

The background of the page is a vibrant red. It is decorated with several abstract geometric shapes: a large white circle with a blue border in the upper right; a smaller white circle with a blue border in the lower left; a large green semi-circle in the lower right; and various other shapes in blue, green, and white, some with white outlines, scattered throughout the corners and edges.

Appendix E
Ground Investigation Factual
Report

CONTENTS

Document Control Sheet




Note on: Methods of describing soils and rocks & abbreviations used on exploratory hole logs

1	AUTHORITY	4
2	SCOPE	4
3	DESCRIPTION OF SITE	4
4	SITE OPERATIONS.....	5
4.1	Summary of site works.....	5
4.2	Boreholes.....	5
4.2.1	Light cable percussion boreholes	5
4.2.2	Dynamic sampled boreholes.....	6
4.3	Standpipe installations.....	6
4.4	Slit trenches.....	7
4.5	Surveying.....	7
4.6	Groundwater monitoring	7
5	LABORATORY WORK.....	7
5.1	Geotechnical laboratory testing of soils.....	7
5.2	Environmental laboratory testing of soils	8
6	GROUND CONDITIONS	8
6.1	General geology of the area	8
6.2	Ground types encountered during investigation of the site	8
6.3	Groundwater.....	9
7	REFERENCES	10

APPENDICES

Appendix A	Site and exploratory hole location plans
Appendix B	Borehole logs
Appendix C	Slit trench logs and sketches
Appendix D	Slit trench photographs
Appendix E	Geotechnical laboratory test results
Appendix F	Environmental laboratory test results
Appendix G	SPT hammer energy measurement report

Document Control Sheet

Report No.:		20-0399E			
Project Title:		Bus Connects Route 13 Bray to City Centre			
Client:		National Transport Authority (NTA)			
Client's Representative:		Jacobs			
Revision:	A02	Status:	Final for Issue	Issue Date:	9 th December 2021
Prepared by:		Reviewed by:		Approved by:	
 Sean Ross BSc MSc MIEI		 Colm Hurley BSc FGS PGeo		 Darren O'Mahony BSc MSc MIEI EurGeol PGeo	

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 used on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler).
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler).
P	Nominal 100mm diameter undisturbed piston sample.
B	Bulk disturbed sample.
LB	Large bulk disturbed sample.
D	Small disturbed sample.
C	Core sub-sample (displayed in the Field Records column on the logs).
L	Liner sample from dynamic sampled borehole.
W	Water sample.
ES / EW	Soil sample for environmental testing / Water sample for environmental testing.
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained).
SPT (c)	Standard penetration test using 60 degree solid cone.
(x,x/x,x,x,x)	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length.
(Y for Z/ Y for Z)	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given seating or test length 'Z' (mm).
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm).
HVP / HVR	In situ hand vane test result (HVP) and vane test residual result (HVR). Results presented in kPa.
V VR	Shear vane test (borehole). Shear strength stated in kPa. V: undisturbed vane shear strength VR: remoulded vane shear strength
Soil consistency description	In cohesive soils, where samples are disturbed and there are no suitable laboratory tests, N values may be used to indicate consistency on borehole logs – a median relationship of $N \times 5 = C_u$ is used (as set out in Stroud & Butler 1975).
dd-mm-yyyy	Date at the end and start of shifts, shown at the relevant borehole depth. Corresponding casing and water depths shown in the adjacent columns.
▽	Water strike: initial depth of strike.
▼	Water strike: depth water rose to.
Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015	
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 13 Bray to City Centre

1 AUTHORITY

On the instructions of Jacobs, (“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 sampling, environmental sampling, groundwater monitoring, in-situ and laboratory testing, and the preparation of a factual report on the findings.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted along the route of the proposed Bus Connects Route from Bray to the City Centre with investigation points at the N11 junction with the Lower Kilmacud Road, junction of the N11 with the Old Bray Road and within the ground of Ravenswell Primary School in Bray, Co. Wicklow.

Borehole works were undertaken in housing estates off the N11 while slit trenches were undertaken within the central median of the road.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 16th October and 2nd November 2020, comprised:

- three light cable percussion boreholes
- one borehole by dynamic (windowless) sampling methods
- a standpipe installation in three boreholes
- six slit trenches

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 four boreholes were put down in a minimum diameter of 150mm through soils strata to their completion depths by a combination of methods, including light percussion boring using a Dando Terrier rig and light cable percussion boring by a Dando 2000 rig.

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

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

4.2.1 Light cable percussion boreholes

Three boreholes (R13-CP01 – R13-CP03) were put down to completion in minimum 200mm diameter using Dando 2000 light cable percussion boring rigs. All boreholes were terminated either at their scheduled completion depths, or else on encountering virtual refusal on obstructions, including large boulders and weathered bedrock.

Hand dug inspection pits were carried out between ground level and 1.20m depth to ensure boreholes were put down at locations clear of services or subsurface obstructions.

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 G.

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

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

Appendix B presents the borehole logs.

4.2.2 Dynamic sampled boreholes

One borehole (R12-WS01) was put down to completion by light percussion boring techniques using a Dando Terrier dynamic sampling rig. The borehole was put down initially in 150mm diameter, reducing in diameter with depth as required, down to 50mm by use of the smallest sampler.

A hand dug inspection pit was carried out between ground level and 1.20m depth to ensure the boreholes were put down clear of services or subsurface obstructions. The borehole was taken to a depth of 2.0m where it was terminated on encountering virtual refusal.

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 G.

Groundwater was not encountered during boring.

Appendix B presents the borehole logs.

4.3 Standpipe installations

A groundwater monitoring standpipe was installed in BH01-BH03.

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

4.4 Slit trenches

Six slit trenches (R13-SLT01-R13-SLT03, R13-SLT03A and R13-SLT04-R13-SLT15) were 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.

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.

4.5 Surveying

The as-built exploratory hole positions were surveyed following completion of site operations by a Site Engineer from Causeway Geotech. Surveying was carried out using a Trimble R6 GPS system employing VRS and real time kinetic (RTK) techniques.

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

4.6 Groundwater monitoring

Following completion of site works, groundwater monitoring was conducted on several rounds. Groundwater monitoring was carried out using a water interface probe.

The monitoring records are presented in Section 6.3.

5 LABORATORY WORK

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

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.

- **soil chemistry:** BRE Test Suite B

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

The test results are presented in Appendix H.

5.2 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 F.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise Glacial Till, fluvioglacial sands and gravels and made ground. These deposits are underlain by Leinster Granite in the north of the route and by the Maulin Formation in the section of the route.

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 R13-CP01 and R13-CP02 encountered 100-200mm of macadam surfacing.

- **Topsoil:** encountered in R13-CP03, R13-WS01 and R13-SLT01-R13-SLT05 ranging in thickness from 100-500mm.
- **Made Ground (sub-base):** approximately 200 to 1200mm of aggregate fill beneath the paved surface in R13-CP01 and R13-CP02,
- **Made Ground (fill):** reworked sandy gravelly clay or silty sandy gravel or brown fine to coarse sand fill encountered at all locations to a maximum depth of 3.50m in R13-CP03. Varying amounts of red brick, concrete, tin and plastic fragments were encountered in R13-CP03, R13-SLT01, R13-SLT02, R13-SLT03 and R13-SLT03A to a maximum depth of 2.30m in R13-CP03.
- **Fluvioglacial deposits:** typically, medium dense sands and gravels interspersed with layers of sandy gravelly clay encountered at all borehole locations.
- **Glacial Till:** sandy gravelly clay or silt, frequently with low cobble content, typically firm or stiff in upper horizons, becoming very stiff with increasing depth.

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 in R13-CP02 through soil as a water strike at 2.30m in R13-CP02.

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

Groundwater was not noted during excavation of any of the slit trenches.

Subsequent groundwater monitoring of the standpipe installations recorded water levels as shown in Table 1.

Table 1: Groundwater monitoring

Date	Water level (mbgl)		
	R13-CP01	R13-CP02	R13-CP03
19/11/2020	2.47	2.24	Dry
19/01/2021	2.12	2.05	Dry
12/02/2021	2.21	1.99	6.11
23/04/2021	3.21	2.33	Dry
02/06/2021	3.39	2.25	Dry
22/06/2021	3.22	2.45	Dry
16/07/2021	3.33	2.46	Dry
20/08/2021	3.28	2.44	Dry
24/09/2021	3.22	2.44	Dry

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

7 REFERENCES

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

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

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

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

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

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

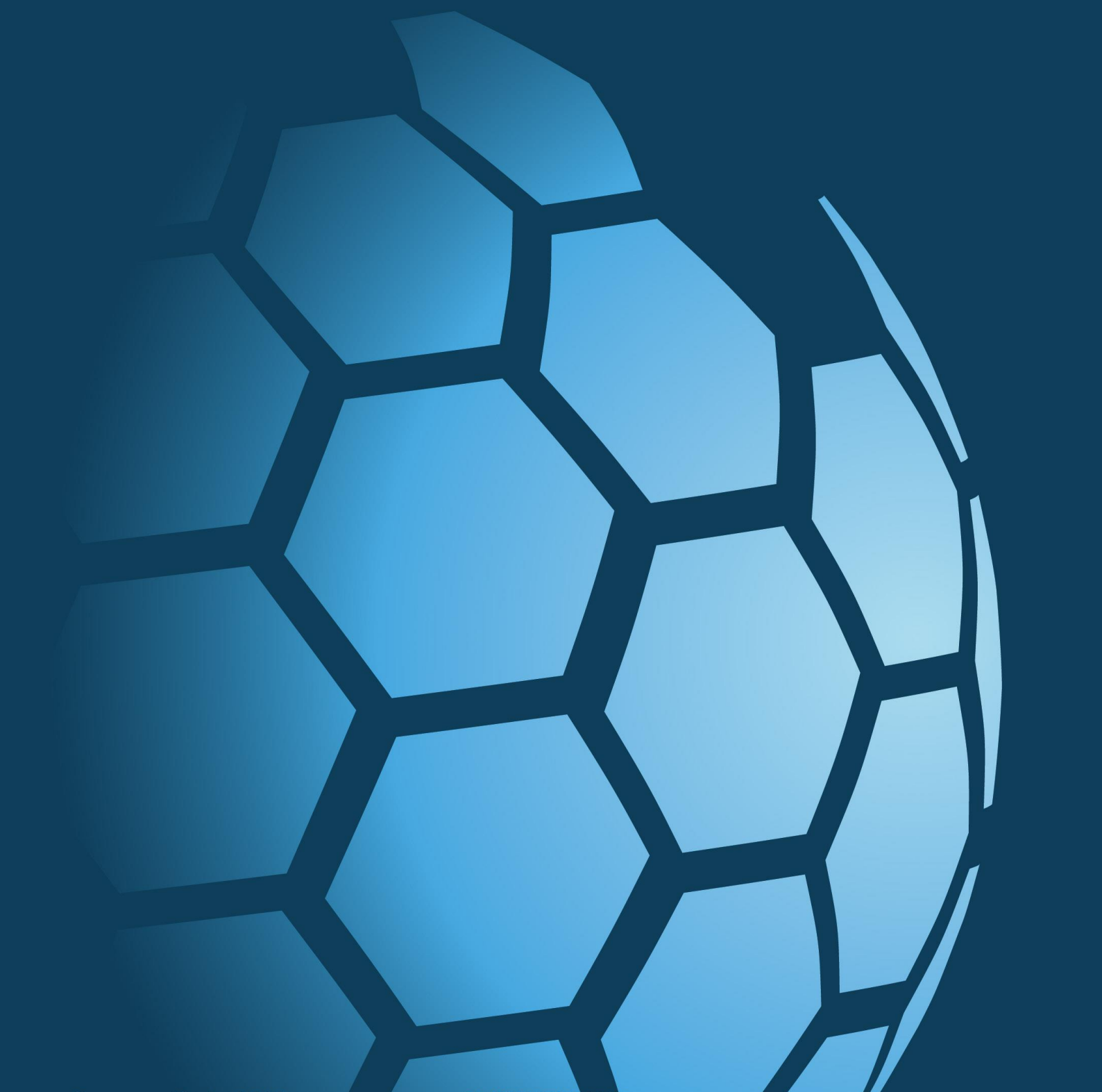
BS EN ISO 14689-1:2018: Geotechnical investigation and testing. Identification and classification of rock. Identification and description.

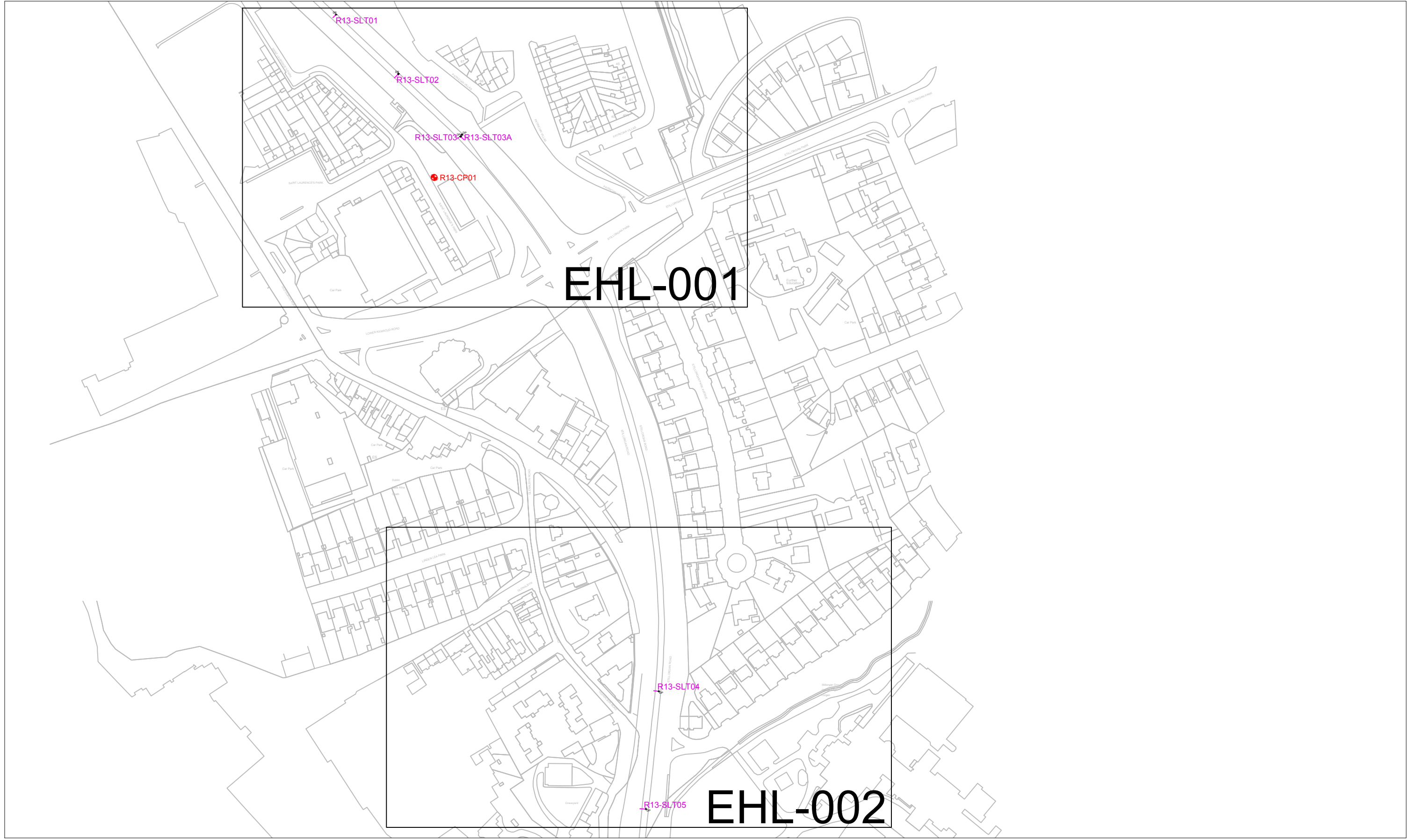
BS EN ISO 22476-3:2005+A1:2011: Geotechnical investigation and testing. Field testing. Standard penetration test.



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APPENDIX A
SITE AND EXPLORATORY HOLE LOCATION PLAN





PROJECT: Bus Connects Route 13 Bray to City Centre

TITLE: Exploratory hole location plan (Overview)

CLIENT: National Transport Authority (NTA)

KEY:
● Borehole
□ Slit Trench



SCALE: NTS@A3

DATE: 18/11/2020

ENGINEER: Jacobs

DRWN: BS
 CHCK: CH

SERIES: 1 of 3
 DWG No: 20-0399E-EHL-OW-001



EHL-003

R13-CP02

PROJECT: Bus Connects Route 13 Bray to City Centre

TITLE: Exploratory hole location plan (Overview)

CLIENT: National Transport Authority (NTA)

KEY:
● Borehole
□ Slit Trench



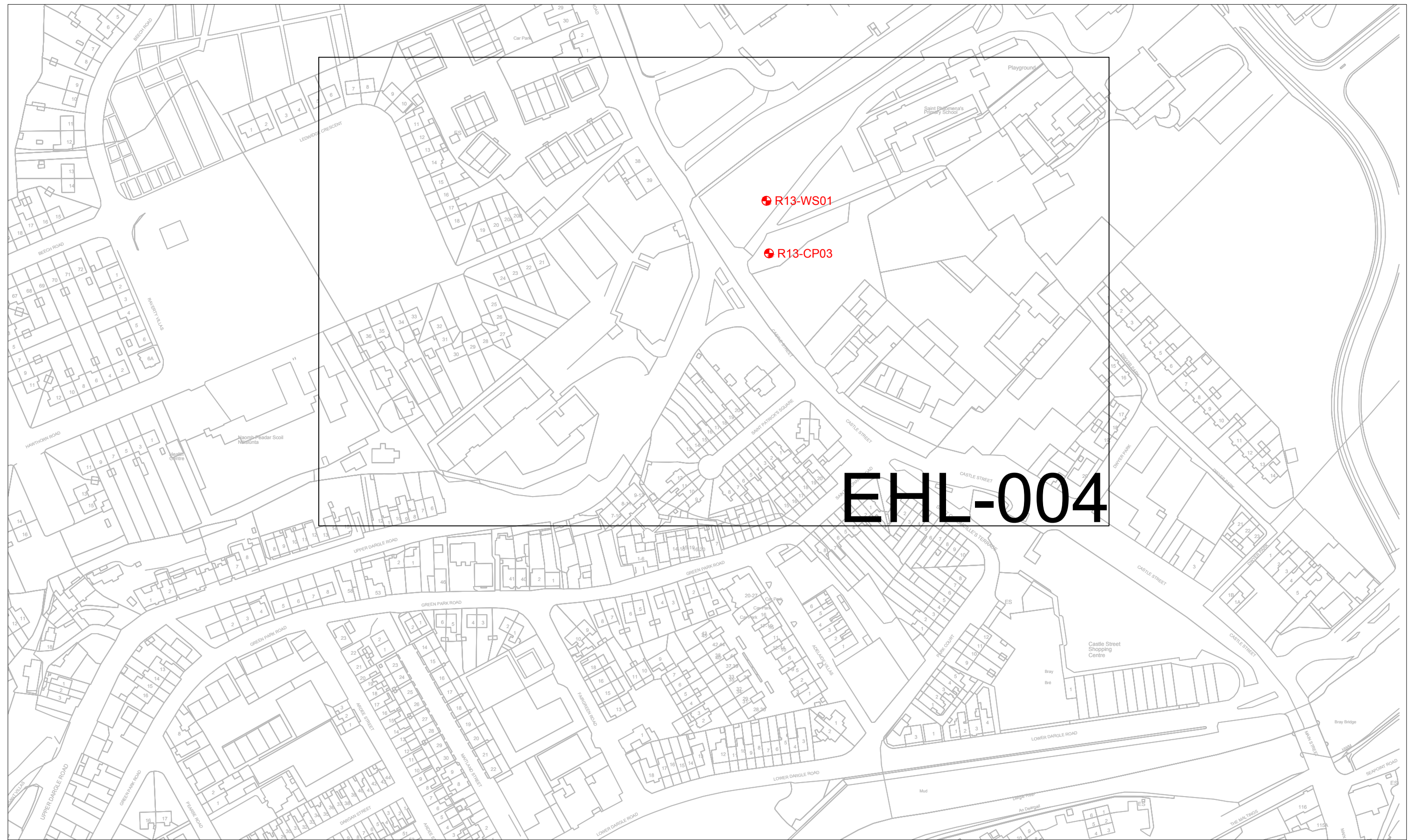
SCALE: NTS@A3

DATE: 18/11/2020

ENGINEER: Jacobs

DRWN: BS
 CHCK: CH

SERIES: 2 of 3
 DWG No: 20-0399E-EHL-OW-001



EHL-004

PROJECT: Bus Connects Route 13 Bray to City Centre

TITLE: Exploratory hole location plan (Overview)

CLIENT: National Transport Authority (NTA)

