CAUSEWAY GEOTECH

APPENDIX F

VARIABLE HEAD PERMEABILITY TEST RESULTS

VARIABLE HEAD PERMEABILITY TEST (Standpipe)

Project Name: Monaghan Landfills - Killycard Borehole No.: GW01

Project No.: 18-0838A Date: 09/10/2018 Test No.: Test 1

Type of test: ***Falling*** Head

Diameter of standpipe (D):	*0.05*	(m)		
Depth to top of filter bgl:	*6.50*	(m)		
Depth to bottom of filter bgl	*10.00*	(m)		
Length of test section of filter (L):	*3.50*	(m)		
Diameter of Filter (D):	*0.20*	(m)		
Standing ground water level (SWL) bgl:	*1.52*	(m)	on	09 October 2018

TIME ELAPSED (mins)	WATER LEVEL* (m)	HEAD H (m)	HEAD RATIO H/Ho
0	-0.30	1.82	1.00
1	0.74	0.78	0.43
1.5	0.88	0.64	0.35
2	0.97	0.55	0.30
2.5	1.06	0.46	0.25
3	1.11	0.41	0.23
3.5	1.16	0.36	0.20
4	1.20	0.32	0.18
4.5	1.24	0.28	0.15
5	1.27	0.25	0.14
10	1.39	0.13	0.07
15	1.43	0.09	0.05
20	1.45	0.07	0.04
25	1.46	0.06	0.03
30	1.46	0.06	0.03
45	1.47	0.05	0.03
60	1.48	0.04	0.02

CALCULATION OF PERMEABILITY OF SOIL:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where:

k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t_1 and t_2

Values of shape factors (F) for various conditions,

Cases (a)-(e), are given in Annex B of BS EN ISO 22282-1:2012

L/D= 17.50

Assumed condition: Case ***E*** , hence:

F=(2*π*L)/(LN(2*(L/D))

F= 6.19

and A = 0.0020 (m^2)

and h_1 = 1.82 (m)

and h_2 = 0.04 (m)

and t_1 = *0* (s)

and t_2 = 3600 (s)

hence, k = **3.361E-07** m/s

CAUSEWAY GEOTECH

VARIABLE HEAD PERMEABILITY TEST (Standpipe)

Project Name: Monaghan Landfills - Killycard Borehole No.: GW02

Project No.: 18-0838A Date: 09/10/2018 Test No.: Test 1

Type of test: ***Falling*** Head

Diameter of standpipe (D):	*0.05*	(m)		
Depth to top of filter bgl:	*7.00*	(m)		
Depth to bottom of filter bgl	*10.00*	(m)		
Length of test section of filter (L):	*3.00*	(m)		
Diameter of Filter (D):	*0.20*	(m)		
Standing ground water level (SWL) bgl:	*2.22*	(m)	on	09 October 2018

TIME ELAPSED (mins)	WATER LEVEL* (m)	HEAD H (m)	HEAD RATIO H/Ho
0	-0.20	2.42	1.00
0.5	0.90	1.32	0.55
1	1.20	1.02	0.42
1.5	1.48	0.74	0.31
2	1.60	0.62	0.26
2.5	1.70	0.52	0.21
3	1.78	0.44	0.18
3.5	1.82	0.40	0.17
4	1.86	0.36	0.15
4.5	1.90	0.32	0.13
5	1.92	0.30	0.12
10	2.04	0.18	0.07
15	2.09	0.13	0.05
20	2.11	0.11	0.05
25	2.13	0.09	0.04
30	2.14	0.08	0.03
45	2.15	0.07	0.03
60	2.16	0.06	0.02
90	2.17	0.05	0.02

CALCULATION OF PERMEABILITY OF SOIL:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where:

k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t_1 and t_2

Values of shape factors (F) for various conditions,

Cases (a)-(e), are given in Annex B of BS EN ISO 22282-1:2012

L/D= 15.00

Assumed condition: Case ***E*** , hence:

F=(2*π*L)/(LN(2*(L/D))

F= 5.54

and A = 0.0020 (m^2)

and h_1 = 2.42 (m)

and h_2 = 0.05 (m)

and t_1 = *0* (s)

and t_2 = 5400 (s)

hence, k = **2.541E-07** m/s

CAUSEWAY GEOTECH

VARIABLE HEAD PERMEABILITY TEST (Standpipe)

Project Name: Monaghan Landfills - Killycard Borehole No.: GW03

Project No.: 18-0838A Date: 09/10/2018 Test No.: Test 1

Type of test: ***Falling*** Head

Diameter of standpipe (D):	*0.05*	(m)		
Depth to top of filter bgl:	*6.00*	(m)		
Depth to bottom of filter bgl	*10.00*	(m)		
Length of test section of filter (L):	*4.00*	(m)		
Diameter of Filter (D):	*0.20*	(m)		
Standing ground water level (SWL) bgl:	*1.71*	(m)	on	09 October 2018

