Chapter 14
(Land, Soils, Geology & Hydrogeology) Appendices

Appendix

14.1 Scheme Walkover Summary

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A2 Scheme Walkover Summary

A2.1 Introduction

The following is a summary of the observations by the Land, Soils, Geology and Hydrogeology Environmental Impact Assessment Team following physical walkovers of the scheme. The walkover occurred on the 11th October 2021. The drawings used to determine the type and extent of proposed works and in turn to inform the site walkover were the General Arrangement Key Plan Drawings No. BCG-0100-00-001 to BCG-100-00-05 (Version P01).

Not all observations have been included in this summary for conciseness. Typically, only observations that could not have been determined from the desk study and that are relevant to the Land, Soils, Geology and Hydrogeology chapter have been included. The omission of an observation or a feature does not negate the feature's importance in terms of the Land, Soils, Geology and Hydrogeology environmental impact assessment.

The observations are summarized in Table 1 and the corresponding photos in A2.3 of this appendix. The sheet locations are in reference to Sheets 01 to 05 of the General Arrangement Key Plan Drawings No. BCG-0100-00-001 to BCG-100-00-05.

A2.2 Summary

Table 1 : Scheme Walkover Summary

Site Notes				
Name	**Category**	**Importance/Activity**	**Location**	**Photo ID**
River Corrib	Waterbody	Extremely High Importance	Sheet 01	Galway_Image01
	Comments: The Proposed Development traverses the River Corrib along the existing Salmon Weir Bridge. The River Corrib is part of 'The Lough Corrib SAC and pNHA'.			
The Lough Corrib SAC	SAC and pNHA	Extremely High Importance	Sheet 01 and North of all sheets	Galway_Image01
	Comments: This area includes Lough Corrib north of the study area and the River Corrib which flows south from Lough Corrib and into the Galway Bay Complex SAC. It must be considered due to its proximity.			
The Galway Bay Complex	SAC and pNHA	Extremely High Importance	Sheet 05 and South of all sheets	Galway_Image02
	Comments: This area includes the coastal waters of inner Galway Bay and Lough Atalia. It must be considered due to its proximity.			
Surface water discharge – Lough Atalia	Waterbodies	Refer to conceptual site model	Sheet 05	Galway_Image03
	Comments: There were to surface water discharges observed entering the eastern end of Lough Atalia. One discharge was clear and entering the Lough at approximately 1L/Sec. The other was milky white to grey and was entering the Lough at approximately <.1L/Sec.			
Inner Galway Bay	SPA	Extremely High Importance	South of all sheets	N/A
	Comments: This area includes the coastal waters of the Corrib Estuary and Inner Galway Bay. It must be considered due to its proximity.			
Demolition site St. Brendan's Avenue	Earthworks/Demolition	Earthworks/Levelling	Sheet 03	Galway_Image04 and 05
	Comments: The junction is proposed to be updated. For the junction to be updated in line with the current plans the corner house on St. Brendan's Avenue is proposed to be demolished. This will result in the demolition of the building and existing walls, there may be minor level changes to accommodate the works.			
Former Petrol Station Headford Road	Earthworks	Earthworks/Levelling	Sheet 03	Galway_Image06
	Comments: The Proposed Development is adjacent to a former Petrol Station on Headford Road. Due to the nature of the works and existing infrastructure already at the location, consideration of this impact is important and mitigation measures may be required if a localised contamination source is identified.			
Road updates	Earthworks	Earthworks/Levelling	Sheet 05	Galway_Image07

<table>
<tr><td>College Road and Lough Atalia Junction</td><td colspan="4">Comments: The junction is proposed to be updated. A level change between Lough Atalia Road and College Road of approximately 3m was noted. Earthworks may be required to accommodate the works</td></tr>
<tr><td rowspan="2">Circle K-College Road</td><td>Earthworks</td><td>Earthworks/Levelling</td><td>Sheet 05</td><td>Galway_Image08</td></tr>
<tr><td colspan="4">Comments: The Proposed Development is to interact with the Circle K garage on College Road. Due to the nature of the works and existing infrastructure already at the location, consideration of this impact is important and mitigation measures may be required if a localised contamination source is identified.

The petrol station is on a reduced level, there were retaining walls surrounding the petrol station separating it from the higher ground level. The forecourt of the petrol station was in good order and appeared clean.</td></tr>
<tr><td rowspan="2">Road widening College Road</td><td>Earthworks</td><td>Earthworks/Levelling</td><td>Sheet 05</td><td>Galway_Image09</td></tr>
<tr><td colspan="4">Comments: College Road is proposed to be widened; this occurs along a housing estate (Accessed from Moneengeisha Road). Minor level changes were noted at this location. There is a small retaining wall here, which allows for a level change between the road and the housing estate carpark. Earthworks will be required to accommodate the works</td></tr>
<tr><td rowspan="2">Road widening at College Road – Dublin Road Junction</td><td>Earthworks</td><td>Earthworks/Levelling</td><td>Sheet 05</td><td>Galway_Image10</td></tr>
<tr><td colspan="4">Comments: The College Road-Dublin Road Junction is proposed to be updated and widened. This may result in the removal of walls and minor level changes to accommodate the works.</td></tr>
<tr><td rowspan="2">Road widening Dublin Road</td><td>Earthworks</td><td>Earthworks/Levelling</td><td>Sheet 05</td><td>Galway_Image11</td></tr>
<tr><td colspan="4">Comments: The Dublin Road is proposed to be widened. This may result in the removal of walls and minor level changes to accommodate the works.</td></tr>
</table>

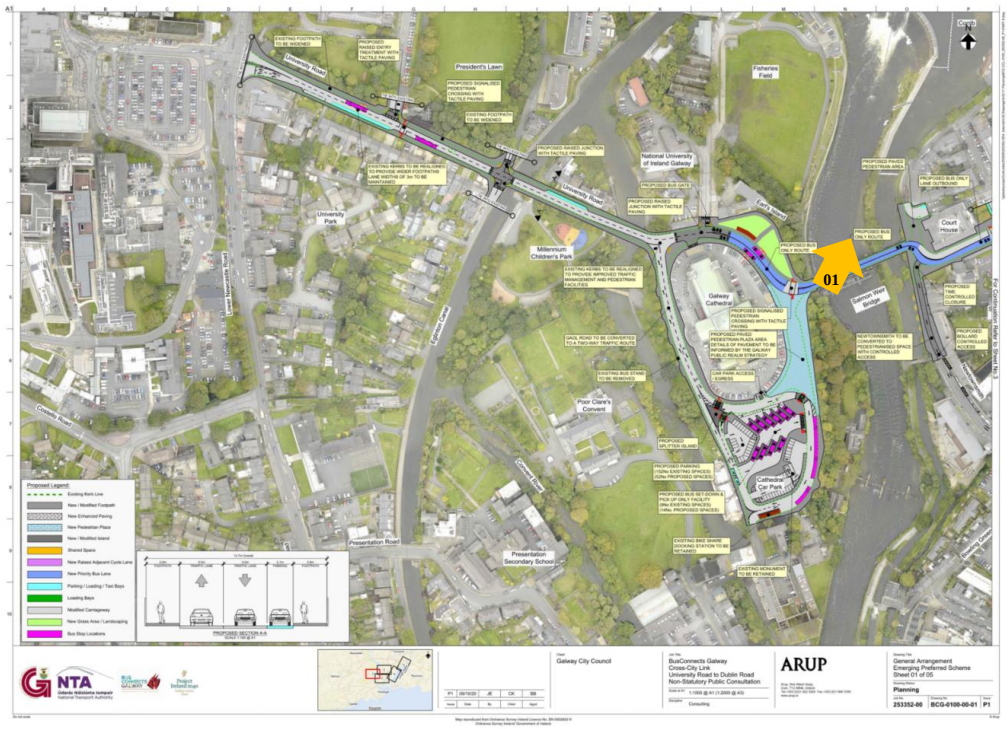
A2.3 Photos

Photos

Caption: River Corrib / Lough Corrib SAC

ID:	Galway_Image01	Date	11/10/2021	Co-ordinates	Easting: 529536 Northing: 725538

Keyplan:



Caption: Galway Bay Complex SAC – Lough Atalia

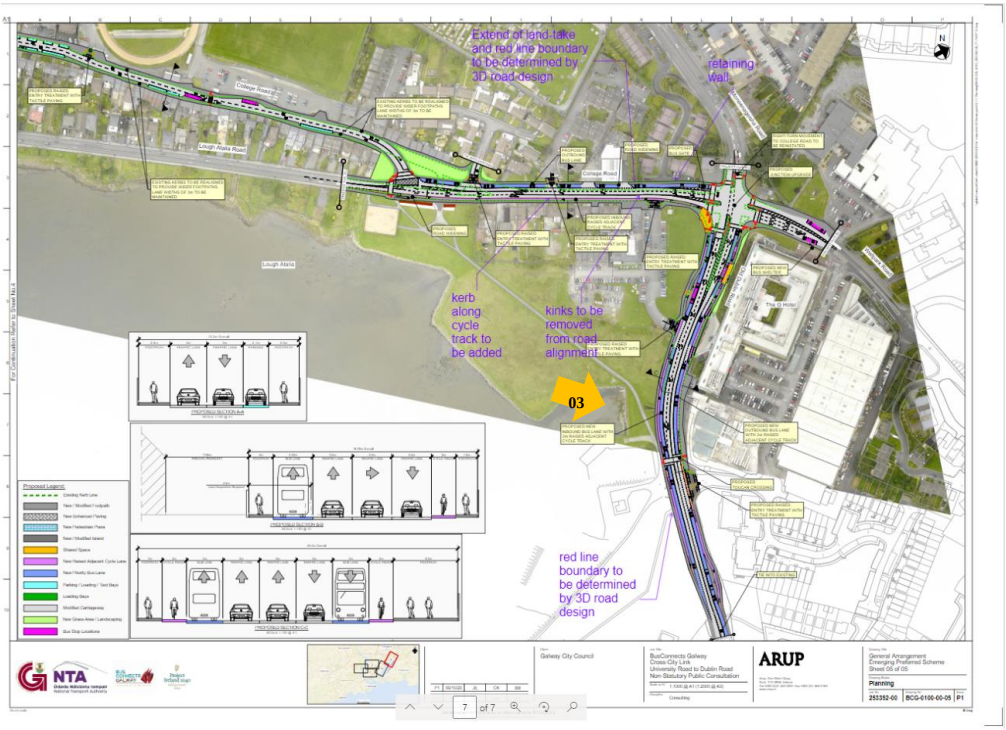
ID	Galway_Image02	Date	11/10/2021	Co-ordinates	Easting: 530445 Northing: 725292

Keyplan:

Caption: Surface water discharge – Lough Atalia

ID	Galway_Image03	Date	11/10/2021	Co-ordinates	Easting: 531159 Northing: 726095

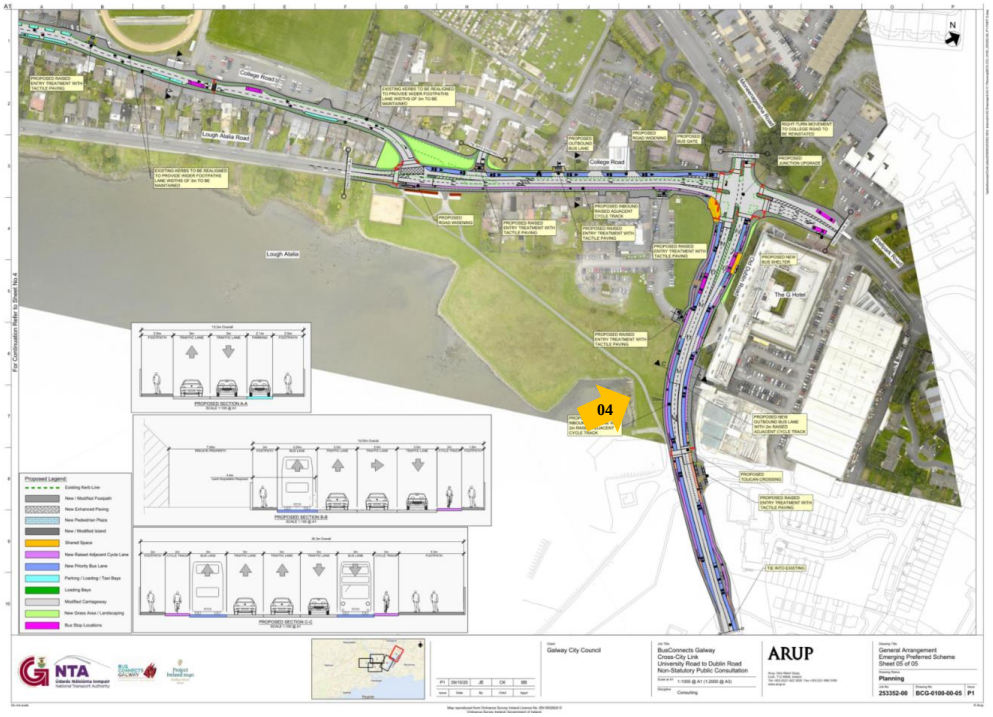
Keyplan:



Caption: Surface water discharge – Lough Atalia

ID	Galway_Image04	Date	11/10/2021	Co-ordinates	Easting: 531159 Northing: 726093

Keyplan:



Caption: Demolition site at 5/6 Headford Road property. Building to be demolished highlighted in red. Extent of the demolition site is not included in the photo. Demolition site also includes property at the rear 20 Saint Brendans Avenue

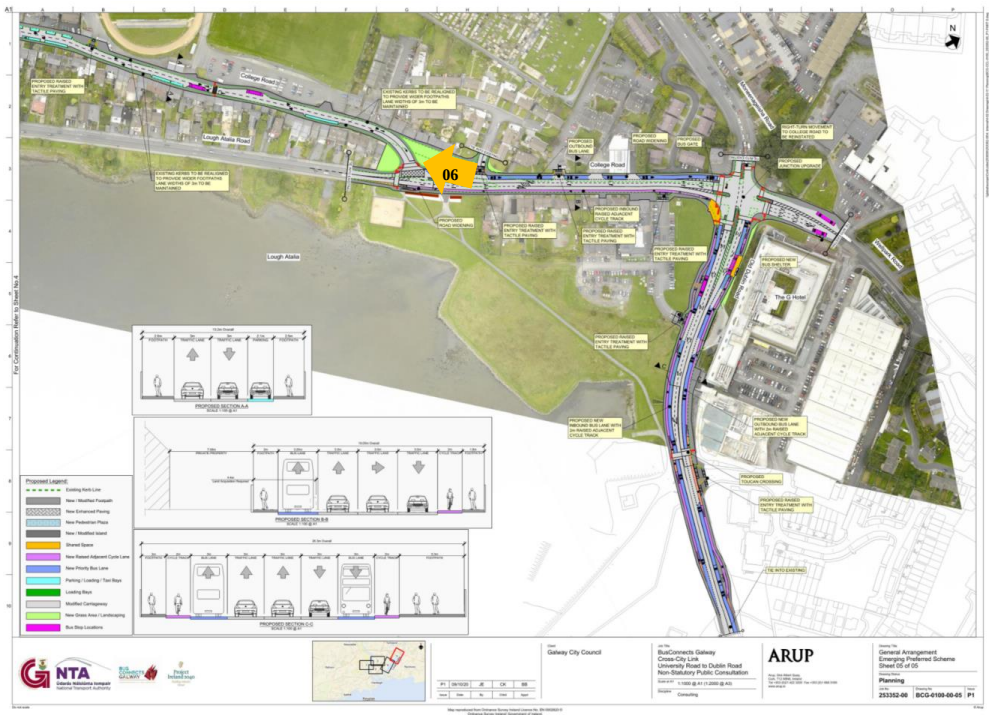
ID	Galway_Image05	Date	11/10/2021	Co-ordinates	Easting: 529876 Northing: 725737

Keyplan

Caption: Lough Atalia Road and College Road Level difference

ID	Galway_Image06	Date	11/10/2021	Co-Ordinates:	Easting: 530927 Northing: 726042

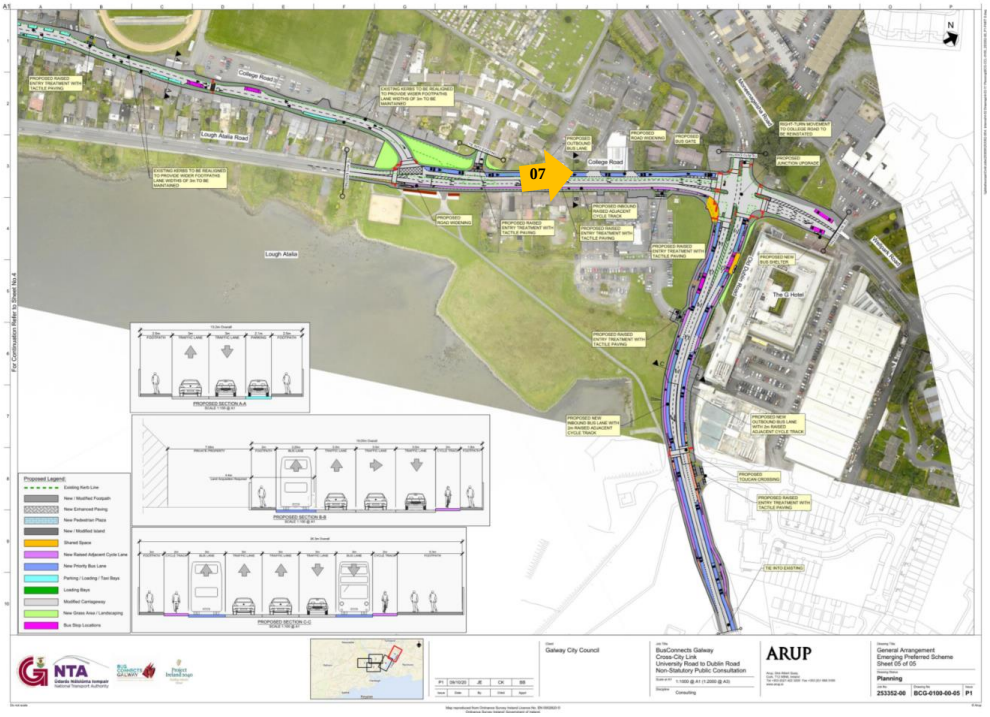
Keyplan:



Caption: Circle K College Road

ID	Galway_Image07	DATE:	11/10/2021	Co-Ordinates:	Easting: 530993 Northing:726151

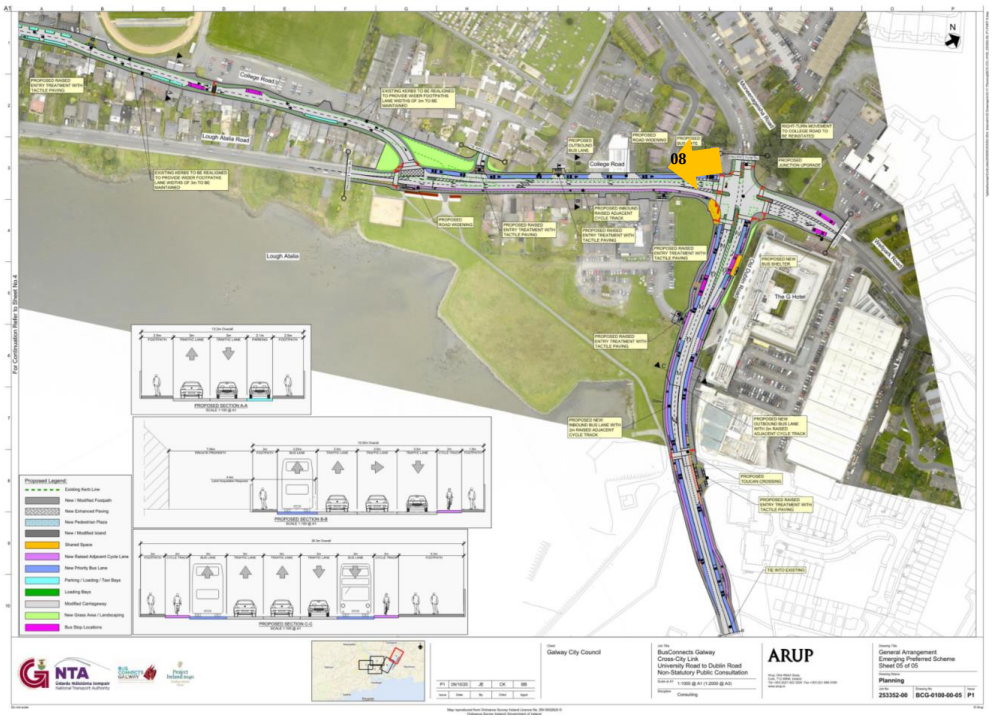
Keyplan:



Caption: Housing estate carpark adjacent to College Road ***note difference in level change between road and carpark with reference to circle K signpost***

ID:	Galway_Image08	Date:	11/10/2021	Co-Ordinates:	Easting: 531026 Northing: 726218

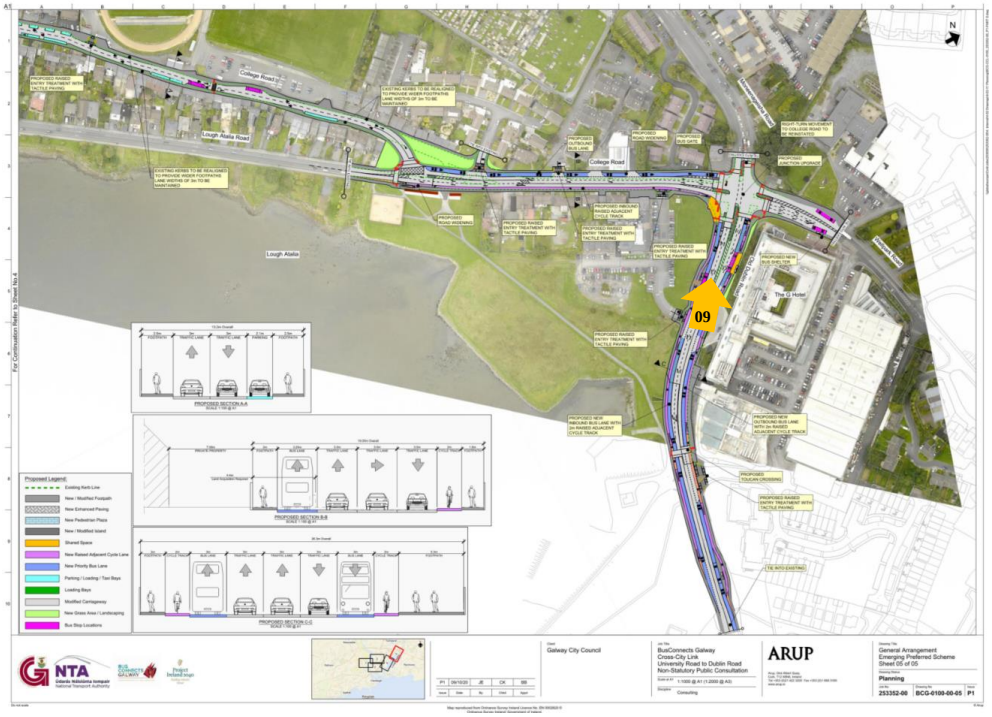
Keyplan:



Caption: Junction of College Road and the Dublin Road

ID:	Galway_Image09	Date:	11/10/2021	Co-Ordinates:	Easting: 531108 Northing: 726204

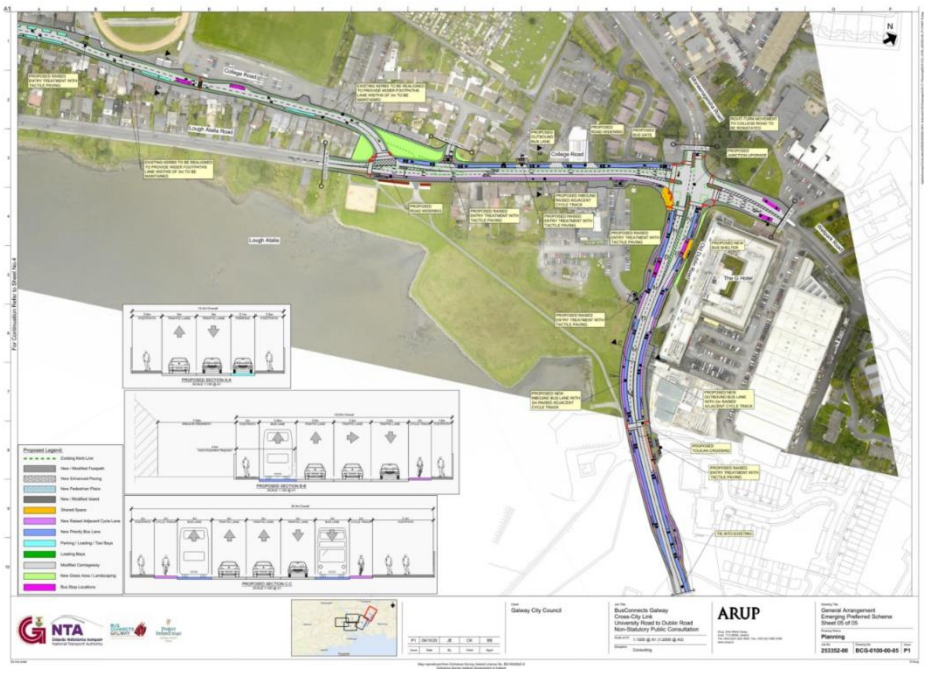
Keyplan:



Caption: Dublin Road

ID:	Galway_Image10	Date:	11/10/2021	Co-Ordinates:	Easting: 531236 Northing: 726106

Keyplan:



BusConnects Galway – Ground Investigation

Client:	Galway City Council
Client's Representative:	Arup
Report No.:	21-1298
Date:	March 2022
Status:	Draft Report

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Document Control Sheet

Report No.:		21-1298			
Project Title:		BusConnects Galway			
Client:		Galway City Council			
Client's Representative:		Arup			
Revision:	A00	**Status:**	Draft Report	**Issue Date:**	10th March 2022
Prepared by:		**Reviewed by:**		**Approved by:**	
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The works were conducted in accordance with:

British Standards Institute (2015) BS 5930:2015+A1:2020, 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+A1:2020, 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 Nx5=Cu is used (as set out in Stroud & Butler 1975).
dd-mm-yyyy	Date at the end and start of shifts, shown at the relevant borehole depth. Corresponding casing and water depths shown in the adjacent columns.
▽	Water strike: initial depth of strike.
▼	Water strike: depth water rose to.
Abbreviations relating to rock core – reference Clause 36.4.4 of BS 5930: 2015+A1:2020	
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.
(xxx/xxx/xxx)	Spacing between discontinuities (minimum/average/maximum) measured in millimetres.

BusConnects Galway

1 AUTHORITY

On the instructions of Arup, ("the Client's Representative"), acting on the behalf of Galway City Council ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design of the proposed BusConnects Galway scheme.

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

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

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

2 SCOPE

The extent of the investigation, as instructed by the Client's Representative, included boreholes, soil sampling, 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 plans in Appendix A, the works were conducted across two main areas as outlined below, east of Galway City.

College Road and Lough Atalia intersection
Works were conducted in the area of Lough Atalia Road, College Road and Old Dublin Road in a mixture of grassy public areas, housing developments and private property including Circle K forecourt on College Road. The area is bounded by Lough Atalia and the Galway Bay Complex Special Area of Conservation (SAC).

St. Brendan's Avenue
BH106 was undertaken on the northbound lane of St. Brendan's Avenue, 30m south of its junction with Bóthar na mBan. The site is bounded by residential properties on all sides.

4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 29th November 2021 and 25th January 2022, comprised:

- Thirteen boreholes
  - one light cable percussion borehole (only hand pit attempted)
  - four boreholes by light cable percussive extended by rotary follow-on drilling
  - six boreholes by dynamic (windowless) sampling
  - one borehole by dynamic (windowless) sampling extended by rotary follow-on drilling
  - one borehole by rotary drilling methods
- a standpipe installation in seven boreholes
- groundwater and surface water sampling and monitoring

The exploratory holes 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 a Dando Terrier rig, light cable percussion boring by a Dando 2000 rigs, and rotary drilling by a Comacchio 205, tracked rotary drilling rig.

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

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

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

Four boreholes (BH101, BH104, BH105A and BH106) were put down by a combination of light cable percussion boring and rotary follow-on drilling techniques with core recovery in 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.

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

Where coring was carried out within bedrock strata, conventional coring methods were used with a metric T2-101 core barrel which produced core lengths up to 1.5m in lengths, 84mm in diameter, and placed in triple channel wooden core boxes.

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

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

4.2.2 Rotary drilled borehole

One borehole (BH103) was put to its completion by rotary drilling techniques only. The borehole was completed using a Comacchio 205 tracked drilling rig.

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

Symmetrix-cased full hole rotary percussive drilling techniques was employed to advance the borehole to bedrock, after which rotary coring was employed to recover core samples of the bedrock. SPTs were carried out at standard intervals throughout the overburden, with environmental samples taken at standard intervals, as directed by the Client's Representative.

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

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

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

4.2.3 Dynamic sampled boreholes

Six boreholes (BH102A, BH103WS, WS101 and WS104-WS106) 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 1.30m and 4.00m where they were terminated on encountering virtual refusal.

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.

Appendix B presents the borehole logs.

4.2.4 Borehole by combined dynamic sampling and rotary follow-on drilling

One borehole (BH102) was put down by a combination of dynamic sampling techniques using a Dando Terrier rig and rotary follow-on drilling techniques with core recovery in bedrock. 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 1.00m depth to ensure the borehole was put down clear of services or subsurface obstructions. The dynamic sampling section of the borehole was taken to a depth of 1.00m where it was terminated on encountering virtual refusal.

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.

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

Rotary percussive methods were employed to advance the borehole to bedrock, with SPTs carried out at standard intervals as required throughout the overburden, after which rotary coring was undertaken to recover core samples of the bedrock.

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

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

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

4.3 Standpipe installations

A groundwater monitoring standpipe was installed in several boreholes as shown in Table 1 below.

Table 1 Summary of standpipe installations

GI Ref	Standpipe type	Response Zone (mbgl)
BH102	50mm standpipe	1.30-4.50
BH103	50mm standpipe	4.50-8.00
BH103WS	50mm standpipe	1.50-2.60
BH104	50mm standpipe	4.50-8.00
BH105	50mm standpipe	4.50-8.00
BH106	50mm standpipe	2.40-6.00

WS104	50mm standpipe	1.50-3.00

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

4.4 PID tests

PID (Photo ionizing detection) testing was undertaken on small, disturbed samples recovered from all boreholes using a hand-held PID meter, to determine if any volatile organic compound contamination was present in the overburden.

Results of the PID tests are presented on the individual borehole logs in Appendix B.

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 R10 GPS system employing VRS and real time kinetic (RTK) techniques.

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

4.6 Groundwater and surface water monitoring

Following completion of site works, groundwater monitoring was conducted over two weeks using groundwater data loggers and manually, using a water interface probe.

Surface water samples were also taken from two locations (SW1 and SW2), on the banks of Lough Atalia.

The monitoring records are presented in Appendix D, including data logger installation records and graphs over the monitoring period.

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:** organic matter 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 E.

5.2 Geotechnical laboratory testing of rock

Laboratory testing of rock sub-samples comprised:

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

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

The test results are presented in Appendix E.

5.3 Environmental laboratory testing of soils and water

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

Testing was carried out for the following Arup suites of soil and groundwater testing:

- Arup Soil Suite Ei – Leachate
- Arup Soil Suite Eii – Soil Total Pollutant
- Arup Soil Suite Eiii – Volatiles Soil
- Arup Soil Suite Eiv – Asbestos Soil
- Arup Soil Suite Ev – Asbestos Quantification
- Arup Soil Suite Eviii – Fuel Additives
- Arup Groundwater Suite

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 made ground and around the Lough Atalia area, estuarine silts and clay. These deposits are underlain by the Burren Formation in the Lough Atalia area and by an unnamed igneous intrusion in the St. Brendan's Avenue area comprising Metagabbro and Orthogneiss.

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:** BH101, BH103, BH103WS, BH106 and WS104 encountered 50-100mm of bitmac. BH102 and BH102A encountered 300mm of concrete,
- **Topsoil:** BH104A, BH105A, WS101, WS105 and WS106 encountered 100-300mm of topsoil.
- **Made Ground (sub-base):** 100-600mm of aggregate fill beneath the paved surface in BH102, BH102A, BH103, BH103WS, BH106 and WS104.
- **Made Ground (fill):** reworked sandy gravelly clay or gravelly sand or sandy gravel fill encountered across the site, to a maximum depth of 2.30m in BH102. Varying amounts of plastic, glass, crockery, red brick and concrete fragments were encountered in BH106, WS101, WS105 and WS106.
- **Estuarine deposits:** encountered in the Lough Atalia area in BH103, BH104, BH105A, WS101, WS105 and WS106 to a maximum depth of 4.90m in BH104 comprising peat, soft grey silt and loose sandy silty gravels.
- **Bedrock (Limestone, Diorite, Gabbro):** Rockhead was encountered at depths ranging from 2.30m in BH102 to 6.70m in BH104.

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, dynamic sampling and rotary drilling through soil as water strikes as shown in Table 2 below.

Table 2 Groundwater strikes encountered during the ground investigation

GI Ref	Water Level (mbgl)	Comments
BH101	2.60	
BH103	7.10	Rose to 2.00m after 20 mins
BH103WS	2.10	
BH104	4.90	Rose to 3.00m after 20 mins
BH105A	5.90	
BH106	5.70	Rose to 1.55m after 20 mins
WS101	1.50	Rose to 0.90m after 20 mins
WS104	2.10	

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

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

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

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

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

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

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

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

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

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

CAUSEWAY GEOTECH

APPENDIX A

SITE AND EXPLORATORY HOLE LOCATION PLANS

CAUSEWAY GEOTECH

Project No.:	21-1298	**Client:**	Galway City Council
Project Name:	BusConnects Galway	**Client's Representative:**	Arup

Legend Key

Title:

Site Location Plan

Last Revised:	**Scale:**
10/03/2022	1:25000

CAUSEWAY GEOTECH

Project No.:	21-1298	**Client:**	Galway City Council
Project Name:	BusConnects Galway	**Client's Representative:**	Arup

Legend Key

- Locations By Type - CP
- Locations By Type - CP+RC
- Locations By Type - DS
- Locations By Type - DS+RC
- Locations By Type - RO+RC
- Locations By Type - SL
- Locations By Type - WS

Title:

Exploratory Hole Location Plan (Sheet 1 of 2)

Last Revised:	**Scale:**
10/03/2022	1:2000

CAUSEWAY GEOTECH

Project No.:	21-1298	**Client:**	Galway City Council
Project Name:	BusConnects Galway	**Client's Representative:**	Arup

Legend Key

Locations By Type - CP+RC

Title:

Exploratory Hole Location Plan (Sheet 2 of 2)

Last Revised:	**Scale:**
10/03/2022	1:1000

CAUSEWAY GEOTECH

APPENDIX B

BOREHOLE LOGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH101
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)
Cable Percussion	Dando 2000	0.00	2.60
Rotary Drilling	Comacchio 205	2.60	3.60
Rotary Coring	Comacchio 205	3.60	5.40

Coordinates: 531035.03 E, 726236.38 N

Final Depth: 5.40 m | Start Date: 30/11/2021 | Driller: RP+JA

Elevation: 4.80 mOD | End Date: 20/01/2022 | Logger: SR+TH

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

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.10 - 0.60	B5				4.70	0.10		BITMAC		
0.50	ES1							MADE GROUND: Firm brown sandy gravelly CLAY with medium cobble content. Sand is fine to coarse. Gravel is subangular fine to medium.		
0.60 - 1.20	B6				4.20	0.60		Firm brown sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to medium. Cobbles are subangular to subrounded.		
1.00	ES2									
1.20 - 2.00	B7				3.60	1.20		Stiff brown slightly gravelly sandy CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subangular.		
1.20 - 1.65	SPT (C)	N=17 (3,3/4,4,5,4) Hammer SN = 1369	0.00	Dry						
1.50	D9									
2.00	3									
2.00	ES3									
2.00 - 2.50	B8									
					2.30	2.50		Dense grey sandy subangular fine to coarse GRAVEL. Sand is fine to coarse.		
2.00 - 2.32	SPT (C)	N=50 (4,3/50 for 170mm) Hammer SN = 1369	2.00	Dry	2.20	2.60		Dense grey sandy subangular fine to coarse GRAVEL. (Driller's description)		
2.50	D10									
2.50 - 2.61	SPT (C)	N=50 (25 for 70mm/50 for 40mm) Hammer SN = 1369 Strike at 2.60m.	2.50	Dry						
3.50 - 3.65	SPT(C)	N=50 (25 for 75mm/50 for 75mm) Hammer SN = 0200	100	100	100	8				
3.80			100	100	40					
4.20										
4.30	C		100	100	100	3				
4.60										
5.00	C		100	100	93					
5.20										
5.40			100	75	0	5				
					1.20	3.60		Medium strong massive grey LIMESTONE with rare fossils. Partially weathered: grey discolouration on some fracture surfaces. Discontinuities: 1. 0 to 10 degree joints, at 3.80m and 65.00m, slightly undulating, rough. 2. 25 to 40 degree joints, medium spaced (85/450/1000), undulating, rough.		
						(1.80)				
					-0.60	5.40		End of Borehole at 5.40m		

TCR | SCR | RQD | FI

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.60			

Chiselling Details

From (m)	To (m)	Time (hh:mm)
2.50	2.60	01:00

Casing Details

To (m)	Diam (mm)
2.60	200

Water Added

From (m)	To (m)

Remarks

Hand dug inspection pit excavated to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
	Water	Terminated at scheduled depth.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH102
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Dynamic Sampling	Dando Terrier	0.00	1.00	
Rotary Drilling	Comacchio 205	1.00	2.30	530985.98 E
Rotary Coring	Comacchio 205	2.30	4.50	726161.37 N

Final Depth:	4.50 m	Start Date:	01/12/2021	Driller:	JC+JA	Sheet 1 of 1
Elevation:	4.08 mOD	End Date:	13/01/2022	Logger:	SR+TH	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
									3.78	0.30		CONCRETE
0.40 - 1.00	B3								3.68	0.40		MADE GROUND: Grey sandy silty angular to subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subangular.
0.50	ES1											
0.50		PID = 0.60ppm										MADE GROUND: Grey gravelly fine to coarse SAND with low cobble content. Gravel is subangular to subrounded fine to coarse. Cobbles
1.00	ES2											are subangular.
1.00 - 1.10	SPT (S)	N=50 (25 for 75mm/50 for 20mm) Hammer SN = 0696					1.00	Dry				
1.00		PID = 0.30ppm										
2.10	EW1											
2.30 - 2.31	SPT(S) N=50 (25 for 7mm/50 for 0mm) Hammer SN = 0200		86	83	83	4	2.30	Dry	1.78	2.30		Strong massive grey LIMESTONE with rare fossil fragments. Partially weathered: dark orangish brown discolouration on some joint surfaces. Discontinuities: 1. 0 to 25 degree joints, medium spaced (49/280/420) slightly undulating, rough, grey discolouration on some joint surfaces. 2. 60 to 65 degree joint at 2.98m to 306m, planar, rough orangish brown staining on joint surface.
										(1.40)		
3.40			100	78	78				0.38	3.70		Medium strong massive grey LIMESTONE. Partially weathered: slightly reduced strength, closer fracture spacing, orangish brown discolouration on some fracture surfaces. Discontinuities: Medium strong massive grey LIMESTONE. Partially weathered: slightly reduced strength, closer fracture spacing, orangish brown discolouration on some joint surfaces. Discontinuities: 1. 20 to 40 egree joints, medium spaced (65/265/450) planar, rough. 2. 60 to 90 degree joints at 3.80 to 4.00m, 4.10m to 4.50m, 4.25m to 4.45m, planar to undulating, rough, orangish brown staining on joint surfaces.
3.80	C											
4.00			100	70	33	9				(0.80)		
4.30			100	75	0							
4.50									-0.42	4.50		End of Borehole at 4.50m

Water: Backfill

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 1.00m. No noticeable groundwater strikes encountered - water added during drilling.

Casing Details		Water Added	
To (m)	Diam (mm)	From (m)	To (m)
2.30	200		

Core Barrel	Flush Type	Termination Reason	Last Updated
T2-101	Water	Terminated at scheduled depth.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH102A
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Dynamic Sampling	Dando Terrier	0.00	1.30	530987.16 E 726161.44 N

Final Depth:	1.30 m	Start Date:	01/12/2021	Driller:	JC	Sheet 1 of 1 Scale: 1:50
Elevation:	4.06 mOD	End Date:	01/12/2021	Logger:	SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					3.76	0.30		CONCRETE		
0.40 - 1.30	B3				3.66	0.40		MADE GROUND: Grey sandy silty angular to subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subangular.		
0.50	ES1							MADE GROUND: Grey gravelly fine to coarse SAND with low cobble content. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular.		
0.50		PID = 0.20ppm								
1.00	ES2									
1.00		PID = 0.30ppm								
					2.76	1.30		End of Borehole at 1.30m		

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

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

Remarks

Hand dug inspection pit excavated to 1.20m.
No groundwater encountered.

Termination Reason	Last Updated
Terminated on refusal.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH103
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Rotary Drilling	Comacchio 205	0.00	5.50	
Rotary Coring	Comacchio 205	5.50	10.40	531009.47 E
				726189.14 N

Final Depth:	10.40 m	Start Date:	14/01/2022	Driller:	JA	Sheet 1 of 2
Elevation:	3.98 mOD	End Date:	17/01/2022	Logger:	SR+TH	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					3.93	0.05		BITMAC
								MADE GROUND: Grey sandy silty subangular fine to coarse GRAVEL. Sand is fine to coarse.
0.50	ES1				3.48	0.50		MADE GROUND: Brownish grey sandy subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subangular.
1.00	ES2							
1.00 - 1.45	SPT (S)	N=14 (5,3/4,3,3,4) Hammer SN = 0200	1.00	Dry	2.78	1.20		Firm brown sandy gravelly CLAY. (Driller's description)
1.95	EW1							
2.50 - 2.95	SPT (S)	N=4 (3,2/1,1,1,1) Hammer SN = 0200	2.50	Dry	1.48	2.50		Soft brown sandy gravelly CLAY. (Driller's description)
4.00 - 4.39	SPT (S)	N=50 (3,4/50 for 240mm) Hammer SN = 0200	4.00	Dry	-0.02	4.00		Dense grey sandy subangular fine to coarse GRAVEL. (Driller'd description)
5.60	C	TCR 83, SCR 67, RQD 56, FI 5			-1.52	5.50		Medium strong to strong massive grey LIMESTONE with occasional fossil fragments. Partially weathered: slightly reduced strength, slightly closer fracture spacing, orangish brown discolouration and clay infill on some fracture surfaces. Discontinuities: 1. 20 to 30 degree joints, medium spaced (50/300/900) slightly undulating, rough, orangish brown discolouration on some joint surfaces, stiff orangish brown clay infill on joint at 6.60m (15mm thick). 2. 70 to 90 degree joints at 6.00m to 6.54m, and 6.65m to 6.75m, undulating, rough, orangish brown staining on joint surfaces. Stiff orangish brown clay infill on joint at 6.00m (up to 40mm thick).
6.40						(1.50)		
		Strike at 7.10m						
		TCR 85, SCR 61, RQD 51			-3.02	7.00		
7.40								Medium strong massive grey LIMESTONE with occasional fossil fragments. Partially weathered: slightly reduced strength. Discontinuities: 1. 10 to 30 degree joint, medium spaced (30/340/500) planar, rough light orangish brown staining on some joint surfaces.
7.40	C	TCR 100, SCR 97, RQD 97, FI 3				(3.40)		
8.90								

Water | Backfill

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
7.10	5.50	20	2.00

Casing Details

To (m)	Diam (mm)
5.50	200

Water Added

From (m)	To (m)

Remarks

Hand dug inspection pit excavated to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
T2-101	Water	Terminated at scheduled depth.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH103
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)
Rotary Drilling	Comacchio 205	0.00	5.50
Rotary Coring	Comacchio 205	5.50	10.40

Coordinates
531009.47 E
726189.14 N

Final Depth: 10.40 m | **Start Date:** 14/01/2022 | **Driller:** JA
Elevation: 3.98 mOD | **End Date:** 17/01/2022 | **Logger:** SR+TH

Sheet 2 of 2
Scale: 1:50
FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
		100	100	100							Medium strong massive grey LIMESTONE with occasional fossil fragments. Partially weathered: slightly reduced strength. Discontinuities: 1. 10 to 30 degree joint, medium spaced (30/340/500) planar, rough light orangish brown staining on some joint surfaces.		
10.40								-6.42	10.40		End of Borehole at 10.40m		

TCR	SCR	RQD	FI

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
7.10	5.50	20	2.00

Casing Details

To (m)	Diam (mm)
5.50	200

Water Added

From (m)	To (m)

Chiselling Details

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

Remarks
Hand dug inspection pit excavated to 1.20m.

Core Barrel	Flush Type	Termination Reason	Last Updated
T2-101	Water	Terminated at scheduled depth.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH103WS
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Dynamic Sampling	Dando Terrier	0.00	4.00	531009.69 E 726188.87 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
4.00 m	20/01/2022	JC	Scale: 1:50
Elevation: 3.96 mOD	**End Date:** 20/01/2022	**Logger:** SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					3.86	0.10		BITMAC
0.50	ES1							MADE GROUND: Grey silty angular to subangular fine to coarse GRAVEL with high cobble content and fragments of plastic. Sand is fine to coarse. Cobbles are subangular.
0.50		PID = 0.10ppm			3.26	0.70		
1.00	ES2							Grey slightly sandy subangular to subrounded fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse. Cobbles are subangular.
1.00		PID = 0.10ppm						
1.50	ES3							
1.50		PID = 0.10ppm						
1.95	EW1							
		Water strike at 2.10m						
2.50	ES4							
2.50		PID = 0.10ppm						
					-0.04	4.00		End of Borehole at 4.00m

Water

Backfill

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

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.10			

Casing Details

To (m)	Diameter
2.00	200

Remarks

Hand dug inspection pit excavated to 1.20m.

Termination Reason

Terminated on refusal.

Last Updated

10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH104
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)
Cable Percussion	Dando 2000	0.00	0.70
Rotary Drilling	Comacchio 205	0.70	6.70
Rotary Coring	Comacchio 205	6.70	11.80

Coordinates: 531072.68 E, 726115.50 N

Final Depth: 11.80 m | Start Date: 02/12/2021 | Driller: RP+JA | Sheet 1 of 2 | Scale: 1:50

Elevation: 3.63 mOD | End Date: 24/01/2022 | Logger: SR+EM | FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
0.00 - 0.70	B2							MADE GROUND: Dark greyish brown sandy clayey subangular to subrounded GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subangular.
0.50	ES1							
					2.93	0.70		MADE GROUND: Dark greyish brown sandy GRAVEL. (Driller's description)
					2.73	0.90		Brown sandy silty GRAVEL. (Driller's description)
2.04	EW1							
2.10 - 2.55	SPT (C)	N=17 (5,8/4,4,3,6) Hammer SN = 0200	2.10		1.53	2.10		Black PEAT. (Driller's description)
3.50 - 3.95	SPT (C)	N=6 (0,1/1,1,2,2) Hammer SN = 0200	3.50					
4.50 - 4.95	SPT (C)	N=15 (4,6/4,4,3,4) Hammer SN = 0200	4.50					
		Water strike at 4.90m.			-1.27	4.90		Dense greyish brown sandy silty GRAVEL. (Driller's description)
					-1.47	5.10		Grey sandy silty GRAVEL. (Possible weathered bedrock)
5.50 - 5.95	SPT (C)	N=43 (10,11/10,11,10,12) Hammer SN = 0200	5.50					
6.50 - 6.58	SPT (C)	N=50 (25 for 3mm/50 for 75mm) Hammer SN = 0200	6.50					
					-3.07	6.70		Medium strong to strong grey massive LIMESTONE. Partially weathered: slightly closer fracture spacing. Discontinuities: 1. 10 to 15 degree joints, closely spaced (70/300/300), slightly undulating, smooth to rough with light grey clay deposits (<1mm thick) on rare joint surfaces, otherwise clean.
7.00	C	TCR 85, SCR 80, RQD 66, FI 3						
7.30						(1.80)		
		TCR 100, SCR 100, RQD 97, FI 20						Medium strong to strong dark grey massive LIMESTONE. Partially weathered: slightly closer fracture spacing with clay deposits on some joint surfaces. Discontinuities: 1. 10 to 15 degree joints medium spaced (100/490/500) undulating, rough with grey clay deposits (up to 3mm thick) on some joint surfaces. 2. 0 to 50 degree joints widely spaced (150/1100/1500) planar, rough, with patchy clay deposits (<1mm thick) on few joint surfaces.
					-4.87	8.50		
8.70	C							
8.80								

Water: ▽ 4.90

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

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
4.90	4.90	20	3.00

Chiselling Details

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

Remarks

Hand dug inspection pit excavated to 0.70m.

Casing Details

To (m)	Diam (mm)
6.70	200

Water Added

From (m)	To (m)

Core Barrel	Flush Type	Termination Reason	Last Updated
T2-101	Water	Terminated at scheduled depth.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH104
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)
Cable Percussion	Dando 2000	0.00	0.70
Rotary Drilling	Comacchio 205	0.70	6.70
Rotary Coring	Comacchio 205	6.70	11.80

Coordinates: 531072.68 E, 726115.50 N

Final Depth: 11.80 m | Start Date: 02/12/2021 | Driller: RP+JA

Elevation: 3.63 mOD | End Date: 24/01/2022 | Logger: SR+EM

Sheet 2 of 2 | Scale: 1:50 | FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
		100	100	94							Medium strong to strong dark grey massive LIMESTONE. Partially weathered: slightly closer fracture spacing with clay deposits on some joint surfaces. Discontinuities: 1. 10 to 15 degree joints medium spaced (100/490/500) undulating, rough with grey clay deposits (up to 3mm thick) on some joint surfaces. 2. 0 to 50 degree joints widely spaced (150/1100/1500) planar, rough, with patchy clay deposits (<1mm thick) on few joint surfaces.		
10.30													
		100	100	90	3				(3.30)				
11.80								-8.17	11.80		End of Borehole at 11.80m		

TCR	SCR	RQD	FI

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
4.90	4.90	20	3.00

Casing Details

To (m)	Diam (mm)
6.70	200

Water Added

From (m)	To (m)

Chiselling Details

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

Remarks

Hand dug inspection pit excavated to 0.70m.

Core Barrel	Flush Type	Termination Reason	Last Updated
T2-101	Water	Terminated at scheduled depth.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH104A
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	0.40	531078.75 E 726098.94 N

Final Depth:	Start Date:	Driller:	Sheet 1 of 1
0.40 m	03/12/2021	RP	Scale: 1:40
Elevation: 3.36 mOD	**End Date:** 03/12/2021	**Logger:** SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.10 - 0.40	B2				3.26	0.10		TOPSOIL		
0.40	ES1				2.96	0.40		MADE GROUND: Firm dark greyish brown sandy gravelly SILT. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subangular.		
								End of Borehole at 0.40m		

0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0 5.5 6.0 6.5 7.0

Water Strikes

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

Casing Details

To (m)	Diameter

Water Added

From (m)	To (m)

Chiselling Details

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

Remarks

Hand dug inspection pit excavated to 0.40m.
No groundwater encountered.

Termination Reason

Terminated on boulder and instruction of the engineer.

Last Updated

10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH105A
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)
Cable Percussion	Dando 2000	0.00	2.40
Rotary Drilling	Comacchio 205	2.40	6.50
Rotary Coring	Comacchio 205	6.50	11.60

Coordinates: 531033.11 E, 726069.97 N

Final Depth: 11.60 m | Start Date: 01/12/2021 | Driller: RP+JA | Sheet 1 of 2 | Scale: 1:50

Elevation: 3.98 mOD | End Date: 25/01/2022 | Logger: SR+EM | FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.10 - 1.20	B5				3.88	0.10		TOPSOIL		
0.50	ES1							MADE GROUND: Firm becoming stiff sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subangular.		
1.00	ES2									
1.20 - 2.40	B6									
1.20 - 1.65	SPT (C)	N=30 (6,7/9,7,8,6) Hammer SN = 1369	1.20	Dry						
1.50	D7									
1.50	ES3									
2.00	ES4				1.98	2.00		Black boulder of LIMESTONE.		
2.00 - 2.40	SPT (C)	N=50 (8,7/50 for 245mm) Hammer SN = 1369	2.00	Dry						
2.40	D8				1.48	2.50		Stiff to very stiff brown sandy gravelly CLAY (Driller's description)		
2.40 - 2.46	SPT (C)	N=50 (25 for 40mm/50 for 15mm) Hammer SN = 1369	2.40	Dry						
2.45	EW1									
2.50 - 2.95	SPT (S)	N=33 (6,17/10,7,10,6) Hammer SN = 0200	2.50							
2.50										
4.00 - 4.45	SPT (S)	N=16 (3,5/3,4,5,4) Hammer SN = 0200	4.00							
					-0.62	4.60		Grey BOULDERS of limestone. (Driller's description)		
					-1.22	5.20		Black boulder of LIMESTONE.		
5.50 - 5.50	SPT (C)	N=50 (25 for 0mm/50 for 0mm) Hammer SN = 0200	5.50							
5.80		Water strike at 5.90m.			-1.82	5.80		Grey sandy silty GRAVEL. (Driller's description) (Possible weathered bedrock)	▼	
7.10		83 80 79 2			-2.52	6.50		Medium strong massive grey LIMESTONE. partially weathered: slightly closer fracture spacing. Discontinuities: 1. 5 to 10 degree joint closely spaced (100/295/350) undulating, rough, clean.		
		100 97 95				(1.80)				
8.60					-4.32	8.30		Medium strong to strong massive dark grey LIMESTONE. Partially weathered: clay deposits on rare joint surfaces. Discontinuities: 1. 20 to 30 degree joints widely spaced (100/725/1010), undulating rough, with patchy light grey clay deposits (up to 2mm thick) on rare joint surfaces, otherwise clean.		
		TCR SCR RQD FI								

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
5.90	5.50		

Casing Details

To (m)	Diam (mm)
2.40	200
6.50	200

Water Added

From (m)	To (m)

Chiselling Details

From (m)	To (m)	Time (hh:mm)
2.40	2.40	01:00

Remarks

Hand dug inspection pit excavated to 1.20m.
Two CP attempts, first terminated on boulder at 0.40m.

Core Barrel	Flush Type	Termination Reason	Last Updated
T2-101	Water	Terminated at scheduled depth.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH105A
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)
Cable Percussion	Dando 2000	0.00	2.40
Rotary Drilling	Comacchio 205	2.40	6.50
Rotary Coring	Comacchio 205	6.50	11.60

Coordinates: 531033.11 E, 726069.97 N

Final Depth: 11.60 m | Start Date: 01/12/2021 | Driller: RP+JA

Elevation: 3.98 mOD | End Date: 25/01/2022 | Logger: SR+EM

Sheet 2 of 2 | Scale: 1:50 | FINAL

Depth (m)	Samples / Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
		100	99	99							Medium strong to strong massive dark grey LIMESTONE. Partially weathered: clay deposits on rare joint surfaces. Discontinuities: 1. 20 to 30 degree joints widely spaced (100/725/1010), undulating rough, with patchy light grey clay deposits (up to 2mm thick) on rare joint surfaces, otherwise clean.		
10.10													
		86	85	80	1				(3.30)				
11.60								-7.62	11.60		End of Borehole at 11.60m		
		TCR	SCR	RQD	FI								

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

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
5.90	5.50		

Chiselling Details

From (m)	To (m)	Time (hh:mm)
2.40	2.40	01:00

Casing Details

To (m)	Diam (mm)
2.40	200
6.50	200

Water Added

From (m)	To (m)

Remarks

Hand dug inspection pit excavated to 1.20m.
Two CP attempts, first terminated on boulder at 0.40m.

Core Barrel	Flush Type	Termination Reason	Last Updated
T2-101	Water	Terminated at scheduled depth.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	BH106
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Cable Percussion	Dando 2000	0.00	2.10	
Rotary Drilling	Comacchio 205	2.10	2.50	529914.25 E
Rotary Coring	Comacchio 205	2.50	6.00	725704.49 N

Final Depth:	6.00 m	Start Date:	06/12/2021	Driller:	RP+JA	Sheet 1 of 1
Elevation:	7.04 mOD	End Date:	19/01/2022	Logger:	SR+TH	Scale: 1:50
						FINAL

Depth (m)	Sample / Tests	Field Records	TCR	SCR	RQD	FI	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
									6.94	0.10		BITMAC
0.20 - 1.20	B5								6.84	0.20		MADE GROUND: Grey sandy silty subangular fine to coarse GRAVEL. Sand is fine to coarse.
0.50	ES1											MADE GROUND: Soft brown sandy gravelly CLAY with low cobble content and fragment of red brick, concrete and bitmac. Sand is fine to coarse. Gravel is subangular fine to coarse. Cobbles are subangular.
1.00	ES2											
1.20 - 2.10	B6								5.84	1.20		
1.20 - 1.65	SPT (S)	N=5 (1,2/1,1,2,1) Hammer SN = 1369					1.20	Dry				Soft grey slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium. Cobbles are subangular.
1.50	D7											
1.50	ES3											
2.00	ES4											
2.00 - 2.10	SPT (S)	N=50 (25 for 15mm/50 for 85mm) Hammer SN = 1369					2.00	Dry	4.94	2.10		Dense sandy silty subangular fine to coarse GRAVEL. (Driller's description)
2.30 - 2.45	SPT(C) N=50 (25 for 75mm/50 for 75mm) Hammer SN = 1369		100	100	68	7			4.54	2.50		Medium strong to strong dark grey GABBRO with greyish white diorite vein intrusions (4 to 6cm thick). Partially weathered: slightly reduced strength, slightly closer fracture spacing, orangish brown discolouration on some fracture surfaces. Discontinuities: 1. 10 to 20 degree joints, medium spaced (40/210/230) planar, rough, dark orangish brown staining on joint surfaces. 2. 30 to 50 degree joints, medium spaced (50/275/620), planar, smooth to rough. 3. 70 to 80 degree joints at 2.85m to 3.10m and 3.12m to 3.37m, undulating, rough, orangish, brown staining on joint surfaces. 2. 30 to 50 degree joints, medium spaced (50/275/620) planar, smooth to rough. 3. 70 to 80 degree joints, at 2.85m to 3.10m and 3.12m to 3.38m, undulating, rough, orangish brown staining on joint surfaces.
3.00			100	100	83							
3.40												
3.70	C		100	70	70					(2.20)		
3.90												
4.00	C		100	97	75							
									2.34	4.70		
4.90			100	100	100	4				(0.45)		Strong greyish white DIORITE. Partially weathered: patchy greenish grey discolouration on fracture surfaces. Discontinuities: 1. 20 to 30 degree joint at 4.90m, planar, rough, greenish grey staining on joint surface. 2. 60 to 70 degree joint at 5.15m, planar, rough, patchy greenish grey staining on joint surface.
5.20	C								1.89	5.15		
5.40			100	92	92	4				(0.85)		
	Strike at 5.70m											
6.00									1.04	6.00		Strong dark grey GABBRO. Largely unweathered. Discontinuities: 1. 20 to 30 degree joints, at 5.40m, 5.4 and 5.5, slightly undulating, rough. 2. 40 to 50 degree joint, at 4.60m to 4.68m, planar, rough, greenish grey mineralisation on joint surface (8 to 10mm thick).
												End of Borehole at 6.00m

Water

Backfill

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

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
5.70	2.50	20	1.55

Chiselling Details

From (m)	To (m)	Time (hh:mm)
2.10	2.10	01:00

Remarks

Hand dug inspection pit excavated to 1.20m.

Casing Details

To (m)	Diam (mm)
2.10	200
2.50	200

Water Added

From (m)	To (m)

Core Barrel	Flush Type	Termination Reason	Last Updated
T2-101	Water	Terminated at scheduled depth.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	WS101
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Dynamic Sampling	Dando Terrier	0.00	3.25	531084.08 E 726208.68 N

Final Depth:	3.25 m	Start Date:	29/11/2021	Driller:	JC	Sheet 1 of 1 Scale: 1:50
Elevation:	3.81 mOD	End Date:	29/11/2021	Logger:	SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
					3.41	0.40		MADE GROUND: TOPSOIL with roots and fragments of plastic		
0.50	D4									
0.50	ES1				3.21	0.60		MADE GROUND: Soft grey slightly sandy slightly gravelly CLAY with fragments of plastic and glass. Sand is fine to medium. Gravel is subangular to subrounded fine to coarse.		
1.00	ES2							Soft brownish grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
					2.51	1.30		Grey slightly sandy subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.		
		Water strike at 1.50m								
1.56	D5				2.16	1.65		Very soft greyish brown slightly sandy SILT with organic fibres.		
1.90	D6									
2.00	ES3				1.71	2.10		Very soft dark brown PEAT.		
					0.91	2.90		Grey sandy angular to subangular fine to coarse GRAVEL. Sand is fine to coarse.		
3.00	D7									
					0.56	3.25		End of Borehole at 3.25m		

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
1.50	1.50	20	0.90

Casing Details

To (m)	Diameter

Remarks

Hand dug inspection pit excavated to 1.20m.

Termination Reason

Terminated on refusal.

Last Updated

10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	WS104
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Dynamic Sampling	Dando Terrier	0.00	3.00	530997.95 E 726165.53 N

Final Depth:	3.00 m	Start Date:	19/01/2022	Driller:	JC	Sheet 1 of 1 Scale: 1:50
Elevation:	3.90 mOD	End Date:	19/01/2022	Logger:	SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description
					3.80	0.10		BITMAC
					3.70	0.20		MADE GROUND: Grey silty angular to subangular fine to coarse GRAVEL.
0.50	B5							
0.50	ES1							MADE GROUND: Grey sandy silty angular to subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded.
0.50		PID = 0.10ppm			3.20	0.70		
1.00	B6							Grey sandy silty subangular to subrounded fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded.
1.00	ES2							
1.00		PID = 0.80ppm						
1.20 - 2.00	B7							
1.50	ES3							
1.50		PID = 0.60ppm						
1.85	EW1							
2.00	ES4							
2.00 - 3.00	B8							
2.00		PID = 0.80ppm Strike at 2.10m.						
					0.90	3.00		End of Borehole at 3.00m

Water

Backfill

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

Water Strikes

Struck at (m)	Casing to (m)	Time (min)	Rose to (m)
2.10	2.10		

Casing Details

To (m)	Diameter

Remarks

Hand dug inspection pit excavated to 1.20m.

Termination Reason

Terminated on refusal.

Last Updated

10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	WS105
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Dynamic Sampling	Danod Terrier	0.00	2.90	530903.19 E 726025.43 N

Final Depth:	2.90 m	Start Date:	30/11/2021	Driller:	JC	Sheet 1 of 1
						Scale: 1:50
Elevation:	4.35 mOD	End Date:	30/11/2021	Logger:	SR	FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
0.30 - 1.00	B4				4.05	0.30		MADE GROUND: TOPSOIL with roots and rootlets		
0.50	ES1							MADE GROUND: Soft brown sandy gravelly CLAY with plastic fragments. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
1.00	ES2				3.35	1.00		Soft greyish brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subrounded.		
1.00 - 1.90	B5									
2.00	D6				2.45	1.90		Firm greyish brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
2.00	ES3									
2.50	D7				2.05	2.30		Stiff grey sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
					1.45	2.90		End of Borehole at 2.90m		

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

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

Remarks

Hand dug inspection pit excavated to 1.20m.

Termination Reason	Last Updated
Terminated on refusal.	10/03/2022

AGS

CAUSEWAY GEOTECH

Project No.	Project Name:	Borehole ID
21-1298	BusConnects Galway	WS106
	Client: Galway City Council	
	Client's Rep: Arup	

Method	Plant Used	Top (m)	Base (m)	Coordinates
Dynamic Sampling	Dando Terrier	0.00	2.80	530922.85 E 726032.93 N

Final Depth:	2.80 m	Start Date:	30/12/2021	Driller:	JC
Elevation:	3.67 mOD	End Date:	30/12/2021	Logger:	SR

Sheet 1 of 1
Scale: 1:50
FINAL

Depth (m)	Sample / Tests	Field Records	Casing Depth (m)	Water Depth (m)	Level mOD	Depth (m)	Legend	Description	Water	Backfill
								MADE GROUND: TOPSOIL with rootlets		
0.30 - 1.00	B4				3.37	0.30		MADE GROUND: Soft brown sandy gravelly CLAY with fragments of crockery. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.		
0.50	ES1									
1.00	ES2				2.67	1.00		Dark grey sandy silty subangular fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subrounded.		
1.20	D5									
1.30 - 2.80	B6				2.37	1.30		Firm to stiff grey sandy gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse. Cobbles are subangular.		
2.00	ES3									
					0.87	2.80		End of Borehole at 2.80m		

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

Water Strikes

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

Casing Details

To (m)	Diameter

Remarks

Hand dug inspection pit excavated to 1.20m.