KEY:
● Borehole
□ Slit Trench



SCALE: NTS@A3

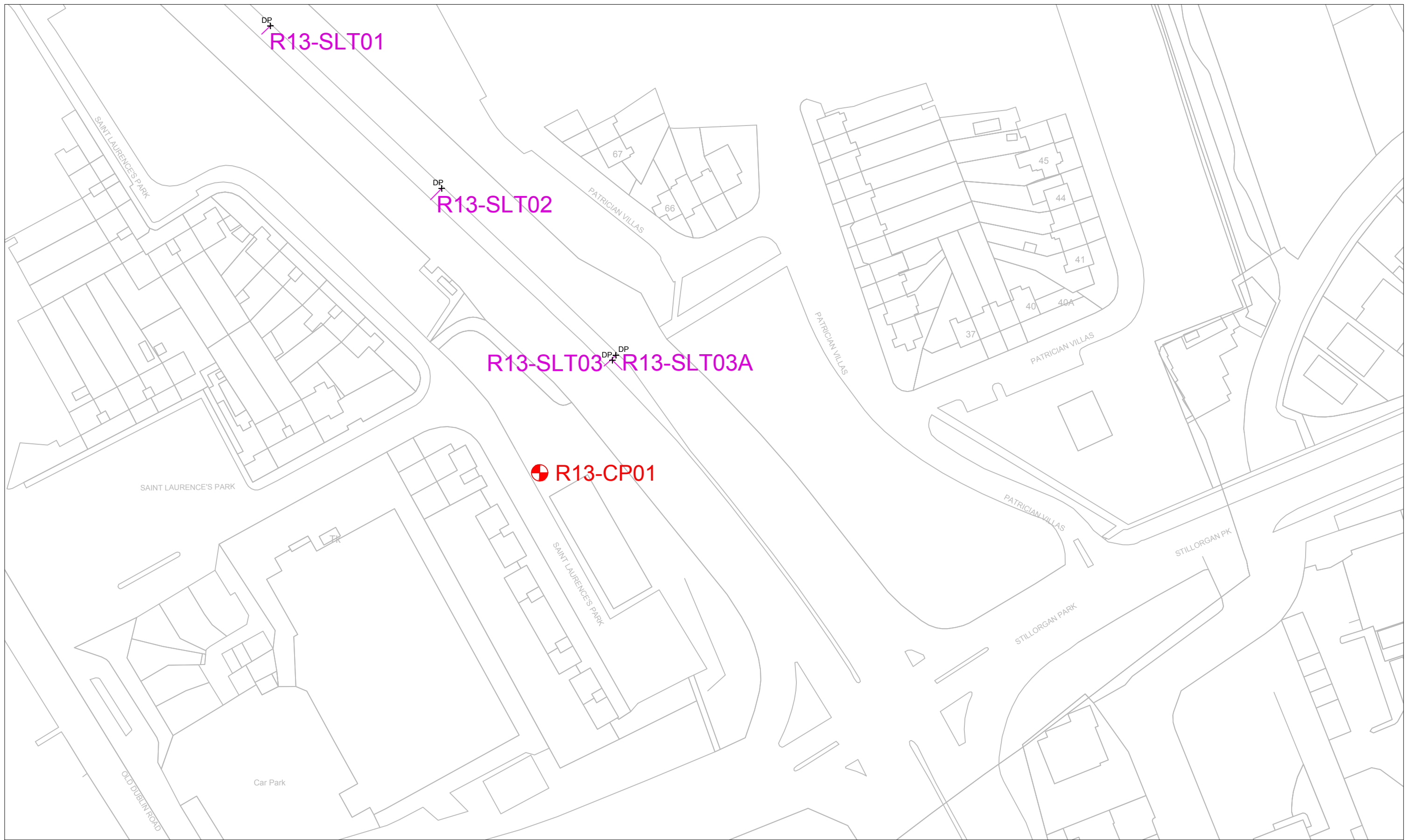
DATE: 18/11/2020

ENGINEER: Jacobs

DRWN: BS
CHK: CH

SERIES: 3 of 3

DWG No: 20-0399E-EHL-OW-001



PROJECT: Bus Connects Route 13 Bray to City Centre

TITLE: Exploratory hole location plan

CLIENT: National Transport Authority (NTA)

KEY:
● Borehole
□ Slit Trench



SCALE: NTS@A3

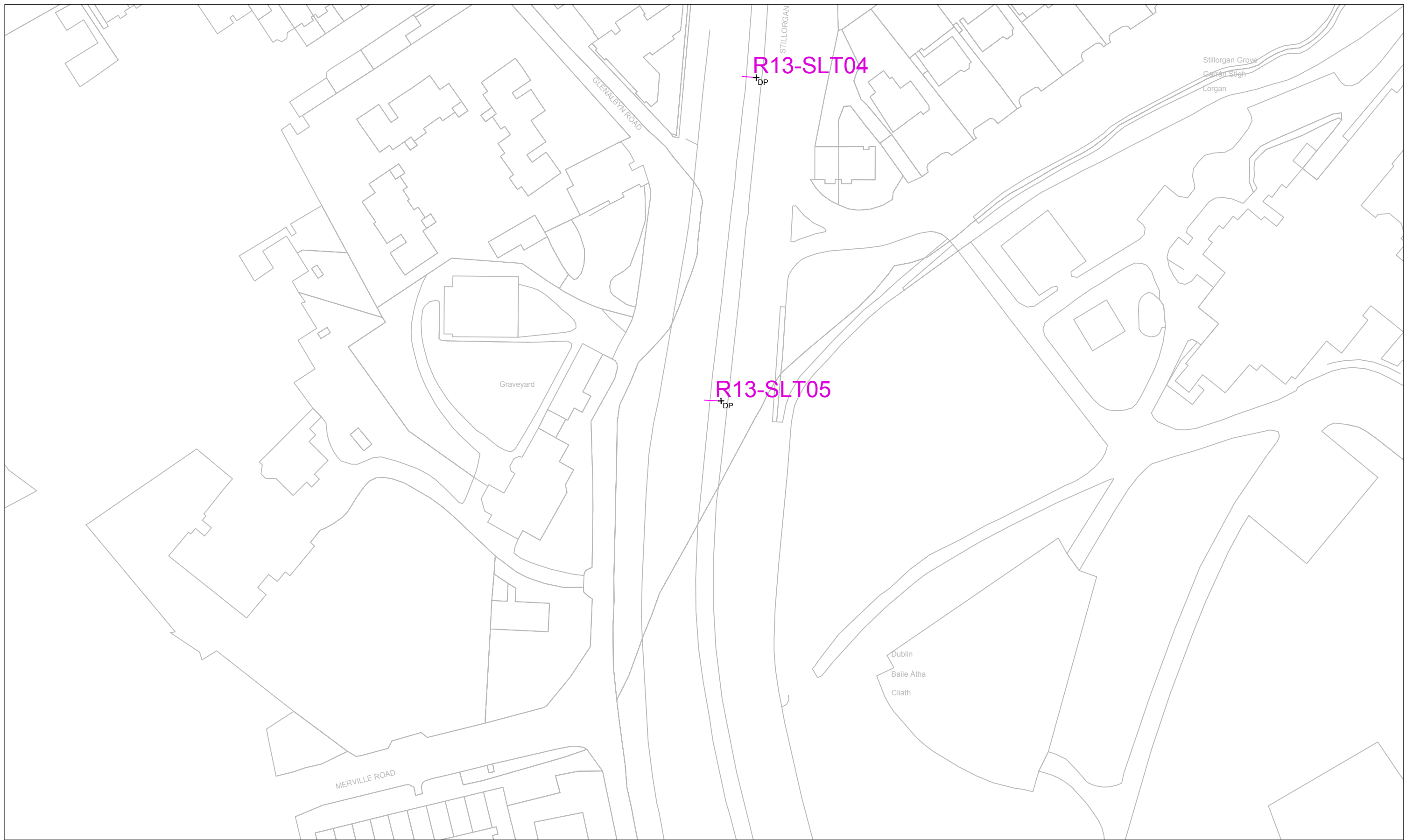
DATE: 18/11/2020

ENGINEER: Jacobs

DRWN: BS
 CHCK: CH

SERIES: 1 of 4

DWG No: 20-0399E-EHL-001



PROJECT: Bus Connects Route 13 Bray to City Centre

TITLE: Exploratory hole location plan

CLIENT: National Transport Authority (NTA)

KEY:
● Borehole
□ Slit Trench



SCALE: NTS@A3

DATE: 18/11/2020

ENGINEER: Jacobs

DRWN: BS
 CHCK: CH

SERIES: 2 of 4

DWG No: 20-0399E-EHL-002



PROJECT: Bus Connects Route 13 Bray to City Centre

TITLE: Exploratory hole location plan

CLIENT: National Transport Authority (NTA)

KEY:
● Borehole
□ Slit Trench



SCALE: NTS@A3

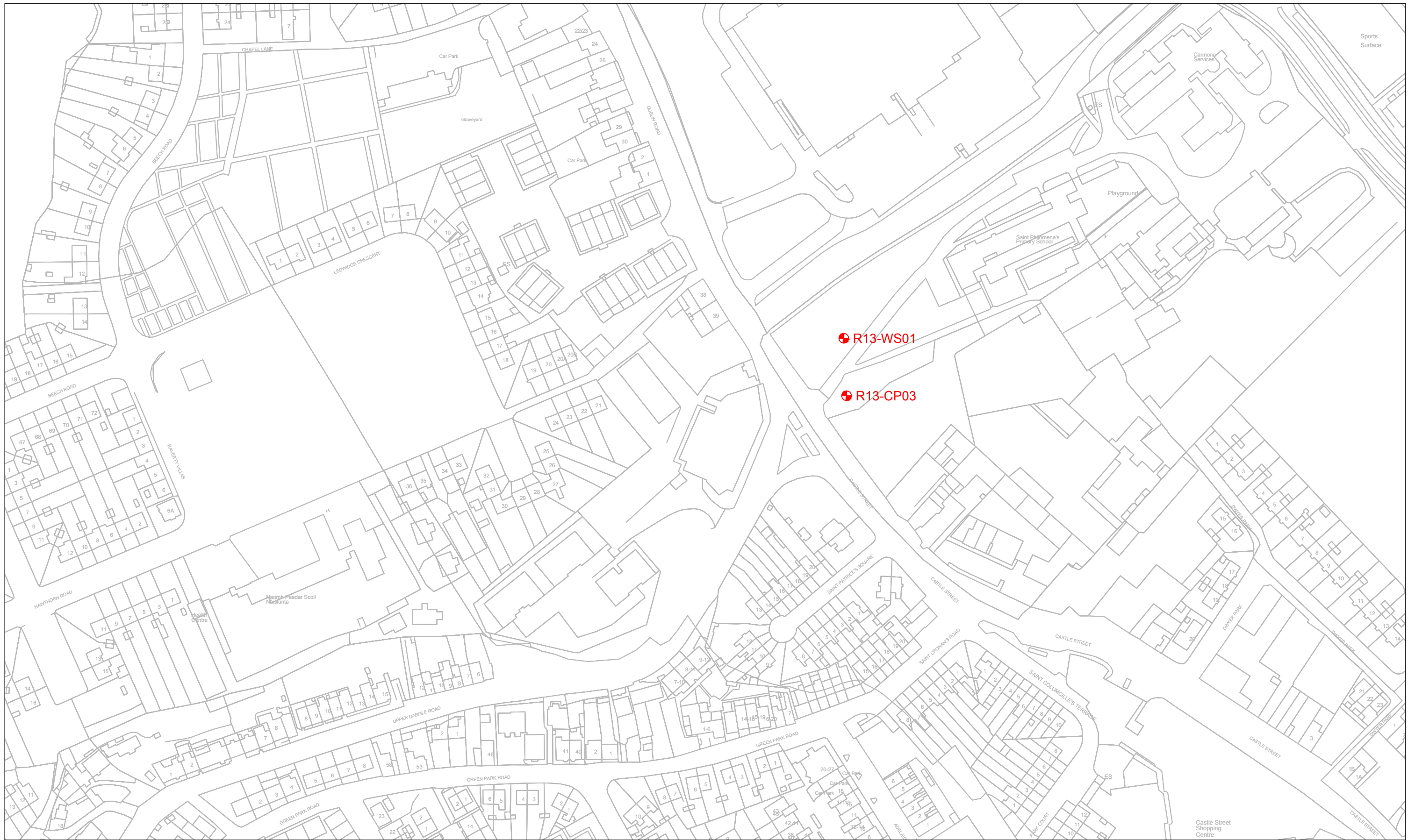
DATE: 18/11/2020

ENGINEER: Jacobs

DRWN: BS
 CHCK: CH

SERIES: 3 of 4

DWG No: 20-0399E-EHL-003



PROJECT: **Bus Connects Route 13 Bray to City Centre**

TITLE: **Exploratory hole location plan**

CLIENT: **National Transport Authority (NTA)**

KEY:
● Borehole
□ Slit Trench



SCALE: **NTS@A3**

DATE: **18/11/2020**

ENGINEER: **Jacobs**

DRWN: **BS**
 CHCK: **CH**

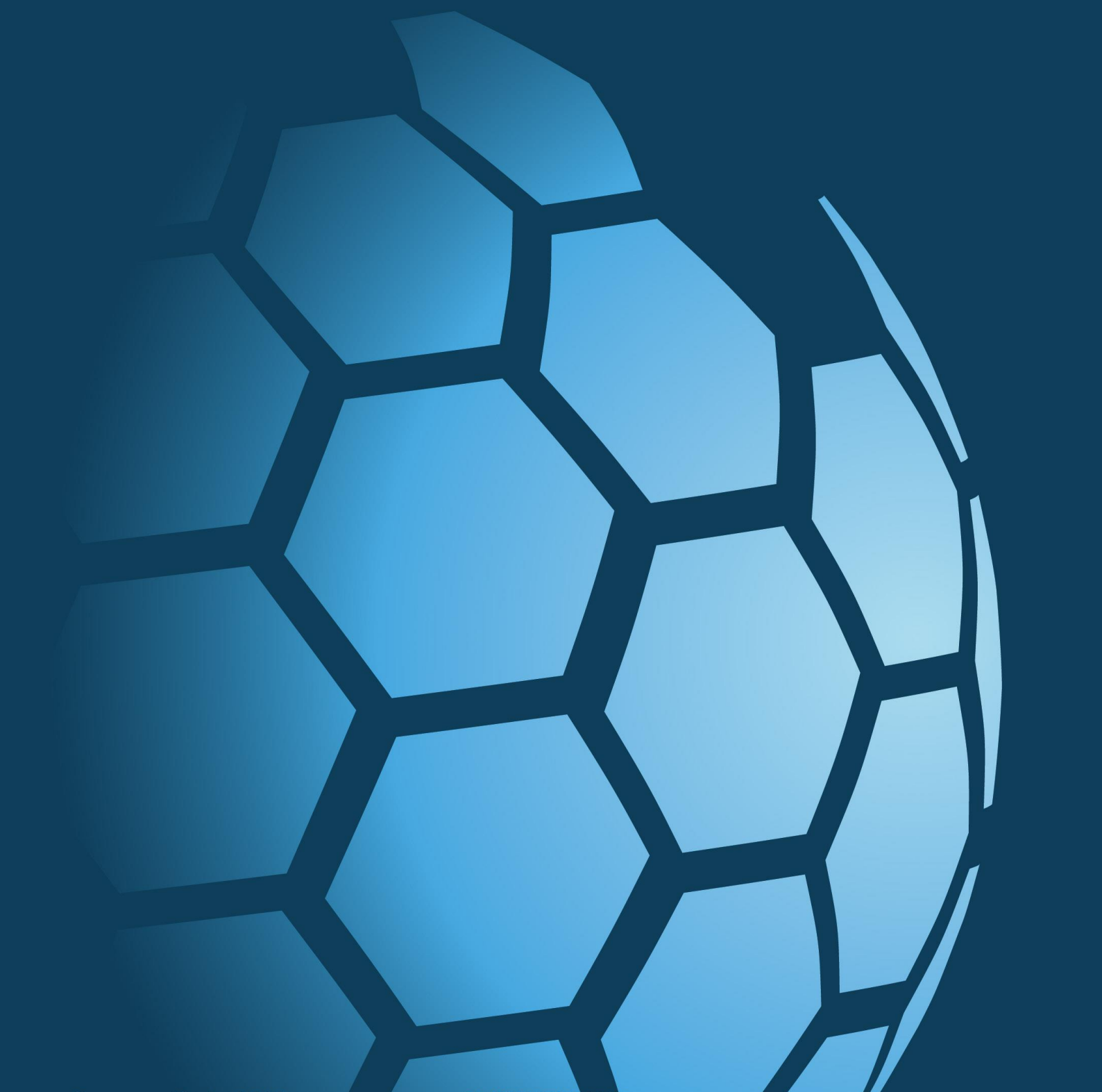
SERIES: **4 of 4**

DWG No: **20-0399E-EHL-004**



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APPENDIX B
BOREHOLE LOGS





Project No.
20-0399E

Project Name: Bus Connects Route 13 Bray to City Centre

Borehole ID
R13-CP01

Client: National Transport Authority (NTA)

Client's Rep: Jacobs

Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base (m) 4.80	Coordinates 720216.36 E 728149.44 N	Final Depth: 4.80 m	Start Date: 28/10/2020	Driller: BM	Sheet 1 of 1 Scale: 1:40
					Elevation: 48.99 mOD	End Date: 28/10/2020	Logger: GH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
48.89						0.10	BITMAC			
48.69						0.30		MADE GROUND: Grey sandy angular fine to coarse GRAVEL of limestone. Sand is fine to coarse.		
0.50	B1							MADE GROUND: Soft brownish grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
0.50	ES7									
1.00	B2									
1.00	ES8									
1.20	D11									
1.20 - 1.65	SPT (S)	N=9 (2,3/2,2,2,3) Hammer SN = 0643	0.00	Dry	47.79	1.20		Firm becoming stiff brown slightly sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
2.00	B3									
2.00	D9									
2.00	ES12									
2.00 - 2.45	SPT (S)	N=21 (4,4/7,5,4,5) Hammer SN = 0643	1.50	Dry						
3.00	B4									
3.00	D13									
3.00	ES10									
3.00 - 3.45	U15	Ublow=25 90%	3.00	Dry						
4.00	B5									
4.00 - 4.20	SPT (S)	N=50 (7,25/50 for 50mm) Hammer SN = 0643	3.00	Dry	44.89	4.10		Very stiff grey slightly sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subangular of mixed lithologies.		
4.50	B6									
4.50	D14									
4.70 - 4.78	SPT (S)	N=50 (25 for 35mm/50 for 50mm) Hammer SN = 0643	3.00	Dry	44.39 44.19	4.60 4.80		Dense grey sandy GRAVEL of mixed lithologies. Sand is fine to coarse. (Possible bedrock)		
End of Borehole at 4.80m										

Water Strikes				Chiselling Details			Remarks	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)		
								Hand dug inspection pit excavated to 1.20m. No groundwater encountered.
Casing Details				Water Added				
To (m)	Diameter	From (m)	To (m)					
3.00	200							
Termination Reason							Last Updated	
Terminated on refusal.							17/12/2020	





Project No.
20-0399E

Project Name: Bus Connects Route 13 Bray to City Centre

Borehole ID
R13-CP02

Client: National Transport Authority (NTA)

Client's Rep: Jacobs

Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base (m) 2.70	Coordinates 722200.70 E 726075.61 N	Final Depth: 2.70 m	Start Date: 27/10/2020	Driller: BM	Sheet 1 of 1 Scale: 1:40
					Elevation: 55.91 mOD	End Date: 27/10/2020	Logger: GH	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill	
0.50	B1	N=10 (2,3/2,2,3,3) Hammer SN = 0643	0.00	Dry	55.70	0.20		BITMAC			
0.50	ES5					MADE GROUND: Grey sandy slightly silty subangular GRAVEL of mixed lithologies. Sand is fine to coarse.					
1.00	B2					54.70	1.20				Medium dense brown sandy subangular to subrounded GRAVEL of mixed lithologies with low cobble content. Sand is fine to coarse. Cobbles are subrounded of mixed lithologies.
1.00	ES6										
1.20	D9	N=10 (2,3/2,3,3,2) Hammer SN = 0643 Strike at 2.30m	1.50	Dry	53.90	2.00		Medium dense brown sandy silty subangular to subrounded GRAVEL of mixed lithologies with low cobble content. Sand is fine to coarse. Cobbles are subrounded of mixed lithologies.			
1.20 - 1.65	SPT (S)										
2.00	B3	N=50 (25 for 50mm/50 for 125mm) Hammer SN = 0643	1.50	Dry	53.40	2.50		Dense grey sandy GRAVEL of mixed lithologies. Sand is fine to coarse. (Possible bedrock)			
2.00	D10										
2.00	ES7										
2.00 - 2.45	SPT (S)				53.20	2.70		End of Borehole at 2.70m			
2.50	B4										
2.50	ES8										
3.00 - 3.18	SPT (S)										