TIME ELAPSED (mins)	WATER LEVEL* (m)	HEAD H (m)	HEAD RATIO H/Ho
0	-0.25	1.96	1.00
0.5	0.35	1.36	0.69
1	0.64	1.07	0.55
1.5	0.76	0.95	0.48
2	0.82	0.89	0.45
2.5	0.86	0.85	0.43
3	0.88	0.83	0.42
3.5	0.89	0.82	0.42
4	0.90	0.81	0.41
4.5	0.91	0.80	0.41
5	0.91	0.80	0.41
10	0.92	0.79	0.40
20	0.93	0.78	0.40
30	0.93	0.78	0.40
45	0.94	0.77	0.39
60	0.95	0.76	0.39
90	0.96	0.75	0.38

CALCULATION OF PERMEABILITY OF SOIL:

Employing Horslev Method (1951)

$$k = \frac{2.3A}{F(t_2 - t_1)} \log \frac{h_1}{h_2}$$

where:

k is the permeability of soil

A is the cross-section area of borehole/standpipe

F is the shape factor (see below)

h_1 and h_2 are the hydraulic heads measured respectively at the times t_1 and t_2

Values of shape factors (F) for various conditions,

Cases (a)-(e), are given in Annex B of BS EN ISO 22282-1:2012

L/D= 20.00

Assumed condition: Case ***E*** , hence:

F=(2*π*L)/(LN(2*(L/D))

F= 6.81

and A = 0.0020 (m^2)

and h_1 = 1.96 (m)

and h_2 = 0.75 (m)

and t_1 = *0* (s)

and t_2 = 5400 (s)

hence, k = **5.118E-08** m/s

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APPENDIX F

GEOTECHNICAL LABORATORY TEST RESULTS

CAUSEWAY GEOTECH

10122

+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

Project Name:	Monaghan Landfills - Killycard
Project No.:	18-0838A
Client:	Monaghan County Council
Engineer:	Fehily Timoney & Company
Date:	09/10/18

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

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

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

Approved Signatory

Stephen Watson
Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

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+44 (0)28 2766 6640
info@causewaygeotech.com
www.causewaygeotech.com

Project Name: Monaghan Landfills - Killycard

Report Reference: 18-0838A – Soils Schedule 1

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

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS 1377-2: 1990: Cl 3.2	3
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2: 1990: Cl 4.4, 5.3 & 5.4	3
SOIL	Bulk and dry density by Linear Measurement Method	BS 1377-2: 1990: Cl 7.2	3
SOIL	Particle size distribution - wet sieving	BS 1377-2: 1990: Cl 9.2	3
SOIL	Particle size distribution - sedimentation hydrometer method	BS 1377-2: 1990: Cl 9.5	3

Summary of Classification Test Results

CAUSEWAY GEOTECH

Project No.	Project Name
18-0838A	Monaghan Landfills - Killycard

Hole No.	Sample				Soil Description	Density		*w*	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		bulk	dry							
						Mg/m3		%	%	%	%	%	Mg/m3	
TP02	1	0.50		B	MADE GROUND: Brown sandy gravelly SILT with fragments of plastic and glass.	2.00	1.68	11.0	52	52 -1pt	35	17		MH
TP07	1	0.50		B	MADE GROUND: Brown sandy gravelly SILT/CLAY with fragments of red brick and plastic.	2.04	1.69	20.0	55	48 -1pt	28	20		MI/CI
TP13	1	0.50		B	MADE GROUND: Brown sandy gravelly silty CLAY with fragments of plastic and glass.	2.07	1.80	15.0	50	45 -1pt	26	19		CI

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

Key

Density test	Liquid Limit	Particle density
Linear measurement unless :	4pt cone unless :	sp - small pyknometer
wd - water displacement	cas - Casagrande method	gj - gas jar
wi - immersion in water	1pt - single point test	

Date Printed: 10/09/2018 00:00

Approved By: Stephen.Watson

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CAUSEWAY GEOTECH

Density Tests - Summary of Results

Project No.	Project Name
18-0838A	Monaghan Landfills - Killycard

Hole No.	Sample				Soil Description	Linear Measurement			Immersion in water			Water displacement			Remarks
	Ref	Top	Base	Type		Bulk density Mg/m^3	Dry density Mg/m^3	w %	Bulk density Mg/m^3	Dry density Mg/m^3	w %	Bulk density Mg/m^3	Dry density Mg/m^3	w %	
TP02	1	0.50		B	MADE GROUND: Brown sandy gravelly SILT with fragments of plastic and glass.	2.00	1.68	19.2							
TP07	1	0.50		B	MADE GROUND: Brown sandy gravelly SILT/CLAY with fragments of red brick and plastic.	2.04	1.69	21.0							
TP13	1	0.50		B	MADE GROUND: Brown sandy gravelly silty CLAY with fragments of plastic and glass.	2.07	1.80	14.8							