Termination Reason

Terminated on refusal.

Last Updated

10/03/2022

AGS

CAUSEWAY GEOTECH

APPENDIX C

CORE PHOTOGRAPHS

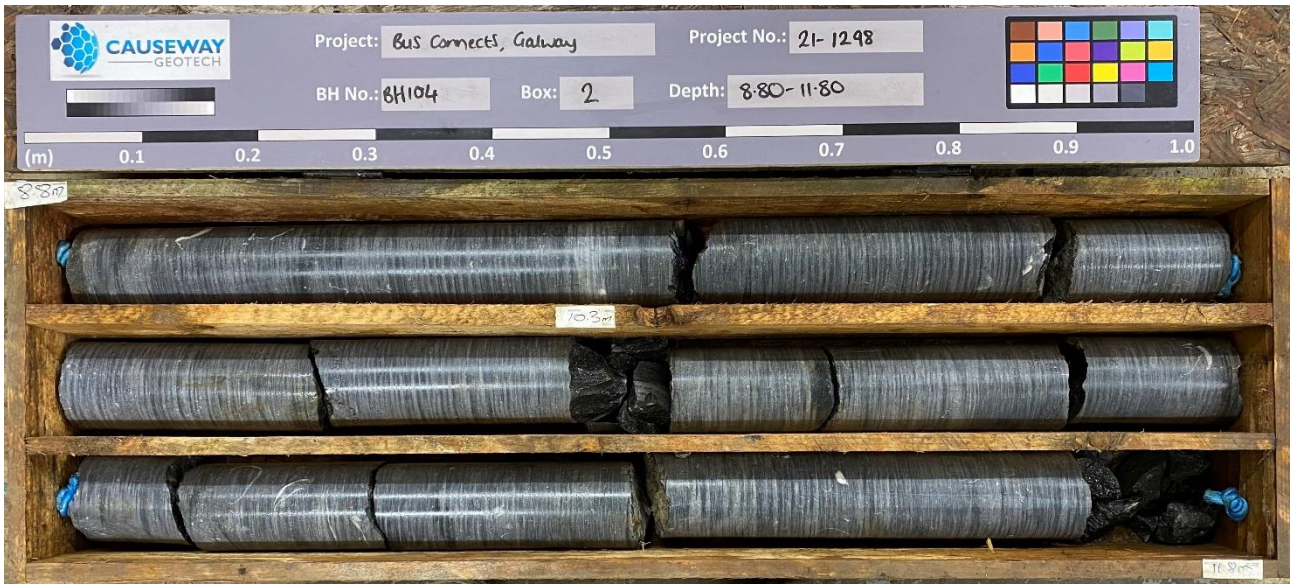
BH101 Box 1 3.60-5.40m

BH102 Box 1 2.30-4.50m

BH103 Box 1 5.50-7.40m

BH103 Box 1 7.40-10.40m

BH104 Box 1 6.70-8.80m



BH104 Box 2 8.80-11.80m

BH105 Box 1 2.00-8.60m

BH105 Box 2 8.60-11.60m

BH106 Box 1 2.50-5.40m

BH106 Box 2 5.40-6.00m

CAUSEWAY GEOTECH

APPENDIX D

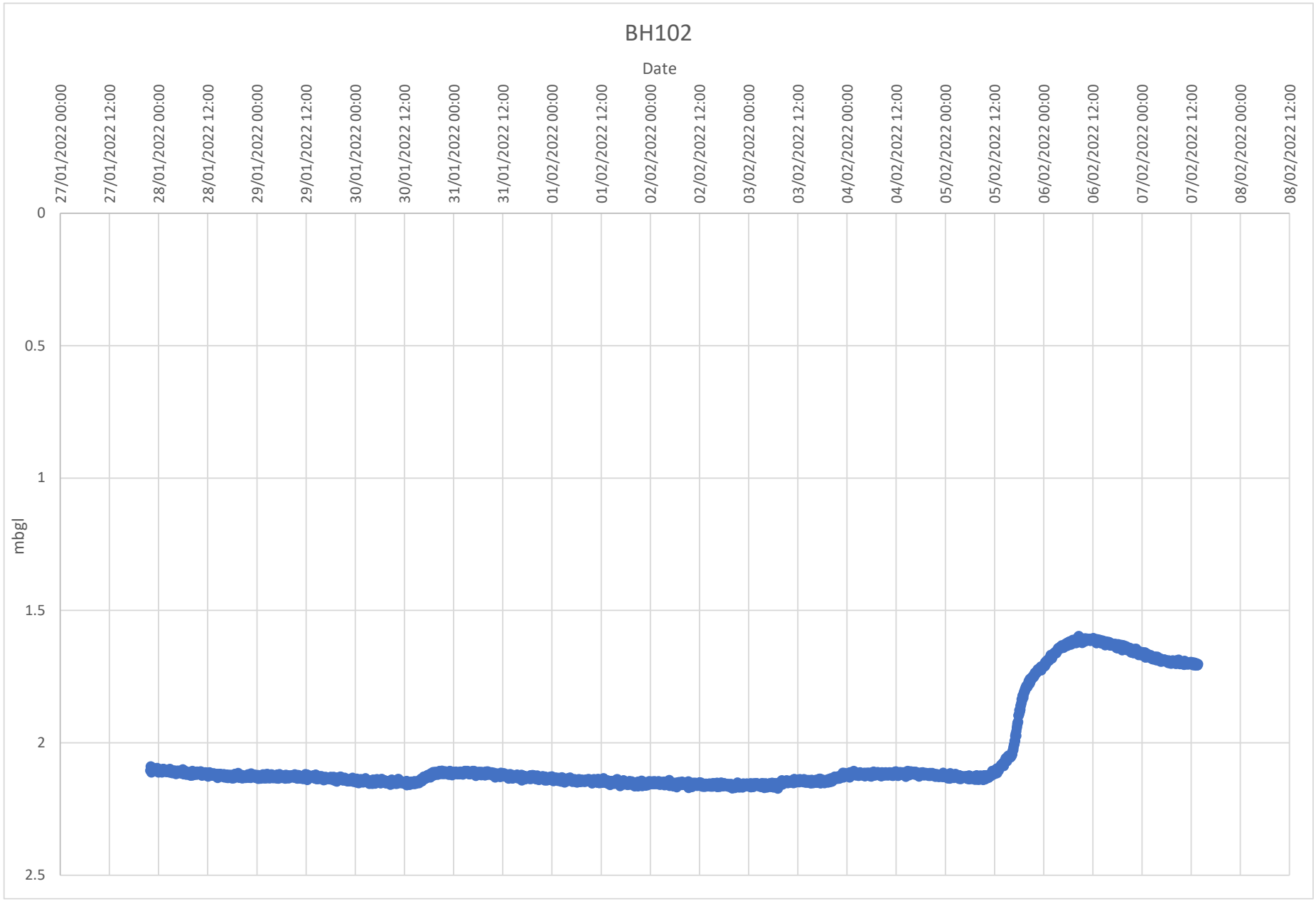
GROUND WATER AND GAS MONITORING RECORDS

Bus Connects Galway

21-1298

DIVER INSTALL RECORDS

INSTALL RECORDS							REMOVAL RECORDS			
BH	Serial No. of Diver	Depth to GW mbgl	Time In	Date In	Depth of BH mbgl	Diver Depth mbgl	Date Out	Time Out	Depth to GW m	No. of days in Ground
BH102	SN696083	2.1	17:30	27/01/2022	4.5m	3.5	07/02/2022	13:43	1.7	11
BH103WS	SN721194(Baro) SN708127(Diver)	1.95	14:20	27/01/2022	2.6m	2	07/02/2022	13:53	1.5	11
BH103	SN696783	1.95	15:00	27/01/2022	8m	2	07/02/2022	13:51	1.5	11
BH104	SN708398	2.04	09:00	27/01/2022	8m	7	07/02/2022	13:22	1.9	11
BH105	SN553442	2.45	10:40	27/01/2022	8m	7	07/02/2022	13:31	2.2	11
BH106	No Diver Install	1.23	\	27/01/2022	6m	5	-	-	-	-
WS104	SN696170	1.85	16:12	27/01/2022	2.95m	2.5	07/02/2022	13:47	1.5	11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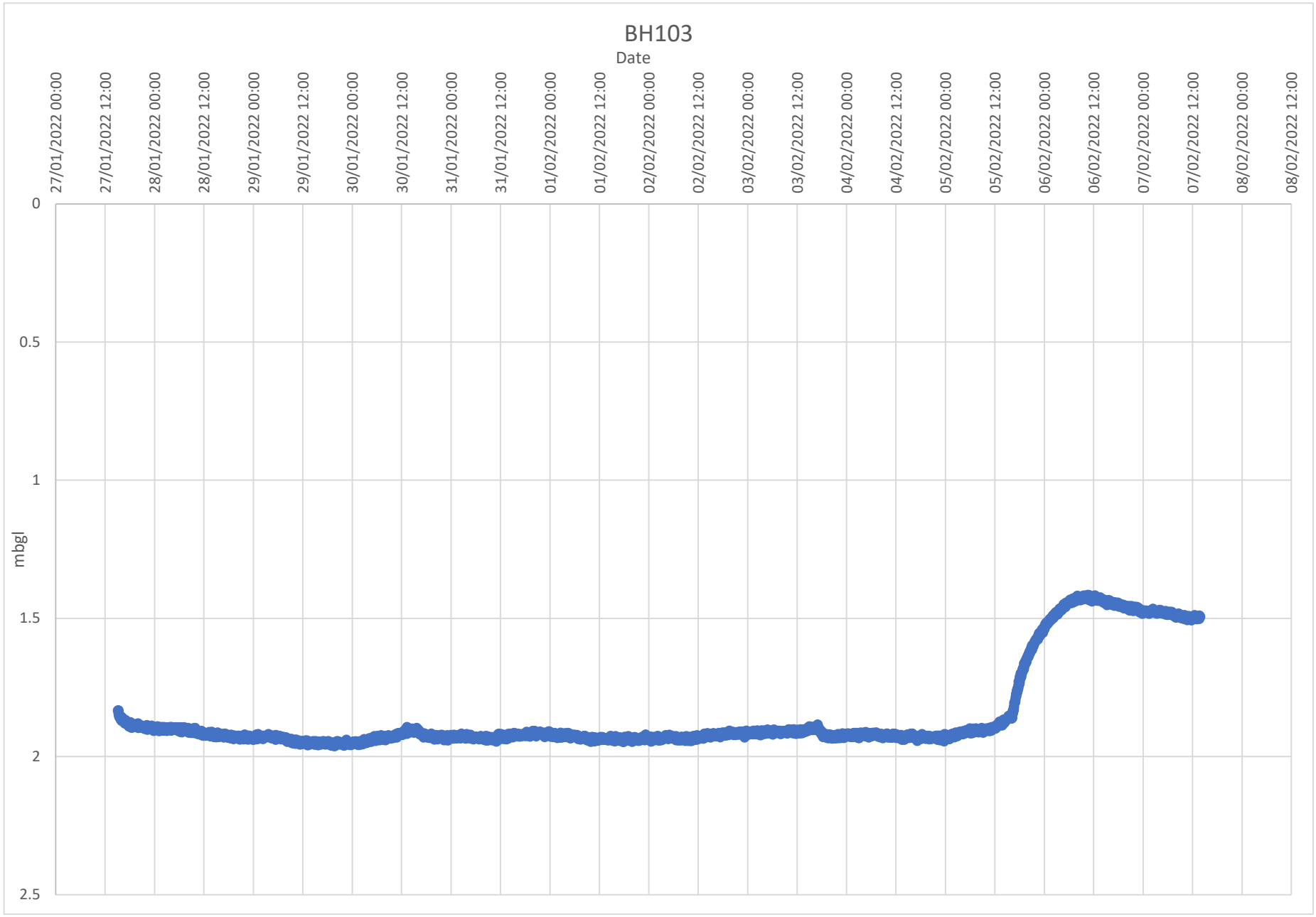
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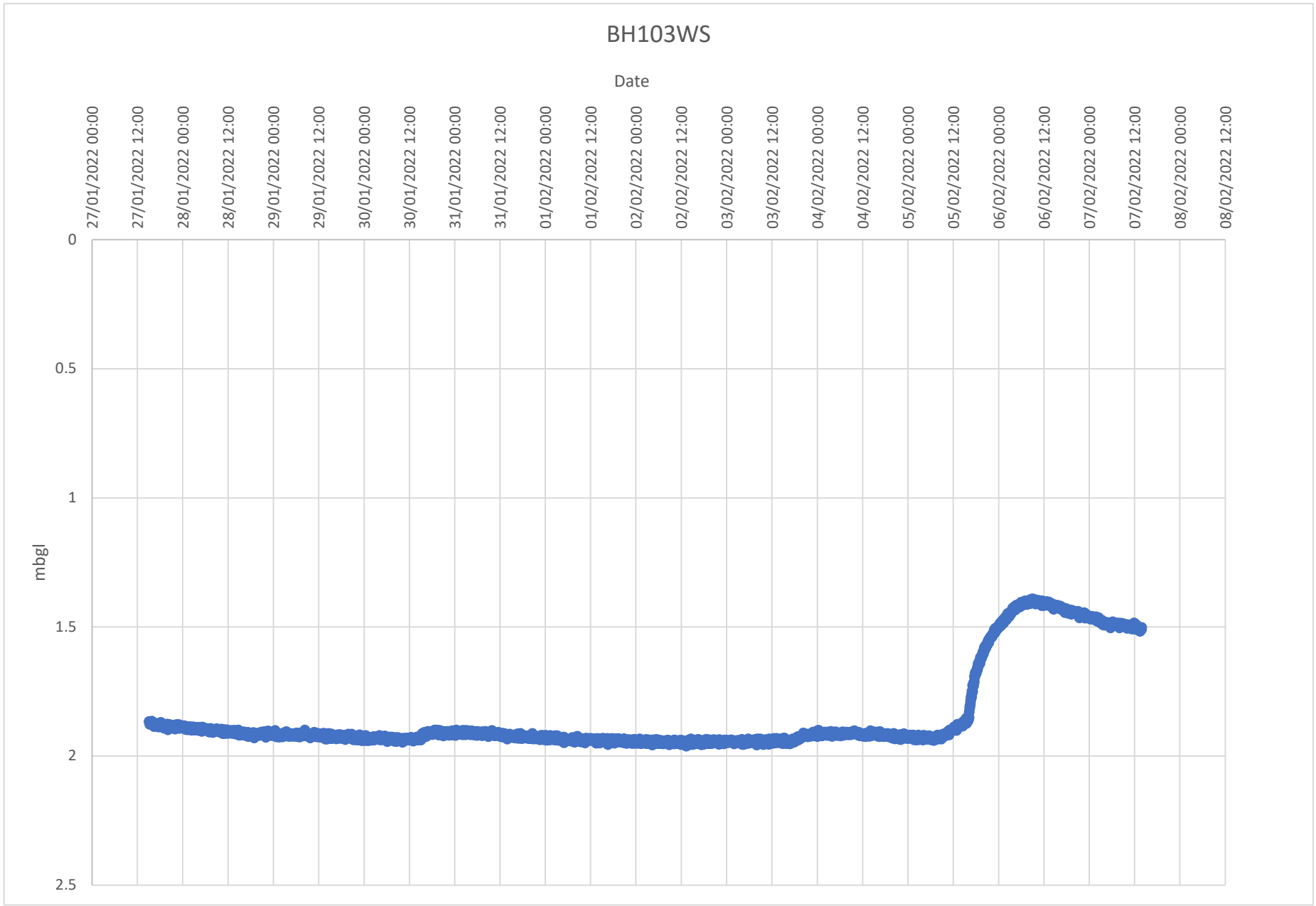
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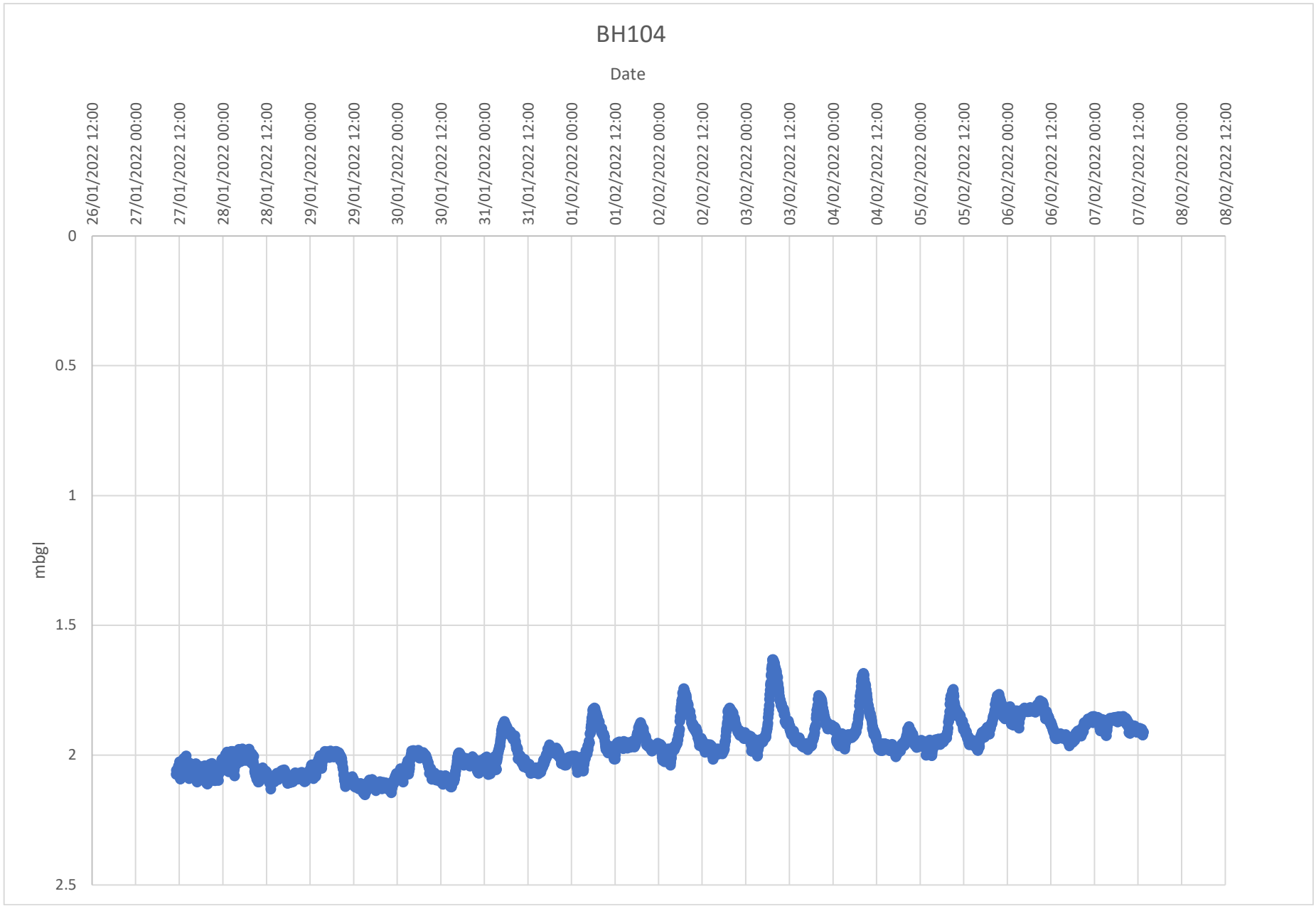
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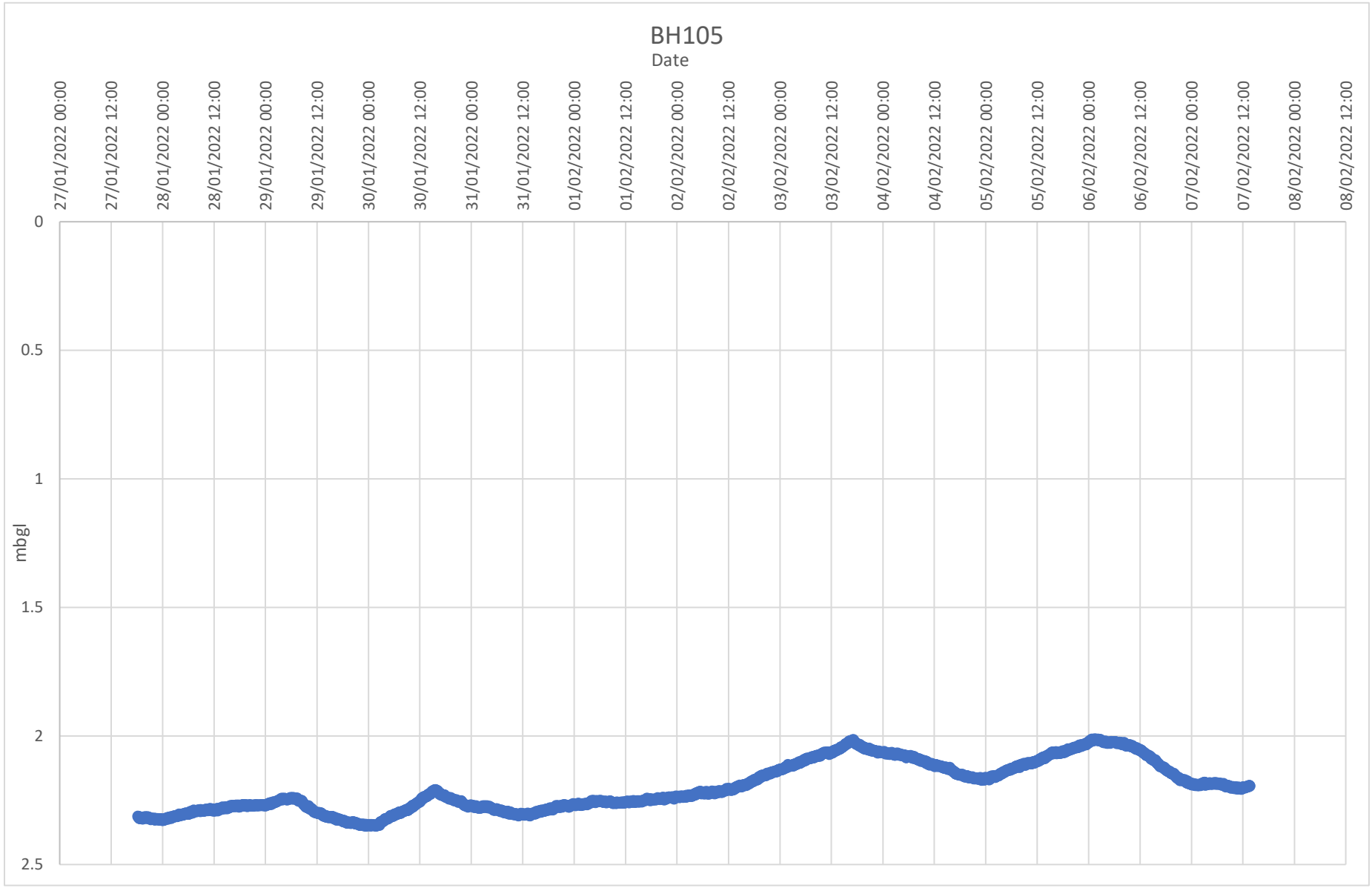
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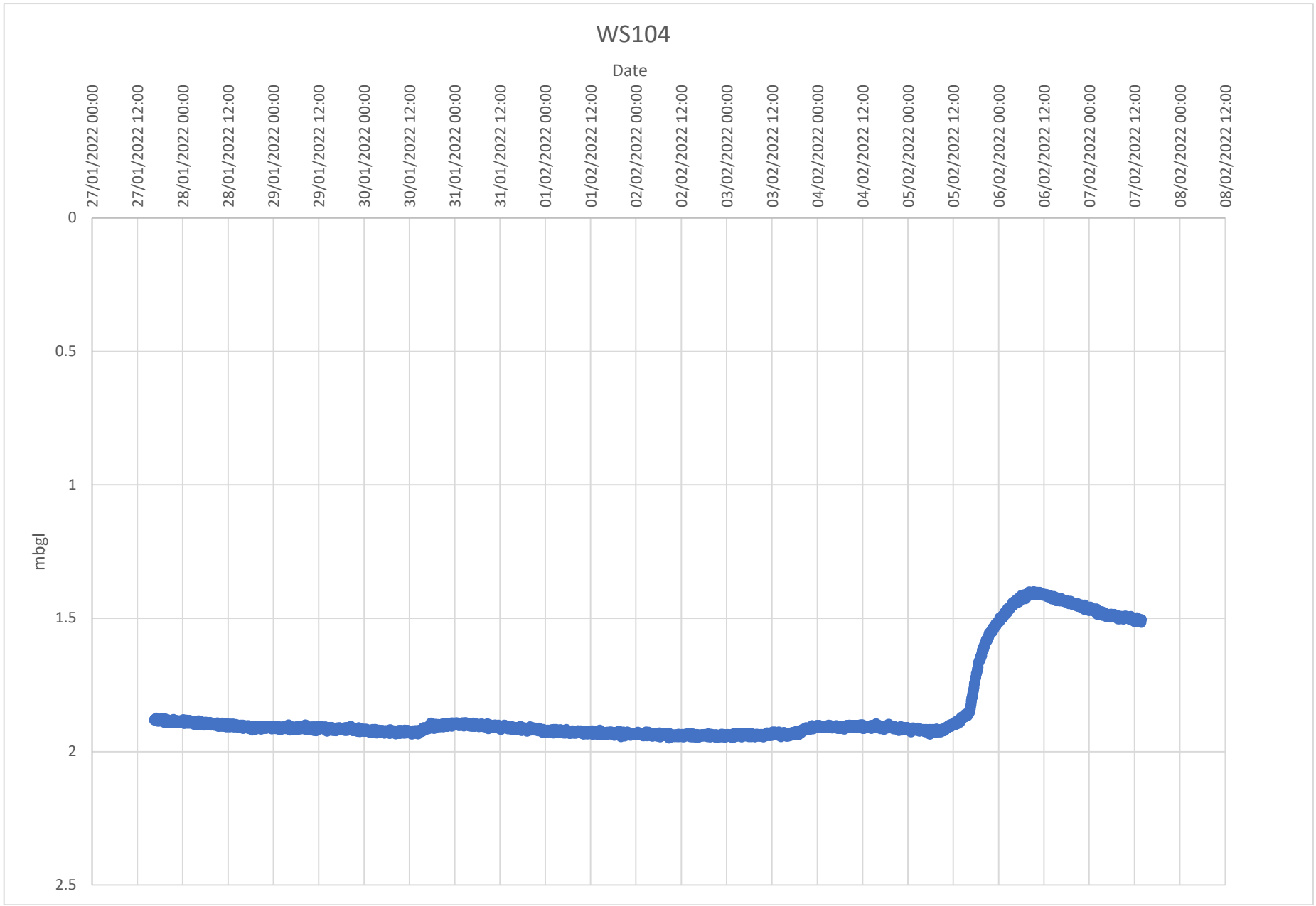
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CAUSEWAY GEOTECH

APPENDIX E

GEOTECHNICAL LABORATORY TEST RESULTS

CAUSEWAY GEOTECH

HEAD OFFICE
Causeway Geotech Ltd
8 Drumahiskey Road
Ballymoney
Co. Antrim, N. Ireland, BT53 7QL
NI: +44 (0)28 276 66640
Registered in Northern Ireland.
Company Number: NI610766

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

www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

2 February 2022

Project Name:	BusConnects Galway
Project No.:	21-1298
Client:	Galway City Council
Engineer:	ARUP

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Contents page(s). This testing was performed between 17/01/2022 and 02/02/2022.

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

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

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

SCS ISO 9001 CERTIFIED
SCS ISO 14001 CERTIFIED
SCS ISO 45001 CERTIFIED
UKAS MANAGEMENT SYSTEMS 9235
UKAS TESTING 10122
AGS
BRITISH DRILLING ASSOCIATION

Project Name: BusConnects Galway

Report Reference: Schedule 1

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

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	12
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	10
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	6
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)*	Organic Matter Content		1

Summary of Classification Test Results

Project No.	Project Name
21-1298	BusConnects Galway

Hole No.	Sample				Soil Description	Density bulk	Density dry	w	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		Mg/m3		%	%	%	%	%	Mg/m3	
BH101	6	0.60	1.20	B	Greyish brown sandy slightly gravelly silty CLAY.			27.0	69	37 -1pt	20	17		CI
BH101	10	2.50		D	Greyish brown sandy very gravelly silty CLAY.			17.0	49	30 -1pt	17	13		CL
BH104A	2	0.10	0.40	B	Greyish brown sandy slightly gravelly clayey SILT.			24.0	46	44 -1pt	28	16		MI
BH105A	7	1.50		D	Greyish brown sandy gravelly silty CLAY.			13.0	47	33 -1pt	20	13		CL
BH105A	8	2.40		D	Greyish brown slightly sandy subangular fine to coarse GRAVEL.			8.2						
BH106	7	1.50		D	Greyish brown sandy slightly gravelly silty CLAY.			10.0	57	21 -1pt	11	10		CL
WS101	6	1.90		D	Greyish brown sandy gravelly clayey SILT.			37.0	97	64 -1pt	45	19		MH
WS101	7	3.00		D	Greyish brown sandy clayey subangular fine to coarse GRAVEL.			4.9						
WS105	6	2.00		D	Greyish brown sandy gravelly silty CLAY.			25.0	78	29 -1pt	17	12		CL
WS105	7	2.50		D	Greyish brown slightly gravelly clayey fien to coarse SAND.			16.0	66	20 -1pt	14	6		ML/CL
WS106	5	1.20		D	Greyish brown sandy clayey subangular fine to coarse GRAVEL with some cobbles.			7.5	61	22 -1pt	3	19		CL
WS106	6	1.30	2.80	B	Greyish brown sandy clayey subangular fine to coarse GRAVEL with some cobbles.			5.6	63	25 -1pt	12	13		CL

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

18/02/2022

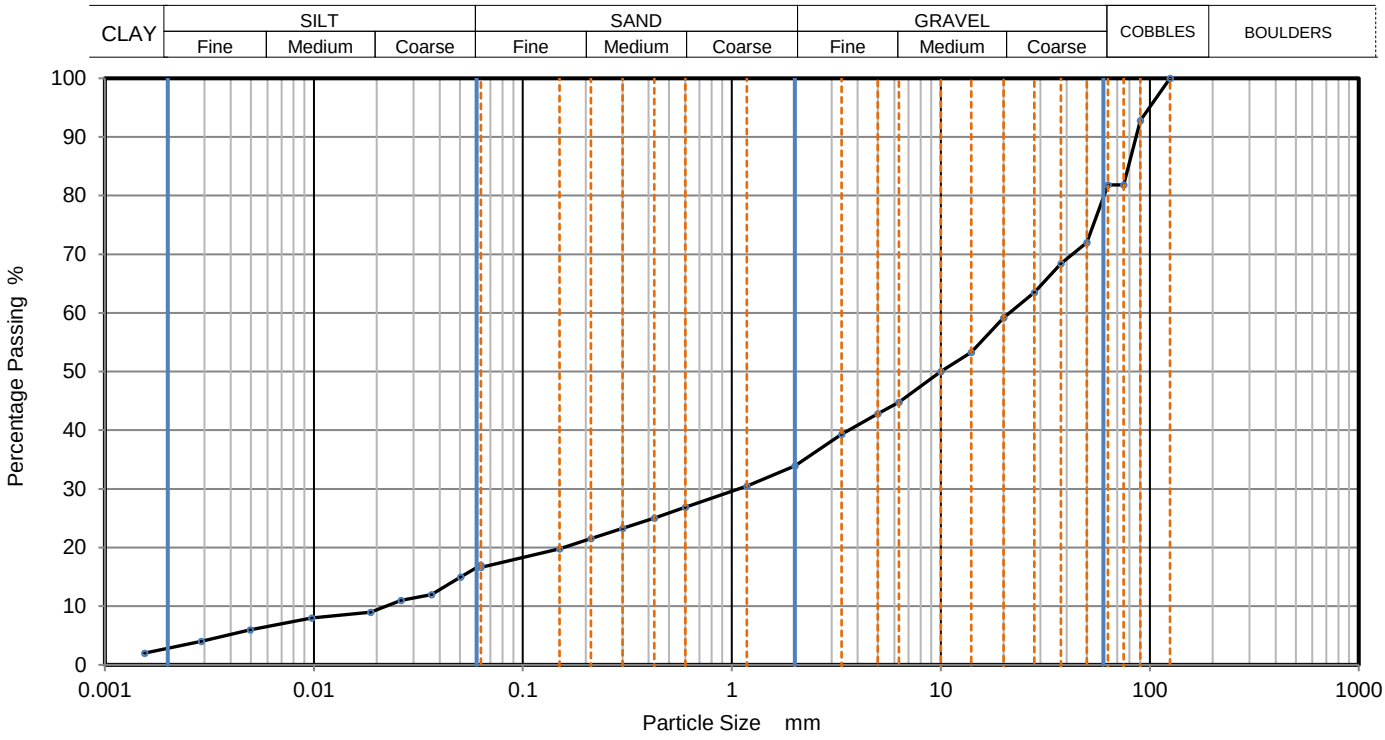
Approved By

Stephen.Watson

UKAS TESTING

10122

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1298**
				Borehole/Pit No.	BH101
Site Name	BusConnects Galway			Sample No.	7
Soil Description	Greyish brown sandy gravelly silty CLAY with cobbles.			Depth, m	1.20
Specimen Reference	2	Specimen Depth	1.2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus202112141



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	17
90	93	0.05033	15
75	82	0.03649	12
63	82	0.02611	11
50	72	0.01868	9
37.5	68	0.00976	8
28	64	0.00496	6
20	59	0.00290	4
14	53	0.00155	2
10	50		
6.3	45		
5	43		
3.35	39		
2	34		
1.18	31		
0.6	27	Particle density	(assumed)
0.425	25	2.65	Mg/m3
0.3	23		
0.212	22		
0.15	20		
0.063	17		

Dry Mass of sample, g: 17838

Sample Proportions	% dry mass
Cobbles	18.2
Gravel	47.9
Sand	17.3
Silt	13.5
Clay	3.1

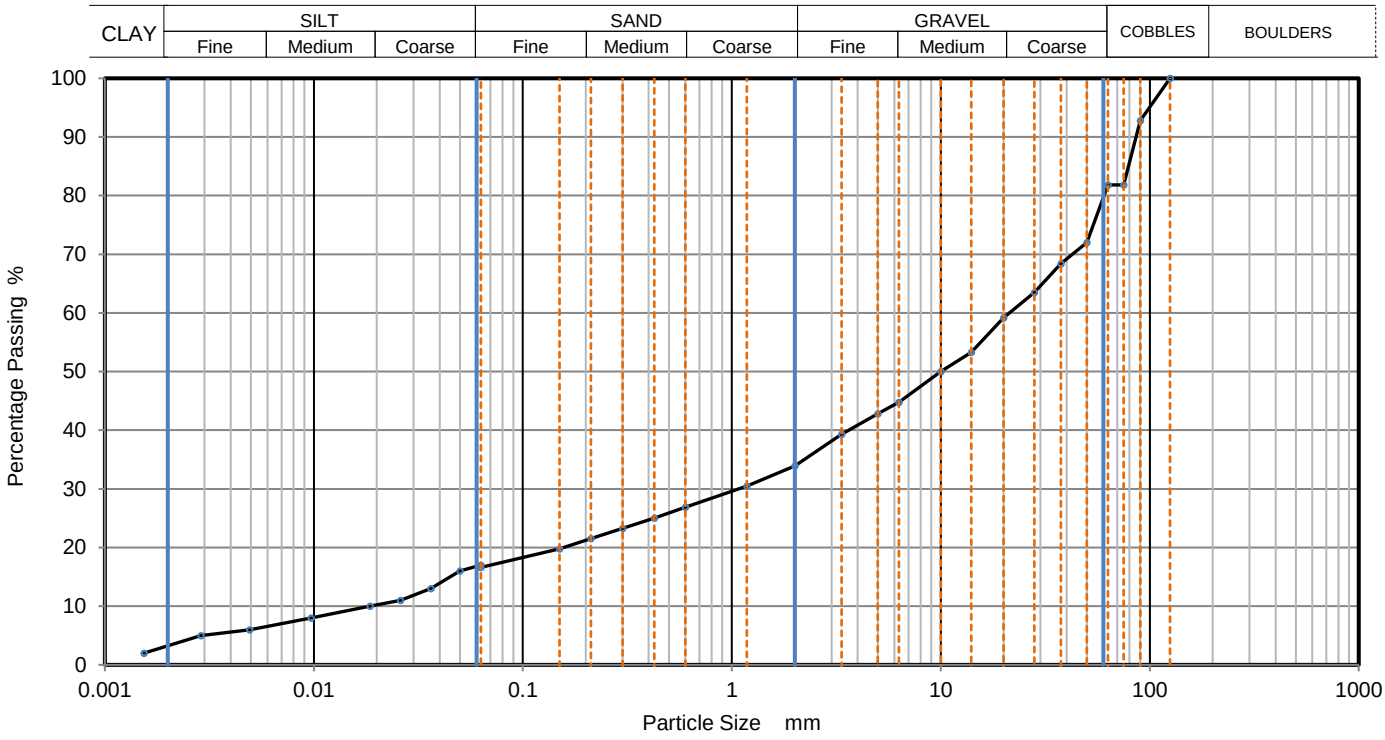
Grading Analysis		
D100	mm	125
D60	mm	21.3
D30	mm	1.07
D10	mm	0.0216
Uniformity Coefficient		990
Curvature Coefficient		2.5

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1298**
				Borehole/Pit No.	BH101
Site Name	BusConnects Galway			Sample No.	8
Soil Description	Greyish brown sandy gravelly silty CLAY with cobbles.			Depth, m	2.00
Specimen Reference	3	Specimen Depth	2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus202112142



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	17
90	93	0.05000	16
75	82	0.03626	13
63	82	0.02595	11
50	72	0.01857	10
37.5	68	0.00970	8
28	64	0.00493	6
20	59	0.00288	5
14	53	0.00154	2
10	50		
6.3	45		
5	43		
3.35	39		
2	34		
1.18	31		
0.6	27	Particle density	(assumed)
0.425	25	2.65	Mg/m3
0.3	23		
0.212	22		
0.15	20		
0.063	17		

Dry Mass of sample, g	17838

Sample Proportions	% dry mass
Cobbles	18.2
Gravel	47.9
Sand	17.3
Silt	13.4
Clay	3.2

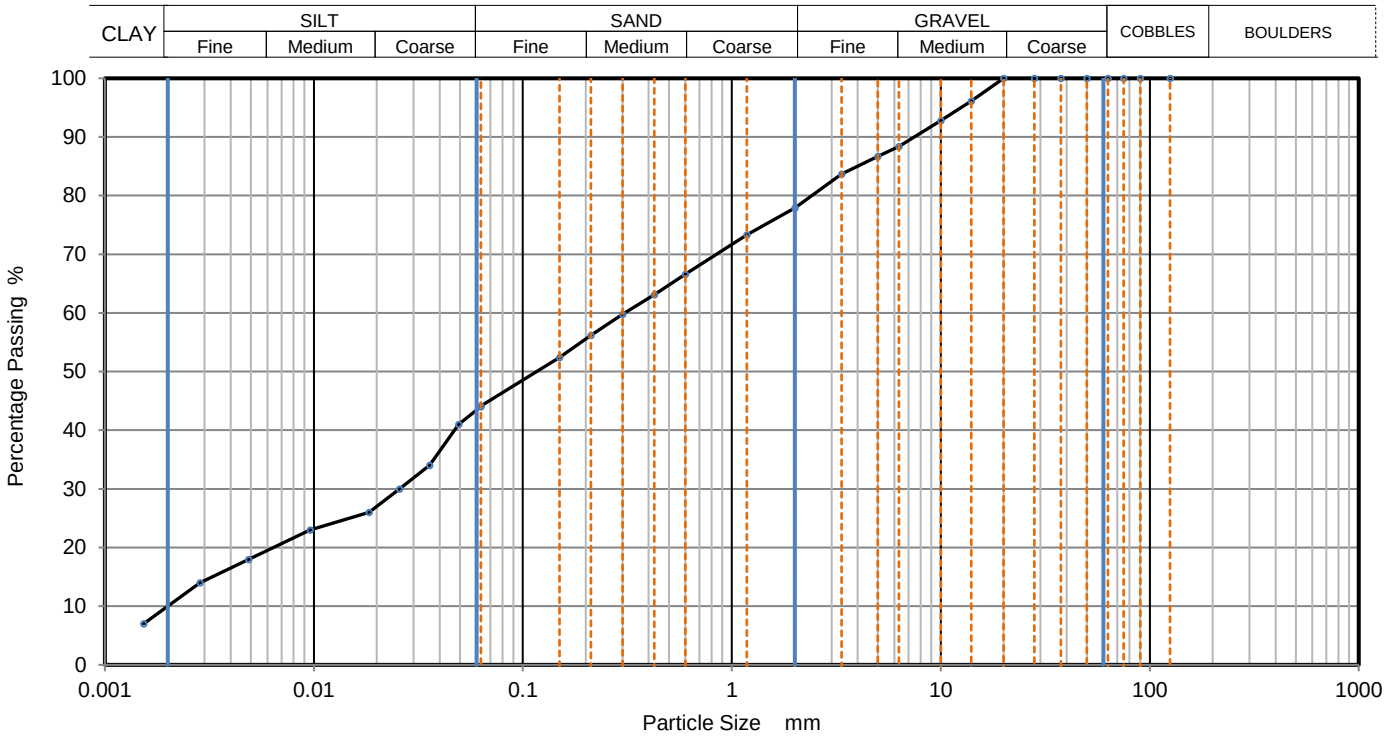
Grading Analysis		
D100	mm	125
D60	mm	21.3
D30	mm	1.07
D10	mm	0.0194
Uniformity Coefficient		1100
Curvature Coefficient		2.8

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1298**
				Borehole/Pit No.	BH106
Site Name	BusConnects Galway			Sample No.	6
Soil Description	Greyish brown sandy slightly gravelly silty CLAY.			Depth, m	1.20
Specimen Reference	3	Specimen Depth	1.2 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus202112147



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	44
90	100	0.04935	41
75	100	0.03581	34
63	100	0.02564	30
50	100	0.01835	26
37.5	100	0.00959	23
28	100	0.00488	18
20	100	0.00285	14
14	96	0.00153	7
10	93		
6.3	88		
5	87		
3.35	84		
2	78		
1.18	73		
0.6	67	Particle density	(assumed)
0.425	63	2.65	Mg/m3
0.3	60		
0.212	56		
0.15	52		
0.063	44		

Dry Mass of sample, g: 511

Sample Proportions	% dry mass
Cobbles	0.0
Gravel	22.1
Sand	33.8
Silt	34.0
Clay	10.1

Grading Analysis		
D100	mm	
D60	mm	0.305
D30	mm	0.0257
D10	mm	0.00198
Uniformity Coefficient		150
Curvature Coefficient		1.1

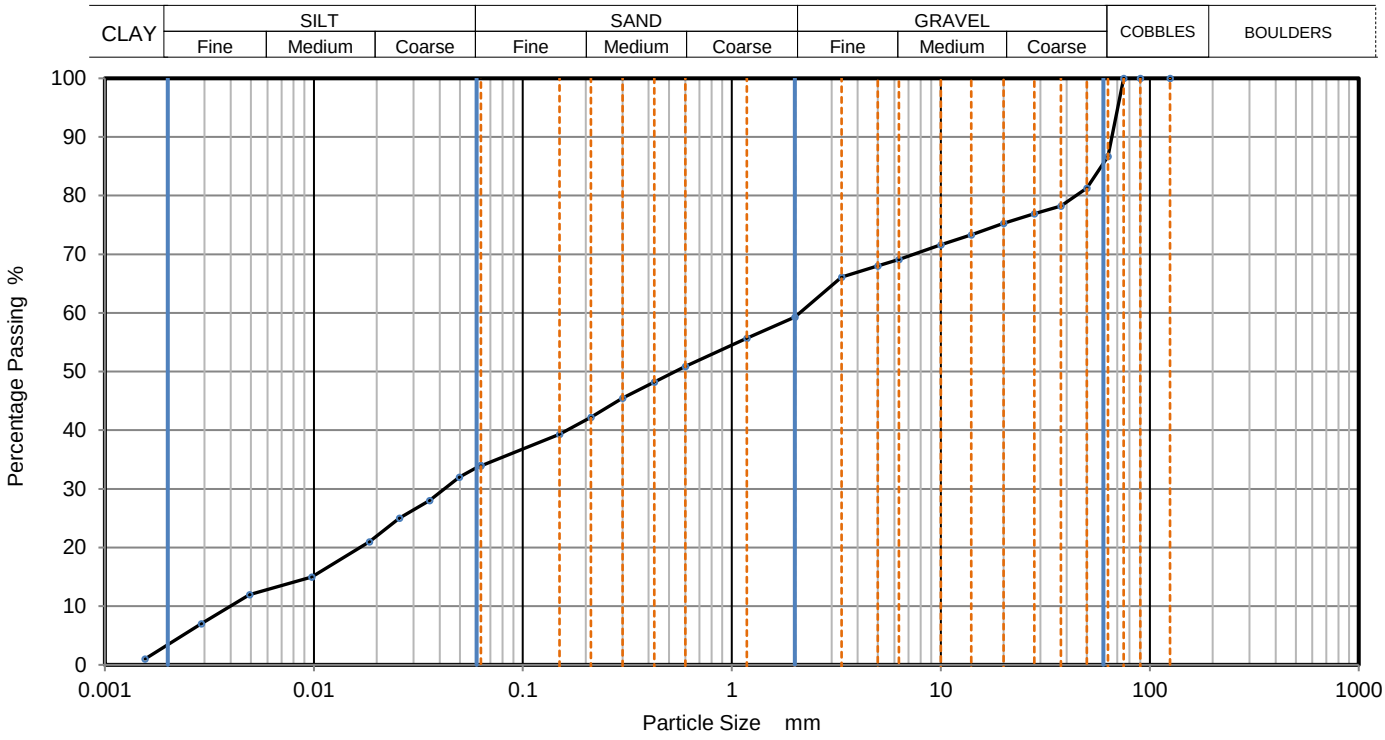
Remarks

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

Approved
Stephen.Watson

PARTICLE SIZE DISTRIBUTION

				Job Ref	**21-1298**
				Borehole/Pit No.	WS105
Site Name	BusConnects Galway			Sample No.	5
Soil Description	Greyish brown sandy gravelly silty CLAY with cobbles.			Depth, m	1.00
Specimen Reference	3	Specimen Depth	1 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2021121412



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.06300	34
90	100	0.04968	32
75	100	0.03581	28
63	87	0.02564	25
50	81	0.01846	21
37.5	78	0.00976	15
28	77	0.00493	12
20	75	0.00289	7
14	73	0.00156	1
10	72		
6.3	69		
5	68		
3.35	66		
2	59		
1.18	56		
0.6	51	Particle density	(assumed)
0.425	48	2.65	Mg/m3
0.3	46		
0.212	42		
0.15	39		
0.063	34		

Dry Mass of sample, g: 6037

Sample Proportions	% dry mass
Cobbles	13.3
Gravel	27.5
Sand	25.4
Silt	29.9
Clay	3.9

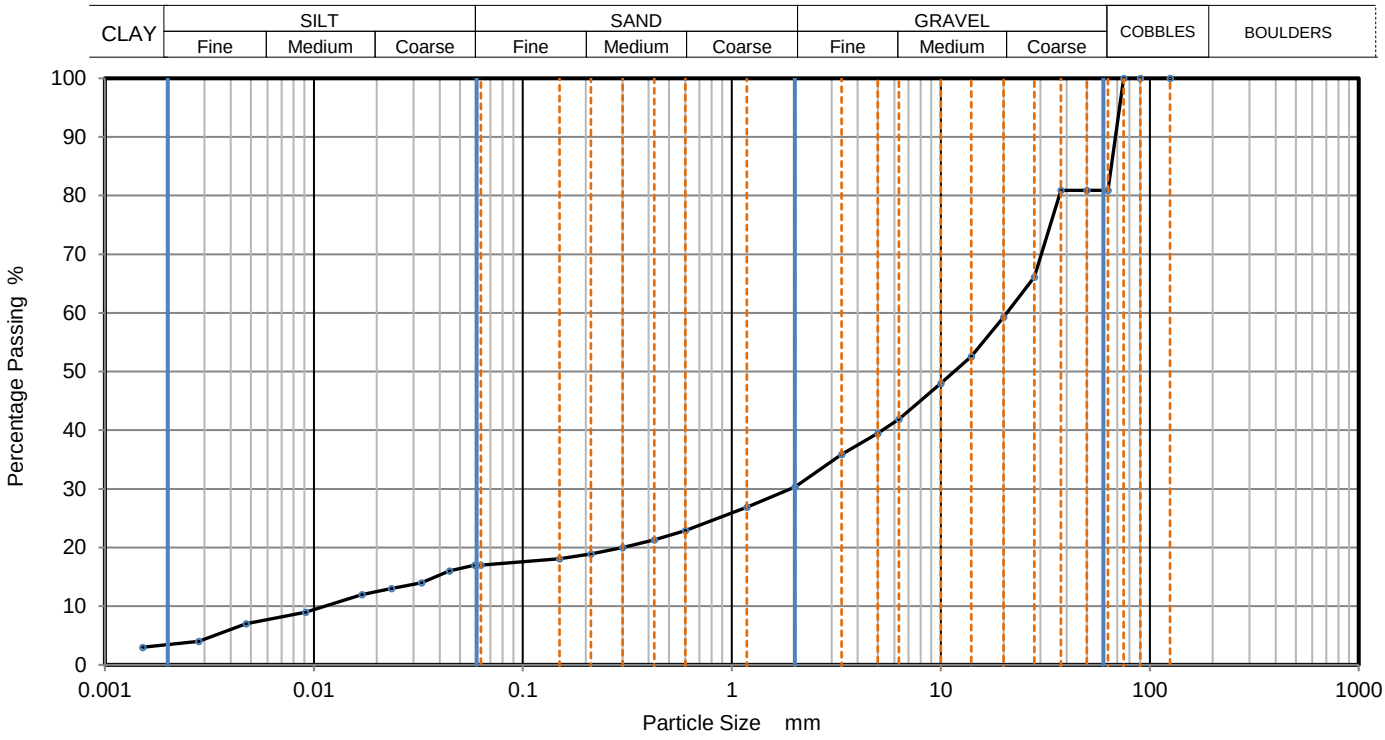
Grading Analysis		
D100	mm	
D60	mm	2.12
D30	mm	0.0415
D10	mm	0.00398
Uniformity Coefficient		530
Curvature Coefficient		0.2

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1298**
				Borehole/Pit No.	WS106
Site Name	BusConnects Galway			Sample No.	5
Soil Description	Greyish brown sandy clayey subangular fine to coarse GRAVEL with some cobbles.			Depth, m	1.20
Specimen Reference	6	Specimen Depth	1.2 m	Sample Type	D
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2021121415



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.05891	17
90	100	0.04454	16
75	100	0.03275	14
63	81	0.02350	13
50	81	0.01698	12
37.5	81	0.00913	9
28	66	0.00474	7
20	59	0.00282	4
14	53	0.00152	3
10	48		
6.3	42		
5	40		
3.35	36		
2	30		
1.18	27		
0.6	23	Particle density	(assumed)
0.425	21	2.65	Mg/m3
0.3	20		
0.212	19		
0.15	18		
0.063	17		

Dry Mass of sample, g: 2351

Sample Proportions	% dry mass
Cobbles	19.1
Gravel	50.6
Sand	13.3
Silt	13.6
Clay	3.4

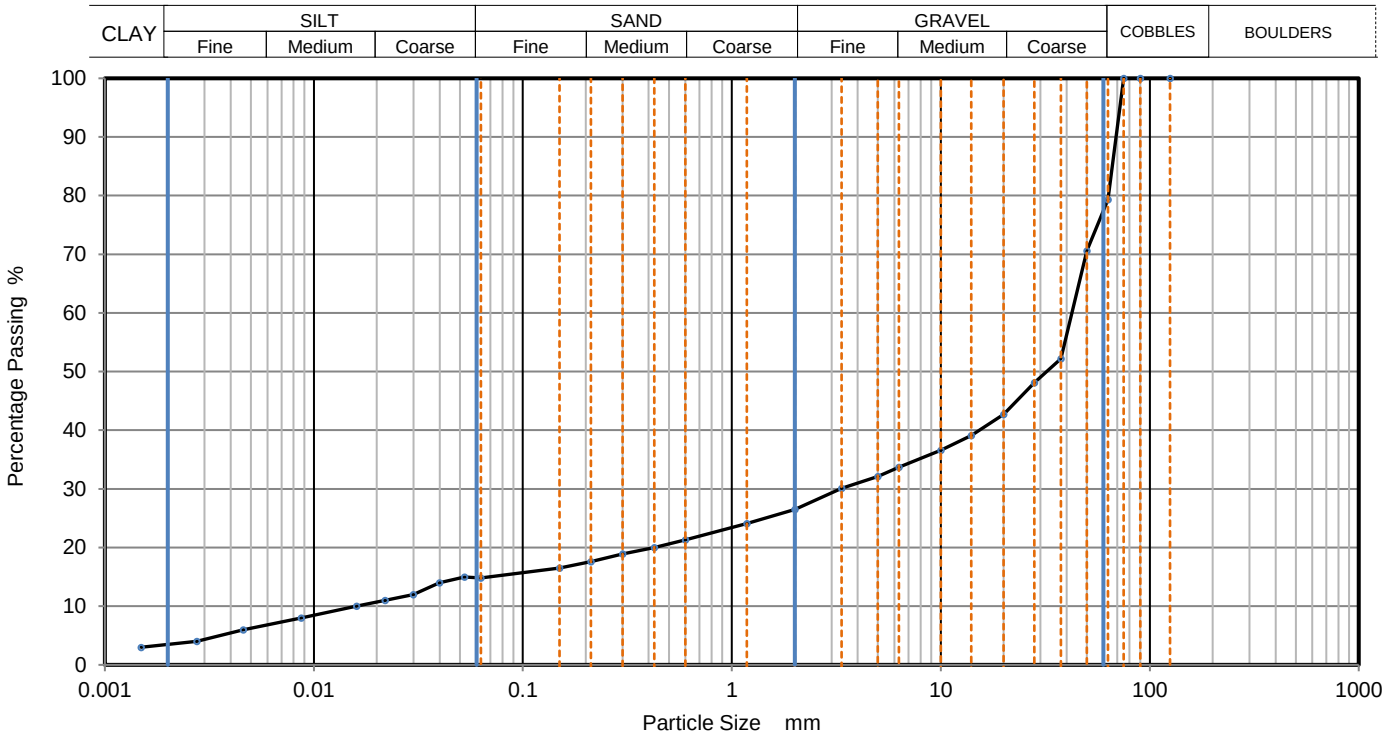
Grading Analysis		
D100	mm	
D60	mm	20.7
D30	mm	1.92
D10	mm	0.0112
Uniformity Coefficient		1900
Curvature Coefficient		16

Remarks

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

Approved
Stephen.Watson

CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**21-1298**
				Borehole/Pit No.	WS106
Site Name	BusConnects Galway			Sample No.	6
Soil Description	Greyish brown sandy clayey subangular fine to coarse GRAVEL with some cobbles.			Depth, m	1.30
Specimen Reference	6	Specimen Depth	1.3 m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2021121416



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.05262	15
90	100	0.03995	14
75	100	0.02991	12
63	79	0.02190	11
50	71	0.01600	10
37.5	52	0.00871	8
28	48	0.00459	6
20	43	0.00275	4
14	39	0.00149	3
10	37		
6.3	34		
5	32		
3.35	30		
2	27		
1.18	24		
0.6	21	Particle density	(assumed)
0.425	20	2.65	Mg/m3
0.3	19		
0.212	18		
0.15	17		
0.063	15		

Dry Mass of sample, g	3231

Sample Proportions	% dry mass
Cobbles	20.7
Gravel	52.9
Sand	11.6
Silt	11.5
Clay	3.3

Grading Analysis		
D100	mm	
D60	mm	42.3
D30	mm	3.31
D10	mm	0.0153
Uniformity Coefficient		2800
Curvature Coefficient		17

Remarks

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

Approved
Stephen.Watson

LAB 05R Version 4

UKAS TESTING

10122

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

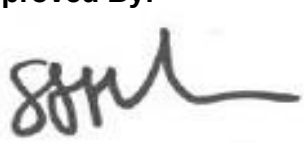
UKAS TESTING
2183

Final Report

Report No.:	22-02179-1
Initial Date of Issue:	26-Jan-2022
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 Michelle Gaffney Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllist
Project	21-1298 Bus Connects Galway

Quotation No.:		**Date Received:**	24-Jan-2022
Order No.:		**Date Instructed:**	24-Jan-2022
No. of Samples:	1		
Turnaround (Wkdays):	7	**Results Due:**	01-Feb-2022
Date Approved:	26-Jan-2022		

Approved By:



Details: Stuart Henderson, Technical Manager

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

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-02179
Quotation No.:			**Chemtest Sample ID.:**		1356500
Order No.:			Client Sample Ref.:		6
			Sample Location:		WS101
			Sample Type:		SOIL
			Top Depth (m):		1.9
			Date Sampled:		20-Jan-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Moisture	N	2030	%	0.020	53
Organic Matter	U	2625	%	0.40	8.6

Test Methods

SOP	Title	Parameters included	Method summary
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
2625	Total Organic Carbon in Soils	Total organic Carbon (TOC)	Determined by high temperature combustion under oxygen, using an Eltra elemental analyser.

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

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

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

LABORATORY RESTRICTION REPORT

Project Reference	21-1298	To	Sean Ross
Project Name	BusConnects Galway	Position	Project Manager
TR reference	21-1298 / 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			
BH105A	8	2.40	D	Atterberg limits	Insufficient cohesive material to conduct test	CANCEL
WS101	5	1.56	D	PSD	Insufficient material to conduct test	CANCEL

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

Laboratory Signature	Project Manager Signature
Joseph Nicholl	Sean Ross
Date	Date
20 January 2022	17 January 2022

HEAD OFFICE
Causeway Geotech Ltd
8 Drumahiskey Road
Ballymoney
Co. Antrim, N. Ireland, BT53 7QL
NI: +44 (0)28 276 66640
Registered in Northern Ireland.
Company Number: NI610766

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

www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

9 March 2022

Project Name:	BusConnects Galway
Project No.:	21-1298
Client:	Galway City Council
Engineer:	ARUP

We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the Contents page(s). This testing was performed between 17/01/2022 and 02/02/2022.

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

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

Stephen Watson

Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

SCS ISO 9001 CERTIFIED
SCS ISO 14001 CERTIFIED
SCS ISO 45001 CERTIFIED
UKAS MANAGEMENT SYSTEMS 9235
UKAS TESTING 10122
AGS
BRITISH DRILLING ASSOCIATION

Project Name: BusConnects Galway

Report Reference: Schedule 2 - ROCK

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

Tests marked with* in this report are not United Kingdom Accreditation Service (UKAS) accredited and are not included in Causeway Geotech Limited's scope of UKAS Accreditation Schedule of Tests. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
ROCK	Point load index	ISRM Commission on Testing Methods. Suggested Method for Determining Point Load Strength 1985	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.

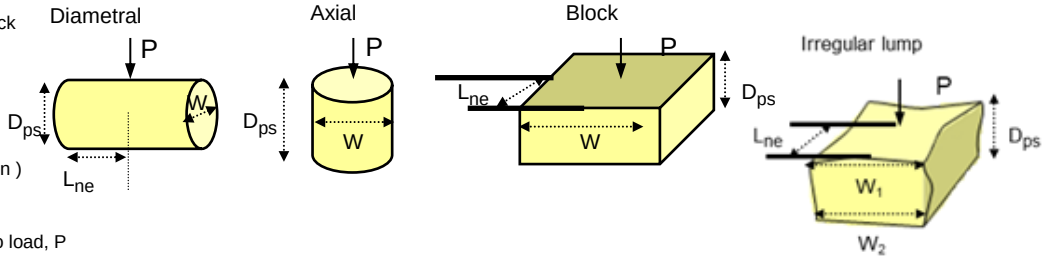
Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
ROCK – Subcontracted to MATtest Ltd *(UKAS 2643)*	Uniaxial compressive strength	ASTM D7012-14	4

Point Load Strength Index Tests
Summary of Results

Project No.	Project Name
21-1298	BusConnects Galway

Borehole No.	Sample			Specimen		Rock Type	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P	Equivalent diameter, De	Point Load Strength Index		Remarks (including water content if measured)
	Depth	Ref.	Type	Ref.	Depth		Type (D, A, I, B)	Direction (L, P or U)		Lne	W	Dps	Dps'			Is	Is(50)	
	m				m					mm	mm	mm	mm	kN	mm	MPa	MPa	
BH101	5.00		C	1	5.00	LIMESTONE	A	U	NO		83.2	111.0	106.0	21.1	106.0	1.9	2.6	
BH102	3.80		C	1	3.80	LIMESTONE	D	U	NO	90.4	82.8	82.8	81.0	13.3	81.9	2.0	2.5	
BH103	7.40		C	1	7.40	LIMESTONE	D	U	NO	62.4	82.3	82.3	78.0	16.4	80.1	2.6	3.2	
BH104	8.70		C	1	8.70	LIMESTONE	A	U	NO		81.9	86.0	84.0	13.8	93.6	1.6	2.1	
BH106	3.70		C	1	3.70	LIMESTONE	D	U	NO	97.9	83.0	83.0	81.0	24.5	82.0	3.6	4.6	
BH106	5.20		C	2	5.20	LIMESTONE	A	U	NO		83.3	103.0	101.0	41.1	103.5	3.8	5.3	

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



Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise

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

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

LAB 17R Version 4

Date Printed: 03/09/2022 00:00

Approved By: Stephen.Watson

UKAS TESTING 10122

MATtest Limited
materials testing & consultancy

10 Queenslie Point
Queenslie Industrial Estate
120 Stepps Road
Glasgow
G33 3NQ

Tel: 0141 774 4032

email: info@mattest.org
Website: www.mattest.org

LABORATORY TEST CERTIFICATE

Certificate No : **22/273 - 01**

To : **Stephen Watson**

Client : **Causeway Geotech Limited**
8 Drumahiskey Road
Ballymoney
Co. Antrim
BT53 7QL

LABORATORY TESTING OF ROCK

Introduction

We refer to samples taken from BusConnects, Galway and delivered to our laboratory on 01st March 2022.

