Appendix A14.2 Ground Investigation Report





Bus Connects Route 6 Lucan to City Centre – Ground Investigation

Client:

National Transport Authority (NTA)

Client's Representative: AECOM/Mott MacDonald

Report No.:

Date:

Status:

20-0399B

December 2020

Final for Issue

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stered in Northern Ireland. Company Number: NI610766 Approved: ISO 9001 • ISO 14001 • OHSAS 18001





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Document Control Sheet

Report No.:		20-0399B						
Project Title:		Bus Connects Route 6 Lucan to City Centre						
Client:		National Transport Authority (NTA)						
Client's Repres	sentative:	AECOM/Mott MacDonald						
Revision: A01		Status:	Final for Issue	Issue Date:	16 th December 2020			
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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).
Р	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 strengthVR: 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.
\bigtriangledown	Water strike: initial depth of strike.
\checkmark	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 6 Lucan 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, slit trenches, 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 on and alongside the N4 road from Junction 2 in the west to Ballyfermot Training Centre adjacent to the R148 (Chapilizod Bypass) in the east. The main land use in the area is residential and light commercial with Liffey Valley Shopping Centre located in the centre of the site. Large residential developments are found east through west.





4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 24th September and 24th October 2020, comprised:

- six light cable percussion boreholes
- one borehole by combined percussion boring and rotary follow-on drilling
- six boreholes by dynamic (windowless) sampling methods
- a standpipe installation in one borehole
- one slit trench

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 thirteen 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 Dando Terrier rigs, light cable percussion boring by Dando 2000 rigs, and rotary drilling (by Hanjin D8 rotary drilling rigs).

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

Six boreholes (R6-CP01, R6-CP03 and R6-CP08 – R6-CP11) were put down to completion in minimum 200mm diameter using Dando 2000 light cable percussion boring rigs. All boreholes were terminated on encountering virtual refusal on obstructions.

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.

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 H.

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

Appendix B presents the borehole logs.

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

One borehole (R6-CP07) was put down by a combination of light percussion boring and rotary follow-on drilling techniques with core recovery in bedrock. Where the light percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to completion/bedrock. Symmetrix cased full-hole drilling was used, with SPTs carried out at standard intervals as required.

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.

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 H.

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.





4.2.3 Dynamic sampled boreholes

Six boreholes (R6-CP02, R6-CP04 – R6-CP06, R6-WS01 & R6-WS02) were put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig. The boreholes were put down initially in 150mm diameter, reducing in diameter with depth as required, down to 50mm by use of the smallest sampler.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down clear of services or subsurface obstructions. The boreholes were taken to depths ranging between 0.87m and 3.60m where they were terminated on encountering virtual refusal on obstructions.

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 H.

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

Any water strikes encountered during boring were recorded along with any changes in their levels as the borehole proceeded. Details of the water strikes are presented on the individual borehole logs.

Appendix B presents the borehole logs.

4.3 Dynamic probes

Two dynamic probes (R6-CP02DP and R6-CP07DP) were conducted as a follow on from the boreholes using the DPSHB method as described in BS EN ISO 22476-3:2005+A1:2011. The method entails a 63.5kg hammer falling 0.75m onto a 50.5mm diameter cone with an apex angle of 90°.

Appendix B provides the dynamic probe logs on the sheet following the relevant borehole log in the form of plots, against depth, of the number of blows per 100mm penetration.

4.4 Standpipe installations

A groundwater monitoring standpipe was installed in boreholes R6-CP07

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





4.5 Slit trenches

One slit trench (R6-TP01) was excavated by a combination of hand digging and mechanical excavation using a compact 3t tracked excavator fitted with a 600mm wide toothless bucket, to locate and identify buried services at the site. An attempt was also made to investigate foundations of existing bridge abutments at this location. A concrete projection was identified at 1.10mbgl however it was not possible to establish or confirm foundation makeup.

Drawing of the trenches and the locations of services encountered during excavation are shown along with the slit trench logs in Appendix D, with photographs presented in Appendix E.

4.6 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) at each location are recorded on the individual exploratory hole logs. The exploratory hole plan presented in Appendix A shows these as-built positions.

4.7 Groundwater monitoring

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

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
- 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 F.

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 F.

5.3 Environmental laboratory testing of soils

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

Testing was carried out on a number of samples according to Engineer's Ireland Suite E and Suite H including testing for a range of determinants:

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

Results of environmental laboratory testing are presented in Appendix G.





6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise mainly Glacial Till. These deposits are underlain by limestone and shale of the Lucan Formation. An area of gravels derived from limestone underlain by the Waulsortian Limestones was noted on the site's western boundary. East of the M50 on the Chapelizod Bypass is underlain by made ground, alluvium and glacial till.

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:** boreholes R6-CP10 & R6-CP11 encountered 0.3mm of macadam surfacing. In addition, R6-TP01 had concrete down to 100mm. Concrete was encountered at 4.0mbgl in borehole R6-CP10
- **Topsoil:** the remainder of the site encountered topsoil in 0.1m-0.3m thickness.
- **Made Ground (sub-base):** approximately 1.0m of aggregate fill beneath the paved surfaces.
- **Made Ground (fill):** reworked sandy gravely clay fill occasionally with fragments of concrete extending to a maximum depth of 4.0m at bridge abutment locations.
- **Alluvium:** very soft clay encountered at depths ranging 3.0m-4.0m in borehole R6-CP09
- **Glacial Till:** sandy gravelly clay, typically firm or stiff in upper horizons, becoming very stiff with increasing depth.
- **Bedrock (Limestone):** Rockhead was encountered at a depth of 7.6m in R6-CP07.

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 through soil as water strikes at 2.5m – 3.1m in boreholes R6-CP03 – R6-CP05 and R6-CP07. Groundwater was encountered in slit trench R6-TP02.





Groundwater was not noted during drilling at the remaining exploratory locations. However, it should be noted that the casing used in supporting the borehole walls during drilling may have sealed out 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 installation recorded water levels as shown in Table 1.

Date	Water level (mbgl)
Date	R6-CP07
19/11/2020	6.35

Table 1: Groundwater monitoring

Continued monitoring of the installed standpipe will give an indication of the seasonal variation in groundwater level which should be factored into design considerations.

7 **REFERENCES**

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

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

BS 5930: 2015: 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.

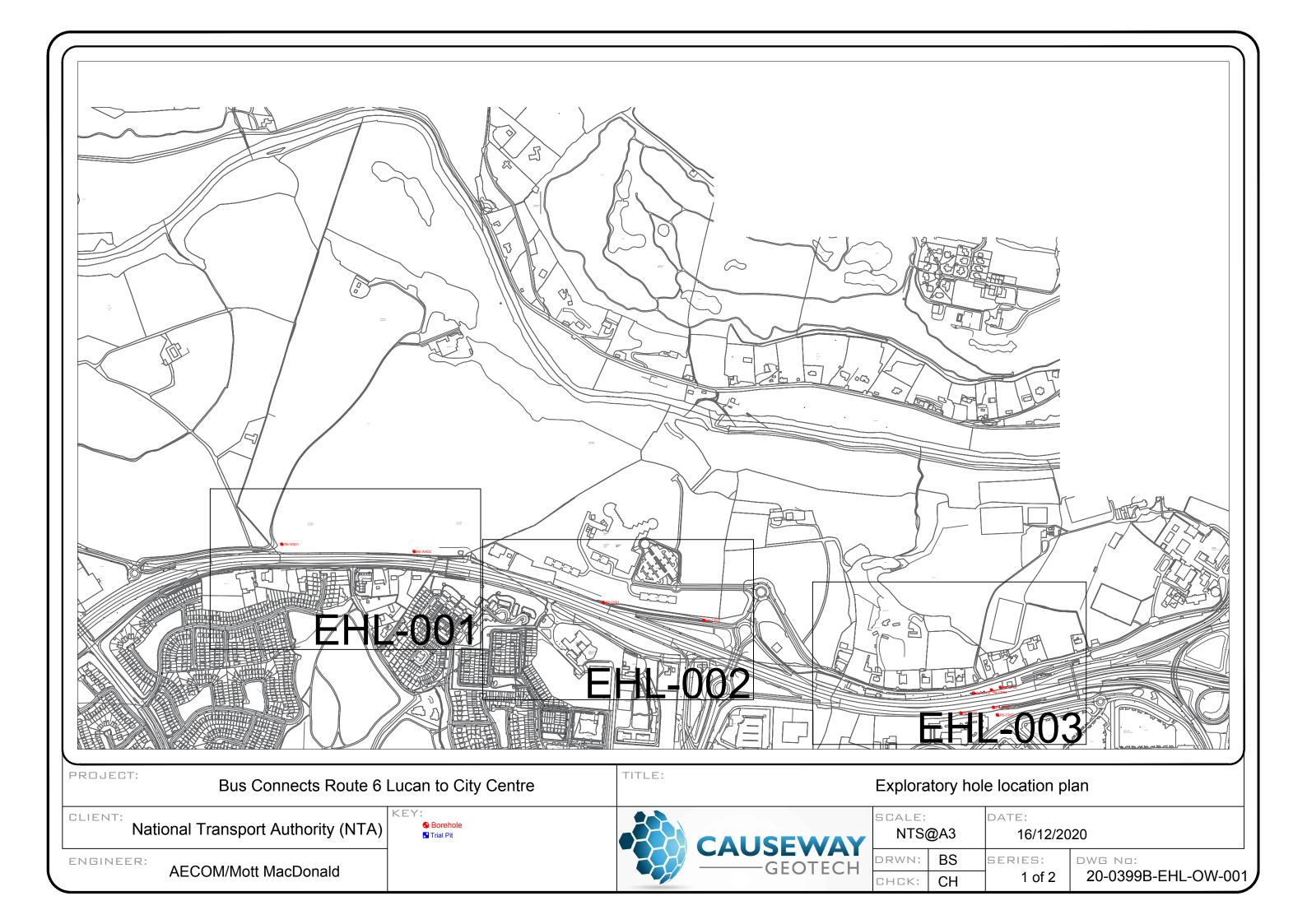
BS EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description.

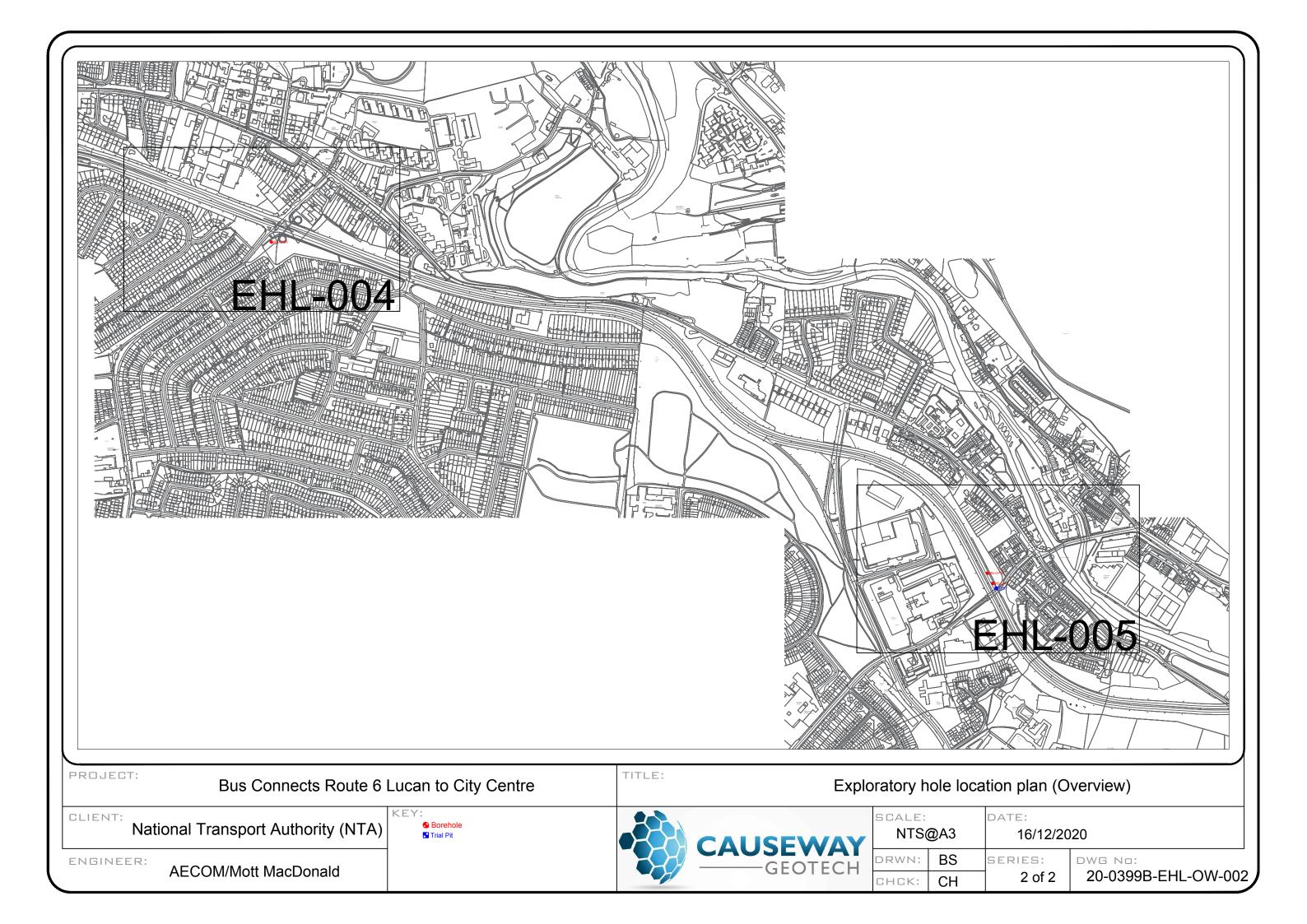
BS EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test.

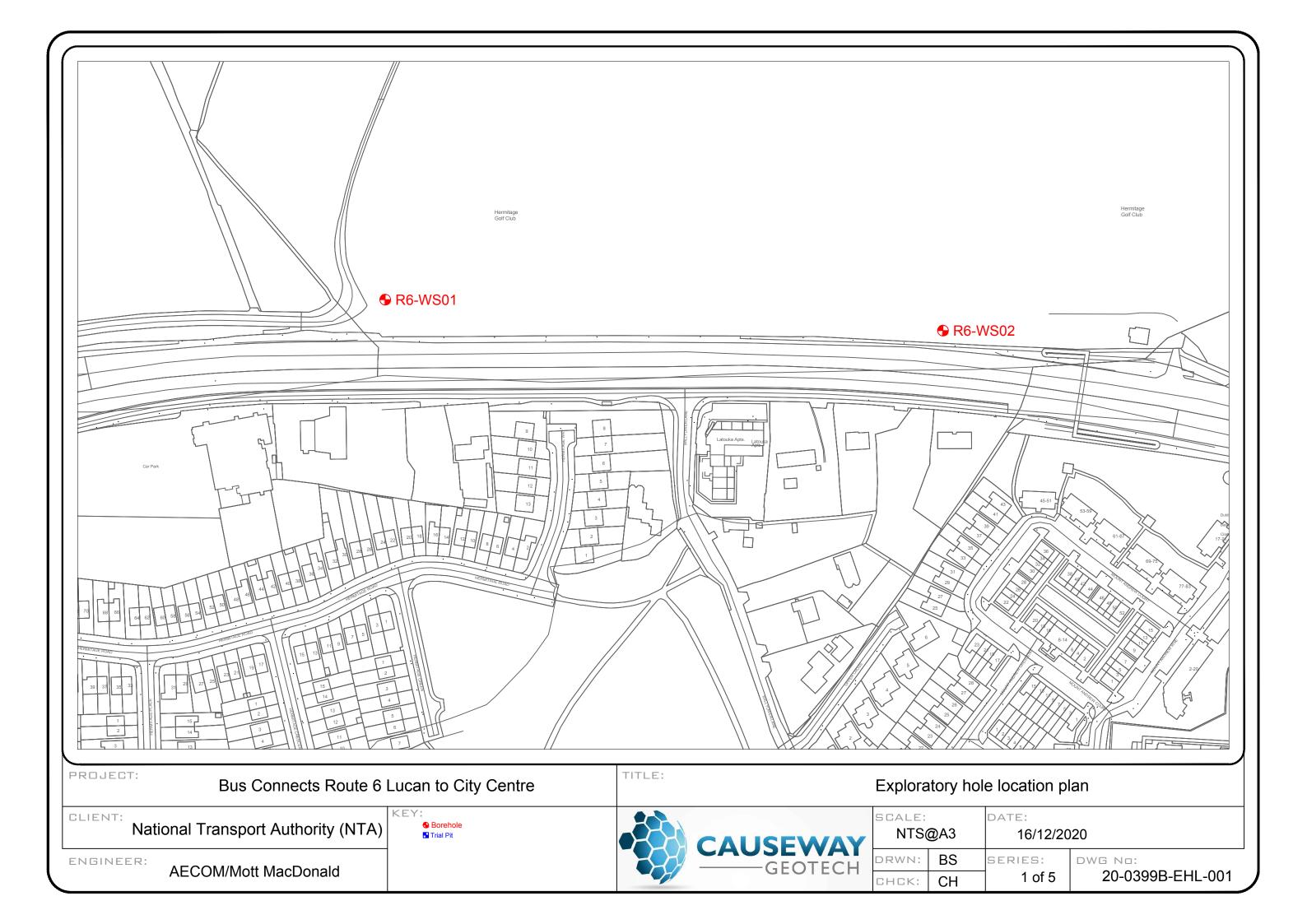


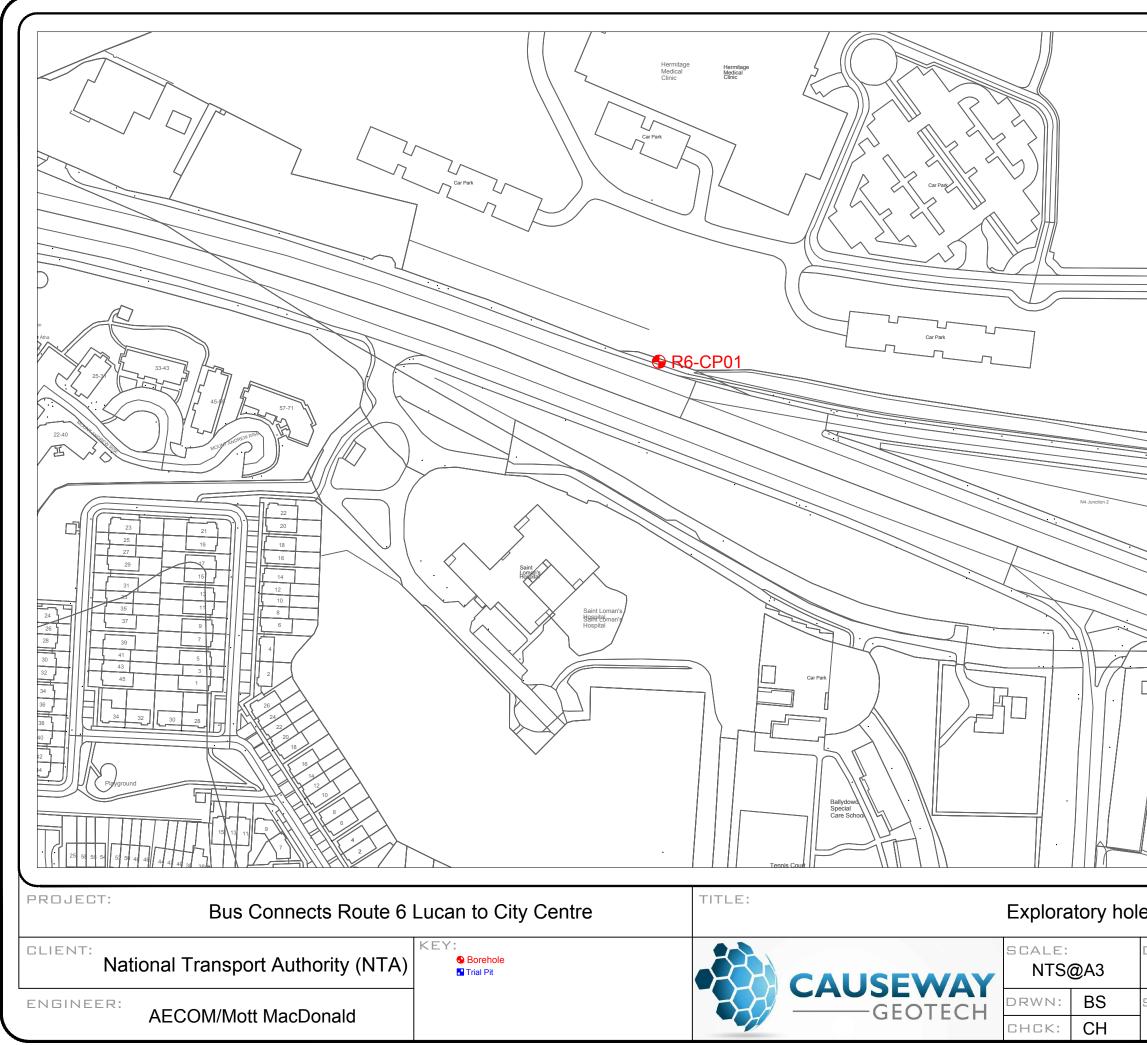
APPENDIX A EXPLORATORY HOLE LOCATION PLAN