Legend w moisture content of the density test specimen

Notes

Tests carried out in accordance with BS1377:Part2:1990 and the following clauses unless annotated otherwise

Linear measurement	clause 7.2
Immersion in water	clause 7.3
Water displacement	clause 7.4

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Approved By: Stephen.Watson

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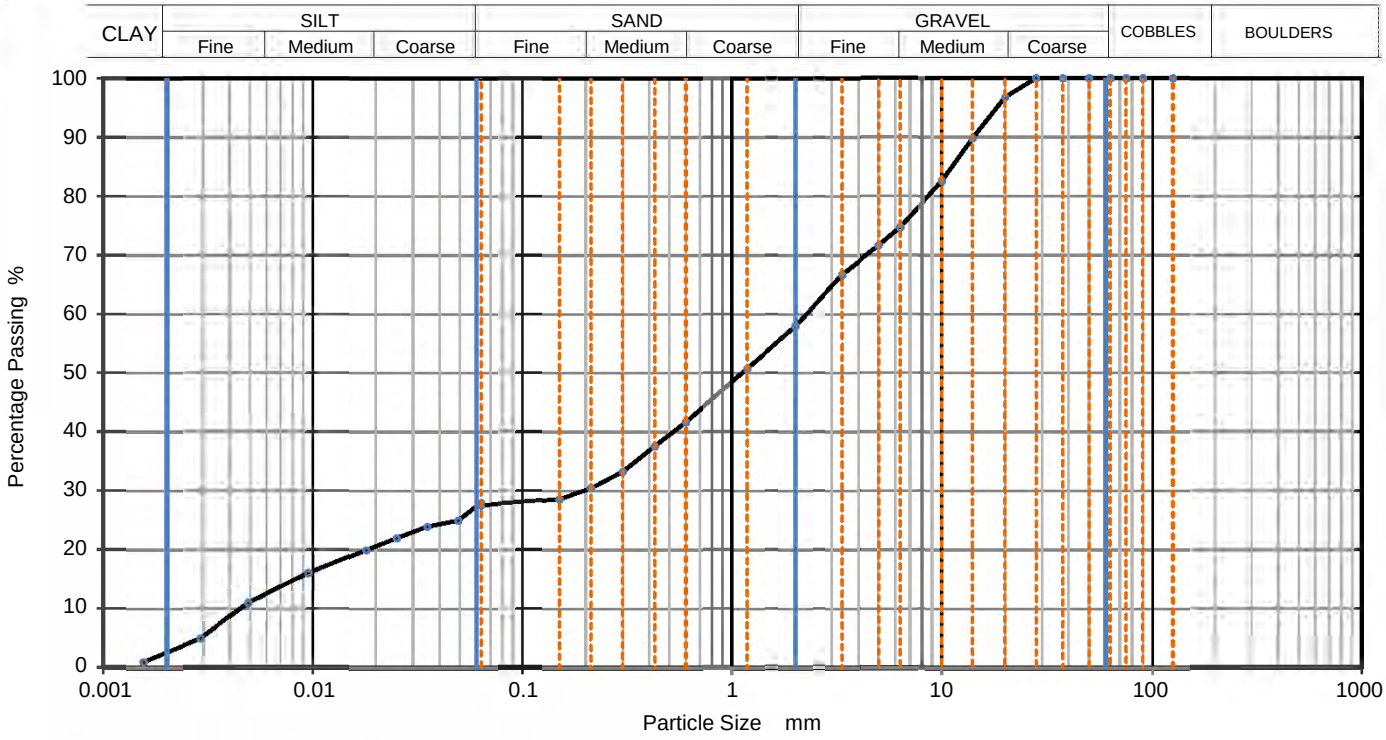
CAUSEWAY GEOTECH	**PARTICLE SIZE DISTRIBUTION**			Job Ref	**18-0838A**
				Borehole/Pit No.	TP02
Site Name	Monaghan Landfills - Killycard			Sample No.	1
Soil Description	MADE GROUND: Brown sandy gravelly SILT with fragments of plastic and glass.			Depth, m	0.50
Specimen Reference	8	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018092988



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	28
90	100	0.0492	25
75	100	0.0350	24
63	100	0.0251	22
50	100	0.0180	20
37.5	100	0.0095	16
28	100	0.0049	11
20	97	0.0029	5
14	90	0.0016	1
10	83		
6.3	75		
5	72		
3.35	67		
2	58		
1.18	51		
0.6	42	Particle density	(assumed)
0.425	38	2.65	Mg/m3
0.3	33		
0.212	31		
0.15	29		
0.063	28		

Dry Mass of sample, g	2328

Sample Proportions	% dry mass
Cobbles	0
Gravel	42
Sand	30
Silt	25
Clay	3

Grading Analysis		
D100	mm	
D60	mm	2.25
D30	mm	0.194
D10	mm	0.00461
Uniformity Coefficient		490
Curvature Coefficient		3.6