Material & Source

Sample Reference	:	See Report Plates
Sampled By	:	Client
Sampling Certificate	:	Not Supplied
Location	:	See Report Plates
Description	:	Rock Cores
Date Sampled	:	Not Supplied
Date Tested	:	01st March 2022 Onwards
Source	:	21-1298 - BusConnects, Galway

Test Results

As Detailed On Page 2 to Page 5 inclusive

Comments

The results contained in this report relate to the sample(s) as received
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
All remaining samples for this project will be disposed of 28 days after issue of this test certificate

Remarks

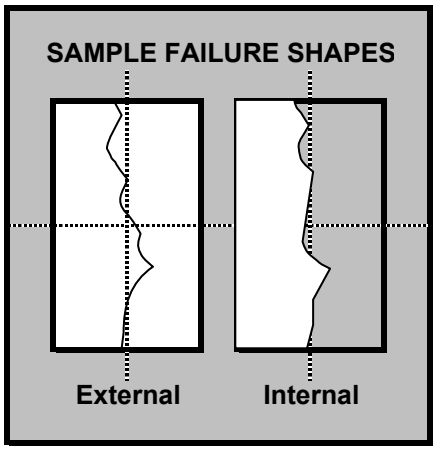
Approved for Issue

T McLelland (Director)

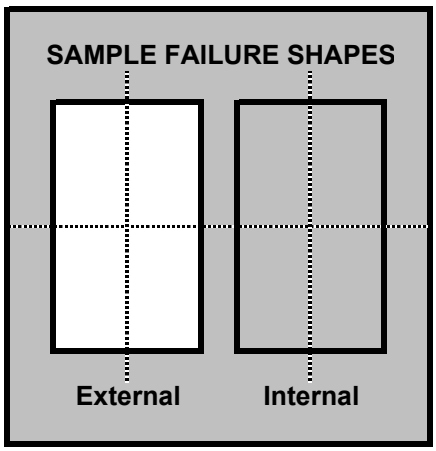
Date 09/03/2022

UKAS TESTING
2643

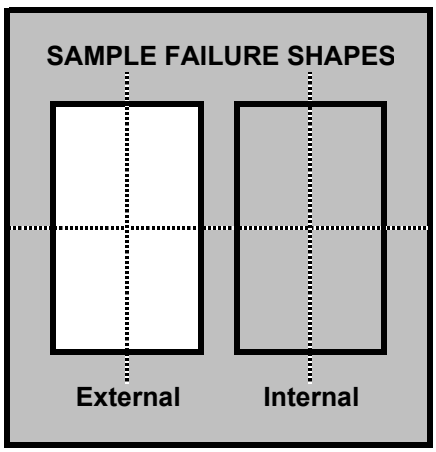
BOREHOLE		**BH101**
SAMPLE		**C**
DEPTH	m	**4.30-4.60**
SAMPLE DIAMETER	mm	**83.73**
SAMPLE HEIGHT	mm	**189.48**
TEST CONDITION		**As Received**
RATE OF LOADING	kN/s	**1.3**
TEST DURATION	min.sec	**3.52**
DATE OF TESTING		**08/03/2022**
LOAD FRAME USED		**2000kN**
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		**Unknown**
FAILURE LOAD	kN	**271.1**
UNCONFINED COMPRESSIVE STRENGTH	MPa	**49.2**
WATER CONTENT (ISRM Suggested Methods)	%	**0.2**
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	**2.68**
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	**2.67**



BOREHOLE		
SAMPLE		
DEPTH	m	
SAMPLE DIAMETER	mm	
SAMPLE HEIGHT	mm	
TEST CONDITION		
RATE OF LOADING	kN/s	
TEST DURATION	min.sec	
DATE OF TESTING		
LOAD FRAME USED		
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		
FAILURE LOAD	kN	
UNCONFINED COMPRESSIVE STRENGTH	MPa	
WATER CONTENT (ISRM Suggested Methods)	%	
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	



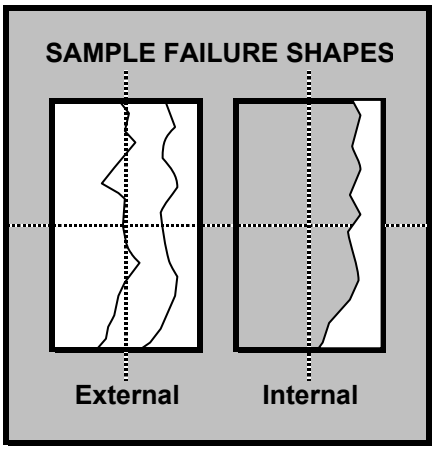
BOREHOLE		
SAMPLE		
DEPTH	m	
SAMPLE DIAMETER	mm	
SAMPLE HEIGHT	mm	
TEST CONDITION		
RATE OF LOADING	kN/s	
TEST DURATION	min.sec	
DATE OF TESTING		
LOAD FRAME USED		
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		
FAILURE LOAD	kN	
UNCONFINED COMPRESSIVE STRENGTH	MPa	
WATER CONTENT (ISRM Suggested Methods)	%	
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	



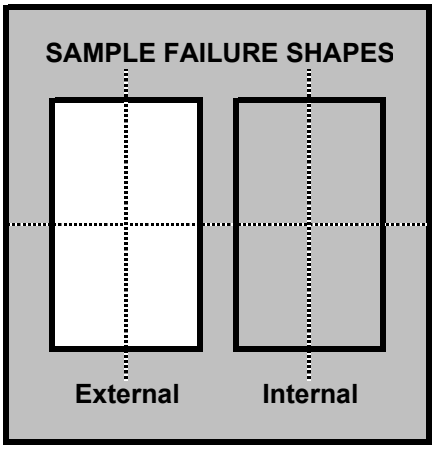
Tested in accordance with ASTM D7012 - 14

SUMMARY OF UNCONFINED COMPRESSIVE STRENGTH

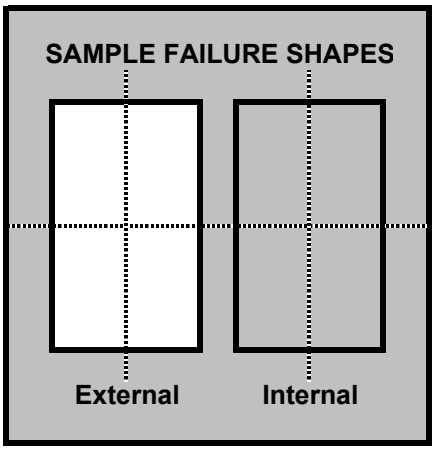
BOREHOLE		**BH103**
SAMPLE		**C**
DEPTH	m	**5.60-6.00**
SAMPLE DIAMETER	mm	**83.75**
SAMPLE HEIGHT	mm	**165.36**
TEST CONDITION		**As Received**
RATE OF LOADING	kN/s	**1.2**
TEST DURATION	min.sec	**4.25**
DATE OF TESTING		**08/03/2022**
LOAD FRAME USED		**2000kN**
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		**Unknown**
FAILURE LOAD	kN	**304.6**
UNCONFINED COMPRESSIVE STRENGTH	MPa	**55.3**
WATER CONTENT (ISRM Suggested Methods)	%	**1.2**
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	**2.57**
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	**2.54**



BOREHOLE		
SAMPLE		
DEPTH	m	
SAMPLE DIAMETER	mm	
SAMPLE HEIGHT	mm	
TEST CONDITION		
RATE OF LOADING	kN/s	
TEST DURATION	min.sec	
DATE OF TESTING		
LOAD FRAME USED		
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		
FAILURE LOAD	kN	
UNCONFINED COMPRESSIVE STRENGTH	MPa	
WATER CONTENT (ISRM Suggested Methods)	%	
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	



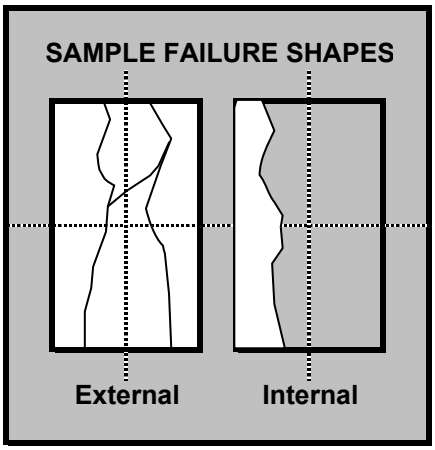
BOREHOLE		
SAMPLE		
DEPTH	m	
SAMPLE DIAMETER	mm	
SAMPLE HEIGHT	mm	
TEST CONDITION		
RATE OF LOADING	kN/s	
TEST DURATION	min.sec	
DATE OF TESTING		
LOAD FRAME USED		
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		
FAILURE LOAD	kN	
UNCONFINED COMPRESSIVE STRENGTH	MPa	
WATER CONTENT (ISRM Suggested Methods)	%	
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	



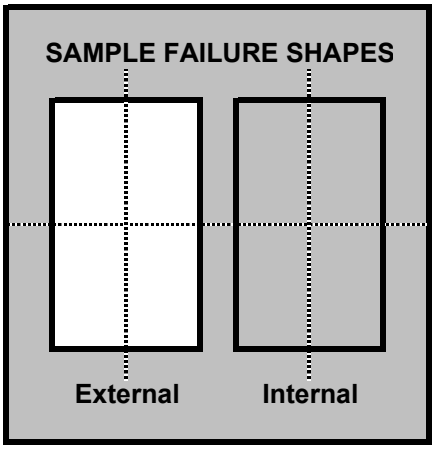
Tested in accordance with ASTM D7012 - 14

SUMMARY OF UNCONFINED COMPRESSIVE STRENGTH

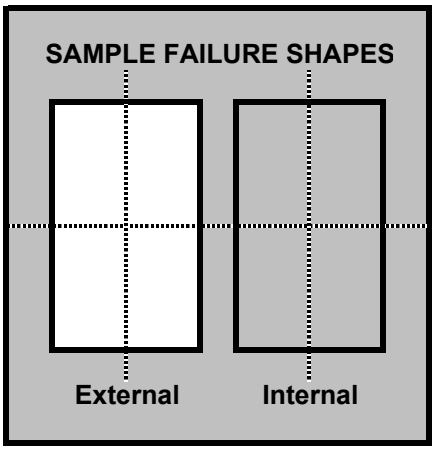
BOREHOLE		**BH104**
SAMPLE		**C**
DEPTH	m	**7.00-7.30**
SAMPLE DIAMETER	mm	**80.30**
SAMPLE HEIGHT	mm	**188.35**
TEST CONDITION		**As Received**
RATE OF LOADING	kN/s	**1.2**
TEST DURATION	min.sec	**4.24**
DATE OF TESTING		**08/03/2022**
LOAD FRAME USED		**2000kN**
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		**Unknown**
FAILURE LOAD	kN	**304.4**
UNCONFINED COMPRESSIVE STRENGTH	MPa	**60.1**
WATER CONTENT (ISRM Suggested Methods)	%	**0.2**
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	**2.65**
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	**2.65**



BOREHOLE		
SAMPLE		
DEPTH	m	
SAMPLE DIAMETER	mm	
SAMPLE HEIGHT	mm	
TEST CONDITION		
RATE OF LOADING	kN/s	
TEST DURATION	min.sec	
DATE OF TESTING		
LOAD FRAME USED		
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		
FAILURE LOAD	kN	
UNCONFINED COMPRESSIVE STRENGTH	MPa	
WATER CONTENT (ISRM Suggested Methods)	%	
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	



BOREHOLE		
SAMPLE		
DEPTH	m	
SAMPLE DIAMETER	mm	
SAMPLE HEIGHT	mm	
TEST CONDITION		
RATE OF LOADING	kN/s	
TEST DURATION	min.sec	
DATE OF TESTING		
LOAD FRAME USED		
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		
FAILURE LOAD	kN	
UNCONFINED COMPRESSIVE STRENGTH	MPa	
WATER CONTENT (ISRM Suggested Methods)	%	
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	

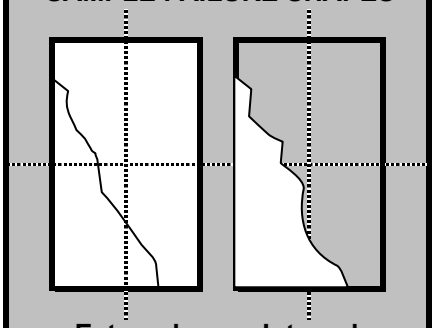


Tested in accordance with ASTM D7012 - 14

SUMMARY OF UNCONFINED COMPRESSIVE STRENGTH

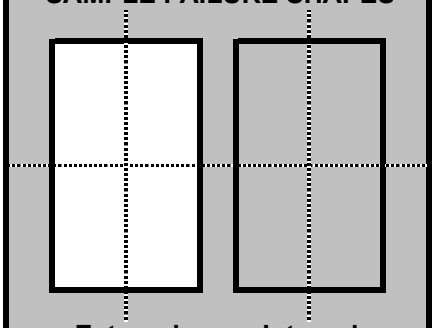
BOREHOLE		**BH106**
SAMPLE		**C**
DEPTH	m	**4.00-4.20**
SAMPLE DIAMETER	mm	**83.56**
SAMPLE HEIGHT	mm	**174.42**
TEST CONDITION		**As Received**
RATE OF LOADING	kN/s	**1.3**
TEST DURATION	min.sec	**4.06**
DATE OF TESTING		**08/03/2022**
LOAD FRAME USED		**2000kN**
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		**Unknown**
FAILURE LOAD	kN	**308.9**
UNCONFINED COMPRESSIVE STRENGTH	MPa	**56.3**
WATER CONTENT (ISRM Suggested Methods)	%	**0.1**
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	**2.84**
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	**2.84**

SAMPLE FAILURE SHAPES



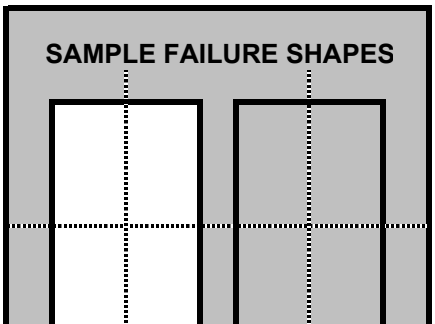
BOREHOLE		
SAMPLE		
DEPTH	m	
SAMPLE DIAMETER	mm	
SAMPLE HEIGHT	mm	
TEST CONDITION		
RATE OF LOADING	kN/s	
TEST DURATION	min.sec	
DATE OF TESTING		
LOAD FRAME USED		
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		
FAILURE LOAD	kN	
UNCONFINED COMPRESSIVE STRENGTH	MPa	
WATER CONTENT (ISRM Suggested Methods)	%	
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	

SAMPLE FAILURE SHAPES



BOREHOLE		
SAMPLE		
DEPTH	m	
SAMPLE DIAMETER	mm	
SAMPLE HEIGHT	mm	
TEST CONDITION		
RATE OF LOADING	kN/s	
TEST DURATION	min.sec	
DATE OF TESTING		
LOAD FRAME USED		
LOAD DIRECTION WITH RESPECT TO LITHOLOGY		
FAILURE LOAD	kN	
UNCONFINED COMPRESSIVE STRENGTH	MPa	
WATER CONTENT (ISRM Suggested Methods)	%	
BULK DENSITY (ISRM Suggested Methods)	Mg/m^3	
DRY DENSITY (ISRM Suggested Methods)	Mg/m^3	

SAMPLE FAILURE SHAPES



Tested in accordance with ASTM D7012 - 14

SUMMARY OF UNCONFINED COMPRESSIVE STRENGTH

CAUSEWAY GEOTECH

APPENDIX F

ENVIRONMENTAL LABORATORY TEST RESULTS

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

Final Report

Report No.:	21-42918-1
Initial Date of Issue:	16-Dec-2021
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 Michelle Gaffney Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllist
Project	21-1298 Busconnects Galway

Quotation No.:	Q21-25429	**Date Received:**	06-Dec-2021
Order No.:		**Date Instructed:**	08-Dec-2021
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	16-Dec-2021
Date Approved:	16-Dec-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		21-42918	21-42918
Quotation No.: Q21-25429				**Chemtest Sample ID.:**		1333978	1333979
Order No.:				Client Sample Ref.:		Ev	Ev
				Sample Location:		BH101	BH101
				Sample Type:		SOIL	SOIL
				Top Depth (m):		0.50	1.00
				Date Sampled:		30-Nov-2021	30-Nov-2021
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**		
Total Dissolved Solids	N	1020	10:1	mg/l	1.0	120	44
Chloride	U	1220	10:1	mg/l	1.0	< 1.0	< 1.0
Fluoride	U	1220	10:1	mg/l	0.050	0.37	0.13
Sulphate	U	1220	10:1	mg/l	1.0	6.0	1.2
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	0.76	1.5
Barium (Dissolved)	U	1455	10:1	µg/l	5.00	13	5.9
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11	< 0.11
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	0.69	< 0.50
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	5.1	4.3
Molybdenum (Dissolved)	U	1455	10:1	µg/l	0.20	0.64	0.53
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	0.71	< 0.50
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	15	1.0
Antimony (Dissolved)	U	1455	10:1	µg/l	0.50	0.73	0.76
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	< 0.50
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	5.5	< 2.5
Mercury Low Level	U	1460	10:1	µg/l	0.010	< 0.010	< 0.010
Dissolved Organic Carbon	U	1610	10:1	mg/l	2.0	8.5	4.7
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030	< 0.030

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42918	21-42918
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1333978	1333979
Order No.:			Client Sample Ref.:		Ev	Ev
			Sample Location:		BH101	BH101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	15	14
pH	M	2010		4.0	8.5	8.5
Arsenic	M	2450	mg/kg	1.0	7.9	5.3
Barium	M	2450	mg/kg	10	35	29
Cadmium	M	2450	mg/kg	0.10	0.97	0.73
Mercury Low Level	M	2450	mg/kg	0.05	0.07	0.06
Molybdenum	M	2450	mg/kg	2.0	< 2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0	< 2.0
Copper	M	2450	mg/kg	0.50	9.7	9.2
Nickel	M	2450	mg/kg	0.50	18	13
Lead	M	2450	mg/kg	0.50	22	25
Selenium	M	2450	mg/kg	0.20	< 0.20	< 0.20
Zinc	M	2450	mg/kg	0.50	43	32
Chromium (Trivalent)	N	2490	mg/kg	1.0	23	14
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
LOI	M	2610	%	0.10	4.8	4.8
Total Organic Carbon	M	2625	%	0.20	0.60	1.1
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10	< 10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42918	21-42918
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1333978	1333979
Order No.:			Client Sample Ref.:		Ev	Ev
			Sample Location:		BH101	BH101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10
Dichlorodifluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Vinyl Chloride	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichlorofluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trans 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromochloromethane	N	2760	µg/kg	0.50	< 0.50	< 0.50
Trichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0
1,2-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromodichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Toluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,2-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromochloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromoethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1,2-Tetrachloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Ethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	< 1.0
m & p-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42918	21-42918
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1333978	1333979
Order No.:			Client Sample Ref.:		Ev	Ev
			Sample Location:		BH101	BH101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0
o-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20
o-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0
Styrene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tribromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Isopropylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Propylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
2-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3,5-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tert-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Sec-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Isopropyltoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,4-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromo-3-Chloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Hexachlorobutadiene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Chlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis-(2-Chloroethyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,3-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,4-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Chloroisopropyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachloroethane	N	2790	mg/kg	0.050	< 0.050	< 0.050
N-Nitrosodi-n-propylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42918	21-42918
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1333978	1333979
Order No.:			Client Sample Ref.:		Ev	Ev
			Sample Location:		BH101	BH101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Nitrobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Isophorone	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dimethylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Chloroethoxy)Methane	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2,4-Trichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chloroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobutadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chloro-3-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylnaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorocyclopentadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,6-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,5-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Chloronaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthylene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dimethylphthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,6-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthene	N	2790	mg/kg	0.050	< 0.050	< 0.050
3-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dibenzofuran	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chlorophenylphenylether	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluorene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Diethyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methyl-4,6-Dinitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Azobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Bromophenylphenyl Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Pentachlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenanthrene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Anthracene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Carbazole	N	2790	mg/kg	0.050	< 0.050	< 0.050
Di-N-Butyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluoranthene	N	2790	mg/kg	0.050	< 0.050	< 0.050

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42918	21-42918
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1333978	1333979
Order No.:			Client Sample Ref.:		Ev	Ev
			Sample Location:		BH101	BH101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Pyrene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Butylbenzyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[a]anthracene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Chrysene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Ethylhexyl)Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Di-N-Octyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[b]fluoranthene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[k]fluoranthene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[a]pyrene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Indeno(1,2,3-c,d)Pyrene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dibenz(a,h)Anthracene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[g,h,i]perylene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Chrysene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42918	21-42918
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1333978	1333979
Order No.:			Client Sample Ref.:		Ev	Ev
			Sample Location:		BH101	BH101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10	< 0.10
SVOC TIC	N	2790	mg/kg	N/A	None Detected	None Detected
VOC TIC	N	2760	µg/kg	N/A	None Detected	None Detected

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
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
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
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.
2790	Semi-Volatile Organic Compounds (SVOCs) in Soils by GC-MS	Semi-volatile organic compounds(cf. USEPA Method 8270)	Acetone/Hexane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

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

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

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

Final Report

Report No.:	21-42988-1
Initial Date of Issue:	16-Dec-2021
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 Michelle Gaffney Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllist
Project	21-1298 Busconnects Galway

Quotation No.:	Q21-25429	**Date Received:**	06-Dec-2021
Order No.:		**Date Instructed:**	08-Dec-2021
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	16-Dec-2021
Date Approved:	16-Dec-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		21-42988	21-42988
Quotation No.: Q21-25429				**Chemtest Sample ID.:**		1334317	1334318
				Sample Location:		WS101	WS101
				Sample Type:		SOIL	SOIL
				Top Depth (m):		0.50	1.00
				Date Sampled:		29-Nov-2021	29-Nov-2021
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**		
Total Dissolved Solids	N	1020	10:1	mg/l	1.0	78	56
Chloride	U	1220	10:1	mg/l	1.0	< 1.0	< 1.0
Fluoride	U	1220	10:1	mg/l	0.050	0.50	0.21
Sulphate	U	1220	10:1	mg/l	1.0	< 1.0	< 1.0
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	0.46	0.73
Barium (Dissolved)	U	1455	10:1	µg/l	5.00	7.0	5.9
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11	< 0.11
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	0.82	< 0.50
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	3.5	4.3
Molybdenum (Dissolved)	U	1455	10:1	µg/l	0.20	0.83	1.7
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	0.59	< 0.50
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	3.1	0.70
Antimony (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	0.83
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	< 0.50
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	< 2.5	< 2.5
Mercury Low Level	U	1460	10:1	µg/l	0.010	< 0.010	< 0.010
Dissolved Organic Carbon	U	1610	10:1	mg/l	2.0	9.6	11
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030	< 0.030

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42988	21-42988
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334317	1334318
			Sample Location:		WS101	WS101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		29-Nov-2021	29-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	21	14
pH	M	2010		4.0	8.4	8.5
Arsenic	M	2450	mg/kg	1.0	8.0	6.9
Barium	M	2450	mg/kg	10	84	33
Cadmium	M	2450	mg/kg	0.10	1.4	0.51
Mercury Low Level	M	2450	mg/kg	0.05	0.20	0.08
Molybdenum	M	2450	mg/kg	2.0	< 2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0	< 2.0
Copper	M	2450	mg/kg	0.50	26	24
Nickel	M	2450	mg/kg	0.50	14	7.2
Lead	M	2450	mg/kg	0.50	270	56
Selenium	M	2450	mg/kg	0.20	0.25	< 0.20
Zinc	M	2450	mg/kg	0.50	160	65
Chromium (Trivalent)	N	2490	mg/kg	1.0	14	7.4
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
LOI	M	2610	%	0.10	7.8	4.3
Total Organic Carbon	M	2625	%	0.20	3.6	2.3
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10	3100	38
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	94	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	360	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	1100	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	1100	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	390	38
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	3100	38
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	53	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	400	44
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	270	210
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	54	460
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	780	710

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42988	21-42988
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334317	1334318
			Sample Location:		WS101	WS101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		29-Nov-2021	29-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	3800	750
Dichlorodifluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Vinyl Chloride	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichlorofluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trans 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromochloromethane	N	2760	µg/kg	0.50	< 0.50	< 0.50
Trichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0
1,2-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromodichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Toluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,2-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromochloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromoethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1,2-Tetrachloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Ethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	< 1.0
m & p-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0
o-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42988	21-42988
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334317	1334318
			Sample Location:		WS101	WS101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		29-Nov-2021	29-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
o-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0
Styrene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tribromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Isopropylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Propylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
2-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3,5-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tert-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Sec-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Isopropyltoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,4-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromo-3-Chloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Hexachlorobutadiene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenol	N	2790	mg/kg	0.050	< 0.050	0.070
2-Chlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis-(2-Chloroethyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,3-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,4-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Chloroisopropyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachloroethane	N	2790	mg/kg	0.050	< 0.050	< 0.050
N-Nitrosodi-n-propylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Nitrobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Isophorone	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42988	21-42988
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334317	1334318
			Sample Location:		WS101	WS101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		29-Nov-2021	29-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
2,4-Dimethylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Chloroethoxy)Methane	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2,4-Trichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	N	2790	mg/kg	0.050	< 0.050	0.070
4-Chloroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobutadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chloro-3-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylnaphthalene	N	2790	mg/kg	0.050	< 0.050	0.058
Hexachlorocyclopentadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,6-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,5-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Chloronaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthylene	N	2790	mg/kg	0.050	0.076	0.15
Dimethylphthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,6-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthene	N	2790	mg/kg	0.050	< 0.050	< 0.050
3-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dibenzofuran	N	2790	mg/kg	0.050	< 0.050	0.070
4-Chlorophenylphenylether	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluorene	N	2790	mg/kg	0.050	< 0.050	0.070
Diethyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methyl-4,6-Dinitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Azobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Bromophenylphenyl Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Pentachlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenanthrene	N	2790	mg/kg	0.050	0.34	0.94
Anthracene	N	2790	mg/kg	0.050	0.076	0.15
Carbazole	N	2790	mg/kg	0.050	< 0.050	0.11
Di-N-Butyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluoranthene	N	2790	mg/kg	0.050	0.99	1.4
Pyrene	N	2790	mg/kg	0.050	0.84	1.2
Butylbenzyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[a]anthracene	N	2790	mg/kg	0.050	0.57	0.58
Chrysene	N	2790	mg/kg	0.050	0.59	0.64

Results - Soil

Project: 21-1298 Busconnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-42988	21-42988
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334317	1334318
			Sample Location:		WS101	WS101
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		29-Nov-2021	29-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Bis(2-Ethylhexyl)Phthalate	N	2790	mg/kg	0.050	< 0.050	0.22
Di-N-Octyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[b]fluoranthene	N	2790	mg/kg	0.050	0.90	0.87
Benzo[k]fluoranthene	N	2790	mg/kg	0.050	0.28	0.30
Benzo[a]pyrene	N	2790	mg/kg	0.050	0.65	0.71
Indeno(1,2,3-c,d)Pyrene	N	2790	mg/kg	0.050	0.37	0.41
Dibenz(a,h)Anthracene	N	2790	mg/kg	0.050	0.12	0.12
Benzo[g,h,i]perylene	N	2790	mg/kg	0.050	0.47	0.54
4-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	M	2800	mg/kg	0.10	0.22	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	0.76	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	0.11	< 0.10
Fluorene	M	2800	mg/kg	0.10	0.45	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	5.7	< 0.10
Anthracene	M	2800	mg/kg	0.10	0.82	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	9.5	0.67
Pyrene	M	2800	mg/kg	0.10	8.1	0.54
Benzo[a]anthracene	M	2800	mg/kg	0.10	4.5	0.36
Chrysene	M	2800	mg/kg	0.10	4.9	0.30
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	6.2	0.54
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	3.0	0.20
Benzo[a]pyrene	M	2800	mg/kg	0.10	4.9	0.37
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	3.7	0.32
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	1.7	0.12
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	3.0	0.29
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	58	3.7
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10	< 0.10
SVOC TIC	N	2790	mg/kg	N/A	None Detected	None Detected
VOC TIC	N	2760	µg/kg	N/A	None Detected	None Detected

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
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
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
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.
2790	Semi-Volatile Organic Compounds (SVOCs) in Soils by GC-MS	Semi-volatile organic compounds(cf. USEPA Method 8270)	Acetone/Hexane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

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

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

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

Final Report

Report No.:	21-43005-1
Initial Date of Issue:	16-Dec-2021
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 Michelle Gaffney Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllist
Project	21-1298 BusConnects Galway

Quotation No.:	Q21-25429	**Date Received:**	06-Dec-2021
Order No.:		**Date Instructed:**	08-Dec-2021
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	16-Dec-2021
Date Approved:	16-Dec-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		21-43005	21-43005
Quotation No.: Q21-25429				**Chemtest Sample ID.:**		1334433	1334434
				Sample Location:		WS106	WS106
				Sample Type:		SOIL	SOIL
				Top Depth (m):		0.50	1.00
				Date Sampled:		30-Nov-2021	30-Nov-2021
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**		
Total Dissolved Solids	N	1020	10:1	mg/l	1.0	100	72
Chloride	U	1220	10:1	mg/l	1.0	1.4	< 1.0
Fluoride	U	1220	10:1	mg/l	0.050	0.21	0.13
Sulphate	U	1220	10:1	mg/l	1.0	< 1.0	< 1.0
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	2.0	3.0
Barium (Dissolved)	U	1455	10:1	µg/l	5.00	18	< 5.0
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11	0.54
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	0.53	< 0.50
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	4.6	3.3
Molybdenum (Dissolved)	U	1455	10:1	µg/l	0.20	0.56	2.7
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	0.68	2.9
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	3.8	2.9
Antimony (Dissolved)	U	1455	10:1	µg/l	0.50	1.4	1.4
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	< 0.50
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	4.7	13
Mercury Low Level	U	1460	10:1	µg/l	0.010	< 0.010	< 0.010
Dissolved Organic Carbon	U	1610	10:1	mg/l	2.0	6.4	3.8
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030	< 0.030

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43005	21-43005
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334433	1334434
			Sample Location:		WS106	WS106
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	18	8.9
pH	M	2010		4.0	8.2	8.4
Arsenic	M	2450	mg/kg	1.0	8.4	8.4
Barium	M	2450	mg/kg	10	67	16
Cadmium	M	2450	mg/kg	0.10	0.52	0.47
Mercury Low Level	M	2450	mg/kg	0.05	0.25	0.05
Molybdenum	M	2450	mg/kg	2.0	< 2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0	< 2.0
Copper	M	2450	mg/kg	0.50	30	7.2
Nickel	M	2450	mg/kg	0.50	11	7.4
Lead	M	2450	mg/kg	0.50	89	20
Selenium	M	2450	mg/kg	0.20	< 0.20	< 0.20
Zinc	M	2450	mg/kg	0.50	85	26
Chromium (Trivalent)	N	2490	mg/kg	1.0	12	6.7
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
LOI	M	2610	%	0.10	4.7	3.0
Total Organic Carbon	M	2625	%	0.20	2.6	0.30
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10	< 10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43005	21-43005
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334433	1334434
			Sample Location:		WS106	WS106
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10
Dichlorodifluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Vinyl Chloride	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichlorofluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trans 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromochloromethane	N	2760	µg/kg	0.50	< 0.50	< 0.50
Trichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0
1,2-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromodichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Toluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,2-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromochloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromoethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1,2-Tetrachloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Ethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	< 1.0
m & p-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0
o-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			Chemtest Job No.:		21-43005	21-43005
Quotation No.: Q21-25429			Chemtest Sample ID.:		1334433	1334434
			Sample Location:		WS106	WS106
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
o-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0
Styrene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tribromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Isopropylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Propylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
2-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3,5-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tert-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Sec-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Isopropyltoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,4-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromo-3-Chloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Hexachlorobutadiene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Chlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis-(2-Chloroethyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,3-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,4-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Chloroisopropyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachloroethane	N	2790	mg/kg	0.050	< 0.050	< 0.050
N-Nitrosodi-n-propylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Nitrobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Isophorone	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43005	21-43005
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334433	1334434
			Sample Location:		WS106	WS106
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
2,4-Dimethylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Chloroethoxy)Methane	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2,4-Trichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chloroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobutadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chloro-3-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylnaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorocyclopentadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,6-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,5-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Chloronaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthylene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dimethylphthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,6-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthene	N	2790	mg/kg	0.050	< 0.050	< 0.050
3-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dibenzofuran	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chlorophenylphenylether	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluorene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Diethyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methyl-4,6-Dinitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Azobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Bromophenylphenyl Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Pentachlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenanthrene	N	2790	mg/kg	0.050	0.27	0.62
Anthracene	N	2790	mg/kg	0.050	0.073	0.14
Carbazole	N	2790	mg/kg	0.050	< 0.050	0.066
Di-N-Butyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluoranthene	N	2790	mg/kg	0.050	0.58	1.1
Pyrene	N	2790	mg/kg	0.050	0.51	0.89
Butylbenzyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[a]anthracene	N	2790	mg/kg	0.050	0.35	0.48
Chrysene	N	2790	mg/kg	0.050	0.32	0.52

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43005	21-43005
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334433	1334434
			Sample Location:		WS106	WS106
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Bis(2-Ethylhexyl)Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Di-N-Octyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[b]fluoranthene	N	2790	mg/kg	0.050	0.48	0.64
Benzo[k]fluoranthene	N	2790	mg/kg	0.050	0.17	0.22
Benzo[a]pyrene	N	2790	mg/kg	0.050	0.35	0.47
Indeno(1,2,3-c,d)Pyrene	N	2790	mg/kg	0.050	0.18	0.26
Dibenz(a,h)Anthracene	N	2790	mg/kg	0.050	< 0.050	0.066
Benzo[g,h,i]perylene	N	2790	mg/kg	0.050	0.21	0.25
4-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	1.8	0.25
Anthracene	M	2800	mg/kg	0.10	1.2	0.13
Fluoranthene	M	2800	mg/kg	0.10	4.7	0.42
Pyrene	M	2800	mg/kg	0.10	4.3	0.32
Benzo[a]anthracene	M	2800	mg/kg	0.10	3.0	0.25
Chrysene	M	2800	mg/kg	0.10	2.4	0.22
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	2.9	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	0.81	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	2.1	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	1.6	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	0.52	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	1.3	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	27	< 2.0
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10	< 0.10
SVOC TIC	N	2790	mg/kg	N/A	None Detected	None Detected
VOC TIC	N	2760	µg/kg	N/A	None Detected	None Detected

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
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
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
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.
2790	Semi-Volatile Organic Compounds (SVOCs) in Soils by GC-MS	Semi-volatile organic compounds(cf. USEPA Method 8270)	Acetone/Hexane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

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

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

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

Final Report

Report No.:	21-43006-1
Initial Date of Issue:	17-Dec-2021
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 Michelle Gaffney Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllist
Project	21-1298 BusConnects Galway

Quotation No.:	Q21-25429	**Date Received:**	06-Dec-2021
Order No.:		**Date Instructed:**	08-Dec-2021
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	16-Dec-2021
Date Approved:	17-Dec-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		21-43006	21-43006
Quotation No.: Q21-25429				**Chemtest Sample ID.:**		1334436	1334437
				Sample Location:		WS105	WS105
				Sample Type:		SOIL	SOIL
				Top Depth (m):		0.50	1.00
				Date Sampled:		30-Nov-2021	30-Nov-2021
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**		
Total Dissolved Solids	N	1020	10:1	mg/l	1.0	85	78
Chloride	U	1220	10:1	mg/l	1.0	< 1.0	1.0
Fluoride	U	1220	10:1	mg/l	0.050	0.23	0.38
Sulphate	U	1220	10:1	mg/l	1.0	< 1.0	2.1
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	2.0	0.67
Barium (Dissolved)	U	1455	10:1	µg/l	5.00	24	14
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11	0.81
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	0.52	1.3
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	8.3	6.4
Molybdenum (Dissolved)	U	1455	10:1	µg/l	0.20	1.0	4.4
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	0.73	0.70
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	7.6	31
Antimony (Dissolved)	U	1455	10:1	µg/l	0.50	1.0	1.2
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	0.83
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	6.3	14
Mercury Low Level	U	1460	10:1	µg/l	0.010	0.018	< 0.010
Dissolved Organic Carbon	U	1610	10:1	mg/l	2.0	5.6	17
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030	< 0.030

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43006	21-43006
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334436	1334437
			Sample Location:		WS105	WS105
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	12	12
pH	M	2010		4.0	8.5	8.2
Arsenic	M	2450	mg/kg	1.0	10	12
Barium	M	2450	mg/kg	10	12	100
Cadmium	M	2450	mg/kg	0.10	0.47	0.94
Mercury Low Level	M	2450	mg/kg	0.05	< 0.05	0.13
Molybdenum	M	2450	mg/kg	2.0	< 2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0	< 2.0
Copper	M	2450	mg/kg	0.50	5.1	18
Nickel	M	2450	mg/kg	0.50	10	12
Lead	M	2450	mg/kg	0.50	5.6	250
Selenium	M	2450	mg/kg	0.20	< 0.20	< 0.20
Zinc	M	2450	mg/kg	0.50	14	72
Chromium (Trivalent)	N	2490	mg/kg	1.0	11	10
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
LOI	M	2610	%	0.10	2.9	4.9
Total Organic Carbon	M	2625	%	0.20	< 0.20	0.60
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10	< 10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	6.8	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	52	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	59	< 5.0

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43006	21-43006
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334436	1334437
			Sample Location:		WS105	WS105
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	59	< 10
Dichlorodifluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Vinyl Chloride	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichlorofluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trans 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromochloromethane	N	2760	µg/kg	0.50	< 0.50	< 0.50
Trichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0
1,2-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromodichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Toluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,2-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromochloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromoethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1,2-Tetrachloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Ethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	< 1.0
m & p-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0
o-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43006	21-43006
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334436	1334437
			Sample Location:		WS105	WS105
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
o-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0
Styrene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tribromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Isopropylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Propylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
2-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3,5-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tert-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Sec-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Isopropyltoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,4-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromo-3-Chloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Hexachlorobutadiene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Chlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis-(2-Chloroethyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,3-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,4-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Chloroisopropyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachloroethane	N	2790	mg/kg	0.050	< 0.050	< 0.050
N-Nitrosodi-n-propylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Nitrobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Isophorone	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43006	21-43006
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334436	1334437
			Sample Location:		WS105	WS105
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
2,4-Dimethylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Chloroethoxy)Methane	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2,4-Trichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chloroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobutadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chloro-3-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylnaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorocyclopentadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,6-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,5-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Chloronaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthylene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dimethylphthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,6-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthene	N	2790	mg/kg	0.050	< 0.050	0.079
3-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dibenzofuran	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chlorophenylphenylether	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluorene	N	2790	mg/kg	0.050	< 0.050	0.079
Diethyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methyl-4,6-Dinitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Azobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Bromophenylphenyl Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Pentachlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenanthrene	N	2790	mg/kg	0.050	0.25	0.66
Anthracene	N	2790	mg/kg	0.050	0.13	0.24
Carbazole	N	2790	mg/kg	0.050	< 0.050	< 0.050
Di-N-Butyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluoranthene	N	2790	mg/kg	0.050	0.91	2.1
Pyrene	N	2790	mg/kg	0.050	0.73	1.6
Butylbenzyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[a]anthracene	N	2790	mg/kg	0.050	0.48	0.96
Chrysene	N	2790	mg/kg	0.050	0.45	0.87

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43006	21-43006
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1334436	1334437
			Sample Location:		WS105	WS105
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		30-Nov-2021	30-Nov-2021
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Bis(2-Ethylhexyl)Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Di-N-Octyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[b]fluoranthene	N	2790	mg/kg	0.050	0.58	1.1
Benzo[k]fluoranthene	N	2790	mg/kg	0.050	0.23	0.36
Benzo[a]pyrene	N	2790	mg/kg	0.050	0.46	0.71
Indeno(1,2,3-c,d)Pyrene	N	2790	mg/kg	0.050	0.23	0.36
Dibenz(a,h)Anthracene	N	2790	mg/kg	0.050	0.10	0.13
Benzo[g,h,i]perylene	N	2790	mg/kg	0.050	0.27	0.43
4-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	< 0.10	6.1
Anthracene	M	2800	mg/kg	0.10	< 0.10	2.4
Fluoranthene	M	2800	mg/kg	0.10	< 0.10	12
Pyrene	M	2800	mg/kg	0.10	< 0.10	8.8
Benzo[a]anthracene	M	2800	mg/kg	0.10	< 0.10	5.8
Chrysene	M	2800	mg/kg	0.10	< 0.10	4.1
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10	5.0
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10	2.5
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10	3.6
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0	50
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10	< 0.10
SVOC TIC	N	2790	mg/kg	N/A	None Detected	None Detected
VOC TIC	N	2760	µg/kg	N/A	None Detected	None Detected

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
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
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
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.
2790	Semi-Volatile Organic Compounds (SVOCs) in Soils by GC-MS	Semi-volatile organic compounds(cf. USEPA Method 8270)	Acetone/Hexane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

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

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

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

Final Report

Report No.:	21-43198-1
Initial Date of Issue:	16-Dec-2021
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 Michelle Gaffney Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllist
Project	21-1298 Bus Connects Galway

Quotation No.:	Q21-25429	**Date Received:**	07-Dec-2021
Order No.:		**Date Instructed:**	08-Dec-2021
No. of Samples:	3		
Turnaround (Wkdays):	7	**Results Due:**	16-Dec-2021
Date Approved:	16-Dec-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		21-43198	21-43198	21-43198
Quotation No.: Q21-25429				**Chemtest Sample ID.:**		1335242	1335246	1335248
Order No.:				Client Sample Ref.:		2	1	3
				Sample Location:		BH104	BH105A	BH105A
				Sample Type:		SOIL	SOIL	SOIL
				Top Depth (m):		0.50	0.50	1.50
				Date Sampled:		06-Dec-2021	06-Dec-2021	06-Dec-2021
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**			
Total Dissolved Solids	N	1020	10:1	mg/l	1.0	65	62	61
Chloride	U	1220	10:1	mg/l	1.0	1.9	1.3	1.8
Fluoride	U	1220	10:1	mg/l	0.050	0.48	0.25	0.22
Sulphate	U	1220	10:1	mg/l	1.0	11	5.1	6.8
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	1.3	5.4	12
Barium (Dissolved)	U	1455	10:1	µg/l	5.00	5.1	12	7.4
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11	< 0.11	< 0.11
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	0.87	0.62	0.82
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	2.7	15	36
Molybdenum (Dissolved)	U	1455	10:1	µg/l	0.20	9.7	2.1	1.9
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	0.74	< 0.50	< 0.50
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	0.78	0.96	1.1
Antimony (Dissolved)	U	1455	10:1	µg/l	0.50	1.2	1.0	1.0
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	6.3	0.53	0.63
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	< 2.5	11	12
Mercury Low Level	U	1460	10:1	µg/l	0.010	< 0.010	0.017	0.076
Dissolved Organic Carbon	U	1610	10:1	mg/l	2.0	4.9	4.8	6.0
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030	< 0.030	< 0.030

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43198	21-43198	21-43198
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1335242	1335246	1335248
Order No.:			Client Sample Ref.:		2	1	3
			Sample Location:		BH104	BH105A	BH105A
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.50	0.50	1.50
			Date Sampled:		06-Dec-2021	06-Dec-2021	06-Dec-2021
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
ACM Type	U	2192		N/A	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	3.0	4.3	9.8
pH	M	2010		4.0	8.8	8.4	8.7
Arsenic	M	2450	mg/kg	1.0	12	21	8.2
Barium	M	2450	mg/kg	10	70	50	27
Cadmium	M	2450	mg/kg	0.10	4.0	0.49	0.27
Mercury Low Level	M	2450	mg/kg	0.05	1.2	0.69	0.40
Molybdenum	M	2450	mg/kg	2.0	< 2.0	2.1	< 2.0
Antimony	N	2450	mg/kg	2.0	2.1	< 2.0	< 2.0
Copper	M	2450	mg/kg	0.50	200	14	7.9
Nickel	M	2450	mg/kg	0.50	8.9	13	7.8
Lead	M	2450	mg/kg	0.50	82	37	20
Selenium	M	2450	mg/kg	0.20	< 0.20	1.1	0.82
Zinc	M	2450	mg/kg	0.50	850	41	20
Chromium (Trivalent)	N	2490	mg/kg	1.0	12	11	5.7
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50
LOI	M	2610	%	0.10	3.0	4.3	4.1
Total Organic Carbon	M	2625	%	0.20	1.8	2.5	2.0
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10	< 10	< 10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43198	21-43198	21-43198
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1335242	1335246	1335248
Order No.:			Client Sample Ref.:		2	1	3
			Sample Location:		BH104	BH105A	BH105A
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.50	0.50	1.50
			Date Sampled:		06-Dec-2021	06-Dec-2021	06-Dec-2021
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10
Dichlorodifluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Chloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Vinyl Chloride	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Bromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Chloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Trichlorofluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,1-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Trans 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,1-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
cis 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Bromochloromethane	N	2760	µg/kg	0.50	< 0.50	< 0.50	< 0.50
Trichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,1,1-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Tetrachloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,1-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Benzene	N	2760	µg/kg	0.20	1.4	< 0.20	< 0.20
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Trichloroethene	N	2760	µg/kg	0.20	2.5	< 0.20	1.3
1,2-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Dibromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Bromodichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
cis-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Toluene	N	2760	µg/kg	0.20	3.1	1.7	2.0
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,1,2-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Tetrachloroethene	N	2760	µg/kg	0.20	15	11	6.7
1,3-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Dibromochloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,2-Dibromoethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Chlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,1,1,2-Tetrachloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Ethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20

Results - Soil

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Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43198	21-43198	21-43198
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1335242	1335246	1335248
Order No.:			Client Sample Ref.:		2	1	3
			Sample Location:		BH104	BH105A	BH105A
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.50	0.50	1.50
			Date Sampled:		06-Dec-2021	06-Dec-2021	06-Dec-2021
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
o-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
o-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
Styrene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Tribromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Isopropylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Bromobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,2,3-Trichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
N-Propylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
2-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,3,5-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
4-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Tert-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,2,4-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Sec-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,3-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
4-Isopropyltoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,4-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
N-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,2-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,2-Dibromo-3-Chloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,2,4-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Hexachlorobutadiene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
1,2,3-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Phenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2-Chlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Bis-(2-Chloroethyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
1,3-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
1,4-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
1,2-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Bis(2-Chloroisopropyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Hexachloroethane	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
N-Nitrosodi-n-propylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
4-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050

Results - Soil

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Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43198	21-43198	21-43198
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1335242	1335246	1335248
Order No.:			Client Sample Ref.:		2	1	3
			Sample Location:		BH104	BH105A	BH105A
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.50	0.50	1.50
			Date Sampled:		06-Dec-2021	06-Dec-2021	06-Dec-2021
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Nitrobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Isophorone	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2,4-Dimethylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Bis(2-Chloroethoxy)Methane	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2,4-Dichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
1,2,4-Trichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Naphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
4-Chloroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Hexachlorobutadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
4-Chloro-3-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2-Methylnaphthalene	N	2790	mg/kg	0.050	< 0.050	0.063	< 0.050
Hexachlorocyclopentadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2,4,6-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2,4,5-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2-Chloronaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Acenaphthylene	N	2790	mg/kg	0.050	< 0.050	0.073	< 0.050
Dimethylphthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2,6-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Acenaphthene	N	2790	mg/kg	0.050	< 0.050	0.094	< 0.050
3-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Dibenzofuran	N	2790	mg/kg	0.050	< 0.050	0.052	< 0.050
4-Chlorophenylphenylether	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2,4-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Fluorene	N	2790	mg/kg	0.050	< 0.050	0.12	< 0.050
Diethyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
4-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
2-Methyl-4,6-Dinitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Azobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
4-Bromophenylphenyl Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Hexachlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Pentachlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Phenanthrene	N	2790	mg/kg	0.050	< 0.050	0.94	0.29
Anthracene	N	2790	mg/kg	0.050	< 0.050	0.36	0.10
Carbazole	N	2790	mg/kg	0.050	< 0.050	0.073	< 0.050
Di-N-Butyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Fluoranthene	N	2790	mg/kg	0.050	0.082	2.1	0.64

Results - Soil

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Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43198	21-43198	21-43198
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1335242	1335246	1335248
Order No.:			Client Sample Ref.:		2	1	3
			Sample Location:		BH104	BH105A	BH105A
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.50	0.50	1.50
			Date Sampled:		06-Dec-2021	06-Dec-2021	06-Dec-2021
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Pyrene	N	2790	mg/kg	0.050	0.093	1.6	0.53
Butylbenzyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Benzo[a]anthracene	N	2790	mg/kg	0.050	< 0.050	1.1	0.37
Chrysene	N	2790	mg/kg	0.050	< 0.050	1.0	0.39
Bis(2-Ethylhexyl)Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Di-N-Octyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Benzo[b]fluoranthene	N	2790	mg/kg	0.050	0.093	1.3	0.47
Benzo[k]fluoranthene	N	2790	mg/kg	0.050	< 0.050	0.46	0.17
Benzo[a]pyrene	N	2790	mg/kg	0.050	< 0.050	1.0	0.34
Indeno(1,2,3-c,d)Pyrene	N	2790	mg/kg	0.050	< 0.050	0.53	0.18
Dibenz(a,h)Anthracene	N	2790	mg/kg	0.050	< 0.050	0.13	0.055
Benzo[g,h,i]perylene	N	2790	mg/kg	0.050	< 0.050	0.64	0.22
4-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10	0.15
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	0.13
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10	0.14
Phenanthrene	M	2800	mg/kg	0.10	< 0.10	1.0	0.97
Anthracene	M	2800	mg/kg	0.10	< 0.10	0.37	0.34
Fluoranthene	M	2800	mg/kg	0.10	0.31	2.3	2.2
Pyrene	M	2800	mg/kg	0.10	0.34	1.8	1.8
Benzo[a]anthracene	M	2800	mg/kg	0.10	0.23	1.6	1.2
Chrysene	M	2800	mg/kg	0.10	0.20	1.3	1.1
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	0.39	2.0	1.7
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	0.22	0.77	0.75
Benzo[a]pyrene	M	2800	mg/kg	0.10	0.33	1.5	1.4
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	1.1	0.97
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	0.31	0.21
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	0.90	0.78
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	2.0	15	14
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43198	21-43198	21-43198
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1335242	1335246	1335248
Order No.:			Client Sample Ref.:		2	1	3
			Sample Location:		BH104	BH105A	BH105A
			Sample Type:		SOIL	SOIL	SOIL
			Top Depth (m):		0.50	0.50	1.50
			Date Sampled:		06-Dec-2021	06-Dec-2021	06-Dec-2021
			Asbestos Lab:		DURHAM	DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**			
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10	< 0.10	< 0.10
SVOC TIC	N	2790	mg/kg	N/A	None Detected	None Detected	None Detected
VOC TIC	N	2760	µg/kg	N/A	None Detected	None Detected	None Detected

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
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
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
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.
2790	Semi-Volatile Organic Compounds (SVOCs) in Soils by GC-MS	Semi-volatile organic compounds(cf. USEPA Method 8270)	Acetone/Hexane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

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

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

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

Final Report

Report No.:	21-43771-1
Initial Date of Issue:	23-Dec-2021
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 Michelle Gaffney Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllist
Project	21-1298 BusConnects Galway

Quotation No.:	Q21-25429	**Date Received:**	10-Dec-2021
Order No.:		**Date Instructed:**	14-Dec-2021
No. of Samples:	1		
Turnaround (Wkdays):	7	**Results Due:**	22-Dec-2021
Date Approved:	23-Dec-2021		

Approved By:

Details: Glynn Harvey, Technical Manager

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

Results - Leachate

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		21-43771
Quotation No.: Q21-25429				**Chemtest Sample ID.:**		1337966
Order No.:				Client Sample Ref.:		1
				Sample Location:		BH106
				Sample Type:		SOIL
				Top Depth (m):		0.50
				Date Sampled:		06-Dec-2021
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**	
Total Dissolved Solids	N	1020	10:1	mg/l	1.0	39
Chloride	U	1220	10:1	mg/l	1.0	< 1.0
Fluoride	U	1220	10:1	mg/l	0.050	0.11
Sulphate	U	1220	10:1	mg/l	1.0	4.6
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	0.72
Barium (Dissolved)	U	1455	10:1	µg/l	5.00	< 5.0
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	1.2
Molybdenum (Dissolved)	U	1455	10:1	µg/l	0.20	2.1
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50
Antimony (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	< 2.5
Mercury Low Level	U	1460	10:1	µg/l	0.010	< 0.010
Dissolved Organic Carbon	U	1610	10:1	mg/l	2.0	3.0
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43771
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1337966
Order No.:			Client Sample Ref.:		1
			Sample Location:		BH106
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		06-Dec-2021
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
ACM Type	U	2192		N/A	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected
Moisture	N	2030	%	0.020	6.5
pH	M	2010		4.0	8.3
Arsenic	M	2450	mg/kg	1.0	7.1
Barium	M	2450	mg/kg	10	57
Cadmium	M	2450	mg/kg	0.10	0.62
Mercury Low Level	M	2450	mg/kg	0.05	0.18
Molybdenum	M	2450	mg/kg	2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0
Copper	M	2450	mg/kg	0.50	30
Nickel	M	2450	mg/kg	0.50	15
Lead	M	2450	mg/kg	0.50	29
Selenium	M	2450	mg/kg	0.20	< 0.20
Zinc	M	2450	mg/kg	0.50	37
Chromium (Trivalent)	N	2490	mg/kg	1.0	25
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50
LOI	M	2610	%	0.10	4.0
Total Organic Carbon	M	2625	%	0.20	1.7
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10	11
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	11
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	11
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	77
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0

Results - Soil

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		21-43771
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1337966
Order No.:			Client Sample Ref.:		1
			Sample Location:		BH106
			Sample Type:		SOIL
			Top Depth (m):		0.50
			Date Sampled:		06-Dec-2021
			Asbestos Lab:		COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**	
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	77
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	87
Benzene	M	2760	µg/kg	1.0	< 1.0
Toluene	M	2760	µg/kg	1.0	< 1.0
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0
o-Xylene	M	2760	µg/kg	1.0	< 1.0
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0
Naphthalene	M	2800	mg/kg	0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	0.14
Anthracene	M	2800	mg/kg	0.10	0.11
Fluoranthene	M	2800	mg/kg	0.10	0.31
Pyrene	M	2800	mg/kg	0.10	0.34
Benzo[a]anthracene	M	2800	mg/kg	0.10	0.34
Chrysene	M	2800	mg/kg	0.10	0.23
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	0.37
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	0.29
Benzo[a]pyrene	M	2800	mg/kg	0.10	0.34
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	0.35
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	0.23
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	0.31
Coronene	N	2800	mg/kg	0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	3.4
PCB 28	U	2815	mg/kg	0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010
PCB 138	U	2815	mg/kg	0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
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
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
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.

Test Methods

SOP	Title	Parameters included	Method summary
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

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

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

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

Final Report

Report No.:	22-01488-1
Initial Date of Issue:	02-Feb-2022
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 Michelle Gaffney Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllist
Project	21-1298 Bus Connects Galway
Quotation No.:	Q21-25429
Date Received:	18-Jan-2022
Order No.:	
Date Instructed:	25-Jan-2022
No. of Samples:	2
Turnaround (Wkdays):	7
Results Due:	02-Feb-2022
Date Approved:	02-Feb-2022
Approved By:	
Details:	Stuart Henderson, Technical Manager

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

Results - Leachate

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		22-01488	22-01488
Quotation No.: Q21-25429				**Chemtest Sample ID.:**		1353352	1357450
Order No.:				Client Sample Ref.:		1	2
				Sample Location:		BH103	BH103
				Sample Type:		SOIL	SOIL
				Top Depth (m):		0.50	1.00
				Date Sampled:		17-Jan-2022	21-Jan-2022
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**		
Total Dissolved Solids	N	1020	10:1	mg/l	1.0	46	42
Chloride	U	1220	10:1	mg/l	1.0	1.1	< 1.0
Fluoride	U	1220	10:1	mg/l	0.050	0.22	0.12
Sulphate	U	1220	10:1	mg/l	1.0	4.7	1.7
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	0.60	1.3
Barium (Dissolved)	U	1455	10:1	µg/l	5.00	< 5.0	< 5.0
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11	0.14
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	0.82	< 0.50
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	1.1	1.6
Molybdenum (Dissolved)	U	1455	10:1	µg/l	0.20	1.1	1.9
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	0.81
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	< 0.50
Antimony (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	< 0.50
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	1.2	< 0.50
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	< 2.5	< 2.5
Mercury Low Level	U	1460	10:1	µg/l	0.010	0.13	< 0.010
Dissolved Organic Carbon	U	1610	10:1	mg/l	2.0	2.1	3.8
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030	< 0.030

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-01488	22-01488
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1353352	1357450
Order No.:			Client Sample Ref.:		1	2
			Sample Location:		BH103	BH103
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		17-Jan-2022	21-Jan-2022
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	2.2	6.4
pH	M	2010		4.0	10.1	9.4
Arsenic	M	2450	mg/kg	1.0	15	16
Barium	M	2450	mg/kg	10	20	35
Cadmium	M	2450	mg/kg	0.10	0.40	0.60
Mercury Low Level	M	2450	mg/kg	0.05	< 0.05	0.13
Molybdenum	M	2450	mg/kg	2.0	< 2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	3.2	< 2.0
Copper	M	2450	mg/kg	0.50	10	12
Nickel	M	2450	mg/kg	0.50	18	17
Lead	M	2450	mg/kg	0.50	9.0	20
Selenium	M	2450	mg/kg	0.20	1.2	< 0.20
Zinc	M	2450	mg/kg	0.50	13	37
Chromium (Trivalent)	N	2490	mg/kg	1.0	8.8	13
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50
LOI	M	2610	%	0.10	1.1	1.3
Total Organic Carbon	M	2625	%	0.20	5.0	4.1
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10	79	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	79	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	79	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	170	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-01488	22-01488
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1353352	1357450
Order No.:			Client Sample Ref.:		1	2
			Sample Location:		BH103	BH103
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		17-Jan-2022	21-Jan-2022
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	170	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	250	< 10
Dichlorodifluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetraethyl Lead	N	2760	µg/kg	10	< 10	< 10
Tetramethyl Lead	N	2760	µg/kg	10	< 10	< 10
Chloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Vinyl Chloride	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chloroethane	N	2760	µg/kg	0.20	< 0.20	1.1
Trichlorofluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trans 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromochloromethane	N	2760	µg/kg	0.50	< 0.50	< 0.50
Trichloromethane	N	2760	µg/kg	0.20	5.4	8.9
1,1,1-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0
1,2-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Trichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Dibromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromodichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
cis-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Toluene	N	2760	µg/kg	0.20	3.5	< 0.20
Toluene	M	2760	µg/kg	1.0	3.5	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,2-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tetrachloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichloropropane	N	2760	µg/kg	0.20	1.5	< 0.20
Dibromochloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromoethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Chlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,1,1,2-Tetrachloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Ethylbenzene	N	2760	µg/kg	0.20	1.2	< 0.20

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-01488	22-01488
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1353352	1357450
Order No.:			Client Sample Ref.:		1	2
			Sample Location:		BH103	BH103
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		17-Jan-2022	21-Jan-2022
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Ethylbenzene	M	2760	µg/kg	1.0	1.2	< 1.0
m & p-Xylene	N	2760	µg/kg	0.20	4.5	< 0.20
m & p-Xylene	M	2760	µg/kg	1.0	4.4	< 1.0
o-Xylene	N	2760	µg/kg	0.20	2.4	< 0.20
o-Xylene	M	2760	µg/kg	1.0	2.4	< 1.0
Styrene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tribromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20
Isopropylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Bromobenzene	N	2760	µg/kg	0.20	0.57	< 0.20
1,2,3-Trichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Propylbenzene	N	2760	µg/kg	0.20	2.6	< 0.20
2-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3,5-Trimethylbenzene	N	2760	µg/kg	0.20	0.89	< 0.20
4-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Tert-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trimethylbenzene	N	2760	µg/kg	0.20	3.3	< 0.20
Sec-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,3-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
4-Isopropyltoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,4-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
N-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2-Dibromo-3-Chloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,4-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Hexachlorobutadiene	N	2760	µg/kg	0.20	< 0.20	< 0.20
1,2,3-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	N	2760	µg/kg	0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Chlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis-(2-Chloroethyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,3-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,4-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Chloroisopropyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachloroethane	N	2790	mg/kg	0.050	< 0.050	< 0.050

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-01488	22-01488
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1353352	1357450
Order No.:			Client Sample Ref.:		1	2
			Sample Location:		BH103	BH103
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		17-Jan-2022	21-Jan-2022
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
N-Nitrosodi-n-propylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Nitrobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Isophorone	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dimethylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Chloroethoxy)Methane	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
1,2,4-Trichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chloroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobutadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chloro-3-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methylnaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorocyclopentadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,6-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4,5-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Chloronaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthylene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dimethylphthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,6-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Acenaphthene	N	2790	mg/kg	0.050	< 0.050	< 0.050
3-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dibenzofuran	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Chlorophenylphenylether	N	2790	mg/kg	0.050	< 0.050	< 0.050
2,4-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluorene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Diethyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050
2-Methyl-4,6-Dinitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Azobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Bromophenylphenyl Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050
Hexachlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Pentachlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Phenanthrene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Anthracene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Carbazole	N	2790	mg/kg	0.050	< 0.050	< 0.050

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-01488	22-01488
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1353352	1357450
Order No.:			Client Sample Ref.:		1	2
			Sample Location:		BH103	BH103
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		17-Jan-2022	21-Jan-2022
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Di-N-Butyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Fluoranthene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Pyrene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Butylbenzyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[a]anthracene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Chrysene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Bis(2-Ethylhexyl)Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Di-N-Octyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[b]fluoranthene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[k]fluoranthene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[a]pyrene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Indeno(1,2,3-c,d)Pyrene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Dibenz(a,h)Anthracene	N	2790	mg/kg	0.050	< 0.050	< 0.050
Benzo[g,h,i]perylene	N	2790	mg/kg	0.050	< 0.050	< 0.050
4-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	0.16	0.13
Pyrene	M	2800	mg/kg	0.10	0.12	0.13
Benzo[a]anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Chrysene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-01488	22-01488
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1353352	1357450
Order No.:			Client Sample Ref.:		1	2
			Sample Location:		BH103	BH103
			Sample Type:		SOIL	SOIL
			Top Depth (m):		0.50	1.00
			Date Sampled:		17-Jan-2022	21-Jan-2022
			Asbestos Lab:		DURHAM	DURHAM
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10	< 0.10
SVOC TIC	N	2790	mg/kg	N/A	None Detected	None Detected
VOC TIC	N	2760	µg/kg	N/A	None Detected	None Detected

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
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
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
2730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2790	Semi-Volatile Organic Compounds (SVOCs) in Soils by GC-MS	Semi-volatile organic compounds(cf. USEPA Method 8270)	Acetone/Hexane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

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

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

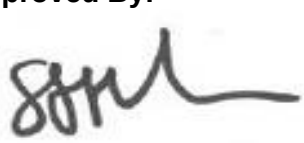
All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

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

Final Report

Report No.:	22-02373-1
Initial Date of Issue:	31-Jan-2022
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 Michelle Gaffney Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllist
Project	21-1298 Bus Connects Galway
Quotation No.:	Q21-25429
Date Received:	24-Jan-2022
Order No.:	
Date Instructed:	25-Jan-2022
No. of Samples:	4
Turnaround (Wkdays):	5
Results Due:	31-Jan-2022
Date Approved:	31-Jan-2022
Approved By:	



Details:	Stuart Henderson, Technical Manager

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

Results - Leachate

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd				**Chemtest Job No.:**		22-02373	22-02373	22-02373	22-02373
Quotation No.: Q21-25429				**Chemtest Sample ID.:**		1357445	1357446	1357449	1357451
Order No.:				Client Sample Ref.:		1	2	1	3
				Sample Location:		WS104	WS104	BH103WS	BH103WS
				Sample Type:		SOIL	SOIL	SOIL	SOIL
				Top Depth (m):		0.50	1.00	0.50	1.50
				Date Sampled:		21-Jan-2022	21-Jan-2022	21-Jan-2022	21-Jan-2022
Determinand	**Accred.**	**SOP**	**Type**	**Units**	**LOD**				
Total Dissolved Solids	N	1020	10:1	mg/l	1.0	39	68	39	65
Chloride	U	1220	10:1	mg/l	1.0	< 1.0	1.1	< 1.0	1.7
Fluoride	U	1220	10:1	mg/l	0.050	0.17	0.11	0.21	0.20
Sulphate	U	1220	10:1	mg/l	1.0	2.8	< 1.0	4.1	2.8
Arsenic (Dissolved)	U	1455	10:1	µg/l	0.20	1.2	2.3	0.50	2.3
Barium (Dissolved)	U	1455	10:1	µg/l	5.00	< 5.0	< 5.0	< 5.0	< 5.0
Cadmium (Dissolved)	U	1455	10:1	µg/l	0.11	< 0.11	< 0.11	< 0.11	0.20
Chromium (Dissolved)	U	1455	10:1	µg/l	0.50	0.92	0.52	0.75	1.2
Copper (Dissolved)	U	1455	10:1	µg/l	0.50	1.1	14	1.4	3.4
Molybdenum (Dissolved)	U	1455	10:1	µg/l	0.20	0.75	0.86	1.1	3.0
Nickel (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	< 0.50	< 0.50	2.1
Lead (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	1.0	< 0.50	1.2
Antimony (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	< 0.50	< 0.50	0.52
Selenium (Dissolved)	U	1455	10:1	µg/l	0.50	< 0.50	< 0.50	0.93	2.3
Zinc (Dissolved)	U	1455	10:1	µg/l	2.5	< 2.5	< 2.5	< 2.5	< 2.5
Mercury Low Level	U	1460	10:1	µg/l	0.010	0.24	0.23	< 0.010	< 0.010
Dissolved Organic Carbon	U	1610	10:1	mg/l	2.0	4.3	11	< 2.0	9.0
Total Phenols	U	1920	10:1	mg/l	0.030	< 0.030	< 0.030	< 0.030	< 0.030

