and the Naas Road in Drimnagh Dublin 12. The junctions also comprise the Luas Red Line from the Red Cow to Connolly station.



4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 13th and 22nd October 2020, comprised:

- four light cable percussion boreholes
- four rotary follow-on boreholes
- a standpipe installation in two boreholes

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

Four boreholes (R8-CPGS01-R8-CPGS04) were put down by a combination of light cable percussion boring using a Dando 2000 rig and rotary follow-on drilling techniques with core recovery in bedrock using a truck mounted Berretta T44 rotary drilling rig.

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.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Undisturbed (U100) samples were taken where appropriate and as directed within fine soils. Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded.

Where water was added to assist with boring, a note has been added to the log to account for same.

Where the cable percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to bedrock after which rotary coring was employed to recover core samples of the bedrock. Symmetrix cased full-hole drilling was used, with SPTs carried out at standard intervals as required.

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 E.

Where coring was carried out within bedrock strata, Geobor S Coring was used. The core was extracted in up to 1.5m lengths using a SK6L core barrel, which produced core of nominal 102mm diameter, and was placed in single channel wooden core boxes.

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

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

4.3 Standpipe installations

A groundwater monitoring standpipe was installed in R8-CPGS02 and R8-CPGS04.

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

4.4 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 R6 GPS system employing VRS and real time kinetic (RTK) techniques.

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

4.5 Groundwater monitoring

Following completion of site works, groundwater monitoring was conducted on one round. Ground water monitoring was carried out using a water interface probe.

The monitoring records are presented in Section 6.3.

5 LABORATORY WORK

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



5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

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

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

The test results are presented in Appendix D.

5.2 Geotechnical laboratory testing of rock

Laboratory testing of rock sub-samples comprised:

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

Test	Test carried out in accordance with										
Point load index	ISRM Suggested Methods (1985) Suggested method for determining point-load										
	strength. Int. J. Rock Mech. Min. Sci. Geomech. Abstr. 22, pp. 53–60										
Uniaxial	ISRM Suggested Methods (1981) Suggested method for determining										
compression	deformability of rock materials in uniaxial compression, Part 2										
strength tests	and										
	ISRM (2007) Ulusay R, Hudson JA (eds) The complete ISRM suggested methods										
	for rock characterization, testing and monitoring, 2007										

The test results are presented in Appendix D.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise Glacial Till. These deposits are underlain by limestones and shales of the Lucan Formation.





6.2 Ground types encountered during investigation of the site

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

- **Paved surface:** all boreholes encountered paving brick at ground level. Beneath this were both bitmac and concrete of varying thickness likely representing old road surfaces. Concrete was encountered to a maximum depth of 1.00m in R8-CPGS01 and R8-CPGS02.
- **Made Ground (sub-base):** approximately 200-300mm of aggregate fill beneath the paved surface beneath the deepest paved surface to a maximum depth of 1.20m in R8-CPGS01 and R8-CPGS02.
- **Glacial Till:** sandy gravelly clay, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth.
- **Bedrock (Limestone):** Rockhead was encountered at depths ranging from 4.50m in R8-CPGS01-R8-CPGS03 to 6.00m in R8-CPGS04.

6.3 Groundwater

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

Groundwater was encountered during percussion boring and rotary drilling through soil and rock as groundwater strikes as shown in Table 1 below.

Table 1: Groundwater strikes encountered during the ground investigation

GI Ref	Water Level (mbgl)	Comments
R8-CPGS01	4.30	
R8-CPGS02	3.40	
RO-CF G302	3.60	Rose to 3.50m after 20 mins
R8-CPGS03	4.20	
R8-CPGS04	3.50	

It should be noted that the casing used in supporting the borehole walls during drilling may have sealed out any additional groundwater strikes and the possibility of encountering groundwater at other depths during excavation works should not be ruled out.

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



Subsequent groundwater monitoring of the standpipe installations recorded water levels as shown in Table 2.

Table 2: Groundwater monitoring

Date	Water level (mbgl)	
Date	R8-CPGS02	R8-CPGS04
19/11/20	3.29	2.53

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

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: 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.

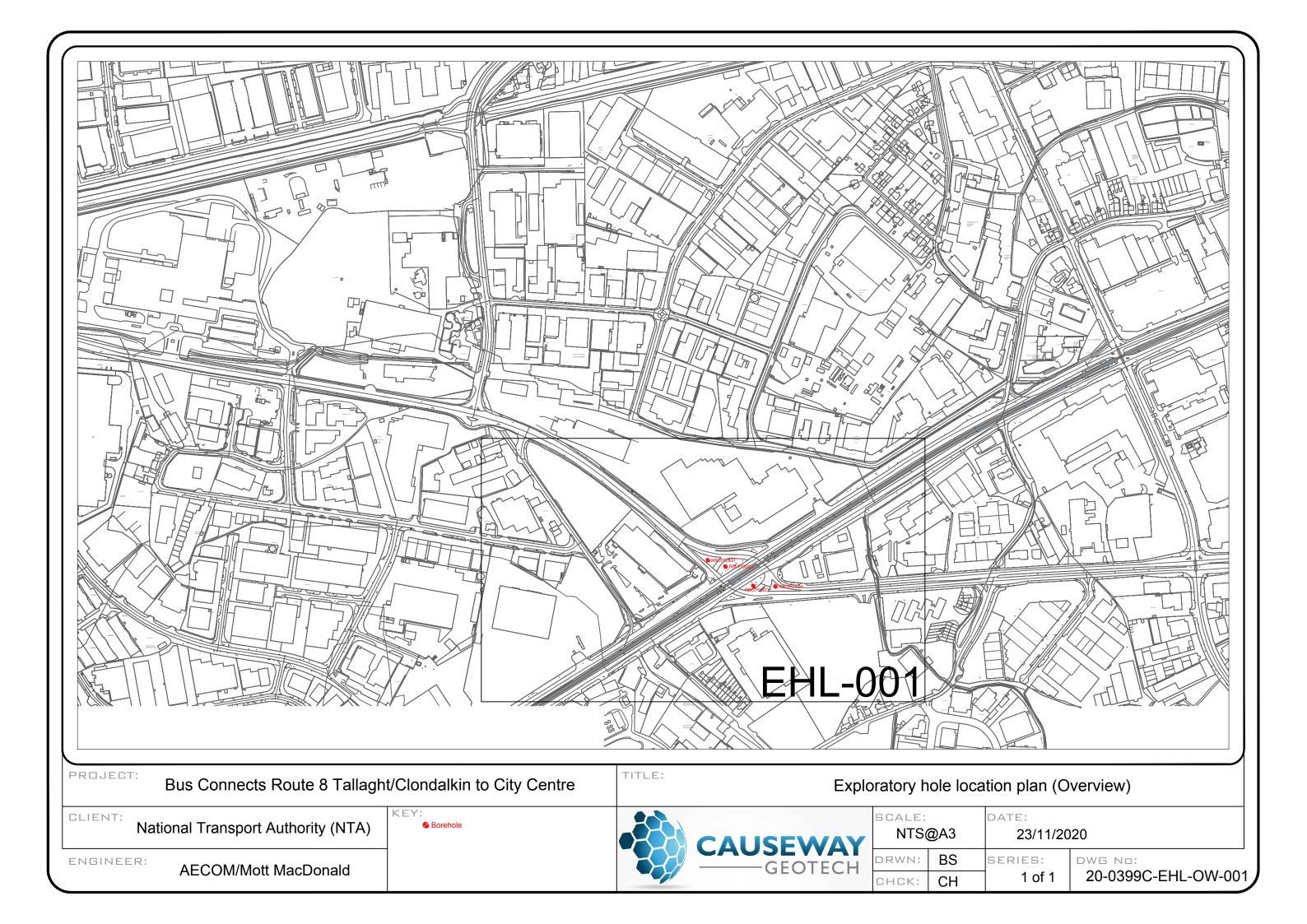
BS EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description.