Water Strikes				Chiselling Details			Remarks Hand dug inspection pit excavated to 1.20m.
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)	
2.30		20	2.20	2.50	2.70	01:00	
Casing Details		Water Added					
To (m)	Diameter	From (m)	To (m)				
1.50	200						
Termination Reason Terminated on refusal.							Last Updated 17/12/2020





Project No.
20-0399E

Project Name: Bus Connects Route 13 Bray to City Centre

Borehole ID
R13-CP03

Client: National Transport Authority (NTA)

Client's Rep: Jacobs

Method Cable Percussion	Plant Used Dando 2000	Top (m) 0.00	Base (m) 7.00	Coordinates 726002.77 E 719137.22 N	Final Depth: 7.00 m	Start Date: 16/10/2020	Driller: BM	Sheet 1 of 1 Scale: 1:40
					Elevation: 10.56 mOD	End Date: 17/10/2020	Logger:	

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
10.46						0.10		TOPSOIL		
0.50	B1							MADE GROUND: Brown very sandy silty subangular to subrounded fine to coarse GRAVEL of mixed lithologies with fragments of red brick. Sand is fine to coarse.		
0.50	ES9									
1.00	B2									
1.00	ES									
1.00	ES10					9.36	1.20	MADE GROUND: Very soft greyish brown sandy gravelly CLAY with frequent fragments of brick. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies.		
1.20	D15									
1.20 - 1.65	SPT (S)	N=2 (0,1/0,1,0,1) Hammer SN = 0643	1.00	Dry						
2.00	B3									
2.00	D16									
2.00	ES11					8.26	2.30	MADE GROUND: Soft brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies.		
2.00 - 2.45	SPT (S)	N=4 (0,1/1,1,1,1) Hammer SN = 0643	1.50	Dry						
3.00	B4									
3.00	ES12									
3.00 - 3.45	U20	Ublow=20 100%	1.50	Dry						
4.00	B5									
4.00	D17									
4.00	ES13									
4.00 - 4.45	SPT (S)	N=30 (4,5/7,7,7,9) Hammer SN = 0643	3.00	Dry						
5.00	B6									
5.00	D18									
5.00	ES14									
5.00 - 5.45	SPT (S)	N=38 (6,6/8,9,9,12) Hammer SN = 0643	3.00	Dry						
6.00	B7									
6.00 - 6.45	U21	Ublow=50 60%	3.00	Dry						
7.00	B8									
7.00	D19									
7.00 - 7.38	SPT (S)	N=50 (9,11/50 for 225mm) Hammer SN = 0643	3.00	Dry						
						5.06	5.50	Dense brown sandy silty subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
						4.06	6.50	Dense brown gravelly clayey fine to coarse SAND. Gravel is subrounded fine to coarse of mixed lithologies.		
						3.56	7.00	End of Borehole at 7.00m		

Water Strikes				Chiselling Details			Remarks
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)	
							Hand dug inspection pit excavated to 1.20m.
Casing Details		Water Added					
To (m)	Diameter	From (m)	To (m)				
Termination Reason							Last Updated
Terminated on refusal.							17/12/2020





Method Light Percussion	Plant Used Dando Terrier	Top (m) 0.00	Base (m) 2.00	Coordinates 726001.49 E 719163.98 N	Final Depth: 2.00 m	Start Date: 19/10/2020	Driller: JC	Sheet 1 of 1 Scale: 1:50
					Elevation: 13.64 mOD	End Date: 19/10/2020	Logger:	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.50	ES1	N=13 (3,4/3,3,3,4) Hammer SN = 0696	0.00	Dry	13.14	0.50		TOPSOIL		
0.50 - 1.30	B2					1.30		Soft to firm brown sandy gravelly SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies.		
1.00	ES3	N=50 (8,10/50 for 285mm) Hammer SN = 0696	0.00	Dry	11.64	1.30		Medium dense light brown very sandy silty subangular to subrounded fine to coarse GRAVEL of mixed lithologies. Sand is fine to coarse.		
1.20	D4					2.00		End of Borehole at 2.00m		
1.20 - 1.65	SPT (C)									
1.30 - 1.60	B5									
1.60 - 2.00	B6									
2.00	ES7									
2.00 - 2.44	SPT (C)									

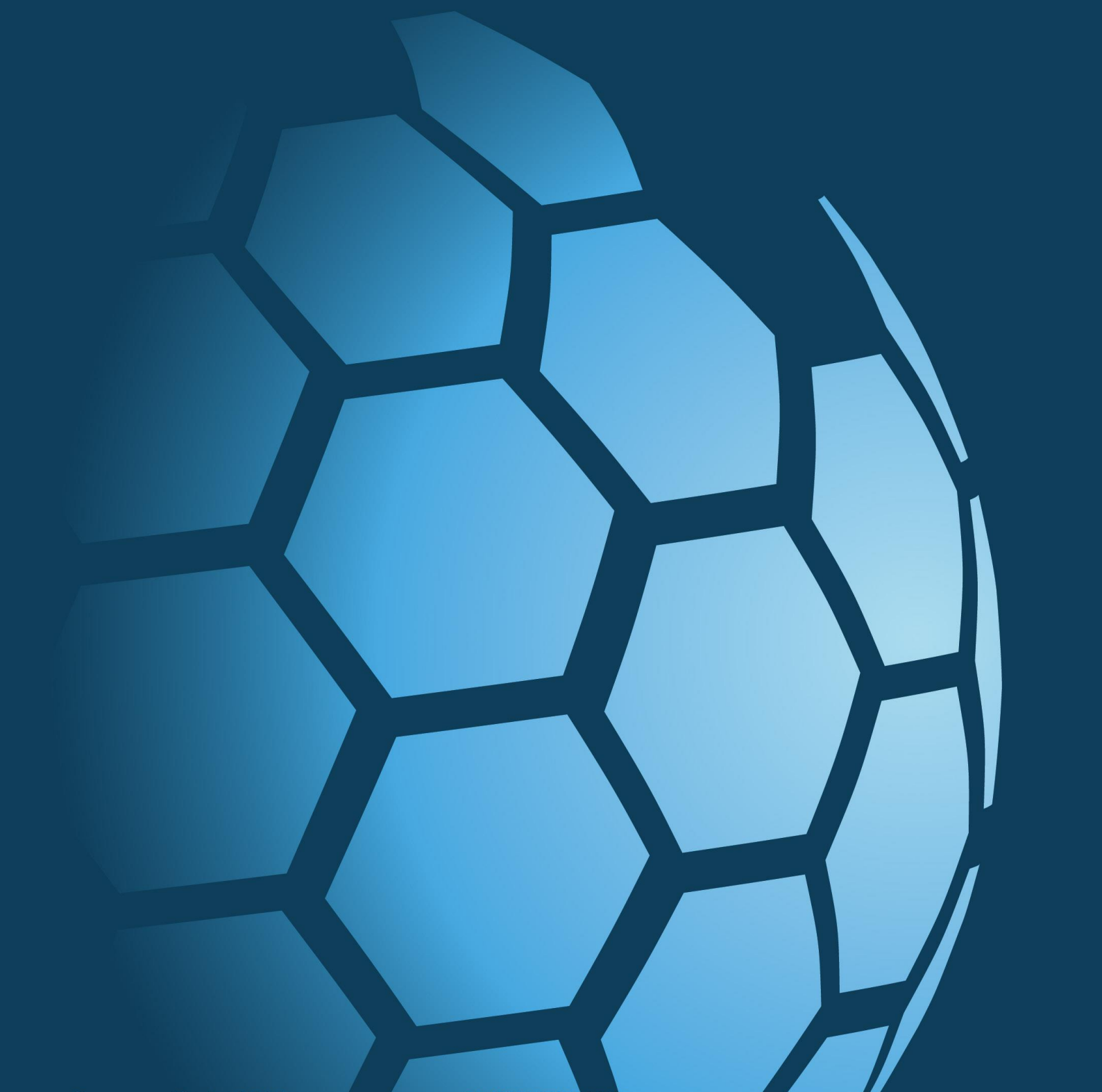
Water Strikes				Casing Details		Remarks
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	To (m)	Diameter	
						Hand dug inspection pit excavated to 1.20m. No groundwater encountered.
Termination Reason						Last Updated
Terminated on refusal.						17/12/2020



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APPENDIX C

SLIT TRENCH LOGS AND DRAWINGS





Project No. 20-0399E	Project Name: Bus Connects Route 13 Bray to City Centre	Trial Pit ID R13-SLT01
Coordinates 720141.85 E 728273.13 N	Client: National Transport Authority (NTA)	Sheet 1 of 1 Scale: 1:25
	Client's Representative: Jacobs	
Method: Slit Trenching	Elevation 48.72 mOD	Date: 20/10/2020
Plant: 3T Tracked Excavator		Logger: MG
		FINAL

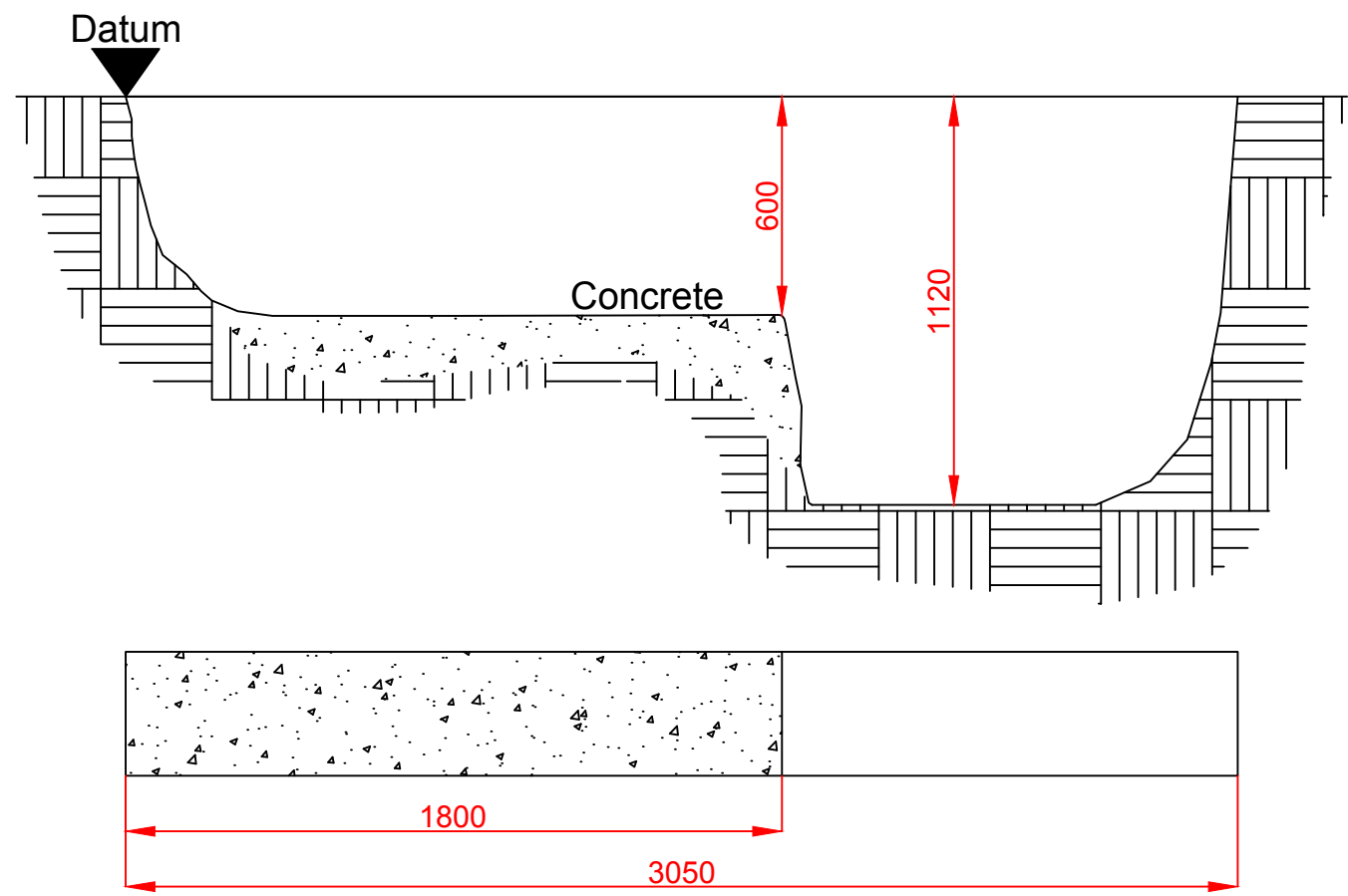
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.50 0.50	B3 ES1		48.52	0.20		TOPSOIL	
			48.12	0.60		MADE GROUND: Soft to firm light brown and brown sandy gravelly CLAY with low cobble content and fragments of brick and concrete. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.	0.5
1.00 1.00	B4 ES2		47.60	1.12		MADE GROUND: Soft to firm dark brown and greyish brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.	1.0
						End of trial pit at 1.12m	1.5 2.0 2.5 3.0 3.5 4.0 4.5

Water Strikes		Depth: 1.12 Width: 0.34 Length: 3.05	Remarks: No groundwater encountered. Concrete encountered at 0.60m on western side of trench.
Struck at (m)	Remarks		
		Stability: Stable	Termination Reason: Terminated on the instruction of the engineer.
		Last Updated 17/12/2020	

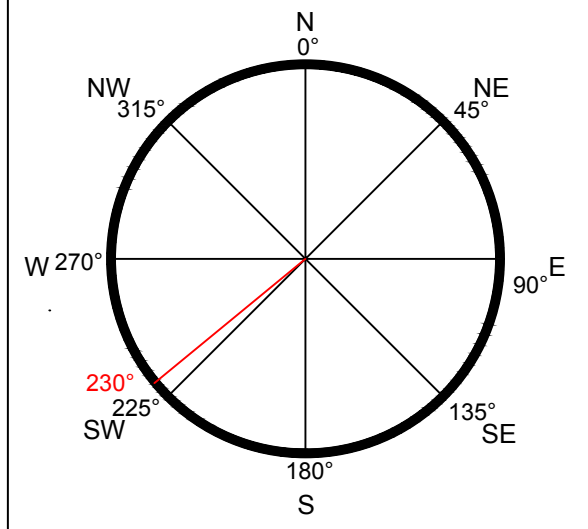
JOB NUMBER: 20-0399E JOB NAME: Route 13 Bray to City Centre LOCATION: R13 - SLT01

CLIENT: National Transport Authority (NTA) CLIENTS REPRESENTATIVE: Jacobs CREW: MG PLANT & EQUIPMENT: 3 Tonne Excavator & Hand Tools

TRENCH: (SECTION & PLAN)



TRENCH - ORIENTATION



TRENCH ORIENTATED : 230° FROM NORTH

COORDINATES: DATUM

EASTING: 720141.845
 NORTHING: 728273.126
 ELEVATION: 48.718MOD

No:	Type of Service:	Diameter (in mm)	Depth to Top of Service (m)	Distance to Centre of Service (m)	Details/Comments
01	Possible ESB	Unknown	0.60	0.90 (assumed)	Lean mix covering ESB
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					

TRENCH LENGTH (m) : 3.05
 TRENCH DEPTH (m) : 1.12
 TRENCH WIDTH (m) : 0.34

STABILITY: STABLE
 GROUNDWATER: NONE

SCALE: NTS@A3
 DRAWN: BS
 CHECKED: CH
 DATE EXCAVATED: 20/10/2020





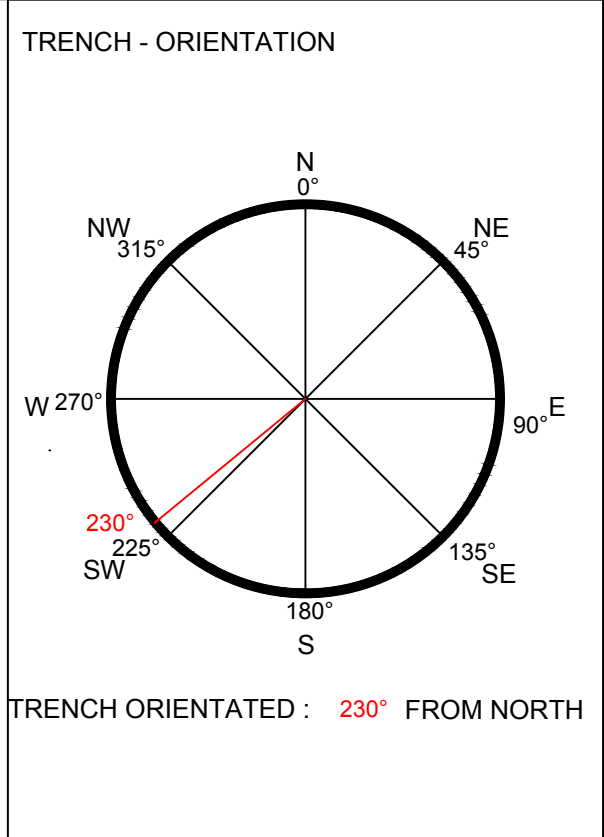
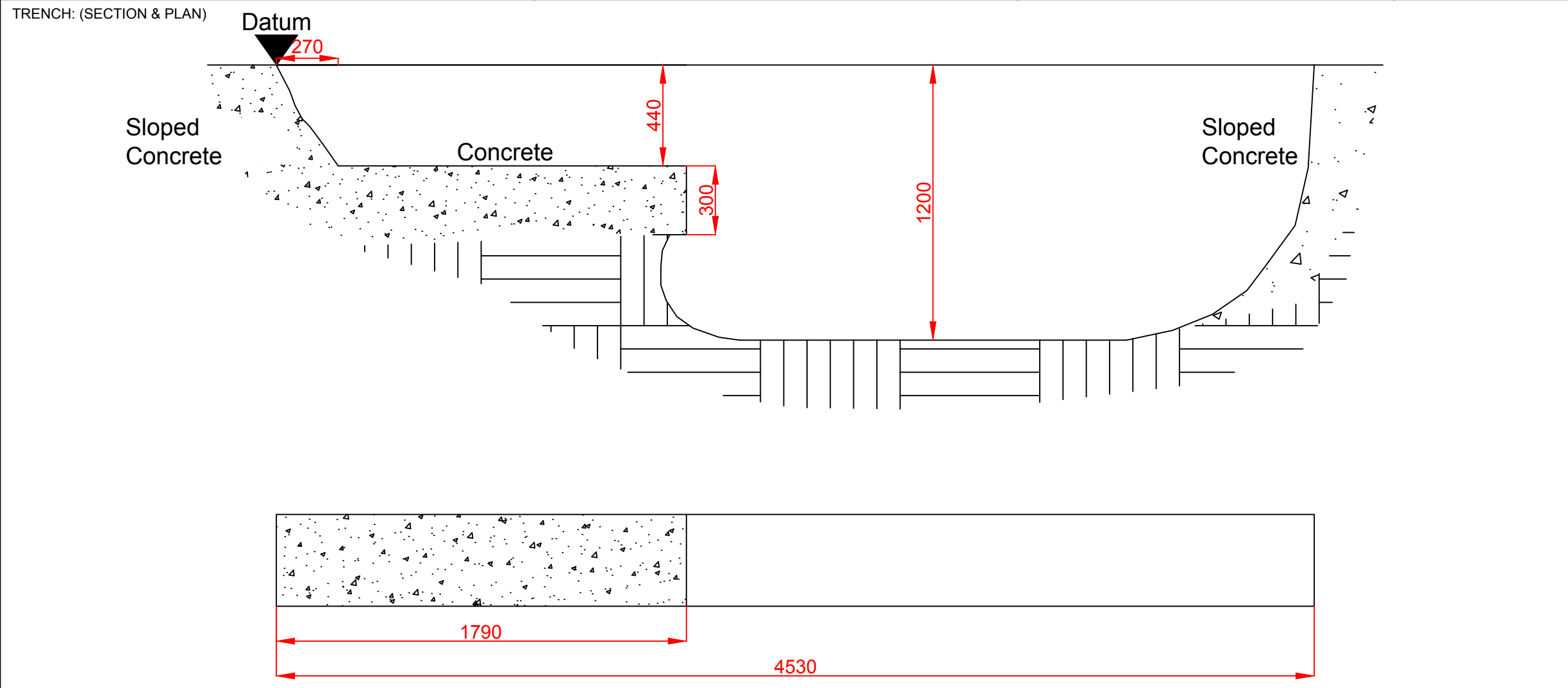
Project No. 20-0399E	Project Name: Bus Connects Route 13 Bray to City Centre	Trial Pit ID R13-SLT02
Coordinates 720189.26 E 728228.16 N	Client: National Transport Authority (NTA)	Sheet 1 of 1 Scale: 1:25
	Client's Representative: Jacobs	
Method: Slit Trenching	Elevation 48.40 mOD	Date: 20/10/2020
Plant: 3T Tracked Excavator		Logger: MG
		FINAL