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-02373	22-02373	22-02373	22-02373
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1357445	1357446	1357449	1357451
Order No.:			Client Sample Ref.:		1	2	1	3
			Sample Location:		WS104	WS104	BH103WS	BH103WS
			Sample Type:		SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.50	1.00	0.50	1.50
			Date Sampled:		21-Jan-2022	21-Jan-2022	21-Jan-2022	21-Jan-2022
			Asbestos Lab:		NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
ACM Type	U	2192		N/A	-	-	-	-
Asbestos Identification	U	2192		N/A	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	0.25	6.9	1.5	5.9
pH	M	2010		4.0	9.3	8.6	9.9	8.9
Arsenic	M	2450	mg/kg	1.0	12	5.1	15	16
Barium	M	2450	mg/kg	10	19	12	17	15
Cadmium	M	2450	mg/kg	0.10	0.39	0.37	0.43	0.60
Mercury Low Level	M	2450	mg/kg	0.05	< 0.05	0.07	< 0.05	< 0.05
Molybdenum	M	2450	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0
Antimony	N	2450	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0
Copper	M	2450	mg/kg	0.50	6.1	15	9.4	5.7
Nickel	M	2450	mg/kg	0.50	6.8	3.8	14	8.8
Lead	M	2450	mg/kg	0.50	15	12	7.6	6.6
Selenium	M	2450	mg/kg	0.20	< 0.20	< 0.20	0.99	< 0.20
Zinc	M	2450	mg/kg	0.50	8.2	8.8	11	9.1
Chromium (Trivalent)	N	2490	mg/kg	1.0	6.8	5.7	7.2	10
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
LOI	M	2610	%	0.10	0.93	2.0	0.88	0.74
Total Organic Carbon	M	2625	%	0.20	6.5	4.3	6.3	4.0
Mineral Oil (TPH Calculation)	N	2670	mg/kg	10	< 10	< 10	< 10	< 10
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C21-C35	M	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-02373	22-02373	22-02373	22-02373
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1357445	1357446	1357449	1357451
Order No.:			Client Sample Ref.:		1	2	1	3
			Sample Location:		WS104	WS104	BH103WS	BH103WS
			Sample Type:		SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.50	1.00	0.50	1.50
			Date Sampled:		21-Jan-2022	21-Jan-2022	21-Jan-2022	21-Jan-2022
			Asbestos Lab:		NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10
Dichlorodifluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Tetraethyl Lead	N	2760	µg/kg	10	< 10	< 10	< 10	< 10
Tetramethyl Lead	N	2760	µg/kg	10	< 10	< 10	< 10	< 10
Chloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Vinyl Chloride	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Bromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Trichlorofluoromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,1-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Trans 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,1-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
cis 1,2-Dichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Bromochloromethane	N	2760	µg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50
Trichloromethane	N	2760	µg/kg	0.20	5.3	< 0.20	6.5	< 0.20
1,1,1-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Tetrachloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,1-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Benzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Benzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
1,2-Dichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Trichloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,2-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Dibromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Bromodichloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
cis-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Toluene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Toluene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Trans-1,3-Dichloropropene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,1,2-Trichloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Tetrachloroethene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,3-Dichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Dibromochloromethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,2-Dibromoethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Chlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,1,1,2-Tetrachloroethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Ethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-02373	22-02373	22-02373	22-02373
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1357445	1357446	1357449	1357451
Order No.:			Client Sample Ref.:		1	2	1	3
			Sample Location:		WS104	WS104	BH103WS	BH103WS
			Sample Type:		SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.50	1.00	0.50	1.50
			Date Sampled:		21-Jan-2022	21-Jan-2022	21-Jan-2022	21-Jan-2022
			Asbestos Lab:		NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Ethylbenzene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
m & p-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
o-Xylene	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
Styrene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Tribromomethane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Isopropylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Bromobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,2,3-Trichloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
N-Propylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
2-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,3,5-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
4-Chlorotoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Tert-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,2,4-Trimethylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Sec-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,3-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
4-Isopropyltoluene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,4-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
N-Butylbenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,2-Dichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,2-Dibromo-3-Chloropropane	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,2,4-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Hexachlorobutadiene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
1,2,3-Trichlorobenzene	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	N	2760	µg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20
Methyl Tert-Butyl Ether	M	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0
N-Nitrosodimethylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-Chlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Bis-(2-Chloroethyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,3-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,4-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,2-Dichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Bis(2-Chloroisopropyl)Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Hexachloroethane	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-02373	22-02373	22-02373	22-02373
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1357445	1357446	1357449	1357451
Order No.:			Client Sample Ref.:		1	2	1	3
			Sample Location:		WS104	WS104	BH103WS	BH103WS
			Sample Type:		SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.50	1.00	0.50	1.50
			Date Sampled:		21-Jan-2022	21-Jan-2022	21-Jan-2022	21-Jan-2022
			Asbestos Lab:		NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
N-Nitrosodi-n-propylamine	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Nitrobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Isophorone	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2,4-Dimethylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Bis(2-Chloroethoxy)Methane	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2,4-Dichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
1,2,4-Trichlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Naphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Chloroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Hexachlorobutadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Chloro-3-Methylphenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-Methylnaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Hexachlorocyclopentadiene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2,4,6-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2,4,5-Trichlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-Chloronaphthalene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Acenaphthylene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dimethylphthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2,6-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Acenaphthene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
3-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dibenzofuran	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Chlorophenylphenylether	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2,4-Dinitrotoluene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluorene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Diethyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Nitroaniline	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
2-Methyl-4,6-Dinitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Azobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Bromophenylphenyl Ether	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Hexachlorobenzene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Pentachlorophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phenanthrene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Anthracene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Carbazole	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-02373	22-02373	22-02373	22-02373
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1357445	1357446	1357449	1357451
Order No.:			Client Sample Ref.:		1	2	1	3
			Sample Location:		WS104	WS104	BH103WS	BH103WS
			Sample Type:		SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.50	1.00	0.50	1.50
			Date Sampled:		21-Jan-2022	21-Jan-2022	21-Jan-2022	21-Jan-2022
			Asbestos Lab:		NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
Di-N-Butyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Fluoranthene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Pyrene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Butylbenzyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo[a]anthracene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Chrysene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Bis(2-Ethylhexyl)Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Di-N-Octyl Phthalate	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo[b]fluoranthene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo[k]fluoranthene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo[a]pyrene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Indeno(1,2,3-c,d)Pyrene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Dibenz(a,h)Anthracene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Benzo[g,h,i]perylene	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Nitrophenol	N	2790	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050
Naphthalene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]anthracene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	M	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Coronene	N	2800	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 17 PAH's	N	2800	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0
PCB 28	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 52	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 90+101	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 118	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 153	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010

Results - Soil

Project: 21-1298 Bus Connects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-02373	22-02373	22-02373	22-02373
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1357445	1357446	1357449	1357451
Order No.:			Client Sample Ref.:		1	2	1	3
			Sample Location:		WS104	WS104	BH103WS	BH103WS
			Sample Type:		SOIL	SOIL	SOIL	SOIL
			Top Depth (m):		0.50	1.00	0.50	1.50
			Date Sampled:		21-Jan-2022	21-Jan-2022	21-Jan-2022	21-Jan-2022
			Asbestos Lab:		NEW-ASB	NEW-ASB	NEW-ASB	NEW-ASB
Determinand	**Accred.**	**SOP**	**Units**	**LOD**				
PCB 138	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010
PCB 180	U	2815	mg/kg	0.010	< 0.010	< 0.010	< 0.010	< 0.010
Total PCBs (7 Congeners)	U	2815	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10
SVOC TIC	N	2790	mg/kg	N/A	None Detected	None Detected	None Detected	None Detected
VOC TIC	N	2760	µg/kg	N/A	None Detected	None Detected	None Detected	None Detected

Test Methods

SOP	Title	Parameters included	Method summary
1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
1220	Anions, Alkalinity & Ammonium in Waters	Fluoride; Chloride; Nitrite; Nitrate; Total; Oxidisable Nitrogen (TON); Sulfate; Phosphate; Alkalinity; Ammonium	Automated colorimetric analysis using 'Aquakem 600' Discrete Analyser.
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
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
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
2730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection
2760	Volatile Organic Compounds (VOCs) in Soils by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics.(cf. USEPA Method 8260)*please refer to UKAS schedule	Automated headspace gas chromatographic (GC) analysis of a soil sample, as received, with mass spectrometric (MS) detection of volatile organic compounds.
2790	Semi-Volatile Organic Compounds (SVOCs) in Soils by GC-MS	Semi-volatile organic compounds(cf. USEPA Method 8270)	Acetone/Hexane extraction / GC-MS

Test Methods

SOP	Title	Parameters included	Method summary
2800	Speciated Polynuclear Aromatic Hydrocarbons (PAH) in Soil by GC-MS	Acenaphthene*; Acenaphthylene; Anthracene*; Benzo[a]Anthracene*; Benzo[a]Pyrene*; Benzo[b]Fluoranthene*; Benzo[ghi]Perylene*; Benzo[k]Fluoranthene; Chrysene*; Dibenz[ah]Anthracene; Fluoranthene*; Fluorene*; Indeno[123cd]Pyrene*; Naphthalene*; Phenanthrene*; Pyrene*	Dichloromethane extraction / GC-MS
2815	Polychlorinated Biphenyls (PCB) ICES7Congeners in Soils by GC-MS	ICES7 PCB congeners	Acetone/Hexane extraction / GC-MS
640	Characterisation of Waste (Leaching C10)	Waste material including soil, sludges and granular waste	ComplianceTest for Leaching of Granular Waste Material and Sludge

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

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

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

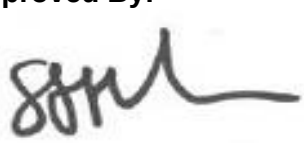
If you require extended retention of samples, please email your requirements to:
customerservices@chemtest.com

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

UKAS TESTING
2183

Final Report

Report No.:	22-03384-1
Initial Date of Issue:	10-Feb-2022
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Sean Ross Carin Cornwall Colm Hurley Darren O'Mahony Gabriella Horan Joe Gervin John Cameron Lucy Newland Martin Gardiner Matthew Gilbert Michelle Gaffney Neil Haggan Patrick Higgins Paul Dunlop Stephen Franey Stephen Watson Stuart Abraham
Project	21-1298 BusConnects Galway
Quotation No.:	Q21-25429
Order No.:	
No. of Samples:	6
Turnaround (Wkdays):	10
Date Approved:	10-Feb-2022
Approved By:	



Date Received:	31-Jan-2022
Date Instructed:	31-Jan-2022
Results Due:	11-Feb-2022

Details: Stuart Henderson, Technical Manager

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

Results - Water

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-03384	22-03384	22-03384	22-03384	22-03384	22-03384
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1362304	1362305	1362306	1362307	1362308	1362310
			Sample Location:		BH102	BH103WS	BH103	BH104	BH105	WS104
			Sample Type:		WATER	WATER	WATER	WATER	WATER	WATER
			Date Sampled:		27-Jan-2022	27-Jan-2022	27-Jan-2022	27-Jan-2022	27-Jan-2022	27-Jan-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Suspended Solids At 105C	U	1030	mg/l	5.0	140	540	180	220	64	18
Total Dissolved Solids	N	1020	mg/l	1.0	380	530	530	7200	600	470
Biochemical Oxygen Demand Low Level	N	1090	mg O2/l	1.0	[B] < 1.0	[B] 1.1	[B] < 1.0	[B] 1.1	[B] < 1.0	[B] 3.4
Chemical Oxygen Demand	U	1100	mg O2/l	10	[B] 12	[B] 10	[B] < 10	[B] 57	[B] < 10	[B] < 10
Alkalinity (Total)	U	1220	mg/l	10	190	370	300	580	300	260
Chloride	U	1220	mg/l	1.0	36	46	66	3200	54	48
Ammoniacal Nitrogen	U	1220	mg/l	0.050	0.093	0.078	0.47	2.6	0.12	0.12
Nitrate	U	1220	mg/l	0.50	4.5	7.2	< 0.50	< 0.50	5.1	4.4
Phosphate	U	1220	mg/l	0.200	< 0.20	< 0.20	< 0.20	< 0.20	0.20	< 0.20
Sulphate	U	1220	mg/l	1.0	66	72	54	380	73	60
Calcium	U	1455	mg/l	2.00	130	49	160	170	93	97
Potassium	U	1455	mg/l	0.50	5.0	4.7	7.0	66	7.8	5.8
Magnesium	U	1455	mg/l	0.20	5.7	7.1	10	200	14	5.5
Sodium	U	1455	mg/l	1.50	22	140	45	1900	140	30
Arsenic (Dissolved)	U	1455	µg/l	0.20	2.9	0.86	19	87	4.4	0.50
Barium (Dissolved)	U	1455	µg/l	5.00	53	40	50	60	35	27
Cadmium (Dissolved)	U	1455	µg/l	0.11	0.70	4.8	1.1	0.13	2.0	0.54
Copper (Dissolved)	U	1455	µg/l	0.50	14	18	52	0.73	9.8	2.9
Iron (Dissolved)	N	1455	µg/l	5.0	2000	340	2800	110	180	6.7
Manganese (Dissolved)	U	1455	µg/l	0.50	250	27	1500	120	39	180
Molybdenum (Dissolved)	U	1455	µg/l	0.20	360	140	50	27	19	3.0
Nickel (Dissolved)	U	1455	µg/l	0.50	4.5	4.2	4.3	78	6.4	1.6
Lead (Dissolved)	U	1455	µg/l	0.50	13	7.5	32	< 0.50	4.3	0.76
Antimony (Dissolved)	U	1455	µg/l	0.50	4.8	0.79	1.2	9.2	1.3	0.72
Selenium (Dissolved)	U	1455	µg/l	0.50	5.6	29	< 0.50	1.2	13	3.0
Zinc (Dissolved)	U	1455	µg/l	2.5	41	55	150	7.1	41	7.5
Mercury Low Level	U	1460	µg/l	0.010	< 0.010	< 0.010	< 0.010	0.047	0.081	0.16
Low-Level Chromium (Hexavalent)	U	1495	µg/l	0.10	[B] 3.9	[B] 2.6	[B] 3.5	[B] 0.20	[B] < 0.10	[B] 2.1
Chromium (Trivalent) LL	U	1450	µg/l	1	3	< 1	< 1	2	1	< 1
Mineral Oil (TPH Calculation)	N	1670	µg/l	10	< 10	< 10	< 10	< 10	< 10	< 10
Aliphatic TPH >C5-C6	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C6-C8	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Aliphatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C7-C8	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10

Results - Water

Project: 21-1298 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-03384	22-03384	22-03384	22-03384	22-03384	22-03384
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1362304	1362305	1362306	1362307	1362308	1362310
			Sample Location:		BH102	BH103WS	BH103	BH104	BH105	WS104
			Sample Type:		WATER	WATER	WATER	WATER	WATER	WATER
			Date Sampled:		27-Jan-2022	27-Jan-2022	27-Jan-2022	27-Jan-2022	27-Jan-2022	27-Jan-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**						
Aromatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Aromatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	1675	µg/l	10	< 10	< 10	< 10	< 10	< 10	< 10
Total Petroleum Hydrocarbons	N	1675	µg/l	10	< 10	< 10	< 10	< 10	< 10	< 10
Organolead Compounds	N	1730	µg/l	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050

Deviations

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

Sample:	Sample Ref:	Sample ID:	Sample Location:	Sampled Date:	Deviation Code(s):	Containers Received:
1362304			BH102	27-Jan-2022	B	Coloured Winchester 1000ml
1362304			BH102	27-Jan-2022	B	EPA Vial 40ml
1362304			BH102	27-Jan-2022	B	Plastic Bottle 1000ml
1362305			BH103WS	27-Jan-2022	B	Coloured Winchester 1000ml
1362305			BH103WS	27-Jan-2022	B	EPA Vial 40ml
1362305			BH103WS	27-Jan-2022	B	Plastic Bottle 1000ml
1362306			BH103	27-Jan-2022	B	Coloured Winchester 1000ml
1362306			BH103	27-Jan-2022	B	EPA Vial 40ml
1362306			BH103	27-Jan-2022	B	Plastic Bottle 1000ml
1362307			BH104	27-Jan-2022	B	Coloured Winchester 1000ml
1362307			BH104	27-Jan-2022	B	EPA Vial 40ml
1362307			BH104	27-Jan-2022	B	Plastic Bottle 1000ml
1362308			BH105	27-Jan-2022	B	Coloured Winchester 1000ml
1362308			BH105	27-Jan-2022	B	EPA Vial 40ml
1362308			BH105	27-Jan-2022	B	Plastic Bottle 1000ml
1362310			WS104	27-Jan-2022	B	Coloured Winchester 1000ml
1362310			WS104	27-Jan-2022	B	EPA Vial 40ml
1362310			WS104	27-Jan-2022	B	Plastic Bottle 1000ml

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
1030	Total Suspended Solids	Total suspended solids	Filtration of a mixed sample through a standard glass fibre filter and determination of the mass of residue retained dried at 105°C.
1090	Biochemical Oxygen Demand	Biochemical Oxygen demand (BOD)	Colorimetric determination of dissolved oxygen in seeded sample after 5 days incubation at 20°C.
1100	Chemical Oxygen Demand	Chemical Oxygen demand (COD)	Dichromate oxidation of organic matter in sample followed by colorimetric determination of residual Cr[VI].
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).
1455	Metals in Waters by ICP-MS	Metals, including: Antimony; Arsenic; Barium; Beryllium; Boron; Cadmium; Chromium; Cobalt; Copper; Lead; Manganese; Mercury; Molybdenum; Nickel; Selenium; Tin; Vanadium; Zinc	Filtration of samples followed by direct determination by inductively coupled plasma mass spectrometry (ICP-MS).
1460	Mercury low-level in Waters by AFS	Mercury	Atomic Fluorescence Spectrometry, with collimated UV source, wavelength 253.7 nm.
1495	Low Level Hexavalent Chromium in Waters	Chromium [VI]	Colorimetric determination of hexavalent chromium expressed as Cr (VI) µg/l in water, using Ion Chromatography and UV-visible spectrophotometry.
1670	Total Petroleum Hydrocarbons (TPH) in Waters by GC-FID	TPH (C6–C40); optional carbon banding, e.g. 3-band – GRO, DRO & LRO	Pentane extraction / GC FID detection
1675	TPH Aliphatic/Aromatic split in Waters by GC-FID(cf. Texas Method 1006 / TPH CWG)	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	Pentane extraction / GCxGC FID detection
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection
1760	Volatile Organic Compounds (VOCs) in Waters by Headspace GC-MS	Volatile organic compounds, including BTEX and halogenated Aliphatic/Aromatics. (cf. USEPA Method 8260)	Automated headspace gas chromatographic (GC) analysis of water samples with mass spectrometric (MS) detection of volatile organic compounds.

Report Information

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U	UKAS accredited
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I/S	Insufficient Sample
U/S	Unsuitable Sample
N/E	not evaluated
<	"less than"
>	"greater than"
SOP	Standard operating procedure
LOD	Limit of detection

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis

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

For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 30 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

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

Final Report

Report No.:	22-03745-1
Initial Date of Issue:	15-Feb-2022
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 Michelle Gaffney Neil Haggan Paul Dunlop Sean Ross Stephen Franey Stephen Watson Stuart Abraham Thomas McAllist
Project	21-1296 BusConnects Galway
Quotation No.:	Q21-25429
Date Received:	02-Feb-2022
Order No.:	
Date Instructed:	02-Feb-2022
No. of Samples:	2
Turnaround (Wkdays):	10
Results Due:	15-Feb-2022
Date Approved:	15-Feb-2022
Approved By:	
Details:	Stuart Henderson, Technical Manager

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

Results - Water

Project: 21-1296 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-03745	22-03745
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1364157	1364158
Order No.:			Client Sample Ref.:		1	1
			Sample Location:		SW1	SW2
			Sample Type:		WATER	WATER
			Top Depth (m):		0.00	0.00
			Date Sampled:		31-Jan-2022	31-Jan-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Suspended Solids At 105C	U	1030	mg/l	5.0	550	55
Total Dissolved Solids	N	1020	mg/l	1.0	380	5500
Biochemical Oxygen Demand Low Level	N	1090	mg O2/l	1.0	18	4.0
Chemical Oxygen Demand	U	1100	mg O2/l	10	66	91
Alkalinity (Total)	U	1220	mg/l	10	230	200
Chloride	U	1220	mg/l	1.0	50	2600
Ammoniacal Nitrogen	U	1220	mg/l	0.050	0.44	0.14
Nitrate	U	1220	mg/l	0.50	5.4	1.7
Phosphate	U	1220	mg/l	0.200	0.40	< 0.20
Sulphate	U	1220	mg/l	1.0	58	410
Calcium	U	1455	mg/l	2.00	84	120
Potassium	U	1455	mg/l	0.50	3.8	51
Magnesium	U	1455	mg/l	0.20	5.3	160
Sodium	U	1455	mg/l	1.50	32	1800
Arsenic (Dissolved)	U	1455	µg/l	0.20	0.70	0.50
Barium (Dissolved)	U	1455	µg/l	5.00	20	18
Cadmium (Dissolved)	U	1455	µg/l	0.11	0.14	< 0.11
Copper (Dissolved)	U	1455	µg/l	0.50	3.7	4.8
Iron (Dissolved)	N	1455	µg/l	5.0	42	< 5.0
Manganese (Dissolved)	U	1455	µg/l	0.50	38	6.8
Molybdenum (Dissolved)	U	1455	µg/l	0.20	7.9	7.7
Nickel (Dissolved)	U	1455	µg/l	0.50	9.3	1.1
Lead (Dissolved)	U	1455	µg/l	0.50	2.3	< 0.50
Antimony (Dissolved)	U	1455	µg/l	0.50	1.8	0.65
Selenium (Dissolved)	U	1455	µg/l	0.50	1.4	1.5
Zinc (Dissolved)	U	1455	µg/l	2.5	190	14
Mercury Low Level	U	1460	µg/l	0.010	< 0.010	< 0.010
Low-Level Chromium (Hexavalent)	U	1495	µg/l	0.10	< 0.10	< 0.10
Chromium (Trivalent) LL	U	1450	µg/l	1	2	13
Mineral Oil (TPH Calculation)	N	1670	µg/l	10	< 10	< 10
Aliphatic TPH >C5-C6	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C6-C8	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10
Aliphatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10
Total Aliphatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0	< 5.0

Results - Water

Project: 21-1296 BusConnects Galway

Client: Causeway Geotech Ltd			**Chemtest Job No.:**		22-03745	22-03745
Quotation No.: Q21-25429			**Chemtest Sample ID.:**		1364157	1364158
Order No.:			Client Sample Ref.:		1	1
			Sample Location:		SW1	SW2
			Sample Type:		WATER	WATER
			Top Depth (m):		0.00	0.00
			Date Sampled:		31-Jan-2022	31-Jan-2022
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Aromatic TPH >C5-C7	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C7-C8	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C8-C10	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C10-C12	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C12-C16	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C16-C21	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C21-C35	N	1675	µg/l	0.10	< 0.10	< 0.10
Aromatic TPH >C35-C44	N	1675	µg/l	0.10	< 0.10	< 0.10
Total Aromatic Hydrocarbons	N	1675	µg/l	5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	1675	µg/l	10	< 10	< 10
Total Petroleum Hydrocarbons	N	1675	µg/l	10	< 10	< 10
Organolead Compounds	N	1730	µg/l	0.050	< 0.050	< 0.050

Test Methods

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1020	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Electrical Conductivity and Total Dissolved Solids (TDS) in Waters	Conductivity Meter
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1675	TPH Aliphatic/Aromatic split in Waters by GC-FID(cf. Texas Method 1006 / TPH CWG)	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	Pentane extraction / GCxGC FID detection
1730	Organo-Leads	Organo-Leads	Solvent extraction / GCMS detection
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customerservices@chemtest.com

CAUSEWAY GEOTECH

APPENDIX G

SPT HAMMER ENERGY MEASUREMENT REPORT

SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

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

SPT Hammer Ref:	0200
Test Date:	27/02/2021
Report Date:	01/03/2021
File Name:	0200.spt
Test Operator:	NPB

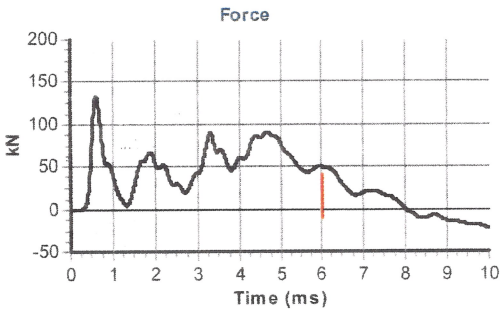
Instrumented Rod Data

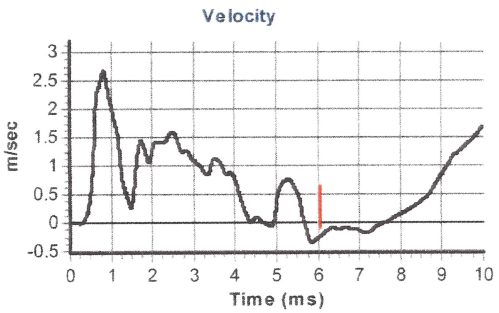
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.3
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	6458
Accelerometer No.2:	9607

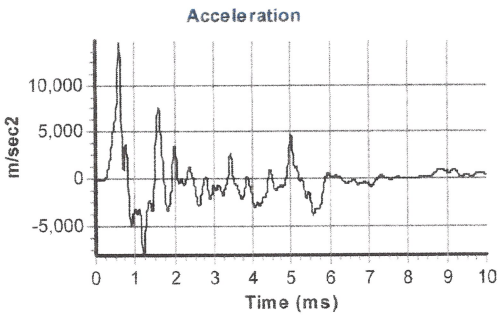
SPT Hammer Information

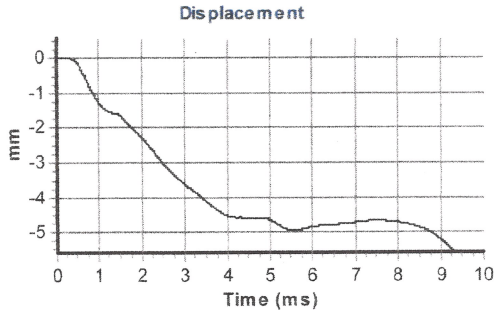
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	11.0

Comments / Location
BALLYMONEY









Calculations

Area of Rod A (mm2):	944
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	282

Energy Ratio E_r (%): **60**

The recommended calibration interval is 12 months

N P Burrows

Signed: N P Burrows
Title: Field Operations Manager

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SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

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

SPT Hammer Ref:	T7
Test Date:	27/02/2021
Report Date:	01/03/2021
File Name:	T7.spt
Test Operator:	NPB

Instrumented Rod Data

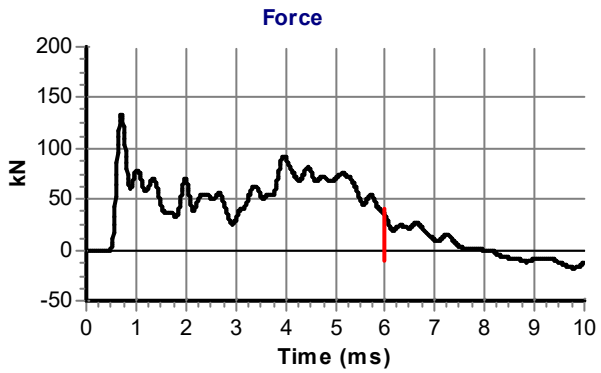
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.3
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	6458
Accelerometer No.2:	9607

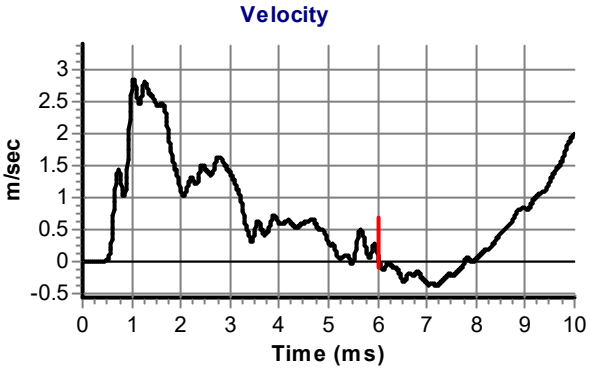
SPT Hammer Information

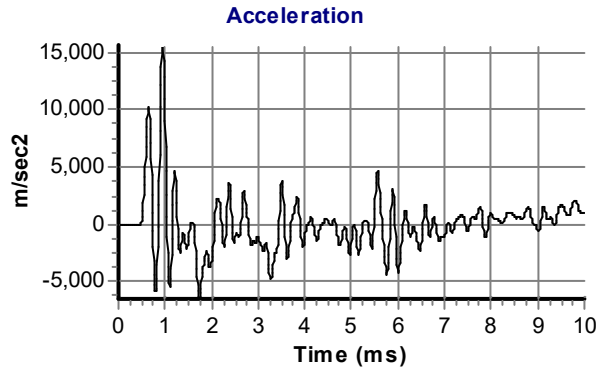
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
SPT String Length L (m):	11.0

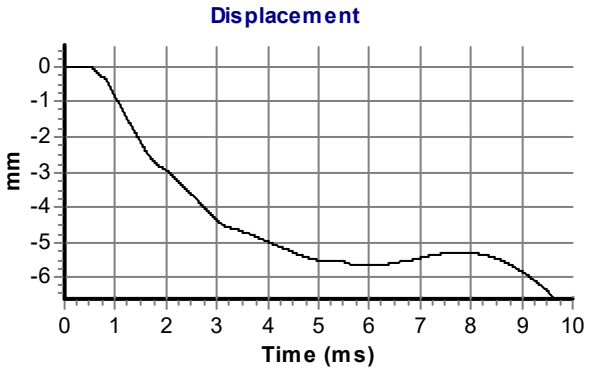
Comments / Location

CHARLWOODS









Calculations

Area of Rod A (mm2):	944
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	330

Energy Ratio E_r (%): **70**

N P Burrows

Signed: N P Burrows

Title: Field Operations Manager

The recommended calibration interval is 12 months

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Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Dynamic sampling
Unit 8
Victory parkway
Victory rd
Derby
DE24 8ZF

Hammer Ref:	D114
Test Date:	20/07/2021
Report Date:	20/04/2021
File Name:	D114.spt
Test Operator:	AP

Instrumented Rod Data

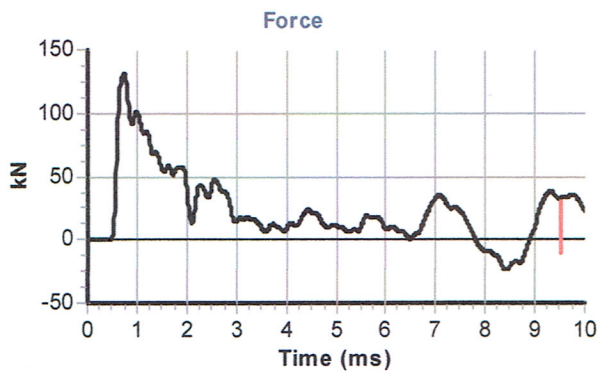
Diameter d_r (mm):	54
Wall Thickness t_r (mm):	6.0
Assumed Modulus E_a (GPa):	208
Accelerometer No.1:	62901
Accelerometer No.2:	62902

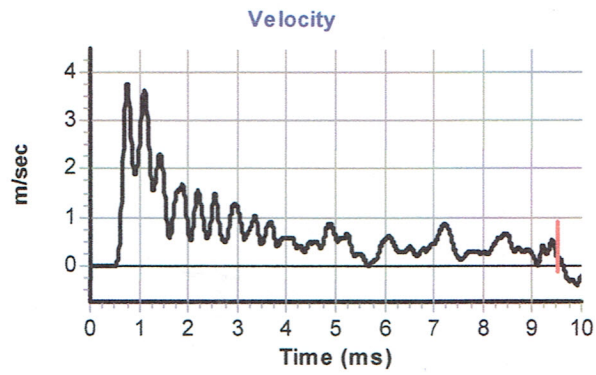
Hammer Information

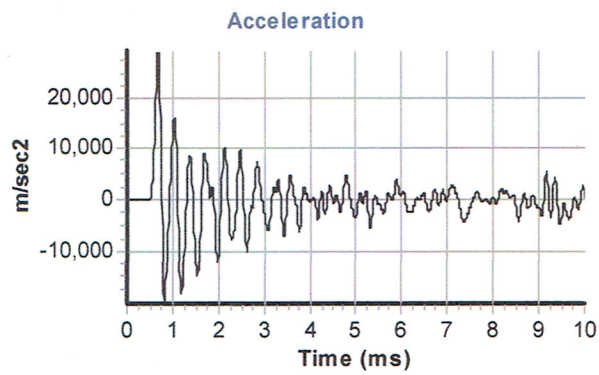
Hammer Mass m (kg):	63.5
Falling Height h (mm):	760
String Length L (m):	15.0

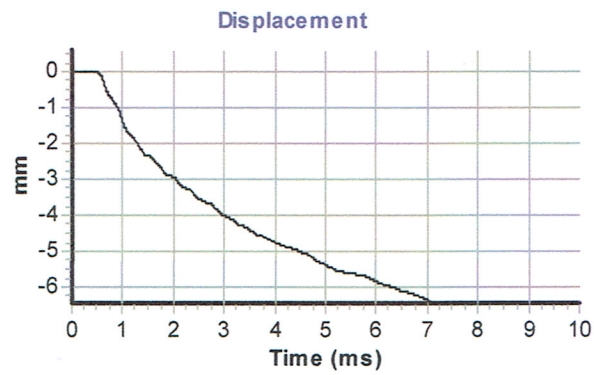
Comments / Location

Drillwell hammer tested at Dynamic samplings yard.





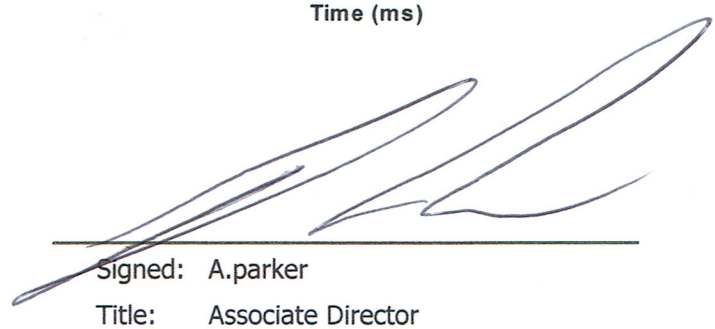




Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	325

Energy Ratio E_r (%): **69**



Signed: A.parker

Title: Associate Director

The recommended calibration interval is 12 months

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Murphy GEOSPATIAL

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Seismic, ERT and GPR Survey Report

Project Name – Bus connect Galway Geophysical Survey

Project Number – 43796

Client – Arup Consulting Engineers

Company Profile

- Over 30 Years in Business
- Eleven offices over Europe
- Over 30 varieties of surveys
- ISO 9001, ISO 14001 & OHSAS18001 registered
- Over 200 highly qualified and experienced staff
- Experience all over the globe
- Latest and most advanced technologies
- Highly skilled, qualified and experienced personnel

Overview

Established in 1983, Murphy Geospatial is committed to providing world class survey solutions cost-effectively, through a combination of highly qualified personnel and the most cutting-edge technological equipment available. With our substantial experience and client-centred approach, we thoroughly understand the challenges faced by our clientele, and currently offer more than thirty varieties of survey that are customizable to meet any requirement. We understand the importance of keeping costs to a minimum in the current climate; our ongoing investments in the latest technologies allow us to provide the most efficient surveying solutions that cut costs and risks for clients across a vast range of industries. As a result, we are widely recognized as one of the most experienced, professional, innovative and technically proficient surveying companies in the UK and Ireland today.

We work with clients across the globe, operating from our offices throughout the UK and Ireland mainly. The foundation of our success is based upon stringent quality control, reliability, efficient turnaround times and effectiveness to provide superior customer service at all times. This is reflected in our long-term relationships with our clients.

Associations and Accreditations

Document Register

Rev	Date	Prepared by	Role	Checked by	Role	Revision Reason
00	09/12/2021	Romaric Limacher/Bláthnaid McKevitt	Geophysicists	Dáire Conlon	Operations Manager	First issues

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1. Introduction

1.1 Terms of Reference

Location:	**College Road, Galway, Co. Galway**
Client:	**Arup**
Survey Date start:	**14/11/2021**

This document is the technical report for this investigation; it therefore supersedes any previous reports whether written or oral.

1.2 Background/Purpose of Investigation

Murphy Geospatial was requested to carry out a geophysical survey on behalf of Arup Consulting Engineers Galway. The purpose of this geophysical survey is to obtain information on the materials in the subsurface to aid in the environmental impact assessment for the BusConnects Galway transport scheme.

1.3 Objective of project

The main objectives of the survey are to determine the soil and rock types, depths to interfaces of materials and irregularities in the materials, and also provide information on the possible contamination in the area using the following non-intrusive survey techniques:

- Seismic refraction
- Electrical resistivity tomography

As the main investigative techniques used are largely non-destructive, the findings given in this report are based on indirect measurements and the interpretation of seismic and resistivity signals. The findings represent the best professional opinions of the authors, based on our experience and the results carried out elsewhere on similar materials and projects.

1.4 Site aerial view

Figure 1 - Aerial view of the surveyed site. In yellow, the area covered by the GPR survey (GPR101). Seismic and ERT lines are in blue (GP101 to 104).

1.5 Key personnel

Project Manager:	**Daire Conlon** *Responsible for the management of the project overall*
Project Coordinator:	**Aidan Doherty** *Responsible for scheduling and coordinating site works.*
Office Processing Manager:	**Zuzana Knotkova** *Responsible for processing and quality assessment of data.*
Head Geophysicist:	**Sophie Mann** *Supervision and quality assessment of geophysical data and results*
Geophysicist:	**Romaric Limacher** *Daily Task briefings, toolbox talks, signing and guarding on site and management of daily activities. Responsible for acquisition, processing and interpretation of seismic, resistivity and GPR data*
Lead Surveyor:	**Maxim Barbos** *Daily Task briefings, toolbox talks, signing and guarding on site and management of daily activities. Responsible for the utility survey and the acquisition of GPR, seismic and resistivity data.*
Geophysicist:	**Bláthnaid McKevitt** *Responsible for the processing and interpretation of seismic, resistivity and GPR data*
Surveyor:	**Ion Turcan** *Responsible for the utility survey and the acquisition of GPR, seismic and resistivity data.*
Safety Advisor:	**Dermot Guiney** *Responsible for safety inductions (internal requirements only), site visitations and advising on safe-working practices; and for environment-related tasks and issues in conjunction with the Environmental Advisor.*

1.6 Specifications and International Standards

All survey works were carried out in accordance with the following guidelines and standards:

- European GPR Association - Policy on the Use of GPR in Utility Detection
- American Society of Civil Engineers- Standard Guideline for the collection and depiction of existing subsurface utility data.
- Radio detection- abc & xyz of locating buried pipes and cables.
- PAS128: 2014 – Publicly Available Specification 128 2014
- British Standards BS5930:2015 +A2:2010'Code of Practice for Site Investigations'

2. Survey Report

2.1 Survey Restrictions

None. The survey was done at night for limiting traffic noise on seismic data.

2.2 Field Data Survey

The survey was carried out in ITM OSGM 15 coordinate system. All levels are related to Malin Head Datum.

Results from the three geophysical methods (Seismic refraction and ERT) are presented in the accompanying Cad drawing. Results are overlaid on the acquired topographical information.

2.3 Traffic Management

In agreement with the owner of the hotel-restaurant, one side of the parking space was blocked to traffic in order to record Line 4/GP101 on the night from Monday the 15th November (evening) to Tuesday the 16th of November (morning). (See Figure 2).

Figure 2 - The red ellipse delimits the blocked access to the parking space.

2.4 Methodology

Seismic Refraction

The names given by the client to the lines are respectively:

- GP101
- GP102
- GP103
- GP104

They have been recorded as Line 1, 2, 3, 4 and 5, the last line being a reshoot of line 2.

All seismic lines have a different geophone spacing for fitting the dimensions of the investigated field, delimited by natural obstacles like walls, bushes and roads.

Line	Direction of Acquisition	Type	Client's Line Name	Line Length
L1	North-East➔South-West	Refraction	GP104	46m
L2	North-East➔South-West	Refraction	GP103	57.5m
L3	North-East➔South-West	Refraction	GP102	23m
L4	North-West➔South-East	Refraction	GP101	217.5m
L5	North-East➔South-West	Refraction	GP103	46m

Table 1 - Recap of Lines respective names and lengths

Lines 1, 2, 3 and 5 are all made of a single section of 24 geophones.

Line 4 is made of multiple sections which, when assembled, make a line of a total length of about 220m.

The achievable depth of investigation is theoretically proportional to the length of a section. Therefore, the longer a section, the deeper the depth of investigation. As the client requested to reach 30m investigation depth, the solution is then to have the longest spread. However, this solution poses 2 problems:

1. Several lines (GP102, 103 and 104) are delimited by natural barriers like walls, bushes, etc. preventing the extension of the section. For this reason, it has not been possible to reach the required investigation depth for these lines.
2. Lengthening a section requires increasing the spacing between geophones, which itself means reducing the lateral resolution.

In this second case, and for GP101, techniques from marine geophysics have been used for having the maximum possible investigation depth by making fewer compromises with resolution. For this line, investigation depth has naturally been limited by the presence of weathered bedrock (and not by the seismic section length), by keeping at the same time the advantages of a 2m lateral resolution.

Here is a summary of the lateral resolution for each line:

Line	Client's Line Name	Line Length	Lateral resolution	Approx. Max. depth
L1	GP104	46 m	2m	12 m
L2	GP103	57.5 m	2.5m	14m
L3	GP102	23 m	1m	5 m
L4	GP101	217.5 m	2m	14 m
L5	GP103	46 m	2m	11 m

Table 2 - Recap of seismic refraction lines respective length, resolution, and maximum investigation depth.

Post site processing took place in Kilcullen office, using the specialized software ZonST2D. Several processing stages were involved, including trigger time correction for each shot, inclusion of topography, and merging sections to virtually recreate the lines.

A 10 kg hammer hitting a plate was used as a seismic source. The source locations were at geophones 1, 6, 12, 18 and 24, and where possible (i.e., if there is no obstruction), off-shots were taken at either end of the lines, at a certain distance from geophones 1 and 24 (distances varying with the presence of natural obstacles). Each shot was stacked at least 4 times.

In instances where seismic lines were crossing a road (L4/GP 101 and L2/GP103), geophones were either:

- planted 50cm~1m before after the planned position. This position change was later considered during processing in office.
- Placed on tripods (see Figure 3)

Each solution had a negligible effect on the final seismic inversion results.

Figure 3 - Geophone on tripod and unplanted/deactivated electrodes on a line crossing an asphalt pathway.

The seismic dataset of L3/GP102 is very clean. Despite having been recorded at night, the rest of the seismic dataset is very noisy. It has been affected (sometimes severely) by the following sources of noise:

- Occasional traffic noise (each line), which was handled either by redoing the shot, or waiting for the vehicle to pass.
- The wind (especially L4/GP101) moving the branches of nearby trees and bushes, and generating vibrations recorded by the geophones
- Rain/drizzle (all lines except L3/GP102), which droplets hit the geophones during the acquisition.

However, after processing, inversion results from the seismic data displayed features which are consistent with ERT inversion features. L4/GP101 is the best example for proving that the noise in the dataset has been properly handled, as both methods constantly shared similar features over their entire length (see Figure 4)

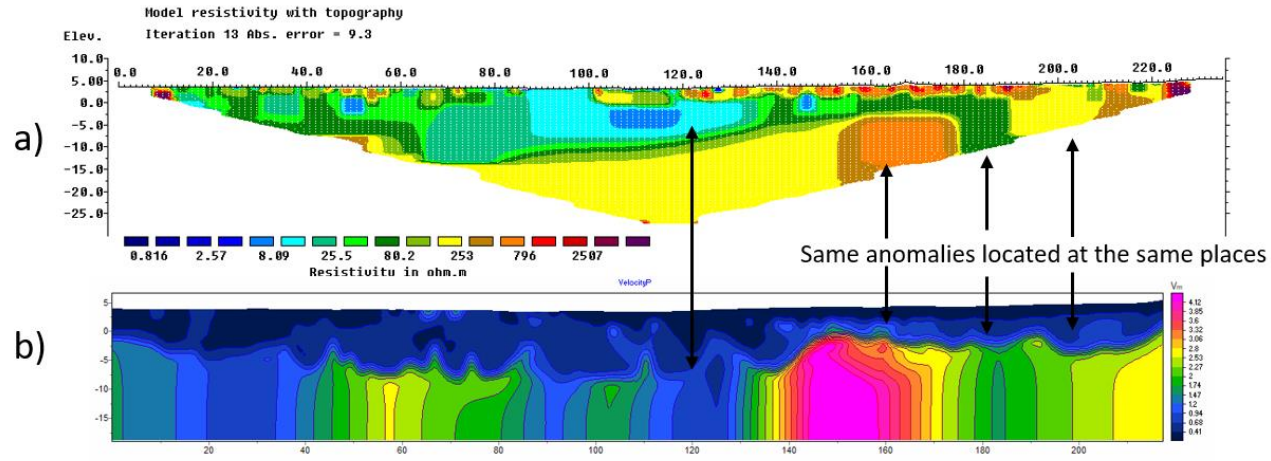


Figure 4 – a) On top, the resistivity section. b) At the bottom, the seismic section. High ad low resistivity anomalies match high and low velocity anomalies, confirming the consistency of both datasets.

Once the raw data was processed, overburden type and thickness, geological features and individual targets were identified on each survey line and mapped out over the survey areas. The seismic results are displayed in AutoCAD.

Resistivity

Unlike seismic refraction, resistivity has not been affected by noise. It has even benefited from the rain as it improved the contact resistance for each single section. In general, the resistivity dataset is very clean and of good quality.

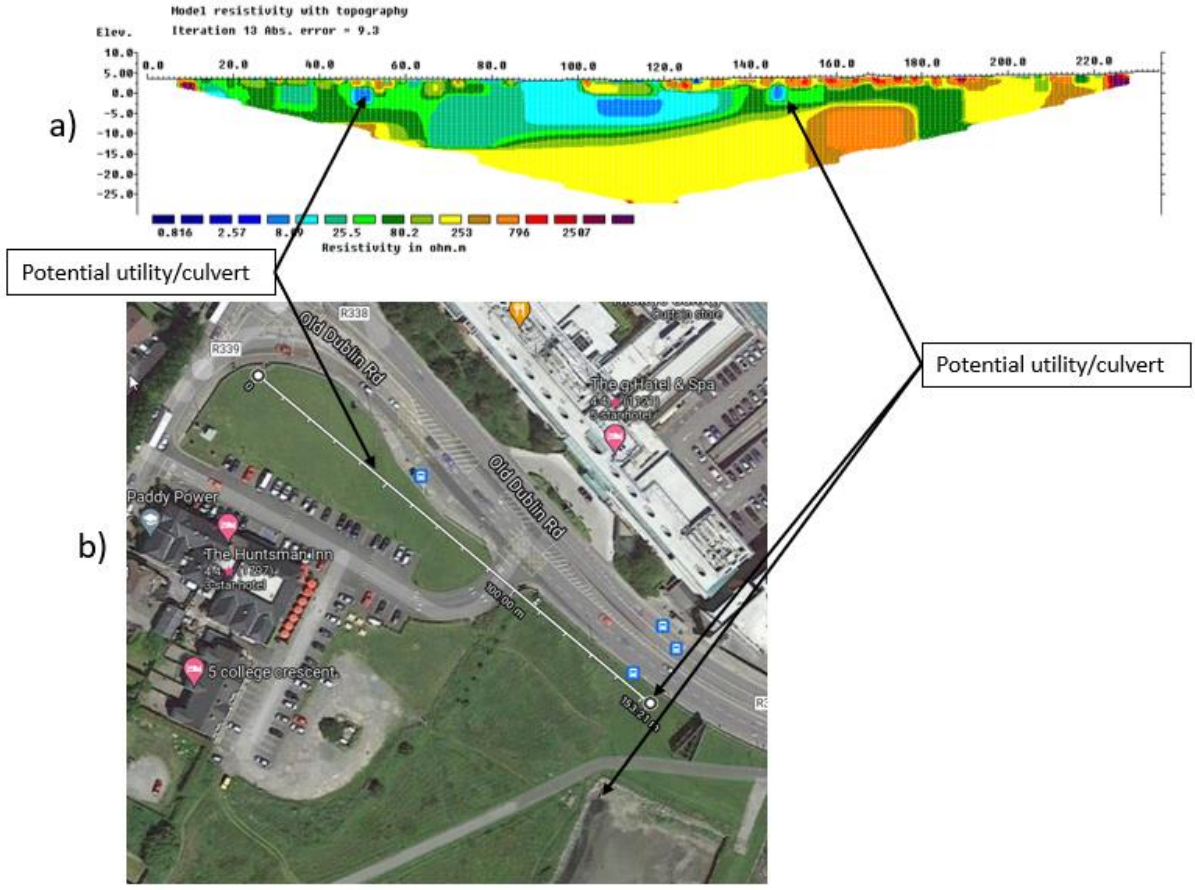


Figure 5 - The quality of the resistivity dataset is such that even potential culverts/utilities have been spotted on the dataset with the lowest spatial resolution (i.e. 2.5m). Positions on this map are only approximate. (Source of the Map: Google Map).

As was the case in the seismic survey:

- L1/GP104, L2-L5/GP103 and L3/GP102 had their respective lengths delimited by natural obstacles met on the field.
- Survey geometry from marine geophysics has been used with L4/GP101 for meeting both targets of 30m depth and lateral resolution of 2.5m.

Here is a summary of all resistivity lines recorded along seismic lines:

Line	Direction of Acquisition	Type	Client's Line Name
L1	North-East➔South-West	ERT	GP104
L2	North-East➔South-West	ERT	GP103
L3	North-East➔South-West	ERT	GP102
L4	North-West➔South-East	ERT	GP101
L5	North-East➔South-West	ERT	GP103

Table 3 - Recap of all resistivity lines recorded on this survey

Unlike seismic, where electrodes could not be planted (like on asphalt road/pathway in Figure 3), electrodes had to be de-activated, as was the case on both L4/GP101 and L2/GP103.

While L4 was minimally affected by the issue, up to 40% of the dataset was missing on L2/GP103 due to electrode deactivation (60 readings were missing out of a total of 155). For this reason, resistivity dataset from line 2 are not exploitable. It has then been agreed with the client to move this line further East: this second line has been recorded as L5.

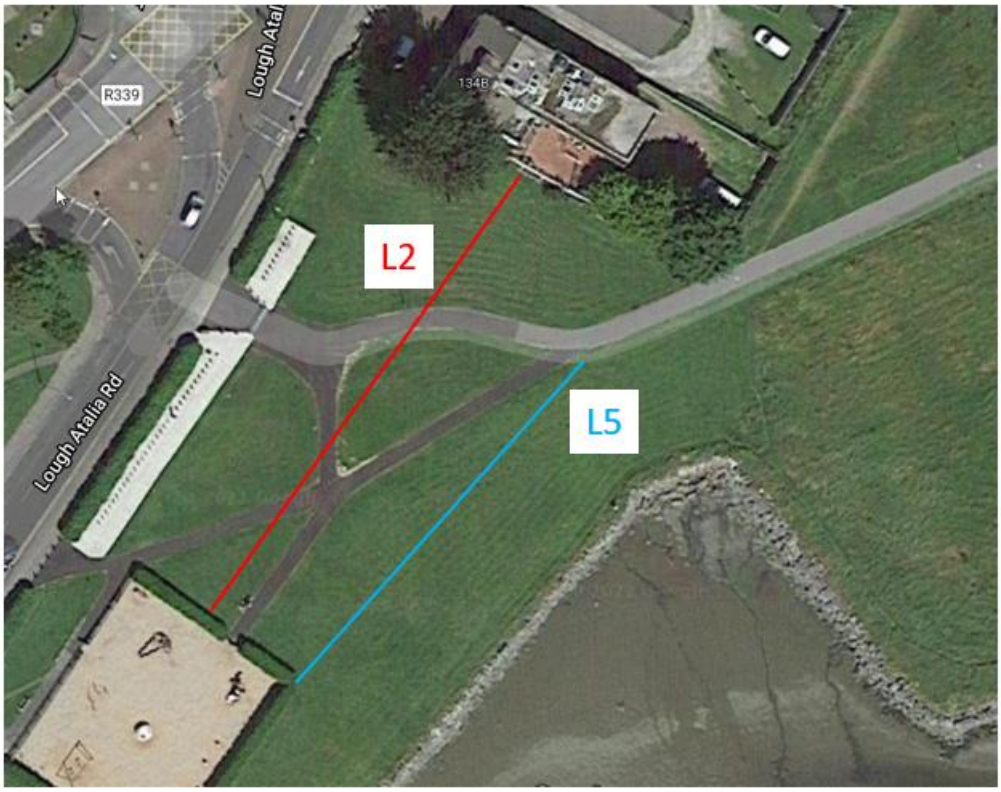


Figure 6 - In red, the initial Line 2 from the project plan, missing 40% of the dataset because it crosses asphalt 3 times. In blue, the new line not affected by the asphalt crossroads. (Source of the Map: Google Map)

Finally, as discussed in the precedent 'Seismic Refraction' paragraph, section length is theoretically related to maximum investigation depth; this is also the case with ERT surveys. For this reason, it was only physically possible (in other terms, having recording sections long enough) to reach the required 30m maximum depth with line GP101/L4.

Line	Client's Line Name	Total line length	Approx. Max. Depth	Lateral resolution
L1	GP104	46 m	5 m	2 m
L2	GP103	62 m	7 m	2 m
L3	GP102	62 m	4 m	1 m
L4	GP101	235 m	30 m	2.5 m
L5	GP103	54m	7 m	2 m

Table 4 - List of ERT lines, their respective length and lateral resolution.

Post site processing then took place in Kilcullen office, using the specialized software Res2DInv. Processing stages involved combination of roll-along sections, topography inclusion and inversion.

2.5 Equipment Used

Geode seismic recording equipment, 24 Geophones

Allied Tigre 64 resistivity metre

GSSI Utility Scan DF

GPS, Total Station

2.6 Surveyors and Geophysicists Involved

Romaric Limacher, Maxim Barbos, Ion Turcan

2.7 Works Programme

Site Works Commenced on **14/11/2021**

Delivery of Final Results – **09/12/2021**

2.8 Software Used for Processing

ZondST2D, Res2DInv, AutoCAD 2018, AutoCAD Civil 3D

2.9 Quality Assurance Site Procedures

Equipment used was calibrated and tested in line with manufacturer guidelines.

Calibration certificates can be provided on request. Distance & angle checks were carried out on site regularly.

2.10 Geology

The geology map from Geological Survey Ireland (GSI) indicates that the bedrock geology in the survey area is pale grey clean skeletal limestone from the Lower Carboniferous (Figure 7). The bedrock geology is part of the Burren Formation.

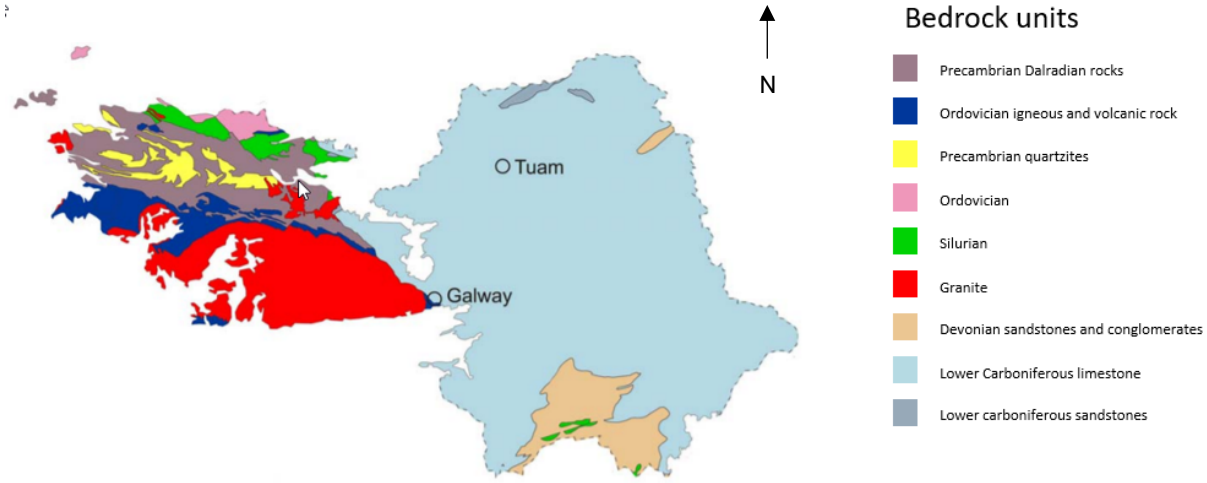


Figure 7 – A geological map of County Galway (source: www.geoschool .com)

Quaternary Sediments in the survey area are listed as being Urban for most of the survey area, with Esturine silts and clays present in south and east. Till derived from limestones area also present in the eastern most part of the survey area (Figure 8)

Groundwater vulnerability is classified as being high in the north of the survey area (in the approximate locations of lines 3 and 4) and as being moderate in the southern part of the survey area (in the approximate locations of lines 1, 2, and 5).

Figure 8 - Map of Quaternary sediments in the survey area (source: www.gsi.ie)

2.11 Findings

As the main investigative technique used is largely non-destructive, the findings given in this report are based on indirect measurements, and the interpretation of both ERT and seismic measurements. The findings represent the best professional opinions of the authors, based on our experience and the results of non-intrusive surveys carried out elsewhere on similar materials and projects.

Data Collection

A Geode seismograph was used with 24x14Hz vertical geophones.

A 10kg hammer and plate were used as a source for seismic acquisition.

ERT acquisition was run alongside the seismic lines at the same time, by an acquisition fully controlled by a field computer. Contact resistances were of good quality (as already mentioned in '2.4-Methodology').

The consistency between ERT and seismic inversions (see Figure 4) prove that the overall quality of the dataset is good.

Seismic Refraction

Seismic refraction is based on the first wave arrivals. At near offsets, the first arrivals are related to the direct wave, which travels in the most superficial layer.

The deeper, more consolidated layer is a rock/layer, and the higher the velocity; consequently, at far offsets, the first arrivals are related to the deeper layers.

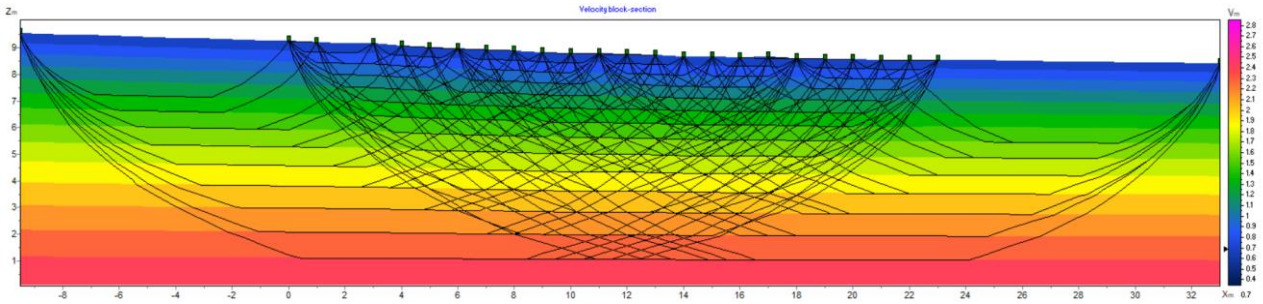


Figure 9 – In black, example of first arrivals trajectories in a representative geological environment, where gradually compacted geological layers lead to gradually increasing velocities.

As discussed previously, the maximum theoretical depth is dependent of the section length. For example, with 46m long sections, a theoretical depth of about 15m is initially expected. On the field, the investigation depth is limited by the bedrock, which sends back all the refracted energy. The maximum investigation depth of each line has been listed on Table 2.

As the purpose of the survey is more environmental than geotechnical, inversion parameters have been set up for improving the detection of low velocity zones, suspected to be sediments not fully saturated with water.

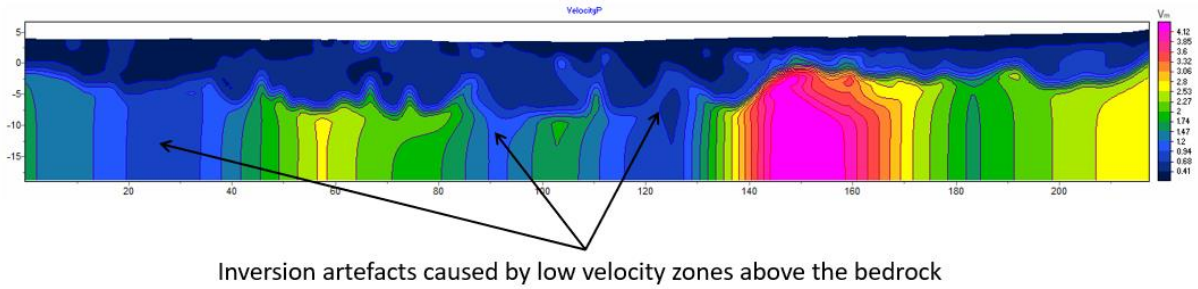


Figure 10 - Inversion artefacts caused by Low velocity sediments above the bedrock. These artifacts have been used for improving the localization of these zones, at the expense of the delineation of the bedrock.

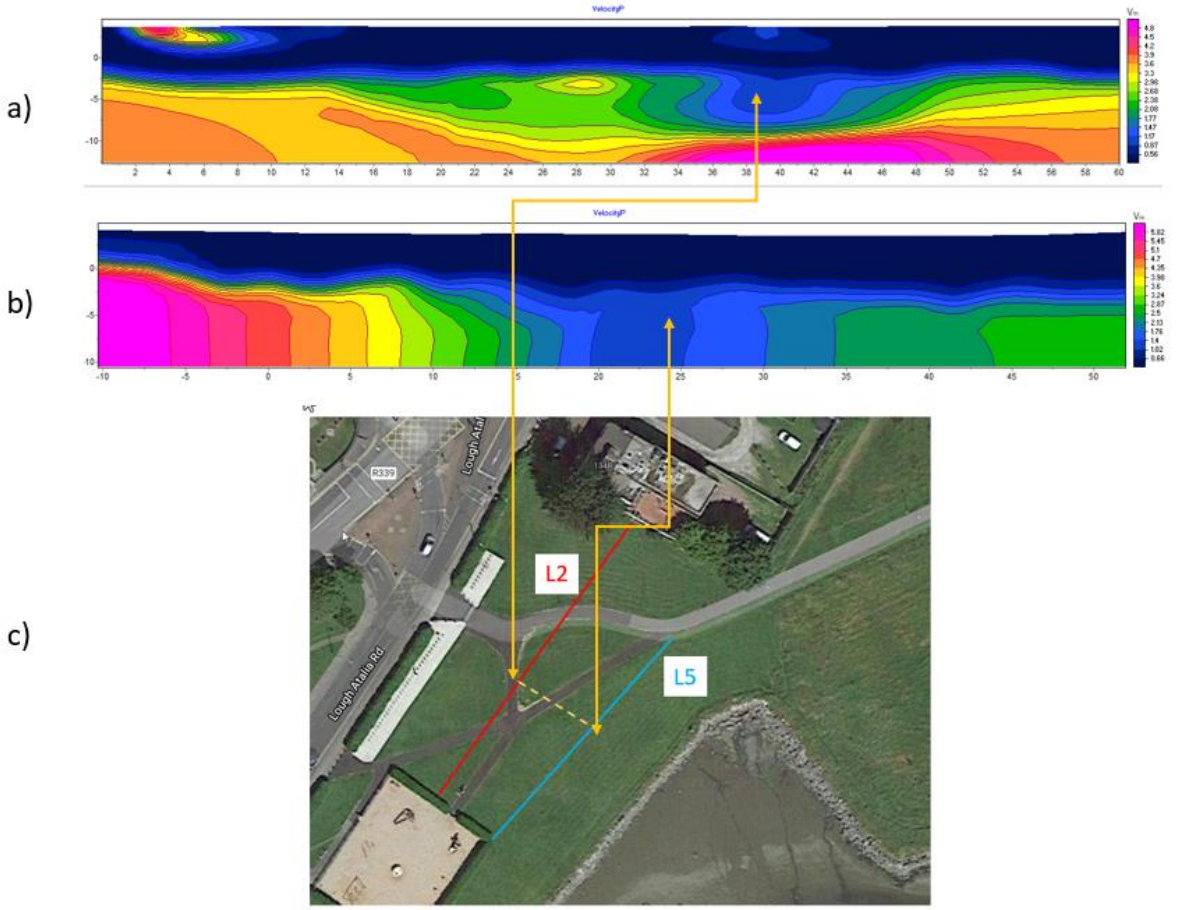


Figure 11 - Another example of low velocity anomaly seen on both L2 (inversion section a) and L5(inversion section b), which seem to consistently align when looking on a map (c).

Other features observed on seismic inversion by-products have also been consistently spotted at the same locations.

Electrical Resistivity Tomography

The most robust configuration is Wenner-Alpha, which has a poor lateral resolution, and would therefore not be fit for detecting lateral variations or buried objects. Wenner-Beta has then been selected to get a good compromise between horizontal and vertical velocity, at the expense of both maximal depth (from 12m with Wenner-Alpha to 8m with Wenner-Beta when using 32 electrodes) and recorded noise. As previously mentioned, the resistance contact was good over the site, and the overall quality of the resistivity dataset is good.

The resistivity data of L2 is non exploitable for reasons mentioned in Section 2.4. Its replacement by L5 solved the problem, with the low resistivity anomaly location matching the low velocity location of seismic inversions, as was observed on L4 (see Figure 4).

In general, the resistivity anomalies complement the observed seismic velocity anomalies well; this fact underlines the consistency of the geophysical dataset.