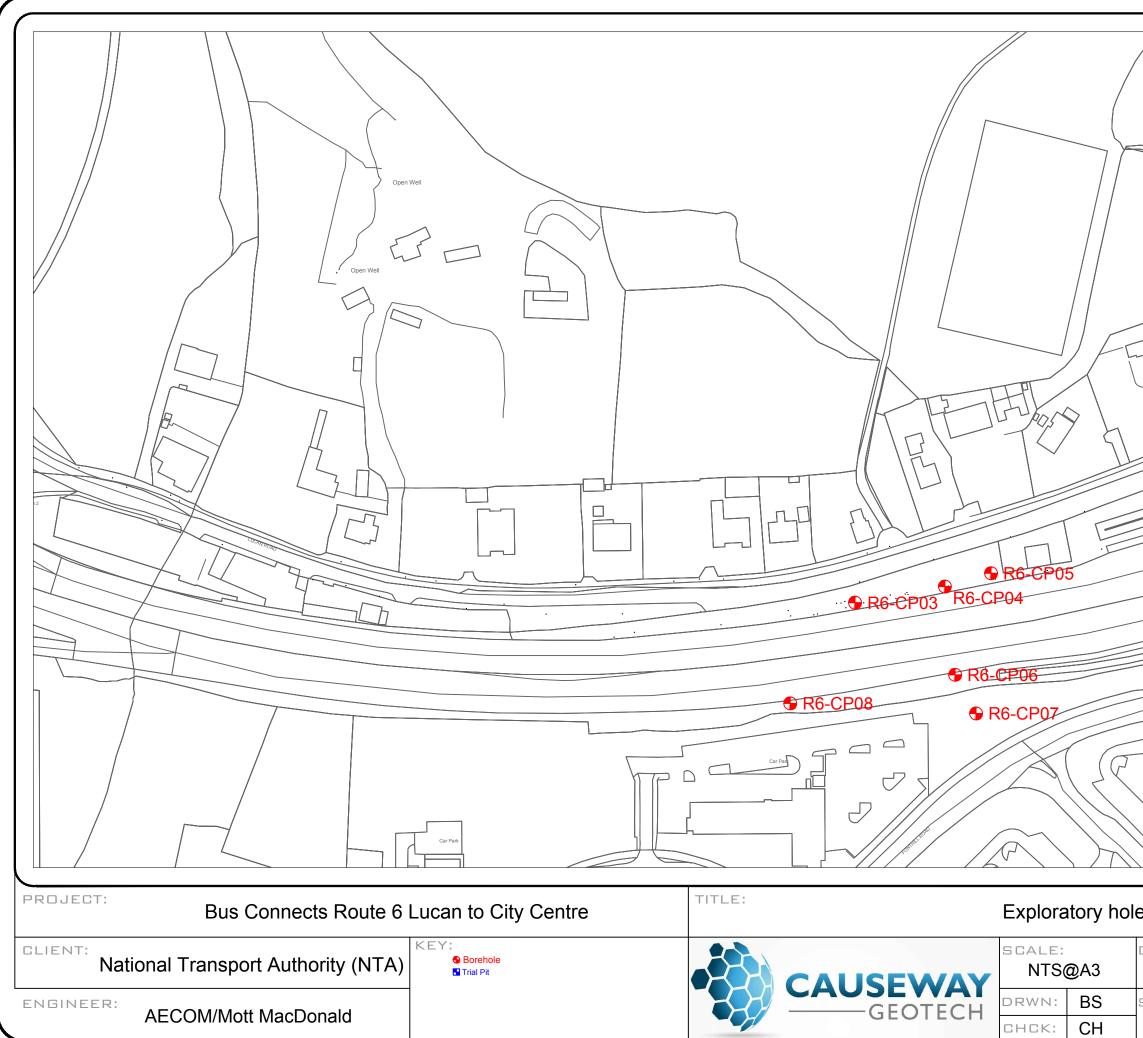




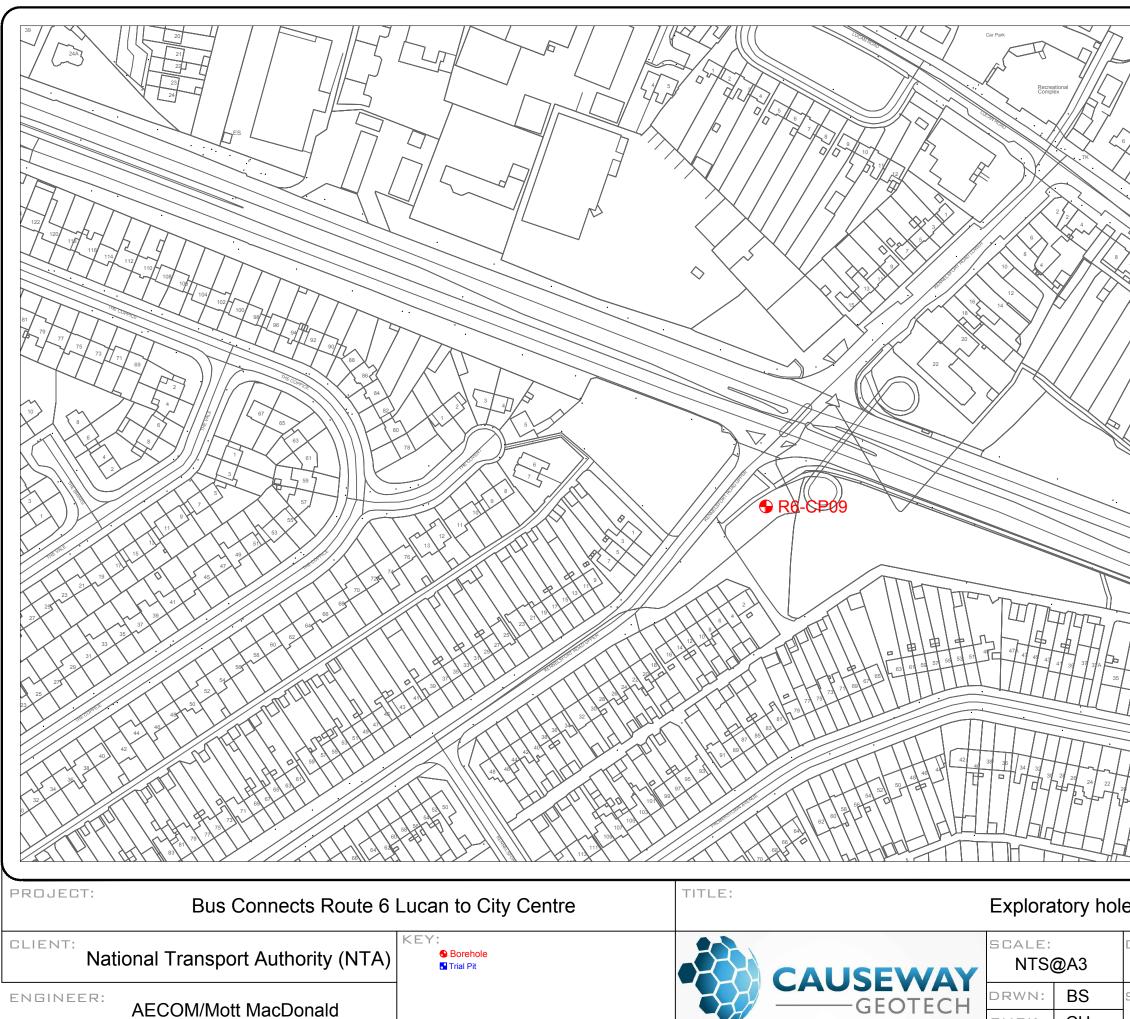




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ENGINEER: AECOM/Mott MacDonald

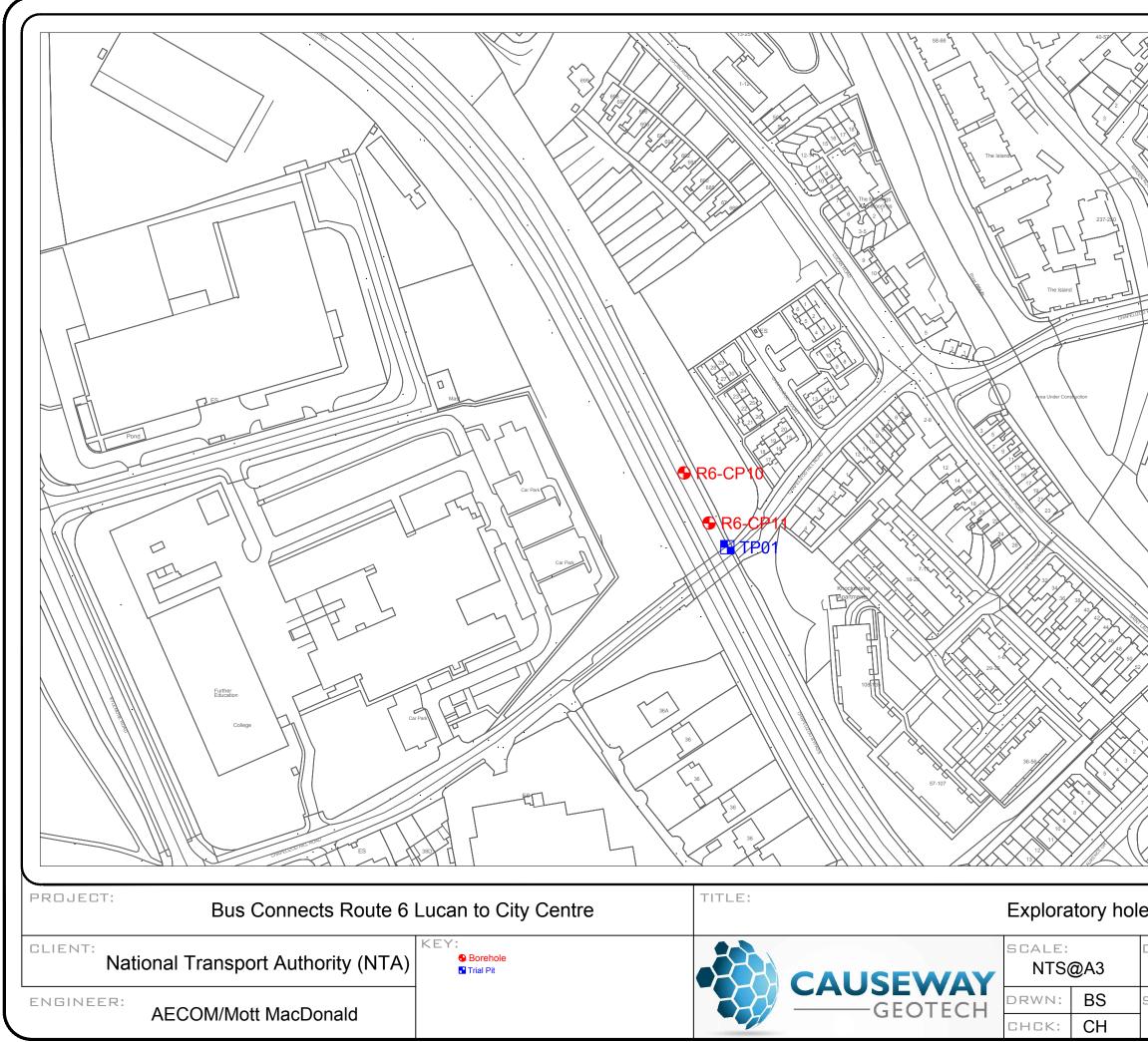
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APPENDIX B BOREHOLE LOGS

		GEOT	ECH				ect No. 1399B	Project Name: Bus Connects Route 6 Lucan to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald	Borehole ID R6-CP01
Metho Cable Perci		Plant Used Dando 2000	Top (m) 0.00	Base		Coord	dinates	Final Depth: 5.00 m Start Date: 19/10/2020 Driller: BM	Sheet 1 of 1
			0.00	5.	00		72.26 E 31.46 N	Elevation: 60.62 mOD End Date: 19/10/2020 Logger: CH	Scale: 1:40 FINAL
Depth (m)	Sample / Tests	Field Record	ls	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend Description	Backfill
0.50 0.50 1.00	B5 ES1 B6					60.52 59.62	- 0.10	TOPSOIL MADE GROUND: Soft brown 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	ES2 D10 SPT (S)	N=8 (2,2/2,2,2,2) Har 0643	nmer SN =	1.20	Dry	55.02	-	Firm brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.	1.5 -
2.00 2.00 2.00 2.00 - 2.45		N=9 (4,2/2,2,2,3) Har 0643	nmer SN =	1.50	Dry		-		2.0
3.00 3.00 3.00 - 3.45	B8 ES4 U14	Ublow=30 80%		1.50	Dry		-		3.0
4.00 4.00 4.00 - 4.45	B9 D12 SPT (S)	N=33 (5,5/7,8,8,10) H = 0643	lammer SN	1.50	Dry	56.62	- 4.00	Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.	
5.00 5.00 - 5.10		N=50 (25 for 50mm/! 50mm) Hammer SN =		1.50	Dry	55.92 55.62	- 4.70 - 5.00	Grey sandy angular coarse GRAVEL of limestone. Sand is fine to coarse. (Possible bedrock) End of Borehole at 5.00m	5.0
							-		5.5 - - - 6.0
							-		6.5 — - -
							- - - -		7.0
Casing Do	etails	Strikes) Time (min) Rose to) Water Added From (m) To (m)	4.7	(m)	elling <u>To (</u> 5.0		ie (hh:mm)	Remarks Iand dug inspection pit excavated to 1.20m. Io groundwater encountered.	
1.50	200							Termination Reason Last Updated erminated on refusal. 16/12/2020	AGS

		GEOT	ECH			Project No. Project Name: Bus Connects Route 6 Lucan to City Centre 20-0399B Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald					Borehole ID R6-CP02		
Method Plant Used Top (m) Base (m) Light Percussion Dando Terrier 0.00 1.90		Coor	dinates	Final De	pth: 1.90 m	Start Date: 22/10/2020	Driller: JC						
1.8.111 0101					50		05.22 E 40.10 N	Elevatio	n: 52.79 mOD	End Date: 22/10/2020	Logger: CH	Scale:	
Depth (m)	Sample / Tests	Field Record	s	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend		Description	<u>.</u>	backf	ill
0.20 - 0.70	B1					52.59	0.20			rey angular to subangular fine Sand is fine to coarse.	e to coarse GRAVEL		0.5 -
0.70 - 1.20 1.00	B2 ES3					52.09	0.70			ravelly CLAY. Sand is fine to co bunded fine to coarse of mixe			1.0 -
1.20 - 1.90 1.20 - 1.65		N=29 (5,7/6,7,8,8) Ha 0696	mmer SN =	0.00	Dry	51.59	1.20	+ +×+ +×++ × - × - + × - × - +		gravelly sandy silty CLAY. Sand r to subrounded fine to medi			1.5 -
1.90 1.90 - 2.35	ES5 SPT (S)	N=38 (6,9/9,11,11,7) SN = 0696	Hammer	0.00	Dry	50.89	1.90 			End of Borehole at 1.90m			2.0 -
							-						2.5 -
													3.0
							- - - -						4.0 -
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							-						5.5 •
							-						6.0 -
							-						6.5
							-						7.5
							-						8.0 -
							-						8.5
							-						9.0 —
truck at (m) Ca		r Strikes 1) Time (min) Rose to (-	Diam	neter _{Ha}	emarks and dug ins groundwa		excavated to 1.20m. ntered.				
							rmination			d by dynamic probing.	Last Updated		GS

		Project No.	Project Name:			Probe ID
	CALISEWAY	20-0399B		6 Lucan to City Centre	9	R6-
	CAUSEWAY GEOTECH	Coordinates				CP02DP
	GLOTLOIT	706305.22 E	National Transport Au			
Method:		735340.10 N	Client's Representa			Sheet 1 of 1
Dynamic Probin	g		AECOM/Mott MacDo			Scale: 1:50
Probe Type:		Elevation	Final Depth:	Date:	Operator:	FINAL
DPSH-B		52.79 mOD			JC	
Depth (m)	10	20	Blows/100mm	40		Torque (Nm)
-						
-						
– -						
-						
- 1 -						
-						
-						
-						
- 2						
-						
-	9 10					
-	999	15				
3					39	50
-						
-						
-						
- 4						
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- 5						
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6						
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Ė.						
- 8						
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F _						
- 9						
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-						
Fall Height: 750 mm	Remarks: Follow on from R6-CP02.					
Hammer Mass:						
64 kg						
Cone Diameter	:					AGS
51 mm						