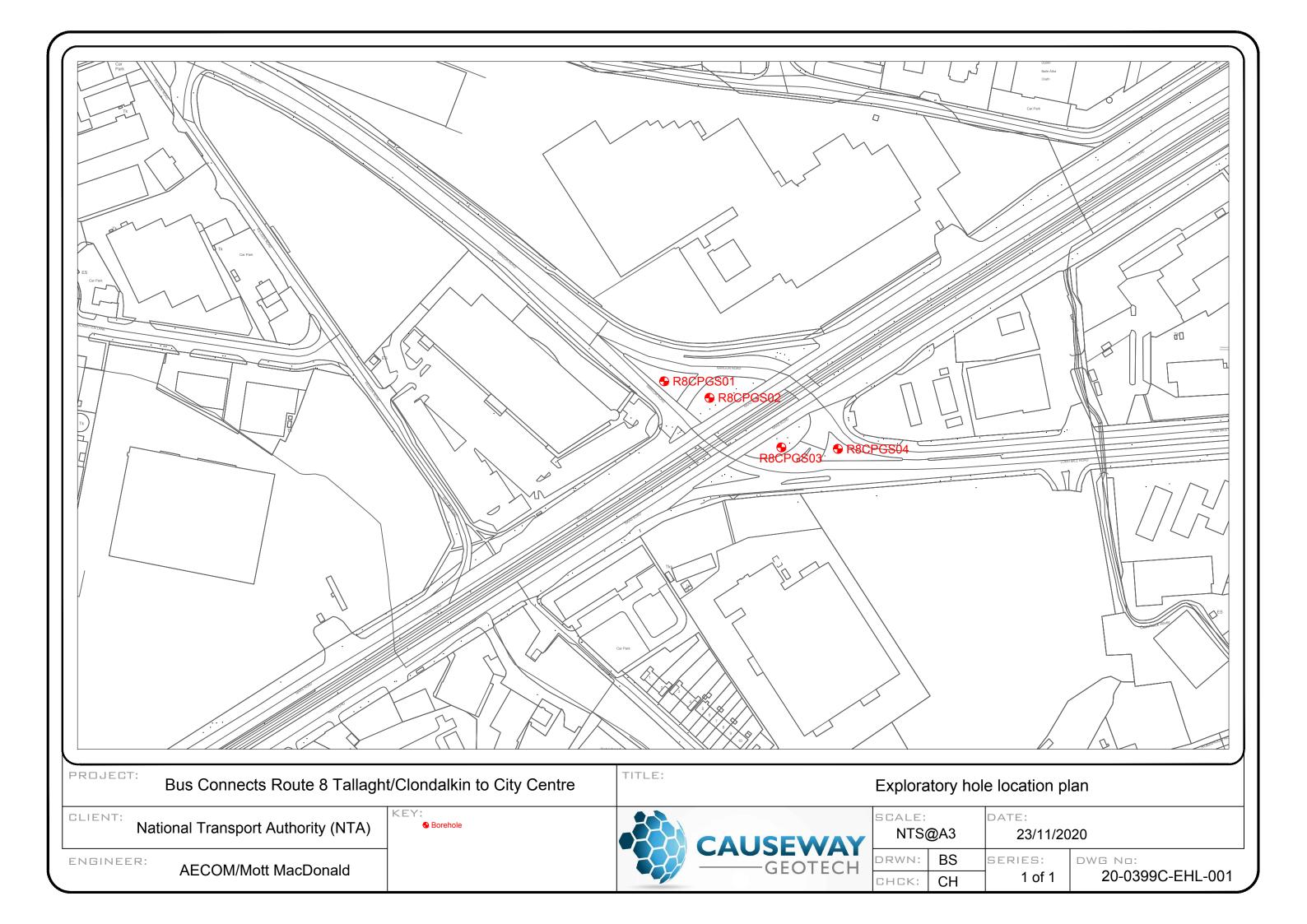
BS EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test.



APPENDIX A SITE AND EXPLORATORY HOLE LOCATION PLAN









APPENDIX B
BOREHOLE LOGS



CAUSEWAY ——GEOTECH Method Plant Used Top (m) Base (m)									20-0	ct No. 399C	Client:	Rep: AECOM/	Transport A	Authority (NT	-A)		R	orehole 8-CPGS	S01
Cable Percuss Rotary Drillin Rotary Corin	ng	Dando 2000 0.00 4.00 Beretta T44 4.00 4.50 Beretta T44 4.50 10.00								0.59 E 1.04 N		Final Depth: 10.00 m Start Date: 13/10/202 Elevation: 48.19 mOD End Date: 19/10/202				BM+GT		50	
	imple / Tests	Fie	eld Re	cords	l		Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend		Desc	ription		1	Water	Backfill	
1.20 D: 1.20	7 52 112 PT (S) 53 8 13 54 PT (S) 9 14 55 5 PT (S) 111 11 trike at 5	Water	/50 fc = 064 /12,11 = 064 100 93 100 Rose	97 73 100 SCR	67 P2 RQD	>20 8	m)	Dry	44.19 43.89 43.69 44.19 43.89 43.69		Remarks Hand dug i	MADE GROUND: PacONCRETE BITMAC MADE GROUND: Graithologies. CONCRETE MADE GROUND: Grof mixed lithologies. Very stiff black slight content. Sand is fin fine to coarse of mi lithologies. Very stiff brownish cobble content. Sand is fin fine to coarse of mi lithologies. Very stiff brownish cobble content. Sand is fin fine to coarse of mi lithologies. Very stiff brownish cobble content. Sand is fine to coarse of mi lithologies. Very stiff brownish cobble content. Sand subrounded fine to subrounded of mixed subrounded of mixed subrounded of mixed subrounded of mixed subrounded in the subrounded of mixed subrounded in the subrounded of mixed subrounded in the subrounded	rey sandy silty s. Sand is fine to the sandy slightly sandy slightly sand is fine to cocarse. Generally sandy gray slightly sand is fine to cocarse of mixed lithologies. grey slightly sand is fine to cocarse of mixed lithologies. grey sandy gray slightly sand is fine to cocarse of mixed lithologies. grey sandy gray sandy gray gray sandy gray sandy gray lithologies. grey sandy gray sand lithologies. grey sandy gray sandy gray sandy gray sandy	subangular fine o coarse. tly gravelly CLAY is ravel is subangular fine of coarse. Cobbles are subangular fine of coarse. Indy slightly gravarse. Gravel is seed lithologies. Cobbles are seed lithologies. Cobbles of coarse o	to coarse Y with low ular to sub ubrounded velly CLAY subangulai obbles are low cobble grey LIME ture spaci re surface ed (25/80/) sits and bi 90 degree l brown sta k grey LIM ghtly close ced (45/22 n clay depo	GRAVEL cobble rounded of of mixed with low r to e content. SSTONE. ng with s. (200), rown joints, aining ESTONE. or fracture (0/720), soits on dightly en			1.0 —
					-		Barre K6L	el	Flush Polyr			on Reason at scheduled depth.			Last Up		W	\AC	- iS