In relation to the detection of possible contamination in the survey area, the resistivity of the contaminated zone in comparison to the surroundings is dependent on the age of the contamination. As discussed by Shevnin et al., (2006), where the contamination of the soil is recent, high resistivity anomalies are created. However, when the contamination is aged (for example greater than four months) a low resistivity anomaly is caused (due to degradation).

In addition, environmental conditions of the survey area have an impact on whether or not contamination can be detected. Conditions such as the presence of clayish sediments, water, and buried objects, could interfere in the delineation of the contamination zone (Arrubarrena-Moreno et al., 2013).

Apart from line 1, no high resistivity anomalies were recorded on the dataset acquired on this survey. Meanwhile, on this site, the potential causes generating low resistivity records are:

- Higher water content
- Higher salinity in the ground than in mainland (proximity to Lough Atalia)
- Presence of clay
- Presence of contamination plume.

As there are 4 different potential scenarios for the same reading, it is not possible to delineate contamination zones in the area (if there is any).

For this reason, it is recommended to perform a geochemical survey in the area to detect possible contamination.

Further details about the combined interpretation of Seismic and resistivity are coming in the next paragraph ‘Interpretation’.

Interpretation

Three layers were observed in the obtained seismic refraction data. Overburden (made ground / peat), sandy gravelly clays and weathered limestone bedrock. These three layers can be clearly observed in the seismic refraction results from this survey. Lateral variations in seismic velocity may indicate that the degree of weathering varies in the survey area.

Resistivity results also show lateral variations along the profiles, these variations may indicate varying levels of water content in the survey area and variations in materials.

Three distinctive geological units were observed:

1) The first unit ranged in thickness from submeter to approx. 4.5 m. P-wave velocity (Vp) is in the range of 0.2-0.4 km/s. Electrical resistivity for this layer varied significantly along each survey line. Average electrical resistivity measurements were in the range of approx. 40 to 500 Ω.m, with anomalies of lower and higher resistivities also present. High resistivities in the near surface may be due to features on the surface, for example tarmac or trees, or features in the near surface such as utilities. Low resistivity anomalies may be due to clay pockets or areas with a higher water content (e.g. water utilities). This layer is interpreted as being made ground and overburden material (e.g. gravelly peat).

2) The second layer ranges in thickness between 2 – 11 m (thickest layer is observed along line 4). Vp is in the range of 0.4 – 1.4 km/s. Electrical resistivity for this layer is lower than the layer above (layer 1), with the exception of line 1. Electrical resistivity for this layer is in the range of 4 to 37 Ω.m, for lines 2 - 5. Based on these values this layer is being interpreted as being composed of sandy gravelly clays, with varying levels of water saturation. Resistivities for line 1 are between 90 – 500 Ω.m. The higher resistivities on line 1 suggest that the lithology in the subsurface may differ in comparison to the other four lines. The nature of this material is unclear however, the obtained values suggest the clay content/ water content is significantly lower along this line. Material could be manmade infilled material such as sandy gravelly material. This would account for the higher resistivity values.

3) The third unit is comprised of varying degrees of moderately to highly weathered limestone bedrock. Vp for this layer is >1.4 km/s. The depth achieved with ERT was shallower in comparison to seismics, due to this the third layer was not detected in several of the ERT profiles. On lines where this layer was detected with ERT, resistivity values were approx. 100 to 1500 Ω.m. Lateral variations in both Vp and electrical resistivity are observed for almost all profile (where bedrock was detected). A decrease in the velocity indicates a possible decrease in the strength of the rock / increase of fractures in the rock. Lower resistivity materials from upper layers can fill in these fractured/ weathered zones. In addition, weathering helps facilitate the infiltration of water. Therefore, these lateral variations are interpreted as being caused by varying degrees of weathering and / or water content.

Layer	Resistivity (Ω.m)	Seismic velocity (km/s)	Material Interpretation
1	40 - 500	0.2 – 0.4	Overburden (made ground / peat)
2	4 - 37	0.4 – 1.4	Sandy gravelly clay
4	100 - 1500	>1.4	moderately – highly weathered limestone bedrock

Table 5 - Interpretation Table

Line 1

Line 1 was acquired in the southwestern section of the survey area. The subsurface along this survey line is interpreted as consisting of materials with a lower clay and/or water content in comparison to the other surveyed lines. As mentioned above, the nature of the material is unclear. Based on the values it is interpreted as possible infill consisting of sandy gravel. In addition, lateral variations in resistivity are also observed on the profile. An area of high resistivity (approx. 460 – 1000 Ω.m) is observed between approx. 22 – 30 m along the survey line. This high resistivity area extends from the bottom of the profile to the near surface. The nature of this high resistivity is unclear. It is possible that this is an area of compact sand or is man-made material such as concrete from an old structure.

Line 2

The terrain constraints (i.e. tarmac pathways) present along this line, had an impact on the quality of the acquired results. As noted in section 2.4) Methodology, several electrodes were unable to be planted due to the pathways. This caused a loss of resolution in the data. Regardless of this, the obtained seismic and ERT profiles were compared, and a combined interpretation was made. The high resistivity anomalies observed in the near surface are possibly due to the presence of tarmac on the surface and/or gravel and cobbles in the near surface.

There is a decrease in the seismic velocities at approx. 36 to 46 m along the survey line. It is unclear if this is caused by a high velocity feature in the near surface which is impacting the inversion and creating this artefact or if this is a highly weathered area. Similarly, the high velocity anomaly observed between 2 and 8 m along the survey line is possibly an artefact from the inversion.

Line 3

Low resistivity anomalies (approx. 6- 16 Ω.m) are observed in the middle layer of this profile. The decrease of resistivity in this layer may be cause by an increase in water saturation and/ or clay content.

A low velocity zone was observed in the resulting seismic inversion from this line. This indicates that an additional fourth layer may also be present along this line. This layer is between layers 1 and 2 and has Vp in the range of approx. 0.14 – 0.19 km/s. This may be an artefact of the inversion or may be caused by a slight change in the lithology or degree of compaction in comparison to the layers above and below.

Line 4

As was the cause in line 2, the presence of tarmac along this survey line prevented some electrodes being planted. This caused a loss of resolution in this area of the profile. This may account for the low resistivity zone observed on the profile between approx. 80 to 120 m. Additional low resistivity anomalies are observed on this profile, one located between approx. 30 – 40 m along the survey line, a second one at approx. 48 m and a third at approx. 145 m.

These anomalies may be due to an increase in water in these areas, for example, the presence of water-filled utilities, or clay pockets.

In the third layer, lateral variations are observed in both the seismic velocities and resistivity values. These lateral variations are interpreted as being due to varying degrees of weathering. As stated previously, seismic velocity decreases with increasing porosity / fracturing. Therefore, the decreases in velocity are interpreted as being caused by areas where the degree of weathering is higher in comparison the surrounding rock. The corresponding decrease in resistivity may be due to an increase in water content as weathering facilitates the infiltration of water or due to an infill of less resistive material.

Line 5

This line was acquired to the east of line 2, near the shore of the lough.

Low resistivities (3-10 Ω.m) are associated with the middle layer of materials along this line. These values may be due to water saturation in this layer.

Bedrock was not reached in the ERT profile however, in the seismic profile a lateral decrease in seismic velocity was observed at approx. 20 – 30 m. As was explained in relation to seismic profile for line 4, the decrease in velocity may be due to an increase in the degree of weathering in this area. The lower velocities may indicate a fracture zone / weaker zone in the bedrock or a channel of erosion.

Conclusion

The data collected from our ERT and Seismic refraction surveys has been affected by contact resistance (ERT), and from Seismic refraction is of good quality. A high quality and a full and accurate picture of the ground has been produced. Nonetheless, as for every indirect measurement, values are given with a 15% of error in average.

Soil and rock types in the survey area were delineated based on the acquired datasets. The thickness of each layer and depth to the interface of materials was able to be determined. The bedrock interface delineation has been slightly sacrificed to enhance the detection of higher water content areas. Despite this compromise, a good delineation has been reached between the weathered bedrock and its overburden. This enabled us to determine the depth to bedrock in the survey area. This objective of the survey was therefore achieved.

The environmental conditions did not permit to detect the potential presence of contamination. We recommend a geochemical survey be carried out in the survey area to detect possible contamination zones.

This report represents the best professional opinion of the authors. Every effort has been made to ensure that all results are accurate and reliable. As in any method of indirect measurement, these results depend upon the interpretation of the information received.

APPENDIX I Methodology

Seismic Refraction

Principle

Seismic method consists in imaging the earth by observing the propagation of seismic waves. To do so, regularly spaced geophones are laid on the surface of the ground along a straight line, before generating a seismic wave with a 10 to 15 kg sledgehammer and a plate.

Seismic energy is then divided between:

1) Reflected waves: between source and receiver, these waves will follow a path similar to the ones depicted in Figure 12, and followed by electromagnetic waves. The principle of a seismic reflection survey is shown in Figure 12. This type of wave is efficient for deep targets investigation, like in oil exploration, but cannot be used in this survey due to constraints inhere to Snell's Law.

2) Refracted waves: these waves follow a ray-path (shown Figure 13) which is governed by Snell's law. Travel-times of first arrivals are picked on records, and their numerical values are added or/and subtracted with first arrivals picked on different geophones or/and with different shots to deduce the velocity of the refractor in one hand, and the depth of the layer on the other.

3) Surface waves: generally, contain an average of 2/3 of the seismic energy, but might be non-existent in some cases, like water saturated peat over bedrock. This specific type of wave has a low attenuation horizontally, but a high attenuation with depth. Its velocity can be related to Shear Wave velocity, which can itself directly be related to the strength of, for example, an embankment.

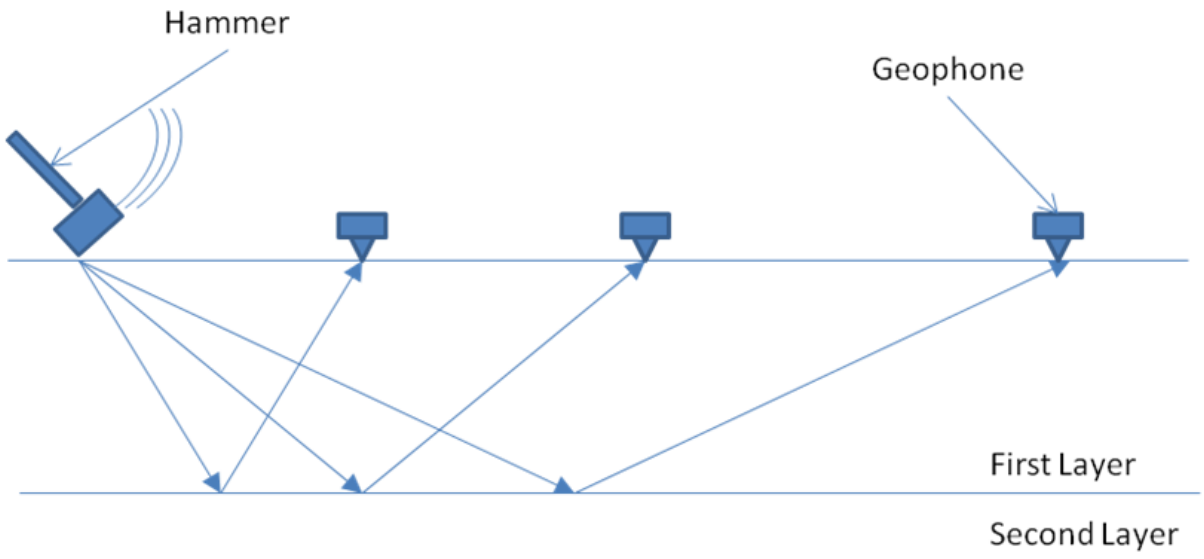


Figure 12: Principle of a Seismic Reflection Survey

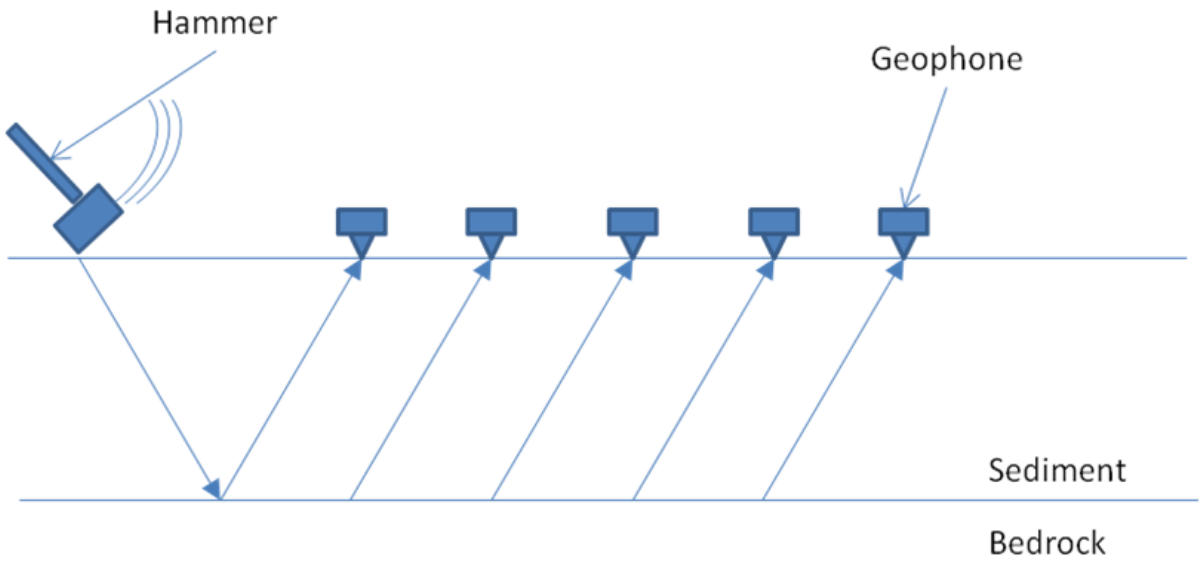


Figure 13: Principle of a Seismic Refraction Survey

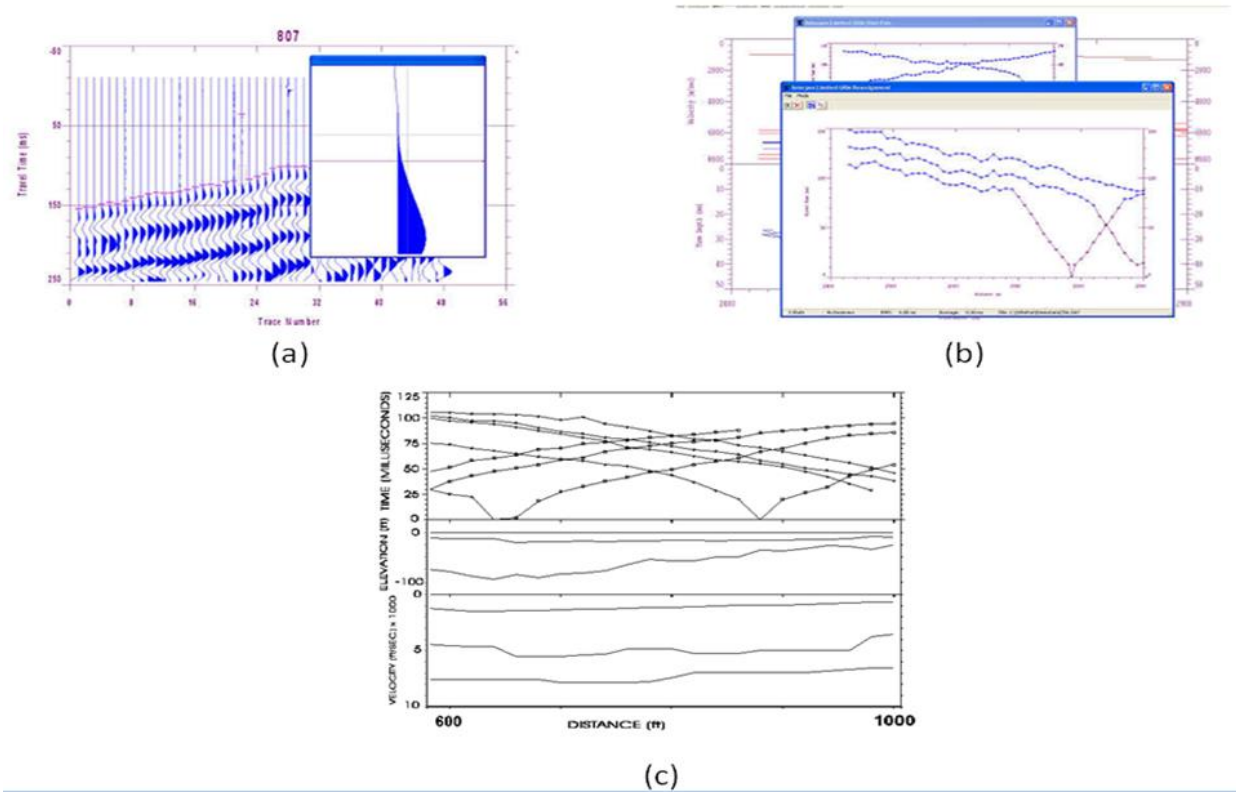


Figure 14: (a) Example of first break picking on a seismic record. (b) Example of first break peaks, before their inversion for (c) getting an interpreted seismic refraction profile.

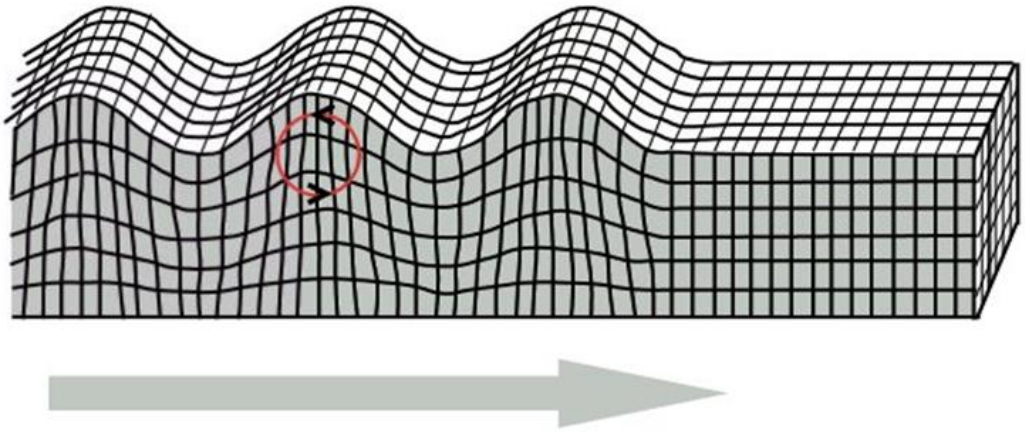


Figure 15: Propagation of a Rayleigh Wave. The grey arrow indicates the direction of propagation, the red circle with the black arrow shows the movement of a particle during the propagation.

Seismic Refraction and MASW methods are complementary, as:

1) Seismic refraction can provide a more accurate information on the dip of each respective lithology, Vp and delineation of layers.

2) MASW can provide more information on Vs and Shear Modulus.

Moreover, while an operator can check and assess the difference between a good and bad first break for a refracted wave, the main concern related to MASW is that the suitability of a surface wave for inversion can only be checked in office, during the processing step.

Implementation on site

The seismic survey will be carried out using a Geode, made by Geometrics, with 24 geophones. This will include mainly a rolled streamed cable (of about 20 to 25 kg), 24 to 26 geophones, the acquisition unit (3.6 kg), a laptop and a standard 12V car battery for alimentation.

Geophones were towed on a land streamer for record for recording the first half of a MASW section, then stopped for recording a refraction section, before resuming the towing and finishing the MASW section.

The source being 10m away from the first geophone while on MASW mode, the MASW section is shifted horizontally compared to the refraction section.

Processing

After the field survey, the seismic data have been processed in two ways with the software ZondST2D:

1) By using a tomography for the seismic refraction. The results of this inversion have later on been used as an initial model for running an inversion for delineating the different geological layers in the same software, in order to find refine the results, which can, in some cases, detect the eventual presence of voids.

2) By using the surface wave analysis module of this same software.

Processing stages for both seismic methods include anthropic noise muting, data picking, velocity assessment, proper inversion settings selection, topographical corrections, etc. Once the raw data are processed in these three different ways, the resulting inverse model MASW section is ready to be interpreted.

Electrical Resistivity Tomography (ERT)

Principle

An electric current I is injected into the ground with two electrodes and the resulting potential ΔV is measured between two other electrodes then the apparent resistivity ρ_a is calculated (Figure 16 - Principle of Electric resistivity measurements).

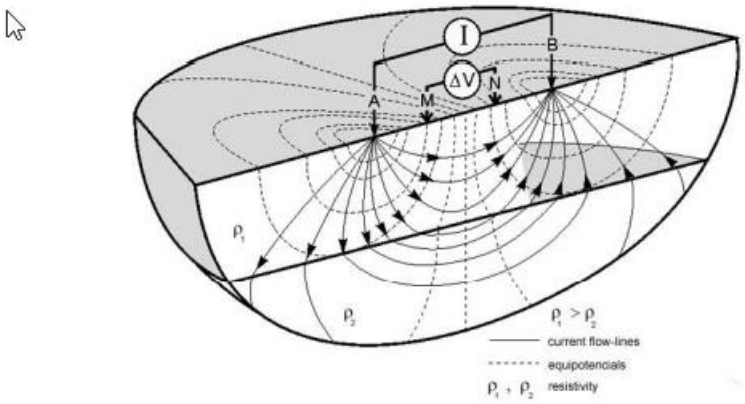


Figure 16 - Principle of Electric resistivity measurements

Apparent resistivity is a weighted average of the resistivities under the four electrodes (Figure 17 - determination of resulting apparent resistivity).

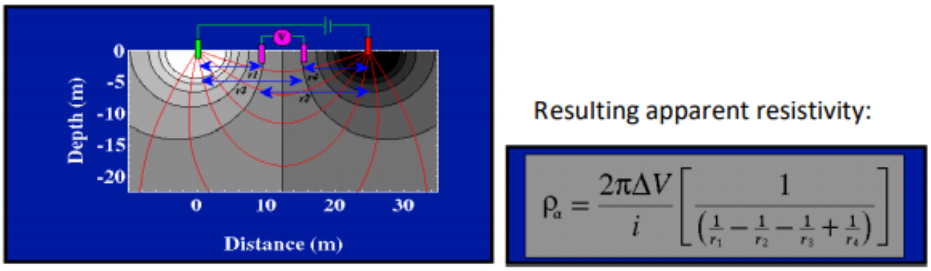


Figure 17 - determination of resulting apparent resistivity

The “true” resistivity of the ground is then determined by inverting field data from apparent resistivity. Figure 18 - Resistivity values of several materials shows a range of resistivity for different materials.

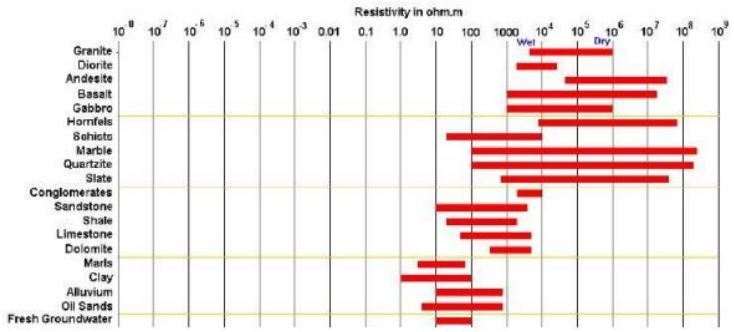


Figure 18 - Resistivity values of several materials

Depth of the measurement depends on array configuration, number of probes and their spacing. Four main electrical arrays can be used, depending on depth investigation and target intended (Figure 19 - Array properties).

Electrical Array	L	Depth Roy/Barker 1971/1989	Noisy surrounding	Target shape	Application
Wenner		0.11L / 0.17L	No	Horizontal extent	Geotechnics Archaeology Mining research
Schlumberger		0.125L / 0.19L	Yes	Unknown	Geology Hydrogeology Archaeology Environment Geotechnics
Dipole-Dipole		0.195L / 0.25L	No	Vertical extent	3D mapping
Pole-Pole		0.35L / X	No	Vertical extent	3D mapping

Figure 19 - Array properties

By measuring the electrical properties of the sub surface, a profile of the strata with depths and thicknesses can be produced. This is done by placing regularly spaced electrodes into the ground along a straight line. Because of the large amounts of data needed, the survey is performed by an automatic system. The resistivity difference between the expected lithologies should lead to a good delineation of the different layers present in this area.

Implementation on site

The resistivity survey has been carried out using an Allied Tigre 64 resistivity meter (Figure 20 - Allied Tigre Resistivity Meter) provided with 64 electrodes. This will include mainly a rolled streamer cable (of about 20 to 25 kg), 64 electrodes (metal stick, max 0.3 m length), the acquisition unit (6kg), a laptop and a standard 12V car battery for alimentation. Using a Wenner array seems to be the best option for mapping the surrounding geology, and for handling the topographical effect generated by the slope because we expect to find horizontal layers in a simple configuration scheme and the expected depth of penetration should be enough.

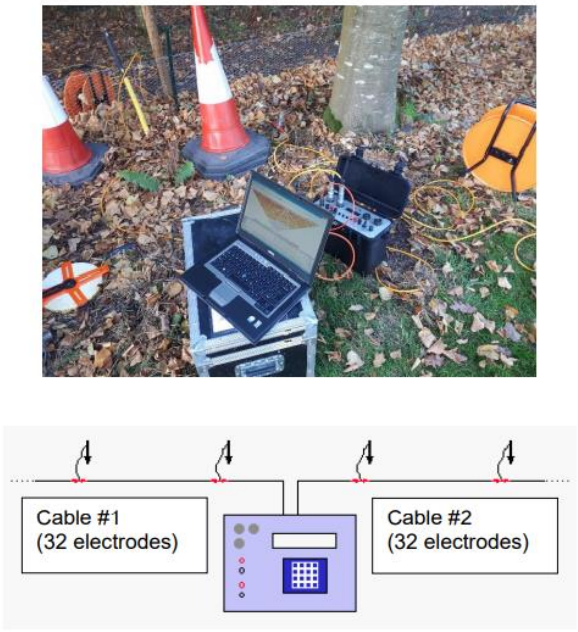


Figure 20 - Allied Tigre Resistivity Meter

By choosing a Wenner-Beta array with 64 electrodes and 2 metres spacing, an average depth of investigation of 8 metres has been reached.

Each resistivity line is surveyed using a total station or a GPS to ensure that the location and orientation of the lines is recorded. All data is stored digitally and has been downloaded each evening.

Processing

After the field survey, the resistivity measurements are usually reduced to apparent resistivity values. A conversion needs to be carried out in order to obtain a resistivity model section that can be used for interpretation ("true" resistivity section). Post site processing is done using specialised software, Res2DInv and Res3DInv. A number of processing stages are involved, including bad data points removal (due to bad contacts, failures during the survey, etc.), proper inversion settings selection, topographical corrections, etc. Once the raw data (measured apparent resistivity pseudo section) are processed, the resulting inverse model resistivity section is ready to be interpreted.

APPENDIX II - UBC or IBC site classification and seismic interpretation

The International Building Code (IBC) specifies the weighted average of S-wave velocity in the top 30 meters or 100 feet as one criterion for determining Site Class.

Table 6. UBC/IBC Site Classifications

Site class	Soil type	UBC V_s30	IBC V_s100
Class A	hard rock	$V_s30 > 1{,}500$ m/s	$V_s100 > 5{,}000$ ft/s
Class B	rock	$760 < V_s30 \leq 1500$ m/s	$2{,}500 < V_s100 \leq 5{,}000$ ft/s
Class C	very dense soil, soft rock	$360 < V_s30 \leq 760$ m/s	$1{,}200 < V_s100 \leq 2{,}500$ ft/s
Class D	stiff soil	$180 < V_s30 \leq 360$ m/s	$600 < V_s100 \leq 1{,}200$ ft/s
Class E	soft soil	$V_s30 < 180$ m/s	$V_s100 < 600$ ft/s
Class F	soils requiring site specific evaluation	Non-applicable	Non-applicable

Calculating traveltime and *Seismic interpretation*, are not active at this time.

Figure 21 - UBC/IBC site classification

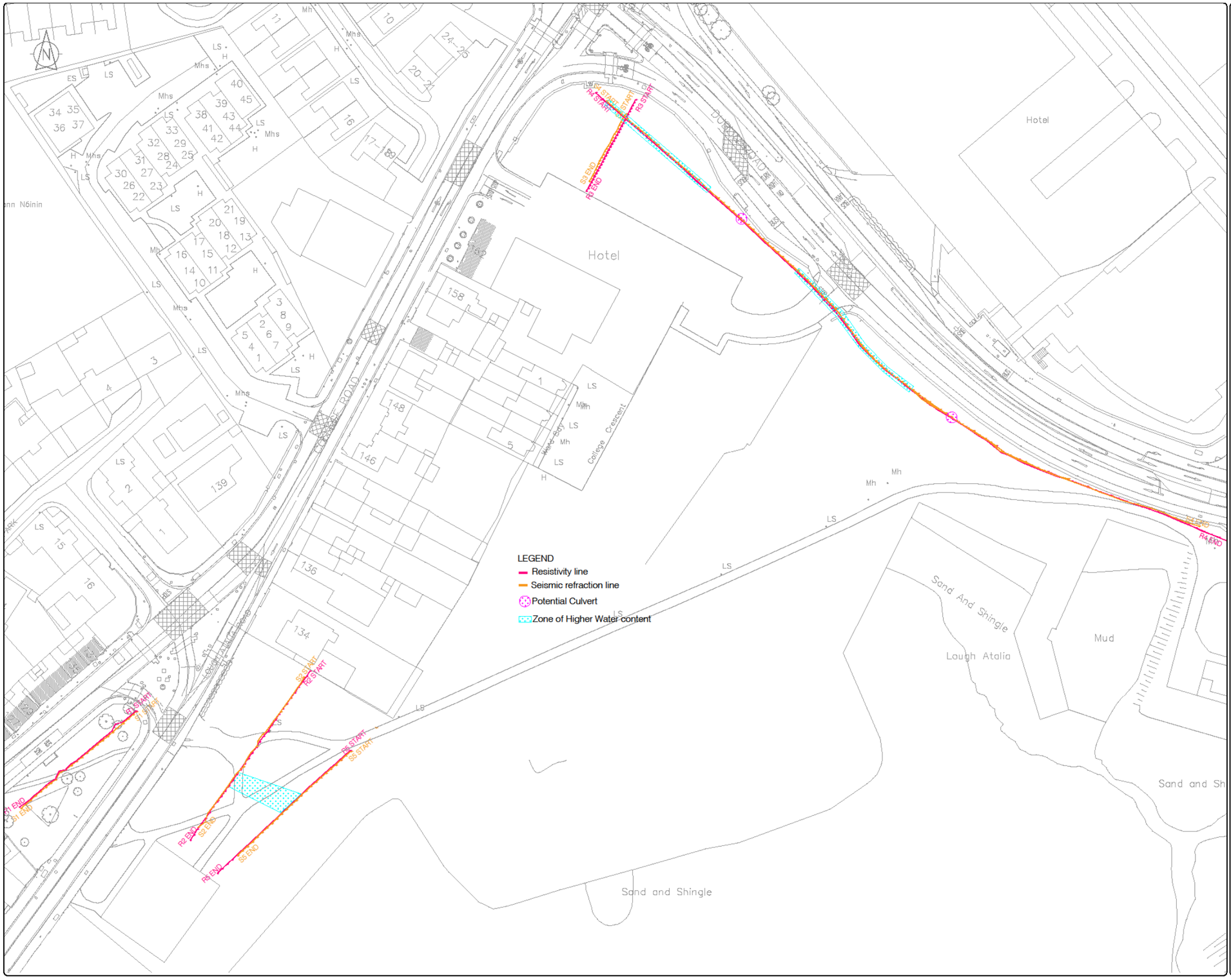
APPENDIX III - Link between P-wave velocity and rock quality

The following chart, defined by Weaver(1975), has been used for assessing the bedrock quality/rippability.

Rock class	I	II	III	IV	V
Description	Very good rock	Good rock	Fair rock	Poor rock	Very poor rock
Seismic velocity (m/s)	>2150	2150-1850	1850-1500	1500-1200	1200-450
Rating	26	24	20	12	5
Rock hardness	Extremely hard rock	Very hard rock	Hard rock	Soft rock	Very soft rock
Rating	10	5	2	1	0
Rock weathering	Unweathered	Slightly weathered	Weathered	Highly weathered	Completely weathered
Rating	9	7	5	3	1
Joint spacing (mm)	>3000	3000-1000	1000-300	300-50	<50
Rating	30	25	20	10	5
Joint continuity	Non continuous	Slightly continuous	Continuous-no gouge	Continuous-some gouge	Continuous-with gouge
Rating	5	5	3	0	0
Joint gouge	No separation	Slight separation	Separation <1mm	Gouge <5mm	Gouge >5mm
Rating	5	5	4	3	1
Strike and dip orientation	Very unfavourable	Unfavourable	Slightly unfavourable	Favourable	Very favourable
Rating	15	13	10	5	3
Total rating	100-90	90-70'	70-50	50-25	<25
Rippability assessment	Blasting	Extremely hard ripping and blasting	Very hard ripping	Hard ripping	Easy ripping
Tractor horsepower		770/385	385/270	270/180	180
Tractor kilowatts		575/290	290/200	200/135	135

Figure 22 - Rippability chart

MAPS



Murphy Geospatial Ltd. Disclaimer

The survey aims to map all existing utilities and sub surface structures and provide information with respect to pipe size, material type and drainage connectivity. However GPR surveying is limited by the following guidelines and it may not be possible to accurately survey, define and locate all services and sub surface features.

- Locational accuracy: is determined by referring to the manufacturers guidelines for the detectors used.
- Existing record information showing underground services is often incomplete and unknown accuracy; therefore it should be regarded only as indicative.
- In ideal conditions these spatial accuracies for the underground utilities are +/-5% for the RD4000 and +/-10% of depth for the GPR to 2.5m deep. However, variations within the subsurface may alter this estimated accuracy.
- Although all reasonable steps have been taken to locate all features, there is no guarantee that all will be shown on the drawing as some above ground features may have obstructed the survey.
- GPR surveying operates best within high resistivity material. Clay overburden can impair GPR surveying.
- Due to the attenuation of the radar signal with depth, resolution is restricted, hence making identification of anomalies difficult with increasing depth.
- The depth penetration and quality of the data depends on the ground conditions on the site. Poor data may be a result of areas with high conductivity. Also, high reflective materials close to the surface i.e. rebar may hide deeper anomalies.
- It is not always possible to trace the entire length of each underground service.
- It is always our intention to use the Utility providers' details, if supplied prior to survey commencement as a guide for location purposes. However, should we not be able to locate those guided services we shall not be held responsible for the accuracy, or otherwise, of the location of that service, as issued by the utility provider and therefore shown "Taken from Records" on the drawing and we are not liable for any loss that may arise due to the lack of accuracy in the guided information.
- Unless otherwise stated, all services and sub surface structures shown on Murphy Geospatial Limited plan drawings have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to run straight.
- Plan accuracies of the order of + or - 150mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run on close proximity, separation may be impossible. Successful tracing of non metallic pipes may be limited.
- Please note that not all buried pipes, cables and ducts can be detected and mapped in consideration of their depth, location, material type, geology and proximity to other utilities. Even an appropriate and professionally executed survey may not be able to achieve a 100% detection rate.
- Services which have been untraceable are shown from Records where possible.
- DP represents distance from the surface level to the top of the service/ radar.

No allowance has been made within our quotation, unless otherwise stated, for the location and mapping of undeclared services. Failure to detect or fully map any declared service will be recorded within the notes accompanying our final drawings.
Where technically possible, depth indications will be given. These should be used for guidance only and wherever critical accuracy is required these should be confirmed by the Client by undertaking trial excavations or similar. Bends, lateral service connections, or the close proximity of other services and local magnetic, atmospheric or ground conditions, could in certain situations influence the accuracy of the plan and depth indication facility. Depths will not be provided unless we are reasonably confident of their validity.
Where Murphy Geospatial Limited issues a CAD drawn utility service plan, this should be read in conjunction with all available public utility records etc. As part of our exhaustive Quality Control procedures Murphy Geospatial Limited Endeavour to add relevant Public Utility record information onto the final issue drawing. An allowance should be made for the width of services, particularly where these are laid in bands or are of significant size etc. For clarification or appropriate easement bands, we would recommend that direct contact is made with the Asset Owner or Statutory Undertaker.
We exclude the following, except where otherwise specified and possible to do so:

- All private service connections, (including water or gas fittings where no through flow of applied signal is possible.
- Pot ended or disconnected cables or terminated short lengths of pipe.
- Internal building services
- Fibre optic cables (except where laid with a standard communications cable or built in tracer wire or similar conductor system) or can be clearly located using ground penetrating radar.
- Small diameter cables less than 17mm diameter, or pipes less than 30mm diameter.
- Above ground services unless specifically requested.
- Lifting manhole covers which require longer than 15 minute effort using standard heavy duty lifting apparatus.
- Services positioned directly below other pipes or cables etc (i.e. masking signal) - intrusive verification options available on request.
- Deep non metallic pipes, ducts or culverts (unless probing) or Pipe Track 3d is specified as part of the fully invasive survey option).
- Passing through defective pipework (displaced joints etc) or acute bends between access points.

Please note that our Quotation does not allow for location of individual service feeds to properties unless reasonable to do so, as access would be required into each property to apply direct connections to inlet points and this would significantly increase the scope of work, survey cost and also cause possible disruption to occupants.
All work carried out by Murphy Geospatial Limited (MG) conforms to the guidelines set out by The Survey Association (TSA).

North

LEGEND
Resistivity line
Seismic refraction line
Potential Culvert
Zone of Higher Water content

Surveyed by : MG	Date: November 2021	Datum :	Main Head
Drawn by : SM	Date: 07.12.2021	Grid System :	
Checked by : GM	Date: 07.12.2021	Irish National Grid ☐ ITM ☒	

Revisions

No	Date	Description
0	07.12.2021	First Drawing

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Client :	Arup Consulting Engineers Galway
Project :	BusConnects Galway Geophysical Survey
Date : 07.12.2021	Scale : 1:500@A1
Description :	Geophysical Survey Survey layout
Drawing Number :	MGS43796_G

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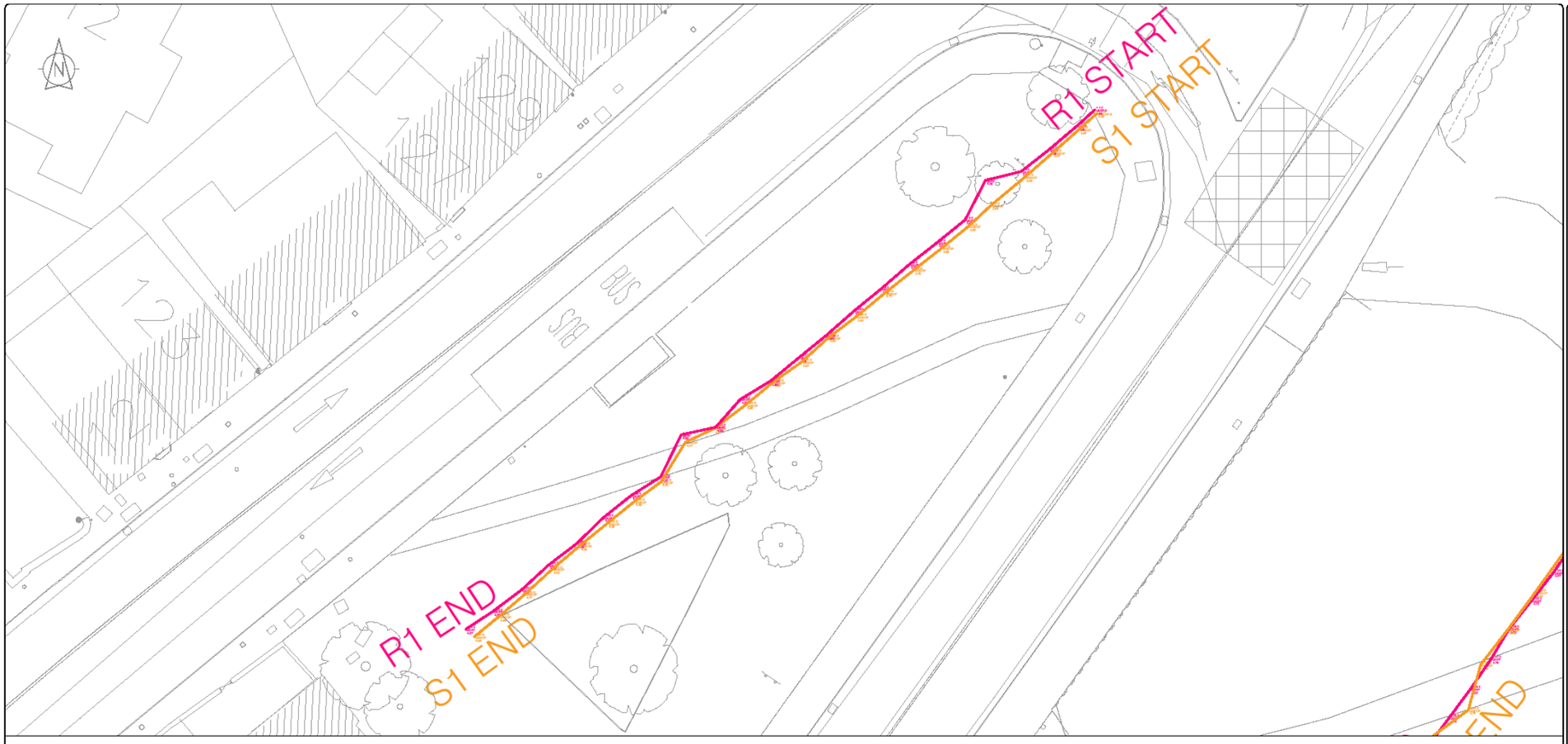

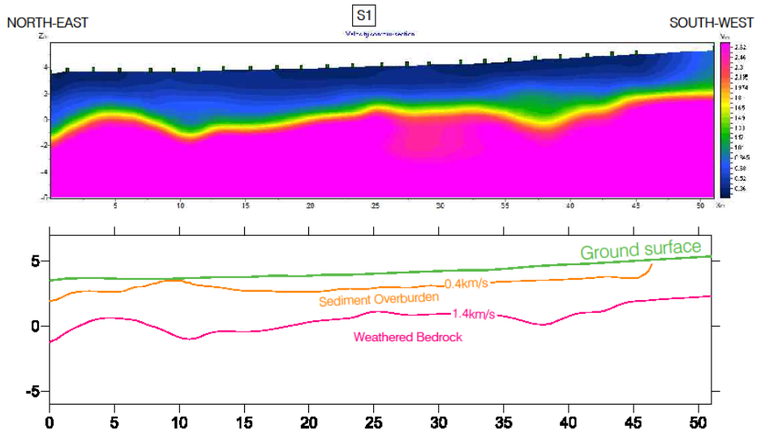

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- Unless otherwise stated, all services and sub surface structures shown on Murphy Geospatial Limited plan drawings have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to run straight.
- Plan accuracies of the order of + or - 150mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run on close proximity, separation may be impossible. Successful tracing of non metallic pipes may be limited.
- Please note that not all buried pipes, cables and ducts can be detected and mapped in consideration of their depth, location, material type, geology and proximity to other utilities. Even an appropriate and professionally executed survey may not be able to achieve a 100% detection rate.
- Services which have been untraceable are shown from Records where possible.
- DP represents distance from the surface level to the top of the service/ radar.

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Where technically possible, depth indications will be given. These should be used for guidance only and wherever critical accuracy is required these should be confirmed by the Client by undertaking trial excavations or similar. Bends, lateral service connections, or the close proximity of other services and local magnetic, atmospheric or ground conditions, could in certain situations influence the accuracy of the plan and depth indication facility. Depths will not be provided unless we are reasonably confident of their validity.

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- Fibre optic cables (except where laid with a standard communications cable or built in tracer wire or similar conductor system) or can be clearly located using ground penetrating radar.
- Small diameter cables less than 17mm diameter, or pipes less than 35mm diameter.
- Above ground services unless specifically requested.
- Lifting manhole covers which require longer than 10 minute effort using standard heavy duty (6kg) apparatus.
- Services positioned directly below other pipes or cables etc (i.e. masking signal) - intrusive verification options available on request.
- Deep non metallic pipes, ducts or culverts (unless probing or Pipe Trach 3d is specified as part of the fully invasive survey option).
- Passing through defective pipework (displaced joints etc) or acute bends between access points.

Please note that our Quotation does not allow for location of individual service feeds to properties unless reasonable to do so, as access would be required into each property to apply direct connections to inlet points and this would significantly increase the scope of work, survey cost and also cause possible disruption to occupants.

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North

LEGEND

- Resistivity line
- Seismic refraction line
- Potential Culvert
- Zone of Higher Water content

Surveyed by : MG	Date: November 2021	Datum : Malin Head
Drawn by : BM	Date: 07.12.2021	Grid System :
Checked by : BM	Date: 07.12.2021	Irish National Grid ☐ ITM ☒

Revisions

No	Date	Description
0	07.12.2021	First Drawing

Murphy GEOSPATIAL

Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography

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Email: info@murphysurveys.ie

Client :	Arup Consulting Engineers Galway
Project :	BusConnects Galway Geophysical Survey
Date : 07.12.2021	Scale : 1:200@A1
Description :	Geophysical Survey Seismic results for S1
Drawing Number :	MGS43796_G

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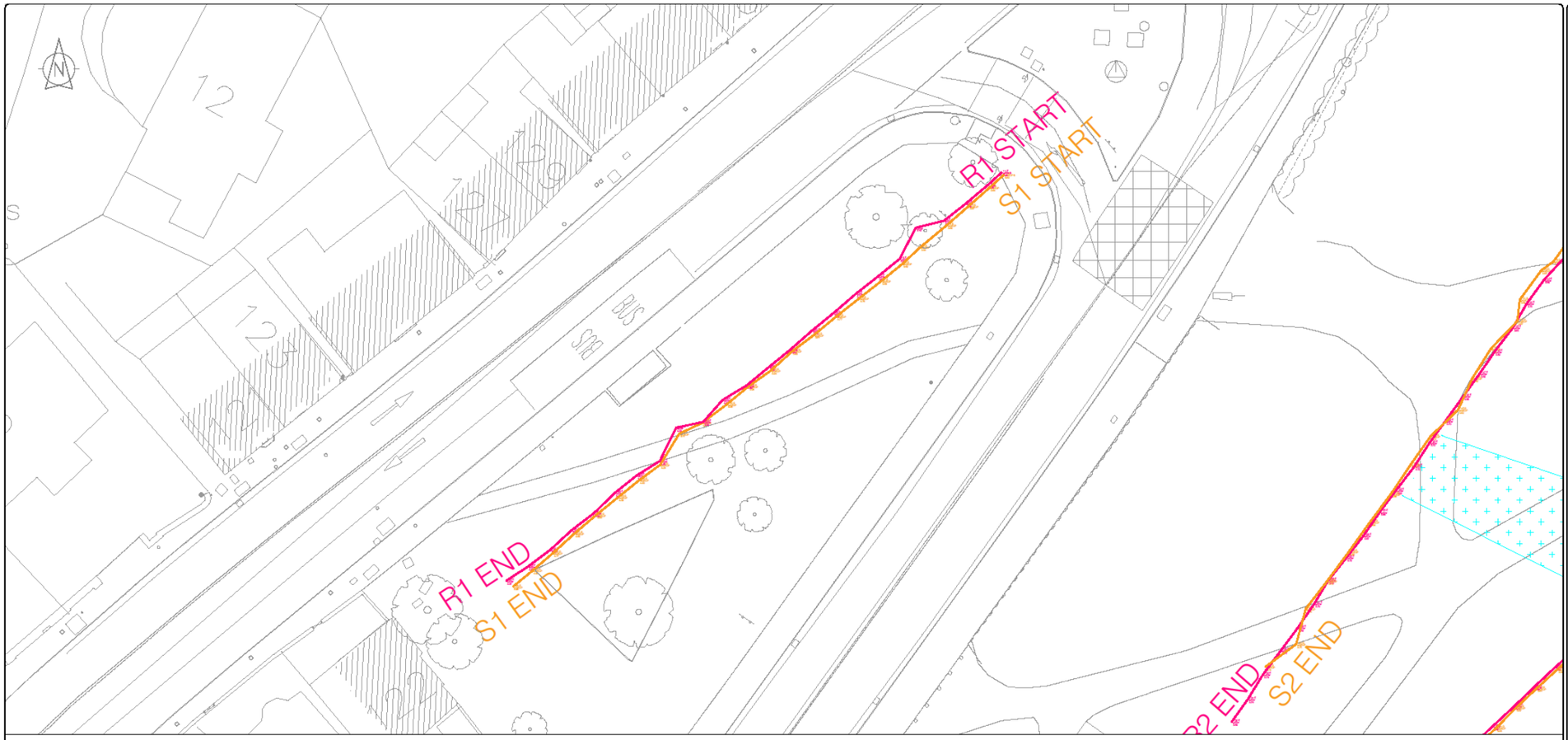

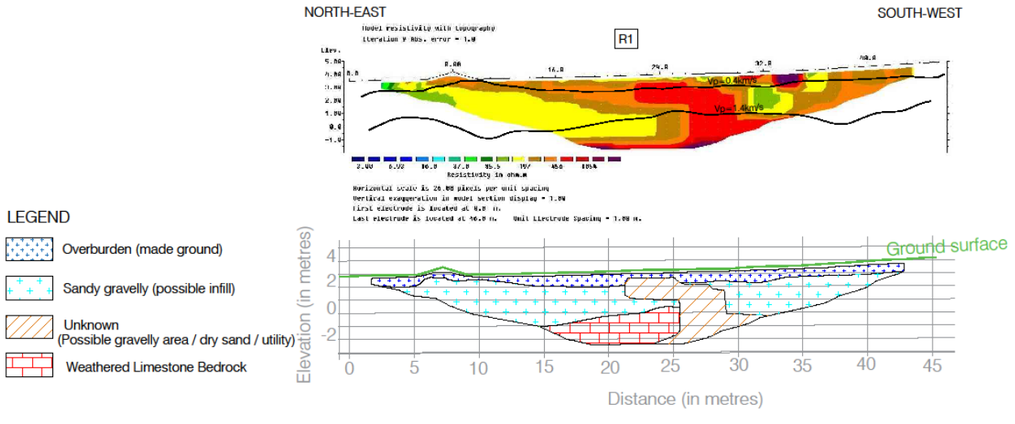

LEGEND

- Overburden (made ground)
- Sandy gravelly (possible infill)
- Unknown (Possible gravelly area / dry sand / utility)
- Weathered Limestone Bedrock

Murphy Geospatial Ltd. Disclaimer

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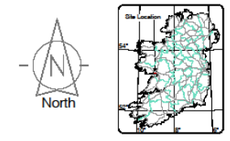

LEGEND

- Resistivity line
- Seismic refraction line
- Potential Culvert
- Zone of Higher Water content

Surveyed by : MG	Date : November 2021	Datum : Malin Head
Drawn by : SM	Date : 07.12.2021	Grid System :
Checked by : SM	Date : 07.12.2021	Irish National Grid ☐ ITM ☒

Revisions

No	Date	Description
0	07.12.2021	First Drawing

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Client :	Arup Consulting Engineers Galway
Project :	BusConnects Galway Geophysical Survey
Date : 07.12.2021	Scale : 1:200@A1
Description :	Geophysical Survey Resistivity results for R1
Drawing Number :	MGS43796_G

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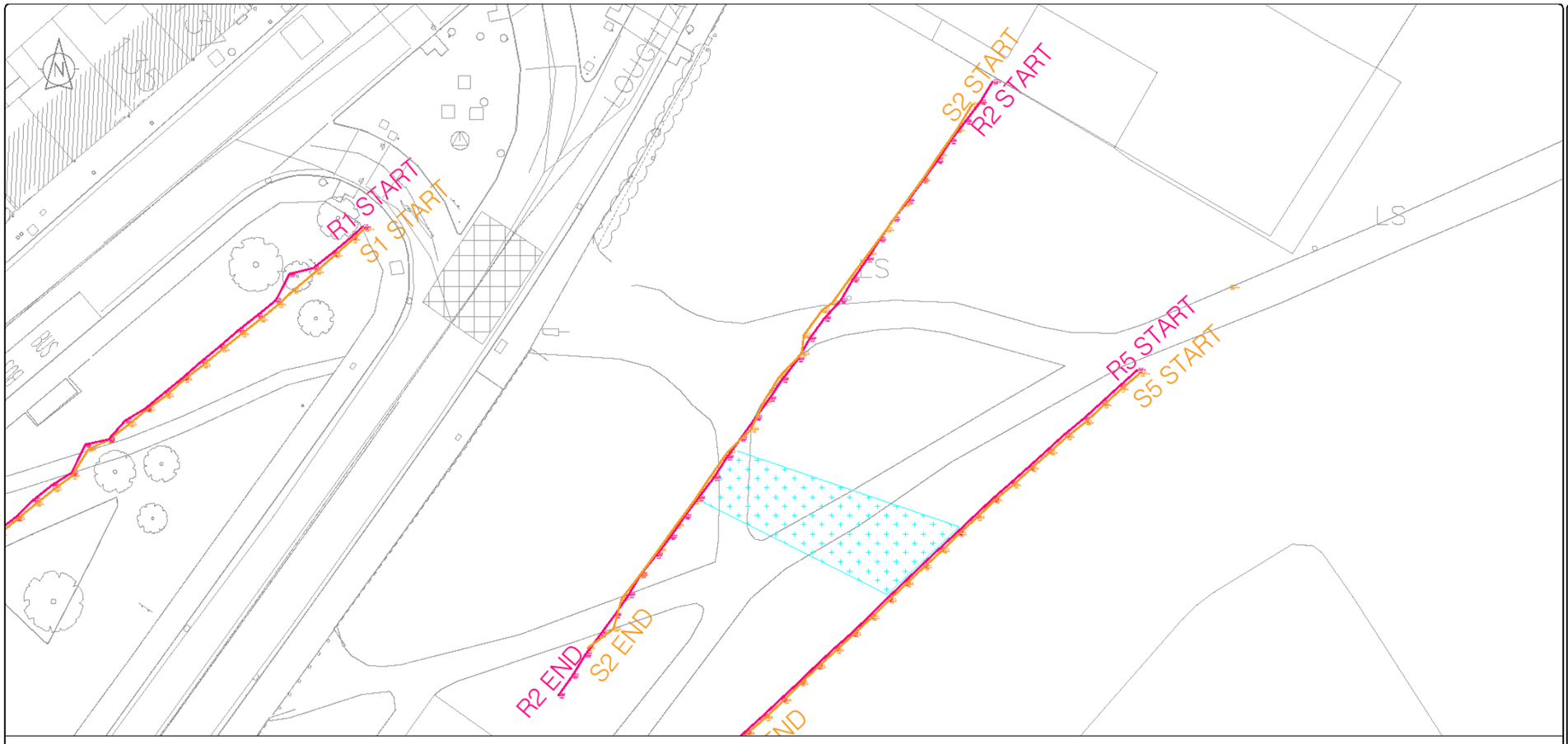

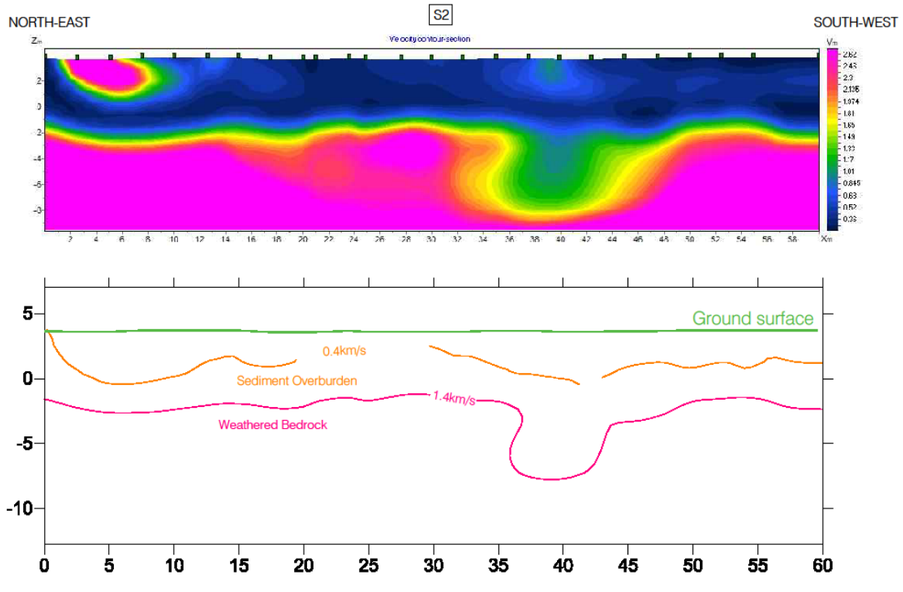

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North

Site Location

LEGEND
- Resistivity line
- Seismic refraction line
- Potential Culvert
- Zone of Higher Water content

Surveyed by : MG	Date : November 2021	Datum : Malin Head
Drawn by : SM	Date : 07.12.2021	Grid System :
Checked by : SM	Date : 07.12.2021	Irish National Grid ☐ ITM ☒

Revisions

No	Date	Description
0	07.12.2021	First Drawing

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Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography
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Kilcullen Business Campus
Kilcullen Co. Kildare
Ireland
Phone: (+353) 045 484040
Fax: (+353) 045 484004
Email: info@murphysurveys.ie

Client :	Arup Consulting Engineers Galway
Project :	BusConnects Galway Geophysical Survey
Date : 07.12.2021	Scale : 1:200@A1
Description :	Geophysical Survey Seismic results for S2
Drawing Number :	MGS43796_G

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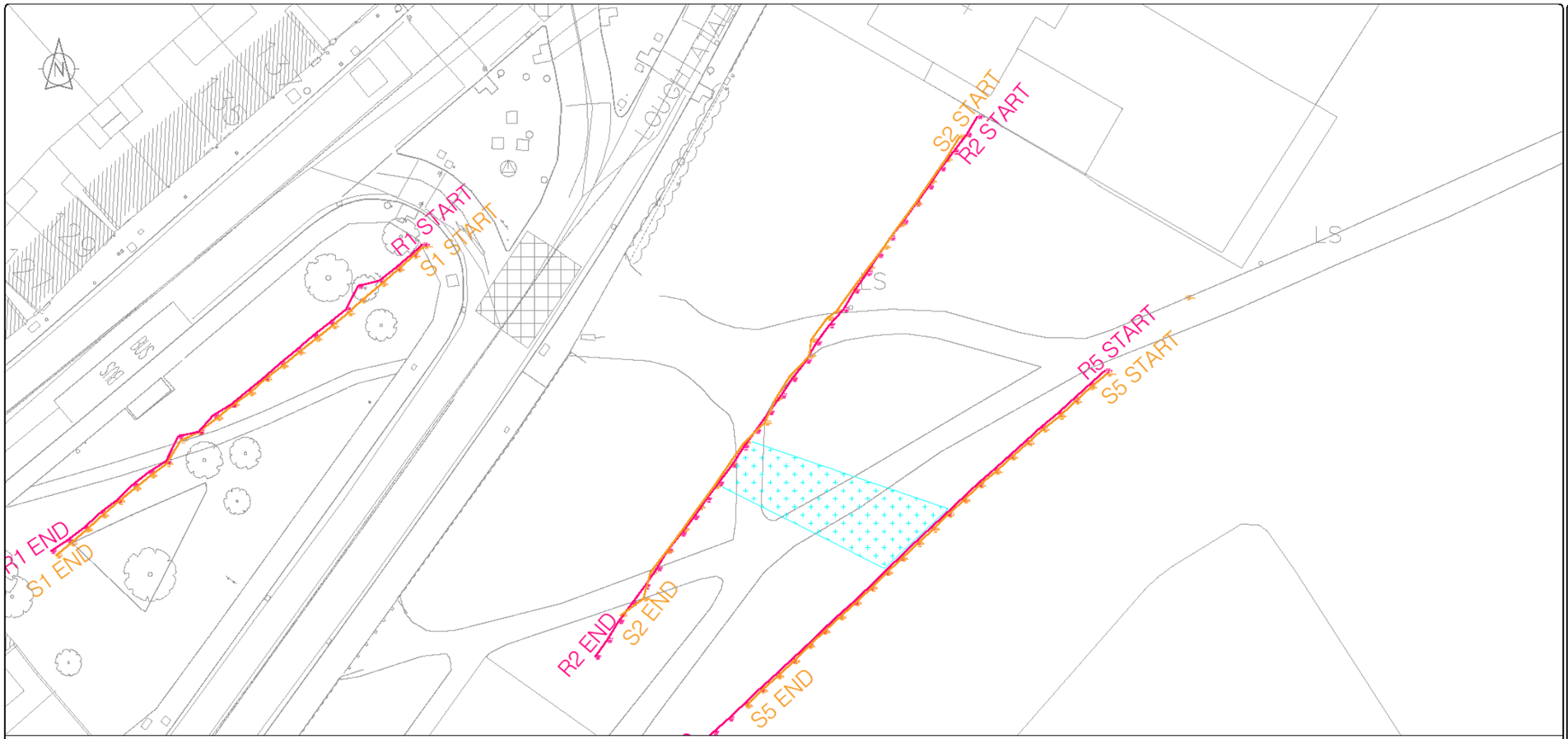

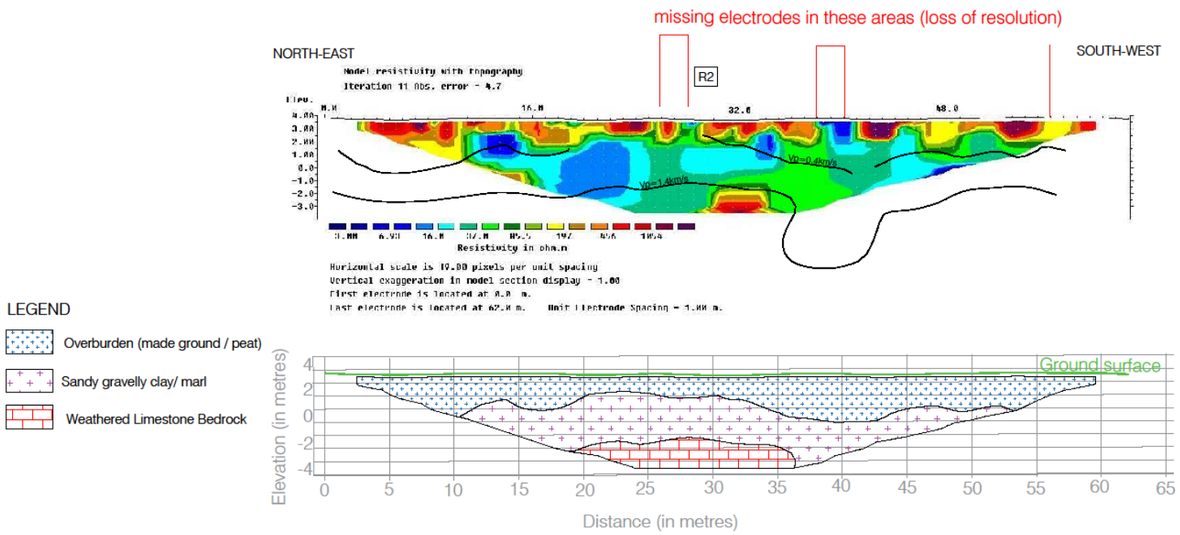

LEGEND

- Overburden (made ground / peat)
- Sandy gravelly clay/ marl
- Weathered Limestone Bedrock

Murphy Geospatial Ltd. Disclaimer

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North

LEGEND

- Resistivity line
- Seismic refraction line
- Potential Culvert
- Zone of Higher Water content

Surveyed by : MG	Date : November 2021	Datum : Irish Height
Drawn by : SM	Date : 07.12.2021	Grid System :
Checked by : SM	Date : 07.12.2021	Irish National Grid ☐ ITM ☒

Revisions

No	Date	Description
A	07.12.2021	First Drawing

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Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography
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Client :	Arup Consulting Engineers Galway
Project :	BusConnects Galway Geophysical Survey
Date : 07.12.2021	Scale : 1:200@A1
Description :	Geophysical Survey Resistivity results for R2
Drawing Number :	MG843796_G

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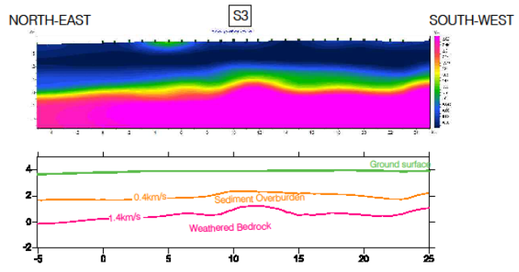

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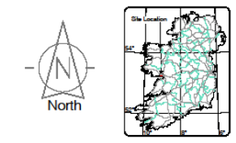

LEGEND
- Resistivity line
- Seismic refraction line
- Potential Culvert
- Zone of Higher Water content

Surveyed by : MG	Date : November 2021	Datum : Main Head
Drawn by : SM	Date : 07.12.2021	Grid System :
Checked by : SM	Date : 07.12.2021	Irish National Grid ☐ Plot ☐

Revisions

No	Date	Description
0	07.12.2021	First Drawing

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Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography
Kildare Cork Dublin Belfast Glasgow Manchester London
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Kilcullen Business Campus
Kilcullen Co. Kildare
Ireland
Phone: (+353) 045 484040
Fax: (+353) 045 484004
Email: info@murphysurveys.ie

Client :	Arup Consulting Engineers Galway
Project :	BusConnects Galway Geophysical Survey
Date : 07.12.2021	Scale : 1:100@A1
Description :	Geophysical Survey Seismic results for S3
Drawing Number :	MGS43796_G

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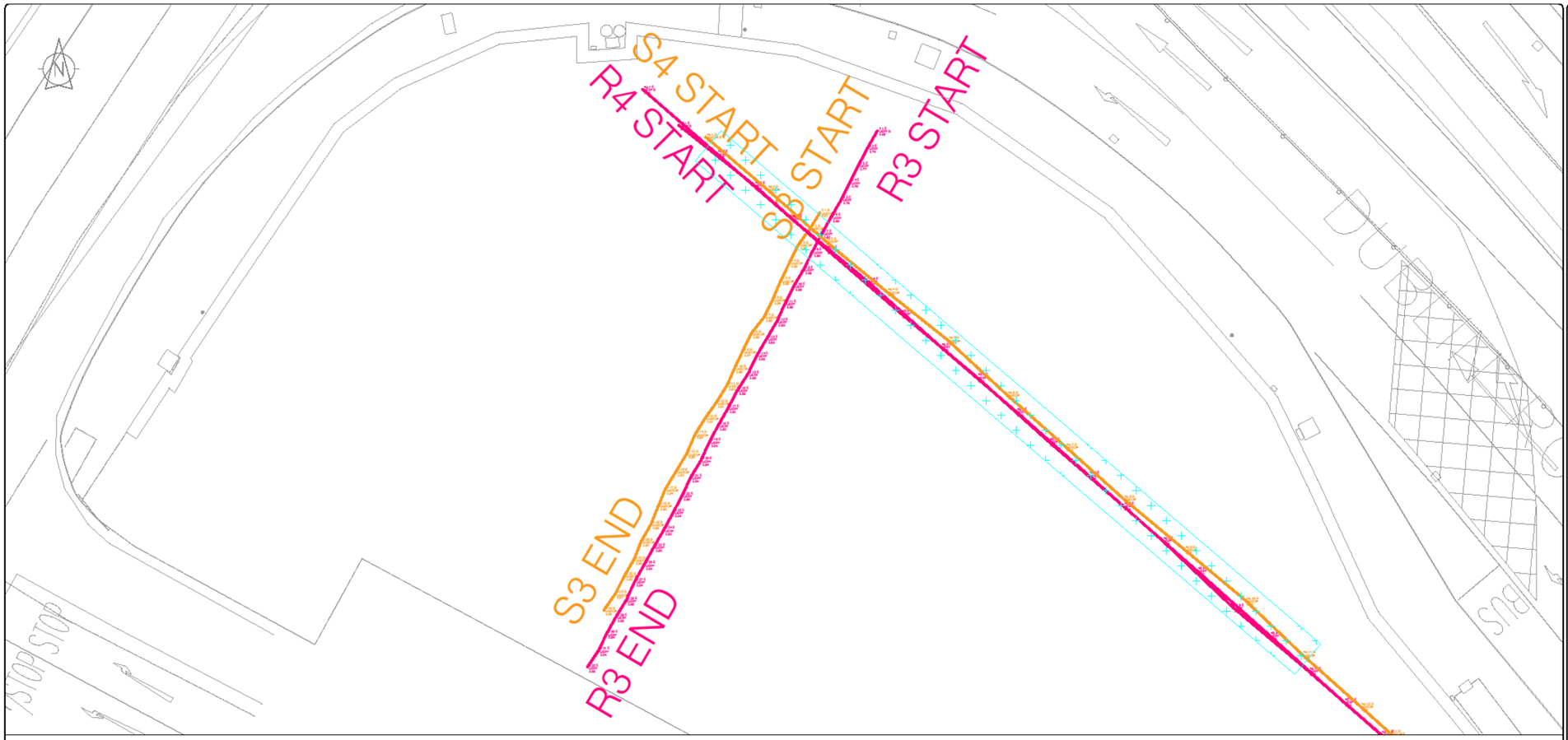

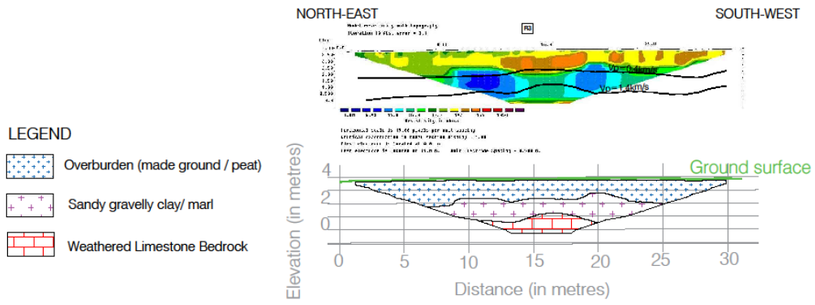

LEGEND

- Overburden (made ground / peat)
- Sandy gravelly clay/ marl
- Weathered Limestone Bedrock

Murphy Geospatial Ltd. Disclaimer

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- Existing record information showing underground services is often incomplete and unknown accuracy; therefore it should be regarded only as an indication.
- In ideal conditions these spatial accuracies for the underground utilities are +/- 5% for the TD-400D and +/- 10% of depth for the GPR to 3.5m deep. However, variations within the subsurface may alter this estimated accuracy.
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- It is not always possible to trace the entire length of each underground service.
- It is always our intention to use the Utility providers' details, if supplied prior to survey commencement as a guide for location purposes. However, should we not be able to locate those (pulled services we shall not be held responsible for the accuracy, or otherwise, of the location of that service, as issued by the utility provider and therefore shown "Taken from Records" on the drawing) and we are not liable for any loss that may arise due to the lack of accuracy in the quoted information.
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- Services which have been untraceable are shown from Records where possible.
- DP represents distance from the surface level to the top of the service/ radar.