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.50 0.50	B3 ES1		48.30	0.10		TOPSOIL	
						MADE GROUND: Soft slightly sandy gravelly silty CLAY with medium cobble content and fragments of brick, concrete, tin, and plastic. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of limestone of mixed lithologies. Cobbles are subrounded of mixed lithologies.	
1.00 1.00	B4 ES2		47.60	0.80		MADE GROUND: Firm to stiff brown and dark greyish brown slightly sandy gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mixed lithologies. Cobbles are subangular of mixed lithologies.	
			47.20	1.20		End of trial pit at 1.20m	

Water Strikes		Depth: 1.20 Width: 0.40 Length: 4.53	Remarks: No groundwater encountered. Lean mix concrete encountered at 0.35m bgl on eastern side of trench.
Struck at (m)	Remarks		
		Stability: Stable	Termination Reason: Terminated on the instruction of the engineer.
		Last Updated 17/12/2020	

JOB NUMBER: 20-0399E JOB NAME: Route 13 Bray to City Centre LOCATION: R13 - SLT02

CLIENT: National Transport Authority (NTA) CLIENTS REPRESENTATIVE: Jacobs CREW: MG PLANT & EQUIPMENT: 3 Tonne Excavator & Hand Tools



COORDINATES: DATUM
 EASTING: 720189.258
 NORTHING: 728228.155
 ELEVATION: 48.397MDD

No:	Type of Service:	Diameter (in mm)	Depth to Top of Service (m)	Distance to Centre of Service (m)	Details/Comments
01	Possible ESB	Unknown	0.44	Unknown	Lean mix covering ESB
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					

TRENCH LENGTH (m) : 4.53
 TRENCH DEPTH (m) : 1.20
 TRENCH WIDTH (m) : 0.40

STABILITY: STABLE
 GROUNDWATER: NONE

SCALE: NTS@A3
 DRAWN: BS
 CHECKED: CH
 DATE EXCAVATED: 20/10/2020





Project No.
20-0399E

Project Name:
Bus Connects Route 13 Bray to City Centre

Trial Pit ID
R13-SLT03

Coordinates
720237.46 E
728181.97 N

Client:
National Transport Authority (NTA)
Client's Representative:
Jacobs

Sheet 1 of 1
Scale: 1:25

Method:
Slit Trenching

Plant:
3T Tracked Excavator

Elevation
47.86 mOD

Date:
20/10/2020

Logger:
MG

FINAL

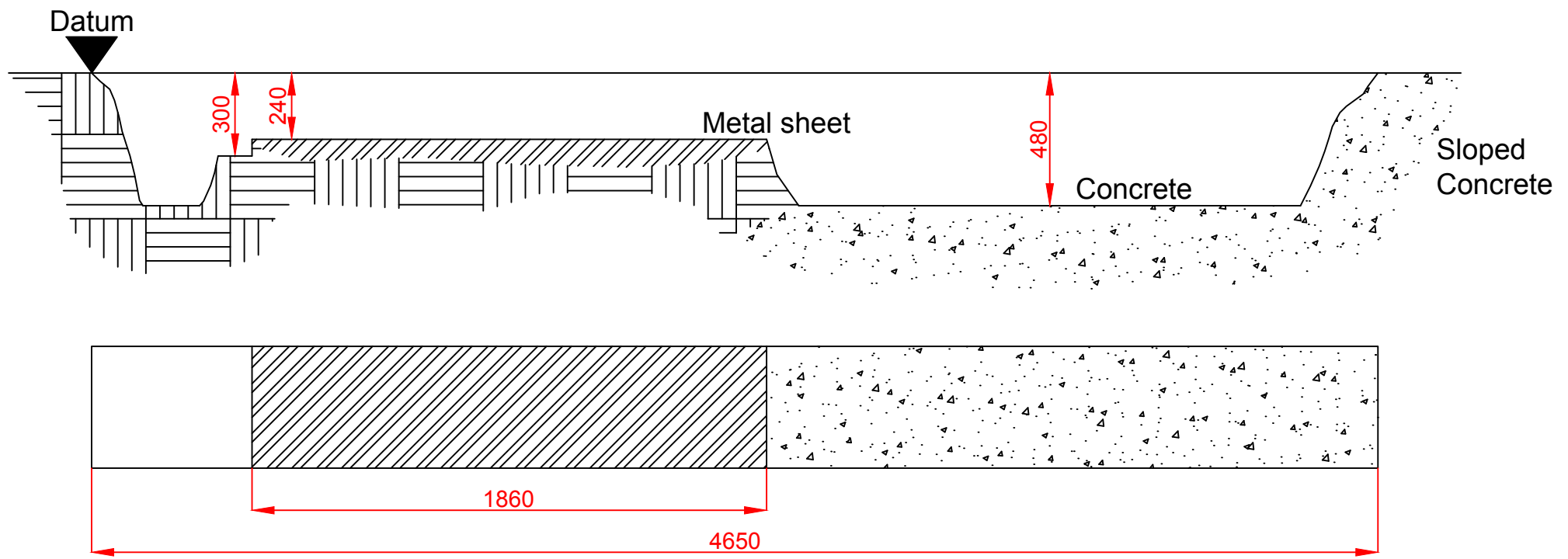
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.20 - 0.40	B2		47.66	0.20		TOPSOIL	
0.40	ES		47.51	0.35		MADE GROUND: Soft slightly sandy gravelly silty CLAY with medium cobble content and fragments of brick, concrete, tin, and plastic. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of limestone. Cobbles are subangular of limestone.	
0.40	ES1		47.38	0.48			CONCRETE
						End of trial pit at 0.48m	

Water Strikes		Depth: 0.48 Width: 0.44 Length: 4.65	Remarks: No groundwater encountered.	Last Updated 17/12/2020	
Struck at (m)	Remarks				
		Stability: Stable	Termination Reason: Terminated on concrete obstruction		

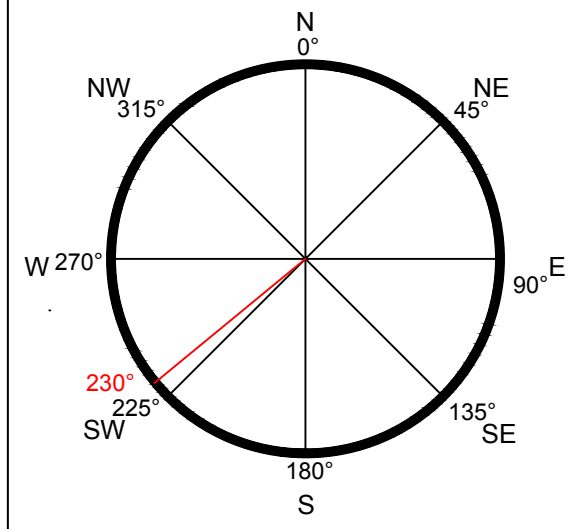
JOB NUMBER: 20-0399E JOB NAME: Route 13 Bray to City Centre LOCATION: R13 - SLT03

CLIENT: National Transport Authority (NTA) CLIENTS REPRESENTATIVE: Jacobs CREW: MG PLANT & EQUIPMENT: 3 Tonne Excavator & Hand Tools

TRENCH: (SECTION & PLAN)



TRENCH - ORIENTATION



TRENCH ORIENTATED : 230° FROM NORTH

COORDINATES: DATUM

EASTING: 720237.458
 NORTHING: 728181.966
 ELEVATION: 47.858MOD

No:	Type of Service:	Diameter (in mm)	Depth to Top of Service (m)	Distance to Centre of Service (m)	Details/Comments
01	Possible ESB	Unknown	0.24	Unknown	Metal sheet covering ESB
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					

TRENCH LENGTH (m) : 4.65
 TRENCH DEPTH (m) : 0.48
 TRENCH WIDTH (m) : 0.44

STABILITY: STABLE

GROUNDWATER: NONE

SCALE: NTS@A3
 DRAWN: BS
 CHECKED: CH
 DATE EXCAVATED: 20/10/2020





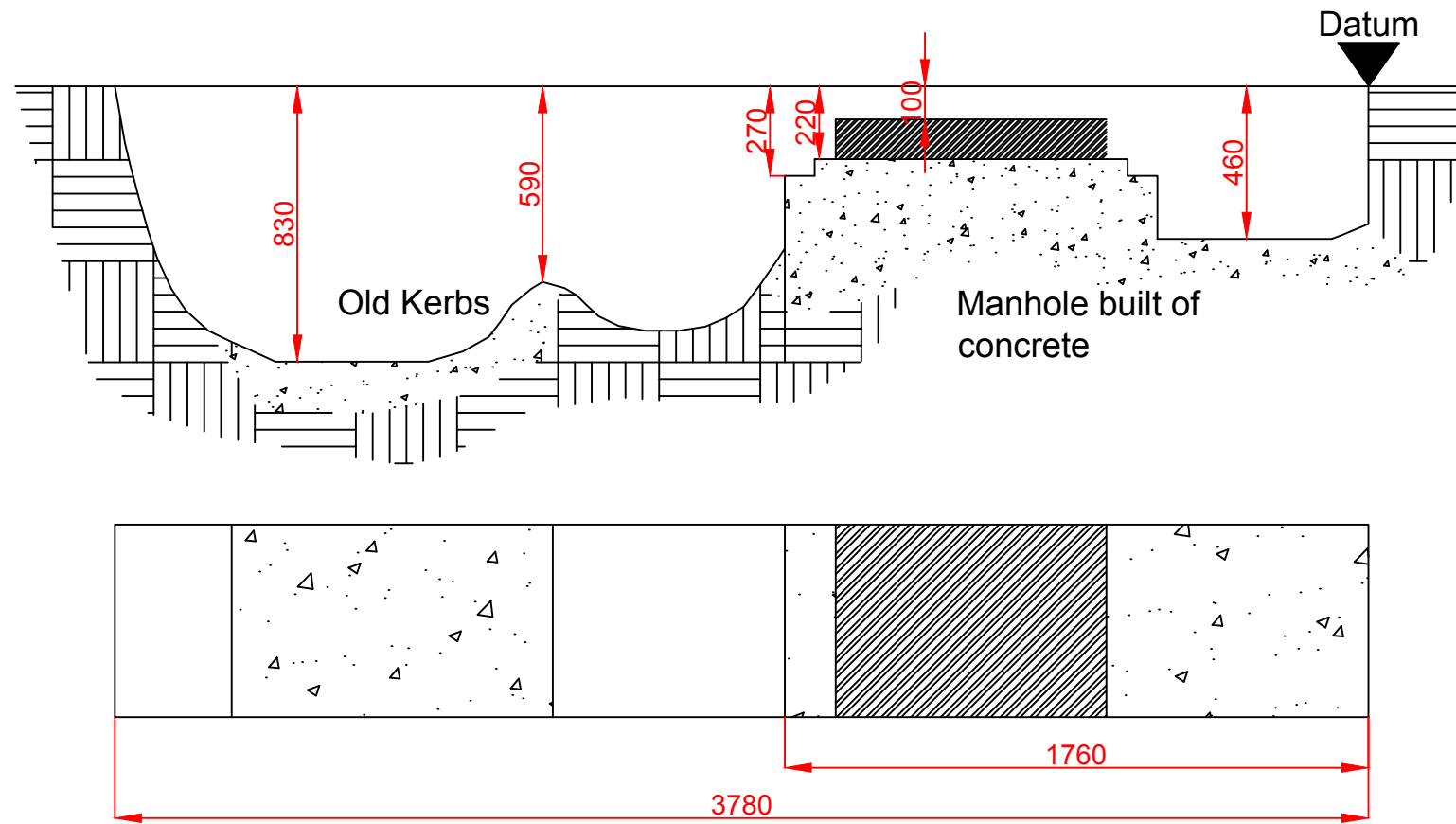
Project No. 20-0399E	Project Name: Bus Connects Route 13 Bray to City Centre	Trial Pit ID R13-SLT03A
Coordinates 720236.49 E 728180.61 N	Client: National Transport Authority (NTA)	Sheet 1 of 1 Scale: 1:25
	Client's Representative: Jacobs	
Method: Slit Trenching	Elevation 47.93 mOD	Date: 20/10/2020
Plant: 3T Tracked Excavator		Logger: MG
FINAL		

Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			47.73	0.20		TOPSOIL	
						MADE GROUND: Soft slightly sandy slightly silty CLAY with medium cobble content, fragments of brick, concrete, tin, and plastic. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of mixed lithologies. Cobbles are subangular of limestone.	
			47.11	0.82		End of trial pit at 0.82m	

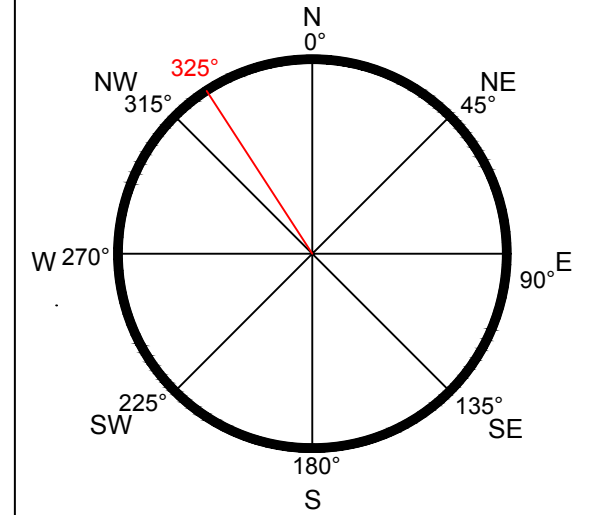
Water Strikes		Depth: 0.82 Width: 0.58 Length: 3.78	Remarks: No groundwater encountered. Old road level encountered at 0.27mbgl. Manhole cover encountered at 0.34mbgl. Old road curbs/pavers encountered at 0.60-0.82mbgl.
Struck at (m)	Remarks		
		Stability: Stable	Termination Reason: Terminated on the instruction of the engineer.
			Last Updated 17/12/2020

JOB NUMBER: 20-0399E	JOB NAME: Route 13 Bray to City Centre	LOCATION: R13 - SLT03A
CLIENT: National Transport Authority (NTA)	CLIENTS REPRESENTATIVE: Jacobs	CREW: MG
		PLANT & EQUIPMENT: 3 Tonne Excavator & Hand Tools

TRENCH: (SECTION & PLAN)



TRENCH - ORIENTATION



TRENCH ORIENTATED : 325° FROM NORTH

COORDINATES: DATUM

EASTING: 720236.490
 NORTHING: 728180.613
 ELEVATION: 47.927MOD

No:	Type of Service:	Diameter (in mm)	Depth to Top of Service (m)	Distance to Centre of Service (m)	Details/Comments
01					No services found
02					
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					

TRENCH LENGTH (m) : 3.78
 TRENCH DEPTH (m) : 0.82
 TRENCH WIDTH (m) : 0.58

STABILITY: STABLE
 GROUNDWATER: NONE

SCALE: NTS@A3
 DRAWN: BS
 CHECKED: CH
 DATE EXCAVATED: 20/10/2020





Project No. 20-0399E	Project Name: Bus Connects Route 13 Bray to City Centre	Trial Pit ID R13-SLT04
Coordinates 720387.00 E 727759.17 N	Client: National Transport Authority (NTA)	Sheet 1 of 1 Scale: 1:25
	Client's Representative: Jacobs	
Method: Slit Trenching	Elevation 53.67 mOD	Date: 02/11/2020
Plant: 3T Tracked Excavator		Logger: GH
FINAL		

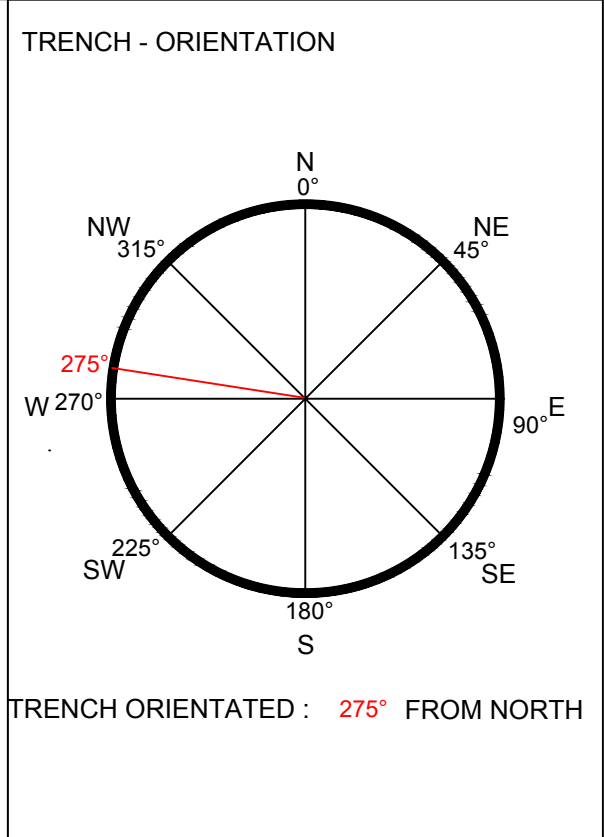
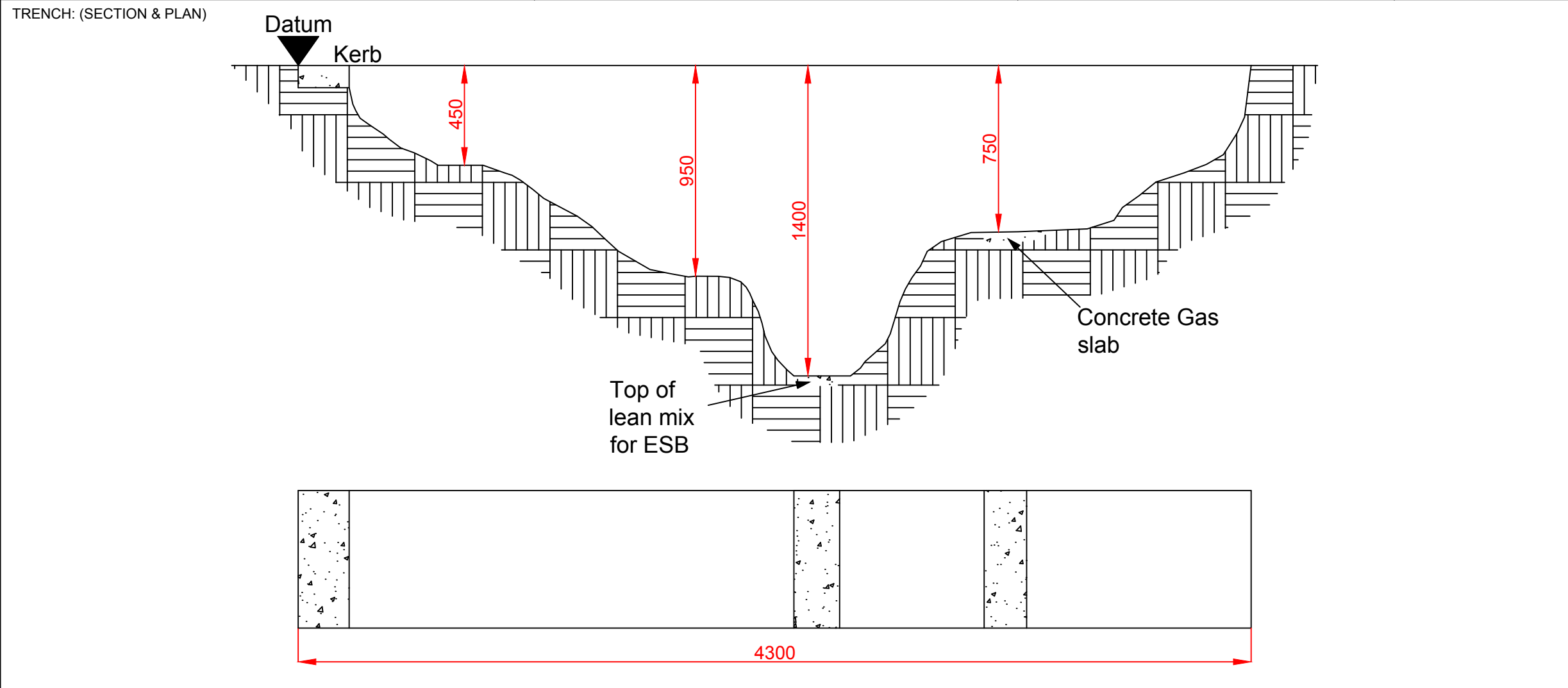
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
0.50 0.50	B1 B2		53.47	0.20	TOPSOIL		
			52.77	0.90	MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.		
			52.27	1.40	MADE GROUND: Brown fine to coarse SAND.		
						End of trial pit at 1.40m	

Water Strikes		Depth: 1.40 Width: 0.60 Length: 4.30	Remarks: No groundwater encountered.
Struck at (m)	Remarks		
		Stability: Stable	Termination Reason: Terminated on the instruction of the engineer.
			Last Updated 17/12/2020



JOB NUMBER: 20-0399E JOB NAME: Route 13 Bray to City Centre LOCATION: R13 - SLT04

CLIENT: National Transport Authority (NTA) CLIENTS REPRESENTATIVE: Jacobs CREW: GH PLANT & EQUIPMENT: 3 Tonne Excavator & Hand Tools