CAUSEWAY GEOTECH									Project No. 20-0399C Client: National Transport Au Client's Rep: AECOM/Mott MacDo						Centre		orehole	
Method Cable Percussion Rotary Drilling	Plant U Dando 2 Beretta	2000)	0.0	(m) 00 00	Base 4.0 4.1	00		dinates 00.59 E	Final De	pth: 10.00 m	Start Date:	13/10/2020	Driller:	BM+GT	Sheet 2 o		
Rotary Coring	Beretta	T44		4.	50	10.		73167	71.04 N	Elevatio	n: 48.19 mOD	End Date:	19/10/2020	Logger:	CH+NP	FINAL		
(m) ·	Samples / Field Records TCR SCR RQD FI Casing Depth (m)							Level mOD	Depth (m)	Legend			cription			Water	Backfill	
Wate	Water	Rose				m)	ellin 1 To (Remarks Hand dug in	Medium strong (loc Partially weathered spacing with brown Discontinuities: 1. 0 to 15 degree be plana and slightly u fracture surfaces. 2. 35 to 40 degree j undulating, smooth fracture surfaces. 3.At 5.25m to 5.55r undulating, smooth surfaces.	l: slightly reduct clay deposits. edding fracture indulating, smooth country widely so with brown country wi	es, medium spaces, medium spaces, medium spaced (240/615 lay infill up to 51 to 8.85m: 75 deg	ced (45/22 n clay depo n/>3400), s mm betwe	r fracture 0/720), sits on lightly en			9.5 -10.010.5 -11.011.5 -12.013.5 -14.015.5 -16.017.5 -18.018.5
				-		Barr K6L	el	Flush Poly			on Reason at scheduled depth.			14/12/2	dated	W	AC	ìS

Meth Cable Perc	nod cussion	Plant U	Jsed 2000	OT I	Top 0.0	(m)	Base	00	20-0	dinates	Project Client: Client's	s Rep: AECOM/Mott MacDonald Sheet 1 of 2
Rotary D Rotary C		Beretta Beretta			4.	00 50	4.5 10.		731660.28 N		Elevatio	on: 47.59 mOD End Date: 20/10/2020 Logger: CH+NP FINAL
Depth (m)	Sample / Tests	Fie	eld Re	cords			Casing Depth (m)	Water Depth (m)	Level mOD 47.49	Depth (m)	Legend	Description Backfill MADE GROUND: Paving brick
0.50 0.50 1.00 1.00 1.20 1.20 - 1.32 2.00 2.00 2.00 - 2.28 3.00 3.00 3.00 - 3.40 4.00 4.00 - 4.08 4.50 4.70 5.45 5.55 6.00 6.00 6.80 7.10 7.50 8.10 9.00 Struck at (m) (a) 3.40 3.60	B7 D11 ES3 SPT (S) B8 ES4 U13 SPT(S) N 25mm/s 50mm/s = 0643 C ES C C C	N=50 (25 for 50mm) Hammer SN Ublow=30 86 Strike at 3.4C Slow seepage I=50 (25 for 60 for Hammer SN	750 fc = 064 0% 0m. e at 3	or 125 13 3.60m 100	85 78 61 RQD	10 5 19 >20 FI	m)	Dry	47.19 46.99 46.59 46.39 46.09 43.99 43.59 43.29 43.09 42.04		Remarks	MADE GROUND: Grey angular fine to coarse GRAVEL of mixed (hthologies). Wery stiff greyish black slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologi
Casing I To (m) I 4.50	Details Diam (mm) 200	Water From (m)		ed o (m)			Barr K6L	el	Flush Poly			ion Reason d at scheduled depth. Last Updated 14/12/2020 14/12/2020

	_		GEC	OTI	EC	Н	lo:	(20-0	ect No. 0399C	Project Name: Bus Connects Route 8 Tallaght/Clondalkin to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald							R8-CPGS02			
Methoo Cable Percu Rotary Dri Rotary Co	ission Iling	Plant U Dando Beretta Beretta	2000 a T44)	0. 4.	.00 .00 .00 .50	4.	(m) 00 50 .00	7097	30.16 E 60.28 N			Start Date: 14/10/202 End Date: 20/10/202					Scale: 1:50			
Depth	Samples	/ Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level	Depth	Legend		Description					Backfill			
(m) .35	С		96	96	81	8			37.59	(m) - 10.00		Medium strong (locally Partially weathered: slig with localised brown clasurfaces. Discontinuities: 1. 10 to 20 degree bedd slightly undulating, smo brown staining on fractu 2. 60 to 85 degree joints to undulating, smooth v localised brown clay infi	weak) thin ghtly reduc ay deposits ding fractur both with p cure surface ts, probably with brown fill up to 12	lly bedded dark ed strength, clo and brown stai res, closely, spac atchy brown cla ss. v widely spaced, a staining on joir	ser fractur ning on fra eed (20/15 ry deposits slightly un t surfaces	e spacing acture 0/310), a and ndulating and	Water		9.5 · · · · · · · · · · · · · · · · · · ·		
Casing De To (m) Dia 4.50	sing to (m)	20 Water	Rose	3.50	m) F	FI 3.70	(m)	ellin _i To (4.0			Remarks Hand dug ir	nspection pit excavated to	o 1.20m.				_		16.5 17.0 17.5 18.0		
							Barı K6L	rel				on Reason at scheduled depth.			14/12/2	dated 2020	W	AG	iS		

		CAUS					L		20-0	ct No. 399C	Project Client: Client's			Authority (N7		Centre	R	R8-CPGS03				
Cable Per Rotary D Rotary O	rcussion Drilling	Plant U Dando Beretta Beretta	2000 T44)	0.0 3.0 4.5	00	3.0 4.5 10.0	00	70977	6.99 E		Final Depth: 10.00 m Start Date: 16/ Elevation: 47.08 mOD End Date: 21/						Scale: 1:	50			
Depth	Sample /								/3162	7.95 N		47.08 mOD		O Logger: CH+NP			FINAL	-				
(m)	Tests	Fie	eld Re	cords			Casing Depth (m)	Water Depth (m)	mOD 46.98	(m) 0.10	Legend	MADE GROUND: Pa		cription			Water	Backfill	_			
0.50 0.50 1.00 1.00 1.20 - 1.65 2.00 2.00 2.00 2.00 - 2.40	B7 ES1 B8 ES2 U20 B9 D16 ES3 SPT (S)	Ublow=20 80 N=50 (2,5/50 Hammer SN		m)		0.00		46.78 46.48 44.58	0.30		CONCRETE MADE GROUND: Gr mixed lithologies. S Firm brown sandy g subangular to subre Very stiff dark grey coarse. Gravel is su	and is fine to o gravelly CLAY. S bunded of mix	coarse. and is fine to co ed lithologies.	oarse. Grav	el is			1.0				
3.00 3.00 3.00 3.00 - 3.06	B10 D11 ES4 SPT (S)	N=50 (25 for 30mm) Hami Strike at 4.20	mer S				0.00	Dry	44.08 42.78	3.00		Very stiff dark grey	sandy gravelly	CLAY. (Driller's (3.0			
4.55 4.70 5.05 5.30	C ES C		100	97	72				42.58	4.50		Medium strong thic weathered: slightly with localised brow Discontinuities: 1. 0 to 15 degree biglanar, and slightly 58mm between soi fracture surfaces. 2. 20 to 40 degree jundulating, smooth	ckly bedded da reduced stren rn clay deposit edding fracture undulating, sn me fracture su loints, widely s	rk grey LIMESTO gth, slightly closes. es, medium span nooth with brow rfaces and oran paced (210/123	ser fracture ced (65/22 vn clay infil ge staining 85/1370),	5/480), Il up to			4.5 — 5.0 — 5.5 — 5.5 —			
6.00 6.00 6.30	c c		100	100	96	6				(5.15)		joint surfaces and r 3. At 5.85m to 6.00 undulating, smooth	m and 7.95m t	o 8.15m: 85 to	-				6.0 —			
7.50 7.50	С		100	100	82														7.5 — 			
9.00 9.05	C	r Strikes	TCR	SCR	RQD		Chic	allina	T Dotoile		Remarks								9.0 —			
		Time (min)	Rose	e to (r	n) Fr	rom (m)	To (m) Tim	e (hh:mm)		nspection pit excavat	ed to 1.20m.									
Casing To (m) 4.50	Details Diam (mm 200	Water) From (m)		ed o (m)		2.50 Core	Barro	3.0 el	Flush	01:00		on Reason			Last Up	dated						
							K6L	-	Polyi			l at scheduled depth.			14/12/	'	W	AC	iS			