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- Internal building services.
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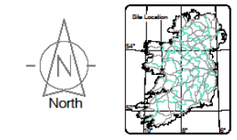

LEGEND

- Resistivity line
- Seismic refraction line
- Potential Culvert
- Zone of Higher Water content

Surveyed by : MG	Date: November 2021	Datum : Malin Head
Drawn by : SM	Date: 07.12.2021	Grid System :
Checked by : SM	Date: 07.12.2021	Irish National Grid ☐ ITM ☒

Revisions

No	Date	Description
0	07.12.2021	Final Drawing

Murphy GEOSPATIAL
Topographic surveys, Measured Building Surveys, Setting-out, As-built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography
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Ireland
Phone: (+353) 045 484040
Fax: (+353) 045 484004
Email: info@murphysurveys.ie

Client :	Arup Consulting Engineers Galway
Project :	BusConnects Galway Geophysical Survey
Date : 07.12.2021	Scale : 1:200@A1
Description :	Geophysical Survey Resistivity results for R3
Drawing Number :	MGS43796_G

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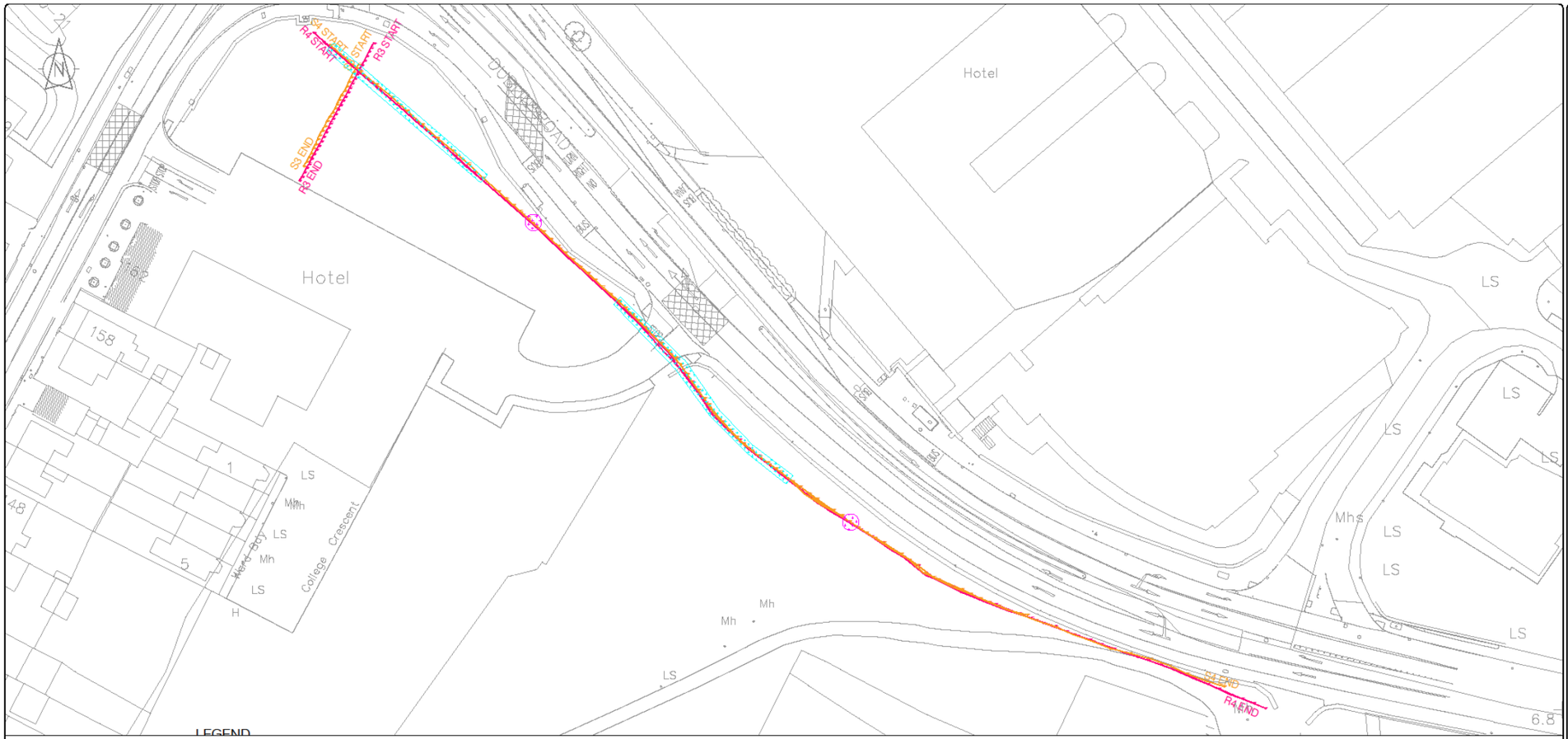

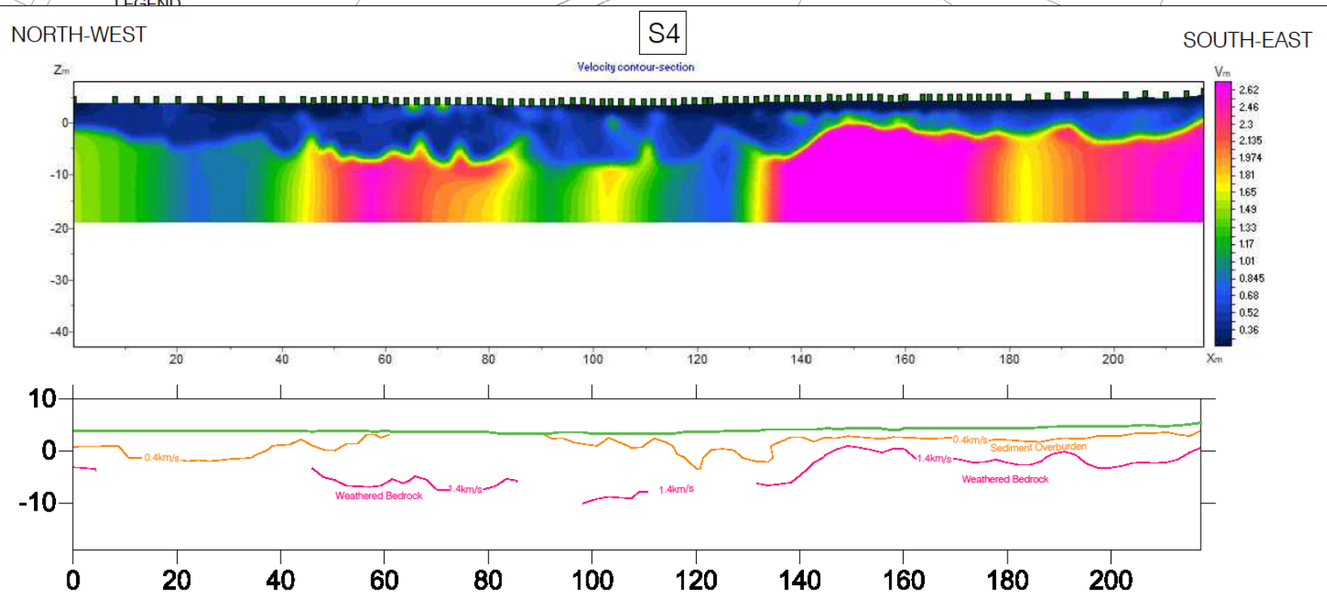

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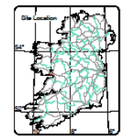

LEGEND
- Resistivity line
- Seismic refraction line
- Potential Culvert
- Zone of Higher Water content

Surveyed by : MG	Date: November 2021	Datum : Malin Head
Drawn by : SM	Date: 07.12.2021	Grid System :
Checked by : SM	Date: 07.12.2021	Irish National Grid ☐ ITM ☒

Revisions

No	Date	Description
0	07.12.2021	First Drawing

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Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography
Kildare Cork Dublin Belfast Glasgow Manchester London
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Ireland
Phone: (+353) 045 484040
Fax: (+353) 045 484004
Email: info@murphysurveys.ie

Client :	Arup Consulting Engineers Galway
Project :	BusConnects Galway Geophysical Survey
Date : 07.12.2021	Scale : 1:500@A1
Description :	Geophysical Survey Seismic results for S4
Drawing Number :	MG843796_G

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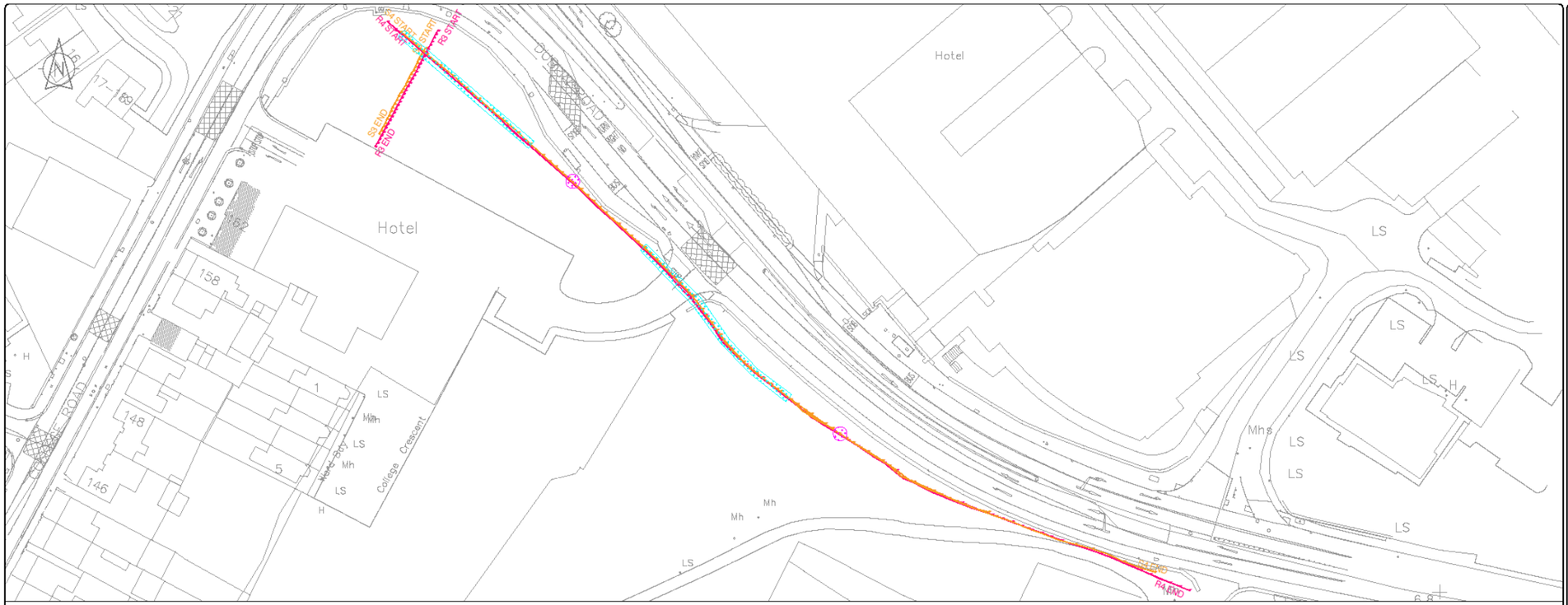
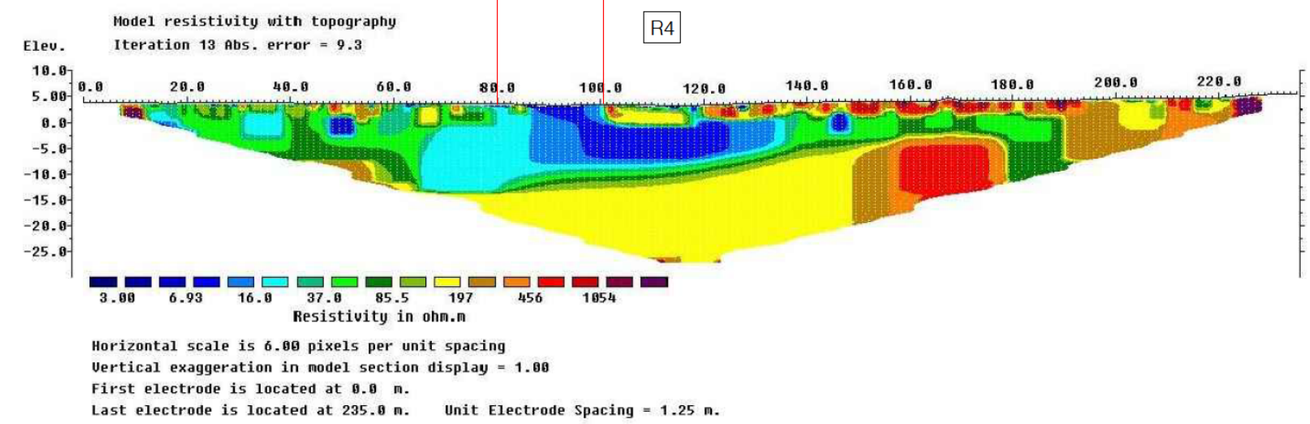


missing electrodes in this area due to road (loss of resolution)

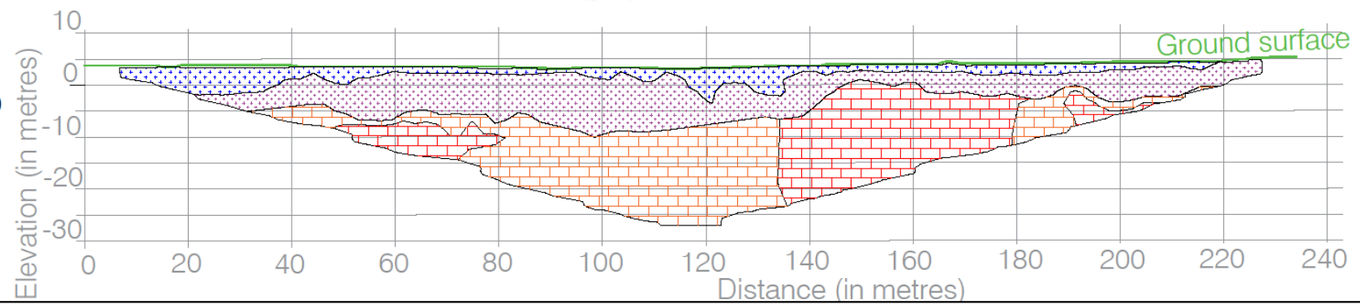
NORTH-WEST

SOUTH-EAST



LEGEND

- Overburden (made ground / peat)
- Sandy gravelly clay /marl
- Weathered Limestone Bedrock (Highly weathered)
- Weathered Limestone Bedrock



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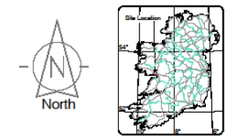

LEGEND

- Resistivity line
- Seismic refraction line
- Potential Culvert
- Zone of Higher Water content

Surveyed by : MG	Date: November 2021	Datum: Main Hotel
Drawn by : SM	Date: 07.12.2021	Grid System:
Checked by : SM	Date: 07.12.2021	Irish National Grid ☐ ITM ☒

Revisions

No	Date	Description
0	07.12.2021	Final Drawing

Murphy GEOSPATIAL
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Email: info@murphysurveys.ie

Client :	Arup Consulting Engineers Galway
Project :	BusConnects Galway Geophysical Survey
Date : 07.12.2021	Scale : 1:500@A1
Description :	Geophysical Survey Resistivity results for R4
Drawing Number :	MGS43796_G

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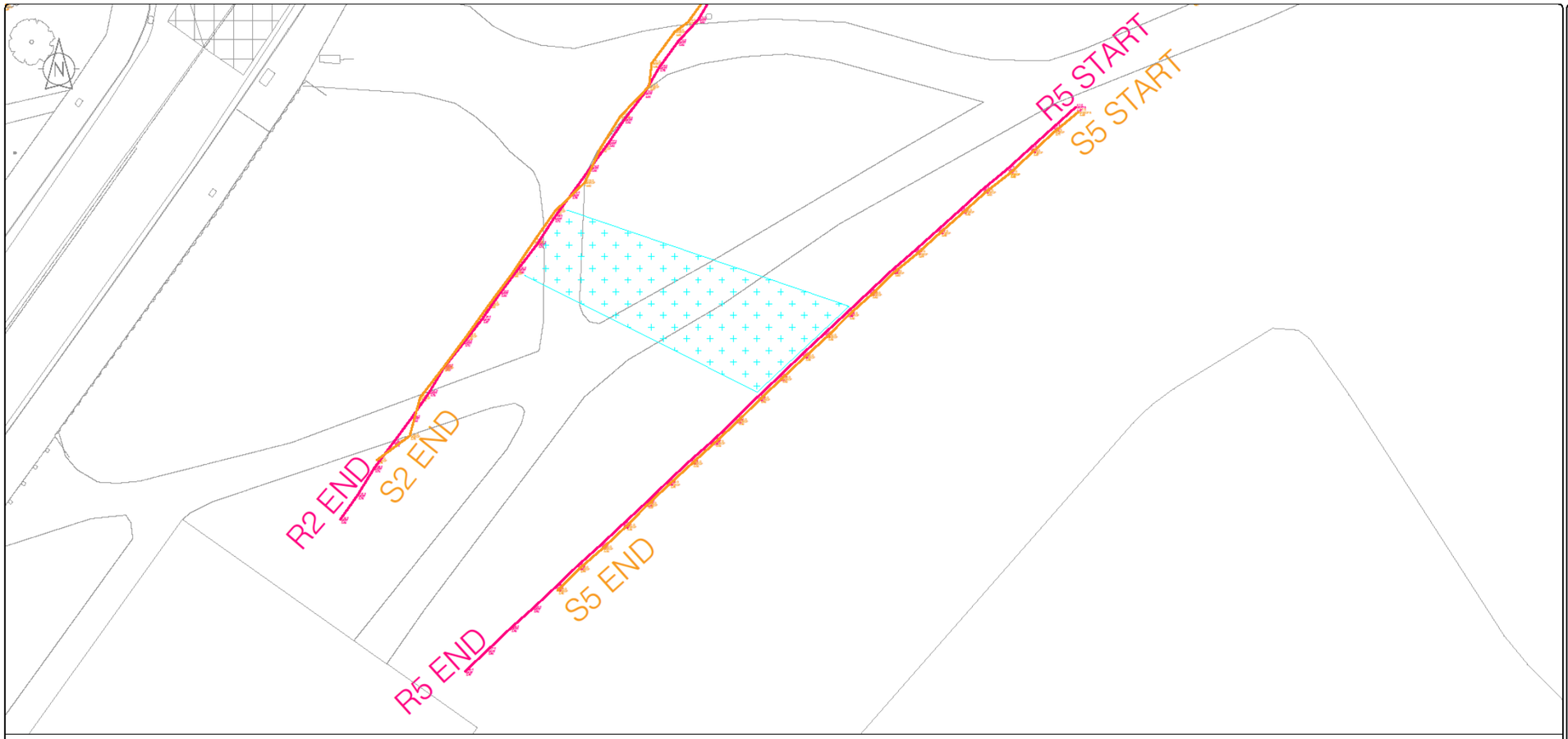

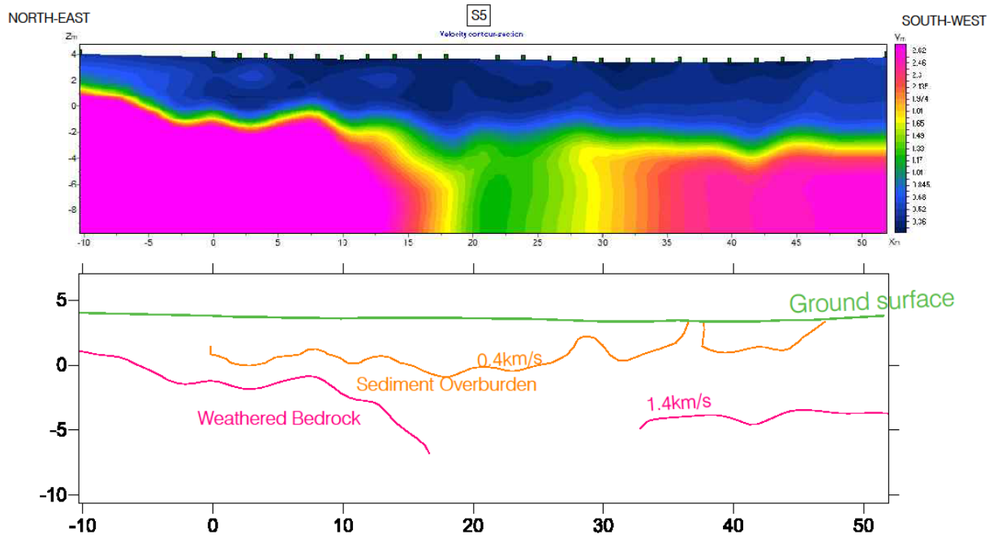

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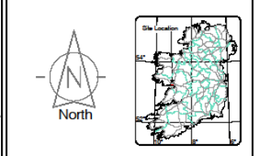
- Above ground services unless specifically requested.
- Lifting manhole covers which require longer than 10 minute effort using standard heavy duty (lifting) apparatus.
- Services positioned directly below other pipes or cables etc (i.e. masking signal) – intrusive verification options available on request.
- Deep non metallic pipes, ducts or cul-verts (unless probing) or Pipe Track 3d is specified as part of the fully invasive survey option).
- Passing through defective pipework (displaced joints etc) or acute bends between access points.

Please note that our Quotation does not allow for location of individual service feeds to properties unless reasonable to do so, as access would be required into each property to apply direct connections to inlet points and this could significantly increase the scope of work, survey cost and also cause possible disruption to occupants.

All work carried out by Murphy Geospatial Limited (MG) conforms to the guidelines set out by The Survey Association (TSA).



LEGEND
- Resistivity line
- Seismic refraction line
- Potential Culvert
- Zone of Higher Water content

Surveyed by : MG	Date : November 2021	Datum : Main Head
Drawn by : SM	Date : 07.12.2021	Grid System :
Checked by : SM	Date : 07.12.2021	Irish National Grid ☐ ITM ☒

Revisions

No	Date	Description
0	07.12.2021	Final Drawing

Murphy GEOSPATIAL
Topographic surveys, Measured Building Surveys, Setting-Out, As-Built Surveys, Hydrographic Surveys, Legal Mapping, Pipeline Surveys, Services Location, Ground Penetrating Radar, Laser Scanning, Rectified Photography
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Client :	Arup Consulting Engineers Galway
Project :	BusConnects Galway Geophysical Survey
Date : 07.12.2021	Scale : 1:200@A1
Description :	Geophysical Survey Seismic results for S5
Drawing Number :	MGS43796_G

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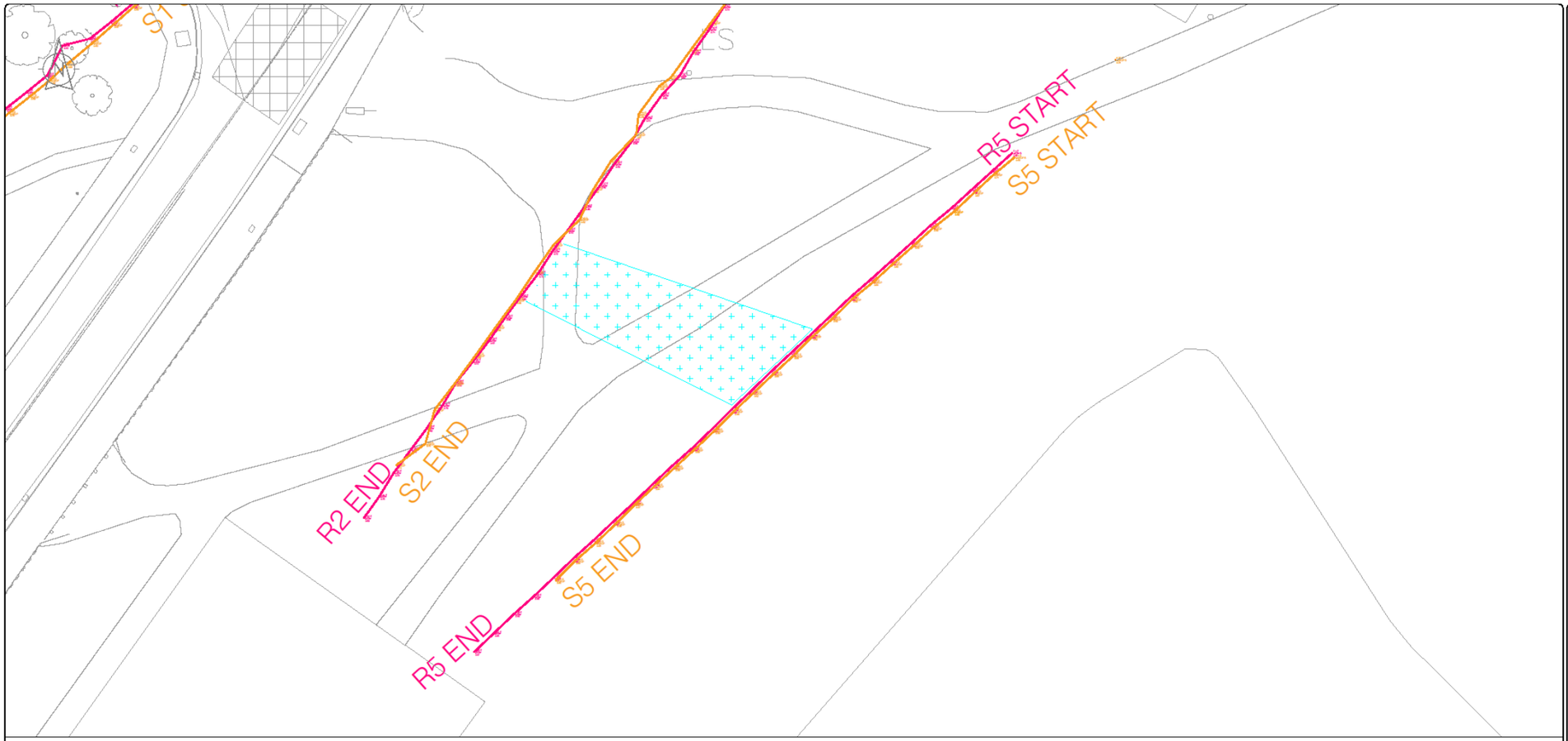

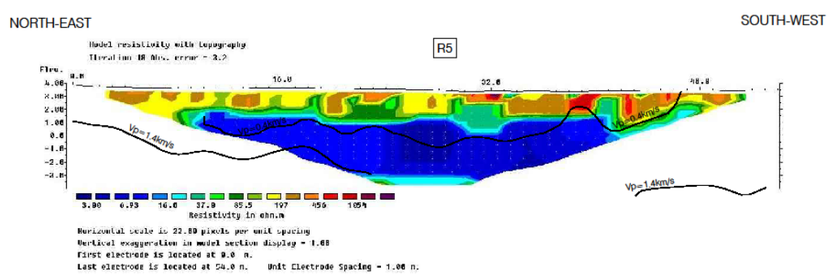

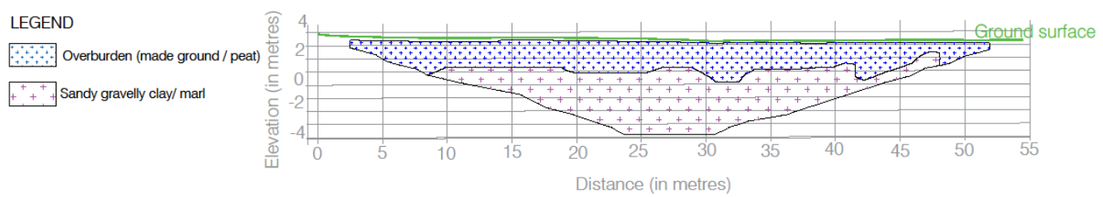

Murphy Geospatial Ltd. Disclaimer

The survey aims to map all existing utilities and sub surface structures and provide information with respect to pipe size, material type and drainage connectivity. However GPR surveying is limited by the following guidelines and it may not be possible to accurately survey, define and locate all services and sub surface features.

- Locational accuracy; is determined by referring to the manufacturers guidelines for the detectors used.
- Existing record information showing underground services is often incomplete and unknown accuracy; therefore it should be regarded only as an indication.
- In ideal conditions these spatial accuracies for the underground utilities are +/- 5% for the 1D/400 and +/- 10% of depth for the GPR to 3.5m deep. However, variations within the subsurface may alter this estimated accuracy.
- Although all reasonable steps have been taken to locate all features, there is no guarantee that all will be shown on the drawing as some above ground features may have obstructed the survey.
- GPR surveying operates best within high resistivity material. Clay overburden can impair GPR surveying.
- Due to the attenuation of the radar signal with depth, resolution is restricted, hence making identification of anomalies difficult with increasing depth.
- The depth penetration and quality of the data depends on the ground conditions on the site. Poor data may be a result of areas with high conductivity. Also, high reflective materials close to the surface i.e. rebar may hide deeper anomalies.
- It is not always possible to trace the entire length of each underground service.
- It is always our intention to use the Utility providers' details, if supplied prior to survey commencement as a guide for location purposes. However, should we not be able to locate those (pulled services we shall not be held responsible for the accuracy, or otherwise, of the location of that service, as issued by the utility provider and therefore shown "Taken from Records" on the drawing and we are not liable for any loss that may arise due to the lack of accuracy in the guided information.
- Unless otherwise stated, all services and sub surface structures shown on Murphy Geospatial Limited plan drawings have been surveyed using approved detectors and the connections between manholes, if not traced, are assumed to run straight.
- Plan accuracies of the order of +- 150mm may be achieved but this figure will depend on the depth of the service below ground level. Where similar services run on close proximity, separation may be impossible. Successful tracing of non metallic pipes may be limited.
- Please note that not all buried pipes, cables and ducts can be detected and mapped in consideration of their depth, location, material type, geology and proximity to other utilities. Even an appropriate and professionally executed survey may not be able to achieve a 100% detection rate.
- Services which have been untraceable are shown from Records where possible.
- DP represents distance from the surface level to the top of the service/ radar.

No allowance has been made within our quotation, unless otherwise stated, for the location and mapping of undeclared services. Failure to detect or fully map any declared service will be recorded within the notes accompanying our final drawings.

Where technically possible, depth indications will be given. These should be used for guidance only and wherever critical accuracy is required these should be confirmed by the Client by; undertaking trial excavations or similar. Bends, lateral service connections, or the close proximity of other services and local magnetic, atmospheric or ground conditions, could in certain situations influence the accuracy of the plan and depth indication facility. Depths will not be provided unless we are reasonably confident of their validity.

Where Murphy Geospatial Limited issues a CAD drawn utility service plan, this should be read in conjunction with all available public utility records etc. As part of our exhaustive Quality Control procedures, Murphy Geospatial Limited Endeavour to add relevant Public Utility record information onto the final issue drawing. An allowance should be made for the width of services; particularly where these are laid in bands or are of significant size etc. For clarification or appropriate easement bands, we would recommend that direct contact is made with the Asset Owner or Statutory Undertaker.

We exclude the following; except where otherwise specified and possible to do so:

- All private service connections, (including water or gas fittings where no through flow of applied signal is possible.
- Pot ended or disconnected cables or terminated short lengths of pipe.
- Internal building services
- Fibre optic cables (except where laid with a standard communications cable or built in tracer wire or similar conductor system) or can be clearly located using ground penetrating radar.
- Small diameter cables less than 17mm diameter, or pipes less than 35mm diameter.
- Above ground services unless specifically requested.
- Lifting manhole covers which require longer than 10 minute effort using standard heavy duty (5ton) apparatus.
- Services positioned directly below other pipes or cables etc (i.e. masking signal) - intrusive verification options available on request.
- Deep non metallic pipes, ducts or culverts (unless probing or Pipe Trac® 3d is specified as part of the fully invasive survey option).
- Passing through defective pipework (displaced joints etc) or acute bends between access points.

Please note that our Quotation does not allow for location of individual service feeds to properties unless reasonable to do so, as access would be required into each property to apply direct connections to inlet points and this would significantly increase the scope of work, survey cost and also cause possible disruption to occupants.

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LEGEND
- Resistivity line
- Seismic refraction line
- Potential Culvert
- Zone of Higher Water content

Surveyed by : MG	Date : November 2021	Datum : Main Head
Drawn by : SM	Date : 07.12.2021	Grid System :
Checked by : SM	Date : 07.12.2021	Irish National Grid ☐ ITM ☒

Revisions

No	Date	Description
0	07.12.2021	First Drawing

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Client : Arup Consulting Engineers Galway

Project : BusConnects Galway Geophysical Survey

Date : 07.12.2021 | Scale : 1:200@A1

Description : Geophysical Survey
Resistivity results for R5

Drawing Number : MGS43796_G

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Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	BH101&0.5&202	BH101&1&20211	BH103&0.5&202	BH103&1&20220	BH103WS&0.5&	BH103WS&1.5&
Hole Ref										BH101	BH101	BH103	BH103	BH103WS	BH103WS
Sample Ref										Ev	Ev	1	2	1	3
Easting										531035.03	531035.03	531009.47	531009.47	531009.69	531009.69
Northing										726236.38	726236.38	726189.14	726189.14	726188.87	726188.87
Hole Elevation (mOD)										4.8	4.8	3.98	3.98	3.96	3.96
Sample Depth (mbgl)										0.5	1	0.5	1	0.5	1.5
Sample Date										30/11/21	30/11/21	17/01/22	21/01/22		
Investigation															
Geology										MG	MG	MG	MG	MG	GG
Antimony	1070	AGAC	mg/kg	2 of 18	0	<2	#VALUE!		0	<2	<2	3.2	<2	<2	<2
Arsenic	79	C4SL/S4U	mg/kg	18 of 18	0	5.1	#VALUE!		0	7.9	5.3	15	16	15	16
Cadmium	106	AGAC	mg/kg	18 of 18	0	0.27	#VALUE!		0	0.97	0.73	0.4	0.6	0.43	0.6
Chromium (Hexavalent)	7.7	GAC/S4U	mg/kg	0 of 18	0	<0.5	#VALUE!		0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium (Trivalent)	1539	AGAC	mg/kg	18 of 18	0	5.7	#VALUE!		0	23	14	8.8	13	7.2	10
Copper	12000	GAC/S4U	mg/kg	18 of 18	0	5.1	#VALUE!		0	9.7	9.2	10	12	9.4	5.7
Lead	630	C4SL	mg/kg	18 of 18	0	5.6	#VALUE!		0	22	25	9	20	7.6	6.6
Mercury Low Level	120	AC (inorga	mg/kg	13 of 18	0	<0.05	#VALUE!		0	0.07	0.06	<0.05	0.13	<0.05	<0.05
Nickel	231	AGAC	mg/kg	18 of 18	0	3.8	#VALUE!		0	18	13	18	17	14	8.8
Selenium	1140	AGAC	mg/kg	5 of 18	0	<0.2	#VALUE!		0	<0.2	<0.2	1.2	<0.2	0.99	<0.2
Zinc	80500	AGAC	mg/kg	18 of 18	0	8.2	#VALUE!		0	43	32	13	37	11	9.1
pH			-	No GAC	-	8.2	#VALUE!		0	8.5	8.5	10.1	9.4	9.9	8.9
Total Organic Carbon			%	No GAC	-	<0.2	#VALUE!		0	0.6	1.1	5	4.1	6.3	4
Phenol	440	(direct co	mg/kg	1 of 17	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aliphatic TPH >C10-C12	12600	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C12-C16	12600	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C16-C21	251000	C (Ali >C1	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C21-C35	251000	C (Ali >C1	mg/kg	4 of 18	0	<1	#VALUE!		0	<1	<1	79	<1	<1	<1
Aliphatic TPH >C35-C44	251000	C (Ali >C1	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C5-C6	575000	AGAC	mg/kg	0 of 18	0	<1	#VALUE!	304.0	0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C6-C8	597000	AGAC	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C8-C10	12500	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C10-C12	5040	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C12-C16	5050	AGAC	mg/kg	2 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C16-C21	3770	AGAC	mg/kg	3 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C21-C35	3770	AGAC	mg/kg	5 of 18	0	<1	#VALUE!		0	<1	<1	170	<1	<1	<1
Aromatic TPH >C35-C44	3770	AGAC	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C7-C8	55800	AC (toluer	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C8-C10	5020	AGAC	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Acenaphthene	14800	AGAC	mg/kg	2 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenz(a,h)Anthracene	0.573	GAC/S4U	mg/kg	8 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluoranthene	3080	AGAC	mg/kg	10 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fluorene	9870	AGAC	mg/kg	3 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Indeno(1,2,3-c,d)Pyrene	81.7	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Phenanthrene	3070	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pyrene	7410	AGAC	mg/kg	10 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Naphthalene	4890	AGAC	mg/kg	1 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Of 17 PAH's			mg/kg	No GAC	-	<2	#VALUE!		0	<2	<2	<2	<2	<2	<2
Acenaphthylene	14800	AGAC	mg/kg	3 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Anthracene	74100	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo[a]anthracene	28.5	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo[a]pyrene	5.72	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo[g,h,i]perylene	636	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo[b]fluoranthene	7.21	AGAC	mg/kg	10 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo[k]fluoranthene	190	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chrysene	57	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Benzene	72	GAC/S4U	mg/kg	1 of 18	0	<0.0002	#VALUE!		0	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Toluene	55800	AGAC	mg/kg	4 of 18	0	<0.0002	#VALUE!		0	<0.0002	<0.0002	0.0035	<0.0002	<0.0002	<0.0002
Ethylbenzene	23900	AGAC	mg/kg	1 of 18	0	<0.0002	#VALUE!		0	<0.0002	<0.0002	0.0012	<0.0002	<0.0002	<0.0002

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	BH101	BH101	BH103	BH103	BH103WS	BH103WS
										Sample Ref	Ev	Ev	1	2	1	3
										Easting	531035.03	531035.03	531009.47	531009.47	531009.69	531009.69
										Northing	726236.38	726236.38	726189.14	726189.14	726188.87	726188.87
										Hole Elevation (mOD)	4.8	4.8	3.98	3.98	3.96	3.96
										Sample Depth (mbgl)	0.5	1	0.5	1	0.5	1.5
										Sample Date	30/11/21	30/11/21	17/01/22	21/01/22		
										Investigation						
										Geology	MG	MG	MG	MG	MG	GG
m & p-Xylene	40700	AC (p-xyle	mg/kg	1 of 18	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	0.0045	<0.0002	<0.0002	<0.0002
o-Xylene	41000	.GAC/S4U	mg/kg	1 of 18	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	0.0024	<0.0002	<0.0002	<0.0002
PCB 118	0.000171	ı backgrou	mg/kg	0 of 18	0	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 138			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 153			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 180			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 28			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 52			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 90+101			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1,2-Tetrachloroethane	1410	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,1,1-Trichloroethane	137000	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,1,2-Trichloroethane	985	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,1-Dichloroethane	45900	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,1-Dichloroethene	10200	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!	2230.0	0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,1-Dichloropropene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2,3-Trichlorobenzene	1780	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2,3-Trichloropropane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2,4-Trichlorobenzene	14900	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2,4-Trimethylbenzene	248	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	0.0033	<0.0002	<0.0002	<0.0002
1,2-Dibromo-3-Chloropropane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2-Dibromoethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2-Dichlorobenzene	89000	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichloroethane	28.9	.GAC/S4U	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2-Dichloropropane	1720	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,3,5-Trimethylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	0.00089	<0.0002	<0.0002	<0.0002
1,3-Dichlorobenzene	247	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,3-Dichloropropane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	0.0015	<0.0002	<0.0002	<0.0002
1,4-Dichlorobenzene	17200	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4,5-Trichlorophenol	620	S4UL	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4,6-Trichlorophenol	598	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4-Dichlorophenol	597	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4-Dimethylphenol	5020	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4-Dinitrotoluene	501	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,6-Dinitrotoluene	251	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Chloronaphthalene	7490	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Chlorophenol	597	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Chlorotoluene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
2-Methyl-4,6-Dinitrophenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Methylnaphthalene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Methylphenol	25080	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Nitroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Nitrophenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
3-Nitroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Bromophenylphenyl Ether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Chloro-3-Methylphenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Chloroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Chlorophenylphenylether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Chlorotoluene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
4-Isopropyltoluene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
4-Methylphenol	25080	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Nitroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Nitrophenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Azobenzene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	BH101	BH101	BH103	BH103	BH103WS	BH103WS
										Sample Ref	Ev	Ev	1	2	1	3
										Easting	531035.03	531035.03	531009.47	531009.47	531009.69	531009.69
										Northing	726236.38	726236.38	726189.14	726189.14	726188.87	726188.87
										Hole Elevation (mOD)	4.8	4.8	3.98	3.98	3.96	3.96
										Sample Depth (mbgl)	0.5	1	0.5	1	0.5	1.5
										Sample Date	30/11/21	30/11/21	17/01/22	21/01/22		
										Investigation						
										Geology	MG	MG	MG	MG	MG	GG
Bis(2-Chloroethoxy)Methane			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bis(2-Chloroisopropyl)Ether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bis(2-Ethylhexyl)Phthalate	9688	AGAC	mg/kg	1 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bis-(2-Chloroethyl)Ether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromobenzene	5217	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	0.00057	<0.0002	<0.0002	<0.0002
Bromochloromethane			mg/kg	No GAC	-	<0.0005	#VALUE!		0		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bromodichloromethane	72.5	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Bromomethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Butylbenzyl Phthalate	126000	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Carbazole			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Chlorobenzene	11450	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chloroethane	601000	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!	2610.0	0		<0.0002	<0.0002	<0.0002	0.0011	<0.0002	<0.0002
Chloromethane	543	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Di-N-Butyl Phthalate	1300	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Di-N-Octyl Phthalate	10700	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenzofuran			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibromochloromethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Dibromomethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Diethyl Phthalate	49400	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dimethylphthalate			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene	15.6	GAC/S4U	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobutadiene	25.2	GAC/S4U	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorocyclopentadiene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachloroethane	124	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Isophorone			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Isopropylbenzene	24500	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Methyl Tert-Butyl Ether	74600	AGAC	mg/kg	0 of 18	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
N-Butylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
N-Nitrosodi-n-propylamine			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
N-Nitrosodimethylamine			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
N-Propylbenzene	24900	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	0.0026	<0.0002	<0.0002	<0.0002
Nitrobenzene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pentachlorophenol	59.8	GAC/S4U	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sec-Butylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Styrene	3016	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tert-Butylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tetrachloroethene	1390	AGAC	mg/kg	3 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tetrachloromethane	886	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Trans 1,2-Dichloroethene	3866	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Trans-1,3-Dichloropropene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tribromomethane	3930	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Trichloroethene	119	AGAC	mg/kg	2 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Trichlorofluoromethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Trichloromethane	2500	GAC/S4U	mg/kg	4 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	0.0054	0.0089	0.0065	<0.0002
Vinyl Chloride	3.49	GAC/S4U	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
cis 1,2-Dichloroethene	1320	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
cis-1,3-Dichloropropene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
ACM Type			-	No GAC	-		#VALUE!		0		-	-	-	-	-	-
Aromatic TPH >C5-C7			mg/kg	No GAC	-	<1	#VALUE!		0		<1	<1	<1	<1	<1	<1
Asbestos Identification			-	No GAC	-		#VALUE!		0		No Asbestos Detected	sbestos Detected	sbestos Detected	sbestos Detected	sbestos Detected	sbestos Detected
Barium			mg/kg	No GAC	-	12	#VALUE!		0		35	29	20	35	17	15
Coronene			mg/kg	No GAC	-	<0.1	#VALUE!		0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorodifluoromethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	Sample Ref	Easting	Northing	Hole Elevation (mOD)	Sample Depth (mbgl)	Sample Date	Investigation	Geology
										BH101	BH101	BH103	BH103	BH103WS	BH103WS			
										Ev	Ev	1	2	1	3			
										531035.03	531035.03	531009.47	531009.47	531009.69	531009.69			
										726236.38	726236.38	726189.14	726189.14	726188.87	726188.87			
										4.8	4.8	3.98	3.98	3.96	3.96			
										0.5	1	0.5	1	0.5	1.5			
										30/11/21	30/11/21	17/01/22	21/01/22					
										MG	MG	MG	MG	MG	GG			
LOI			%	No GAC	-	0.74	#VALUE!		0	4.8	4.8	1.1	1.3	0.88	0.74			
Molybdenum			mg/kg	No GAC	-	<2	#VALUE!		0	<2	<2	<2	<2	<2	<2			
SVOC TIC			mg/kg	No GAC	-		#VALUE!		0	None Detected	None Detected	None Detected	None Detected	None Detected	None Detected			
Tetraethyl Lead			mg/kg	No GAC	-	<0.01	#VALUE!		0			<0.01	<0.01	<0.01	<0.01			
Tetramethyl Lead			mg/kg	No GAC	-	<0.01	#VALUE!		0			<0.01	<0.01	<0.01	<0.01			
Total Aliphatic Hydrocarbons			mg/kg	No GAC	-	<5	#VALUE!		0	<5	<5	79	<5	<5	<5			
Total Aromatic Hydrocarbons			mg/kg	No GAC	-	<5	#VALUE!		0	<5	<5	170	<5	<5	<5			
Total PCBs (7 Congeners)			mg/kg	No GAC	-	<0.1	#VALUE!		0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1			
Total Petroleum Hydrocarbons			mg/kg	No GAC	-	<10	#VALUE!		0	<10	<10	250	<10	<10	<10			
VOC TIC			mg/kg	No GAC	-		#VALUE!		0	0	0	0	0	0	0			

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	BH104&0.5&202	BH105A&0.5&	BH105A&1.5&	BH106&0.5&	WS101&0.5&202	WS101&1&2021
Hole Ref										BH104	BH105A	BH105A	BH106	WS101	WS101
Sample Ref										2	1	3	1		
Easting										531072.68	531033.11	531033.11	529914.25	531084.08	531084.08
Northing										726115.5	726069.97	726069.97	725704.49	726208.68	726208.68
Hole Elevation (mOD)										3.63	3.98	3.98	7.04	3.81	3.81
Sample Depth (mbgl)										0.5	0.5	1.5	0.5	0.5	1
Sample Date										06/12/21				29/11/21	29/11/21
Investigation															
Geology										MG	MG	MG	MG	MG	MG
Antimony	1070	AGAC	mg/kg	2 of 18	0	<2	#VALUE!		0	2.1	<2	<2	<2	<2	<2
Arsenic	79	C4SL/S4U	mg/kg	18 of 18	0	5.1	#VALUE!		0	12	21	8.2	7.1	8	6.9
Cadmium	106	AGAC	mg/kg	18 of 18	0	0.27	#VALUE!		0	4	0.49	0.27	0.62	1.4	0.51
Chromium (Hexavalent)	7.7	GAC/S4U	mg/kg	0 of 18	0	<0.5	#VALUE!		0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium (Trivalent)	1539	AGAC	mg/kg	18 of 18	0	5.7	#VALUE!		0	12	11	5.7	25	14	7.4
Copper	12000	GAC/S4U	mg/kg	18 of 18	0	5.1	#VALUE!		0	200	14	7.9	30	26	24
Lead	630	C4SL	mg/kg	18 of 18	0	5.6	#VALUE!		0	82	37	20	29	270	56
Mercury Low Level	120	AC (inorga	mg/kg	13 of 18	0	<0.05	#VALUE!		0	1.2	0.69	0.4	0.18	0.2	0.08
Nickel	231	AGAC	mg/kg	18 of 18	0	3.8	#VALUE!		0	8.9	13	7.8	15	14	7.2
Selenium	1140	AGAC	mg/kg	5 of 18	0	<0.2	#VALUE!		0	<0.2	1.1	0.82	<0.2	0.25	<0.2
Zinc	80500	AGAC	mg/kg	18 of 18	0	8.2	#VALUE!		0	850	41	20	37	160	65
pH			-	No GAC	-	8.2	#VALUE!		0	8.8	8.4	8.7	8.3	8.4	8.5
Total Organic Carbon			%	No GAC	-	<0.2	#VALUE!		0	1.8	2.5	2	1.7	3.6	2.3
Phenol	440	(direct co	mg/kg	1 of 17	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05		<0.05	0.07
Aliphatic TPH >C10-C12	12600	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	360	<1
Aliphatic TPH >C12-C16	12600	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	1100	<1
Aliphatic TPH >C16-C21	251000	C (Ali >C1	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	1100	<1
Aliphatic TPH >C21-C35	251000	C (Ali >C1	mg/kg	4 of 18	0	<1	#VALUE!		0	<1	<1	<1	11	390	38
Aliphatic TPH >C35-C44	251000	C (Ali >C1	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C5-C6	575000	AGAC	mg/kg	0 of 18	0	<1	#VALUE!	304.0	0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C6-C8	597000	AGAC	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C8-C10	12500	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	94	<1
Aromatic TPH >C10-C12	5040	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	53	<1
Aromatic TPH >C12-C16	5050	AGAC	mg/kg	2 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	400	44
Aromatic TPH >C16-C21	3770	AGAC	mg/kg	3 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	270	210
Aromatic TPH >C21-C35	3770	AGAC	mg/kg	5 of 18	0	<1	#VALUE!		0	<1	<1	<1	77	54	460
Aromatic TPH >C35-C44	3770	AGAC	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C7-C8	55800	AC (toluer	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C8-C10	5020	AGAC	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Acenaphthene	14800	AGAC	mg/kg	2 of 18	0	<0.05	#VALUE!		0	<0.05	0.094	<0.05	<0.1	<0.05	<0.05
Dibenz(a,h)Anthracene	0.573	GAC/S4U	mg/kg	8 of 18	0	<0.05	#VALUE!		0	<0.05	0.13	0.055	0.23	0.12	0.12
Fluoranthene	3080	AGAC	mg/kg	10 of 18	0	<0.05	#VALUE!		0	0.082	2.1	0.64	0.31	0.99	1.4
Fluorene	9870	AGAC	mg/kg	3 of 18	0	<0.05	#VALUE!		0	<0.05	0.12	<0.05	<0.1	<0.05	0.07
Indeno(1,2,3-c,d)Pyrene	81.7	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	0.53	0.18	0.35	0.37	0.41
Phenanthrene	3070	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	0.94	0.29	0.14	0.34	0.94
Pyrene	7410	AGAC	mg/kg	10 of 18	0	<0.05	#VALUE!		0	0.093	1.6	0.53	0.34	0.84	1.2
Naphthalene	4890	AGAC	mg/kg	1 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.1	<0.05	0.07
Total Of 17 PAH's			mg/kg	No GAC	-	<2	#VALUE!		0	2	15	14	3.4	58	3.7
Acenaphthylene	14800	AGAC	mg/kg	3 of 18	0	<0.05	#VALUE!		0	<0.05	0.073	<0.05	<0.1	0.076	0.15
Anthracene	74100	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	0.36	0.1	0.11	0.076	0.15
Benzo[a]anthracene	28.5	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	1.1	0.37	0.34	0.57	0.58
Benzo[a]pyrene	5.72	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	1	0.34	0.34	0.65	0.71
Benzo[g,h,i]perylene	636	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	0.64	0.22	0.31	0.47	0.54
Benzo[b]fluoranthene	7.21	AGAC	mg/kg	10 of 18	0	<0.05	#VALUE!		0	0.093	1.3	0.47	0.37	0.9	0.87
Benzo[k]fluoranthene	190	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	0.46	0.17	0.29	0.28	0.3
Chrysene	57	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	1	0.39	0.23	0.59	0.64
Benzene	72	GAC/S4U	mg/kg	1 of 18	0	<0.0002	#VALUE!		0	0.0014	<0.0002	<0.0002	<0.001	<0.0002	<0.0002
Toluene	55800	AGAC	mg/kg	4 of 18	0	<0.0002	#VALUE!		0	0.0031	0.0017	0.002	<0.001	<0.0002	<0.0002
Ethylbenzene	23900	AGAC	mg/kg	1 of 18	0	<0.0002	#VALUE!		0	<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	BH104	BH105A	BH105A	BH106	WS101	WS101
										Sample Ref	2	1	3	1		
										Easting	531072.68	531033.11	531033.11	529914.25	531084.08	531084.08
										Northing	726115.5	726069.97	726069.97	725704.49	726208.68	726208.68
										Hole Elevation (mOD)	3.63	3.98	3.98	7.04	3.81	3.81
										Sample Depth (mbgl)	0.5	0.5	1.5	0.5	0.5	1
										Sample Date	06/12/21				29/11/21	29/11/21
										Investigation						
										Geology	MG	MG	MG	MG	MG	MG
m & p-Xylene	40700	AC (p-xyle	mg/kg	1 of 18	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002
o-Xylene	41000	.GAC/S4U	mg/kg	1 of 18	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002
PCB 118	0.000171	ı backgrou	mg/kg	0 of 18	0	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 138			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 153			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 180			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 28			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 52			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 90+101			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1,2-Tetrachloroethane	1410	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,1,1-Trichloroethane	137000	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,1,2-Trichloroethane	985	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,1-Dichloroethane	45900	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,1-Dichloroethene	10200	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!	2230.0	0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,1-Dichloropropene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,2,3-Trichlorobenzene	1780	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,2,3-Trichloropropane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,2,4-Trichlorobenzene	14900	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
1,2,4-Trimethylbenzene	248	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,2-Dibromo-3-Chloropropane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,2-Dibromoethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,2-Dichlorobenzene	89000	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
1,2-Dichloroethane	28.9	.GAC/S4U	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,2-Dichloropropane	1720	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,3,5-Trimethylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,3-Dichlorobenzene	247	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
1,3-Dichloropropane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
1,4-Dichlorobenzene	17200	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2,4,5-Trichlorophenol	620	S4UL	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2,4,6-Trichlorophenol	598	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2,4-Dichlorophenol	597	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2,4-Dimethylphenol	5020	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2,4-Dinitrotoluene	501	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2,6-Dinitrotoluene	251	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2-Chloronaphthalene	7490	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2-Chlorophenol	597	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2-Chlorotoluene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
2-Methyl-4,6-Dinitrophenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2-Methylnaphthalene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	0.063	<0.05		<0.05	0.058
2-Methylphenol	25080	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2-Nitroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
2-Nitrophenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
3-Nitroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
4-Bromophenylphenyl Ether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
4-Chloro-3-Methylphenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
4-Chloroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
4-Chlorophenylphenylether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
4-Chlorotoluene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
4-Isopropyltoluene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
4-Methylphenol	25080	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
4-Nitroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
4-Nitrophenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Azobenzene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	BH104	BH105A	BH105A	BH106	WS101	WS101
										Sample Ref	2	1	3	1		
										Easting	531072.68	531033.11	531033.11	529914.25	531084.08	531084.08
										Northing	726115.5	726069.97	726069.97	725704.49	726208.68	726208.68
										Hole Elevation (mOD)	3.63	3.98	3.98	7.04	3.81	3.81
										Sample Depth (mbgl)	0.5	0.5	1.5	0.5	0.5	1
										Sample Date	06/12/21				29/11/21	29/11/21
										Investigation						
										Geology	MG	MG	MG	MG	MG	MG
Bis(2-Chloroethoxy)Methane			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Bis(2-Chloroisopropyl)Ether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Bis(2-Ethylhexyl)Phthalate	9688	AGAC	mg/kg	1 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	0.22
Bis-(2-Chloroethyl)Ether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Bromobenzene	5217	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Bromochloromethane			mg/kg	No GAC	-	<0.0005	#VALUE!		0		<0.0005	<0.0005	<0.0005		<0.0005	<0.0005
Bromodichloromethane	72.5	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Bromomethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Butylbenzyl Phthalate	126000	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Carbazole			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	0.073	<0.05		<0.05	0.11
Chlorobenzene	11450	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Chloroethane	601000	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!	2610.0	0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Chloromethane	543	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Di-N-Butyl Phthalate	1300	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Di-N-Octyl Phthalate	10700	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Dibenzofuran			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	0.052	<0.05		<0.05	0.07
Dibromochloromethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Dibromomethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Diethyl Phthalate	49400	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Dimethylphthalate			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Hexachlorobenzene	15.6	GAC/S4U	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Hexachlorobutadiene	25.2	GAC/S4U	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Hexachlorocyclopentadiene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Hexachloroethane	124	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Isophorone			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Isopropylbenzene	24500	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Methyl Tert-Butyl Ether	74600	AGAC	mg/kg	0 of 18	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.001	<0.0002	<0.0002
N-Butylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
N-Nitrosodi-n-propylamine			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
N-Nitrosodimethylamine			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
N-Propylbenzene	24900	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Nitrobenzene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Pentachlorophenol	59.8	GAC/S4U	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05		<0.05	<0.05
Sec-Butylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Styrene	3016	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Tert-Butylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Tetrachloroethene	1390	AGAC	mg/kg	3 of 17	0	<0.0002	#VALUE!		0		0.015	0.011	0.0067		<0.0002	<0.0002
Tetrachloromethane	886	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Trans 1,2-Dichloroethene	3866	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Trans-1,3-Dichloropropene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Tribromomethane	3930	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Trichloroethene	119	AGAC	mg/kg	2 of 17	0	<0.0002	#VALUE!		0		0.0025	<0.0002	0.0013		<0.0002	<0.0002
Trichlorofluoromethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Trichloromethane	2500	GAC/S4U	mg/kg	4 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
Vinyl Chloride	3.49	GAC/S4U	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
cis 1,2-Dichloroethene	1320	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
cis-1,3-Dichloropropene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002
ACM Type			-	No GAC	-		#VALUE!		0		-	-	-	-	-	-
Aromatic TPH >C5-C7			mg/kg	No GAC	-	<1	#VALUE!		0		<1	<1	<1	<1	<1	<1
Asbestos Identification			-	No GAC	-		#VALUE!		0		No Asbestos Detected	sbestos Detected	sbestos Detected	sbestos Detected	sbestos Detected	sbestos Detected
Barium			mg/kg	No GAC	-	12	#VALUE!		0		70	50	27	57	84	33
Coronene			mg/kg	No GAC	-	<0.1	#VALUE!		0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorodifluoromethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002		<0.0002	<0.0002