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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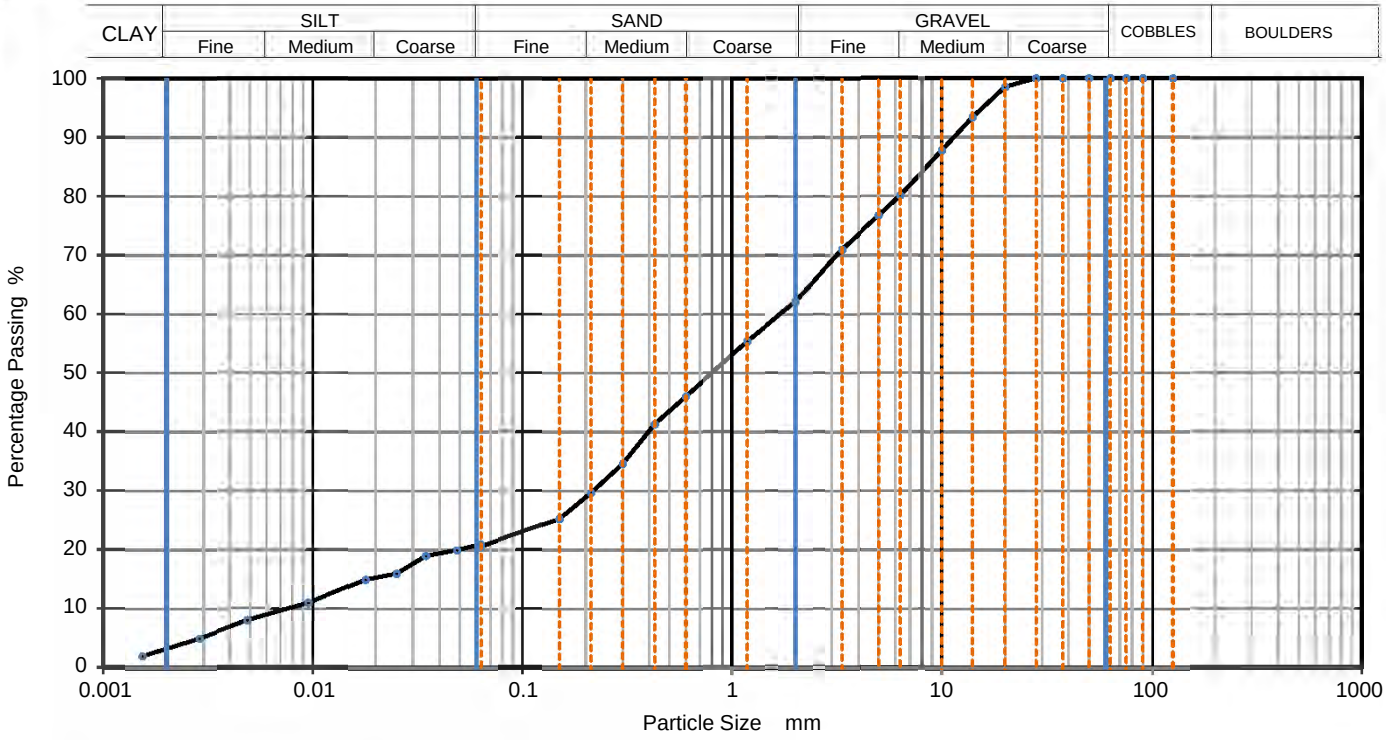
PARTICLE SIZE DISTRIBUTION

				Job Ref	**18-0838A**
				Borehole/Pit No.	TP07
Site Name	Monaghan Landfills - Killycard			Sample No.	1
Soil Description	MADE GROUND: Brown sandy gravelly SILT/CLAY with fragments of red brick and plastic.			Depth, m	0.50
Specimen Reference	8	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018092989



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	21
90	100	0.0485	20
75	100	0.0346	19
63	100	0.0251	16
50	100	0.0179	15
37.5	100	0.0095	11
28	100	0.0049	8
20	99	0.0029	5
14	93	0.0015	2
10	88		
6.3	80		
5	77		
3.35	71		
2	62		
1.18	55		
0.6	46	Particle density	(assumed)
0.425	41	2.65	Mg/m3
0.3	35		
0.212	30		
0.15	25		
0.063	21		

Dry Mass of sample, g: 2213

Sample Proportions	% dry mass
Cobbles	0
Gravel	38
Sand	42
Silt	17
Clay	4

Grading Analysis		
D100	mm	
D60	mm	1.68
D30	mm	0.216
D10	mm	0.00692
Uniformity Coefficient		240
Curvature Coefficient		4