•	CAUSEW GEOT	AY ECH			ect No. 0399B	Project Client: Client'	National	nects Route 6 Lucan to Transport Authority (N 'Mott MacDonald			orehole R6-CP0	
Method	Plant Used	Top (m)		i) Cooi	rdinates	Final De	epth: 4.00 m	Start Date: 20/10/2020	Driller: BM		heet 1 of	
Cable Percussion	n Dando 2000	0.00	4.00		928.72 E .71.78 N	Elevatio	-	End Date: 20/10/2020			FINAL	
Depth Samp (m) Test		;	Casing Wate Depth Dept (m) (m)	Level mOD	Depth (m)	Legend		Description		Nater	Backfill	
(m) Test 0.50 B5 0.50 ES1 1.00 B6 1.00 B7 1.20 - 1.65 B7 2.00 B7 2.00 ES1 2.00 ES1 3.00 B7 3.00 ES1 3.00 SPT (4.00 A.00 4.00 A.00	s Field Records J Ublow=50 90% Ublow=50 90% Ublow=50 90% S) N=10 (2,2/2,2,2,4) Har 0643 G643 Water strike at 3.00m S) N=50 (25 for 25mm/5) 50mm) Hammer SN = S) N=50 (25 for 25mm/5) 50mm) Hammer SN =	nmer SN = nmer SN = 0 for 0643	Depti (m) Depti (m) 1.00 Dry 1.50 Dry 1.50 3.0 1.50 3.0 1.50 Tc	 moo 50.76 50.46 50.26 49.86 49.66 49.66 49.66 49.66 49.66 	(m) (m) 0.10 0.40 0.60 1.20 1.20 -		Coarse. Gravel is sul lithologies. MADE GROUND: Gr lithologies. Sand is I MADE GROUND: So coarse. Gravel is sul lithologies. Brown fine to coars Soft becoming firm fine to coarse. Grav mixed lithologies.	oft brown sandy gravelly CLAY bangular to subrounded fine rey sandy subrounded GRAVE fine to coarse. ft brown sandy gravelly CLAY bangular to subrounded fine e SAND. brown slightly gravelly sandy el is subangular to subround subround subround subround fare coarse gravel. (Possible b End of Borehole at 4.00m	to coarse of mixed L of mixed Sand is fine to to coarse of mixed r silty CLAY. Sand is ed fine to medium of strong limestone	f		0.5 - 1.0 - 1.5 - 2.0 - 2.5 - 3.0 - 3.5 - 4.0 - 4.5 - 5.5 - 6.0 - 6.5 - 7.0 -
Casing Details To (m) Diame	Water Added er From (m) To (m)						ion Reason d on refusal.		Last Updated		AG	

		GEOT	ECH	b. (20	oject No. -0399B	Client:	t Name: Bus Connects R National Transp s Rep: AECOM/Mott N	oort Authority (N	-	F	orehole ID R6-CP04
Metho Light Percu		Plant Used Dando Terrier	Top (m) 0.00	Base (1 3.60		5969.62 E	Final D	epth: 3.60 m Start D	Date: 21/10/2020	Driller: JC		heet 1 of 1 Scale: 1:50
Depth				Casing Wa	735	5179.08 N	Elevatio	on: 51.36 mOD End Da	ate: 21/10/2020	Logger: SF		FINAL
(m) 0.10 0.10 - 1.20 0.50 1.00 1.20 - 1.70 1.20 - 1.65		Field Records N=36 (8,12/13,7,7,9) H SN = 0696		0.00 D	ry mol	6 0.10	Legend	TOPSOIL MADE GROUND: Stiff browr content and concrete fragm subangular to subrounded f	ents. Sand is fine to	coarse. Gravel is	Water	Backfill 0.5 - 1.0 - 1.5 -
1.70 1.70 - 2.00 2.00 2.50 3.00	ES5 B5 U6 D7 ES8	Ublow=127 80%		0.00 D	49.6 ry 48.3			Stiff brown sandy gravelly S subrounded to subangular f Soft brown sandy gravelly S	ine to coarse of mixe	ed lithologies.		2.0 - 2.5 - 3.0 -
3.00 - 3.60 3.00 - 3.45 3.60 - 3.78	SPT (C)	N=4 (2,1/1,1,1,1) Ham 0696 Water strike at 3.00m N=50 (19,25/50 for 30 Hammer SN = 0696		0.00 3. 0.00 D	47.7	6 - 3.60		to coarse. Gravel is subangu mixed lithologies.		ne to coarse of		3.5 -
												4.5 - 5.0 -
												6.0 -
												7.0
			-									9.0 -
<u>itruck at (m) Ca</u> 3.00		r Strikes)) Time (min) Rose to (20 2.70		sing De n) Di		Remarks Hand dug ins	spection p	t excavated to 1.20m.				
					·	Terminatio Terminated o		1		Last Updated		AGS

		CAUSEV	VAY			-	ect No. 1399B	Project Client:			nects Route 6				orehole R6-CP0	
	- \	GEOT	ECH			20-0	3770	Client:			l Transport Au /Mott MacDo		IA)		10-UFU	15
Meth Light Per		Plant Used Dando Terrier	Top (m) 0.00	-	e (m) 52		dinates	Final De	-		Start Date: 2		Driller: JC		heet 1 o Scale: 1:	
							90.65 E 35.16 N	Elevatio	on: 51	1.55 mOD	End Date: 2	20/10/2020	Logger: CH		FINAL	
Depth (m)	Sample / Tests	Field Record	ls	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend			Descri	ption		Water	Backfill	
0.10 - 1.20	B1			(,	(,	51.45	0.10		TOPSOIL MADE G		rm becoming stil	ff brown sand	ly gravelly CLAY with			-
0.50	ES2								high cob subroun	ble conten ded fine to		coarse. Grave	el is subangular to			0.5 —
1.00	ES3						-									1.0
1.20 1.20 - 1.65	D4 SPT (S)	N=15 (3,3/2,4,5,4) Ha 0696	ammer SN =	0.00	Dry											1.5
2.00	U5	Ublow=86 100%		0.00	Dry	49.65	1.90		Sand is f		se. Gravel is suba		htly gravelly CLAY. prounded fine to			2.0
2.50 2.50 2.60 - 3.52 3.00	D6 ES6 B7 D9						- - - - -							×		2.5 — - - 3.0 —
3.00 3.00 3.00 - 3.45	ES8	N=30 (4,6/5,4,9,12) H = 0696		0.00	Dry	48.03	- - - - 3.52									
3.52 - 3.73	SPT (C)	Water strike at 3.10m N=50 (20,37/50 for 6 Hammer SN = 0696		0.00	3.20		-				End of Boreho	ole at 3.52m				4.0
							-									4.5 -
																5.0
							-									
																6.0
																-
																6.5 -
							-									7.0
							-									7.5 -
							-									8.0
							-									8.5 -
							-									- - 9.0
	Wate	r Strikes	Ca	sing D	Detai	ls Re	marks									
Struck at (m) 3.10	Casing to (m 3.10	n <u>)</u> Time (min) Rose to 20 2.90		n)	Diam	ieter Hai	nd dug insj	pection pi	t excavate	d to 1.20m.						
	I					Те	rminatior	n Reason	I				Last Updated		<u>۸</u>	
	I					Ter	rminated o	n refusal.					16/12/2020		AG	S

•		GEOT	AY ECH			-	ect No. 399B	Projec Client: Client	National	nects Route 6 Lucan to Transport Authority (N Mott MacDonald		Borehole II R6-CP06
Metho Light Percu		Plant Used Dando Terrier	Top (m) 0.00	Base 2.6			dinates 74.30 E	Final De	epth: 2.60 m	Start Date: 21/10/2020	Driller: JC	Sheet 1 of 1 Scale: 1:50
							38.90 N	Elevatio	on: 51.61 mOD	End Date: 21/10/2020	Logger: CH	FINAL
Depth (m) 0.10 - 0.40	Sample / Tests B1	Field Records		Casing Depth (m)	Water Depth (m)	Level mOD 51.51	Depth (m)	Legend	TOPSOIL	Description		Backfill
0.10 0.40						51.51	0.10		MADE GROUND: Gr	ey sandy angular to subangu hologie. Sand is fine to coars		
0.50 0.60 - 1.20	ES2 B3					51.01	0.60		MADE GROUND: Lig GRAVEL of mixed lit	th grey angular to subangula hologies.	ar fine to coarse	0.
1.00 1.20 - 1.80 1.20 - 1.65	ES4 B5 SPT (S)	N=6 (1,1/2,1,2,1) Ham 0696	mer SN =	0.00	Dry	50.41	1.20		MADE GROUND: Lo coarse GRAVEL of m	ose light grey angular to sub nixed lithologies.	angular fine to	1.
1.90 1.90	D6 ES6					49.81	1.80			dy gravelly CLAY with low co el is subangular to subround		5
2.00 2.00		Ublow=140 100%		0.00	Dry		-		mixed lithologies. Co lithologies.	obbles are subangular to sub	prounded of mixed	
2.50 2.60 - 2.85		N=50 (6,14/50 for 100 Hammer SN = 0696	mm)	0.00	Dry	49.01	2.60			End of Borehole at 2.60m		2.
							-					3.
							-					4.
							- -					
							-					4.
							- - - -					5.
							-					5.
							-					6.
							-					6.
												7.
							-					7.
							-					8.
							- - -					8.
						,	-					
truck at (m) Ca		r Strikes) Time (min) Rose to ()		n)	etail Diam	eter _{Hai}	marks nd dug ins groundwa		t excavated to 1.20m. ntered.			
							rminatior				Last Updated	MAG:

	8/ -		ΕC	DTI	ECI	Η			20-0	ect No.)399B	Project Name: Bus Connects Route 6 Lucan to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald	Borehole ID R6-CP07
Meth Light Pero Rotary D	cussion Drilling	Plant L Dando T Hanjin	errie D8		0. 4.	00	Base 4.0 5.2	00 20	7069	dinates 83.83 E	Final Depth: 10.70 m Start Date: 24/09/2020 Driller: JC+KW	Sheet 1 of 2 Scale: 1:50
Rotary (Sample /	Hanjin	08		5.	20	10.		7351: Level	21.30 N	Elevation: 56.05 mOD End Date: 23/10/2020 Logger: CH+NP	FINAL
(m)	Tests	Fie	ld Re	cords			Casing Depth (m)	Water Depth (m)	mOD	(m)	Legend Description	Backfill
0.20 - 1.00 0.50 0.50	B5 ES ES6								55.85	0.20	MADE GROUND: Firm brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.	0.5
1.00 1.00 1.00 - 2.00 1.20 - 1.65		N=5 (2,1/1,1, 0696	,1,2)	Hamr	mer S	N =	0.00	Dry	55.05	- 1.00	Soft brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.	
2.00 2.00 2.00 - 2.50 2.50 - 3.20	B9 B10	Ublow=38 09					0.00	Dry	53.55	2.50	Stiff grey slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is	2.5
3.00 3.00	D11 ES3	Seepage at 2				CN.	0.00	D-	52.85	3.20	subangular to subrounded fine to coarse of mixed lithologies.	· · · · · · · · · · · · · · · · · · ·
3.00 - 3.45 3.20 3.20 - 4.00		N=22 (3,3/5, 0696	6,5,6) Ham	nmer	SN =	0.00	Dry			coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.	3.5
4.00	ES4								52.05	4.00	Very stiff brown very sandy gravelly CLAY with high cobble content. (Driller's description)	
5.20 5.20	C11 ES								50.85 50.55	5.20 (0.30) 5.50	Brown slightly silty andy subangular fine to coarse GRAVEL of limestone. Sand is fine to coarse.	· · · · · · · · · · · · · · · · · · ·
			100			NI				(0.70)	Firm brown sandy gravelly SILT. Sand is fine to coarse. Gavel is subangular fine to coarse of limestone.	6.0
6.20 6.20	C11					NI			49.85	6.20 (0.65)	Brown and grey sandy silty subangular fine to coarse GRAVEL of mixed lithologies with medium cobble content. Sand is fine to coarse. Cobbles are subangular of limestone.	6.5
6.85	С		100	23	7	NI			49.20 48.95	6.85 (0.25) 7.10 (0.50)	Medium strong (locally weak) dark grey LIMESTONE. Partially weathered: slightly reduced strength, closer fracture spacing with silty gravelly sand deposits. Discontinuities:	7.0
7.60 7.70 7.80	C C								48.45	7.60	 1. 0 to 10 degree bedding fractures, closely spaced (50/80/110), undulating, rough with brown silty gravelly sand up to 28mm between fracture surfaces. Brown silty gravelly fine to coarse SAND. Gravel is subangular of 	7.5
8.50	с		93	93	75	5				(1.45)	Image:	8.5
8.85 - 9.05	с								47.00	9.05	planar and slightly undulating, smooth, clean. Medium strong thinly bedded grey LIMESTONE. Partially weathered:	9.0
9.20			TCR	SCR	RQD	FI						
		Strikes							g Detail		emarks	
Struck at (m) 2.50	Casing to (m 2.50) Time (min)	KOSE	e to (r	<u>n) F</u>	rom (<u>m)</u>	То (<u>rn) Tin</u>		and dug inspection pit excavated to 1.20m. o groundwater encountered. /S section extended by dynamic probing.	
Casing I To (m) 5.20	Details Diam (mm) 200	Water From (m)	_	ed o (m)								
5.20	200						Barr	el			ermination Reason Last Updated erminated at scheduled depth. 16/12/2020	AGS

	Ċ		SE GE(A EC	Y H			ect No.)399B	Project Name Client: Client's Pop:	National	l Transport Au	uthority (NT			orehole ID R6-CP07
Meth Light Per Rotary D Rotary (cussion Drilling	Plant (Dando ⊺ Hanjir Hanjir	Terrie n D8	er	0. 4.	o (m) .00 .00 .20	Base (m 4.00 5.20 10.70	70698	dinates 83.83 E 21.30 N	Client's Rep: Final Depth: Elevation:	10.70 m	/Mott MacDo Start Date: 2 End Date: 2	24/09/2020	Driller: JC+KW	' <u>s</u>	heet 2 of 2 Scale: 1:50 FINAL
Depth	Samples	/ Field Records	TCR	SCR	RQD	FI	Casing Water Depth Depth	Level	Depth	Legend		Descri	ption		ater	Backfill
Rotary (Coring	Hanjir	n D8	1	5.	.20	1	73512	21.30 N	Legend Mediu slighth sandy Discor 1.0 to planar 2. At 1 clean. 3. At 9	um strong thin y reduced stro silt deposits. 10 degree be and undulati urfaces. .0.35m to 10.3 0.05m to 10.3 bocalised grey s	Descrip nly bedded grey l rength, closer frac- edding fractures, ing, smooth with .45m: 25 to 75 de 15m: 80 to 90 deg	ption LIMESTONE. F cture spacing , closely space n grey sandy si egree joint, ur gree joint, unc its on joint su	Logger: CH+NF Partially weathered: with localised ge ed (30/150/390), ilt deposits on some indulating, smooth, dulating, smooth rface at 9.20m to	Water	
Struck at (m) 2.50		Strikes		e to (n				ng Details	ne (hh:mm) 	emarks land dug inspectic o groundwater er	ncountered.					17.5
Casing To (m) 5.20	Details Diam (mm) 200	Water From (m)		led o (m)		Core	e Barrel	Flush		VS section extended		ic probing.		Last Updated		
	I					S	SK6L	Poly	ymer T	erminated at sche	duled depth.			16/12/2020		AGS

	CAUSEWAY GEOTECH	Project No. 20-0399B Coordinates	Client:	te 6 Lucan to City Ce	ntre	Probe ID R6- CP07DP
		706983.83 E	National Transport			
Method:		735121.30 N	Client's Represen			Sheet 1 of 1
Dynamic Probing]		AECOM/Mott Mac			Scale: 1:50
Probe Type:		Elevation	Final Depth:	Date:	Operator:	FINAL
DPSH-B		56.05 mOD	6.20		JC	FINAL
Depth			Blows/100mm			Torque
(m)	10	20	30)	40	(Nm)
-						
-						
- 1						
_						
-						
-						
2						
-						
- 3						
-						
-						
F						
4	99					
E .	9					
-	11 11 10 10					
-	10	14				
_ 5		16 16	0			
		3				
-		14				
_		14				
	10	14				
- 6				30		50
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E						
7						—
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— 9 —						
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Fall Height:	Remarks:					
750 mm	Follow on from R6-CP07 WS Secti	on.				
Hammer Mass: 64 kg						[
Cone Diameter: 51 mm	1					AGS
						1

		GEOT	AY ECH			ject No. -0399B	Project Name: Bus Connects Route 6 Lucan to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald	Borehole ID R6-CP08
Metho Cable Perc		Plant Used Dando 2000	Top (m) 0.00	Base (1 4.20	-	ordinates	Final Depth: 4.20 m Start Date: 21/10/2020 Driller: BM	Sheet 1 of 1
					706	899.18 E 125.89 N	Elevation: 52.30 mOD End Date: 21/10/2020 Logger: CH	Scale: 1:40 FINAL
Depth (m)	Sample / Tests	Field Records		Casing Wa Depth De (m) (r	n) Level		Legend Description	Backfill
0.50	В5				51.90	- - - - 0.40	MADE GROUND: Soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel i subangular to subrounded fine to coarse of mixed lithologies. Loose brown gravelly silty fine to coarse SAND. Gravel is subrounded	0.5 -
0.50	ES1 B6 ES2				51.20	- - - - - - - - - - - - - - - - - - -	fine to medium of mixed lithologies.	1.0
1.00 1.20 1.20 - 1.65	D10 SPT (S)	N=16 (2,3/2,3,4,7) Han 0643	nmer SN =	0.00 D			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	B7 ES3 ES7 U13	Ublow=50 100%		0.00 D	50.30 ry	D - 2.00	Stiff greyish brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.	2.0 -
3.00 3.00 3.00 3.00 - 3.45		N=23 (4,5/5,5,6,7) Han 0643	nmer SN =	0.00 D	ry	- - - - - - - -		3.0
4.00 4.00 4.00 - 4.15	89 D12 SPT (S)	N=50 (40 for 125mm/5 25mm) Hammer SN = (0.00 D	48.30 ry 48.10	-	Grey sandy silty subangular coarse GRAVEL of limestone. Sand is fine to coarse. (Possible bedrock) End of Borehole at 4.20m	4.0
						- - - -		4.5 -
								5.0 -
						-		6.0 -
						- - - -		6.5 -
						- - -		7.0
						-		
struck at (m) Ca		r Strikes)) Time (min) Rose to (r	n) From (4.00	m) T	ling Deta To (m) 4.20	Fime (hh:mm)	Remarks Hand dug inspection pit excavated to 1.20m. No groundwater encountered.	
Casing D To (m)	etails Diameter	Water Added From (m) To (m)						
							Termination Reason Last Updated Terminated on refusal. 16/12/2020	AGS