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	Sample Ref	Easting	Northing	Hole Elevation (mOD)	Sample Depth (mbgl)	Sample Date	Investigation	Geology
										BH104	2	531072.68	726115.5	3.63	0.5	06/12/21		MG
										BH105A	1	531033.11	726069.97	3.98	0.5			MG
										BH105A	3	531033.11	726069.97	3.98	1.5			MG
										BH106	1	529914.25	725704.49	7.04	0.5			MG
										WS101		531084.08	726208.68	3.81	0.5	29/11/21		MG
										WS101		531084.08	726208.68	3.81	1	29/11/21		MG
LOI			%	No GAC	-	0.74	#VALUE!		0			3		4.3		4.1		4		7.8		4.3
Molybdenum			mg/kg	No GAC	-	<2	#VALUE!		0			<2		2.1		<2		<2		<2		<2
SVOC TIC			mg/kg	No GAC	-		#VALUE!		0			None Detected		None Detected		None Detected				None Detected		None Detected
Tetraethyl Lead			mg/kg	No GAC	-	<0.01	#VALUE!		0													
Tetramethyl Lead			mg/kg	No GAC	-	<0.01	#VALUE!		0													
Total Aliphatic Hydrocarbons			mg/kg	No GAC	-	<5	#VALUE!		0			<5		<5		<5		11		3100		38
Total Aromatic Hydrocarbons			mg/kg	No GAC	-	<5	#VALUE!		0			<5		<5		<5		77		780		710
Total PCBs (7 Congeners)			mg/kg	No GAC	-	<0.1	#VALUE!		0			<0.1		<0.1		<0.1		<0.1		<0.1		<0.1
Total Petroleum Hydrocarbons			mg/kg	No GAC	-	<10	#VALUE!		0			<10		<10		<10		87		3800		750
VOC TIC			mg/kg	No GAC	-		#VALUE!		0			0		0		0				0		0

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	WS104&0.5&	WS104&1&	WS105&0.5&202	WS105&1&2021	WS106&0.5&202	WS106&1&2021
Hole Ref										WS104	WS104	WS105	WS105	WS106	WS106
Sample Ref										1	2				
Easting										530997.95	530997.95	530903.19	530903.19	530922.85	530922.85
Northing										726165.53	726165.53	726025.43	726025.43	726032.93	726032.93
Hole Elevation (mOD)										3.9	3.9	4.35	4.35	3.67	3.67
Sample Depth (mbgl)										0.5	1	0.5	1	0.5	1
Sample Date												30/11/21	30/11/21	30/11/21	30/11/21
Investigation															
Geology										MG	GG	MG	MG	MG	MG
Antimony	1070	AGAC	mg/kg	2 of 18	0	<2	#VALUE!		0	<2	<2	<2	<2	<2	<2
Arsenic	79	C4SL/S4U	mg/kg	18 of 18	0	5.1	#VALUE!		0	12	5.1	10	12	8.4	8.4
Cadmium	106	AGAC	mg/kg	18 of 18	0	0.27	#VALUE!		0	0.39	0.37	0.47	0.94	0.52	0.47
Chromium (Hexavalent)	7.7	GAC/S4U	mg/kg	0 of 18	0	<0.5	#VALUE!		0	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Chromium (Trivalent)	1539	AGAC	mg/kg	18 of 18	0	5.7	#VALUE!		0	6.8	5.7	11	10	12	6.7
Copper	12000	GAC/S4U	mg/kg	18 of 18	0	5.1	#VALUE!		0	6.1	15	5.1	18	30	7.2
Lead	630	C4SL	mg/kg	18 of 18	0	5.6	#VALUE!		0	15	12	5.6	250	89	20
Mercury Low Level	120	AC (inorga	mg/kg	13 of 18	0	<0.05	#VALUE!		0	<0.05	0.07	<0.05	0.13	0.25	0.05
Nickel	231	AGAC	mg/kg	18 of 18	0	3.8	#VALUE!		0	6.8	3.8	10	12	11	7.4
Selenium	1140	AGAC	mg/kg	5 of 18	0	<0.2	#VALUE!		0	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Zinc	80500	AGAC	mg/kg	18 of 18	0	8.2	#VALUE!		0	8.2	8.8	14	72	85	26
pH			-	No GAC	-	8.2	#VALUE!		0	9.3	8.6	8.5	8.2	8.2	8.4
Total Organic Carbon			%	No GAC	-	<0.2	#VALUE!		0	6.5	4.3	<0.2	0.6	2.6	0.3
Phenol	440	(direct co	mg/kg	1 of 17	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Aliphatic TPH >C10-C12	12600	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C12-C16	12600	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C16-C21	251000	C (Ali >C1	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C21-C35	251000	C (Ali >C1	mg/kg	4 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C35-C44	251000	C (Ali >C1	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C5-C6	575000	AGAC	mg/kg	0 of 18	0	<1	#VALUE!	304.0	0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C6-C8	597000	AGAC	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aliphatic TPH >C8-C10	12500	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C10-C12	5040	AGAC	mg/kg	1 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C12-C16	5050	AGAC	mg/kg	2 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C16-C21	3770	AGAC	mg/kg	3 of 18	0	<1	#VALUE!		0	<1	<1	6.8	<1	<1	<1
Aromatic TPH >C21-C35	3770	AGAC	mg/kg	5 of 18	0	<1	#VALUE!		0	<1	<1	52	<1	<1	<1
Aromatic TPH >C35-C44	3770	AGAC	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C7-C8	55800	AC (toluer	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Aromatic TPH >C8-C10	5020	AGAC	mg/kg	0 of 18	0	<1	#VALUE!		0	<1	<1	<1	<1	<1	<1
Acenaphthene	14800	AGAC	mg/kg	2 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	0.079	<0.05	<0.05
Dibenz(a,h)Anthracene	0.573	GAC/S4U	mg/kg	8 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.1	0.13	<0.05	0.066
Fluoranthene	3080	AGAC	mg/kg	10 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.91	2.1	0.58	1.1
Fluorene	9870	AGAC	mg/kg	3 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	0.079	<0.05	<0.05
Indeno(1,2,3-c,d)Pyrene	81.7	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.23	0.36	0.18	0.26
Phenanthrene	3070	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.25	0.66	0.27	0.62
Pyrene	7410	AGAC	mg/kg	10 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.73	1.6	0.51	0.89
Naphthalene	4890	AGAC	mg/kg	1 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Total Of 17 PAH's			mg/kg	No GAC	-	<2	#VALUE!		0	<2	<2	<2	50	27	<2
Acenaphthylene	14800	AGAC	mg/kg	3 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Anthracene	74100	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.13	0.24	0.073	0.14
Benzo[a]anthracene	28.5	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.48	0.96	0.35	0.48
Benzo[a]pyrene	5.72	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.46	0.71	0.35	0.47
Benzo[g,h,i]perylene	636	GAC/S4U	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.27	0.43	0.21	0.25
Benzo[b]fluoranthene	7.21	AGAC	mg/kg	10 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.58	1.1	0.48	0.64
Benzo[k]fluoranthene	190	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.23	0.36	0.17	0.22
Chrysene	57	AGAC	mg/kg	9 of 18	0	<0.05	#VALUE!		0	<0.05	<0.05	0.45	0.87	0.32	0.52
Benzene	72	GAC/S4U	mg/kg	1 of 18	0	<0.0002	#VALUE!		0	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Toluene	55800	AGAC	mg/kg	4 of 18	0	<0.0002	#VALUE!		0	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Ethylbenzene	23900	AGAC	mg/kg	1 of 18	0	<0.0002	#VALUE!		0	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	WS104	WS104	WS105	WS105	WS106	WS106
										Sample Ref	1	2				
										Easting	530997.95	530997.95	530903.19	530903.19	530922.85	530922.85
										Northing	726165.53	726165.53	726025.43	726025.43	726032.93	726032.93
										Hole Elevation (mOD)	3.9	3.9	4.35	4.35	3.67	3.67
										Sample Depth (mbgl)	0.5	1	0.5	1	0.5	1
										Sample Date			30/11/21	30/11/21	30/11/21	30/11/21
										Investigation						
										Geology	MG	GG	MG	MG	MG	MG
m & p-Xylene	40700	AC (p-xyle	mg/kg	1 of 18	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
o-Xylene	41000	.GAC/S4U	mg/kg	1 of 18	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
PCB 118	0.000171	ı backgrou	mg/kg	0 of 18	0	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 138			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 153			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 180			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 28			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 52			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
PCB 90+101			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
1,1,1,2-Tetrachloroethane	1410	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,1,1-Trichloroethane	137000	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,1,2-Trichloroethane	985	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,1-Dichloroethane	45900	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,1-Dichloroethene	10200	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!	2230.0	0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,1-Dichloropropene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2,3-Trichlorobenzene	1780	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2,3-Trichloropropane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2,4-Trichlorobenzene	14900	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2,4-Trimethylbenzene	248	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2-Dibromo-3-Chloropropane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2-Dibromoethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2-Dichlorobenzene	89000	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,2-Dichloroethane	28.9	.GAC/S4U	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,2-Dichloropropane	1720	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,3,5-Trimethylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,3-Dichlorobenzene	247	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
1,3-Dichloropropane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
1,4-Dichlorobenzene	17200	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4,5-Trichlorophenol	620	S4UL	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4,6-Trichlorophenol	598	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4-Dichlorophenol	597	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4-Dimethylphenol	5020	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,4-Dinitrotoluene	501	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2,6-Dinitrotoluene	251	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Chloronaphthalene	7490	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Chlorophenol	597	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Chlorotoluene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
2-Methyl-4,6-Dinitrophenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Methylnaphthalene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Methylphenol	25080	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Nitroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
2-Nitrophenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
3-Nitroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Bromophenylphenyl Ether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Chloro-3-Methylphenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Chloroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Chlorophenylphenylether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Chlorotoluene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
4-Isopropyltoluene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
4-Methylphenol	25080	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Nitroaniline			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
4-Nitrophenol			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Azobenzene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05

Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	WS104	WS104	WS105	WS105	WS106	WS106
										Sample Ref	1	2				
										Easting	530997.95	530997.95	530903.19	530903.19	530922.85	530922.85
										Northing	726165.53	726165.53	726025.43	726025.43	726032.93	726032.93
										Hole Elevation (mOD)	3.9	3.9	4.35	4.35	3.67	3.67
										Sample Depth (mbgl)	0.5	1	0.5	1	0.5	1
										Sample Date			30/11/21	30/11/21	30/11/21	30/11/21
										Investigation						
										Geology	MG	GG	MG	MG	MG	MG
Bis(2-Chloroethoxy)Methane			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bis(2-Chloroisopropyl)Ether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bis(2-Ethylhexyl)Phthalate	9688	AGAC	mg/kg	1 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bis-(2-Chloroethyl)Ether			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Bromobenzene	5217	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Bromochloromethane			mg/kg	No GAC	-	<0.0005	#VALUE!		0		<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005
Bromodichloromethane	72.5	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Bromomethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Butylbenzyl Phthalate	126000	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Carbazole			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	0.066
Chlorobenzene	11450	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chloroethane	601000	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!	2610.0	0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Chloromethane	543	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Di-N-Butyl Phthalate	1300	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Di-N-Octyl Phthalate	10700	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenzofuran			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dibromochloromethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Dibromomethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Diethyl Phthalate	49400	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Dimethylphthalate			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobenzene	15.6	GAC/S4U	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorobutadiene	25.2	GAC/S4U	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachlorocyclopentadiene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Hexachloroethane	124	AGAC	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Isophorone			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Isopropylbenzene	24500	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Methyl Tert-Butyl Ether	74600	AGAC	mg/kg	0 of 18	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
N-Butylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
N-Nitrosodi-n-propylamine			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
N-Nitrosodimethylamine			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
N-Propylbenzene	24900	AGAC	mg/kg	1 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Nitrobenzene			mg/kg	No GAC	-	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Pentachlorophenol	59.8	GAC/S4U	mg/kg	0 of 17	0	<0.05	#VALUE!		0		<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Sec-Butylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Styrene	3016	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tert-Butylbenzene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tetrachloroethene	1390	AGAC	mg/kg	3 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tetrachloromethane	886	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Trans 1,2-Dichloroethene	3866	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Trans-1,3-Dichloropropene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Tribromomethane	3930	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Trichloroethene	119	AGAC	mg/kg	2 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Trichlorofluoromethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Trichloromethane	2500	GAC/S4U	mg/kg	4 of 17	0	<0.0002	#VALUE!		0		0.0053	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
Vinyl Chloride	3.49	GAC/S4U	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
cis 1,2-Dichloroethene	1320	AGAC	mg/kg	0 of 17	0	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
cis-1,3-Dichloropropene			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002
ACM Type			-	No GAC	-		#VALUE!		0		-	-	-	-	-	-
Aromatic TPH >C5-C7			mg/kg	No GAC	-	<1	#VALUE!		0		<1	<1	<1	<1	<1	<1
Asbestos Identification			-	No GAC	-		#VALUE!		0		No Asbestos Detected	sbestos Detected	sbestos Detected	sbestos Detected	sbestos Detected	sbestos Detected
Barium			mg/kg	No GAC	-	12	#VALUE!		0		19	12	12	100	67	16
Coronene			mg/kg	No GAC	-	<0.1	#VALUE!		0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Dichlorodifluoromethane			mg/kg	No GAC	-	<0.0002	#VALUE!		0		<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002

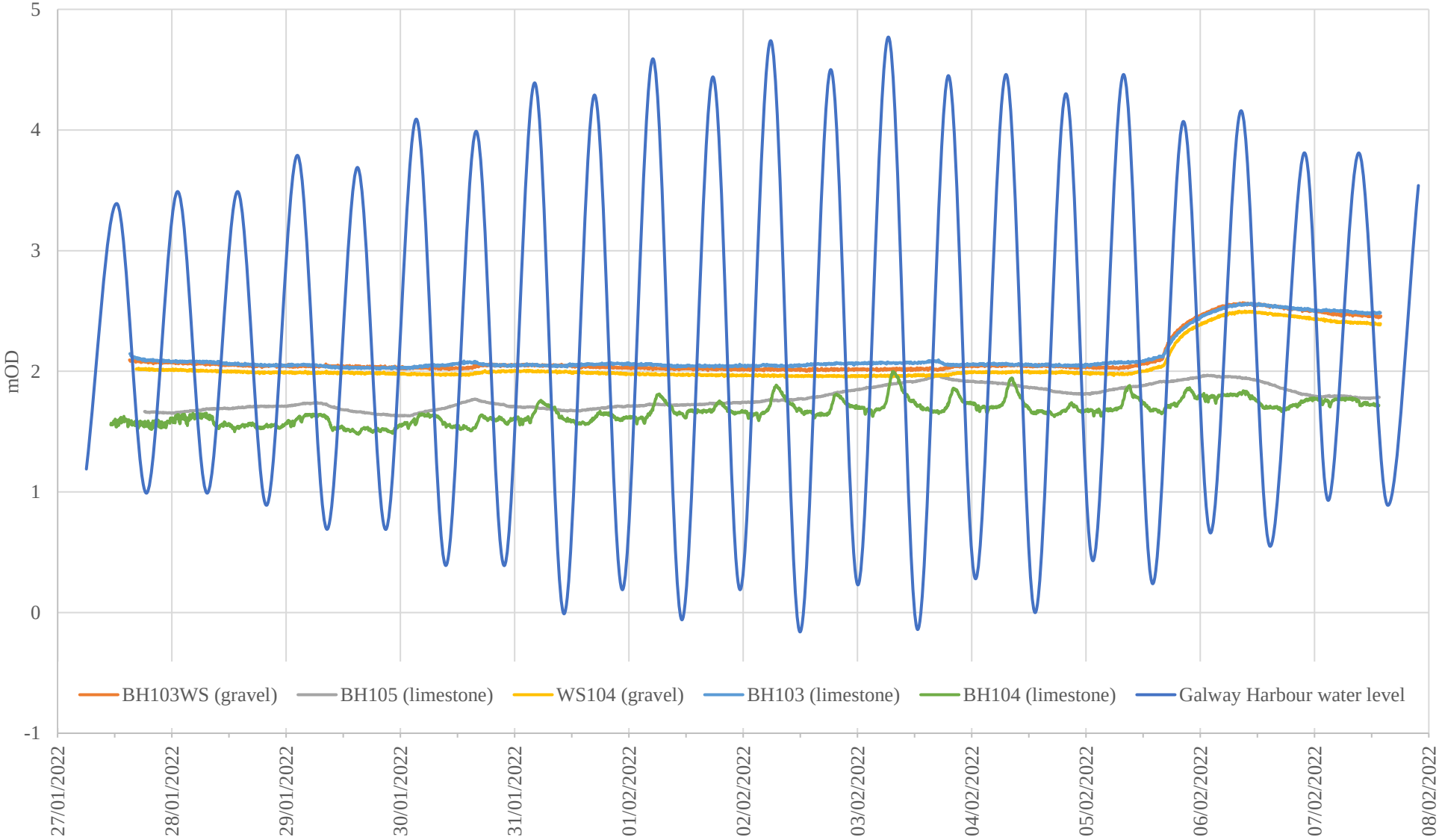
Concentration exceeds GAC	100.00
Limit of Detection value exceeds GAC	<0.1
Concentration exceeds saturation value but not GAC	50

ARUP

Contaminant Name	GAC	GAC Source	Units	Total > LOD	Total > GAC	Min	Max	Saturation Value	Total > Saturation	Hole Ref	WS104	WS104	WS105	WS105	WS106	WS106
										Sample Ref	1	2				
										Easting	530997.95	530997.95	530903.19	530903.19	530922.85	530922.85
										Northing	726165.53	726165.53	726025.43	726025.43	726032.93	726032.93
										Hole Elevation (mOD)	3.9	3.9	4.35	4.35	3.67	3.67
										Sample Depth (mbgl)	0.5	1	0.5	1	0.5	1
										Sample Date			30/11/21	30/11/21	30/11/21	30/11/21
										Investigation						
										Geology	MG	GG	MG	MG	MG	MG
LOI			%	No GAC	-	0.74	#VALUE!		0		0.93	2	2.9	4.9	4.7	3
Molybdenum			mg/kg	No GAC	-	<2	#VALUE!		0		<2	<2	<2	<2	<2	<2
SVOC TIC			mg/kg	No GAC	-		#VALUE!		0		None Detected	None Detected	None Detected	None Detected	None Detected	None Detected
Tetraethyl Lead			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01				
Tetramethyl Lead			mg/kg	No GAC	-	<0.01	#VALUE!		0		<0.01	<0.01				
Total Aliphatic Hydrocarbons			mg/kg	No GAC	-	<5	#VALUE!		0		<5	<5	<5	<5	<5	<5
Total Aromatic Hydrocarbons			mg/kg	No GAC	-	<5	#VALUE!		0		<5	<5	59	<5	<5	<5
Total PCBs (7 Congeners)			mg/kg	No GAC	-	<0.1	#VALUE!		0		<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Total Petroleum Hydrocarbons			mg/kg	No GAC	-	<10	#VALUE!		0		<10	<10	59	<10	<10	<10
VOC TIC			mg/kg	No GAC	-		#VALUE!		0		0	0	0	0	0	0

Appendix 14.4

Hydrograph showing groundwater levels recorded in the east of the proposed Galway Busconnects scheme



Galway City Council

BusConnects Galway: Cross-City Link (University Road to Dublin Road)

Appendix 14.5 - Land Contamination Remedial Strategy

253352-04-04-03

Issue | August 2022

This report considers the particular instructions and requirements of our client.

It is not intended for and should not be relied upon by any third party and no responsibility is undertaken to any third party.

Job number 253352253352

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1 Introduction

Ove Arup & Partners Ireland (trading as Arup) have been appointed to provide multi-disciplinary engineering services for the proposed BusConnects Galway – Cross City Link Scheme (hereafter referred to as the Proposed Scheme) on behalf of Galway City Council. The Proposed Scheme is located from University Road to Dublin Road Galway City.

The Proposed Scheme redline boundary includes permanent acquisition of land within the footprint of the existing College Road Service Station (CRSS) operated by Circle K and temporary acquisition of the entire CRSS. Arup is providing technical guidance relating to the Land Contamination Remedial Strategy of the CRSS. This report comprises Appendix 14.5 of Volume 4 of the EIAR to Chapter 14 Land, Soils, Hydrogeology and Geology chapter of the EIAR (Volume 2).

The CRSS is located within the north-east of the Proposed Scheme. The area can be viewed on Diagram 1, the site is located 200m from Lough Atalia which is part of the Galway Bay Complex Special Area of Conservation (SAC).

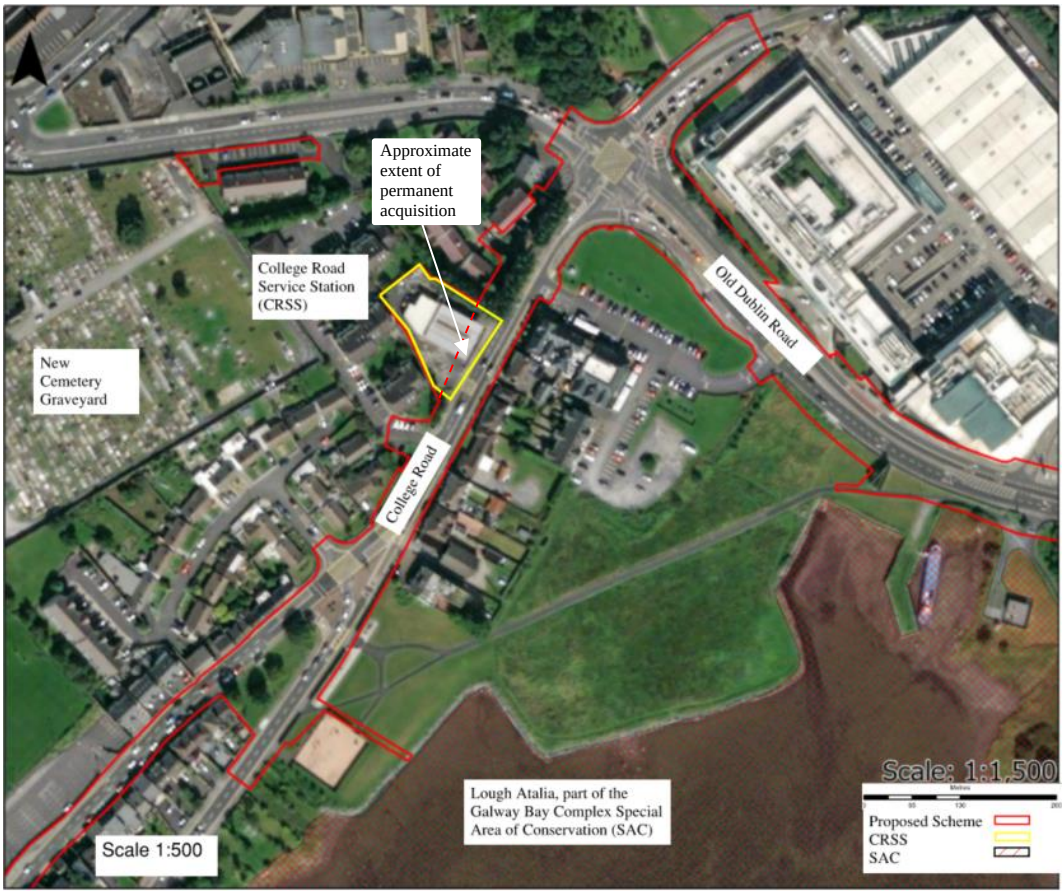


Diagram 1: Site layout and study area

1.1 Purpose of this report

The CRSS has been highlighted in the EIAR for the Proposed Scheme (refer to Chapter 14 Land, Soils, Geology and Hydrogeology) to be a potential soil and groundwater contamination source. As a result of this, the extent of the CRSS within the permanently acquired area is subject to a detailed assessment to determine the presence and extent of any contamination. The permanent acquisition includes the footpath and carriageway of the Proposed Scheme. The extent of the footpath and carriage way at the CRSS forecourt can be seen in Sheet 10 of the general arrangement drawings and Diagram 1 above. For the purpose of this report the area of the CRSS within the permanently acquisitioned land is referred to as 'the site'. The within the temporary acquisition and outside of the site in not considered in this assessment.

Ground investigations were carried out for the purpose of investigating the stability of the soils to inform the scheme design. The information obtained from the ground investigations were also used in the preparation of the NIS and EIAR.

1.2 Approach

The CRSS and study area has been assessed following the methodology presented in the following:

- Environmental Protection Agency (EPA) guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites.[1];

In accordance with the EPA's methodology a desk-top review has been carried out of the publicly available information on the site history, the ground conditions and local nearby sensitive receptors. This information has been combined with the results of a site walkover on 11 October 2021, to inform the design and the scope of an extensive ground investigation (GI) at the site between October 2021 and April 2022.

The results of the GI were used to describe the local geology and hydrogeology and develop a conceptual site model. The results are summarised under site geology (Section 6.1) and local hydrogeology sections (Section 6.2) of this report. The soil and water samples collected were compared to human health and environmental assessment criteria in a generic quantitative risk assessment (Section 7.0).

[1] Environmental Protection Agency (EPA), 2013. Guidance on the Management of Contaminated Land and Groundwater at EPA Licensed Sites;

2 Sources of information

This report has been prepared alongside Chapter 14: Land, Soils, Hydrogeology and Geology of the Galway Cross Citylink EIAR (Volume 4). This report uses the same data sets as listed in Section 14.2.3 of Chapter 14 of the EIAR Volume 2 and are listed below for completeness.

2.1 Publicly available datasets

The publicly available datasets acquired and consulted are as listed in Section 14.2.3 of Chapter 14: Land, Soils, Hydrogeology and Geology. All datasets were accessed in 2021 and are listed in Table 1 below.

Table 1: Publicly Available datasets

Source	Name	Description
Ordnance Survey Ireland (OSI)	Current and historical ordnance survey maps	Current and historical survey maps produced by the OSI.
	Including OSI Galway Maps from 1949-1952, 1978 and 1991	Current and historical survey maps produced by the OSI.
OSI	Aerial photography	Current and historical survey maps produced by the OSI.
Google	Aerial photography	Current aerial imagery produced by Google
Bing	Aerial photography	Current aerial imagery produced by Bing (Bing 2019)
Teagasc	Teagasc Soils Data	Surface soils classification and description
Geological Survey Ireland (GSI)	Quaternary Mapping	Geological maps of the site area produced by the GSI and available on GSI online map viewer.
	Bedrock Mapping	
	Aggregate Potential Mapping	
	Mineral Localities	
	Geotechnical viewer	

Source	Name	Description
	Groundwater Mapping	
	Groundwater Levels	
	National Landslide Database	
	Karst Database	
	Active Quarries and pits	
	County Geological Sites (CGS) and Geological Heritage Areas	
EPA	Corine Land Cover 2018	These datasets are based on interpretation of satellite imagery and national in-situ vector data.
	Designated Natural Heritage Area (NHA). Special Protections Area (SPA), Special Area of Conservation (SAC) sites	
	River Network Map	
	EPA Hydro Net	Reports of groundwater level monitoring points.
National Parks and Wildlife Service (NPWS)	Mapping within the area of the Proposed Scheme	This dataset provides information on national parks, protected sites, and nature reserves
National Monuments Service (NMS)	Archaeological Monuments	This dataset provides all recorded archaeological monuments (NMS 2019)
Department of Communications, Energy and Natural Resources (DCENR)	State Mining and Prospecting Facilities	A booklet contains a list of all current and prospecting mining facilities.
	Historic Mine Sites – Inventory and Risk Classification	(DCENR 2019)

2.2 Scheme Walkover

A scheme walkover survey was carried out on 11 October 2021 to inform and verify the review of publicly available datasets.

The findings of the scheme walkover relevant to this Remedial Strategy are discussed in Section 3.3 of this report.

2.3 Ground Investigation

Both intrusive and non-intrusive (geophysical) ground investigations have been carried out as part of this project to inform the design of the Proposed Scheme. These ground investigations were carried out between October 2021 and April 2022. The reports from both investigations are presented in Appendix 14.1 of Volume 4 of the EIAR and are used in the assessment of the site specific conditions, these are further discussed in Section 5 of this report.

3 Site Use

3.1 Regional Geology and Hydrogeology

For a detailed description of the regional Geology and Hydrogeology refer to Section 14.3.2 of Chapter 14 of the EIAR (Volume 2). A summary of the findings relevant to the CRSS are listed below.

- The ground conditions are recorded to be made ground under and in vicinity of the site. Till derived from limestone is shown to be present to the north-east of the site and is likely to be present under the made ground;
- A drumlin is shown to be present to the west of the site;
- The site and area around the site are underlain by the Burren Formation which is recorded as a Regionally Important Aquifer;
- The aquifer is karstified and known to contain conduits transferring water from sink-holes to springs. The closest feature, a spring, is located 0.65km south-east of the site; and
- The site is located approximately 200m to the north-west of Lough Atalia which is part of the Galway Bay Complex Special Area of Conservation (SAC) an ecologically sensitive area that among other features includes habitats such as tidal mudflats and sand flats and coastal lagoons.

3.2 Current Site Use

The CRSS is located just south of the College Road - Lough Atalia intersection at Irish Transverse Mercator 531016E 726172N.

The site is bounded by College Road to the east and residential buildings/gardens/carparking to the north, west and south. The topography of the site is relatively flat at around 6mOD. The CRSS can be seen in Diagram 2.

Diagram 2: College Road Service Station

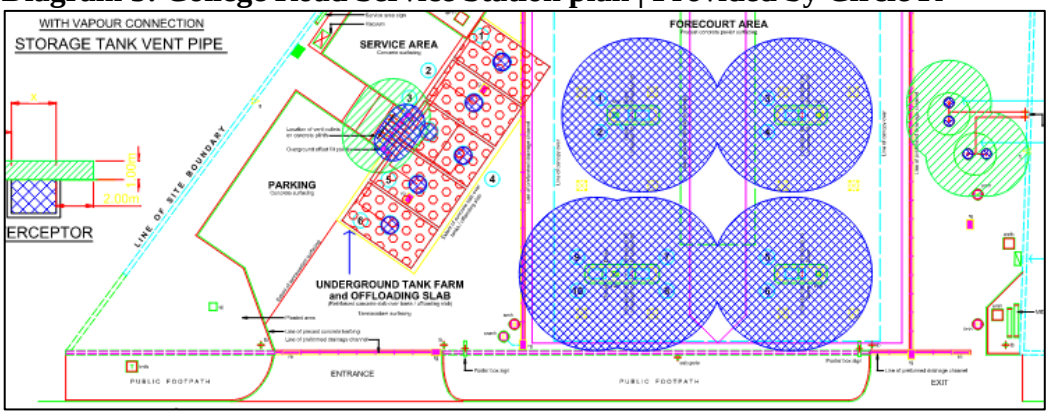
The site includes the following facilities:

- A working Service Station (Circle K) including;
    - A forecourt with working petrol and diesel fuel pumps;
    - Underground fuel tanks containing petrol and diesel;
    - Service area including air/water pumps and a vacuum;
    - Car wash facilities;
    - Retail and store area; and
    - Laundry facilities including pay as you go washing machines and tumble dryers.

An extract of a plan provided by Circle K showing the current position of the underground tanks at College Road Service Station is shown on

Diagram **3**. A full copy of the plan is provided at Appendix A1 of this report.

Diagram 3: College Road Service Station plan | Provided by Circle K



3.3 Site Walkover

A scheme walkover survey was carried out on 11 October 2021 to inform and verify the review of the publicly available datasets.

The findings relating to the site observed during the Proposed Scheme walkover are summarised below:

- The CRSS is on a reduced level, there are retaining walls surrounding the service station separating it from the higher ground level. The forecourt of the CRSS was in good order and appeared clean. The service station is shown in Diagram 2; and
- Lough Atalia is part of the Galway Bay Complex SAC lies approximately 200m south-east of the site. The Lough is tidal. Seepages were seen on the banks of the lough during low tide hence groundwater is likely to discharge into the lough from the surrounding area including under the site. No olfactory or visual evidence of contamination was observed on the bank or shore of the lough during low tide. Lough Atalia can be seen in Diagram 4.

Diagram 4: Lough Atalia viewed 1km southwest of the CRSS

4 Preliminary Assessment

4.1 Site History

This section describes the historical use of the site based on observations from the historical Ordnance Survey of Ireland (OSI) mapping and aerial photography. The site history of CRSS and associated figures are presented in Appendix A2 of this report. A summary of the site history is presented in Table 2.

Table 2: Summary of the site history

Date	Activities at the CRSS	Activities in Surrounding Area
1837 – 1842 (6" OSi first edition Map)	Small historical development probably residential along College Road and undeveloped fields or residential gardens.	There is a marsh area to the east of the site north of Lough Atalia which is described as 'Flooded at spring tides'.
1888 – 1913 (25" OSi Map)	The site is shown undeveloped and the small development along college road is not shown. It is likely this area was used as agricultural land during this time.	A watercourse is shown approximately 50m to the east of the site which drains form north to south into Lough Atalia. The marsh area is mapped to the east of the site north of Lough Atalia which is described as 'Liable to Floods'.
1913 – 1930s (last edition 6'' OSi Map)	No change	There are a number of housing developments marked to the east of College Road suggesting they had been built between the 1913 and 1930s. No notable change elsewhere
1945 – 1962 (OSi Mapping)	No change	No notable change
1977 – 1980 (OSi Mapping)	There is a footprint of a building underlying the west of the site. The footprint does not appear to be residential.	Additional development of housing east of College Road.
1991 – 1991 (Osi Mapping)	The service station outline is shown.	There has also been further development of buildings to the east of the site at the existing location of the Huntsman Inn, this development has taken place in the area previously shown to be liable to flooding. Watercourse 50m east of the site is not shown and instead is covered by the building which now include The Huntsman Inn.
1995 Aerial Photography	No change	There has been further residential development north-east of the CRSS
2000 Aerial Photography	The building footprints is smaller suggesting that	There has been residential development surrounding the north-eastern area of the site

Date	Activities at the CRSS	Activities in Surrounding Area
	construction of a new building is underway.	
2005 to present Aerial Photography	Show the site as it is presently.	No change

4.2 Discussions with the current site owner (Circle K)

Arup and Galway City Council staff met with Circle K management in November 2021 to discuss the ground investigations. During discussions with Circle K, it was noted by the manager of the CRSS that the site had originally been developed as a printworks. Subsequently the site was developed as a service station initially operated by Shell, then Statoil, Topaz and finally Circle K. It was reported that the site had operated as a filling station since the 1960s.

4.3 Potential Sources of Contamination

Based on the site history and observations noted in the Site Walkover, the following are considered to be the most pertinent potential sources of contamination for the site:

- The soil and groundwater under the site potentially impacted by historical industrial building which was reported to be a print works; and
- The soil and groundwater under the present day and historical use as a service/filling station and the underground services and tanks.

4.3.1 Potential Contaminants of Concern

The potential contaminants profile associated with the print works[2] is listed below. It should be noted that individual sites will not necessarily have all the characteristics described.

- Metals and metalloids;
- Inorganic compounds;
- Acids/bases;
- Asbestos;
- Organic compounds including:
    - Aliphatic/aromatic hydrocarbons and halogenated solvents;
- Fuels;
- Polychlorinated biphenyls (PCBs);
- Effluent treatment chemicals.

[2] Department of Environment (DoE) Industry Profiles – Chemical works, coatings (paints and printing inks) manufacturing works (Accessed through CLAIRE: https://www.claire.co.uk/useful-government-legislation-and-guidance-by-country/198-doe-industry-profiles)

In addition, due to the presence of the working fuel pumps and underground fuel storage tanks within or directly adjacent to the site the following potential contaminants are also considered[3]. It should be noted that individual sites will not necessarily have all of the characteristics described

- Organic contaminants including;
  - Petroleum Spirit (including simple aromatics, such as benzene and additives, such as organo-lead compounds and ethers);
  - Diesel; and
  - Paraffin.

Other potential contaminants maybe present associated with the site use on the CRSS but are not considered as they are not relevant to the strip of land within the redline of the Proposed Scheme.

5 Ground Investigation

Both intrusive and non-intrusive geophysical ground investigations (GI) have been carried out to inform the design of the Proposed Scheme. The GIs were carried out between October 2021 and January 2022. The GIs comprised geotechnical, geophysical and geo-environmental investigations. The purpose of these ground investigations was to inform the Land, Soils, Geology and Hydrogeology Chapter of the EIAR (Volume 2). The reports from both investigations are presented in Appendix 14.1 of Volume 4 of the EIAR.

Considering the sensitive location of the GI the project ecologist (Moore Group) were consulted and confirmed that "*Given the level of urban activity in this area of Lough Atalia, it's unlikely that there would be an effect on Wintering Birds".*

5.1 Non-Intrusive Investigation

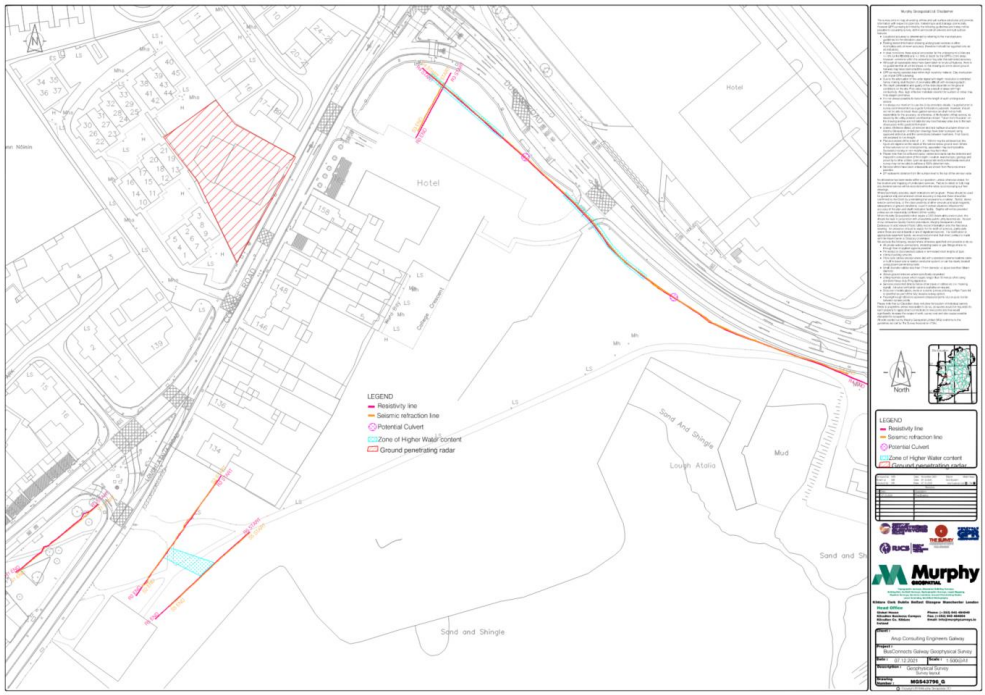
The non-intrusive geophysical ground investigation took place adjacent to the College Road-Lough Atalia Road junction Galway City, the layout of the investigation is shown in Diagram 5.

The non-intrusive geophysical investigation included the following works:

- 350m of Seismic Refraction Profiling geophysics across four designated locations to produce 2D geophysical profiles;
- 350m of Electrical Resistivity Tomography (ERT) across four designated locations to produce 2D geophysical profiles; and
- 2,000m^2 of Ground Penetrating Radar at the Service Station on College Road to identify any existing underground services.

[3] Department of Environment (DoE) Industry Profiles – Road vehicle fuelling, service and repair – garages and filling stations (Accessed through CLAIRE: https://www.claire.co.uk/useful-government-legislation-and-guidance-by-country/198-doe-industry-profiles)

Diagram 5: Non-Intrusive Geophysical Survey plan



5.2 Intrusive Investigation

The intrusive ground investigation consisted of two locations in Galway City, one property of St. Brendan's Avenue and the other on land adjacent to College Road (R339) between the junction with Lough Atalia Road and the junction with Old Dublin Road (R338) including the forecourt of the CRSS. The focus of this report will be on the ground investigation results from the College Road-Lough Atalia area, this layout of the investigation is shown in Diagram 6.

The intrusive ground investigation included the following works in the vicinity of the CRSS:

- Five (5) No. of cable percussion boreholes to refusal, with follow-on rotary.
- Five (5) No. of window samples of up to 5 mBGL;
- Five (5) No. of surface water sampling locations;
- Six (6) No. of standpipe monitoring locations (two of which were in window sample holes);
- Geotechnical and geo-environmental sampling and testing;
- Groundwater boreholes were developed and purged prior to sampling;
- Interface probe measurements;
- Datalogger installation in all installations for one week; and
- Monitoring on three occasions over four months of water quality in all boreholes and five surface water sampling points, at three locations in Lough Atalia (SW03, SW04 and SW05) and two seepage locations on the bank of Lough Atalia (SW01 and SW02).

Diagram 6: Intrusive Ground Investigation plan in the vicinity of CRSS

6 Conceptual Site Model

A Conceptual Site Model (CSM) has been developed for area surrounding the College Road-Old Dublin Road Junction. The CSM has been developed based on the 2021 GI.

6.1 Local Geology

The following assessment of the geology of the site and ground conditions has been inferred from available information. The geological conditions influence the CSM and will be discussed further in Section 6.4. The ground conditions are described in Table 3,

Table **4** and Diagram 7 below. These are based on the findings of ground investigation locations presented in Diagram 6 above.

These locations include the following:

- BH101, BH102, BH103, BH104 and BH105.
- WS101, BH103WS, WS104, WS105 and WS106.

Table 3: Ground conditions on the CRSS site

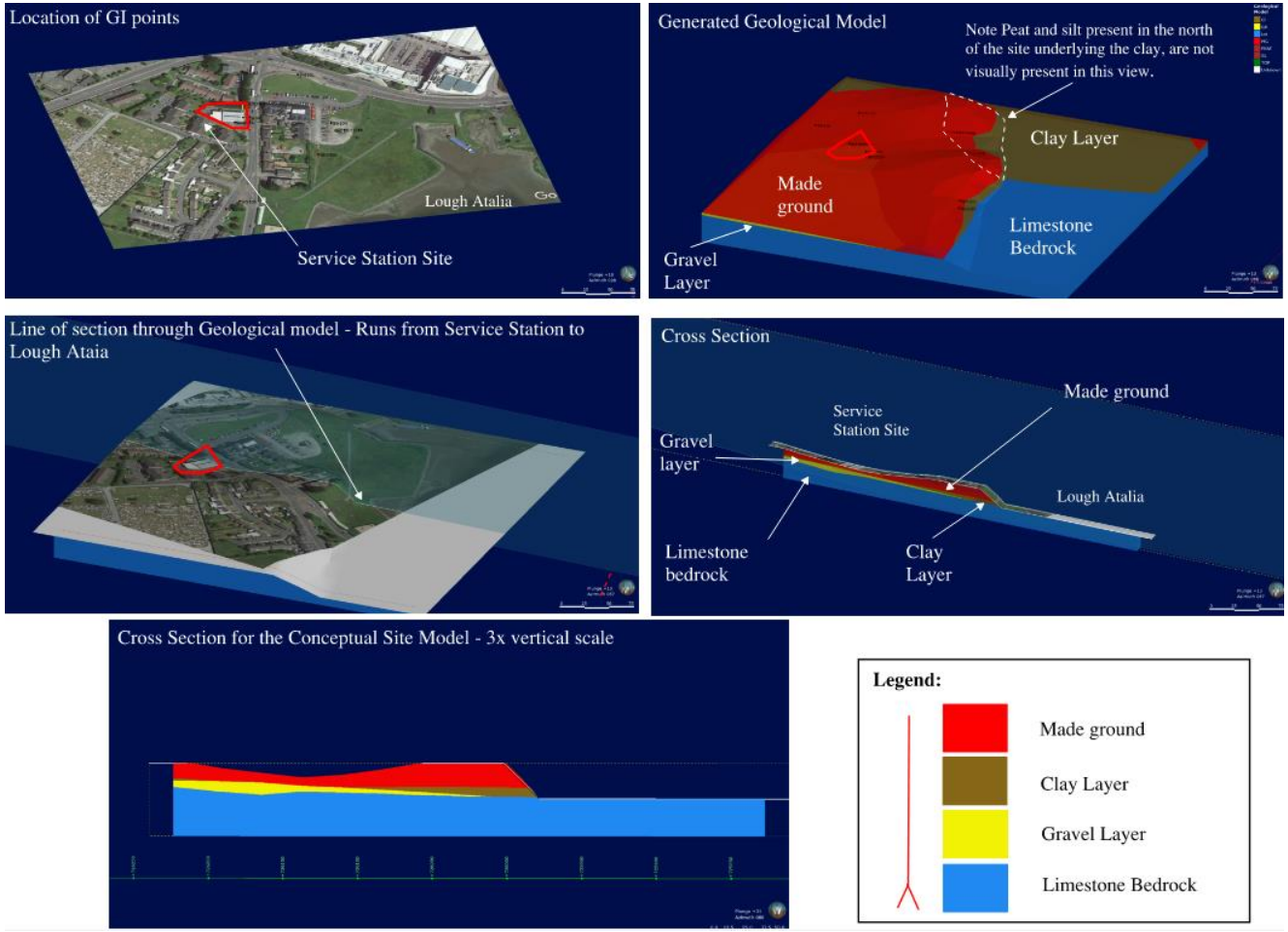
Stratum	Description	Ground Investigation location where present	Depth to Top of Stratum (m below ground level)	Thickness of Stratum (m)
Bitmac / Concrete	Tarmacadam and concrete hardstanding	BH102, BH102A BH103, BH103WS and WS104	0	0.05 – 0.3
Made Ground	Underlying Service Station forecourt – Brown to Grey silty sandy angular to subangular fine to coarse GRAVEL with high cobble content and fragments of plastic.	BH102, BH102A BH103, BH103WS, WS104	0 – 0.1	0.3 – 2.0
Subsoils	Grey to brown sandy silty subangular to subrounded fine to coarse GRAVEL with low to medium cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded.	BH101, BH103, BH103WS, BH104 and WS104	2.5 – 4.0	0.3 – 3.3
Bedrock	The Burren Formation –medium strong massive grey Limestone, with local areas of partial weathering and clay deposits along rare joint surfaces.	BH103 and BH104	2.3 – 6.7	Unknown

Table 4: Ground conditions surrounding site

Stratum	Description	Ground Investigation location where present	Depth to Top of Stratum (m below ground level)	Thickness of Stratum (m)
Topsoil	Topsoil with roots and fragments of plastic	BH105A, BH105, WS101, WS105 & WS106	0	0.1 - 0.4
Bitmac / Concrete	Tarmacadam and concrete hardstanding	BH101 and BH102	0	0.05 – 0.3
Made ground	Underlying the car park between the CRSS and Lough Atalia – Firm becoming stiff sandy gravelly Clay with low cobble content.	BH104, BH104A, BH105A and WS101	0 – 0.1	0.3 – 2.0
Sub-soils	Soft to stiff brown to grey sandy gravelly CLAY. Sand is fine to	BH101, BH104, BH105A, WS101, WS105 and WS106	0.6 – 1.0	0.7 – 1.9

Stratum	Description	Ground Investigation location where present	Depth to Top of Stratum (m below ground level)	Thickness of Stratum (m)
	coarse. Gravel is subangular to subrounded fine to coarse. 0.3m thick sand lens noted within WS106. Sand described as dark grey gravelly fine to coarse SAND. Gravel is subangular to subrounded fine to coarse.			
	Grey to brown sandy silty subangular to subrounded fine to coarse GRAVEL with low to medium cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded.	BH101, BH103, BH103WS, BH104, BH105A, WS101 and WS104	2.5 – 4.0	0.3 – 3.3
	Very soft to soft grey to brown slightly clayey SILT with organic fibres.	WS101	1.65	0.45
	Very soft to soft dark brown-black fibrous Peat	WS101 and BH104	2.1	0.8 – 2.8
Bedrock	The Burren Formation –medium strong massive grey Limestone, with local areas of partial weathering and clay deposits along rare joint surfaces.	BH101, BH104 and BH105	2.3 – 6.7	Unknown

Diagram 7: Geological Model of the Site Study area.



6.2 Local Hydrogeology

During the 2021/2022 intrusive ground investigation, groundwater strikes were observed in both the gravel deposits and in the limestone bedrock beneath the site. Groundwater was monitored by hand and using loggers during the 2021/2022 ground investigation in six standpipes installed in either the gravel deposits or the limestone bedrock between the 27th of January 2022 and the 7th of February 2022. The groundwater conditions influence the CSM and is discussed further in Section 6.4.

6.2.1 Groundwater level monitoring

A summary of the groundwater monitoring data collected during the ground investigation period is presented in Table 5.

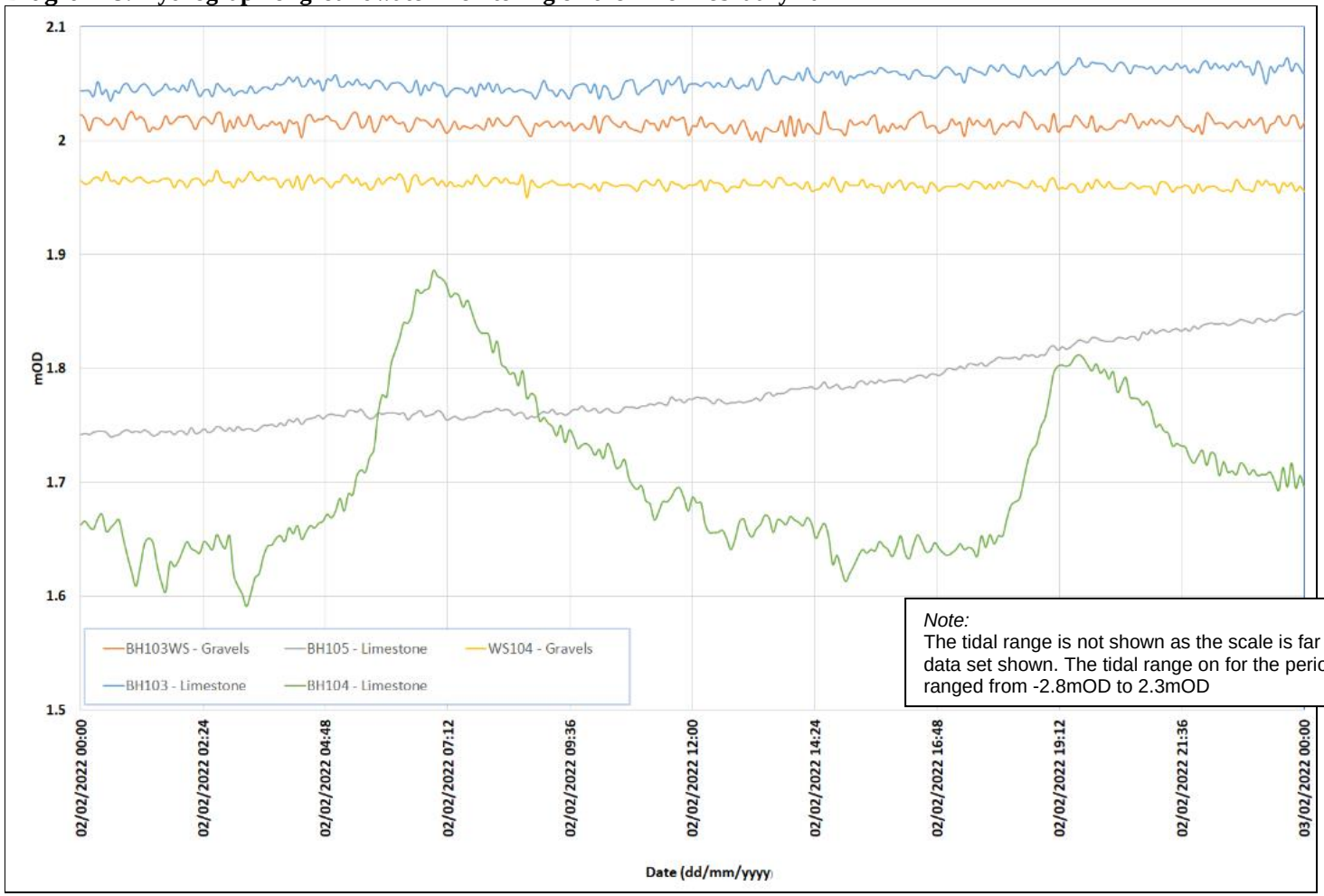
Table 5: Summary of Groundwater levels

Lithology monitored	Boreholes	Range of Groundwater Levels (mBGL)	Range of Groundwater Level (mOD)
Gravel	BH103WS	1.4 – 1.9	2.0 – 2.6
	WS104	1.4 – 1.9	1.95 – 2.5
The Burren Formation	BH102	1.6 – 2.2	1.9 – 2.5
	BH103	1.4 – 2.0	2.0 – 2.6
	BH104	1.6 – 2.2	1.5 – 2.0
	BH105	1.4 – 2.0	1.6 - 2.0

A hydrograph showing all the groundwater monitoring data collected on the 2nd of February 2022 during the ground investigation are presented in Diagram 8. Appendix A14.4 of Volume 4 of this EIAR shows a summary hydrograph of all groundwater monitoring data collected. Only BH104 was observed to respond to the tide.

Under the site the gravels directly overlie the bedrock hence the water observed in the gravel and the Burren Formation are in hydraulic connectivity. In some areas surrounding the site there is a low-permeability clay layer separating the made ground and the gravel deposits, this clay layer will act as an aquitard and restricts the movement of water from the made ground into the underlying gravels or limestone.

Diagram 8: Hydrograph of groundwater monitoring on the 2nd of February 2022



Note:
The tidal range is not shown as the scale is far larger than the data set shown. The tidal range on for the period shown ranged from -2.8mOD to 2.3mOD

6.2.2 Non-aqueous phase liquids

Non-aqueous phase liquid (e.g. unleaded or diesel) monitoring took place as part of the monitoring. No non-aqueous phase liquid was recorded during the monitoring.

Generally, there was no olfactory or visual evidence of non-aqueous phase liquids noted during the investigation or monitoring. The one exception to this was recorded during the drilling of BH102 when a sheen was noticed on the groundwater, but no odours were recorded.

6.2.3 Groundwater flow

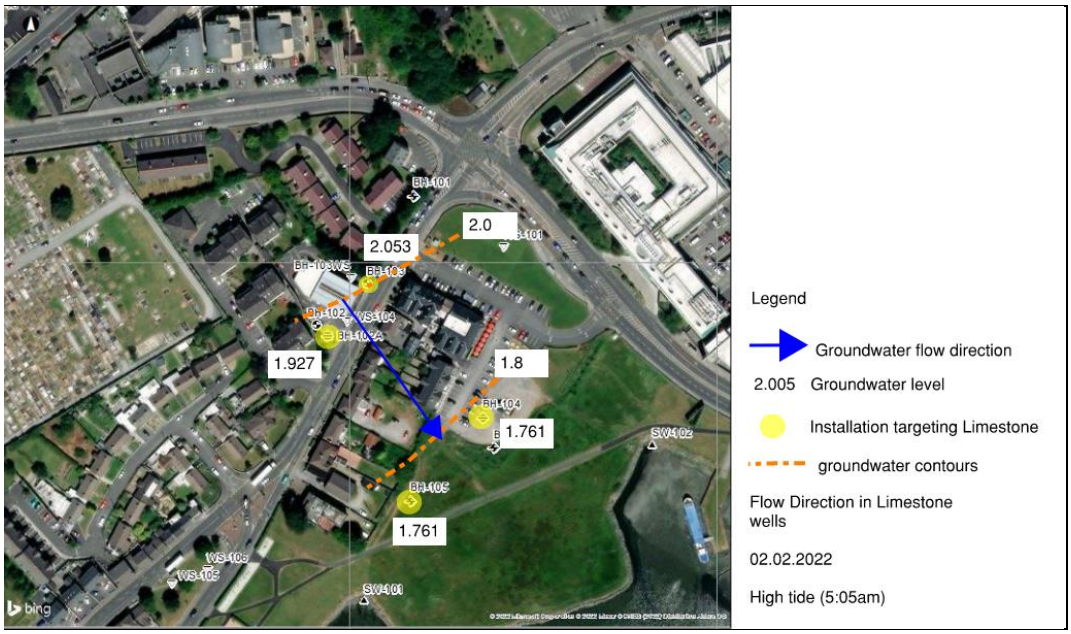
Based on the groundwater levels in the gravels and the limestone bedrock, the groundwater flow direction has inferred to be generally to the south-east towards Lough Atalia.

This suggests that the boreholes and window samples on the CRSS forecourt are up-hydraulic gradient (BH103WS, BH102, BH103, WS104) and that the boreholes between Old College Road and Lough Atalia are down-hydraulic gradient (BH104 and BH105). The groundwater in the gravel and limestone is in continuity under CRSS.

Considering the proximity of the former water channel identified in the 1913 OSi mapping, the shallow water table and the presence of shallow gravel under the site it is probable that groundwater in the gravels previously used to drain to the lough via the historic water channel. Seepages were noted on the bank of Lough Atalia in the vicinity of where the former water channel used to meet the Lough. Hence it is possible that the water that used to drain to the channel still drains to the Lough via these seepages. Consequently, is plausible that groundwater from WS104 and BH103WS could travel in the gravel and enter the Lough via seepages at the location of SW101.

The groundwater contours in the Limestone suggests that groundwater in the Limestone bedrock from BH102, BH103, BH104 and BH105 drains to the south-east to Lough Atalia. This drainage likely occurs through fracture pathways in the limestone bedrock and discharges diffusely into Lough Atalia during low tide. Considering that groundwater in the gravel and limestone is in continuity it is plausible that recharge from the CRSS could enter the limestone from the gravel and then discharge to the lough. This groundwater flow direction is presented in Diagram 9.

Diagram 9: Groundwater contour mapping of limestone bedrock on 2nd February 2022



Water levels in the gravels under the site appear to be unaffected by the tide (WS104 and BH103WS). Water levels in the limestone seem to be subject to influence of the tide. The boreholes on the forecourt (BH103 and BH102) seem to have minor influence with ranges between low and high tide limited to <0.05m. The boreholes at the Lough Atalia reclaimed area (BH104 and BH105) are influenced by the tide with ranges in water level between low and high tide of <0.1m. The fluctuations in the tide were not observed to change the groundwater flow direction.

On the 5th of February, 19.8mm of rain was recorded by Met Éireann in Athenry Co. Galway[4]. The water levels in both the gravels and bedrock rose on the 6th of February. This increase in groundwater measurements on the 6th of February suggests recharge was seeping down through the made ground and entering the underlying aquifer. Hence the gravel and limestone are very vulnerable to surface contamination.

6.3 Site Hydrology

The site is located 150m north-west of Lough Atalia, the extent of the Lough Atalia can be seen on Figure 14.5 of Volume 3 of this EIAR. Lough Atalia is located to the east of study area. Lough Atalia is an estuarine lagoon connected directly to the Corrib Estuary within Galway Bay. It is considered to be part of the Galway Bay Complex Special Area of Conservation (SAC), this is due to its biodiversity. As the Lough is tidal the water quality in the study area is likely to be influenced by the saline water quality in Lough Atalia.

[4] Met Éireann historic daily data accessed March 2022. https://www.met.ie/climate/available-data/daily-data

There are no observed water features at the CRSS. Surface water drains from the site through surface water drainage system to a combined drainage system. The surface water from the CRSS drains into a foul system which is then pumped to a Wastewater Treatment Plant (WWTP) to undergo treatment. It is understood that there are no septic tank or soakaways on site.

6.4 Summary

A conceptual site model (CSM) has been developed from the ground information in the surrounding area. The site consists of made ground which overlies a gravel layer which sits on top of the Limestone Bedrock. Groundwater is present in the gravel and limestone and the groundwater in these layers is in continuity. The groundwater in both strata respond quickly to recharge. The groundwater in the gravel is likely to drain to the lough via seepages on the bank of Lough Atalia and via limestone into the base of the lough.

It must be noted that silt and peat deposits were observed in the north-east of the study area but are not underlying the site and do not affect the potential pathways to the lough so are not to be considered further.

Based on the preliminary assessment the CRSS has two potential sources of contamination within the site, the soils and groundwater under the filling areas affected by current and previous uses and the current underground services and tanks.

The receptors that have been highlighted are the Lough Atalia part of the Galway Bay Complex SAC and current and future site users.

Based on this CSM above three potential source-pathways-receptor linkages have been identified between the soils and groundwater under CRSS and Lough Atalia:

1. Between CRSS and Lough Atalia via the limestone. This potential contamination pathway is due to the presence of gravels directly underlying the made ground on the service station site. The gravels directly underlying the made ground provide a direct pathway for contaminants to access the underlying limestone aquifer, which drains to the Lough Atalia.
2. Between CRSS and the Lough Atalia via the gravels. The groundwater within the gravels is vulnerable to contamination from the made ground. These gravels have the potential to drain to the south directly to the banks of Lough Atalia during low tide (discussed in Section 6.2 and 6.3).
3. Between soils and future site users who could come into contact with soil.

The CSM and these potential pathways are highlighted on Diagram 10.

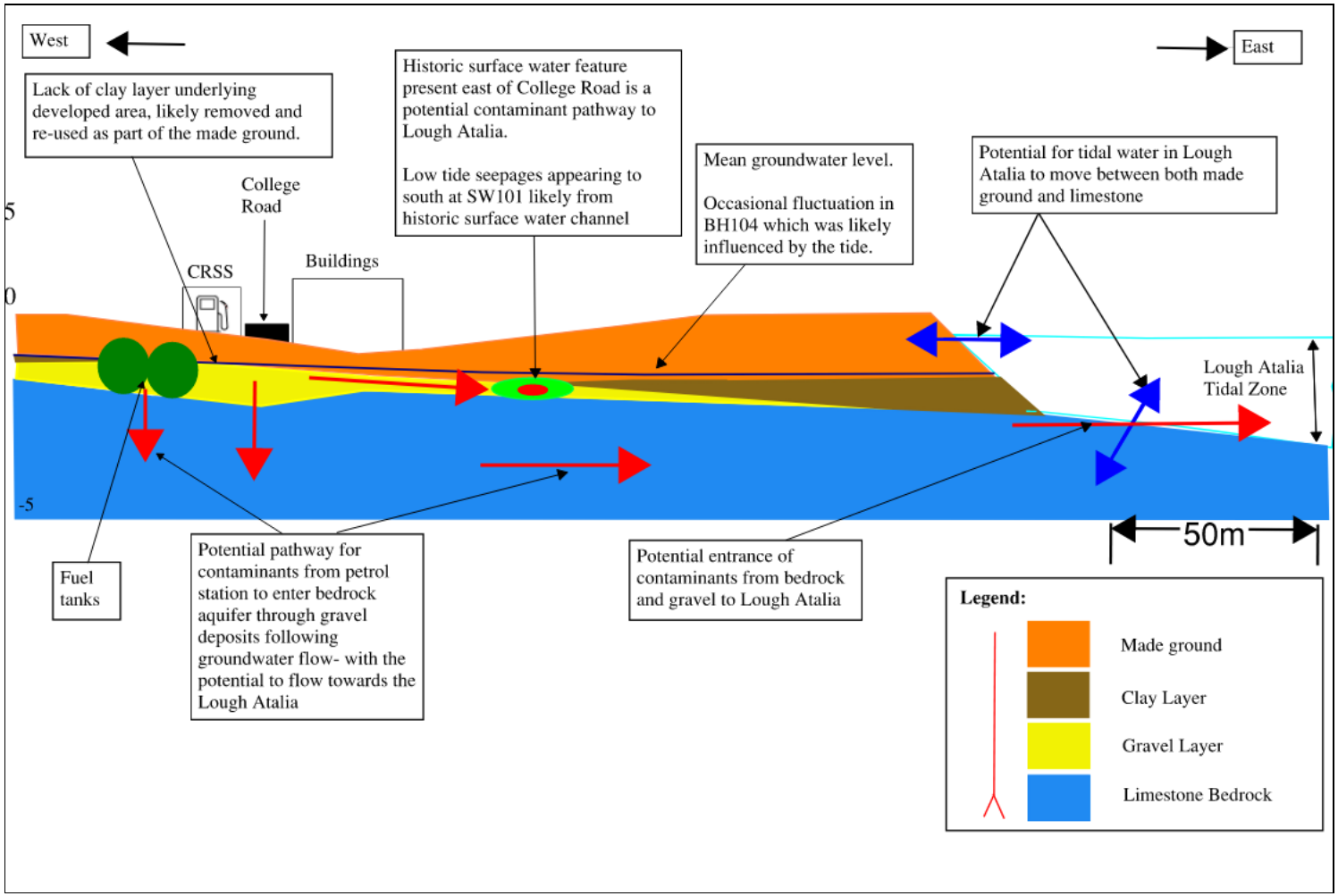


Diagram 11: Conceptual Site Model

7 Generic Quantitative Risk Assessment (GQRA)

7.1.1 Soil Analysis

The results of the soil analysis performed on the samples collected have been compared against soil criteria applicable to human health risk for long-term exposure to soil in a public open space close to a residential setting which is directly applicable to the Proposed Scheme. A copy of the assessment is presented in Appendix 14.3 of Volume 4 of this EIAR.

The results of this assessment show that there are no exceedances for these criteria measured in the soil analysis for the site. Based on these results it is considered that there is no significant risk of harm to the current or proposed future site users in relation to exposure to these soils. However, it must be considered that localised areas of contamination could still be present across the site.

7.1.2 Groundwater Analysis

As the most relevant receptor for the purposes of the assessment is the ecologically sensitive SAC, the water quality has been compared with the 2009 Surface Water Regulations[5] and the 2010 Groundwater Regulations[6] where suitable standards do not exist. In the rare exceptions that other parameters were noted without standards, the Environmental Protection Agency's 2003 Interim Guideline Values[7] and the United States Environmental Protection Agency's National Recommended water quality criteria[8] have been used. Drinking water standards were not used for the assessment as no groundwater abstractions were highlighted between the site and Lough Atalia.