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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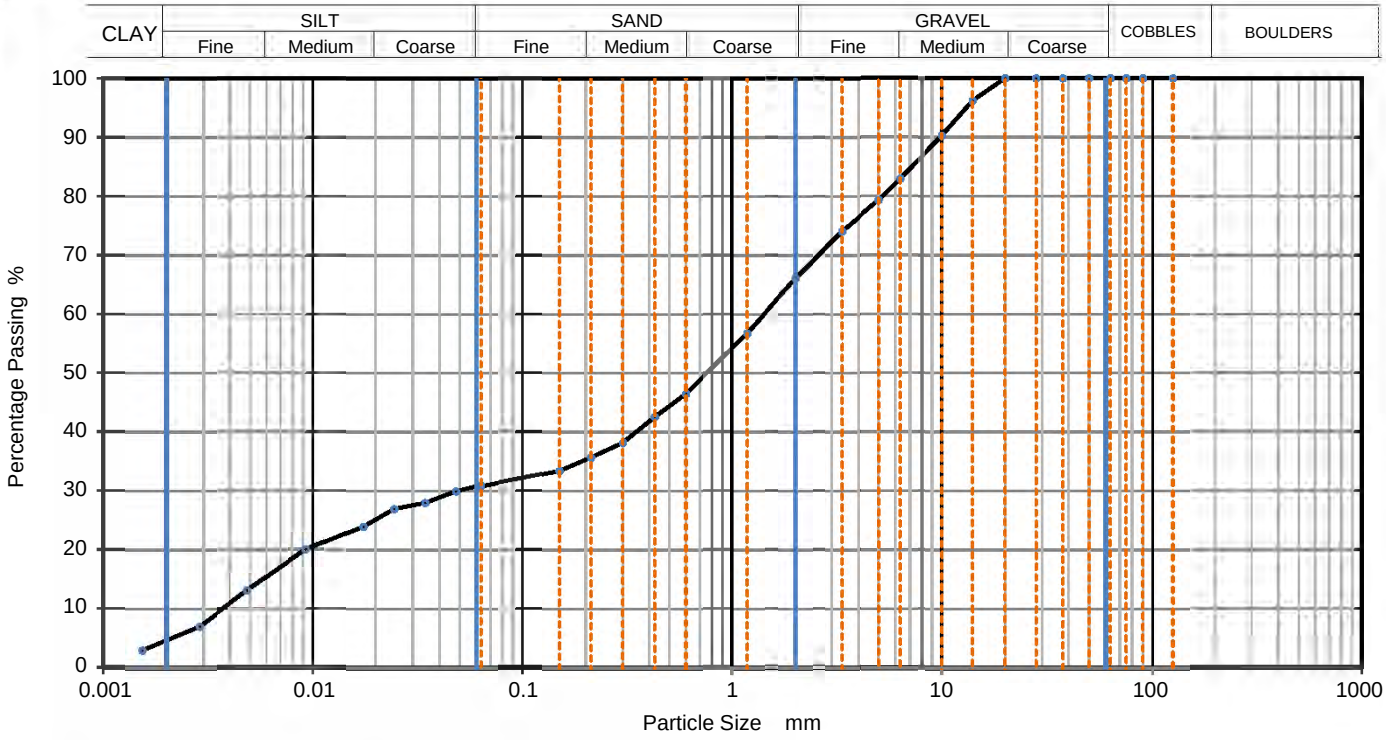
PARTICLE SIZE DISTRIBUTION

CAUSEWAY GEOTECH				Job Ref	18-0838A
				Borehole/Pit No.	TP13
Site Name	Monaghan Landfills - Killycard			Sample No.	1
Soil Description	MADE GROUND: Brown sandy gravelly silty CLAY with fragments of plastic and glass.			Depth, m	0.50
Specimen Reference	8	Specimen Depth	m	Sample Type	B
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2018092990



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	31
90	100	0.0479	30
75	100	0.0343	28
63	100	0.0244	27
50	100	0.0175	24
37.5	100	0.0093	20
28	100	0.0048	13
20	100	0.0029	7
14	96	0.0015	3
10	90		
6.3	83		
5	79		
3.35	74		
2	66		
1.18	57		
0.6	47	Particle density	(assumed)
0.425	43	2.65	Mg/m3
0.3	38		
0.212	36		
0.15	33		
0.063	31		

Dry Mass of sample, g: 3145

Sample Proportions	% dry mass
Cobbles	0
Gravel	34
Sand	35
Silt	26
Clay	5

Grading Analysis		
D100	mm	
D60	mm	1.41
D30	mm	0.0513
D10	mm	0.00369
Uniformity Coefficient		380
Curvature Coefficient		0.5

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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CAUSEWAY GEOTECH

APPENDIX G

ENVIRONMENTAL LABORATORY TEST RESULTS

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

Final Report

Report No.:	18-29299-1
Initial Date of Issue:	05-Oct-2018
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 John Cameron Lucy Newland Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Sean Ross Stephen Franey Stephen Watson Stuart Abraham
Project	18-0838A Monaghan Landfills, Killycard