Method Cable Percussion	Plant U	Jsed	OTE	ECI	H (m)	Base	_	20-0	399C	Project Client: Client's Final De	Rep: AECOM/	Transport A	Authority (NT	(A)	Centre BM+GT	Borehole ID R8-CPGS03 Sheet 2 of 2 Scale: 1:50			
Rotary Drilling Rotary Coring	Beretta Beretta			3.0 4.		4.5 10.			76.99 E 27.95 N	Elevatio	n: 47.08 mOD	End Date:	21/10/2020	Logger:	CH+NP		FINAL		
Depth (m) Samp	es / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend		Desc	ription			Water	Backfill		
Wat Truck at (m) Casing to 4.20 Casing Details To (m) Diam (m) 4.50 Zoo Zoo	Water	Rose	scr e to (n			m)	elling To (Remarks Hand dug in	Medium strong thic weathered: slightly with localised brow Discontinuities: 1. 0 to 15 degree be planar, and slightly 58mm between sor fracture surfaces. 2. 20 to 40 degree jundulating, smooth joint surfaces and n 3. At 5.85m to 6.00 undulating, smooth 9.43m to 9.51m Browns Soft becoming firm Gravel is subangula	reduced strenn clay depositive dedding fracture undulating, some fracture surplication of the control of the co	gth, slightly closes. ses, medium spaces, medium spaces, medium spaces, medium spaces, faces and orange paced (210/123 lay infill up to 6roint surfaces. o 8.15m: 85 to 9 lay infill gravelly CLAY. Sa	teed (65/22) or clay infil ge staining 5/1370), mm between 90 degree j	e spacing 5/480), I up to on en some joints, ees.			10.5 - 11	
						Barr K6L	el	Flush			on Reason at scheduled depth.			14/12/2	dated 2020	W	AG	iS	

Meth Cable Pro	hod	Plant L	Jsed		Тор	(m)	Base	_	20-0	ect No. 399C	Project Client: Client's	s Rep: AECOM,	Transport /	Authority (N	ΓA)	Centre BM+GT	R	of 2	
Cable Per Rotary D Rotary O	Orilling	Dando : Beretta Beretta	T44	ŀ	0.0 4.0 6.0	00	4.0 6.0 12.0	0	709813.86 E 731627.02 N		Elevation: 46.53 mOD End Date: 22/10				020 Logger: CH+NP			Scale: FIN	
Depth (m)	Sample / Tests	Fie	eld Re	cords			Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend			1	Water	Backfi	II		
0.50 0.50 1.00 1.00	B5 ES1 B6 ES2								46.43 46.23 45.83	0.10		MADE GROUND: Pa CONCRETE MADE GROUND: Gi lithologies. Firm brown sandy g subangular to subre	rey angular fin	Sand is fine to co	oarse. Grav	rel is		***	0.5 —
1.20 1.20 - 1.65	D12 SPT (S)	N=13 (2,2/3, 0643	N=13 (2,2/3,3,3,4) Hammer SN = 0.00 Dry 0643																1.5
2.00 2.00 2.00 - 2.45	B7 ES3 U13	Ublow=20 10				0.00	Dry	44.53	2.00		Stiff greyish black s content. Sand is fir fine to coarse of mi lithologies.	ne to coarse. (Gravel is subang	ular to sub	rounded			2.0	
3.00 3.00 3.00 3.00 - 3.45	B8 D11 ES4 SPT (S)	N=20 (2,3/4,0643) Han	nmer :	SN =	0.00	Dry	42.93	3.60		Very stiff greyish bl	ack clightly ca	ody cliabthy group	olly CLAV (Sand is	•		3.0	
		Strike at 3.50							4.00		fine to coarse. Gra							4.0 —	
4.00 4.00 4.00 - 4.07	B12 D13 SPT (S)	N=50 (25 for 15mm/50 for 50mm) Hammer SN = 0643 N=50 (8,15/50 for 100mm)							42.53			mixed lithologies. Very stiff greyish bl	ack sandy grav	velly CLAY. (Drill	er's descrip	otion)			4.5
5.00 - 5.25	SPT (S)								41.03	5.50		Grey LIMESTONE. (Drillar's dascri	ntion)					5.0
												GICY EINVESTONE. (Dillici 3 descri	ption					-
6.00 6.10 6.20	C C		100	70	51	4 NI			40.53	6.00		Medium strong thin weathered: slightly with brown slightly Discontinuities: 1. 0 to 10 degree by slightly undulating, clay infill up to 40m	reduced strer sandy slightly edding fractur smooth with	ngth, slightly close gravelly clay de es, closely space brown slightly sa	ser fracture posits. ed (50/170, andy slight	/470), ly gravelly			6.5 —
7.40 7.50 7.60	ES C					>20				(2.25)		staining on fracture 2. At 7.20m to 7.60 brown slightly sand ioint surfaces.	e surfaces. m: 85 to 90 de ly slightly grav	egree joint, undu elly clay infill up	ulating, rou to 7mm be	igh with etween			7.5 —
7.70	C		100	97	69	8			38.28	8.25		6.75m to 7.20m: Firm gre to coarse. Gravel is suba Medium strong bed LIMESTONE. Partial	coming strong	thickly bedded	dark grey				8.0 — - - - - - 8.5 —
8.90 9.00 9.20	c c					11						localised brown cla Discontinuities: 1. 0 to 10 degree by planar and slightly	y deposits. edding fractur	es, closely space	ed (30/150,	/400),			9.0
	Wate	r Strikes	TCR	SCR	RQD	FI	Chise	elling	g Details	[;	Remarks								
Casing To (m)	Casing to (m Details Diam (mm	Time (min) Water	Add		m) Fr	rom (3.60	m)	To (m) Tim			nspection pit excavat	ed to 1.20m.						
6.00	200				-		Barre K6L	el	Flush Poly			ion Reason d at scheduled depth.			Last Up 14/12/		W	\A	GS