		GEOT	AY ECH				ct No. 399B	Project Client: Client's		nects Route 6 Transport Au 'Mott MacDoi	thority (NT		Borehol R6-CP	
Metho Cable Perc		Plant Used Dando 2000	Top (m) 0.00	Base 5.1		Coord	dinates	Final De	pth: 5.10 m	Start Date: 2	3/10/2020	Driller: BM	Sheet 1	
							36.68 E 55.33 N	Elevatio	n: 45.94 mOD	End Date: 2	3/10/2020	Logger: CH	Scale: 1 FINA	
Depth (m)	Sample / Tests	Field Records	5	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	TOPSOIL	Descrip	tion		Backfill	I
0.50 0.50	B5 ES1					45.64	- 0.30 - - -		MADE GROUND: So to coarse. Gravel is mixed lithologies.					0.5
1.00 1.00 1.00 1.20 1.20 1.20 - 1.65		N=2 (3,0/0,1,0,1) Ham 0696	imer SN =	0.00		44.74	- 1.20		MADE GROUND: Ve fine to coarse. Grave mixed lithologies.				5	1.0
2.00 2.00 2.00 2.00 - 2.45		N=2 (0,1/0,1,0,1) Ham 0696	imer SN =	0.00	Dry		-							2.0
3.00 3.00 3.00 3.00 3.00 - 3.45	B8 ES4 ES8 U15	Ublow=15 80%		0.00		42.94	- 3.00		Very soft brown san subangular to subro					3.0 3.5
4.00 4.00 4.00 - 4.45		N=25 (4,4/5,6,7,7) Hai 0696	mmer SN =	0.00		41.94	- - 4.00 -		Stiff brown sandy gr subangular to subro				_	4.0 4.5
5.00 5.00 5.00 - 5.15		N=50 (34 for 125mm/ 21mm) Hammer SN =		0.00		41.14 40.84	- 4.80 - 5.10		Grey sandy angular coarse. (Possible be			Sand is fine to		5.0
							- - - - -							5.5
							- - - -							6.5
							- - -							7.0
		r Strikes				Details		Remarks						
Casing D	Details) Time (min) Rose to (<u>m) From (</u> 4.90		<u>To (m</u> 5.10				nspection pit excavate vater encountered.	ed to 1.20m.				
To (m)	Diameter	From (m) To (m)						Terminatio Terminated	on Reason			Last Updated		~

		GEOT	ECH		20-	ect No. 0399B	Project Name: Bus Connects Route 6 Lucan to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald	Borehole ID R6-CP10
Metho Cable Perce		Plant Used Dando 2000	Top (m) 0.00	Base (n 4.10	n) Cool	rdinates	Final Depth: 4.10 m Start Date: 24/10/2020 Driller: BM	Sheet 1 of 1
			0.00	1.10		996.96 E 297.36 N	Elevation: 25.45 mOD End Date: 24/10/2020 Logger: GH	Scale: 1:40
Depth (m)	Sample / Tests	Field Records	5	Casing Wat Depth Dep (m) (m	th) mOD	Depth (m)	Legend Description	be Backfill ≥
0.50 0.50	B1 ES2				25.15	- - 0.30 - -	BITMAC MADE GROUND: Black slightly sandy angular fine to coarse GRAV of limestone. Sand is fine to coarse.	EL
1.00 1.00 1.20 1.20 1.20 - 1.65		N=9 (6,4/2,2,2,3) Ham 0643	imer SN =	1.00 Dr	24.45 Y	- 1.00	MADE GROUND: Firm becoming stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.	1.0
2.00 2.00 2.00 2.00 - 2.45		N=20 (4,4/5,4,5,6) Har 0643	mmer SN =	1.50 Dr	у	- - - - - - -		2.0
3.00 3.00 3.00 3.00 - 3.45		N=39 (6,7/9,9,10,11) ł SN = 0643	lammer	1.50 Dr	22.45 y	- 3.00	MADE GROUND: Very stiff brown sandy gravelly CLAY. Sand is fine coarse. Gravel is subangular to subrounded fine to coarse of mixe lithologies.	
4.00 4.00 - 4.08	B12 SPT (C)	N=50 (25 for 50mm/50 25mm) Hammer SN =		1.50 Dr	21.45 y 21.35		CONCRETE End of Borehole at 4.10m	4.0 -
								5.0 -
						- - - - - -		6.0 -
								65 - 7.0 -
						-		
Casing Do To (m)	asing to (m Details Diameter	Strikes) Time (min) Rose to (Water Added From (m) To (m)	3.90	(m) T	ing Detai o (m) Ti 4.10	me (hh:mm)	emarks and dug inspection pit excavated to 1.20m. o groundwater encountered.	
1.50	200						rmination Reason Last Updated rminated on concrete. 16/12/2020	AGS

		GEOT	AY ECH			ject No. -0399B	Project Name: Bus Connects Route 6 Lucan to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald	Borehole ID R6-CP11
Metho Cable Perc		Plant Used Dando 2000	Top (m) 0.00	Base (4.20		ordinates	Final Depth: 4.20 m Start Date: 24/10/2020 Driller: BM	Sheet 1 of 1
Cable Perc	ussion	Dando 2000	0.00	4.20	710	008.77 E 273.64 N	Elevation: 25.13 mOD End Date: 24/10/2020 Logger: GH	Scale: 1:40 FINAL
Depth (m)	Sample / Tests	Field Record	s	Depth De	ater Level pth m) mOD		Legend Description	Backfill
						-	BITMAC	-
0.50 0.50	B2 ES1				24.83	3 - 0.30	MADE GROUND: Black sandy angular fine to coarse GRAVEL of limestone. Sand is fine to coarse.	- - 0.5 - - -
1.00 1.00 1.20 1.20 1.20 1.20 - 1.65		N=10 (4,3/2,3,2,3) Ha 0643	mmer SN =	1.00 D	24.03 ry	3 1.10	MADE GROUND: Firm becoming stiff brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium of mixed lithologies.	1.0 — - - 1.5 —
2.00 2.00 2.00 2.00 - 2.45		N=21 (4,4/5,5,5,6) Ha 0643	mmer SN =	1.50 D	ry	- - - - - - - - -		2.0
3.00 3.00 3.00 3.00 3.00 3.00 - 3.45	B10 D11 ES11 ES9 SPT (S)	N=45 (7,8/10,10,12,1) SN = 0643	3) Hammer	1.50 D	22.13 ry	3 - 3.00	Possible MADE GROUND: Very stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.	3.0
4.00 4.00 - 4.12	B12 SPT (S)	N=50 (41 for 100mm/ 25mm) Hammer SN =		1.50 D	ry 20.93	- - - - - -	End of Borehole at 4.20m	4.0
						-		4.5 -
						- - -		- - 5.5 -
						- - - -		6.0
						- - - -		6.5 -
						- - - -		7.0 —
		- Chuileac					Personale	
Struck at (m) Ca		r Strikes	(m) From (4.10	(m) ⁻	ling Deta ro (m) 4.20	ils Time (hh:mm) 01:00	Remarks Hand dug inspection pit excavated to 1.20m. No groundwater encountered.	
Casing D To (m) 1 1.50 1	Petails Diameter 200	Water Added From (m) To (m))					
							Termination Reason Last Updated Terminated on refusal. 16/12/2020	AGS

•	/ -	GEOT	ECH	h.		20-0	ect No.)399B	Project Name: Bus Connects Route 6 Lucan to City Centre Client: National Transport Authority (NTA) Client's Rep: AECOM/Mott MacDonald	Borehole II R6-WS01
Metho Light Percu		Plant Used Dando Terrier	Top (m) 0.00		e (m) 40		dinates	Final Depth: 1.40 m Start Date: 24/09/2020 Driller: JC	Sheet 1 of 1 Scale: 1:50
							29.45 E 16.12 N	Elevation: 53.45 mOD End Date: 24/09/2020 Logger: CH	FINAL
Depth (m)	Sample / Tests	Field Records	;	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend Description	Backfill
0.20 0.40 0.40 - 1.40 0.50 1.00 1.20	D1 ES2 B2 ES4 ES5					53.05	- - - - - - -	Very dense brown very sandy silty subangular to subrounded fine coarse GRAVEL of mixed lithologies. Sand is fine to coarse.	to 0.1
20 20 - 1.58		N=50 (8,11/50 for 235 Hammer SN = 0696	mm)	0.00	Dry	52.05	- 1.40	End of Borehole at 1.40m	1.
							-		2.
							-		2.:
							-		3.
							-		3.
							-		4.1
							-		4.
							-		5.1
							-		5.
							-		6.
							-		6.
							-		7.
							-		7.
							-		8.
							-		8.
							F		9.
ruck at (m) Ca		Strikes) Time (min) Rose to (n)	Diam	eter _{Ha}		ection pit excavated to 1.20m. er encountered.	
							rminatio		N AG:

	/ -	GEOT	ECH	n -	(20-0	ct No. 399B	Client:	City Centre ITA)	F	orehole II		
Metho Light Percu		Plant Used Dando Terrier	Top (m) 0.00	Base 0.8			dinates	Final De	pth: 0.87 m	Start Date: 24/09/2020	Driller: JC		heet 1 of 1 Scale: 1:50
							35.37 E 99.12 N	Elevatio	n: 64.42 mOD	End Date: 24/09/2020	Logger: CH		FINAL
Depth (m)	Sample / Tests	Field Records		Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	TOPSOIL	Description		Water	Backfill
).30).30 - 0.87).50	ES1 B1 ES2					64.12	0.30		Very dense brown v	very sandy very silty subangu ′EL of mixed lithologies. Sand			0.
.87 - 1.28		N=50 (11,10/50 for 26 Hammer SN = 0696	5mm)	0.00	Dry	63.55	0.87			End of Borehole at 0.87m	I		1.
							- - -						1
							-						2
							-						2.
							-						3.
							-						3.
							-						4.
							-						4.
							-						5.
							-						5.
							-						6.
							-						6.
													7.
							-						7.
							-						8
							-						9.
												_	
ruck at (m) Ca		• Strikes) Time (min) Rose to (i			Detai l Diam	eter _{Ha}		pection pit iter encour	excavated to 0.87m. Itered.				
						Те	rminatio	n Reason			Last Updated		AG



APPENDIX C CORE PHOTOGRAPHS



R6-CP07 Box 3 (7.70-9.20m)

	• CA	USEWA) GEOTECH		Project:	Bus Co	meots 1	26		Projec	t No.: <u>20-0</u> 3	998		F		H
-				BH No.:	RG-CP07	Bo	x: 4		Depth:	9.20-10	POM				
(m)	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5
in the												J.	A.	F	

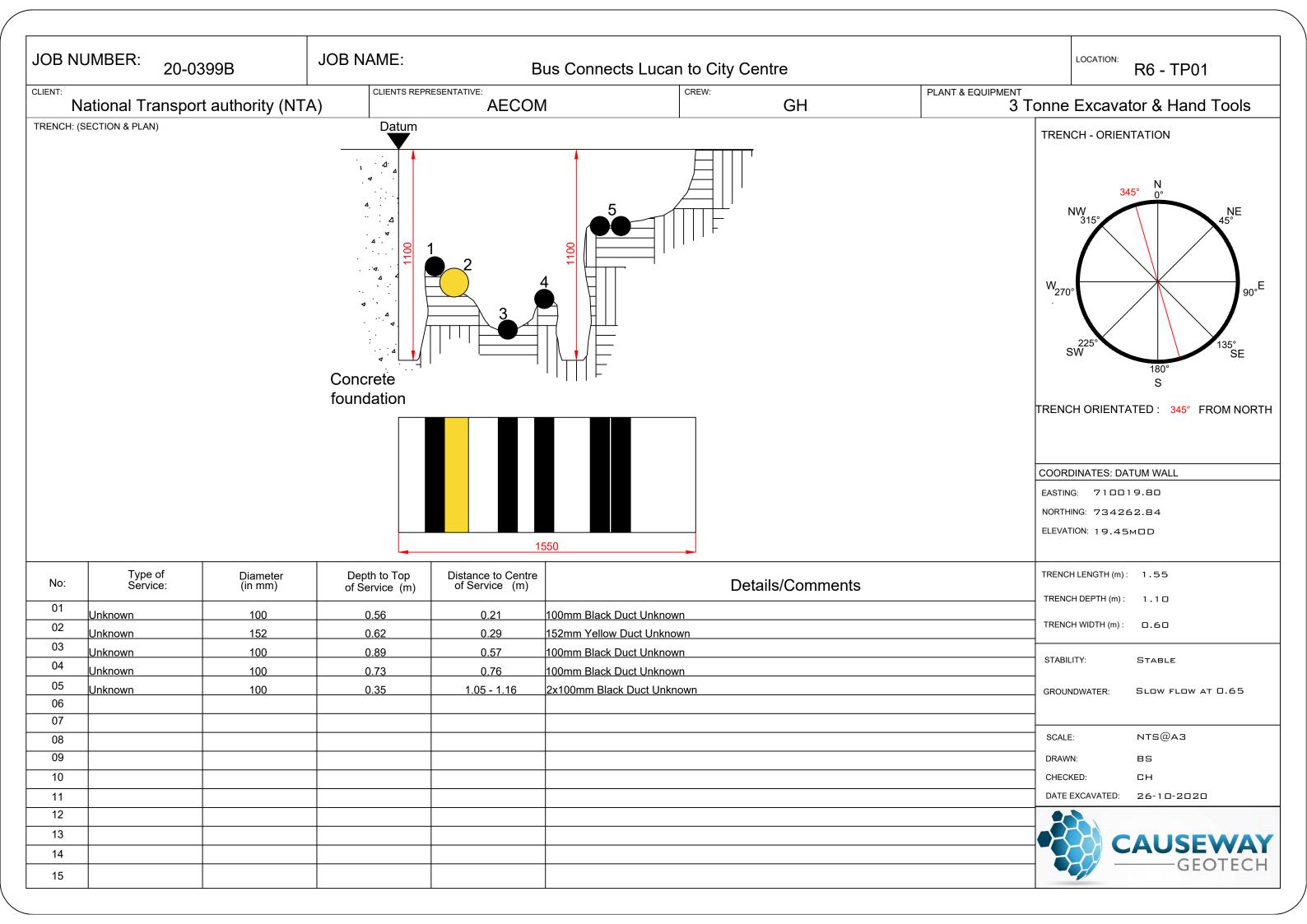
R6-CP07 Box 4 (9.20-10.70m)





APPENDIX D SLIT TRENCH LOGS AND SKETCHES

				ect No. 0399B		Name: nnects Route 6 Lucan to City Centre		Т	rial Pit ID
	CAUS	EWAY EOTECH		dinates	Client:			F	R6-TP01
	(.	EOIECH			Nation	al Transport Authority (NTA)			
Method:				19.80 E	Client's	Representative:		Sł	neet 1 of 1
Slit Trenching				52.84 N		I/Mott MacDonald		S	cale: 1:25
Plant:				ation/	Date:		Logger:		FINAL
3t Tracked Exc				mOD	26/10/	2020	GH	-	
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description		Water	
			19.35 19.27	0.10		MADE GROUND: Grey slightly sandy angular fine to o vimestone. Sand is fine to coarse.			-
			10.07	- - - - 0.49		MADE GROUND: Dark grey slightly sandy angular fine of limestone. Sand is fine to coarse.	e to coarse GRAVEL		-
0.50	B1	Slow seepage at 0.65m.	18.97	_ 0.48 - - - - - - - - -		MADE GROUND: Brown slightly sandy clayey angular GRAVEL of limestone. Sand is fine to coarse.	fine to coarse	¥	0.5
			18.35	1.10		End of trial pit at 1.10m		_	-
				- - -					-
				- - -					1.5 —
				-					-
				- - -					- 2.0
				- - -					-
				• • •					-
				- - -					2.5 —
				-					-
				-					
				-					-
				-					-
				-					3.5 —
				- - -					-
				- - - 					4.0
				- - -					-
				- - -					-
				-					4.5 —
				- - -					-
				-					-
Wate Struck at (m) 0.65	r Strikes Remarks Slow seepage		Rema Base		ion unab	le to be determined to presences of services.			1
	0.65m.	Length: 1.55 Stability:	Term	ination Re	ason:		Last Updated		
		Stable	Termi	inated at s	cheduled	depth.	16/12/2020		AGS





APPENDIX E SLIT TRENCH PHOTOGRAPHS



R6-TP01



December 2020

Report No.: 20-0399A



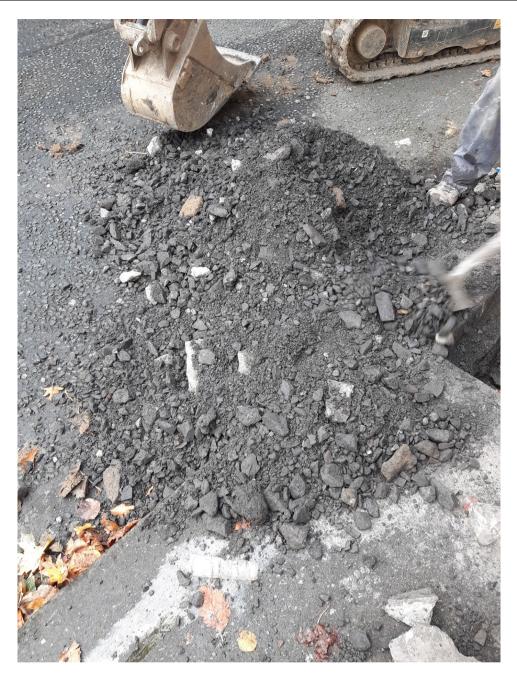
R6-TP01



R6-TP01



Report No.: 20-0399A



R6-TP01



December 2020

Report No.: 20-0399A



R6-TP01



December 2020



APPENDIX F GEOTECHNICAL LABORATORY TEST RESULTS





HEAD OFFICE

Registered in Northern Ireland.