Quotation No.:		**Date Received:**	24-Sep-2018
Order No.:		**Date Instructed:**	27-Sep-2018
No. of Samples:	2		
Turnaround (Wkdays):	7	**Results Due:**	05-Oct-2018
Date Approved:	05-Oct-2018		

Approved By:

Details: Glynn Harvey, Laboratory Manager

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

Results - 2 Stage WAC

Project: 18-0838A Monaghan Landfills, Killycard

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	18-29299								
Chemtest Sample ID:	694799								
Sample Ref:									
Sample ID:									
Sample Location:	TP08								
Top Depth(m):	0.50								
Bottom Depth(m):									
Sampling Date:	21-Sep-2018								
Determinand	**SOP**	**Accred.**	**Units**				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%			0.92	3	5	6
Loss On Ignition	2610	U	%			3.0	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				7.8	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	0.0041	< 0.050	< 0.050	0.5	2	25
Barium	1450	U	0.0028	0.0063	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	< 0.00010	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	0.0033	0.0031	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0017	0.0045	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	0.0013	0.0022	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	< 0.0010	0.0040	< 0.050	< 0.050	0.4	10	40
Lead	1450	U	< 0.0010	0.0095	< 0.010	0.080	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0028	0.014	< 0.50	< 0.50	4	50	200
Chloride	1220	U	< 1.0	< 1.0	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.11	0.13	< 1.0	1.3	10	150	500
Sulphate	1220	U	8.2	6.2	16	65	1000	20000	50000
Total Dissolved Solids	1020	N	37	28	73	290	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	8.2	6.6	< 50	68	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	14

Leachate Test Information	
Leachant volume 1st extract/l	0.322
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.278

Waste Acceptance Criteria

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

Chemtest
The right chemistry to deliver results

Results - 2 Stage WAC

Project: 18-0838A Monaghan Landfills, Killycard

							Landfill Waste Acceptance Criteria Limits		
Chemtest Job No:	18-29299								
Chemtest Sample ID:	694800								
Sample Ref:									
Sample ID:									
Sample Location:	TP04								
Top Depth(m):	0.50								
Bottom Depth(m):									
Sampling Date:	21-Sep-2018								
Determinand	**SOP**	**Accred.**	**Units**				**Inert Waste Landfill**	**Stable, Non-reactive hazardous waste in non-hazardous Landfill**	**Hazardous Waste Landfill**
Total Organic Carbon	2625	U	%			3.0	3	5	6
Loss On Ignition	2610	U	%			7.4	--	--	10
Total BTEX	2760	U	mg/kg			< 0.010	6	--	--
Total PCBs (7 Congeners)	2815	U	mg/kg			< 0.10	1	--	--
TPH Total WAC (Mineral Oil)	2670	U	mg/kg			< 10	500	--	--
Total (Of 17) PAH's	2700	N	mg/kg			< 2.0	100	--	--
pH	2010	U				7.6	--	>6	--
Acid Neutralisation Capacity	2015	N	mol/kg			< 0.0020	--	To evaluate	To evaluate
Eluate Analysis			**2:1 mg/l**	**8:1 mg/l**	**2:1 mg/kg**	**Cumulative mg/kg 10:1**	**Limit values for compliance leaching test using BS EN 12457 at L/S 10 l/kg**		
Arsenic	1450	U	< 0.0010	0.0065	< 0.050	0.054	0.5	2	25
Barium	1450	U	0.0061	0.0086	< 0.50	< 0.50	20	100	300
Cadmium	1450	U	< 0.00010	0.00011	< 0.010	< 0.010	0.04	1	5
Chromium	1450	U	< 0.0010	< 0.0010	< 0.050	< 0.050	0.5	10	70
Copper	1450	U	0.0034	0.0086	< 0.050	< 0.050	2	50	100
Mercury	1450	U	< 0.00050	< 0.00050	< 0.0010	< 0.0050	0.01	0.2	2
Molybdenum	1450	U	< 0.0010	0.0015	< 0.050	< 0.050	0.5	10	30
Nickel	1450	U	0.0012	0.0059	< 0.050	0.051	0.4	10	40
Lead	1450	U	< 0.0010	0.017	< 0.010	0.14	0.5	10	50
Antimony	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.06	0.7	5
Selenium	1450	U	< 0.0010	< 0.0010	< 0.010	< 0.010	0.1	0.5	7
Zinc	1450	U	0.0026	0.020	< 0.50	< 0.50	4	50	200
Chloride	1220	U	< 1.0	1.1	< 10	< 10	800	15000	25000
Fluoride	1220	U	0.096	0.14	< 1.0	1.3	10	150	500
Sulphate	1220	U	6.0	4.7	12	49	1000	20000	50000
Total Dissolved Solids	1020	N	43	28	84	300	4000	60000	100000
Phenol Index	1920	U	< 0.030	< 0.030	< 0.30	< 0.50	1	-	-
Dissolved Organic Carbon	1610	U	15	12	< 50	130	500	800	1000