COORDINATES: DATUM
 EASTING: 720386.999
 NORTHING: 727759.170
 ELEVATION: 53.671 MDD

No:	Type of Service:	Diameter (in mm)	Depth to Top of Service (m)	Distance to Centre of Service (m)	Details/Comments
01	ESB	Unknown	1.40	2.30	Lean mix covering ESB
02	Gas	160	0.75	3.00	Lean mix covering Gas
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					

TRENCH LENGTH (m) : 4.30
 TRENCH DEPTH (m) : 1.40
 TRENCH WIDTH (m) : 0.60

STABILITY: STABLE
 GROUNDWATER: NONE

SCALE: NTS@A3
 DRAWN: BS
 CHECKED: CH
 DATE EXCAVATED: 02/11/2020





Project No. 20-0399E	Project Name: Bus Connects Route 13 Bray to City Centre	Trial Pit ID R13-SLT05
Coordinates 720377.30 E 727669.68 N	Client: National Transport Authority (NTA)	Sheet 1 of 1 Scale: 1:25
	Client's Representative: Jacobs	
Method: Slit Trenching	Elevation 54.38 mOD	Date: 02/11/2020
Plant: 3T Tracked Excavator		Logger: GH
FINAL		

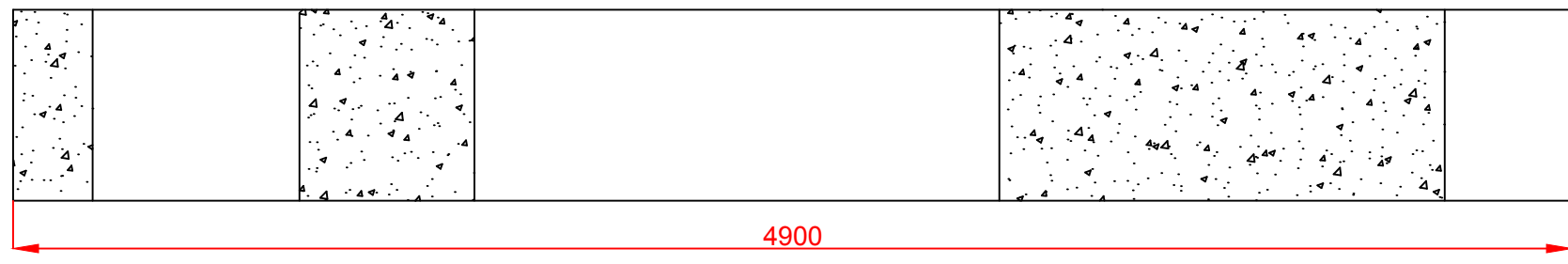
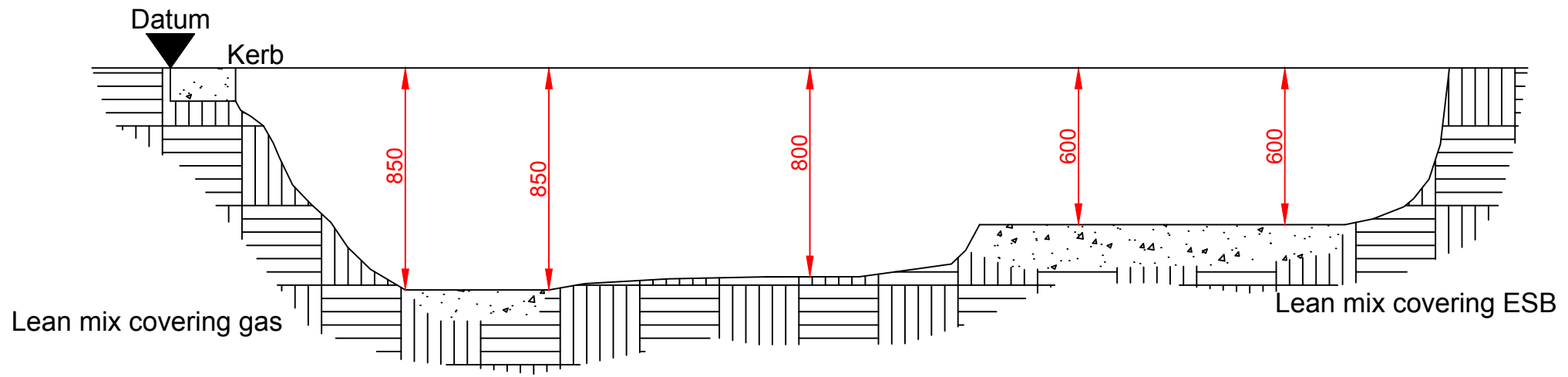
Depth (m)	Sample / Tests	Field Records	Level (mOD)	Depth (m)	Legend	Description	Water
			54.18	0.20		TOPSOIL	
			53.78	0.60		MADE GROUND: Firm brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse of mixed lithologies. Cobbles are subrounded of mixed lithologies.	0.5
			53.53	0.85		MADE GROUND: Brown fine to coarse SAND.	1.0
						End of trial pit at 0.85m	1.5
							2.0
							2.5
							3.0
							3.5
							4.0
							4.5

Water Strikes		Depth: 0.85 Width: 0.60 Length: 4.90	Remarks: No groundwater encountered.
Struck at (m)	Remarks		
		Stability: Stable	Termination Reason: Terminated on the instruction of the engineer.
		Last Updated 17/12/2020	

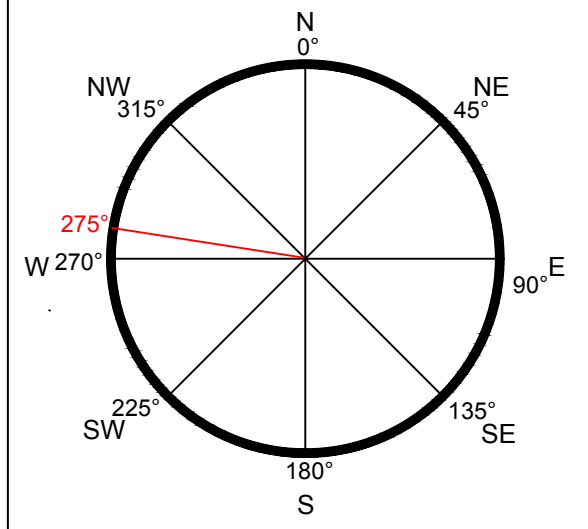
JOB NUMBER: 20-0399E JOB NAME: Route 13 Bray to City Centre LOCATION: R13 - SLT05

CLIENT: National Transport Authority (NTA) CLIENTS REPRESENTATIVE: Jacobs CREW: GH PLANT & EQUIPMENT: 3 Tonne Excavator & Hand Tools

TRENCH: (SECTION & PLAN)



TRENCH - ORIENTATION



TRENCH ORIENTATED : 275° FROM NORTH

COORDINATES: DATUM

EASTING: 720377.295
 NORTHING: 727669.677
 ELEVATION: 54.381 MOD

No:	Type of Service:	Diameter (in mm)	Depth to Top of Service (m)	Distance to Centre of Service (m)	Details/Comments
01	Gas	550	0.85	0.90 - 1.45	Lean mix covering Gas
02	ESB	1700	0.60	3.10 - 4.50	Lean mix covering ESB
03					
04					
05					
06					
07					
08					
09					
10					
11					
12					
13					
14					
15					

TRENCH LENGTH (m) : 4.90
 TRENCH DEPTH (m) : 0.85
 TRENCH WIDTH (m) : 0.60

STABILITY: STABLE
 GROUNDWATER: NONE

SCALE: NTS@A3
 DRAWN: BS
 CHECKED: CH
 DATE EXCAVATED: 02/11/2020

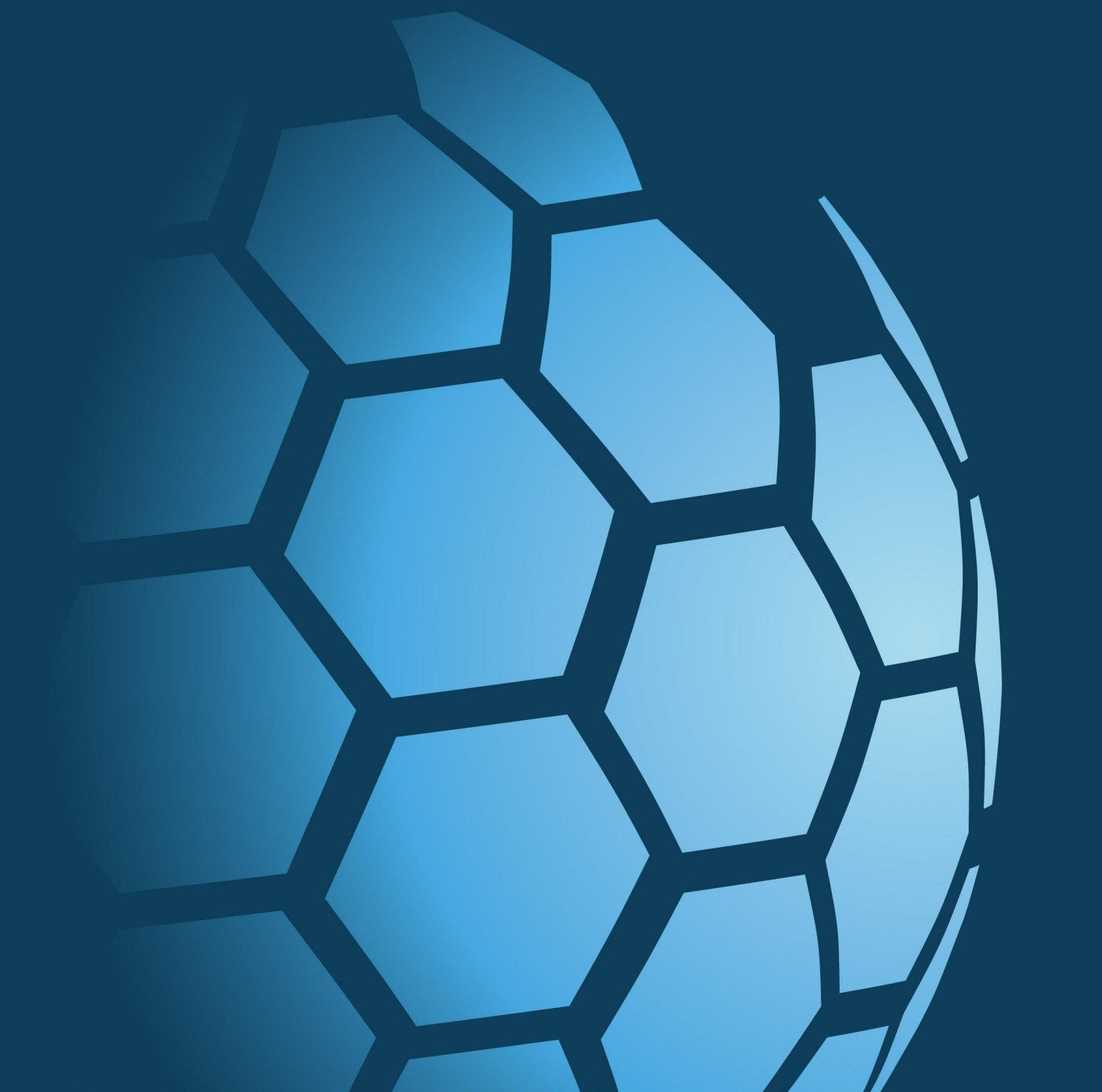




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— GEOTECH

APPENDIX D

SLIT TRENCH PHOTOGRAPHS





R13-SLT01



R13-SLT01



R13-SLT01



R13-SLT01



R13-SLT01



R13-SLT01



R13-SLT01



R13-SLT02



R13-SLT02



R13-SLT02



R13-SLT02



R13-SLT02



R13-SLT02



R13-SLT02



R13-SLT02



R13-SLT03



R13-SLT03



R13-SLT03



R13-SLT03



R13-SLT03



R13-SLT03



R13-SLT03A



R13-SLT03A



R13-SLT03A



R13-SLT03A



R13-SLT03A



R13-SLT03A



R13-SLT03A



R13-SLT03A



R13-SLT04



R13-SLT04



R13-SLT04



R13-SLT04



R13-SLT04



R13-SLT04



R13-SLT04



R13-SLT04



R13-SLT04



R13-SLT04



R13-SLT04



R13-SLT05



R13-SLT05



R13-SLT05



R13-SLT05



R13-SLT05



R13-SLT05



R13-SLT05



R13-SLT05



R13-SLT05



R13-SLT05



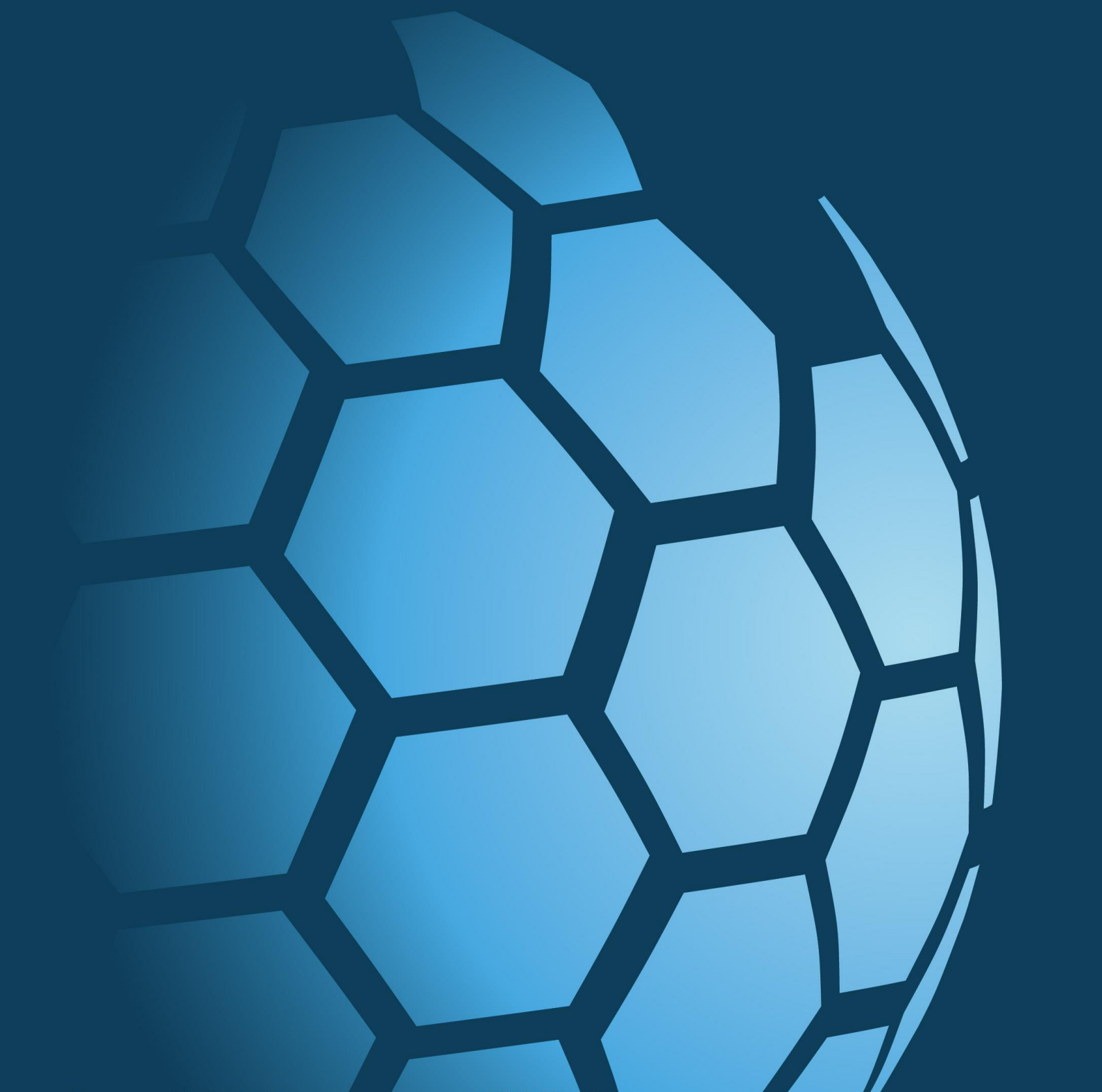
R13-SLT05



CAUSEWAY
— GEOTECH

APPENDIX E

GEOTECHNICAL LABORATORY TEST RESULTS





**SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT**

19 November
2020

Project Name:	Bus Connects - Route 13 – Bray to City Centre
Project No.:	20-0399E
Client:	National Transport Authority (NTA)
Engineer:	AECOM

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Contents page(s).

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

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

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd



Project Name: Bus Connects - Route 13 – Bray 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	9
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	2
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	9
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	6

SUB-CONTRACTED TESTS

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


Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – Subcontracted to Eurofins Chemtest Ltd (UKAS 2183)	BRE Test – Suite B		4

Summary of Classification Test Results

Project No. 20-0399E	Project Name Bus Connects Route 13 Bray to City Centre
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Hole No.	Sample				Soil Description	Density		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type		bulk Mg/m3	dry							
R13-CP01	3	2.00		B	Brown sandy gravelly silty CLAY.			14.0	64	32 -1pt	17	15		CL
R13-CP01	13	3.00		D	Brown sandy gravelly silty CLAY.			14.0						
R13-CP01	14	4.50		D	Brown sandy gravelly silty CLAY.			16.0						
R13-CP02	9	1.20		D	Grey gravelly clayey subangular fine to coarse GRAVEL.			7.5						
R13-CP02	3	2.00		B	Brown sandy very gravelly silty CLAY.			7.6						
R13-CP03	16	2.00		D	Brown sandy gravelly silty CLAY.			22.0	58	36 -1pt	22	14		CI
R13-CP03	17	4.00		D	Brown sandy silty CLAY.			17.0						
R13-CP03	7	6.00		B	Brown gravelly slightly clayey fine to coarse SAND.			7.3						
R13-WS01	5	1.30		B	Brown gravelly clayey fine to coarse SAND.			6.4						

All tests performed in accordance with BS1377:1990 unless specified otherwise LAB 01R Version 4

Key Density test Liquid Limit Particle density Linear measurement unless : 4pt cone unless : sp - small pyknometer wd - water displacement cas - Casagrande method gj - gas jar wi - immersion in water 1pt - single point test	Date Printed 19/11/2020	Approved By Stephen.Watson	 10122
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PARTICLE SIZE DISTRIBUTION

Job Ref **20-0399E**

Borehole/Pit No. **R13-CP01**

Site Name **Bus Connects Route 13 Bray to City Centre**

Sample No. **4**

Soil Description **Brown sandy gravelly silty CLAY.**

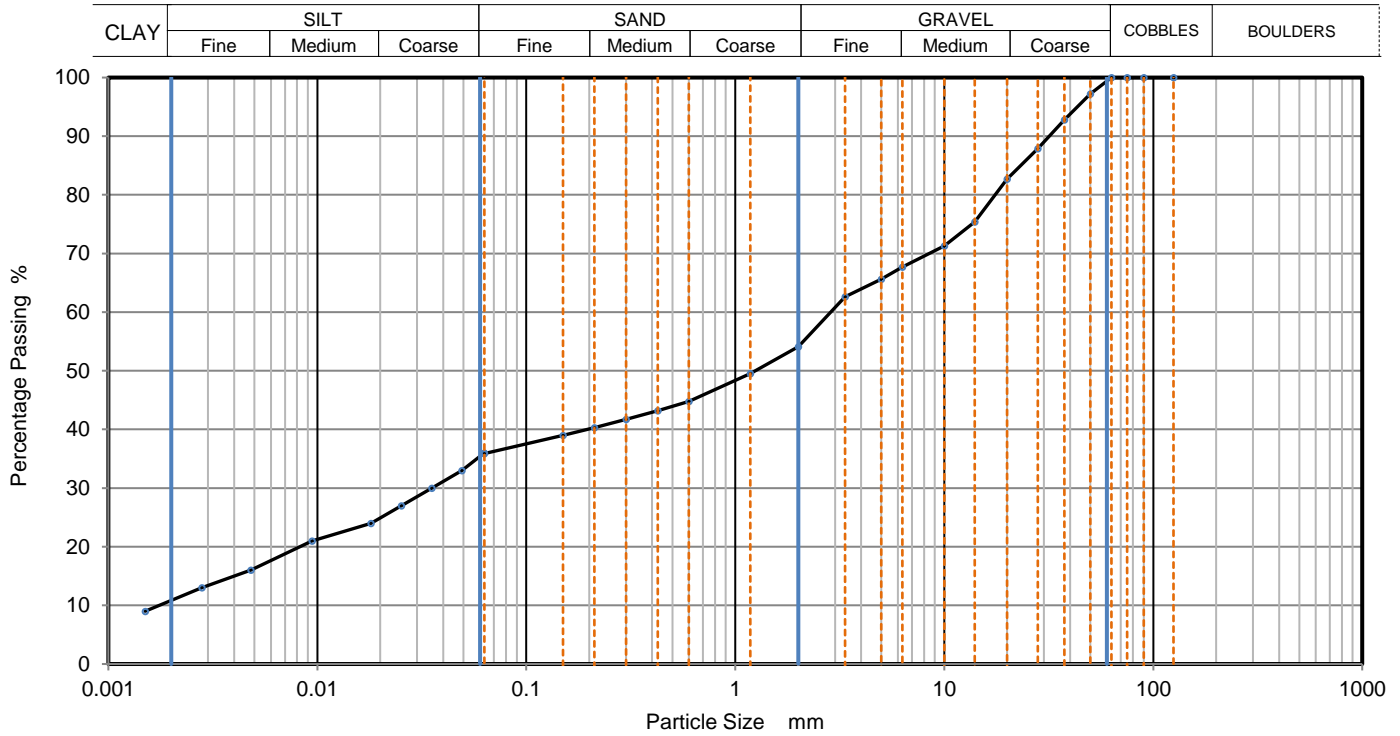
Depth, m **3.00**

Specimen Reference **2** Specimen Depth **3** m

Sample Type **B**

Test Method **BS1377:Part 2:1990, clauses 9.2 and 9.5**

KeyLAB ID **Caus2020110347**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	36
90	100	0.04921	33
75	100	0.03524	30
63	100	0.02523	27
50	97	0.01806	24
37.5	93	0.00944	21
28	88	0.00480	16
20	83	0.00280	13
14	75	0.00150	9
10	71		
6.3	68		
5	66		
3.35	63		
2	54		
1.18	50		
0.6	45	Particle density (assumed)	
0.425	43	2.65 Mg/m3	
0.3	42		
0.212	40		
0.15	39		
0.063	36		