Company Number: NI610766

REGIONAL OFFICE

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> 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 6 - Lucan to City Centre
Project No.:	20-0399B
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.

topen Woton

Stephen Watson Laboratory Manager Signed for and on behalf of Causeway Geotech Ltd









1





Project Name: Bus Connects - Route 6 - Lucan 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	37
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	12
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	14
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	11
SOIL	Moisture Condition Value at natural moisture content	BS 1377-4: 1990: Cl 5.4	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	6
ROCK	Uniaxial Compressive Strength (UCS)*	ISRM Suggested Methods -Rock Characterization Testing and Monitoring, Ed. E T Brown - 1981	1

SUB-CONTRACTED TESTS

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

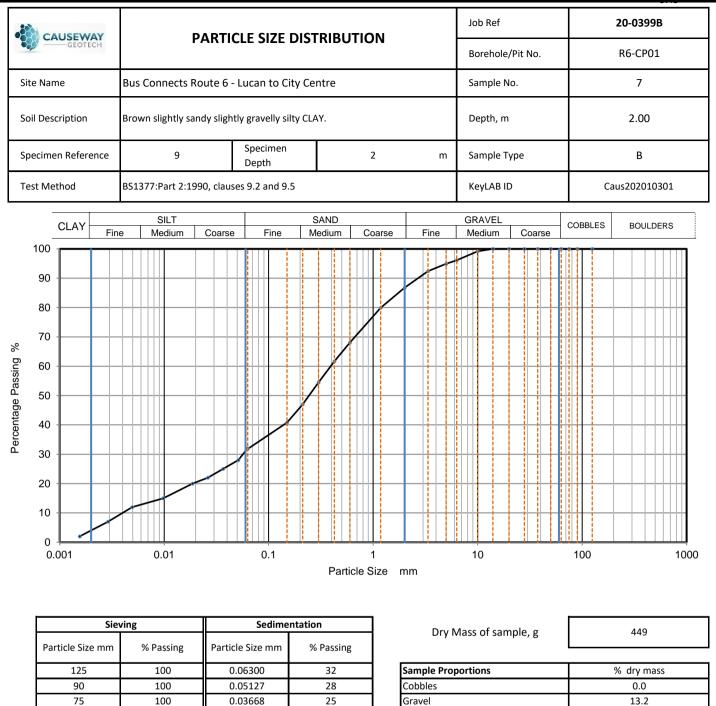
Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – Subcontracted to Eurofins Chemtest Ltd <i>(UKAS</i> 2183)	pH Value of Soil		17
SOIL – Subcontracted to Eurofins Chemtest Ltd (UKAS 2183)	Sulphate Content water extract		17

	JSE GEO	VAY TECH			Summar	y of C	las	sific	ation	Test	Res	sult	s	
Project No.			Project	roject Name Bus Connects Route 6 - Lucan to City Centre										
20-03	99B												-	
Hole No.	Ref	Sar Top	nple Base	Туре	Soil Description	bulk	dry		425µm				Particle density	Casagrande Classification
						Mg/m	13	%	%	%	%	%	Mg/m3	
R6-CP01	6	1.00		В	Brown slightly sandy silty CLAY.			12.0						
R6-CP01	7	2.00		в	Brown slightly sandy slightly gravelly silty CLAY.			15.0	70	28 -1pt	19	9		CL
R6-CP01	14	3.00		U	Brown slightly sandy silty CLAY.			15.0						
R6-CP01	12	4.00		D	Brown slightly sandy silty CLAY.			16.0						
R6-CP01	13	5.00		D	Brown slightly sandy silty CLAY.			9.0						
R6-CP02	2	0.70		В	Brown slightly sandy silty CLAY.			24.0						
R6-CP02	4	1.20		в	Brown sandy slightly gravelly silty CLAY.			17.0	83	37 -1pt	21	16		CI
R6-CP03	12	1.20		U	Brown sandy gravelly silty CLAY.			33.0						
R6-CP03	7	2.00		В	Brown sandy gravelly silty CLAY.			16.0	60	30 -1pt	20	10		CL
R6-CP03	11	3.00		D	Brown sandy slightly gravelly silty CLAY.			15.0						
R6-CP04	4	1.20		В	Brown sandy slightly gravelly silty CLAY.			15.0						
R6-CP04	6	2.00		U	Brown sandy slightly gravelly silty CLAY.			14.0						
All tests performed in accordance with				h BS1	377:1990 unless specified	otherwis	e						LAE	01R Version 4
Key Density test Linear measurement unless :					Liquid Limit Particle 4 4pt cone unless : sp - sma			Date F	Printed 19/11/20	20	Appr	oved	Ву	
wd - wat wi - imn		acement in water			asagrande method gj - ga: ngle point test	s jar					Step	hen.	Watson	UKAS TESTING 10122

	JSE GEO	VAY TECH			Summar	y of C	las	sific	ation	Test	Res	sult	S	
Project No. 20-03	399B		Project	Name		Connect	s Rou	ıte 6 - L	ucan to	City Cer	ntre			
Hole No.	Ref	Saı Top	nple Base	Туре	Soil Description	Dens bulk	dry	W	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
R6-CP04	9	3.00		В	Brown sandy slightly gravelly silty CLAY.	Mg/m	13	%	%	%	%	%	Mg/m3	
R6-CP05	4	1.20		D	Brown sandy slightly gravelly silty CLAY.			16.0						
R6-CP05	5	2.00		U	Brown sandy gravelly silty CLAY.			14.0						
R6-CP05	6	2.50		D	Brown sandy gravelly silty CLAY.			12.0						
R6-CP05	7	2.60		В	Brown sandy gravelly silty CLAY.			9.6	47	28 -1pt	18	10		CL
R6-CP06	9	2.00		U	Brown sandy gravelly silty CLAY.			12.0						
R6-CP07	5	0.20		В	Brown sandy slightly gravelly silty CLAY.			18.0	72	41 -1pt	23	18		CI
R6-CP07	7	1.00		В	Brown sandy slightly gravelly silty CLAY.			18.0	63	40 -1pt	25	15		MI/CI
R6-CP07	11	3.00		D	Brown sandy slightly gravelly silty CLAY.			22.0						
R6-CP07	11	5.20		С	Brown sandy gravelly silty CLAY.			13.0	48	28 -1pt	13	15		CL
R6-CP07	11	6.20		С	Brown sandy very gravelly silty CLAY with coobles.			8.5						
R6-CP08	10	1.20		D	Brown sandy slightly gravelly silty CLAY.			17.0						
All tests perfor	Il tests performed in accordance with B				377:1990 unless specified	otherwis	е						LAB	01R Version 4
Linear n wd - wat	Density test Liqu Linear measurement unless : 4pt wd - water displacement cas				Liquid Limit Particle density 4pt cone unless : sp - small pyknometer cas - Casagrande method gj - gas jar 1pt - single point test				Printed	20	Appr		By Watson	$\begin{bmatrix} & & & \\ & & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & \\ & & & & \\ & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ & & & & \\ $

	JSE\ -geo	VAY TECH			Summar	y of C	las	sific	ation	Test	Res	sult	S	
Project No. 20-03	99B		Project	Name		Connect	s Rou	ıte 6 - L	ucan to	City Cer	ntre			
Hole No.	Ref	Sar Top	nple Base	Туре	Soil Description	Dens bulk	dry	W %	Passing 425µm %	LL %	PL	PI %	Particle density	Casagrande Classification
R6-CP08	7	2.00		В	Brown sandy slightly gravelly silty CLAY.	Mg/m	13	16.0	59	% 29 -1pt	% 19	10	Mg/m3	CL
R6-CP08	11	3.00		D	Brown sandy gravelly silty CLAY.			17.0						
R6-CP08	12	4.00		D	Greyish brown sandy very gravelly silty CLAY.			7.9						
R6-CP09	11	1.20		D	Greyish brown sandy slightly gravelly silty CLAY.			25.0						
R6-CP09	12	2.00		D	Greyish brown sandy silty CLAY.			26.0						
R6-CP09	7	2.00		в	Greyish brown sandy silty CLAY.			26.0	50	32 -1pt	16	16		CL
R6-CP09	15	3.00		U	Greyish brown sandy silty CLAY.			27.0						
R6-CP10	4	1.00		в	Greyish brown sandy gravelly silty CLAY.			12.0	48	31 -1pt	17	14		CL
R6-CP10	6	2.00		D	Greyish brown sandy gravelly silty CLAY.			10.0						
R6-CP10	10	3.00		в	Greyish brown sandy gravelly silty CLAY.			12.0	50	28 -1pt	17	11		CL
R6-CP11	3	1.20		D	Greyish brown sandy slightly gravelly silty CLAY.			15.0						
R6-CP11					Greyish brown sandy slightly gravelly silty CLAY.			14.0	60	30 -1pt	15	15		CL
All tests perfor	Il tests performed in accordance with BS13				377:1990 unless specified	otherwis	e						LAB	01R Version 4
Linear m	Density test Liquir Linear measurement unless : 4pt cr wd - water displacement cas -					e density nall pyknom s jar	eter	Date F	Printed		Appr		By Watson	

•	CAU		VAY TECH			Summa	ry of C	las	sific	ation	Test	Res	sult	S	
Project N	o. 20-03			Project	Name		a Cannaat	a Day		ucon to	City Co	otro			
	20-03	990		mala		Бu	s Connect		r	1		1		.	
Hole N	lo.	Ref	Тор	nple Base	Туре	Soil Description	Dens bulk Mg/n	dry	W %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
R6-CP	11	11	3.00		D	Greyish brown sandy slightly gravelly silty CLAY.			11.0						
All tests p	perform	ned ii	n accord	cordance with BS1377:1990 unless specifie			d otherwis	е						LAE	3 01R Version 4
Key Density test Liquid Limit Linear measurement unless : 4pt cone unle wd - water displacement cas - Casagr					e unless : sp -	icle density small pyknom gas jar	neter		Printed 19/11/20	20	Appr	roved	Ву		
w	vi - imm	ersion	in water		1pt - sii	ngle point test						Step	hen.	Watson	10100



125 100 0.06300 32 90 100 0.05127 28 75 100 0.03668 25 63 100 0.02624 22 50 100 0.01866 20 37.5 100 0.00980 15 28 100 0.00495 12 20 100 0.00290 7 14 100 0.00155 2 10 99 6.3 96 5 95 3.35 92 1.18 80 0.6 68 Particle density (assumed) 0.425 62 2.65 Mg/m3	Particle Size mm	% Passing	Particle Size mm	% Passing
75 100 0.03668 25 63 100 0.02624 22 50 100 0.01866 20 37.5 100 0.00980 15 28 100 0.00495 12 20 100 0.00290 7 14 100 0.00155 2 10 99 6.3 96 5 95 3.35 92 1.18 80 0.6 68 Particle density (assumed)	125	100	0.06300	32
63 100 0.02624 22 50 100 0.01866 20 37.5 100 0.00980 15 28 100 0.00495 12 20 100 0.00290 7 14 100 0.00155 2 10 99 6.3 96 5 95 3.35 92 1.18 80 0.6 68 Particle density (assumed)	90	100	0.05127	28
50 100 0.01866 20 37.5 100 0.00980 15 28 100 0.00495 12 20 100 0.00290 7 14 100 0.00155 2 10 99 6.3 96 5 95 3.35 92 1.18 80 0.6 68 Particle density (assumed)	75	100	0.03668	25
37.5 100 0.00980 15 28 100 0.00495 12 20 100 0.00290 7 14 100 0.00155 2 10 99 6.3 96 5 95 3.35 92 1.18 80 0.6 68 Particle density (assumed)	63	100	0.02624	22
28 100 0.00495 12 20 100 0.00290 7 14 100 0.00155 2 10 99 6.3 96 5 95 3.35 92 1.18 80 0.6 68 Particle density (assumed)	50	100	0.01866	20
20 100 0.00290 7 14 100 0.00155 2 10 99 6.3 96 5 95 3.35 92 2 87 1.18 80 0.6 68 Particle density (assumed)	37.5	100	0.00980	15
14 100 0.00155 2 10 99 6.3 96 5 95 3.35 92 2 87 1.18 80 0.6 68 Particle density (assumed)	28	100	0.00495	12
10 99	20	100	0.00290	7
6.3 96 5 95 3.35 92 2 87 1.18 80 0.6 68 Particle density (assumed)	14	100	0.00155	2
5 95 3.35 92 2 87 1.18 80 0.6 68 Particle density (assumed)	10	99		
3.35 92	6.3	96		
2 87	5	95		
1.18 80 0.6 68 Particle density (assumed)	3.35	92		
0.6 68 Particle density (assumed)	2	87		
	1.18	80		
0.425 62 2.65 Mg/m3	0.6	68	Particle density	(assumed)
	0.425	62	2.65	Mg/m3
0.3 55	0.3	55		
0.212 47	0.212	47		
0.15 41	0.15	41		
0.063 32	0.063	32		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	13.2
Sand	55.0
Silt	28.1
Clay	3.7

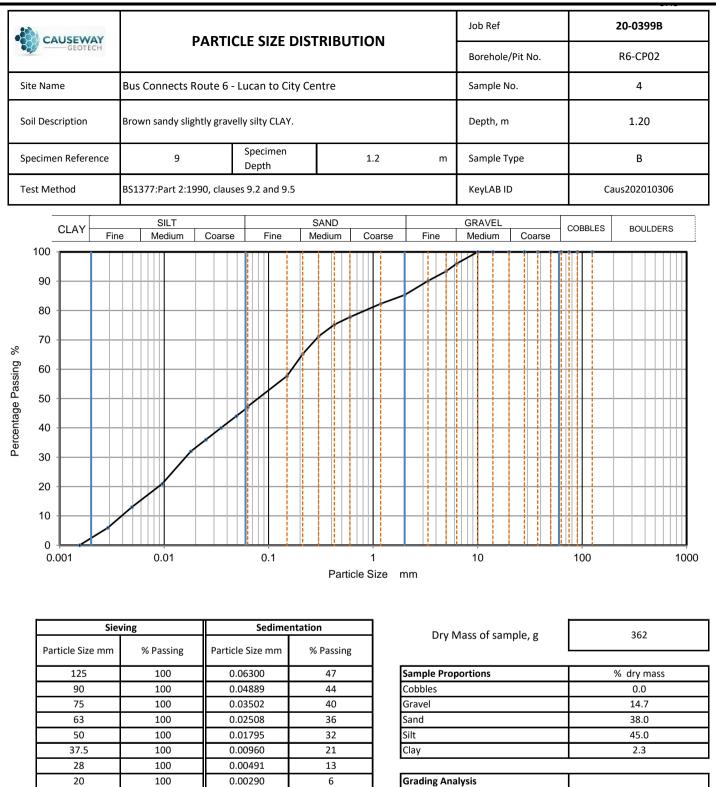
Grading Analysis		
D100	mm	
D60	mm	0.392
D30	mm	0.0564
D10	mm	0.00413
Uniformity Coefficient		95
Curvature Coefficient		2

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



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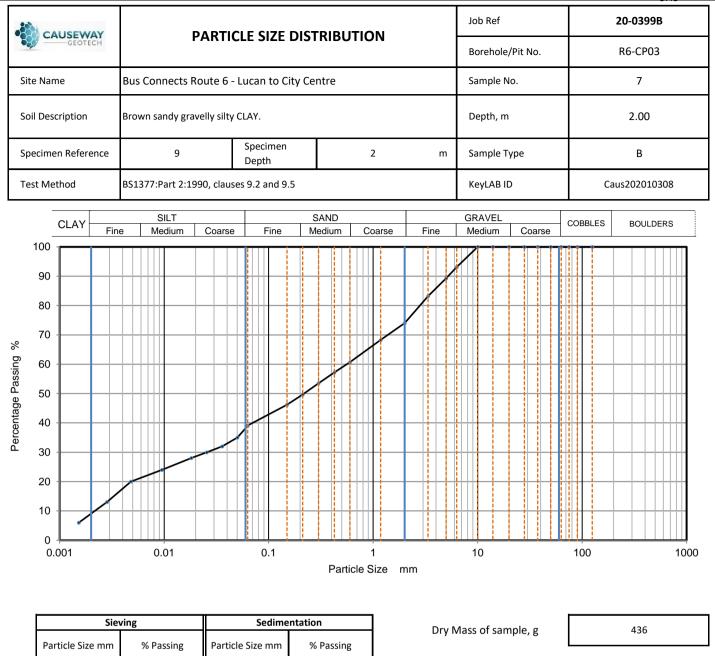
75	100	0.03502	40
63	100	0.02508	36
50	100	0.01795	32
37.5	100	0.00960	21
28	100	0.00491	13
20	100	0.00290	6
14	100	0.00155	0
10	100		
6.3	96		
5	93		
3.35	90		
2	85		
1.18	82		
0.6	78	Particle density	(assumed)
0.425	75	2.65	Mg/m3
0.3	71		
0.212	65		
0.15	58		
0.063	47		
	Approved		

Grading Analysis		
D100	mm	
D60	mm	0.167
D30	mm	0.0159
D10	mm	0.00392
Uniformity Coefficient		43
Curvature Coefficient		0.39

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



LAB 05R Version 4



Sievilig		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.06300	39	
90	100	0.05016	35	
75	100	0.03591	32	
63	100	0.02554	30	
50	100	0.01817	28	
37.5	100	0.00949	24	
28	100	0.00480	20	
20	100	0.00283	13	
14	100	0.00152	6	
10	100			
6.3	93			
5	89			
3.35	83			
2	74			
1.18	68			
0.6	61	Particle density	(assumed)	
0.425	57	2.65	Mg/m3	
0.3	54			
0.212	50	1		
0.15	46	1		
0.063	39	1		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	26.0
Sand	34.9
Silt	30.3
Clay	8.8

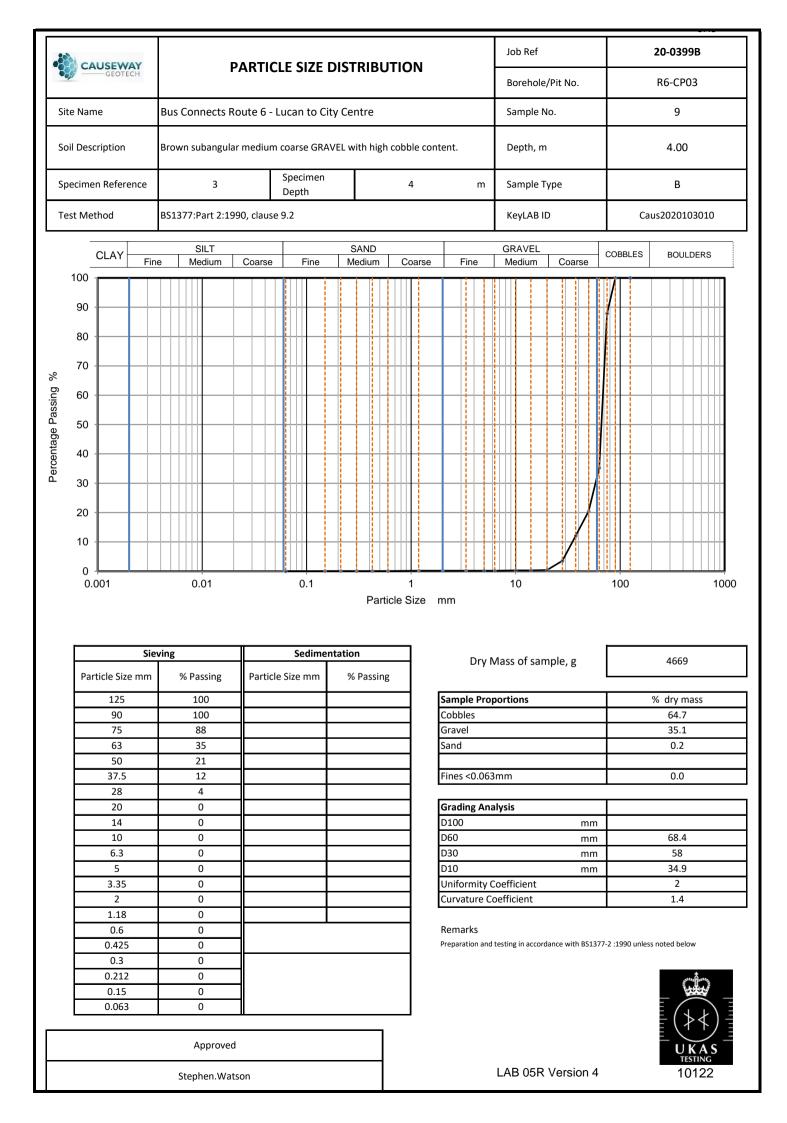
Grading Analysis		
D100	mm	
D60	mm	0.558
D30	mm	0.0265
D10	mm	0.0022
Uniformity Coefficient		250
Curvature Coefficient		0.57