Solid Information	
Dry mass of test portion/kg	0.175
Moisture (%)	16

Leachate Test Information	
Leachant volume 1st extract/l	0.316
Leachant volume 2nd extract/l	1.400
Eluant recovered from 1st extract/l	0.300

Waste Acceptance Criteria

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

Report Information

Key

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

Comments or interpretations are beyond the scope of UKAS accreditation
The results relate only to the items tested
Uncertainty of measurement for the determinands tested are available upon request
None of the results in this report have been recovery corrected
All results are expressed on a dry weight basis
The following tests were analysed on samples as received and the results subsequently corrected to a dry weight basis TPH, BTEX, VOCs, SVOCs, PCBs, Phenols
For all other tests the samples were dried at < 37°C prior to analysis
All Asbestos testing is performed at the indicated laboratory
Issue numbers are sequential starting with 1 all subsequent reports are incremented by 1

Sample Deviation Codes

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

Sample Retention and Disposal

All soil samples will be retained for a period of 45 days from the date of receipt
All water samples will be retained for 14 days from the date of receipt
Charges may apply to extended sample storage

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

Appendix III

Groundwater & Surface Water Sampling Analysis Results

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

Fehily Timoney
3rd Floor
North Park Offices
North Park Business Park
North Road
Dublin
Dublin 11

Attention: Daniel Hayden

CERTIFICATE OF ANALYSIS

Date:	22 October 2018
Customer:	D_FTIM_DUB
Sample Delivery Group (SDG):	181003-45
Your Reference:	P1724
Location:	Killycard
Report No:	477957

This report has been revised and directly supersedes 476315 in its entirety.

We received 5 samples on Wednesday October 03, 2018 and 5 of these samples were scheduled for analysis which was completed on Thursday October 11, 2018. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

Approved By:

Sonia McWhan
Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	181003-45	**Client Reference:**	P1724	**Report Number:**	477957
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476315

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
18449562	GW01		0.00 - 0.00	02/10/2018
18449572	GW02		0.00 - 0.00	02/10/2018
18449587	GW03		0.00 - 0.00	02/10/2018
18449607	SW1		0.00 - 0.00	02/10/2018
18449622	SW2		0.00 - 0.00	02/10/2018

Maximum Sample/Coolbox Temperature (°C) : **11.0**

ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG:	181003-45	**Client Reference:**	P1724	**Report Number:**	477957
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476315

Results Legend

X Test

N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

Lab Sample No(s)							18449562						18449572						18449587				18449607
Customer Sample Reference							GW01						GW02						GW03				SW1
AGS Reference																							
Depth (m)							0.00 - 0.00						0.00 - 0.00						0.00 - 0.00				0.00 - 0.00
Container							250ml BOD (ALE212)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)		250ml BOD (ALE212)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)		250ml BOD (ALE212)	500ml Plastic (ALE208)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	
Sample Type							GW	GW	GW	GW	GW		GW	GW	GW	GW	GW		GW	GW	GW	GW	SW
Alkalinity as CaCO3	All	NDPs: 0 Tests: 3						X						X						X			
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 5							X						X						X		X
Anions by Kone (w)	All	NDPs: 0 Tests: 5						X						X						X		X	
BOD True Total	All	NDPs: 0 Tests: 2																			X		
Coliforms (W)	All	NDPs: 2 Tests: 1	N										N										
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 5						X						X						X		X	
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 3					X					X						X					
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 5				X				X						X							X
Dissolved Oxygen by Probe	All	NDPs: 0 Tests: 5		X				X						X						X		X	
Fluoride	All	NDPs: 0 Tests: 3		X				X						X									
Mercury Dissolved	All	NDPs: 0 Tests: 3				X				X						X							
pH Value	All	NDPs: 0 Tests: 5		X				X						X						X		X	
Total Organic and Inorganic Carbon	All	NDPs: 0 Tests: 3			X				X						X								

				18449622
				SW2
				0.00 - 0.00
1000ml glass bottle (ALE220)	250ml BOD (ALE212)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	
SW	SW	SW	SW	
		X		
X				
	X			
X				
			X	
X				
X				

Validated

CERTIFICATE OF ANALYSIS

SDG:	181003-45	**Client Reference:**	P1724	**Report Number:**	477957
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476315