Method	d	AUS	Jsed		Тор	(m)	Base		20-0	ct No. 399C	Project Client: Client's	Rep: AECOM/	Transport /	Authority (NT	¯A)	Centre BM+GT	R	R8-CPGS04 Sheet 2 of 2			
Cable Percu Rotary Dril Rotary Co	lling	Dando Beretta Beretta	T44		4.	00 00 00	4.0 6.0 12.	00		3.86 E 7.02 N	Elevatio			22/10/2020		CH+NP	:	Scale: 1 FINA			
Depth (m)	Samples /	Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend		Des	cription		1	Water	Backfill			
10.15 10.50 11.05	С			100		>20				(3.75)		Medium strong bec LIMESTONE. Partial localised brown clar Discontinuities: 1. 0 to 10 degree be planar and slightly up to 7mm betwee 2. At 8.30m to 8.74 90 degree incipient clay infill up to 8mn 3. At 9.80m to 9.90 with brown staining	ly weathered: y deposits. edding fractur undulating, sn n some fractu m, 9.60m to 9 joints, undula n and no stain m; 70 degree			9.5					
12.00						3			34.53	12.00			End of Bore	hole at 12.00m					12.0		
																			12.5 —		
Struck at (m) Cas 3.50	Water			scr e to (r			m)	ellin	g Details m) Tim 00 (Remarks	nspection pit excavate	ed to 1.20m.						17.0 — 17.5 — 18.0 — 18.5 — 18		
Casing De To (m) Dia 6.00	etails am (mm) 200	Water From (m)		ed o (m)			Barr	el	Flush Polyi			on Reason			Last Up 14/12/	dated		\A(



APPENDIX C CORE PHOTOGRAPHS



Bus Connects Route 8 Tallaght/Clondalkin to City Centre

Report No.: 20-0399C



R8-CPGS01 Box 1 4.50-6.00m



R8-CPGS01 Box 2 6.00-7.50m



R8-CPGS01 Box 3 7.50-9.00m



R8-CPGS01 Box 4 9.00-10.00m





R8-CPGS02 Box 1 4.50-6.00m



R8-CPGS02 Box 2 6.00-7.50m



R8-CPGS02 Box 3 7.50-9.00m



R8-CPGS02 Box 4 9.00-10.00m





R8-CPGS03 Box 1 4.50-6.00m



R8-CPGS03 Box 2 6.00-7.50m



R8-CPGS03 Box 3 7.50-9.00m



R8-CPGS03 Box 4 9.00-10.00m





R8-CPGS04 Box 1 6.00-7.50m



R8-CPGS04 Box 2 7.50-9.00m



R8-CPGS04 Box 3 9.00-10.50m



R8-CPGS04 Box 4 10.50-12.00m





APPENDIX D GEOTECHNICAL LABORATORY TEST RESULTS





HEAD OFFICE

Registered in Northern Ireland. Company Number: NI610766

REGIONAL OFFICE Causeway Geotech (IRL) Ltd

Unit 3 Balbriggan Business Park, Balbriggan Co Dublin, Ireland, K32 EH36 ROI: +353 (0)1 526 7465

> Registered in Ireland. Company Number: 633786

www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

19 November 2020

Project Name:	Bus Connects Route 8 Tallaght/Clondalkin to City Centre					
Project No.:	20-0399C					
Client:	National Transport Authority (NTA)					
Engineer:	AECOM					

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).

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: Bus Connects - Route 8 - Tallaght/Clondalkin to City Centre

Report Reference: Schedule 1

The table below details the tests carried out, the specifications used, and the number of tests included in this report.

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. 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	14
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	3
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
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS 1377-7: 1990: Cl 8	1
ROCK	Point load index	ISRM Commission on Testing Methods. Suggested Method for Determining Point Load Strength 1985	20
ROCK	Uniaxial Compressive Strength (UCS)*	ISRM Suggested Methods -Rock Characterization Testing and Monitoring, Ed. E T Brown - 1981	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)	pH Value of Soil		4
SOIL – Subcontracted to Eurofins Chemtest Ltd (UKAS 2183)	Sulphate Content water extract		4



Summary of Classification Test Results

Project No.

Project Name

20-0399C

Bus Connects Route 8 - Tallaght/Clondalkin to City Centre

Hole No.			mple		Soil Description	Dens bulk	ity dry	W	Passing 425µm	LL	PL	PI	Particle density	Casagrande
11010 140.	Ref	Тор	Base	Туре	Con Becompain	Mg/m		%	%	%	%	%	Mg/m3	Classification
R8-CPGS01	12	1.20		D	Grey sandy silty subangular fine to coarse GRAVEL.			7.9						
R8-CPGS01	13	2.00		D	Brown sandy gravelly silty CLAY.			10.0						
R8-CPGS01	14	3.00		D	Grey sandy silty subangular fine to coarse GRAVEL.			0.8						
R8-CPGS02	10	1.20		D	Greyish brown gravelly silty fine to coarse SAND.			6.9						
R8-CPGS02	11	2.00		D	Grey sandy slightly gravelly silty CLAY.			10.0						
R8-CPGS02	13	3.00		U	Grey sandy gravelly silty CLAY.			21.0	78	39 -1pt	19	20		CI
R8-CPGS02	12	4.00		D	Brown gravelly clayey fine to coarse SAND.			4.8						
R8-CPGS03	8	1.00		В	Grey sandy very gravelly silty CLAY.			15.0						
R8-CPGS03	20	1.20			Grey sandy slightly gravelly silty CLAY.			21.0	76	36 -1pt	19	17		Cl
R8-CPGS03	16	2.00		D	Grey sandy gravelly silty CLAY.			7.7						
R8-CPGS03	11	3.00		D	Greyish brown sandy silty subangular fine to coarse GRAVEL.			1.6						
R8-CPGS04	13	2.00		U	Brown sandy slightly gravelly silty CLAY.			19.0	74	37 -1pt	19	18		CI
1					· · · · · · · · · · · · · · · · · · ·									

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

LAB 01R Version 4

Key

Density test Liquid Limit Particle density

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

wd - water displacement cas - Casagrande method

wi - immersion in water 1pt - single point test

Date Printed

gj - gas jar

19/11/2020

U KAS

Stephen.Watson

Approved By



Summary of Classification Test Results

Project No. Project Name

20-0399C

Bus Connects Route 8 - Tallaght/Clondalkin to City Centre

20 00														
		Sar	mple	ı		Dens		w	Passing	LL	PL	ΡI	Particle	Casagrande
Hole No.	Ref	Тор	Base	Туре	Soil Description	bulk	dry		425µm	0.4	0,	0,	density	Classification
						Mg/m	13	%	%	%	%	%	Mg/m3	
R8-CPGS04	 	0.00		_	Ones and the server the cities OLAY			0.0						
R8-CPGS04	11	3.00		D	Grey sandy gravelly silty CLAY.			9.8						
R8-CPGS04	40	4.00		_	Grey slightly sandy slightly silty			0.0						
R6-CPG504	13	4.00		D	subangular fine to coarse GRAVEL.			0.9						
												_		
												\vdash		
	\vdash											\vdash		
All tests perfor	med i	n accord	lance wit	h BS1	377:1990 unless specified	otherwis	e						LAE	3 01R Version 4