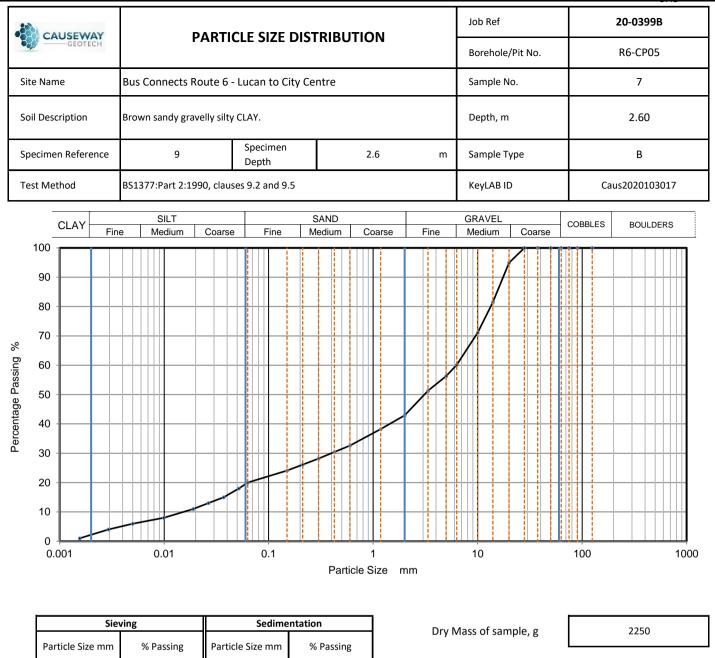
Preparation and testing in accordance with BS1377-2 :1990 unless noted below



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Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.06300	20	
90	100	0.05188	18	
75	100	0.03711	15	
63	100	0.02654	13	
50	100	0.01897	11	
37.5	100	0.00990	8	
28	100	0.00501	6	
20	95	0.00292	4	
14	82	0.00155	1	
10	71			
6.3	60			
5	56			
3.35	51			
2	43			
1.18	38			
0.6	33	Particle density	(assumed)	
0.425	30	2.65	Mg/m3	
0.3	28			
0.212	26]		
0.15	24]		
0.063	20			

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	57.1
Sand	23.0
Silt	17.8
Clay	2.1

Grading Analysis		
D100	mm	
D60	mm	6.25
D30	mm	0.398
D10	mm	0.0161
Uniformity Coefficient		390
Curvature Coefficient		1.6

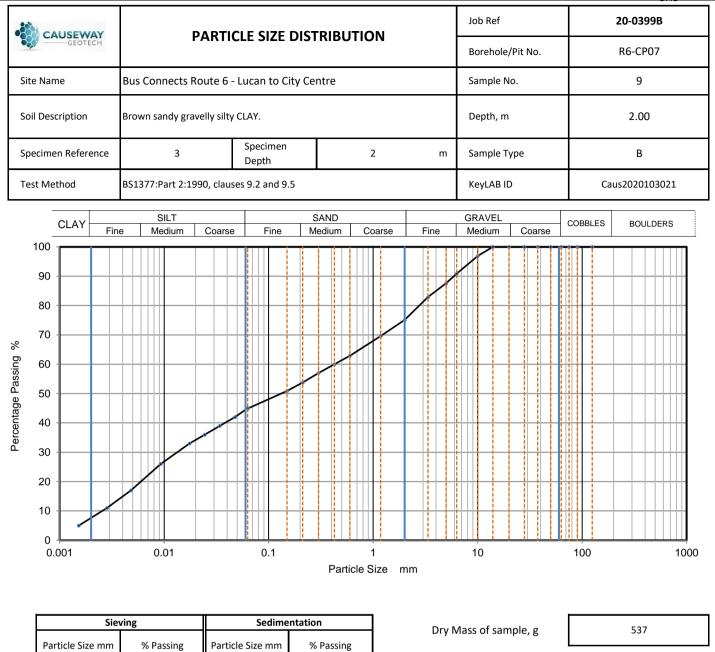
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Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	45
90	100	0.04758	42
75	100	0.03411	39
63	100	0.02444	36
50	100	0.01751	33
37.5	100	0.00927	26
28	100	0.00480	17
20	100	0.00283	11
14	100	0.00152	5
10	97		
6.3	91		
5	88		
3.35	83		
2	75		
1.18	70		
0.6	63	Particle density	(assumed)
0.425	60	2.65	Mg/m3
0.3	57		
0.212	54		
0.15	51		
0.063	45		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	24.9
Sand	30.2
Silt	37.5
Clay	7.4

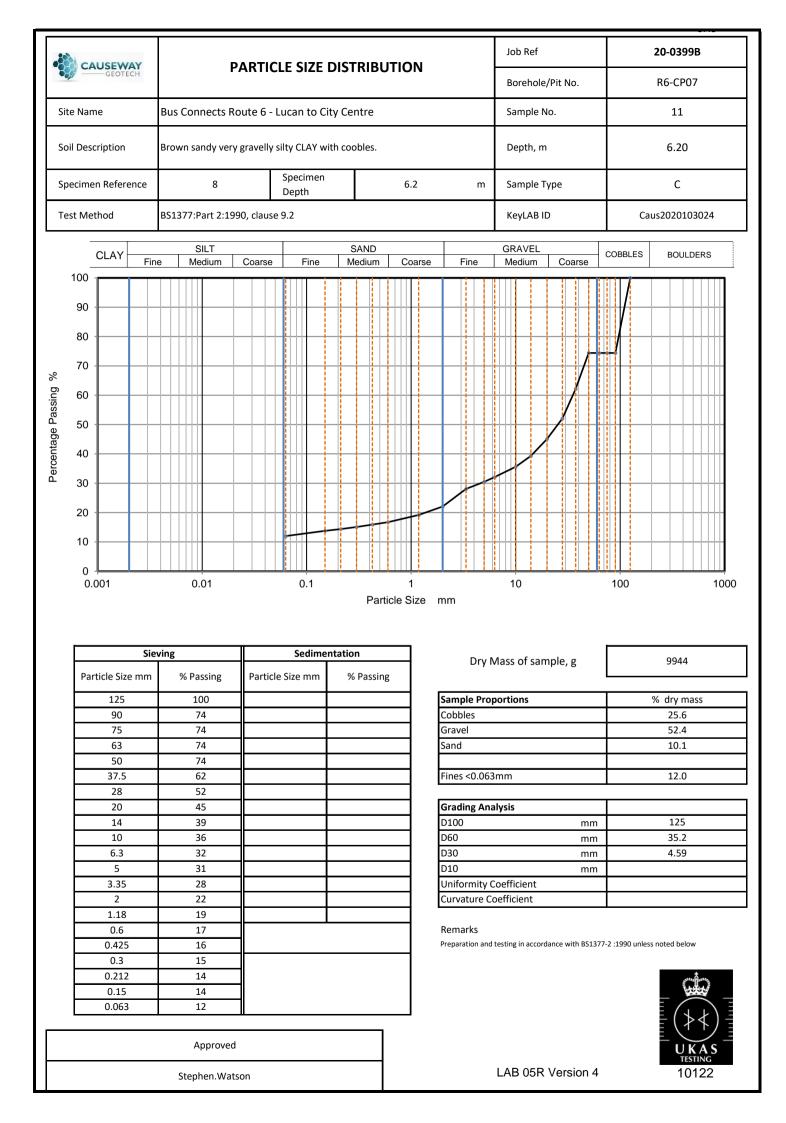
Grading Analysis		
D100	mm	
D60	mm	0.425
D30	mm	0.0135
D10	mm	0.00261
Uniformity Coefficient		160
Curvature Coefficient		0.16

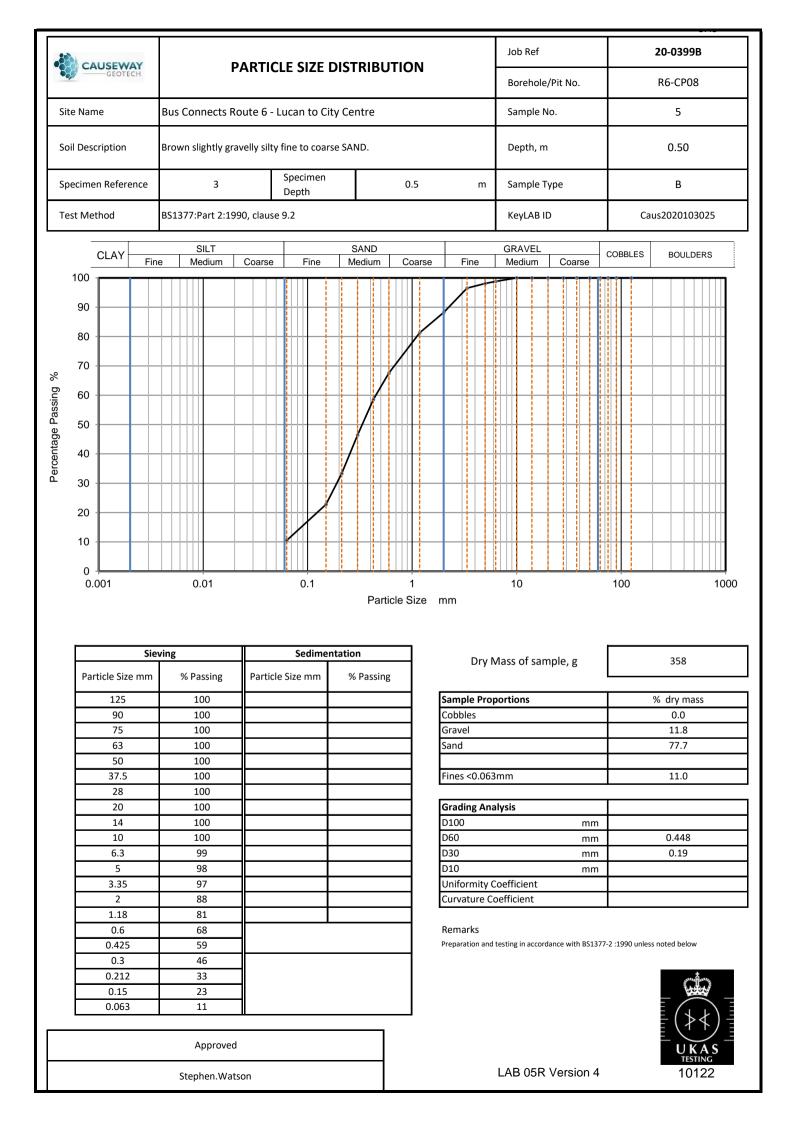
Preparation and testing in accordance with BS1377-2 :1990 unless noted below

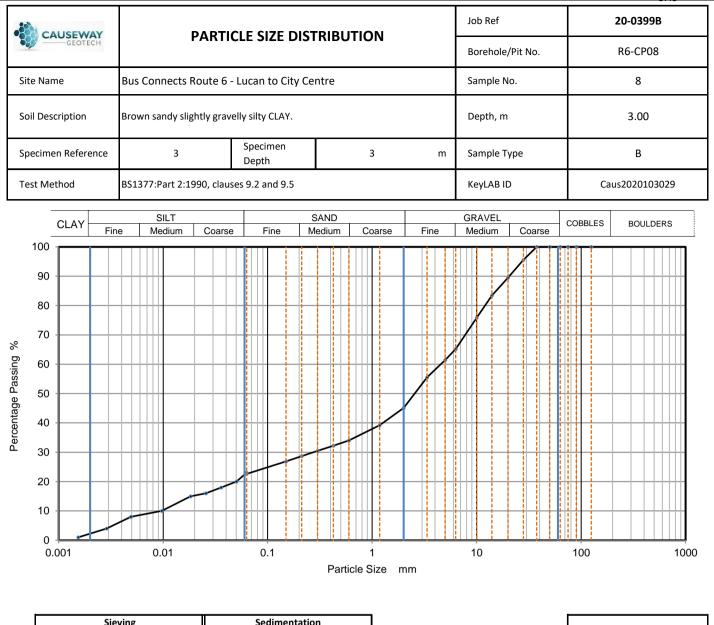


LAB 05R Version 4

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Sieving		Sedim	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	23
90	100	0.05016	20
75	100	0.03591	18
63	100	0.02570	16
50	100	0.01828	15
37.5	100	0.00971	10
28	96	0.00491	8
20	90	0.00288	4
14	83	0.00154	1
10	76		
6.3	65		
5	61		
3.35	56		
2	45		
1.18	39		
0.6	34	Particle density	(assumed)
0.425	32	2.65	Mg/m3
0.3	31		
0.212	29		
0.15	27		
0.063	23		

Dry Mass of sample, g

2219

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	54.9
Sand	22.5
Silt	20.2
Clay	2.4

Grading Analysis		
D100	mm	
D60	mm	4.56
D30	mm	0.271
D10	mm	0.0101
Uniformity Coefficient		450
Curvature Coefficient		1.6

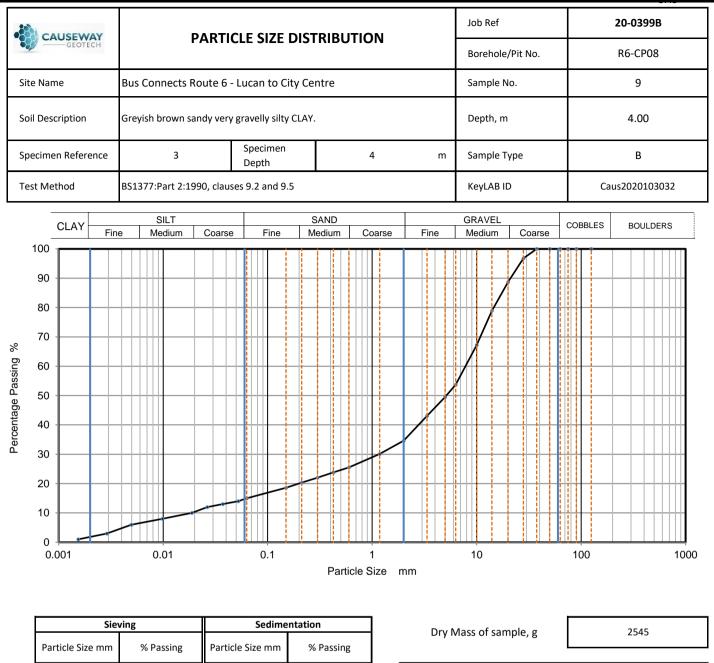
Remarks

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



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Jieving		Jeuimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	15
90	100	0.05231	14
75	100	0.03720	13
63	100	0.02645	12
50	100	0.01881	10
37.5	100	0.00982	8
28	97	0.00496	6
20	89	0.00290	3
14	79	0.00154	1
10	67		
6.3	54		
5	50		
3.35	43		
2	35		
1.18	30		
0.6	26	Particle density	(assumed)
0.425	24	2.65	Mg/m3
0.3	22		
0.212	20]	
0.15	19]	
0.063	15		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	65.4
Sand	19.6
Silt	12.9
Clay	2.1

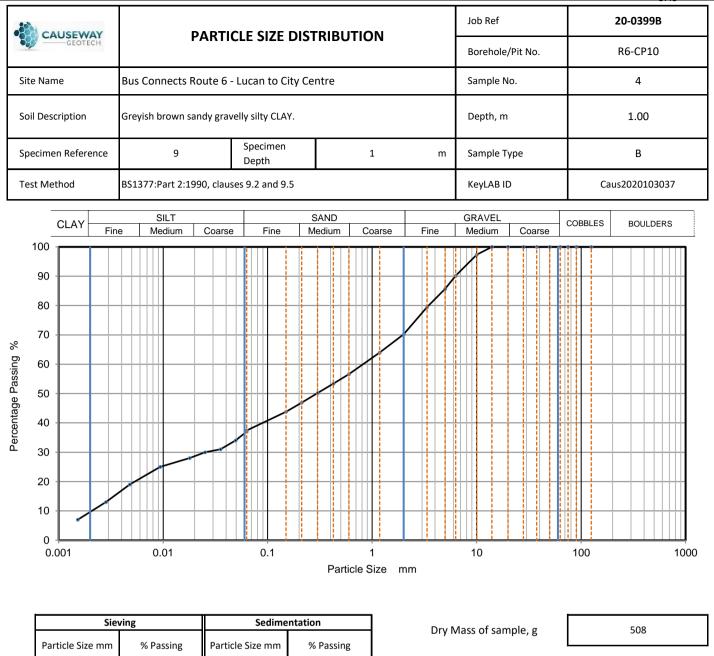
Grading Analysis		
D100	mm	
D60	mm	7.82
D30	mm	1.16
D10	mm	0.0169
Uniformity Coefficient		460
Curvature Coefficient		10

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



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Sicving		Scamentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.06300	37	
90	100	0.04939	34	
75	100	0.03537	31	
63	100	0.02517	30	
50	100	0.01791	28	
37.5	100	0.00936	25	
28	100	0.00479	19	
20	100	0.00283	13	
14	100	0.00152	7	
10	97			
6.3	90			
5	86			
3.35	80			
2	70			
1.18	64			
0.6	57	Particle density	(assumed)	
0.425	53	2.65	Mg/m3	
0.3	50			
0.212	47]		
0.15	44]		
0.063	37	1		

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	29.8
Sand	32.7
Silt	27.4
Clay	10.1

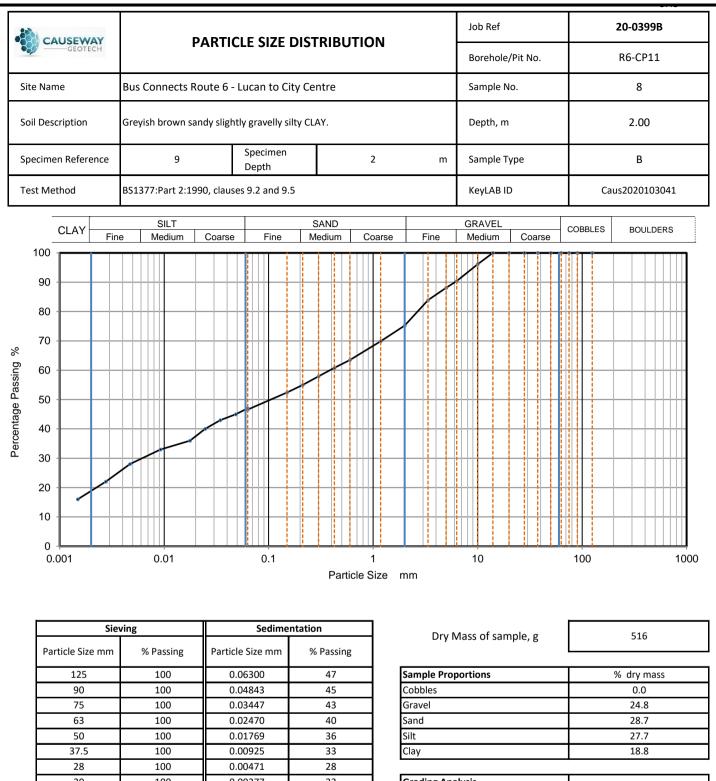
Grading Analysis		
D100	mm	
D60	mm	0.817
D30	mm	0.0256
D10	mm	0.00197
Uniformity Coefficient		410
Curvature Coefficient		0.41