The results of the water analysis are presented in Appendix 14.4 of Volume 4 of this EIAR and a comparison of the results with the water quality screening standard is presented in Appendix A14.6 of Volume 4 of this EIAR.

The results of the groundwater analysis are discussed below:

- There were two exceedances of total petroleum hydrocarbons (TPHs) or general hydrocarbon indicators recorded, these exceedances are presented on Diagram 12 below. One was recorded underlying the CRSS at BH102 on the 28th of March 2022. There was also exceedance of TPHs recorded in the seepage into the Lough at SW01 on the 13th of April 2022. The oil contamination appears to be localised and occurs sporadically.

[5] S.I. No. 272/2009 - European Communities Environmental Objectives (Surface Waters) Regulations 2009 (as amended)
[6] S.I. No. 9/2010 - European Communities Environmental Objectives (Groundwater) Regulations 2010 (as amended)
[7] S.I. No. 722/2003 - European Communities (Water Policy) Regulations 2003
[8] Environmental Protection Agency (EPA) of USA - National Recommended Water Quality criteria under Section 302(a) of the Clean Water Act

This likely reflects drips or minor fuel spills at the CRSS that get flushed down to the gravel deposits and bedrock aquifer by surface water infiltration. This suggests that there are localised occurrences of contamination of TPH under the CRSS that is infiltrating into the bedrock aquifer on site and travelling downstream;

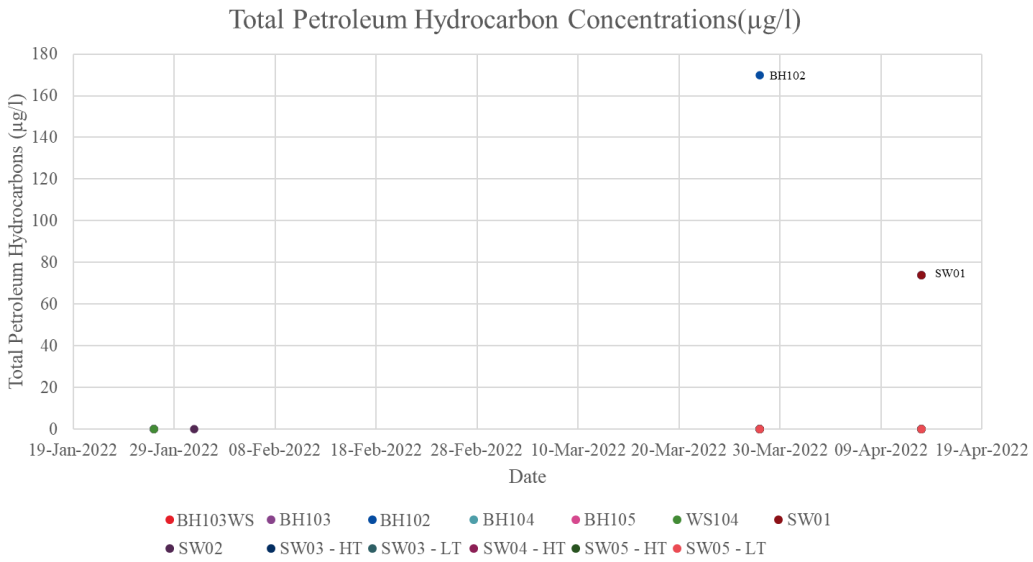


Diagram 12: TPH Concentrations (µg/l) [screening standard is 7.5µg/l]

- In addition to the TPH on the 28th of March 2022, the following compounds were seen in BH 102: 1,2,4-Trimethylbenzene and m-xylene and p-xylene. These are attributable to the presence of petroleum hydrocarbons in the groundwater. They are not recorded in Lough Atalia.
- There are exceedances of the iron and manganese screening standards observed in the gravel and limestone under the CRSS and downstream (See Diagram 12). The iron and manganese levels are likely to be as a result of the breakdown of hydrocarbons in the vicinity. Iron and manganese were recorded above the screening standard in the lough. On some occasions these recordings were greater than that observed at the CRSS, suggesting that the iron and manganese concentrations are also related to background contamination.
- There are exceedances of the ammoniacal nitrogen limit noted at all locations across the site. These exceedances are likely to be due to the site being down hydraulic gradient of the New Cemetery graveyard *and/or* the presence of a leaking septic tank in the vicinity of the site. The highest concentration of ammoniacal nitrogen is found in BH104 downstream of the CRSS and under some fill material suggesting that the fill could also be a source and one which is not on site.
- There is an exceedance of the arsenic limit noted underlying the site at BH103 on the 27th of January 2022 and underlying the reclaimed area at BH104 on all three occasions. The exceedances measured downstream at BH104 are higher than that measured at BH103. This suggests that the contamination is unlikely to be originating from the CRSS. Arsenic is not recorded above the screening limit in the Lough.

- There is an exceedance of the cadmium limit noted in all boreholes, the concentration of which fluctuates throughout the year. These exceedances are shown in Diagram 13 below. There are higher concentrations of cadmium noted in the gravel groundwater under the CRSS than the limestone bedrock. Cadmium was recorded in the seepage discharging into the Lough and in the Lough at low tide. Concentrations of cadmium in the bedrock decrease downstream of the CRSS. This suggests that contamination of cadmium under the CRSS and is infiltrating into the bedrock aquifer on site and travelling downstream. This could be present as a result of historic works at the CRSS or naturally elevated concentrations in the fill material.

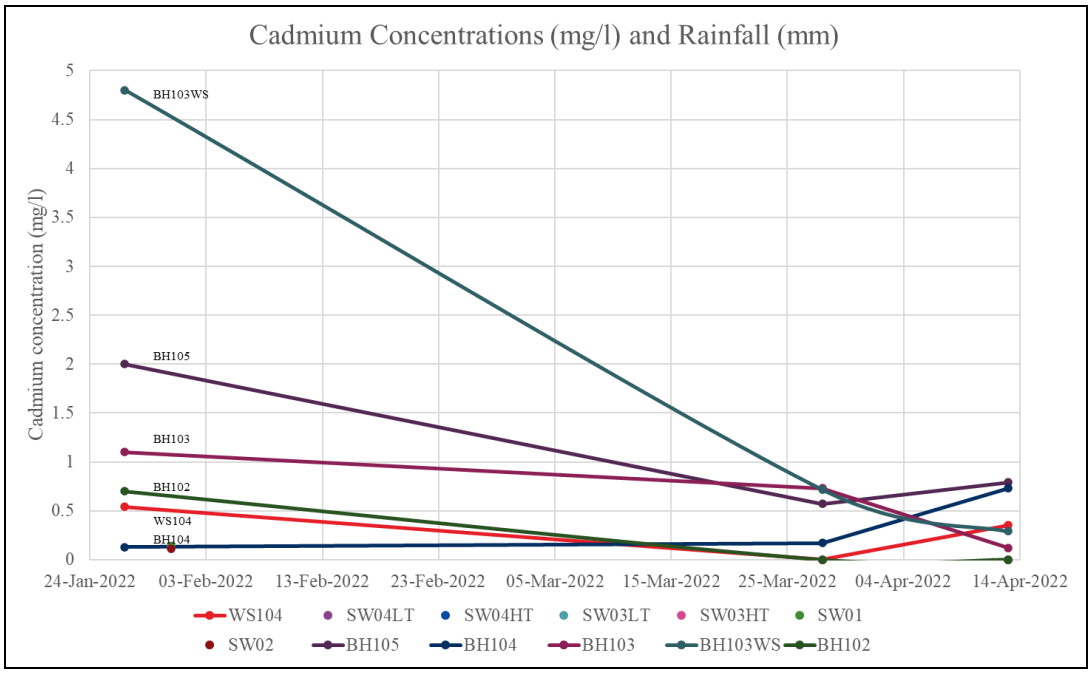


Diagram 13: Cadmium concentrations (µg /l) [screening standard is 0.08µg/l]

- There is an exceedance of the chloride, potassium, sodium, magnesium and sulphate limits measured in a number of locations including the Lough (See Diagram 13). These exceedances are likely due to the influence of seawater on the area.
- There are occasional exceedances of the lead limit on site in the bedrock groundwater at BH102, BH103 and BH104. Exceedances are not noted in the overlying gravel groundwater suggesting that the contamination source is polluting the bedrock upstream and is not related to the CRSS. No exceedances are recorded in the Lough.
- There is an exceedance of the nickel limit noted in BH104 only on the 27th of January 2022. As this contaminant is not present at the CRSS it is not related to the site.
- Finally, three exceedances of the zinc limit were measured in both BH103 and SW101 on 27 January 2022, BH104 on 28 March 2022 and in WS104 on the 28th March and 13th of April 2022. However, these exceedances are sporadic and not recorded in the Lough. Consequently, they are considered to represent localized contamination which is only having a small to negligible impact on water quality.

Based on these results it is considered that the cadmium and TPH concentrations recorded in the seepages on the banks of Lough Atalia above the screening standards could originate from the made ground under CRSS including the area within the permanently acquired part of the Proposed Scheme.

8 Remedial Strategy

The following text outlines the remedial strategy for the contamination observed and the requirements for decommissioning the area of the CRSS within the boundary of the Proposed Scheme.

8.1 Cadmium

Cadmium is recorded in the groundwater under the CRSS and downstream. This cadmium is likely to be derived from the made ground under CRSS including the permanently acquired part of the Proposed Scheme. Considering that some of the made ground will be removed as part of the construction of the Proposed Scheme it is considered the removal of the source within the permanently acquired part of the Proposed Scheme and replacement with clean fill is the most appropriate remedial option rather than treatment.

As part of the detailed design a quantitative groundwater risk and surface water risk assessment shall be carried out by a competent geoenvironmental expert to establish a concentration of cadmium in the soil that does not present a risk to the quality of water entering Lough Atalia. This may require additional ground investigation. The risk assessment shall be used to define the extent and depth of the area for excavation.

Conservatively if it is assumed that the entire footprint of the CRSS within the permanently acquired part of the Proposed Scheme will be removed to the full depth of the made ground (~1m), the estimated volume of disposal is approximately 200m^3. Based on the samples collected the top 0.7m of the forecourt within the Proposed Scheme the made ground is classified as suitable for disposal to a non-hazardous waste facility (approximately 170m^3). The rest of the made ground is suitable for disposal to an inert waste facility (approximately 30m^3). Within this volume, it is probable that there will be localised ‘hot spots’ around the tanks and the pumps that could be classified as hazardous, but this will be assessed during the excavation.

It is possible that made ground left under the remainder of CRSS outside of the permanently acquired part of the Proposed Scheme could also be a source. However, made ground outside of the permanently acquired part of the Proposed Scheme is not included in this assessment and not discussed further.

Following any excavation, the removal of the source shall be verified by testing of the soil under the made ground to demonstrate that the residual soil does not comprise a potential source.

In addition, groundwater and surface water testing should be carried to confirm the finding to the quantitative groundwater and surface water risk assessment.

8.2 Decommissioning of the filling station

The works at CRSS to accommodate the Proposed Scheme will involve temporary acquisition of the entire CRSS property and decommissioning of all fuel tanks for the duration of the works. The works will include the complete removal of two of the six existing underground fuel storage tanks, two existing pumping stations and removal or relocation of buried services (e.g. pipework and drainage). The primary purpose of this is to ensure that all potentially contaminative materials are removed in a safe manner.

During decommissioning, the information provided by the Association for Petroleum & Explosives Administration (APEA) and the Energy Institute in the 'Design, construction, modification, maintenance and decommissioning of filling stations 4th edition' will be followed[9]. A summary of the decommissioning process is presented below:

- Decommissioning process should take place as soon as is practicable after operation has ceased;
- Carrying out a full risk assessment taking into consideration all matters considering health and safety and environmental protection;
- Removal from site of the storage tanks and associated pipework or rendering tanks safe *(in situ)*;
- Removal of all dispensers within the area being permanently acquired;
- Cleaning and where appropriate, removal of oil/water separator and connected surface water drainage system; and
- Disconnection and, where appropriate, removal of the electrical installation.

8.2.1 Total petroleum hydrocarbons (TPHs)

TPH has been recorded in groundwater beneath the CRSS and downstream on the banks of Lough Atalia. This TPH is likely to reflect drips or minor fuel spills at the CRSS that get flushed down to the gravel deposits and bedrock aquifer by surface water infiltration. Ceasing operation of CRSS within the permanently acquired part of the Proposed Scheme is likely to improve the situation. In addition, during decommissioning should any contaminated soils be identified within the permanently acquired part of the Proposed Scheme, these shall be removed.

As part of the detailed design a quantitative groundwater risk and surface water risk assessment shall be carried out by a competent geoenvironmental expert to establish a concentration of TPH in the soil that does not present a risk to the

[9] Energy Institute (EI) Design, construction, modification, maintenance and decommissioning of filling stations (known as the Blue Book) (EI 2018)

quality of water entering Lough Atalia. This may require additional ground investigation. The risk assessment shall be used to define the extent and depth of the area for excavation if required.

Following any excavation and the decommissioning of the CRSS, the removal of the source shall be verified by testing of the soil under the made ground to demonstrate that the residual soil does not comprise a potential source.

In addition, groundwater and surface water testing should be carried to confirm the finding to the quantitative groundwater and surface water risk assessment.

8.2.2 Underground tanks and services

All excavation and decommissioning will be supervised by a competent environmental engineer who is independent to the firm carrying out the works. During the excavation and removal, it should be assumed that the material in the surrounding area is contaminated with fuel. The contractor will arrange for any material that is suspected of being contaminated to be assessed by a competent person on site as soon as possible. Care and mitigation measures will be taken to ensure that any contaminated material is not permitted to become mobile and migrate to other areas. Any contaminated material present will be dealt with in accordance with the applicable waste legislation in Ireland.

For further guidance see BS 6187 Code of practice for demolition[10] (section 7.10 Excavation and removal of redundant petroleum tanks).

9 Conclusions

Ove Arup & Partners Ireland (trading as Arup) has been appointed to provide multi-disciplinary engineering services for the proposed BusConnects Galway – Cross City Link development (Proposed Scheme) on behalf of Galway City Council. The Proposed Scheme redline boundary includes land take within the footprint of the existing CRSS operated by Circle K. The CRSS within the permanently acquired part of the Proposed Scheme is subject to a detailed assessment to determine the presence and extent of any contamination.

The assessment found that the site has been previously a print works and a filling station has been operated on the site since the 1960s. A detailed ground investigation was carried out which did not prove any significant soil from the storage of fuels on the site.

Based on the results of the ground investigation, cadmium and occasional occurrences of TPH is present in groundwater under the site and downstream of the site. These exceedances are likely to originate from made ground under the CRSS.

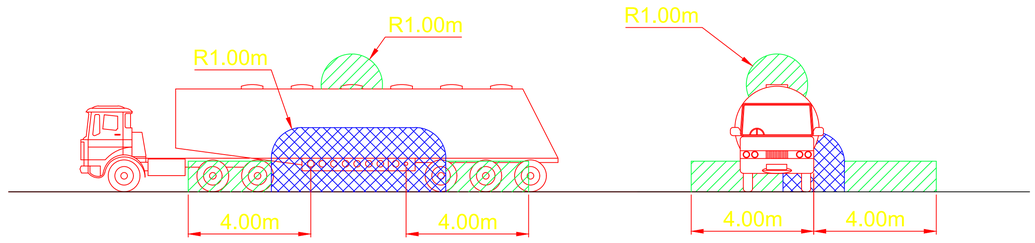
[10] BS 6187:2011 Code of practice for full and partial demolition

It is possible that cadmium originating from the made ground under the CRSS is also the source of elevated cadmium in the seepages on the banks of Lough Atalia. It is likely that the exceedances of TPH underlying the CRSS and observed in the seepages on the banks of Lough Atalia is related to localised fuel spills at the CRSS.

In respect of the cadmium and TPH recorded in the groundwater it is considered that subject to the finding of a risk assessment the removal of the sources of the contamination and disposal of them at an appropriately licenced facility is the most appropriate solution.

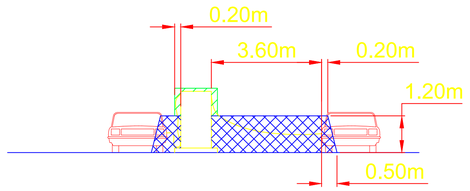
It will be necessary to decommission tanks and any buried services under the site to enable the Proposed Scheme in accordance with the 'Design, construction, modification, maintenance and decommissioning of filling stations' 4th edition[6].

The removal of the contaminated made ground and the decommissioning of the existing CRSS within the permanently acquired part of the Proposed Scheme will prevent the Proposed Scheme from impacting the water quality in the groundwater and the water quality entering Lough Atalia. Notwithstanding this it is possible that made ground left under the remainder of CRSS (outside of the permanently acquired part of the Proposed Scheme) could also be a source of cadmium and TPH and may continue to impact on the SAC.



(END VIEW) (SIDE VIEW)

TANKER LOADING & UNLOADING

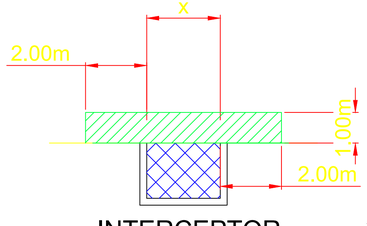


DISPENSERS

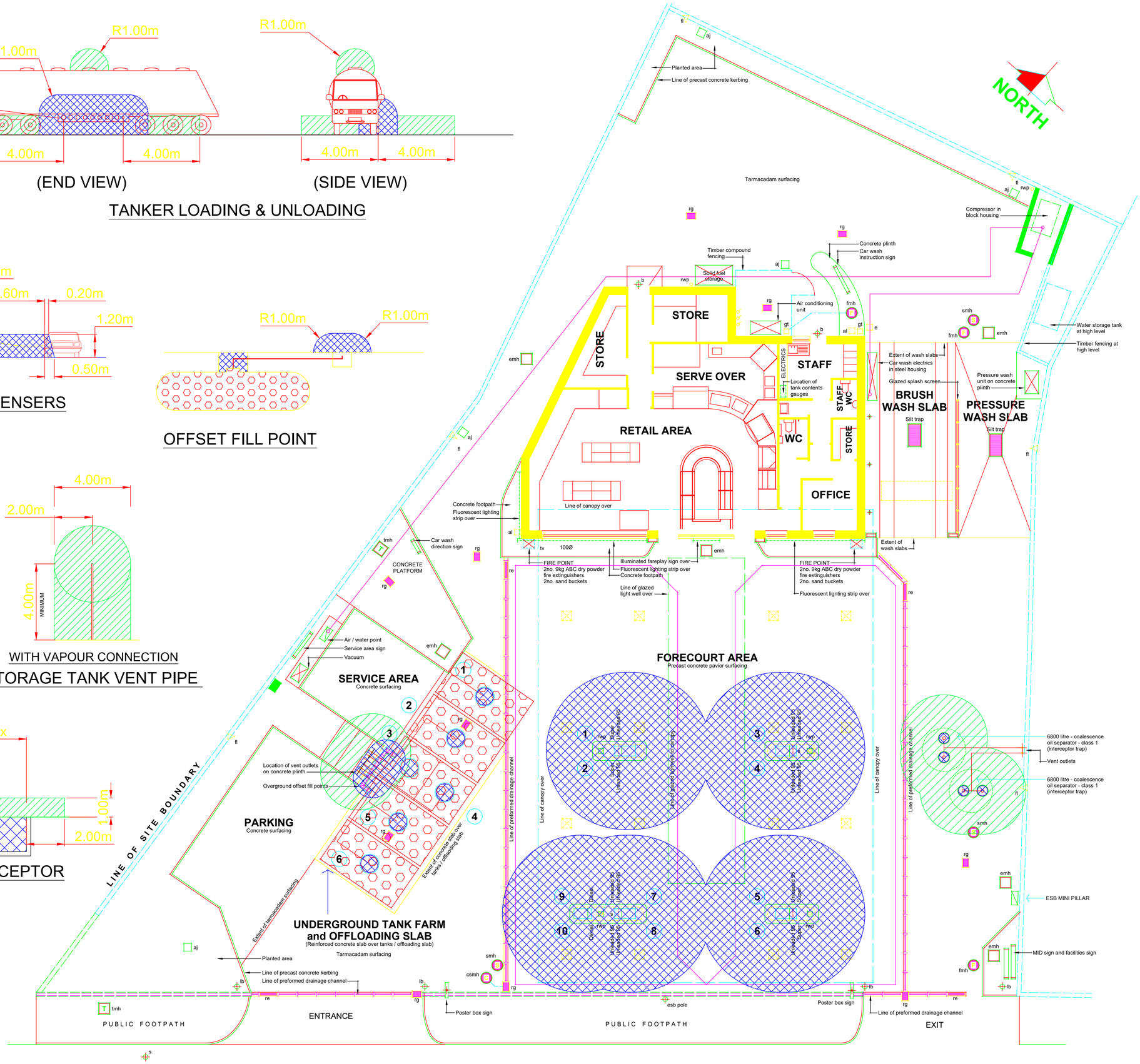
OFFSET FILL POINT

WITH VAPOUR CONNECTION

STORAGE TANK VENT PIPE



INTERCEPTOR



1. Designed to:

(a) Hazardous Area Classification Code:
Part 15 of the IP Model Code of Safe Practice in the Petroleum Industry in July 2005, 3rd Edition.

(b) Et105:2001, National Rules For Electrical Installations in potentially Explosive Athospheres.

2. Prodict Gas Group
Gasoline: IIA T3
Derve: IIA T3
MGO: IIA T2
Kero: IIA T3
Ethanol: IIB T2

3. All dimensions in meters

HAZARDOUS AREA ZONES

ZONE 0

ZONE 1

ZONE 2

TANK No.	CAPACITY	PRODUCT
1	19,400 LITRES	UNLEADED
2	19,400 LITRES	UNLEADED
3	9,500 LITRES	UNLEADED
4	9,800 LITRES	UNLEADED
5	19,700 LITRES	UNLEADED
6	19,700 LITRES	DERV

client
College Road, Galway, Co. Galway

drawing title
EPD_AREA_CLASSIFICATION

TOPAZ
Topaz Energy Ltd.
Beech Hill,
Clonskeagh,
Dublin 4.
Tel : 01 202 8800

drawn	SB	scale	1:250
job no.	REV-1	date	27/6/17

drawing no.
EPD

Appendix

Site History

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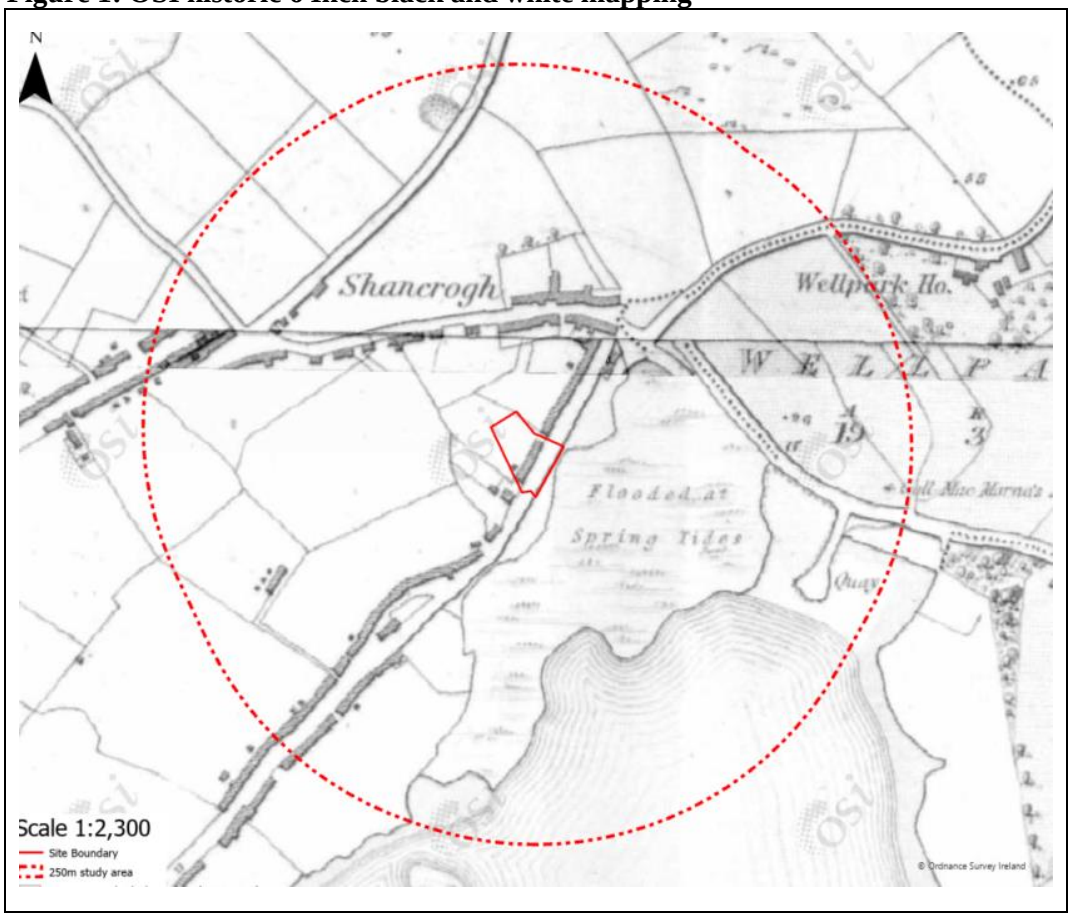
A2 Site History

A2.1 Site History from 1837 - 1842

The OSI first edition 6-inch mapping from 1837-1842 shows that the area underlying the site was comprised of some local historical development focused along College Road and the west of the site is underlain by fields. These fields are likely to be residential gardens at the back of the developments along College Road. There is a marsh area to the east of the site north of Lough Atalia which is described as 'Flooded at spring tides' suggesting that this area was an existing flood plain. This can be seen in Figure 1 below:

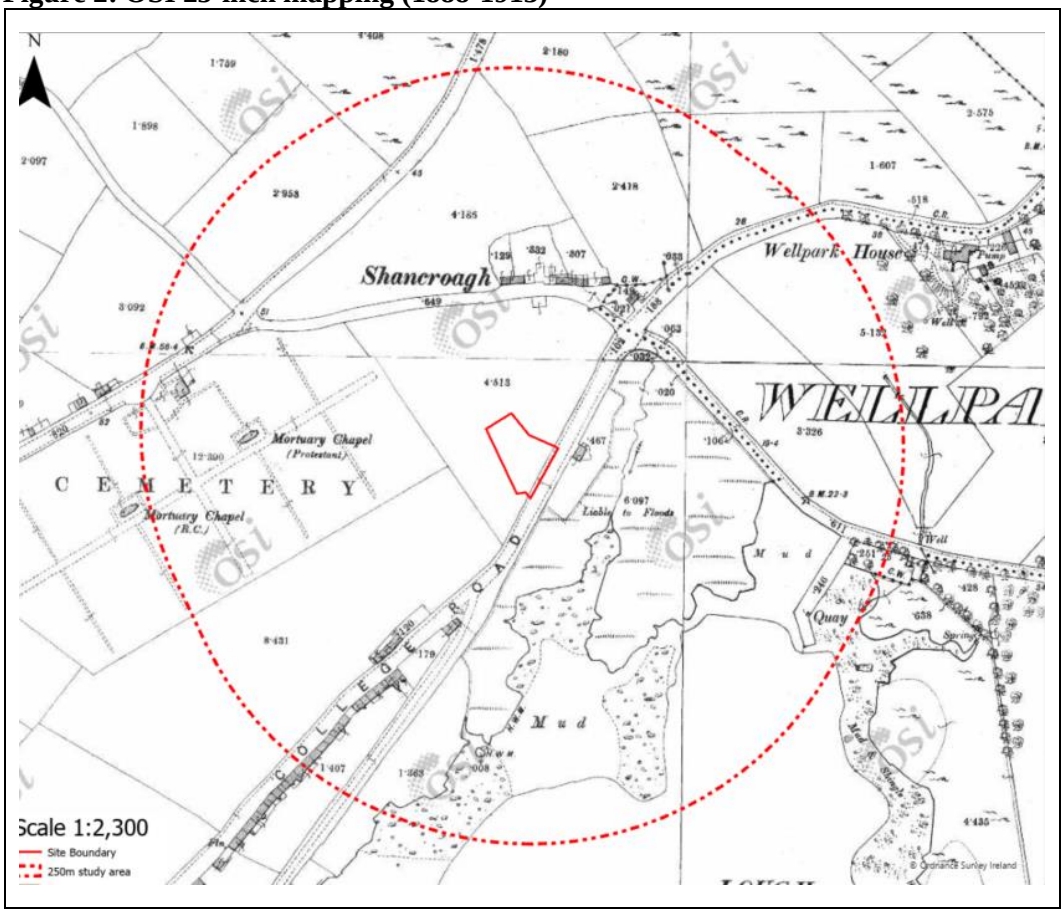
Figure 1: OSI historic 6 Inch black and white mapping



A2.2 Site History from 1888-1913

The OSI 25-inch mapping from 1888-1913 shows the site as part of a larger field, the historical developments along College Road seemed to have been removed. It is likely this area was used as agricultural land during this time. One housing development is noted to the east of College Road adjacent to Lough Atalia. The marsh area is mapped to the east of the site north of Lough Atalia which is described as 'Liable to Floods'. A watercourse is shown approximately 50m to the east of the site which drains into Lough Atalia. This can be seen in Figure 2 below:

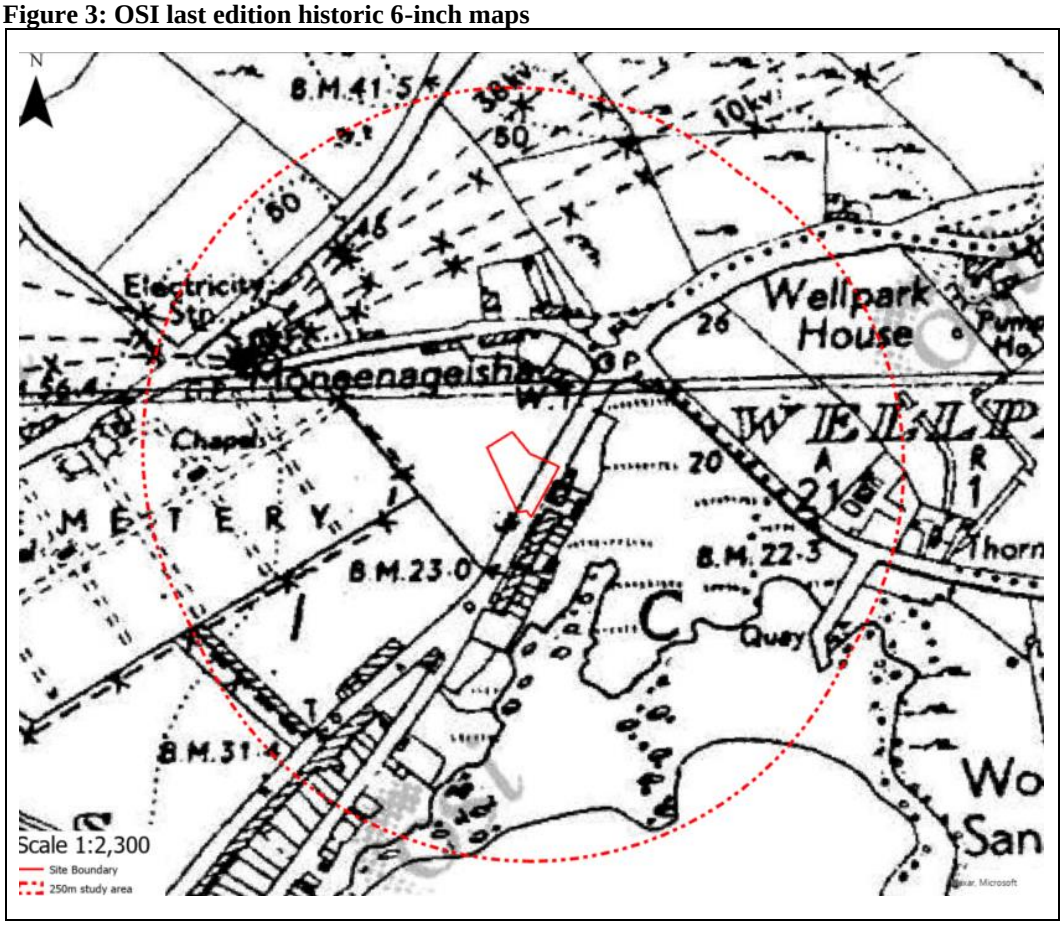
Figure 2: OSI 25-inch mapping (1888-1913)



A2.3 Site History from 1830s to 1930s

The OSI last edition historic 6-inch maps in this area were drawn from 1913-1930s. The maps show the SSCR as part of a larger field. There are a number of housing developments marked to the east of College Road suggesting they had been built between the 1913 and 1930s. The maps show the area east of the site as a marsh land. This can be seen in Figure 3 below:

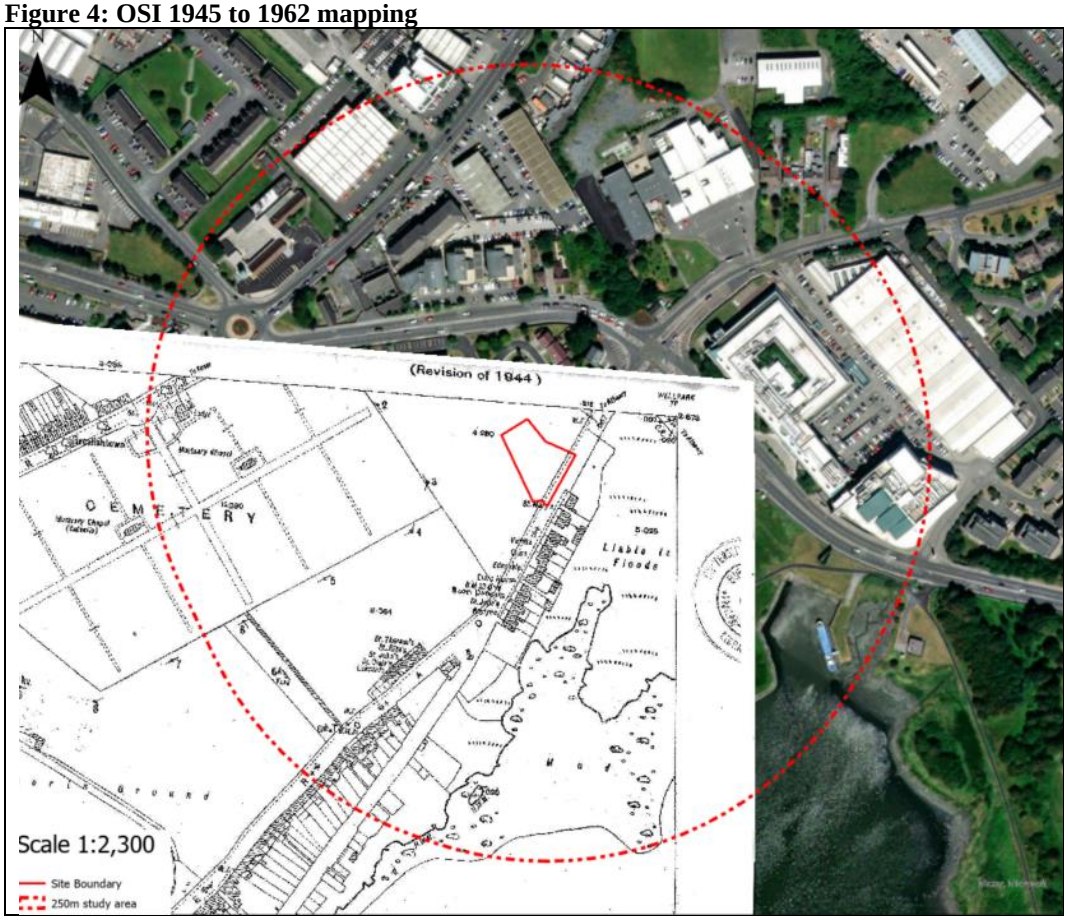
Figure 3: OSI last edition historic 6-inch maps



A2.4 Site History from 1945 to 1962

The OSI Galway City maps from 1945 to 1962 again shows the site similar to that of the last edition of the historic 6-inch maps, suggesting there has been no change on site between the 1930s and 1960s. These maps show the area east of the site as a marsh land at Lough Atalia, they included labelling the area as it as 'Liable to Floods', much of the coast here is described as 'Mud'.

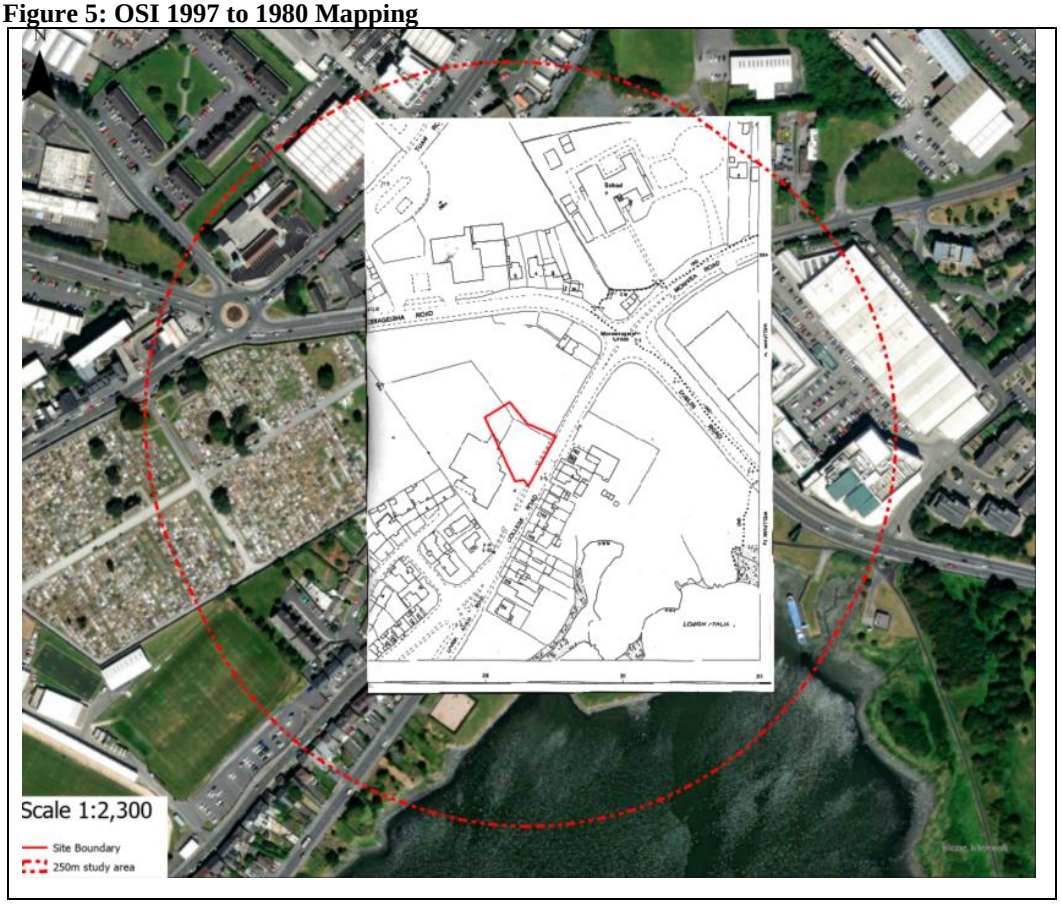
Figure 4: OSI 1945 to 1962 mapping



A2.5 Site History from 1977 to 1980

The 1977 to 1980 OSi mapping for this area show that the area has been developed, there is a footprint of a building underlying the west of the CRSS. The footprint does not appear to be residential but likely industrial. This suggests that development in these areas took place between 1962 and 1977. This can be seen on Figure 5 below:

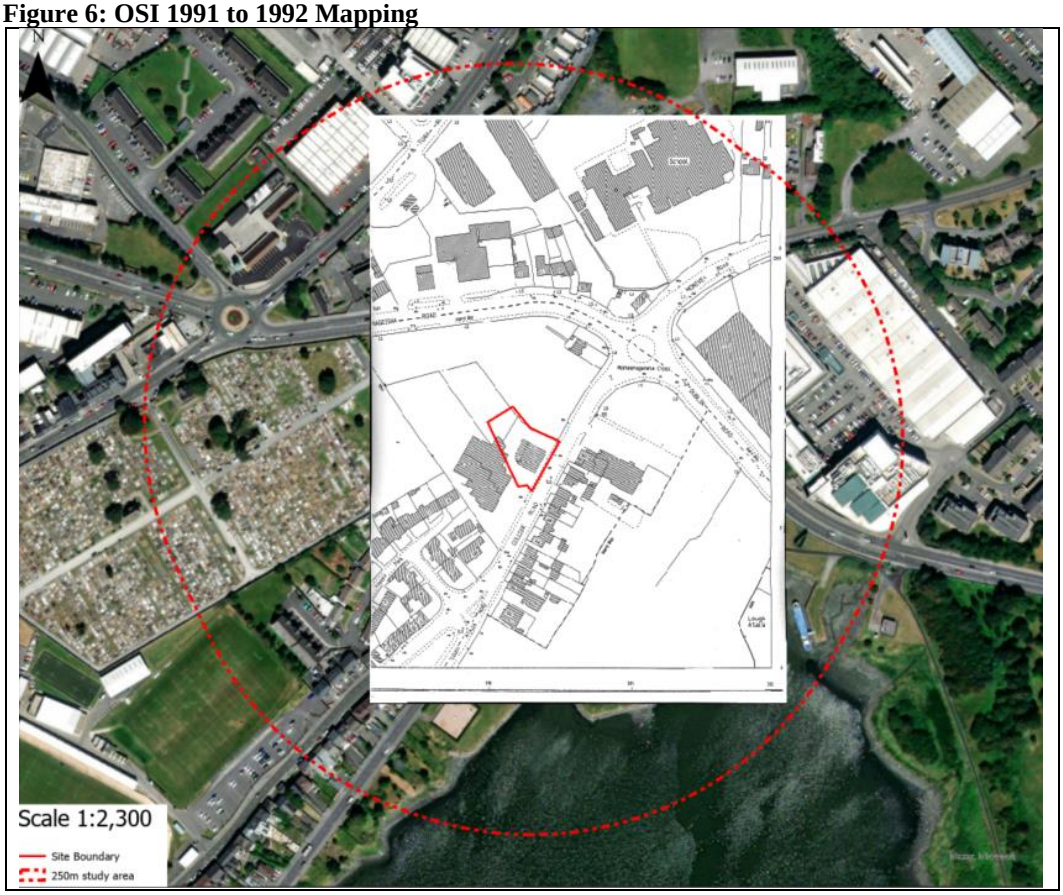
Figure 5: OSI 1997 to 1980 Mapping



A2.6 Site History from 1991 to 1992

The 1991 to 1992 OSi mapping shows that there are two large buildings within the site footprint. These buildings as mentioned above were reported as being a printworks. This suggests that there had been construction at the site between 1977 and 1991. There has also been further development of commercial buildings to the east of the site at the existing location of the Huntsman Inn, this development has taken place on reclaimed land. These observations are shown in Figure 6 below:

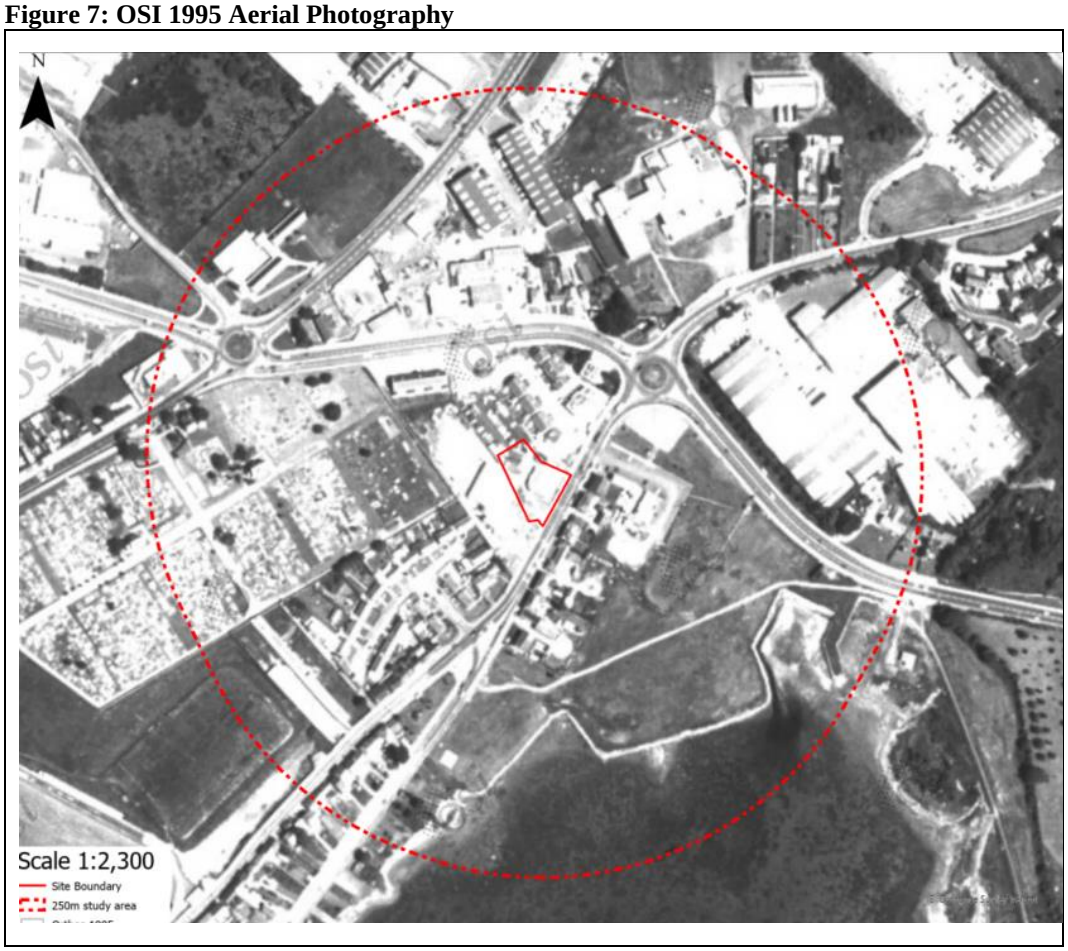
Figure 6: OSI 1991 to 1992 Mapping



A2.7 Site History 1995

The OSI 1995 Aerial photography exhibits no change at the CRSS but there has been further residential development surrounding the CRSS within the Study Area. This imagery suggests there was no development at the current CRSS between 1992 and 1995 at the site. This imagery can be seen below in Figure 7:

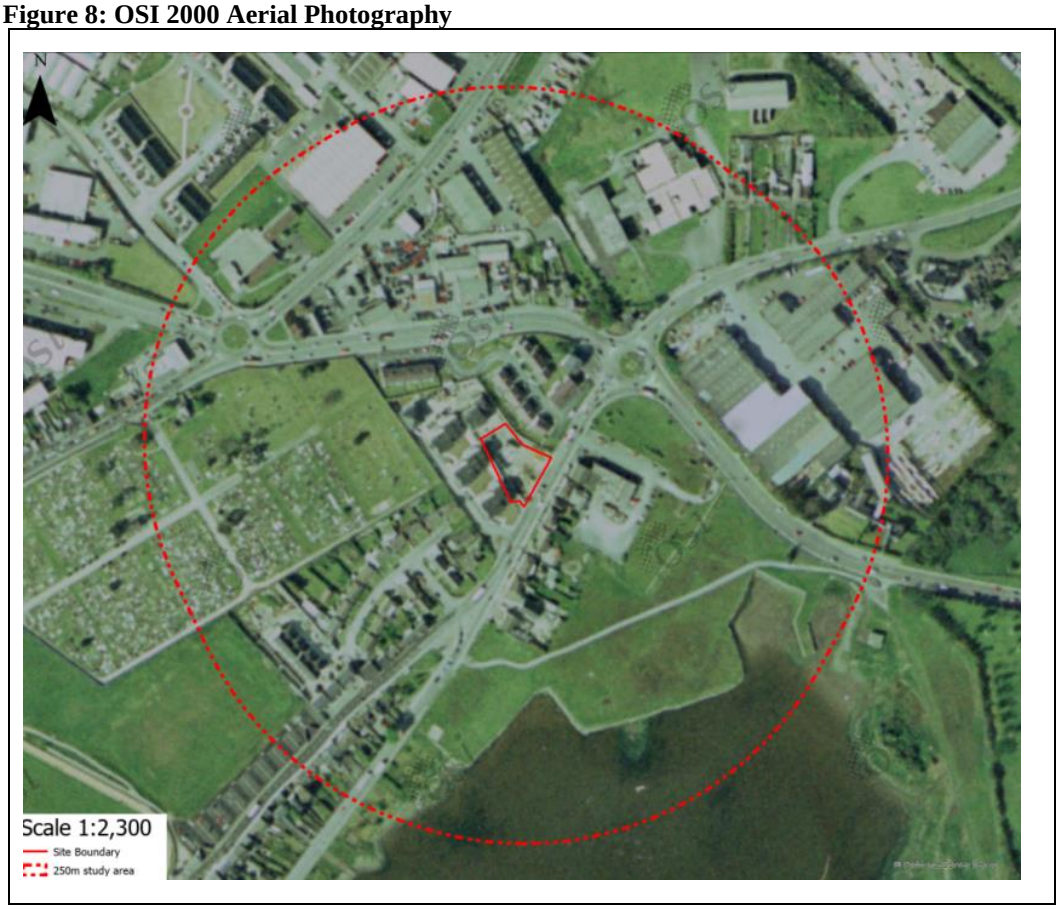
Figure 7: OSI 1995 Aerial Photography



A2.8 Site History 2000

The OSI Aerial from 2000 photography shows that there has been housing development surrounding the eastern area of the site, at this time it appears as though the site is vacant prior to construction of the Service Station. This suggests that there was demolition and construction on the site between 1995 and 2000. This can be seen in Figure 8 below:

Figure 8: OSI 2000 Aerial Photography



A2.9 Site History 2005 to 2018

The OSI Aerial photography from 2005 to 2018 and the 2019 Google Earth Aerial imagery show the site as it is presently. This suggests that construction of the Service Station took place between 2000 and 2005. This can be seen in Figure 9 below – showing the 2005 OSI Aerial photography.

Figure 9: OSI 2005 Aerial Photography

ARUP

Parameters	LOD	Groundwater Screening Standards	Units	Chemtest Sample ID	22-03384	22-03384	22-03384	22-03384	22-03384	22-03384	22-03745	22-03745	22-12073	22-12073	22-12073	22-12073	22-12073	22-12073	22-12073	22-12073	22-12073	22-12073
				Sample Location	BH103WS	WS104	BH102	BH103	BH104	BH105	SW1 - South	SW2 - West	SW1	SW3-LT	SW3-HT	SW4-LT	SW4-HT	SW5-LT	SW5-HT	BH105	BH104	BH103
				Sampling Round	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	2	2	2
				Approx. Location																		
				Installation Monitoring	Overburden	Overburden	Bedrock	Bedrock	Bedrock	Bedrock	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Bedrock	Bedrock	Bedrock
				Sample Type	GWATER	GWATER	GWATER	GWATER	GWATER	GWATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	GWATER	GWATER	GWATER
				Date Sampled	27-Jan-2022	27-Jan-2022	27-Jan-2022	27-Jan-2022	27-Jan-2022	27-Jan-2022	31-Jan-2022	31-Jan-2022	28-Mar-2022	28-Mar-2022	28-Mar-2022	28-Mar-2022	28-Mar-2022	28-Mar-2022	28-Mar-2022	28-Mar-2022	28-Mar-2022	28-Mar-2022
Aliphatic TPH >C10-C12	0.10	400	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C12-C16	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C16-C21	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C21-C35	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C35-C44	0.10	nv	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C5-C6	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C6-C8	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C8-C10	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Alkalinity (Total)	10	nv	mg/l		370	260	190	300	580	300	230	200	200	190	140	180	150	140	140	320	510	280
Ammoniacal Nitrogen as NH3	0.050	0.065	mg/l		0.078	0.12	0.093	0.47	2.6	0.12	0.44	0.14	0.1	0.58	0.3	0.061	0.1	0.086	0.47	0.058	1.7	0.063
Antimony	0.50	5.6	µg/l		0.79	0.72	4.8	1.2	9.2	1.3	1.8	0.65	0.54	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.56	1.2	< 0.50	0.68
Aromatic TPH >C10-C12	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C12-C16	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C16-C21	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C21-C35	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C35-C44	0.10	nv	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C5-C7	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C7-C8	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aromatic TPH >C8-C10	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Arsenic	0.20	7.5	µg/l		0.86	0.5	2.9	19	87	4.4	0.7	0.5	0.28	1.6	0.75	2.1	1	1.1	1	1.5	14	0.6
Barium	5.00	100	µg/l		40	27	53	50	60	35	20	18	19	21	20	27	26	29	41	53	43	34
Biochemical Oxygen Demand Low Level	1.0	nv	mg/l		1.1	3.4	< 1.0	< 1.0	1.1	< 1.0	18	4	< 1.0	1	< 1.0	2	< 1.0	< 1.0	< 1.0	< 1.0	2	3
Cadmium	0.11	0.08	µg/l		4.8	0.54	0.7	1.1	0.13	2	0.14	0.11	< 0.11	< 0.11	< 0.11	< 0.11	< 0.11	< 0.11	< 0.11	0.57	0.17	0.73
Calcium	2.00	200	mg/l		49	97	130	160	170	93	84	120	88	130	120	130	120	130	130	150	130	65
Chemical Oxygen Demand	10	nv	mg/l		10	< 10	12	< 10	57	< 10	66	91	14	54	54	55	45	49	47	13	41	15
Chloride	1	187.5	mg/l		46	48	36	66	3200	54	50	2600	81	3400	3200	3300	3300	3700	3000	560	2000	54
Chromium (trivalent)	1	nv	µg/l		< 1	< 1	3	< 1	2	1	2	13	< 1	< 1	< 1	< 1	< 1	< 1	< 1	< 1	2	< 1
Copper	0.5	1500	µg/l		18	2.9	14	52	0.73	9.8	3.7	4.8	4.1	0.91	1.4	1.6	1	0.92	3.7	5.8	2	7.5
Iron	5	200	µg/l		340	6.7	2000	2800	110	180	42	5	17	260	15	420	96	100	13	5.6	270	23
Lead	0.5	7.5	µg/l		7.5	0.76	13	32	< 0.50	4.3	2.3	0.5	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.78	0.61
Low-Level Chromium (Hexavalent)	0.1	nv	µg/l		2.6	2.1	3.9	3.5	0.2	< 0.10	0.1	0.1	0.24	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.85
Magnesium	0.2	50	mg/l		7.1	5.5	5.7	10	200	14	5.3	160	6.4	220	210	220	230	240	210	34	130	7.5
Manganese	0.5	50	µg/l		27	180	250	1500	120	39	38	6.8	7	190	10	160	69	120	6	220	180	0.96
Mercury	0.01	0.75	µg/l		< 0.010	0.16	< 0.010	< 0.010	0.047	0.081	0.01	0.01	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Mineral Oil (TPH Calculation)	10	nv	µg/l		< 10	< 10	< 10	< 10	< 10	< 10	10	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Molybdenum	0.2	nv	µg/l		140	3	360	50	27	19	7.9	7.7	1.2	2.2	1.9	2	1.7	1.9	2.2	2.6	3.4	7
Nickel	0.5	15	µg/l		4.2	1.6	4.5	4.3	78	6.4	9.3	1.1	1.2	1.3	0.76	1.3	0.78	0.88	2.2	4.2	8.4	3
Nitrate	0.5	37.5	mg/l		7.2	4.4	4.5	< 0.50	< 0.50	5.1	5.4	1.7	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.53	< 0.50	1.3
Organolead Compounds	0.05	No match	ug/l		< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	0.05	0.05	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phosphate	0.2	nv	mg/l		< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	0.2	0.4	0.2	0.27	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Potassium	0.5	5	mg/l		4.7	5.8	5	7	66	7.8	3.8	51	3.3	73	66	69	68	75	64	12	47	5
Selenium	0.50	170	µg/l		29	3	5.6	< 0.50	1.2	13	1.4	1.5	0.91	< 0.50	< 0.50	0.6	< 0.50	< 0.50	0.55	0.77	< 0.50	22
Sodium	1.50	150	mg/l		140	30	22	45	1900	140	32	1800	47	1900	1800	1900	1900	2200	1800	280	1100	110
Sulphate	1.0	187.5	mg/l		72	60	66	54	380	73	58	410	51	460	450	430	460	510	440	100	220	89
Suspended Solids At 105C	5.0	nv	mg/l		540	18	140	180	220	64	550	55	< 5.0	3100	170	1800	590	1300	610	420	84	47000
Total Aliphatic Hydrocarbons	5.0	nv	µg/l		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Aromatic Hydrocarbons	5.0	0.075	µg/l		< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Dissolved Solids	1.0	1000	mg/l		530	470	380	530	7200	600	380	5500	980	7000	6600	6500	7000	7200	4900	1400	4200	510
Total Petroleum Hydrocarbons	10	10	µg/l			< 10		< 10	< 10	< 10			< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Total TPH >C10-C40	10	nv	µg/l		< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Zinc	2.5	75	µg/l		55	7.5	41	150	7.1	41	190	14	14	< 2.5	4.7	< 2.5	< 2.5	< 2.5	19	24	5.7	7.1

ARUP

Parameters	LOD	Groundwater Screening Standards	Units	Chemtest Sample ID	22-12073	22-12073	22-12073	22-14537	22-14537	22-14537	22-14537	22-14537	22-14537	22-14537	22-14537	22-14537	22-14537	22-14537	22-14537	22-14537
				Sample Location	BH102	BH103WS	WS104	BH103WS	WS104	BH102	BH103	BH104	BH105	SW01	SW03LT	SW03HT	SW04LT	SW04HT	SW05LT	SW05HT
				Sampling Round	2	2	2	3	3	3	3	3	3	3	2	2	2	2	2	2
				Approx. Location																
				Installation Monitoring	Bedrock	Overburden	Overburden	Overburden	Overburden	Bedrock	Bedrock	Bedrock	Bedrock	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water	Surface water
				Sample Type	GWATER	GWATER	GWATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER	WATER
				Date Sampled	28-Mar-2022	28-Mar-2022	28-Mar-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022	13-Apr-2022
Aliphatic TPH >C10-C12	0.10	400	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aliphatic TPH >C12-C16	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aliphatic TPH >C16-C21	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aliphatic TPH >C21-C35	0.10	7.5	µg/l		150	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aliphatic TPH >C35-C44	0.10	nv	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aliphatic TPH >C5-C6	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Aliphatic TPH >C6-C8	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aliphatic TPH >C8-C10	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Alkalinity (Total)	10	nv	mg/l		140	280	250	520	380	100	460	550	430	230	160	160	170	150	150	150
Ammoniacal Nitrogen as NH3	0.050	0.065	mg/l		0.24	< 0.050	0.12	0.23	0.23	0.55	0.24	1.2	0.44	0.5	1.6	1.3	1.4	1.2	1.1	1.2
Antimony	0.50	5.6	µg/l		0.68	0.74	4.1	0.61	0.97	0.86	0.52	0.52	1.1	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	0.73	< 0.50
Aromatic TPH >C10-C12	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	41	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aromatic TPH >C12-C16	0.10	7.5	µg/l		19	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aromatic TPH >C16-C21	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aromatic TPH >C21-C35	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	33	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aromatic TPH >C35-C44	0.10	nv	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aromatic TPH >C5-C7	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aromatic TPH >C7-C8	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Aromatic TPH >C8-C10	0.10	7.5	µg/l		< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	[C] < 0.10	< 0.10
Arsenic	0.20	7.5	µg/l		1.5	0.59	0.41	1.2	0.46	1.4	0.45	19	1.5	0.28	1.2	0.88	1.3	0.85	1	0.97
Barium	5.00	100	µg/l		13	32	34	46	52	11	43	39	140	16	26	24	26	24	25	22
Biochemical Oxygen Demand Low Level	1.0	nv	mg/l		2	< 1.0	< 1.0	[B] 3.0	[B] 3.0	[B] 5.0	[B] 1.0	[B] 4.0	[B] 3.0	[B] 16	[B] 5.0	[B] < 1.0	[B] 3.0	[B] < 1.0	[B] 4.0	[B] 5.0
Cadmium	0.11	0.08	µg/l		< 0.11	0.72	< 0.11	0.29	0.35	< 0.11	0.12	0.73	0.79	< 0.11	< 0.11	< 0.11	< 0.11	< 0.11	0.26	< 0.11
Calcium	2.00	200	mg/l		63	56	92	34	120	36	55	160	200	77	190	200	190	190	190	190
Chemical Oxygen Demand	10	nv	mg/l		21	12	17	[B] < 10	[B] < 10	[B] < 10	[B] < 10	[B] 20	[B] 26	[B] 27	[B] 110	[B] 41	[B] 110	[B] 37	[B] 100	[B] 110
Chloride	1	187.5	mg/l		47	43	47	54	90	140	53	1200	2900	80	8600	8800	8800	8300	8500	8500
Chromium (trivalent)	1	nv	µg/l		< 1	1	< 1	< 1	< 1	2	1	3	4	4	4	4	4	4	3	4
Copper	0.5	1500	µg/l		1.3	9.4	1.5	16	6.7	2.1	5.5	8.6	6.2	3.2	1.6	1.9	1.3	1.8	1.9	1.8
Iron	5	200	µg/l		< 5.0	33	< 5.0	270	390	19	21	2000	24	81	94	20	130	20	21	19
Lead	0.5	7.5	µg/l		< 0.50	0.64	< 0.50	3.7	5.6	< 0.50	< 0.50	15	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	1.3	< 0.50
Low-Level Chromium (Hexavalent)	0.1	nv	µg/l		0.66	0.73	0.99	[B] 3.9	[B] 4.3	[B] 3.3	[B] 4.1	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] < 0.10	[B] 0.48	[B] 0.28	[B] 0.50	[B] 0.48	[B] < 0.10
Magnesium	0.2	50	mg/l		3.4	6.4	4.2	6.7	14	5.5	8.9	74	160	6.2	460	480	470	470	450	470
Manganese	0.5	50	µg/l		0.87	< 0.50	0.75	13	45	14	1.5	290	330	9.2	53	2.6	69	3.1	5.6	1.7
Mercury	0.01	0.75	µg/l		< 0.010	< 0.010	< 0.010	0.04	0.039	0.06	0.039	0.039	0.038	0.041	0.052	0.042	0.048	0.044	0.038	0.042
Mineral Oil (TPH Calculation)	10	nv	µg/l		150	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Molybdenum	0.2	nv	µg/l		8	8.7	3.2	12	2.8	8.3	5.6	3.7	3.7	2.7	4.8	4.3	4.5	4.4	4.4	4.3
Nickel	0.5	15	µg/l		2.4	3.9	1	5.2	2.8	5.8	4.5	10	6.2	4.1	3.4	2.9	3.2	3	3	2.8
Nitrate	0.5	37.5	mg/l		1.1	0.94	1.7	2.1	9.2	1.8	2.9	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organolead Compounds	0.05	No match	ug/l		< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phosphate	0.2	nv	mg/l		< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20	< 0.20
Potassium	0.5	5	mg/l		7.1	4.7	15	5.5	13	8.6	5.4	28	48	4.2	140	150	150	140	150	150
Selenium	0.50	170	µg/l		3	27	4.9	28	6.7	2.9	13	3.7	1	1.3	0.74	0.68	0.9	0.66	0.73	0.67
Sodium	1.50	150	mg/l		30	130	34	210	120	70	110	610	1800	44	4800	5100	5200	5400	5700	5300
Sulphate	1.0	187.5	mg/l		49	100	53	90	64	56	73	120	400	53	1100	1100	1100	1000	1100	1100
Suspended Solids At 105C	5.0	nv	mg/l		220	29000	2500	19000	20000	420	60000	2600	640	200	2400	210	4400	200	590	140
Total Aliphatic Hydrocarbons	5.0	nv	µg/l		150	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	[C] < 5.0	< 5.0
Total Aromatic Hydrocarbons	5.0	0.075	µg/l		19	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	74	< 5.0	< 5.0	< 5.0	< 5.0	[C] < 5.0	< 5.0
Total Dissolved Solids	1.0	1000	mg/l		310	520	420	600	700	260	550	2300	5400	490	14000	8200	14000	9200	14000	8800
Total Petroleum Hydrocarbons	10	10	µg/l		170	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	74	< 10	< 10	< 10	< 10	[C] < 10	< 10
Total TPH >C10-C40	10	nv	µg/l		150	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	[C] < 10	< 10
Zinc	2.5	75	µg/l		< 2.5	7	81	47	120	5.8	4.5	110	49	34	3.6	3.5	< 2.5	3.9	5.3	3.7