Dry Mass of sample, g

6625

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	45.9
Sand	18.1
Silt	25.0
Clay	11.0

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	1700
Curvature Coefficient	0.26

Remarks

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

Approved

Stephen.Watson





PARTICLE SIZE DISTRIBUTION

Job Ref **20-0399E**

Borehole/Pit No. **R13-CP01**

Site Name **Bus Connects Route 13 Bray to City Centre**

Sample No. **6**

Soil Description **Brown sandy gravelly silty CLAY.**

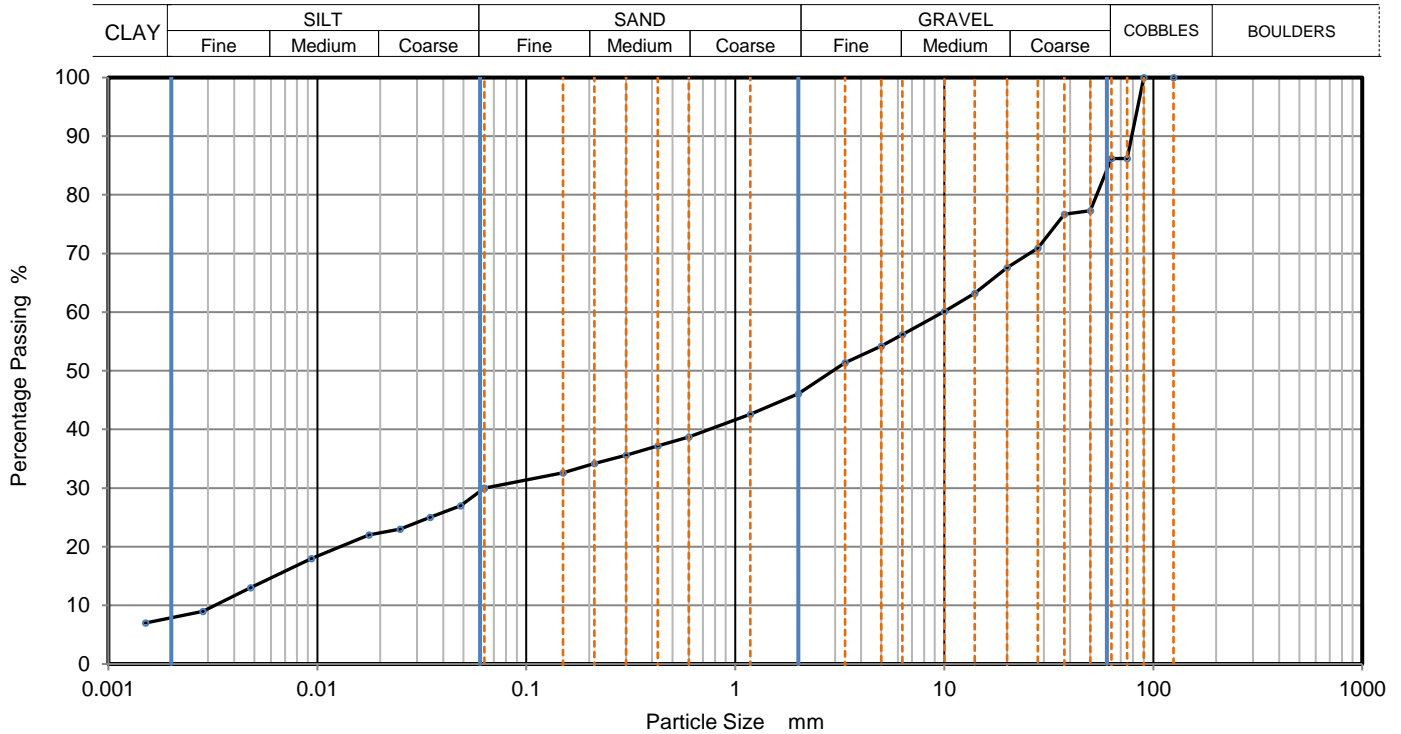
Depth, m **4.50**

Specimen Reference **2** Specimen Depth **4.5** m

Sample Type **B**

Test Method **BS1377:Part 2:1990, clauses 9.2 and 9.5**

KeyLAB ID **Caus2020110349**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	30
90	100	0.04843	27
75	86	0.03470	25
63	86	0.02485	23
50	77	0.01769	22
37.5	77	0.00936	18
28	71	0.00479	13
20	68	0.00283	9
14	63	0.00150	7
10	60		
6.3	56		
5	54		
3.35	51		
2	46		
1.18	43		
0.6	39		
0.425	37	Particle density (assumed) 2.65 Mg/m3	
0.3	36		
0.212	34		
0.15	33		
0.063	30		

Dry Mass of sample, g

14073

Sample Proportions	% dry mass
Cobbles	13.8
Gravel	40.1
Sand	16.1
Silt	21.8
Clay	8.2

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	3200
Curvature Coefficient	

Remarks

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



Approved

Stephen.Watson

LAB 05R Version 4

10122



PARTICLE SIZE DISTRIBUTION

Job Ref **20-0399E**

Borehole/Pit No. **R13-CP02**

Site Name **Bus Connects Route 13 Bray to City Centre**

Sample No. **2**

Soil Description **Grey slightly sandy subangular fine to coarse GRAVEL.**

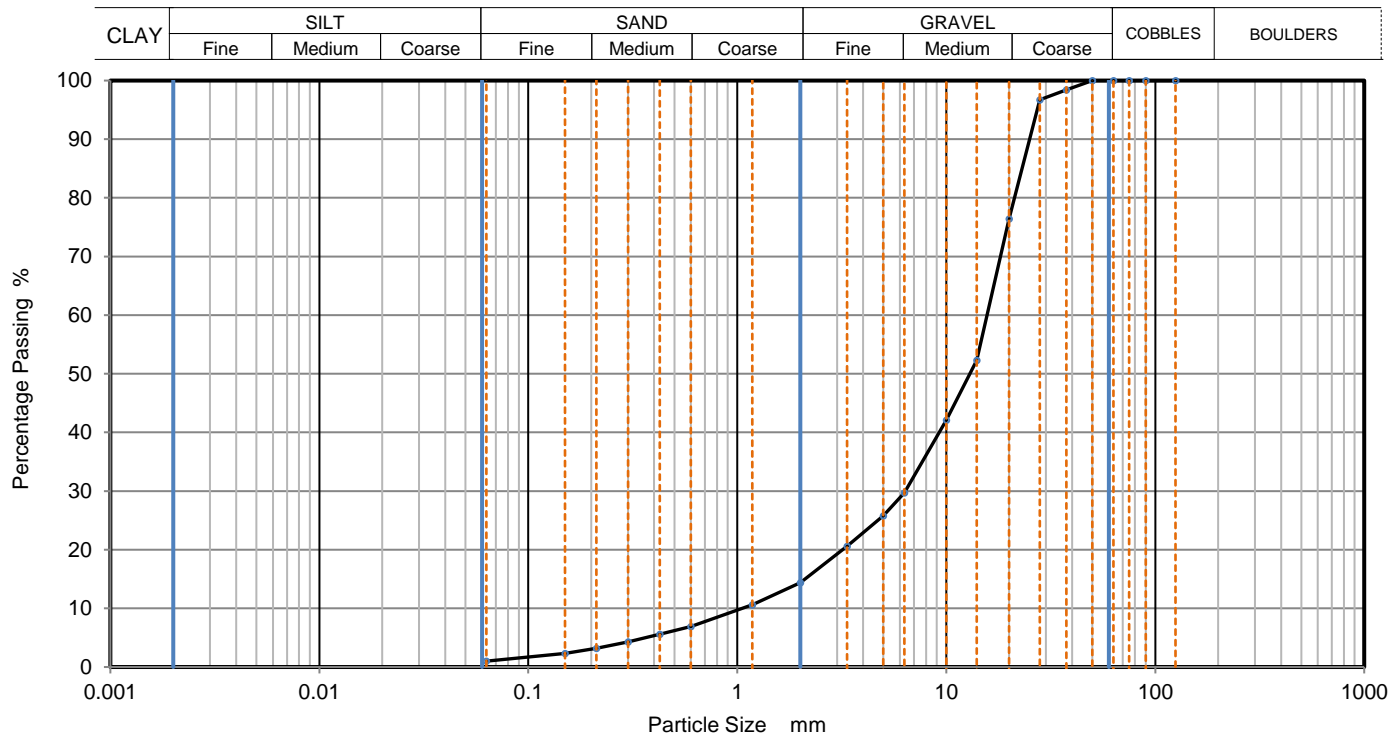
Depth, m **1.00**

Specimen Reference **2** Specimen Depth **1** m

Sample Type **B**

Test Method **BS1377:Part 2:1990, clause 9.2**

KeyLAB ID **Caus2020110351**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	98		
28	97		
20	76		
14	52		
10	42		
6.3	30		
5	26		
3.35	21		
2	14		
1.18	11		
0.6	7		
0.425	6		
0.3	4		
0.212	3		
0.15	2		
0.063	1		

Dry Mass of sample, g

9965

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	85.6
Sand	13.4
Fines <0.063mm	1.0

Grading Analysis		
D100	mm	
D60	mm	15.7
D30	mm	6.38
D10	mm	1.06
Uniformity Coefficient		15
Curvature Coefficient		2.5

Remarks

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

Approved

Stephen.Watson





PARTICLE SIZE DISTRIBUTION

Job Ref **20-0399E**

Borehole/Pit No. **R13-CP02**

Site Name **Bus Connects Route 13 Bray to City Centre**

Sample No. **3**

Soil Description **Brown sandy very gravelly silty CLAY.**

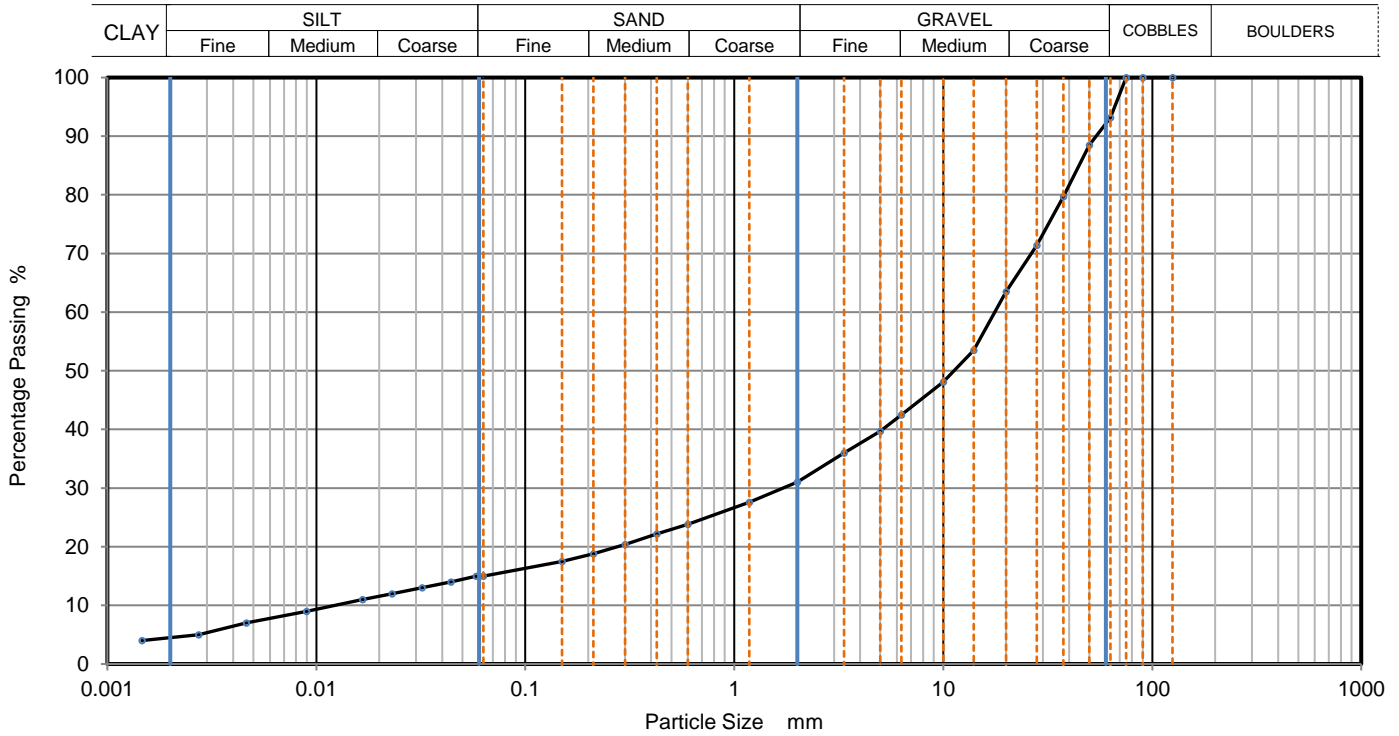
Depth, m **2.00**

Specimen Reference **4** Specimen Depth **2** m

Sample Type **B**

Test Method **BS1377:Part 2:1990, clauses 9.2 and 9.5**

KeyLAB ID **Caus2020110353**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.05820	15
90	100	0.04400	14
75	100	0.03211	13
63	93	0.02305	12
50	89	0.01666	11
37.5	80	0.00896	9
28	71	0.00462	7
20	64	0.00273	5
14	54	0.00146	4
10	48		
6.3	43		
5	40		
3.35	36		
2	31		
1.18	28		
0.6	24		
0.425	22	Particle density (assumed) 2.65 Mg/m3	
0.3	20		
0.212	19		
0.15	18		
0.063	15		

Dry Mass of sample, g **6718**

Sample Proportions	% dry mass
Cobbles	6.8
Gravel	62.1
Sand	16.1
Silt	10.1
Clay	4.9

Grading Analysis	
D100	mm
D60	mm 17.7
D30	mm 1.71
D10	mm 0.0126
Uniformity Coefficient	1400
Curvature Coefficient	13

Remarks

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

Approved

Stephen.Watson





PARTICLE SIZE DISTRIBUTION

Job Ref **20-0399E**

Borehole/Pit No. **R13-CP03**

Site Name **Bus Connects Route 13 Bray to City Centre**

Sample No. **2**

Soil Description **Brown gravelly clayey fine to coarse SAND.**

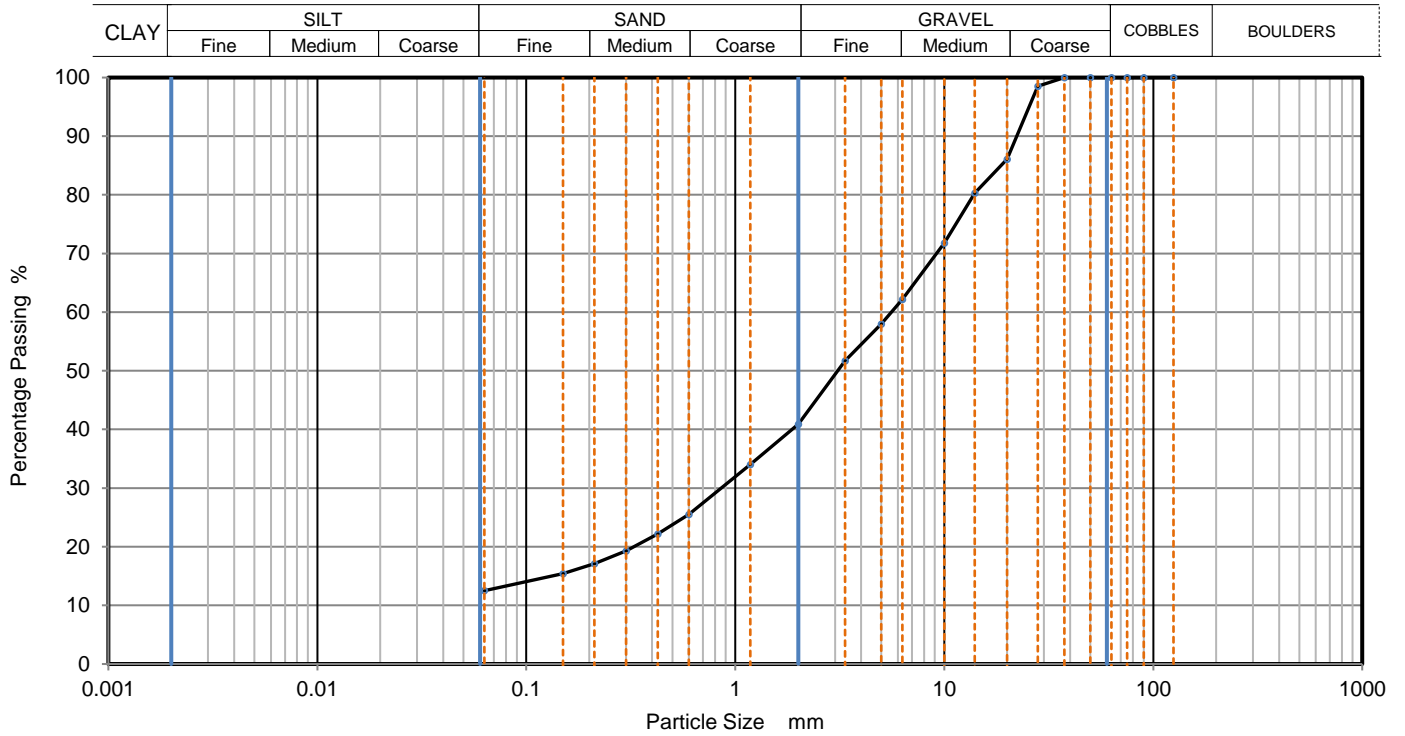
Depth, m **1.00**

Specimen Reference **2** Specimen Depth **1** m

Sample Type **B**

Test Method **BS1377:Part 2:1990, clause 9.2**

KeyLAB ID **Caus2020110354**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	99		
20	86		
14	80		
10	72		
6.3	62		
5	58		
3.35	52		
2	41		
1.18	34		
0.6	26		
0.425	22		
0.3	19		
0.212	17		
0.15	15		
0.063	13		

Dry Mass of sample, g

2531

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	59.1
Sand	28.4
Fines <0.063mm	12.0