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

Key

Density test Liquid Limit Particle density

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

wd - water displacement

wi - immersion in water

cas - Casagrande method

1pt - single point test

gj - gas jar

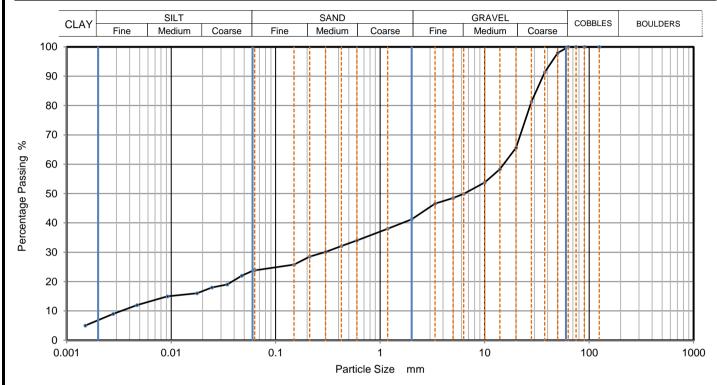
Date Printed

19/11/2020

Approved By

Stephen.Watson

CAUSEWAY	DAD	ICLE SIZE DIST	FDIRLITION	Job Ref	20-0399C	
GEOTECH	PARI	ICLE SIZE DIST	Borehole/Pit No.	R8-CPGS03		
Site Name	Bus Connects Route	8 - Tallaght/Clonda	lkin to City Centre		Sample No.	8
Soil Description	Grey sandy very gravell	y silty CLAY.	Depth, m	1.00		
Specimen Reference	4	Specimen Depth	1	m	Sample Type	В
Test Method	BS1377:Part 2:1990, cla	BS1377:Part 2:1990, clauses 9.2 and 9.5				Caus2020103052



Siev	ving	Sedimentation				
Particle Size mm	% Passing	Particle Size mm	% Passing			
125	100	0.06290	24			
90	100	0.04744	22			
75	100	0.03447	19			
63	100	0.02454	18			
50	98	0.01769	16			
37.5	91	0.00925	15			
28	81	0.00471	12			
20	66	0.00278	9			
14	58	0.00150	5			
10	54					
6.3	50					
5	49					
3.35	47					
2	41					
1.18	38					
0.6	34	Particle density	(assumed)			
0.425	32	2.65	Mg/m3			
0.3	30					
0.212	29					
0.15	26					
0.063	24					

Dry Mass of sample, g	6123

Sample Proportions	% dry mass				
Cobbles	0.0				
Gravel	58.8				
Sand	17.4				
Silt	16.6				
Clay	7.2				

Grading Analysis		
D100	mm	
D60	mm	15.2
D30	mm	0.294
D10	mm	0.00318
Uniformity Coefficient		4800
Curvature Coefficient		1.8

Remarks

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



Approved

Stephen.Watson

LAB 05R Version 4

CAUSEWAY	Unconsolidate			Job Ref	20-0399C	
——GEOTECH	Compression Test without measurement of pore pressure - single specimen				Borehole/Pit No.	R8-CPGS04
Site Name	Bus Connects Route	8 - Tallaght/Clor	ndalkin to City Centro	Sample No.	13	
Soil Description	Brown sandy slightly	gravelly silty CL	AY.	Depth	2.00	
Specimen Reference	6	Specimen Depth	2.05	m	Sample Type	U
Specimen Description	Stiff brown sandy slig	htly gravelly silty	/ CLAY.	KeyLAB ID	Caus2020103056	
Test Method	BS1377 : Part 7 : 199	90, clause 8, sing	gle specimen		Date of test	09/11/2020

Test Number Length Diameter **Bulk Density** Moisture Content Dry Density

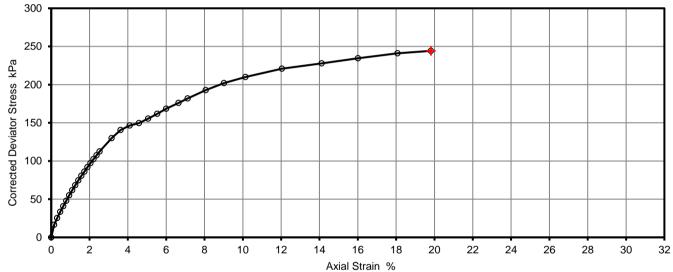
Rate of Strain Cell Pressure At failure

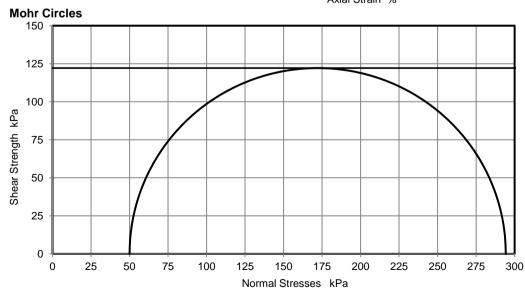
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

1	
209.4	mm
104.5	mm
2.39	Mg/m3
10.6	%
2.16	Mg/m3

2.0	%/min
50	kPa
19.8	%
244	kPa
122	kPa ½(σ1 - σ3)f

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects based on Fig 11 BS1377-7:1990

Mohr circles and their interpretation is not covered by BS1377-7. This is provided for information only.