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



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Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	47
90	100	0.04843	45
75	100	0.03447	43
63	100	0.02470	40
50	100	0.01769	36
37.5	100	0.00925	33
28	100	0.00471	28
20	100	0.00277	22
14	100	0.00149	16
10	96		
6.3	90		
5	88		
3.35	84		
2	75		
1.18	70		
0.6	64	Particle density	(assumed)
0.425	61	2.65	Mg/m3
0.3	58		
0.212	55		
0.15	52		
0.063	47		

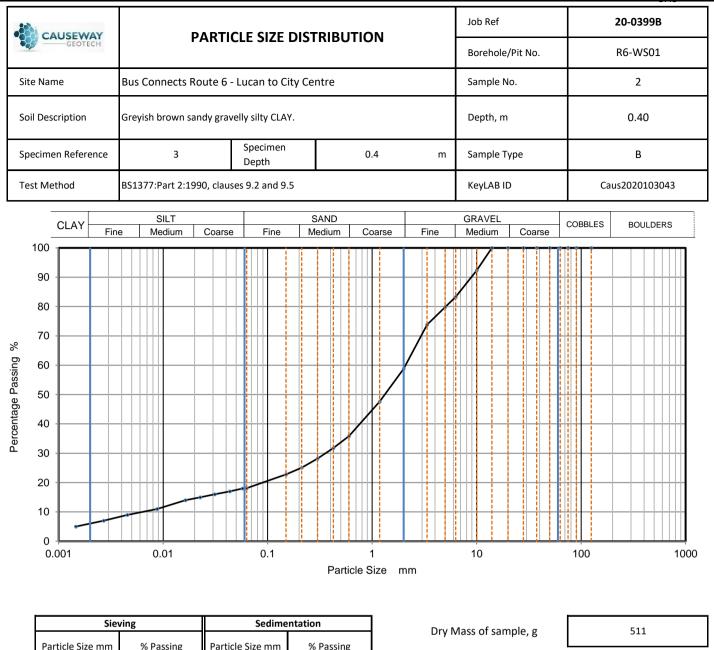
Grading Analysis		
D100	mm	
D60	mm	0.385
D30	mm	0.00643
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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



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Sieving		Sedimentation			
Particle Size mm	% Passing	Particle Size mm	% Passing		
125	100	0.05742	18		
90	100	0.04343	17		
75	100	0.03122	16		
63	100	0.02260	15		
50	100	0.01635	14		
37.5	100	0.00875	11		
28	100	0.00455	9		
20	100	0.00269	7		
14	100	0.00146	5		
10	92				
6.3	83				
5	80				
3.35	74				
2	59				
1.18	48				
0.6	36	Particle density	(assumed)		
0.425	32	2.65	Mg/m3		
0.3	28				
0.212	25				
0.15	23				
0.063	18				

Sample Proportions	% dry mass			
Cobbles	0.0			
Gravel	41.2			
Sand	40.7			
Silt	12.1			
Clay	6.0			

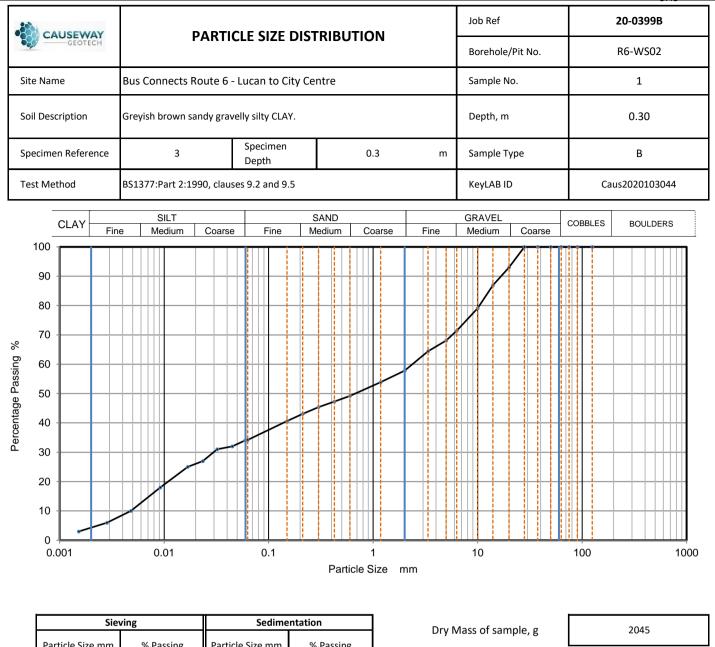
Grading Analysis		
D100	mm	
D60	mm	2.08
D30	mm	0.358
D10	mm	0.00607
Uniformity Coefficient		340
Curvature Coefficient		10

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



LAB 05R Version 4

Approved Stephen.Watson



Siev	ving	Sedimentation			
Particle Size mm	% Passing	Particle Size mm	% Passing		
125	100	0.05937	34		
90	100	0.04486	32		
75	100	0.03221	31		
63	100	0.02346	27		
50	100	0.01682	25		
37.5	100	0.00916	18		
28	100	0.00480	10		
20	93	0.00283	6		
14	87	0.00152	3		
10	79				
6.3	71				
5	68				
3.35	64				
2	58				
1.18	54				
0.6	49	Particle density	(assumed)		
0.425	47	2.65	Mg/m3		
0.3	45				
0.212	43				
0.15	41				
0.063	34				

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	42.2
Sand	23.6
Silt	29.8
Clay	4.4

Grading Analysis		
D100	mm	
D60	mm	2.38
D30	mm	0.0309
D10	mm	0.00469
Uniformity Coefficient		510
Curvature Coefficient		0.085

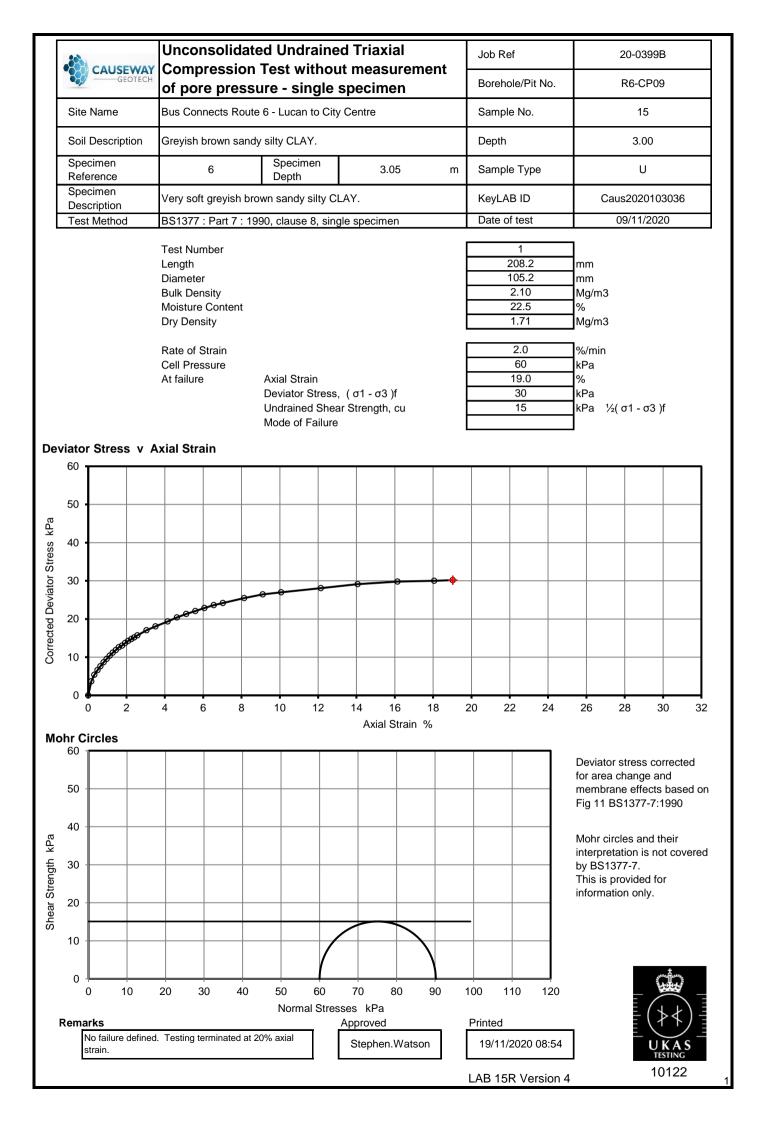
Preparation and testing in accordance with BS1377-2 :1990 unless noted below



LAB 05R Version 4

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	JSEW GEOT	AY ECH	Moisture Condition Value at Natural Moisture Content Summary of Results					ent		
Project No.			Project Name							
20-0	399B			Bus Connects Route 6 - Lucan to City Centre						
Hole No.			nple	-	Soil Description	Retained on 20mm sieve	Moisture Content <20mm	Moisture Condition Value	Method of Interpretation	Remarks
	Ref	Тор	Base	Туре		%	%			
R6-CP07	7	1.00		в	Brown sandy slightly gravelly silty CLAY.	30	19	9.3	Best fit line	
									L	AB 10R Version 5
Key Test performed in accordance with BS1377:Part4:1990, clause 5.4 unless annotated otherwise			Date Printed 18/11		Approved By Stepher	n.Watson				



•	GEOTE			Point Load Strength Index Tests Summary of Results														
Project No.	20-0399B			Proje	ect Nam	е		Bus C	connec	ts Ro	ute 6 -	Lucan	to City	Centre	•			
Borehole	Sa	ample		Spe	ecimen			Type ISRM	lid (Y/N)		Dime	ensions		Force P	Equivalent diameter, De	Point Strengtl		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 mm	W	Dps mm	Dps' mm	kN	au Equivale	Is MPa	Is(5 0) ^{MPa}	water content if measured)
R6-CP07	6.85		с	1	6.85	LIMESTONE	А	U	NO		101.5	56.0	55.0	23.2	84.3	3.3	4.1	
R6-CP07	7.60		с	2	7.60	LIMESTONE	D	U	NO	68.3	101.6	101.6	99.0	30.1	100.3	3.0	4.1	
R6-CP07	7.80		с	3	7.80	LIMESTONE	D	U	YES	58.5	101.6	101.6	98.0	11.6	99.8	1.2	1.6	
R6-CP07	8.50		с	4	8.50	LIMESTONE	D	U	YES	71.0	101.7	101.7	98.0	10.1	99.8	1.0	1.4	
R6-CP07	9.40		с	5	9.40	LIMESTONE	I	U	NO	102.1	80.7	58.0	56.0	5.6	75.9	1.0	1.2	
R6-CP07	10.60		С	6	10.60	LIMESTONE	A	U	NO	101.6	101.6	62.0	60.0	5.2	88.1	0.7	0.9	
Test Type D - Diametral, A Direction L - parallel to pla P - perpendicula U - unknown or r Dimensions Dps - Distance b Dps' - at failure (Lne - Length fror W - Width of sh	nes of weakr r to planes of andom etween plate see ISRM no n platens to r	ness weakr ns (pla ote 6) nearest	ness aten se t free e	paratic	D _{ps}	ametral P me	D _{ps}	Axia		L		Blow	•	P V	D _{ps}	Irregula	ar lump	P D _{ps}
Detailed legend	for test and d	limensi	ons, ba			ods : 2007, unless s shown above.	noted o	therwis	se		Date Printed Approved By							
Size factor, F =	(De/50)0.45	tor all t	tests.				LAB 1	7R V	ersio	n 4				Stepl	nen.V	/atson		TESTING

	JSEW GEOT	AY ECH	U	UNIAXIAL COMPRESSION TEST ON ROCK - SUMMARY OF RESULTS													
Project No. 20-03	99B		Projec	t Nam	e		Bus Co	nnects	Route 6 -	Lucan to	City Centre	e					
		Sar	nple				Specime mensior		Bulk	Bulk Water		al Compre	ession3				
Hole No.	Ref	Тор	Base	Туре	Rock Type	Dia.	Length	H/D	Density2	Content 1	Condition	Mode of failure	UCS	Remarks			
						mm	mm		Mg/m3	%		landro	MPa				
R6-CP07		8.85	9.05	с	LIMESTONE	101.6	254.0	2.5	2.67	0.6	as received	F	35.6				
2	ISRM p ISRM p	986 clause 9153 part	e (vii), Cal 1, determi	iper met ination o	105 ± 3 oC, specimen a hod used for determina f Uniaxial Compressive ad otherwise in the rem	ation of bu e Strength	lk volume			density	Mode of failu S - Single sh AC - Axial cle	ear	MS - multiple F - Fragment				
Test Specificati											17/11/2020			Table 1 sheet			
												Stepher	.Watson	1			

Chemtest

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

Report No.:	20-30010-1		
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	20-0399B Bus Connects Route 6		
Quotation No.:		Date Received:	05-Nov-2020
Order No.:		Date Instructed:	05-Nov-2020
No. of Samples:	16		
Turnaround (Wkdays):	5	Results Due:	11-Nov-2020
Date Approved:	10-Nov-2020		
Approved By:			
Ulya Mary			
Details:	Glynn Harvey, Technical Manager		

2183 **Final Report**

Chemtest

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

<u> Results - Soil</u>

Client: Causeway Geotech Ltd		Che	mtest Jo	b No.:	20-30010	20-30010	20-30010	20-30010	20-30010	20-30010	20-30010	20-30010	20-30010
Quotation No.:	(Chemtest Sample ID.:			1092206	1092207	1092208	1092209	1092210	1092211	1092212	1092213	1092214
Order No.:		Client Sample Ref.:			10	1	5	6	6	7	12		7
		Client Sample ID.:			R6-CP03	R6-CP04	R6-CP04	R6-CP05	R6-CP06	R6-CP07	R6-CP07	R6-CP07	R6-CP08
		Sample Type:			SOIL	SOIL							
		Top Depth (m):		2.00	0.10	1.70	2.50	1.90	1.00	3.20	5.20	2.00	
		Date Sampled:		04-Nov-2020									
Determinand	Accred.	SOP	Units	LOD									
Moisture	N	2030	%	0.020	14	9.2	11	7.7	8.6	14	20	12	13
рН	U	2010		4.0	8.8	8.7	8.5	8.7	8.9	8.6	8.2	8.8	8.9
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.069	0.024	< 0.010

<u> Results - Soil</u>

Client: Causeway Geotech Ltd		Chemtest Job No.:		20-30010	20-30010	20-30010	20-30010	20-30010	20-30010	20-30010	
Quotation No.:	C	Chemtest Sample ID.:			1092215	1092216	1092217	1092218	1092219	1092220	1092221
Order No.:		Client Sample Ref.:		11	8	3	3	11	2	1	
		Client Sample ID.:		R6-CP09	R6-CP09	R6-CP10	R6-CP11	R6-CP11	R6-WS01	R6-WS02	
		Sample Type:			SOIL						
			Top De	oth (m):	1.20	3.00	1.20	1.20	3.00	0.40	0.30
			Date Sa	ampled:	04-Nov-2020						
Determinand	Accred.	SOP	Units	LOD							
Moisture	N	2030	%	0.020	17	15	7.3	8.1	11	7.2	8.1
рН	U	2010		4.0	8.6	8.6	8.5	8.2	9.4	8.7	8.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.025	< 0.010	0.082	1.2	0.21	< 0.010	< 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
Μ	MCERTS and UKAS accredited
Ν	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
Т	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 Ltd Depot Road Newmarket CB8 0AL Tel: 01638 606070 Email: info@chemtest.com

Final Report			Tel: 01638 606070 Email: info@chemtest.com
Report No.:	20-31075-1		
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	20-0399B Route 6 Lucan to City Centre)	
Quotation No.:		Date Received:	16-Nov-2020
Order No.:		Date Instructed	16-Nov-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	Results Due:	20-Nov-2020
Date Approved:	19-Nov-2020		
Approved By:			
Manney			
Details:	Glynn Harvey, Technical Manager		

2183

Chemtest

Eurofins Chemtest Ltd Depot Road Newmarket CB8 0AL Tel: 01638 606070 Email: info@chemtest.com Project: 20-0399B Route 6 Lucan to City Centre

Client: Causeway Geotech Ltd		Cher	ntest Jo	ob No.:	20-31075
Quotation No.:	0	Chemte	st Sam	ple ID.:	1097049
		Sa	ocation:	R6-CP07	
		Sample Type			SOIL
	Top Depth (m)			oth (m):	6.85
	Date Sampled:			ampled:	13-Nov-2020
Determinand	Accred.	SOP	Units	LOD	
Moisture	N	2030	%	0.020	1.9
рН	U	2010		4.0	8.6
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.088

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
	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES

Report Information

Key

1.09	
U	UKAS accredited
Μ	MCERTS and UKAS accredited
Ν	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
Т	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)

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LABORATORY RESTRICTION REPORT

Project Reference	20-0399B		То	Sean Ross	
Project Name	Bus Connects Route 9 - Lucan t	o City Cent	Position	Project Manager	
riojeername					Joseph Nicholl
TR reference	20-0399B	/	G01	Position	Laboratory Quality Manager

The following sample(s) and test(s) are restricted as detailed below. Could you please complete the "Required Action" column and return the completed form to the laboratory.