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

Remarks

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

Approved

Stephen.Watson





PARTICLE SIZE DISTRIBUTION

Job Ref **20-0399E**

Borehole/Pit No. **R13-CP03**

Site Name **Bus Connects Route 13 Bray to City Centre**

Sample No. **5**

Soil Description **Brown sandy silty CLAY.**

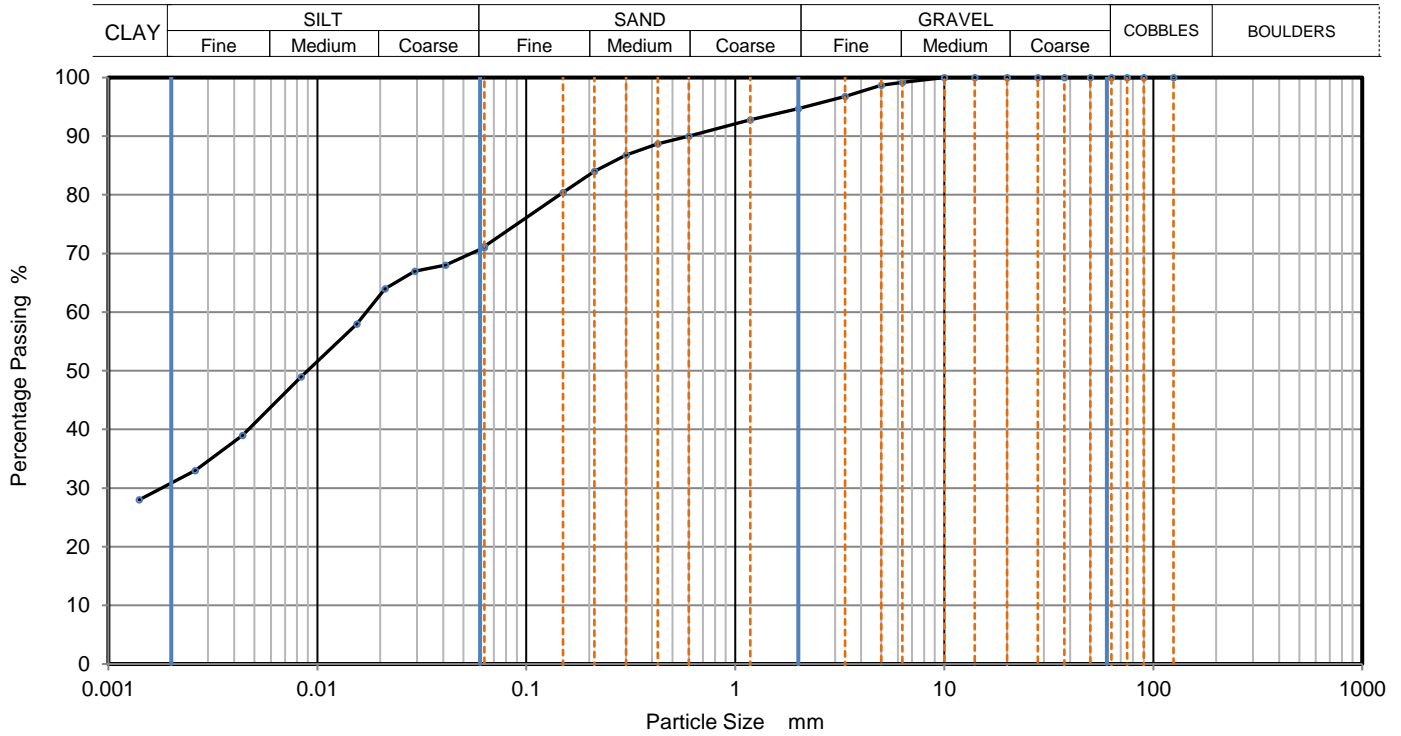
Depth, m **4.00**

Specimen Reference **2** Specimen Depth **4** m

Sample Type **B**

Test Method **BS1377:Part 2:1990, clauses 9.2 and 9.5**

KeyLAB ID **Caus2020110356**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	71
90	100	0.04104	68
75	100	0.02929	67
63	100	0.02109	64
50	100	0.01543	58
37.5	100	0.00835	49
28	100	0.00439	39
20	100	0.00260	33
14	100	0.00140	28
10	100		
6.3	99		
5	99		
3.35	97		
2	95		
1.18	93		
0.6	90	Particle density (assumed)	
0.425	89	2.65 Mg/m3	
0.3	87		
0.212	84		
0.15	80		
0.063	71		

Dry Mass of sample, g **216**

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	5.3
Sand	23.5
Silt	40.3
Clay	30.9

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

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



Approved

Stephen.Watson



PARTICLE SIZE DISTRIBUTION

Job Ref **20-0399E**

Borehole/Pit No. **R13-CP03**

Site Name **Bus Connects Route 13 Bray to City Centre**

Sample No. **7**

Soil Description **Brown gravelly slightly clayey fine to coarse SAND.**

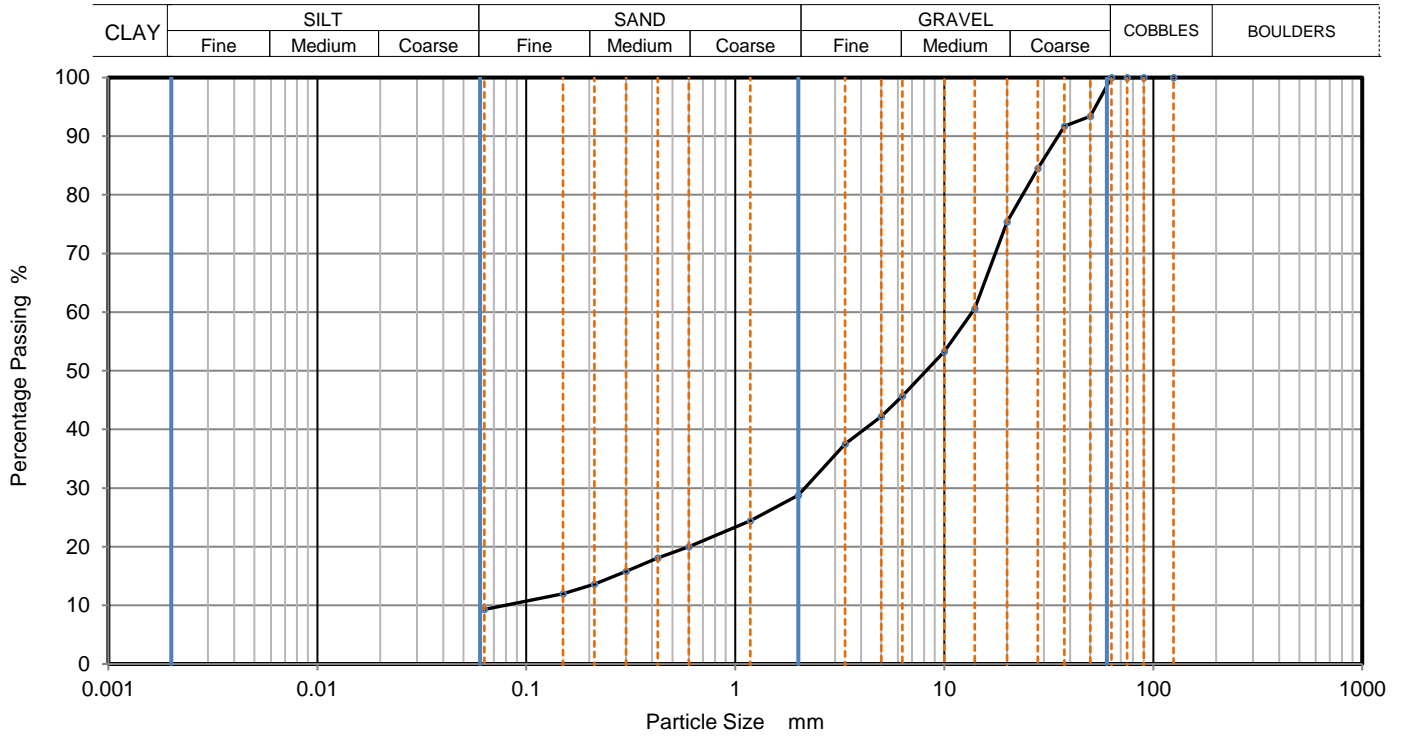
Depth, m **6.00**

Specimen Reference **4** Specimen Depth **6** m

Sample Type **B**

Test Method **BS1377:Part 2:1990, clause 9.2**

KeyLAB ID **Caus2020110358**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	93		
37.5	92		
28	85		
20	75		
14	61		
10	53		
6.3	46		
5	42		
3.35	38		
2	29		
1.18	24		
0.6	20		
0.425	18		
0.3	16		
0.212	14		
0.15	12		
0.063	9		

Dry Mass of sample, g 6501

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	71.2
Sand	19.5
Fines <0.063mm	9.0

Grading Analysis	
D100	mm
D60	mm 13.6
D30	mm 2.15
D10	mm 0.0794
Uniformity Coefficient	170
Curvature Coefficient	4.3

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

Approved

Stephen.Watson





PARTICLE SIZE DISTRIBUTION

Job Ref **20-0399E**

Borehole/Pit No. **R13-WS01**

Site Name **Bus Connects Route 13 Bray to City Centre**

Sample No. **5**

Soil Description **Brown gravelly clayey fine to coarse SAND.**

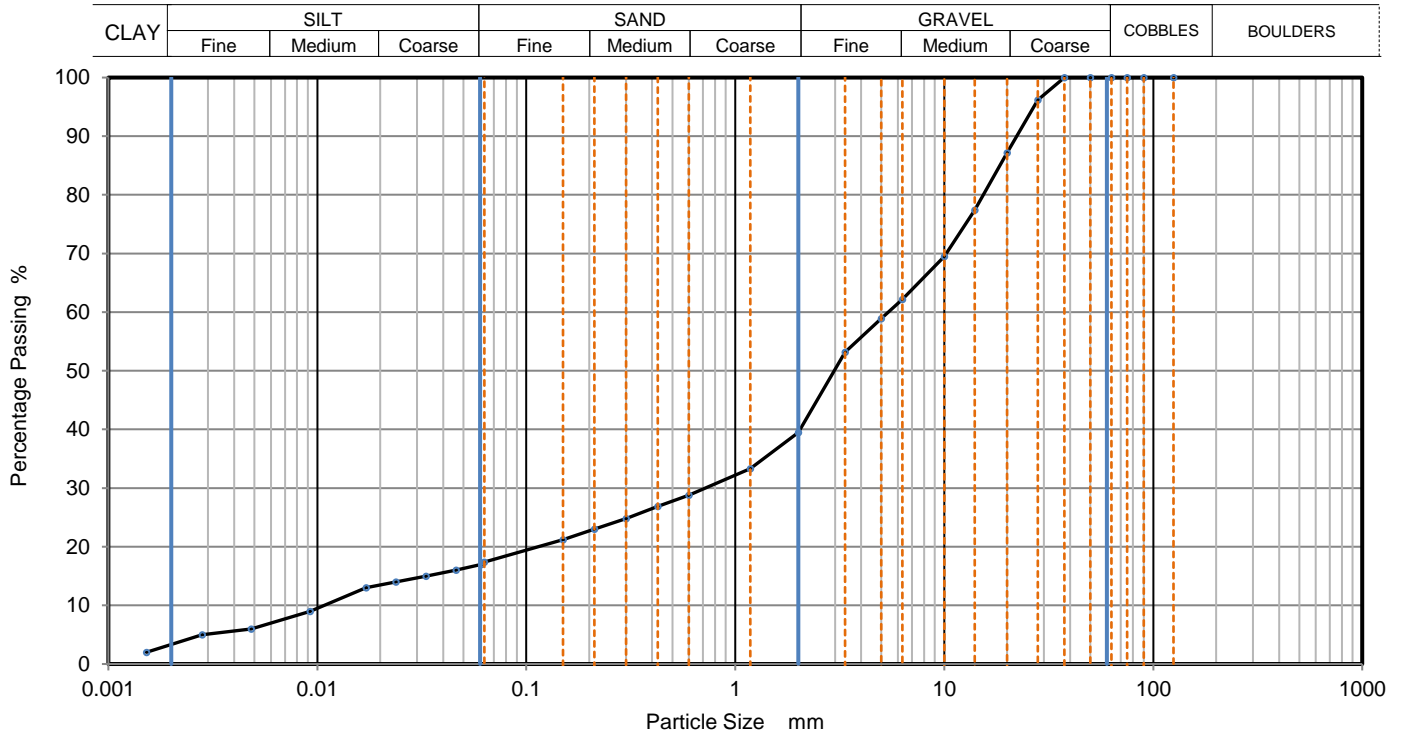
Depth, m **1.30**

Specimen Reference **4** Specimen Depth **1.3** m

Sample Type **B**

Test Method **BS1377:Part 2:1990, clauses 9.2 and 9.5**

KeyLAB ID **Caus2020110359**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06107	17
90	100	0.04609	16
75	100	0.03307	15
63	100	0.02372	14
50	100	0.01712	13
37.5	100	0.00925	9
28	96	0.00482	6
20	87	0.00281	5
14	77	0.00152	2
10	70		
6.3	62		
5	59		
3.35	53		
2	40		
1.18	33		
0.6	29		
0.425	27	Particle density (assumed) 2.65 Mg/m3	
0.3	25		
0.212	23		
0.15	21		
0.063	17		

Dry Mass of sample, g

3435

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	60.5
Sand	22.0
Silt	13.9
Clay	3.6

Grading Analysis		
D100	mm	
D60	mm	5.41
D30	mm	0.721
D10	mm	0.0102
Uniformity Coefficient		530
Curvature Coefficient		9.4

Remarks

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

Approved

Stephen.Watson

LAB 05R Version 4



10122



PARTICLE SIZE DISTRIBUTION

Job Ref **20-0399E**

Borehole/Pit No. **R13-WS01**

Site Name **Bus Connects Route 13 Bray to City Centre**

Sample No. **6**

Soil Description **Brown sandy clayey subangular fine to coarse GRAVEL.**

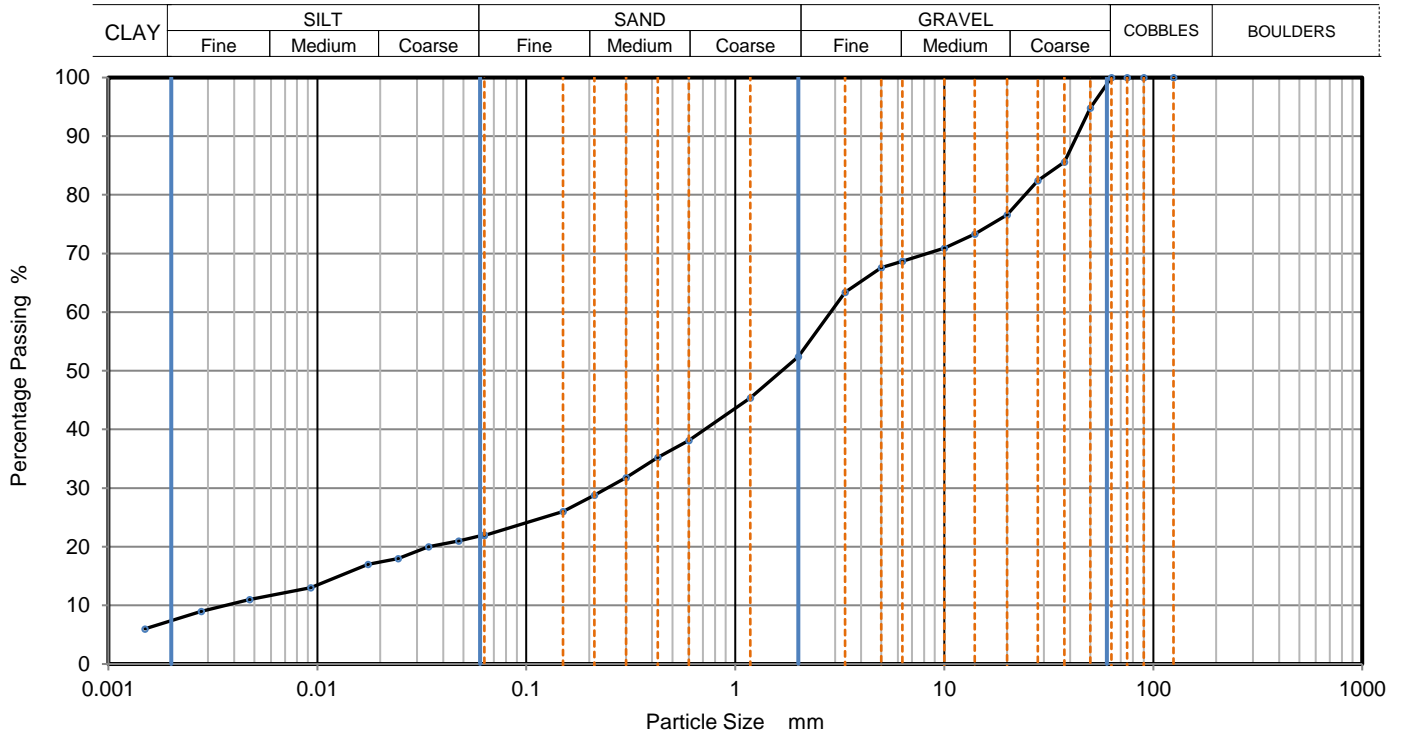
Depth, m **1.60**

Specimen Reference **2** Specimen Depth **1.6** m

Sample Type **B**

Test Method **BS1377:Part 2:1990, clauses 9.2 and 9.5**

KeyLAB ID **Caus2020110360**



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	22
90	100	0.04744	21
75	100	0.03401	20
63	100	0.02437	18
50	95	0.01746	17
37.5	86	0.00930	13
28	82	0.00474	11
20	77	0.00278	9
14	73	0.00150	6
10	71		
6.3	69		
5	68		
3.35	63		
2	52		
1.18	45		
0.6	38		
0.425	35	Particle density (assumed)	
0.3	32	2.65 Mg/m3	
0.212	29		
0.15	26		
0.063	22		

Dry Mass of sample, g

5323

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	47.6
Sand	30.5
Silt	14.7
Clay	7.2

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	760
Curvature Coefficient	5.5

Remarks

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

Approved

Stephen.Watson





Final Report

Report No.: 20-30179-1
Initial Date of Issue: 11-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
Gabiella 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 20-0399E Route 13 Bray to City Centre

Quotation No.:		Date Received:	06-Nov-2020
Order No.:		Date Instructed:	06-Nov-2020
No. of Samples:	4		
Turnaround (Wkdays):	5	Results Due:	12-Nov-2020
Date Approved:	11-Nov-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: 20-0399E Route 13 Bray to City Centre

Client: Causeway Geotech Ltd	Chemtest Job No.:				20-30179	20-30179	20-30179	20-30179
Quotation No.:	Chemtest Sample ID.:				1092939	1092940	1092941	1092942
Order No.:	Client Sample Ref.:				9	14	2	20
	Sample Location:				R13-CP01	R13-CP01	R13-CP02	R13-CP03
	Sample Type:				SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				2.00	4.50	1.00	3.00
	Date Sampled:				05-Nov-2020	05-Nov-2020	05-Nov-2020	05-Nov-2020
Determinand	Accred.	SOP	Units	LOD				
Moisture	N	2030	%	0.020	13	10	6.9	14
pH (2.5:1)	N	2010		4.0	8.7	8.8	10.8	8.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	0.025	0.51	< 0.010
Total Sulphur	U	2175	%	0.010	< 0.010	0.046	0.14	
Sulphate (Acid Soluble)	U	2430	%	0.010	0.035	0.030	0.25	

Test Methods

SOP	Title	Parameters included	Method summary
2010	pH Value of Soils	pH	pH Meter
2030	Moisture and Stone Content of Soils(Requirement of MCERTS)	Moisture content	Determination of moisture content of soil as a percentage of its as received mass obtained at <37°C.
2040	Soil Description(Requirement of MCERTS)	Soil description	As received soil is described based upon BS5930
2120	Water Soluble Boron, Sulphate, Magnesium & Chromium	Boron; Sulphate; Magnesium; Chromium	Aqueous extraction / ICP-OES
2175	Total Sulphur in Soils	Total Sulphur	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.
2430	Total Sulphate in soils	Total Sulphate	Acid digestion followed by determination of sulphate in extract by ICP-OES.