Remarks

No failure defined. Testing terminated at 20% axial strian

Approved

Stephen.Watson

Printed

16/11/2020 14:12

LAB 15R Version 4

CA	AUSEW, GEOTE						Po				trenç ary o				its			
Project No.	-0399C			Proje	ct Name	Э	В	us Co	nnects	s Rout	te 8 - T	allaght	/Clonda	alkin to	City C	Centre		
Borehole	Sa	mple		Spe	cimen	0.17	Test Type see ISRM		Type (N/X) pile		Dimens		Dimensions		Equivalent diameter, De	Point Strengt		Remarks (including
No.	Depth m	Ref.	Туре	Ref.	Depth m	Rock Type	Type (D, A, I, B)	Direction (L, P or U)	Failure Valid (Y/N)	Lne	W	Dps	Dps'	kN	g Equival	Is MPa	Is(5 0) _{MPa}	water content if measured)
R8-CPGS01	4.60		С	1	4.60	LIMESTONE	А	U	NO		101.5	57.0	55.0	21.0	84.3	3.0	3.7	
R8-CPGS01	5.00		С	2	5.00	LIMESTONE	Α	U	YES		101.6	61.0	57.0	18.4	85.9	2.5	3.2	
R8-CPGS01	5.75		С	3	5.75	LIMESTONE	D	U	NO	88.9	101.8	101.8	100.0	24.3	100.9	2.4	3.3	
R8-CPGS01	5.90		С	4	5.90	LIMESTONE	D	U	YES	81.2	101.6	101.6	99.0	19.6	100.3	1.9	2.7	
R8-CPGS01	6.35		С	5	6.35	LIMESTONE	Α	U	YES		101.7	54.0	50.0	17.1	80.5	2.6	3.3	
R8-CPGS01	6.90		С	6	6.90	LIMESTONE	D	U	NO	78.3	101.4	101.4	97.0	14.9	99.2	1.5	2.1	
R8-CPGS02	4.50		С	7	4.50	LIMESTONE	D	U	NO	74.6	101.4	101.4	99.0	22.3	100.2	2.2	3.0	
R8-CPGS02	5.45		С	8	5.45	LIMESTONE	А	U	YES		101.3	59.0	56.0	17.6	85.0	2.4	3.1	
R8-CPGS02	6.00		С	9	6.00	LIMESTONE	D	U	YES	69.7	101.4	101.4	99.0	18.2	100.2	1.8	2.5	
R8-CPGS02	7.10		С	10	7.10	LIMESTONE	D	U	YES	73.9	101.5	101.5	97.0	19.8	99.2	2.0	2.7	
R8-CPGS03	4.55		С	11	4.55	LIMESTONE	D	U	YES	70.2	101.1	101.1	98.0	19.1	99.5	1.9	2.6	
R8-CPGS03	5.30		С	12	5.30	LIMESTONE	А	U	YES		101.3	48.0	44.0	18.0	75.3	3.2	3.8	
R8-CPGS03	6.30		С	13	6.30	LIMESTONE	D	U	NO	77.5	101.2	101.2	100.0	20.8	100.6	2.1	2.8	
R8-CPGS03	6.80		С	14	6.80	LIMESTONE	Α	U	YES		101.3	55.0	51.0	17.6	81.1	2.7	3.3	
R8-CPGS04	6.00		С	15	6.00	LIMESTONE	D	U	NO	72.1	101.2	101.2	100.0	21.6	100.6	2.1	2.9	
R8-CPGS04	6.10		O	16	6.10	LIMESTONE	Α	U	YES		101.3	59.0	54.0	24.5	83.5	3.5	4.4	
R8-CPGS04	7.60		С	17	7.60	LIMESTONE	D	U	NO	80.6	101.3	101.3	100.0	22.6	100.6	2.2	3.1	
R8-CPGS04	8.90		O	18	8.90	LIMESTONE	Α	U	YES		101.2	51.0	47.0	16.5	77.8	2.7	3.3	
Test Type D - Diametral, A - Axial, I - Irregular Lump, B - Block Direction L - parallel to planes of weakness P - perpendicular to planes of weakness U - unknown or random Dimensions Dps - Distance between platens (platen separation) Dps' - at failure (see ISRM note 6) Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P										Dps								
Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise Detailed legend for test and dimensions, based on ISRM, is shown above. Size factor, F = (De/50)0.45 for all tests. LAB 17R Version 4 Date Printed Approved By 19/11/2020 Stephen.Watson																		

Project No. Point Load S Summ															ts			
Project No.)-0399C			Proje	ect Name	Э	R	us Co	nnacte	e Pout	te 8 - T	allaght	(Clond	alkin to	City (Centre		
Borehole		ample		Spe	ecimen		Test	Type ISRM		S Koui		ensions	Cionda	Force	Equivalent diameter, S	Point Load Strength Index		Remarks (including
No.	Depth	Ref.	Туре	Ref.	Depth	Rock Type	Type (D, A, I, B)	Direction (L, P or U)	Failure Valid (Y/N)	Lne	W	Dps	Dps'	kN		Is MPa	Is(5 0) _{MPa}	water content if measured)
R8-CPGS04	9.20		С	19	9.20	LIMESTONE	D	U	YES	mm 85.2	mm 101.4	mm 101.4	97.0	19.4	mm 99.2	2.0	2.7	
R8-CPGS04	10.15		С	20	10.15	LIMESTONE	D	U	NO	81.0	101.3	101.3	99.0	22.7	100.1	2.3	3.1	
Test Type D - Diametral, A - Axial, I - Irregular Lump, B - Block Direction L - parallel to planes of weakness P - perpendicular to planes of weakness U - unknown or random Dimensions Dps - Distance between platens (platen separation) Dps' - at failure (see ISRM note 6) Lne - Length from platens to nearest free end W - Width of shortest dimension perpendicular to load, P											_							
Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise Detailed legend for test and dimensions, based on ISRM, is shown above. Size factor, F = (De/50)0.45 for all tests.												U K A S TESTING 10122						



UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS

Project No.

Project Name

20-0399C

Bus Connects Route 8 - Tallaght/Clondalkin to City Centre

		Sar	nple				Specime mensio		Bulk	Water	Uniaxi	ial Compre	ession ³	
Hole No.	Ref	Тор	Base	Туре	Rock Type	Dia.	Length mm	H/D	Density ² Mg/m ³	Content ¹ %	Condition	Mode of failure	UCS MPa	Remarks
R8-CPGS01		6.60		С	LIMESTONE	101.4	261.7	2.6	2.69	0.2	as received	F	99.9	
R8-CPGS01		7.50		С	LIMESTONE	101.4	251.9	2.5	2.69	0.1	as received	F	73.4	
R8-CPGS01		9.35		С	LIMESTONE	101.5	252.8	2.5	2.69	0.2	as received	F	93.6	
R8-CPGS02		5.55		С	LIMESTONE	101.4	253.7	2.5	0.27	0.1	as received	F	80.2	
R8-CPGS02		6.80		С	LIMESTONE	101.4	254.1	2.5	2.68	0.3	as received	F	88.2	
R8-CPGS02		8.10		С	LIMESTONE	101.5	252.7	2.5	2.68	0.1	as received	F	80.7	
R8-CPGS02		9.35		С	LIMESTONE	101.4	252.6	2.5	2.68	0.2	as received	F	104.0	
R8-CPGS03		5.05		С	LIMESTONE	101.5	254.1	2.5	2.69	0.2	as received	F	88.7	
R8-CPGS03		6.00		С	LIMESTONE	101.5	251.9	2.5	2.69	0.2	as received	F	92.4	
R8-CPGS03		7.50		С	LIMESTONE	101.4	253.6	2.5	2.72	0.2	as received	F	72.8	
R8-CPGS03		9.05		С	LIMESTONE	101.3	251.5	2.5	2.68	0.1	as received	F	76.7	
R8-CPGS04		6.20		С	LIMESTONE	101.4	255.6	2.5	2.68	0.2	as received	F	104.0	
R8-CPGS04		7.70		С	LIMESTONE	101.4	254.4	2.5	2.71	0.1	as received	F	99.3	
R8-CPGS04		11.05		С	LIMESTONE	101.5	251.0	2.5	2.67	0.1	as received	F	108.0	
Notes														

- 1 ISRM p87 test 1, water content at 105 \pm 3 $^{\circ}\text{C},$ specimen as tested for UCS
- 2 ISRM p86 clause (vii), Caliper method used for determination of bulk volume and derivation of bulk density
- $3\,$ ISRM p153 part 1, determination of Uniaxial Compressive Strength (UCS) of Rock Materials

S - Single shear AC - Axial cleavage

Mode of failure :

MS - multiple shear

Axial cleavage F - Fragmented

above notes apply unless annotated otherwise in the remarks

above notes apply unless annotated otherwise in the remarks				
Test Specification	Date Printed	Approved By	Table	
International Society for Rock Mechanics, The complete ISRM suggested methods for Rock Characterization Testing and Monitoring, 2007	19/11/2020		sheet	1
		Stephen.Watson		1



eurofins

Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Chemtest

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-30005-1

Initial Date of Issue: 10-Nov-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 McAllis

Project 20-0399C Bus Connects 8

Quotation No.: Date Received: 05-Nov-2020

Order No.: Date Instructed: 05-Nov-2020

No. of Samples: 4

Turnaround (Wkdays): 5 Results Due: 11-Nov-2020

Date Approved: 10-Nov-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Results - Soil