Hole	5	Sample		Test		
Number	Number	Depth	Туре	Туре	Reason for Restriction	Required Action
R6 CP01	14	(m) 3.00	U	UU Triaxial	Unable to obtain specimen for test - coarse gravel content too high	CANCEL
R6 CP03	12	1.20	U	UU Triaxial	Unable to obtain specimen for test - sample broken by layer of sand	CANCEL
R6 CP04	6	2.00	U	UU Triaxial	Unable to obtain specimen for test - sample broken on extrusion	CANCEL
R6 CP05	5	2.00	U	UU Triaxial	Unable to obtain specimen for test - coarse gravel content too high	CANCEL
R6 CP06	9	2.00	U	UU Triaxial	Unable to obtain specimen for test - cobbles present in sample	CANCEL
R6 CP07	7	1.00	В	UU Triaxial	Unable to obtain specimen for test - cobbles present in sample	CANCEL
R6 CP07		6.20	С	UU Triaxial	Unable to obtain specimen for test - cobbles present in sample	CANCEL
R6 CP08	13	2.00	U	UU Triaxial	Unable to obtain specimen for test - coarse gravel content too high	CANCEL
For electronic reporting a form of electronic signature or printed name is				eis	Laboratory Signature Joseph Nicholl	Project Manager Signature Sean Ross
acceptab	le				Date 10 November 2020	Date



APPENDIX G ENVIRONMENTAL LABORATORY TEST RESULTS



Chemtest

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

Report No.:	20-26018-1		
Initial Date of Issue:	02-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	20-0399B Bus Connects Route 6		
Quotation No.:	Q20-21063	Date Received:	28-Sep-2020
Order No.:		Date Instructed:	28-Sep-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	Results Due:	02-Oct-2020
Date Approved:	02-Oct-2020		
Approved By:			

Details:

Glynn Harvey, Technical Manager



Chemtest

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

Results - Leachate

Client: Causeway Geotech Ltd	Chemtest Job No.				ob No.:	20-26018
Quotation No.: Q20-21063		(ple ID.:	1071187		
			Sa	ample Lo	ocation:	R6-CP07
	Sample Type:				e Type:	SOIL
	Top Depth (m):				oth (m):	0.50
	Date Sampled:				25-Sep-2020	
Determinand	Accred. SOP Type Units LOD					
Ammonium	U 1220 10:1 mg/l 0.050				0.45	
Ammonium	Ν	1220	10:1	mg/kg	0.10	9.3

Client: Causeway Geotech Ltd			ob No.:		
Quotation No.: Q20-21063	(st Sam		1071187
		Sa	ample Lo		R6-CP07
				e Type:	SOIL
			Тор Dep	, ,	0.50
			Date Sa	ampled:	25-Sep-2020
			os Lab:	COVENTRY	
Determinand	Accred.	SOP	Units	LOD	
АСМ Туре	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	14
рН	М	2010		4.0	8.7
Boron (Hot Water Soluble)	М	2120	mg/kg	0.40	0.56
Sulphur (Elemental)	М	2180	mg/kg	1.0	3.2
Cyanide (Total)	М	2300	mg/kg	0.50	< 0.50
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	9.1
Sulphate (Total)	М	2430	%	0.010	0.023
Arsenic	М	2450	mg/kg	1.0	4.8
Barium	М	2450	mg/kg	10	42
Cadmium	М	2450	mg/kg	0.10	< 0.10
Chromium	М	2450	mg/kg	1.0	29
Molybdenum	М	2450	mg/kg	2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0
Copper	М	2450	mg/kg	0.50	15
Mercury	М	2450	mg/kg	0.10	< 0.10
Nickel	М	2450	mg/kg	0.50	25
Lead	М	2450	5	0.50	14
Selenium	М	2450	mg/kg	0.20	< 0.20
Zinc	М	2450	mg/kg	0.50	50
Chromium (Trivalent)	N	2490	mg/kg	1.0	29
Chromium (Hexavalent)	Ν	2490	mg/kg	0.50	< 0.50
Total Organic Carbon	М	2625	%	0.20	1.4
Mineral Oil	N	2670	mg/kg	10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	М	2680	0 0	1.0	< 1.0
Aliphatic TPH >C10-C12	М	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	М	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C16-C21	М	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	М	2680	00	1.0	< 1.0
Aliphatic TPH >C35-C44	Ν	2680	mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	Ν	2680	0 0	5.0	< 5.0
Aromatic TPH >C5-C7	Ν	2680	0 0	1.0	< 1.0
Aromatic TPH >C7-C8	Ν	2680	0 0	1.0	< 1.0
Aromatic TPH >C8-C10	М	2680	mg/kg	1.0	< 1.0

Client: Causeway Geotech Ltd		Che	ob No.:	20-26018	
Quotation No.: Q20-21063	(Chemte	st Sam	ple ID.:	1071187
		Sa	ample Lo	ocation:	R6-CP07
			e Type:	SOIL	
			oth (m):	0.50	
			ampled:	25-Sep-2020	
				os Lab:	COVENTRY
Determinand	Accred.		Units	LOD	
Aromatic TPH >C10-C12	M	-	mg/kg	1.0	< 1.0
Aromatic TPH >C12-C16	М		mg/kg	1.0	< 1.0
Aromatic TPH >C16-C21	U		mg/kg	1.0	< 1.0
Aromatic TPH >C21-C35	М		mg/kg	1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	0	1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10
Benzene	M	2760	µg/kg	1.0	< 1.0
Toluene	M	2760	10 0	1.0	< 1.0
Ethylbenzene	M	2760		1.0	< 1.0
m & p-Xylene	M	2760		1.0	< 1.0
o-Xylene	M	2760		1.0	< 1.0
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0
Naphthalene	M	2800	0 0	0.10	< 0.10
Acenaphthylene	N		mg/kg	0.10	< 0.10
Acenaphthene	M	2800	0 0	0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10
Phenanthrene	M		mg/kg	0.10	< 0.10
Anthracene Fluoranthene	M		mg/kg	0.10	< 0.10 < 0.10
Pyrene	M		mg/kg mg/kg	0.10	< 0.10
Benzo[a]anthracene	M		mg/kg	0.10	< 0.10
Chrysene	M	2800		0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	M	2800		0.10	< 0.10
Benzo[a]pyrene	M	2800	0 0	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	1	mg/kg	0.10	< 0.10
Coronene	N		mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0
PCB 28	U		mg/kg	0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010
PCB 90+101	U	2815		0.010	< 0.010
PCB 118	U	2815	00		< 0.010
PCB 153	U		mg/kg		< 0.010
PCB 138	U	-	mg/kg	0.010	< 0.010
PCB 180	U		mg/kg	0.010	< 0.010
Total PCBs (7 Congeners)	U	2815		0.10	< 0.10

Client: Causeway Geotech Ltd		Che	b No.:	20-26018	
Quotation No.: Q20-21063	(Chemte	ple ID.:	1071187	
		Sa	ocation:	R6-CP07	
			e Type:	SOIL	
			oth (m):	0.50	
			mpled:	25-Sep-2020	
			os Lab:	COVENTRY	
Determinand	Accred.	SOP	Units	LOD	
Total Phenols	М	2920	mg/kg	0.30	< 0.30

Chemtest Job No:	20-26018 1071187				Landfill \	Naste Acceptanc	e Criteria
Chemtest Sample ID: Sample Ref: Sample ID:	1071187					Limits Stable, Non- reactive	
Sample ID. Sample Location: Top Depth(m):	R6-CP07 0.50				Inert Waste	hazardous waste in non-	Hazardous Waste
Bottom Depth(m):	0.50				Landfill	hazardous	Landfill
Sampling Date:	25-Sep-2020				Lanum	Landfill	Lanum
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	1.4	3	5	6
Loss On Ignition	2610	М	%	8.7			10
Total BTEX	2760	М	mg/kg	< 0.010	6		
Total PCBs (7 Congeners)	2815	М	mg/kg	< 0.10	1		
TPH Total WAC (Mineral Oil)	2670	М	mg/kg	< 10	500		
Total (Of 17) PAH's	2800	Ν	mg/kg	< 2.0	100		
pH	2010	М		8.7		>6	
Acid Neutralisation Capacity	2015	N	mol/kg	0.057		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 l/kg
Arsenic	1450	U	< 0.0010	< 0.050	0.5	2	25
Barium	1450	U	0.0077	< 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	0.0070	0.070	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0031	< 0.050	0.5	10	30
Nickel	1450	U	0.0030	< 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	0.0091	< 0.50	4	50	200
Chloride	1220	U	12	120	800	15000	25000
Fluoride	1220	U	0.35	3.5	10	150	500
Sulphate	1220	U	12	120	1000	20000	50000
Total Dissolved Solids	1020	Ν	140	1400	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	4.8	< 50	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.090
Moisture (%)	14

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	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.
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	determination by inductively coupled plasma
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	рН	pH Meter
2015	Acid Neutralisation Capacity	Acid Reserve	Titration
	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

|--|

ney	
U	UKAS accredited
Μ	MCERTS and UKAS accredited
Ν	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
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	Uncertainty of measurement for the determinands tested are available upon request
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If you require extended retention of samples, please email your requirements to: <u>customerservices@chemtest.com</u>

Chemtest

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

Report No.:20-29269-1Initial Date of Issue:03-Nov-2020ClientCauseway Geotech LtdClient Address:& Drumahiskey Road Balamore Ballymoney County Antrim BT53 70LContact(s):Carin Corwall Colm Hurley Darren O'Mahony Gabriella Horan John Cameron Lucy Newland Martin Gardiner Mathew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Praney Stephen Praney Stephen Praney Stephen Praney Stephen Praney Stephen Praney Stephen Praney Stephen Starbaham Thomas McAllisDate Received: 29-Oct-2020ProjectQ20-21063Date Received: 29-Oct-202029-Oct-2020No. of Samples:1Turnaround (Wkdays):5Results Due: Custor04-Nov-2020Date Approved:03-Nov-2020Results Due:04-Nov-2020Date Approved:03-Nov-2020Results Due:04-Nov-2020				
ClientCauseway Geotech LtdClient Address:& Drumahiskey Road Balamore Ballymoney County Antrim BTS3 7QLContact(s):Carin Cornwall Colm Hurley Daren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Mathew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stephen Watson Stuart Abraham Thomas McAllisProject20-0399B Bus Connects Route 6Quotation No.:1Order No::1Turnaround (Wkdays)5Stephen PraneyResults Due:Stamples:1Turnaround (Wkdays)5Approved By:04-Nov-2020	Report No.:	20-29269-1		
Client Address:& Drumahiskey Road Balnamore Ballymoney County Antrim BT53 TQLContact(s):Carin Cornwall Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Mattin Gardiner Matthew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen Watson Stephen Watson Steph	Initial Date of Issue:	03-Nov-2020		
Balanamore Ballymoney County Antrim BT53 7QLContact(s):Cain Cornwall Colm Hurley Darren O'Mahony Gabrielle Horan Joe Gervin John Cameron Lucy Newland Matrin Gardiner Mattinew Gilbert Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen McCracken Stephen McCracken McCracken Stephen McCracken Stephen McCracken Stephen McCracken Stephen McCracken Stephen McCracken Stephen McCracken Stephen McCracken <th>Client</th> <th>Causeway Geotech Ltd</th> <th></th> <th></th>	Client	Causeway Geotech Ltd		
Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin 	Client Address:	Balnamore Ballymoney County Antrim		
Quotation No.:Q20-21063Date Received:29-Oct-2020Order No.:Date Instructed:29-Oct-2020No. of Samples:129-Oct-2020Turnaround (Wkdays):5Results Due:04-Nov-2020Date Approved:03-Nov-202011Approved By:111	Contact(s):	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		
Order No.:Date Instructed:29-Oct-2020No. of Samples:11Turnaround (Wkdays):5Results Due:04-Nov-2020Date Approved:03-Nov-2020Approved By:	Project	20-0399B Bus Connects Route 6		
No. of Samples:1Results Due:04-Nov-2020Turnaround (Wkdays):5Results Due:04-Nov-2020Date Approved:03-Nov-2020	Quotation No.:	Q20-21063	Date Received:	29-Oct-2020
Turnaround (Wkdays):5Results Due:04-Nov-2020Date Approved:03-Nov-2020	Order No.:		Date Instructed:	29-Oct-2020
Date Approved:03-Nov-2020Approved By:	No. of Samples:	1		
Approved By:	Turnaround (Wkdays):	5	Results Due:	04-Nov-2020
	Date Approved:	03-Nov-2020		
		-		

Details:

Glynn Harvey, Technical Manager



Chemtest

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

Client: Causeway Geotech Ltd		Che	mtest Jo	ob No.:	20-29269
Quotation No.: Q20-21063	(Chemte	st Sam	ple ID.:	1088344
		Sa	ample Lo	ocation:	R6-CP09
			Sample	e Type:	SOIL
			Top Dep	oth (m):	1.00
			Date Sa	ampled:	23-Oct-2020
			Asbest	-	COVENTRY
Determinand	Accred.	SOP	Units	LOD	
АСМ Туре	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	9.6
pН	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	mg/kg	0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	20
Cadmium	U	2450		0.10	1.4
Chromium	U	2450		1.0	13
Copper	U	2450		0.50	23
Mercury	U	2450		0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	32
Lead	U	2450	mg/kg	0.50	27
Zinc	U	2450	mg/kg	0.50	56
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		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	0.66
Anthracene	U	2700	mg/kg	0.10	0.19
Fluoranthene	U	2700	mg/kg	0.10	1.3
Pyrene	U	2700	mg/kg	0.10	1.4
Benzo[a]anthracene	U	2700		0.10	0.72
Chrysene	U	2700		0.10	0.72
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		0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700		0.10	< 0.10
Benzo[g,h,i]perylene	U	2700		0.10	< 0.10
Coronene	Ν	2700		0.10	< 0.10
Total Of 17 PAH's	Ν	2700	mg/kg	2.0	5.0
Total Phenols	U	2920		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

1.09	
U	UKAS accredited
Μ	MCERTS and UKAS accredited
Ν	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
Т	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>

Chemtest

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

Final Report			Tel: 01638 606070 Email: info@chemtest.com
Report No.:	20-29273-1		
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 Franey Stephen McCracken Stephen Watson Stuart Abraham Thomas McAllis		
Project	20-0399B Bus Connects Route 6		
Quotation No.:	Q20-21063	Date Received	29-Oct-2020
Order No.:		Date Instructed	1: 29-Oct-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	Results Due:	04-Nov-2020
Date Approved:	04-Nov-2020		
Approved By:			

Details:

2183

Glynn Harvey, Technical Manager

Chemtest

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

Client: Causeway Geotech Ltd		Che	ntest Jo	ob No.:	20-29273
Quotation No.: Q20-21063	(Chemte	st Sam	ple ID.:	1088370
		Sa	ample Lo	ocation:	R6-CP10
			Sample	e Type:	SOIL
			Top Dep	oth (m):	1.00
			Date Sa	ampled:	24-Oct-2020
			Asbest	os Lab:	COVENTRY
Determinand	Accred.	SOP	Units	LOD	
АСМ Туре	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	Ν	2030	%	0.020	11
рН	U	2010		4.0	8.3
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	0.50
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50
Arsenic	U	2450	mg/kg	1.0	18
Cadmium	U	2450	mg/kg	0.10	1.6
Chromium	U	2450	mg/kg	1.0	16
Copper	U	2450	mg/kg	0.50	24
Mercury	U	2450	mg/kg	0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	41
Lead	U	2450	mg/kg	0.50	27
Zinc	U	2450	mg/kg	0.50	79
Organic Matter	U	2625	%	0.40	1.9
Total TPH >C6-C40	U	2670	0 0	10	230
Naphthalene	U	2700	mg/kg	0.10	9.2
Acenaphthylene	U	2700	mg/kg	0.10	0.57
Acenaphthene	U	2700	mg/kg	0.10	5.7
Fluorene	U	2700	mg/kg	0.10	4.8
Phenanthrene	U	2700	0 0	0.10	18
Anthracene	U	2700	mg/kg	0.10	3.1
Fluoranthene	U	2700	mg/kg	0.10	11
Pyrene	U	2700	mg/kg	0.10	10
Benzo[a]anthracene	U	2700	0 0	0.10	4.5
Chrysene	U	2700	0 0	0.10	4.7
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	4.8
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	2.0
Benzo[a]pyrene	U	2700	mg/kg	0.10	4.0
Indeno(1,2,3-c,d)Pyrene	U	2700	0 0	0.10	2.1
Dibenz(a,h)Anthracene	U	2700	0 0	0.10	0.98
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	2.2
Coronene	N	2700	0	0.10	< 0.10
Total Of 17 PAH's	Ν	2700	mg/kg	2.0	88
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
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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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I/S	Insufficient Sample
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<	"less 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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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 H SPT HAMMER ENERGY MEASUREMENT REPORT





SPT Hammer Energy Test Report

.0643

NPB

22/02/2020

03/03/2020 .0643.spt

in accordance with BSEN ISO 22476-3:2005

Southern Testing
Keeble House
Stuart Way
East Grinstead
West Sussex
RH19 4QA

Instrumented Rod Data

Diameter dr (mm):	54
Wall Thickness tr (mm):	6.0
Assumed Modulus E _a (GPa):	200
Accelerometer No.1:	6458
Accelerometer No.2:	9607

SPT Hammer Information

Hammer Mass m (k	(g): 63.5
Failing Height h (m	m): 760
SPT String Length L ((m): 10.0

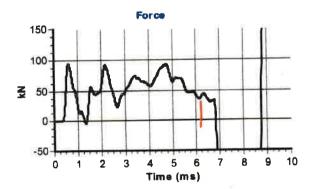
Comments / Location

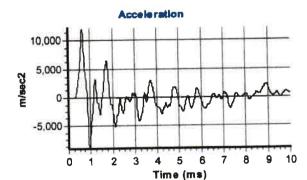
SPT Hammer Ref:

Test Date: Report Date:

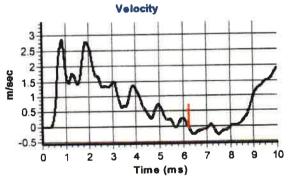
File Name:

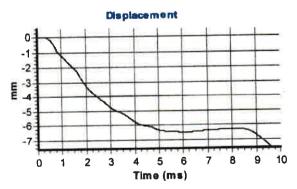
Test Operator:





BALLEYMONEY





Calculations

905 Area of Rod A (mm2): 473 Theoretical Energy E_{theor} (J): 400 Measured Energy E_{meas} (J): Energy Ratio E_r (%): 85



Signed: **Neil Burrows** Field Operations Manager Title:

The recommended calibration interval is 12 months



SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

	COT Hommon Information	
RH19 4QA	Test Operator:	NPB
East Grinstead West Sussex	File Name:	.T7.spt
Stuart Way	Report Date:	03/03/2020
Southern Testing Keeble House	SPT Hammer Ref: Test Date:	.T7 22/02/2020

Instrumented Rod Data

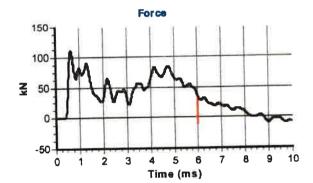
Diameter d _r (mm):	54
Wall Thickness tr (mm):	6.0
Assumed Modulus E _a (GPa):	200
Accelerometer No.1:	6458
Accelerometer No.2:	9607

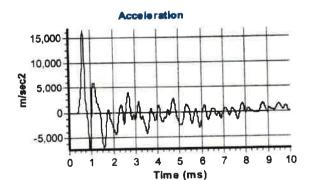
SPT Hammer Information

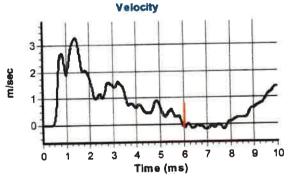
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	10.0

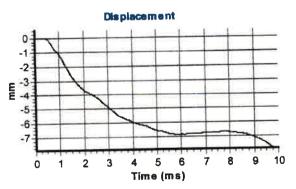
Comments / Location

BALLEYMONEY









Calculations

905 Area of Rod A (mm2): Theoretical Energy E_{theor} (J): 473 399 Measured Energy E_{meas} (J): Energy Ratio E_r (%): 84

Signed: Neil Burrows Field Operations Manager Title:

The recommended calibration interval is 12 months