Report Information

Key

U	UKAS accredited
M	MCERTS and UKAS accredited
N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

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

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com

LABORATORY RESTRICTION REPORT

Project Reference	20-0399E	To	Sean Ross
Project Name	Bus Connects Route 9 - Bray to City Centre	Position	Project Manager
TR reference	20-0399E / G01	From	Joseph Nicholl
		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 Number	Sample			Test Type	Reason for Restriction	Required Action
	Number	Depth (m)	Type			
R13 CP01	15	3.00	U	UU Triaxial Oedometer	Unable to obtain specimen for test - coarse gravel content too high	CANCEL

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

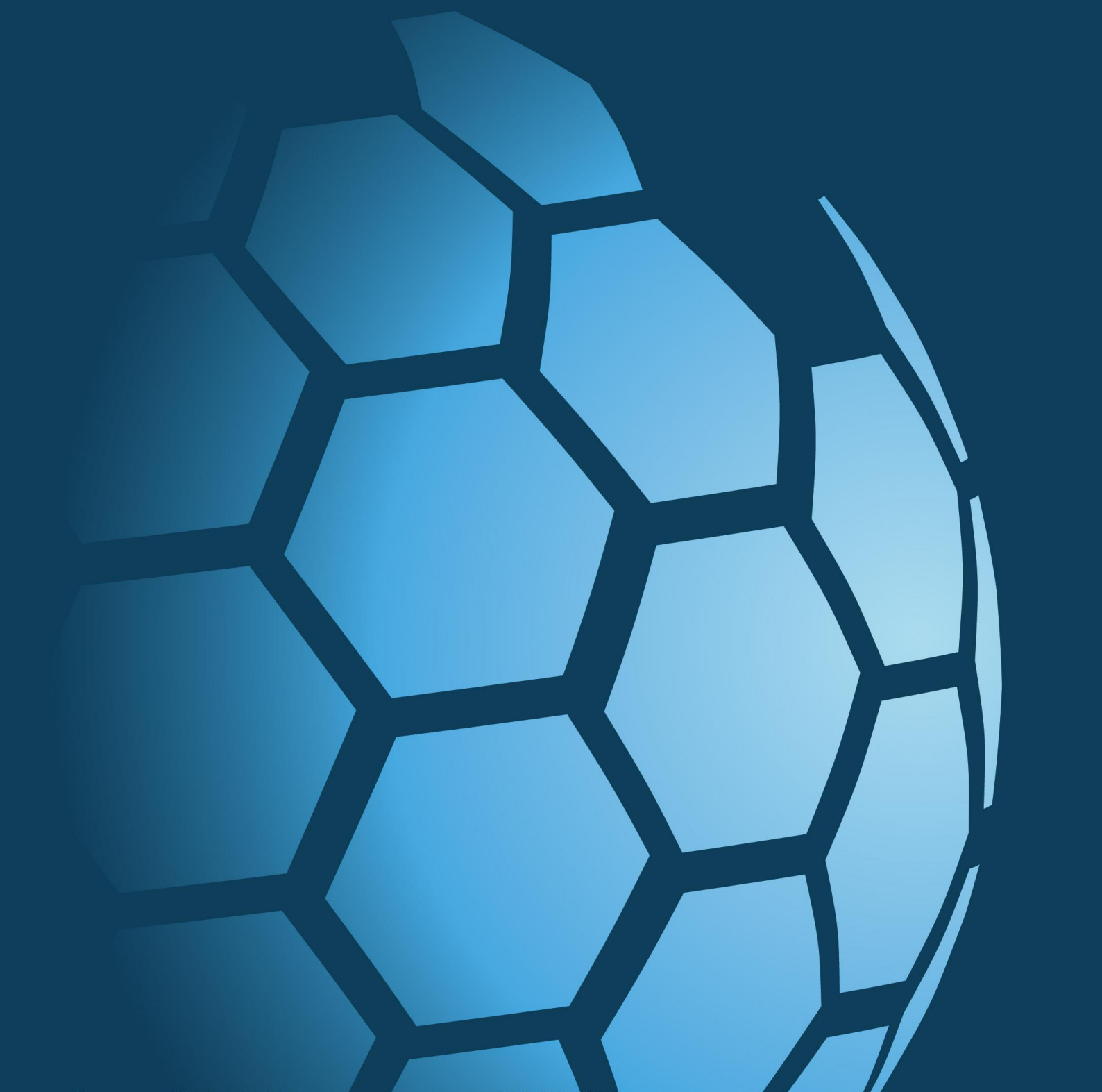
Laboratory Signature Joseph Nicholl	Project Manager Signature Sean Ross
Date 13 November 2020	Date



CAUSEWAY
— GEOTECH

APPENDIX F

ENVIRONMENTAL LABORATORY TEST RESULTS





Final Report

Report No.: 20-28443-1
Initial Date of Issue: 26-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
Gabiella 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: 20-0399E Bus Connects Route 13

Quotation No.:		Date Received:	21-Oct-2020
Order No.:		Date Instructed:	21-Oct-2020
No. of Samples:	1		
Turnaround (Wkdays):	5	Results Due:	27-Oct-2020
Date Approved:	26-Oct-2020		

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: 20-0399E Bus Connects Route 13

Client: Causeway Geotech Ltd	Chemtest Job No.:		20-28443		
Quotation No.:	Chemtest Sample ID.:		1084161		
	Sample Location:		R13-CP03		
	Sample Type:		SOIL		
	Top Depth (m):		1.0		
	Date Sampled:		19-Oct-2020		
	Asbestos Lab:		DURHAM		
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	10
pH	M	2010		4.0	9.5
Boron (Hot Water Soluble)	M	2120	mg/kg	0.40	0.78
Sulphate (2:1 Water Soluble) as SO4	M	2120	g/l	0.010	< 0.010
Cyanide (Total)	M	2300	mg/kg	0.50	< 0.50
Arsenic	M	2450	mg/kg	1.0	21
Cadmium	M	2450	mg/kg	0.10	0.47
Chromium	M	2450	mg/kg	1.0	13
Copper	M	2450	mg/kg	0.50	12
Mercury	M	2450	mg/kg	0.10	< 0.10
Nickel	M	2450	mg/kg	0.50	17
Lead	M	2450	mg/kg	0.50	42
Zinc	M	2450	mg/kg	0.50	34
Organic Matter	M	2625	%	0.40	1.3
Total TPH >C6-C40	M	2670	mg/kg	10	< 10
Naphthalene	M	2700	mg/kg	0.10	< 0.10
Acenaphthylene	M	2700	mg/kg	0.10	< 0.10
Acenaphthene	M	2700	mg/kg	0.10	< 0.10
Fluorene	M	2700	mg/kg	0.10	< 0.10
Phenanthrene	M	2700	mg/kg	0.10	< 0.10
Anthracene	M	2700	mg/kg	0.10	< 0.10
Fluoranthene	M	2700	mg/kg	0.10	< 0.10
Pyrene	M	2700	mg/kg	0.10	< 0.10
Benzo[a]anthracene	M	2700	mg/kg	0.10	< 0.10
Chrysene	M	2700	mg/kg	0.10	< 0.10
Benzo[b]fluoranthene	M	2700	mg/kg	0.10	< 0.10
Benzo[k]fluoranthene	M	2700	mg/kg	0.10	< 0.10
Benzo[a]pyrene	M	2700	mg/kg	0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2700	mg/kg	0.10	< 0.10
Dibenz(a,h)Anthracene	M	2700	mg/kg	0.10	< 0.10
Benzo[g,h,i]perylene	M	2700	mg/kg	0.10	< 0.10
Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700	mg/kg	2.0	< 2.0
Total Phenols	M	2920	mg/kg	0.30	< 0.30

Results - Single Stage WAC

Project: 20-0399E Bus Connects Route 13

Chemtest Job No: 20-28443 Chemtest Sample ID: 1084161 Sample Ref: Sample ID: Sample Location: R13-CP03 Top Depth(m): 1.0 Bottom Depth(m): Sampling Date: 19-Oct-2020				Landfill Waste Acceptance Criteria			
				Limits			
				Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill	
Determinand	SOP	Accred.	Units				
Total Organic Carbon	2625	M	%	0.75	3	5	6
Loss on Ignition					--	--	10
Total BTEX	2760	M	mg/kg	< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	M	mg/kg	< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	M	mg/kg	< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg	< 2.0	100	--	--
pH					--	>6	--
Acid Neutralisation Capacity					--	To evaluate	To evaluate
Eluate Analysis			10:1 Eluate mg/l	10:1 Eluate mg/kg	Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg		
Arsenic	1450	U	0.0038	< 0.050	0.5	2	25
Barium	1450	U	0.0017	< 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	0.0018	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	< 0.010	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.010	0.1	0.5	7
Zinc	1450	U	< 0.0010	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 10	800	15000	25000
Fluoride	1220	U	0.14	1.4	10	150	500
Sulphate	1220	U	2.1	21	1000	20000	50000
Total Dissolved Solids	1020	N	57	570	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.30	1	-	-
Dissolved Organic Carbon	1610	U	4.9	< 50	500	800	1000

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

Waste Acceptance Criteria

Landfill WAC analysis (specifically leaching test results) must not be used for hazardous waste classification purposes. This analysis is only applicable for hazardous waste landfill acceptance and does not give any indication as to whether a waste may be hazardous or non-hazardous.

Test Methods

SOP	Title	Parameters included	Method summary
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	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1610	Total/Dissolved Organic Carbon in Waters	Organic Carbon	TOC Analyser using Catalytic Oxidation
1920	Phenols in Waters by HPLC	Phenolic compounds including: Phenol, Cresols, Xylenols, Trimethylphenols Note: Chlorophenols are excluded.	Determination by High Performance Liquid Chromatography (HPLC) using electrochemical detection.
2010	pH Value of Soils	pH	pH Meter
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	Alkaline 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)
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.
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
2920	Phenols in Soils by HPLC	Phenolic compounds including Resorcinol, Phenol, Methylphenols, Dimethylphenols, 1-Naphthol and TrimethylphenolsNote: chlorophenols are excluded.	60:40 methanol/water mixture extraction, followed by HPLC determination using electrochemical detection.
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

U	UKAS accredited
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N	Unaccredited
S	This analysis has been subcontracted to a UKAS accredited laboratory that is accredited for this analysis
SN	This analysis has been subcontracted to a UKAS accredited laboratory that is not accredited for this analysis
T	This analysis has been subcontracted to an unaccredited laboratory
I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"

Comments or interpretations are beyond the scope of UKAS accreditation

The results relate only to the items tested

Uncertainty of measurement for the determinands tested are available upon request

None of the results in this report have been recovery corrected

All results are expressed on a dry weight basis

The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols

For all other tests the samples were dried at < 37°C prior to analysis

All Asbestos testing is performed at the indicated laboratory

Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

- A - Date of sampling not supplied
- B - Sample age exceeds stability time (sampling to extraction)
- C - Sample not received in appropriate containers
- D - Broken Container
- E - Insufficient Sample (Applies to LOI in Trommel Fines Only)

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt

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

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

customerservices@chemtest.com



Final Report

Report No.: 20-28569-1
Initial Date of Issue: 27-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
Gabiella 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 20-0399E Bus Connects Route 13

Quotation No.: Q20-21063 **Date Received:** 22-Oct-2020

Order No.: **Date Instructed:** 22-Oct-2020

No. of Samples: 1

Turnaround (Wkdays): 5 **Results Due:** 28-Oct-2020

Date Approved: 27-Oct-2020

Approved By:

Details: Glynn Harvey, Technical Manager

Results - Soil

Project: 20-0399E Bus Connects Route 13

Client: Causeway Geotech Ltd		Chemtest Job No.:		20-28569	
Quotation No.: Q20-21063		Chemtest Sample ID.:		1084750	
		Sample Location:		R13-SLT03	
		Sample Type:		SOIL	
		Top Depth (m):		0.40	
		Date Sampled:		20-Oct-2020	
		Asbestos Lab:		COVENTRY	
Determinand	Accred.	SOP	Units	LOD	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
ACM Detection Stage	U	2192		N/A	-
Moisture	N	2030	%	0.020	11
pH	U	2010		4.0	8.9
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.43
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	15
Cadmium	U	2450	mg/kg	0.10	1.6
Chromium	U	2450	mg/kg	1.0	12
Copper	U	2450	mg/kg	0.50	24
Mercury	U	2450	mg/kg	0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	35
Lead	U	2450	mg/kg	0.50	69
Zinc	U	2450	mg/kg	0.50	77
Organic Matter	U	2625	%	0.40	3.1
Total TPH >C6-C40	U	2670	mg/kg	10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10
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Chrysene	U	2700	mg/kg	0.10	< 0.10
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Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10
Coronene	N	2700	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2700	mg/kg	2.0	< 2.0
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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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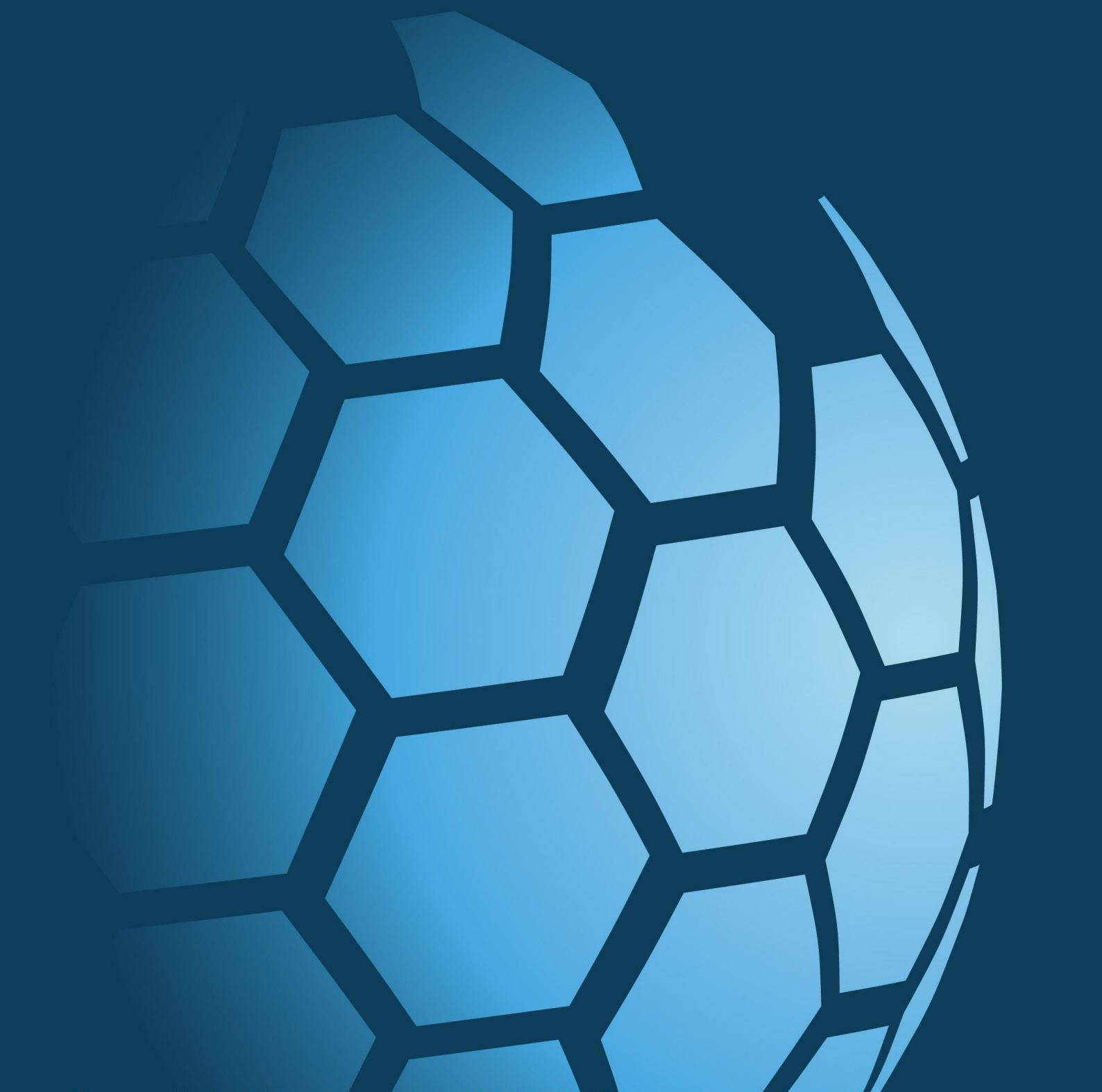
customerservices@chemtest.com



CAUSEWAY
— GEOTECH

APPENDIX G

SPT HAMMER ENERGY MEASUREMENT REPORT



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

SPT Hammer Ref: .0643
Test Date: 22/02/2020
Report Date: 03/03/2020
File Name: .0643.spt
Test Operator: NPB

Instrumented Rod Data

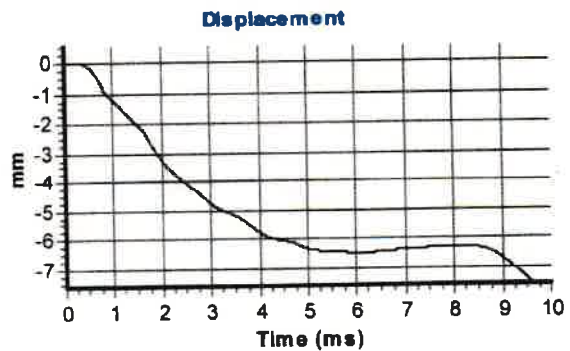
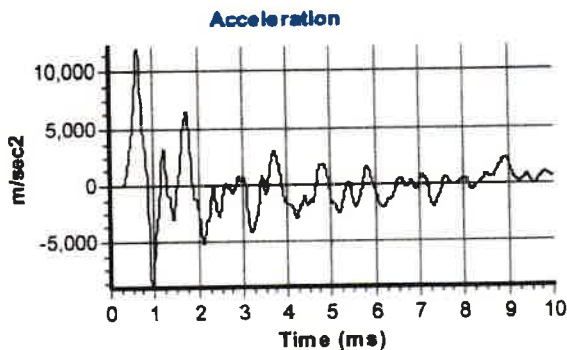
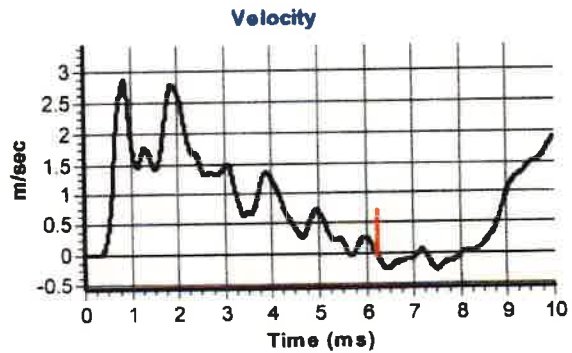
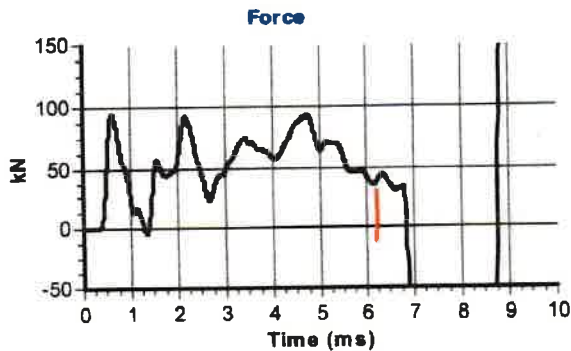
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.0
Assumed Modulus E_a (GPa): 200
Accelerometer No.1: 6458
Accelerometer No.2: 9607

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

Area of Rod A (mm^2): 905
Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 400

Energy Ratio E_r (%): **85**

NPB Burrows
Signed: Neil Burrows
Title: Field Operations Manager

The recommended calibration interval is 12 months

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

SPT Hammer Ref: .T7
Test Date: 22/02/2020
Report Date: 03/03/2020
File Name: .T7.spt
Test Operator: NPB

Instrumented Rod Data

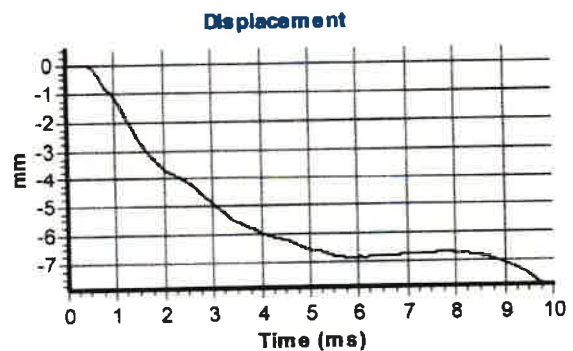
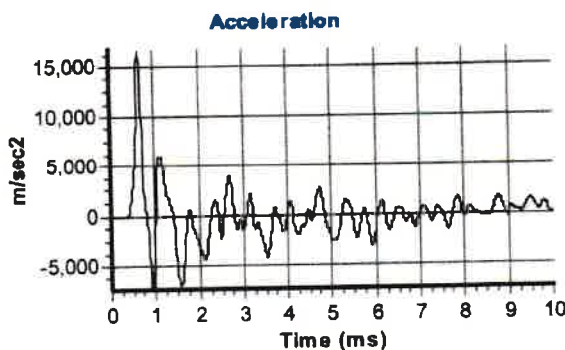
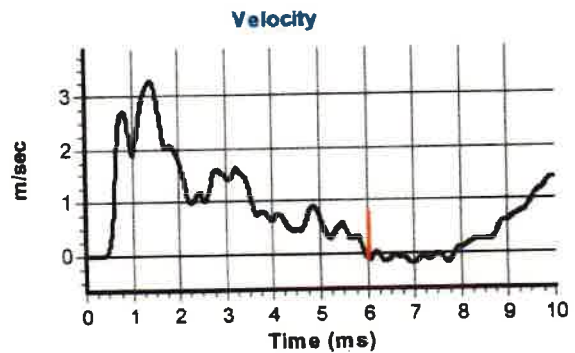
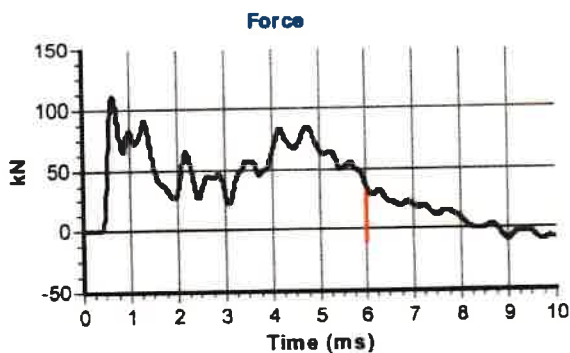
Diameter d_r (mm): 54
Wall Thickness t_r (mm): 6.0
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Comments / Location


BALLEYMONEY



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Theoretical Energy E_{theor} (J): 473
Measured Energy E_{meas} (J): 399

Energy Ratio E_r (%): **84**


Signed: Neil Burrows
Title: Field Operations Manager

The recommended calibration interval is 12 months