Project: 20-0399C Bus Connects 8

Client: Causeway Geotech Ltd		Chemtest Job No.:				20-30005	20-30005	20-30005
Quotation No.:	(Chemte	st Sam	ple ID.:	1092179	1092180	1092181	1092182
Order No.:		Client Sample Ref.:				10	8	12
	Sample Location:				R8-CPGS01	R8-CPGS01	R8-CPGS03	R8-CPGS04
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				2.00	4.00	1.00	4.00
			Date Sa	ampled:	04-Nov-2020	04-Nov-2020	04-Nov-2020	04-Nov-2020
Determinand	Accred.	SOP	Units	LOD				
Moisture	N	2030	%	0.020	13	8.5	14	0.47
рН	U	2010		4.0	8.4	8.7	8.6	9.6
Sulphate (2:1 Water Soluble) as SO4	U 2120 g/l 0.010				0.36	0.13	0.17	0.014

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	рН	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"

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 45 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: <u>customerservices@chemtest.com</u>



💸 eurofins

Chemtest
Eurofins Chemtest Ltd
Depot Road
Newmarket
CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Final Report

Report No.: 20-31072-1

Initial Date of Issue: 19-Nov-2020

Client Causeway Geotech Ltd

Client Address: 8 Drumahiskey Road

Balnamore Ballymoney County Antrim BT53 7QL

Contact(s): Carin Cornwall

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 McAllis

Project 20-0399C Route 8 Tallaght/

Clondalkin to City Centre

Quotation No.: Date Received: 16-Nov-2020

Order No.: Date Instructed: 16-Nov-2020

No. of Samples: 4

Turnaround (Wkdays): 5 Results Due: 20-Nov-2020

Date Approved: 19-Nov-2020

Approved By:

Details: Glynn Harvey, Technical Manager



Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL

Tel: 01638 606070 Email: info@chemtest.com

Results - Soil

Project: 20-0399C Route 8 Tallaght/Clondalkin to City Centre

Client: Causeway Geotech Ltd		Che	mtest Jo	ob No.:	20-31072	20-31072	20-31072	20-31072
Quotation No.:	Chemtest Sample ID.:			1097043	1097044	1097045	1097046	
	Sample Location:				R8CPGS01	R8CPGS02	R8CPGS03	R8CPGS04
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				4.50	4.70	4.70	7.40
			Date Sa	ampled:	13-Nov-2020	13-Nov-2020	13-Nov-2020	13-Nov-2020
Determinand	Accred.	SOP	Units	LOD				
Moisture	N	2030	%	0.020	0.38	0.58	1.3	5.1
рН	U	2010		4.0	8.9	9.2	8.8	8.9
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.018	0.023	0.059	< 0.010

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	рН	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
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LABORATORY RESTRICTION REPORT

Projec	t Referenc	;e		20-03	99C	То	Sean Ross
Proj	ect Name	Вι	ıs Conn	ects Route 8 Tallag	ht/Clondalkin to City Centre	Position	Project Manager
TR	reference			20-0399C	/ G01	From Position	Joseph Nicholl Laboratory Quality Manage
he following the	ng sample(s laboratory.	and test(s) are re		ow. Could you please complete the		
Hole Number	Number	Sample Depth (m)	Туре	Test Type	Reason for Restrict	ion	Required Action
R8 CPG S02	13	3.00	U	UU Triaxial	Unable to obtain specime - coarse gravel content t		CANCEL
R8 CPG S03	20	1.20	U	UU Triaxial	Unable to obtain specime - coarse gravel content t		CANCEL
			\square				
			H				

For electronic reporting a form of electronic signature or printed name is acceptable

Laboratory Signature Joseph Nicholl	Project Manager Signature Sean Ross
Date 13 November 2020	Date



APPENDIX E SPT HAMMER ENERGY MEASUREMENT REPORT





SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing Keeble House Stuart Way East Grinstead West Sussex

RH19 4QA

.0209 SPT Hammer Ref:

Test Date:

22/02/2020

Report Date:

03/03/2020

File Name:

.0209.spt

Test Operator:

NPB

Instrumented Rod Data

54 Diameter d_r (mm): 6.0 Wall Thickness t_r (mm): Assumed Modulus Ea (GPa): 200 6458

Accelerometer No.1:

Accelerometer No.2:

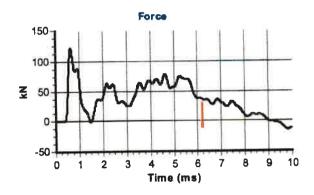
9607

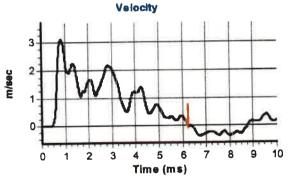
SPT Hammer Information

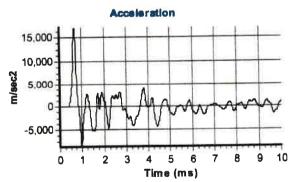
Hammer Mass m (kg): 63.5 Falling Height h (mm): 760 SPT String Length L (m): 10.0

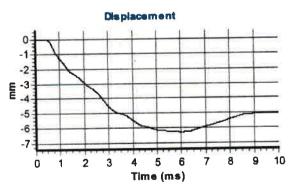
Comments / Location

BALLEYMONEY









Calculations

Area of Rod A (mm2): 905 473 Theoretical Energy Etheor (J): 317 Measured Energy E_{meas} (J):

Energy Ratio E_r (%):

67

Neil Burrows Signed:

Title:

Field Operations Manager

The recommended calibration interval is 12 months



SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing Keeble House Stuart Way East Grinstead

West Sussex RH19 4QA SPT Hammer Ref:

.0643

Test Date:

22/02/2020

Report Date:

03/03/2020

File Name:

.0643.spt

Test Operator:

NPB

Instrumented Rod Data

Diameter d_r (mm):

54

Wall Thickness t_r (mm):

6.0

Assumed Modulus Ea (GPa): 200

0.0

Accelerometer No.1:

6458

Accelerometer No.2:

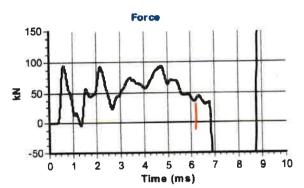
9607

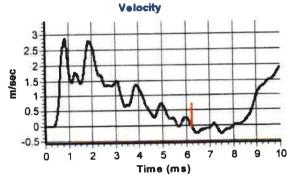
SPT Hammer Information

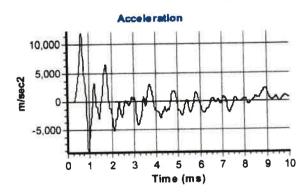
Hammer Mass m (kg): 63.5 Falling Height h (mm): 760 SPT String Length L (m): 10.0

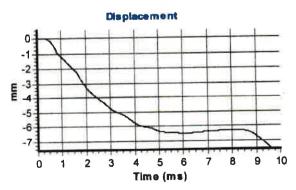
Comments / Location

BALLEYMONEY









Calculations

Area of Rod A (mm2):

905

Theoretical Energy E_{theor} (J):

473

Measured Energy E_{meas} (J):

400

Energy Ratio E , (%):

85

Signed: Neil Burrows

Title:

Field Operations Manager

The recommended calibration interval is 12 months