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW01	GW02	GW03	SW1	SW2
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
			Sample Type	Ground Water (GW)	Ground Water (GW)	Ground Water (GW)	Surface Water (SW)	Surface Water (SW)
			Date Sampled	02/10/2018	02/10/2018	02/10/2018	02/10/2018	02/10/2018
			Sample Time	.	.	.	.	.
			Date Received	03/10/2018	03/10/2018	03/10/2018	03/10/2018	03/10/2018
			SDG Ref	181003-45	181003-45	181003-45	181003-45	181003-45
			Lab Sample No.(s)	18449562	18449572	18449587	18449607	18449622
			AGS Reference					
Coliforms, Total*	CFU/100ml	SUB				>2420		
Alkalinity, Total as CaCO3	<2 mg/l	TM043		230 #	265 #	405 #		
BOD, unfiltered	<1 mg/l	TM045					3.23 #	<1 #
Oxygen, dissolved	<0.3 mg/l	TM046		8.55	8.35	8.34	12.2	9.04
Organic Carbon, Total	<3 mg/l	TM090		9.29 #	<3 #	3.15 #		
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099		14.5 #	1.13 #	4.1 #	0.318 #	<0.2 #
Fluoride	<0.5 mg/l	TM104		<0.5 #	<0.5 #	<0.5 #		
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120		0.736 #	0.473 #	0.708 #	0.421 #	0.434 #
Arsenic (diss.filt)	<0.5 µg/l	TM152		14.7 #	3.67 #	2.15 #		
Boron (diss.filt)	<10 µg/l	TM152		23.5 #	13.8 #	16.1 #		
Cadmium (diss.filt)	<0.08 µg/l	TM152		<0.08 #	0.108 #	0.111 #		
Chromium (diss.filt)	<1 µg/l	TM152		<1 #	<1 #	<1 #		
Copper (diss.filt)	<0.3 µg/l	TM152		0.769 #	1.48 #	2.36 #		
Lead (diss.filt)	<0.2 µg/l	TM152		0.524 #	168 #	74.3 #		
Manganese (diss.filt)	<3 µg/l	TM152		1230 #	172 #	267 #		
Nickel (diss.filt)	<0.4 µg/l	TM152		22.8 #	4.52 #	5.79 #		
Phosphorus (diss.filt)	<10 µg/l	TM152		91.6 #	<10 #	79.3 #		
Zinc (diss.filt)	<1 µg/l	TM152		38.7 #	18.7 #	25 #		
Sodium (Dis.Filt)	<0.076 mg/l	TM152		21.5 #	17.1 #	44.3 #	33.4 #	30.4 #
Magnesium (Dis.Filt)	<0.036 mg/l	TM152		15.1 #	21.5 #	21 #		
Potassium (Dis.Filt)	<0.2 mg/l	TM152		8.15 #	2.72 #	3.59 #	5.02 #	5.04 #
Calcium (Dis.Filt)	<0.2 mg/l	TM152		109 #	64.2 #	105 #		
Iron (Dis.Filt)	<0.019 mg/l	TM152		0.772 #	<0.019 #	0.0356 #		
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 #	<0.01 #	<0.01 #		
Chloride	<2 mg/l	TM184		31.7 #	13.8 #	15.1 #	46.9 #	46.6 #
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184		0.119 #	0.119 #	0.111 #		
Sulphate (soluble) as S	<1 mg/l	TM184		49.7 #	<1 #	1.97 #	7.63 #	7.4 #
Cyanide, Total	<0.05 mg/l	TM227		<0.05 #	<0.05 #	<0.05 #		
pH	<1 pH Units	TM256		6.69 #	7.68 #	7.48 #	7.84 #	7.54 #

Validated

CERTIFICATE OF ANALYSIS

SDG:	181003-45	**Client Reference:**	P1724	**Report Number:**	477957
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476315

Notification of NDPs (No determination possible)

Date Received : 03/10/2018 10:13:24

Sample No	Customer Sample Ref.	Depth (m)	Test	Comment
18449562	GW01	0.00 - 0.00	Coliforms (W)	See Comments for cancellation details
18449572	GW02	0.00 - 0.00	Coliforms (W)	See Comments for cancellation details

CERTIFICATE OF ANALYSIS

SDG:	181003-45	**Client Reference:**	P1724	**Report Number:**	477957
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476315

Table of Results - Appendix

Method No	Reference	Description
SUB		Subcontracted Test
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM045	MEWAM BOD5 2nd Ed.HMSO 1988 / Method 5210B, AWWA/APHA, 20th Ed., 1999; SCA Blue Book 130	Determination of BOD5 (ATU) Filtered by Oxygen Meter on liquids
TM046	Method 4500G, AWWA/APHA, 20th Ed., 1999	Measurement of Dissolved Oxygen by Oxygen Meter
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM227	Standard methods for the examination of waters and wastewaters 20th Edition, AWWA/APHA Method 4500.	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

CERTIFICATE OF ANALYSIS

SDG:	181003-45	**Client Reference:**	P1724	**Report Number:**	477957
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476315

Test Completion Dates

Lab Sample No(s)	18449562	18449572	18449587	18449607	18449622
Customer Sample Ref.	GW01	GW02	GW03	SW1	SW2
AGS Ref.					
Depth	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Type	Ground Water	Ground Water	Ground Water	Surface Water	Surface Water
Alkalinity as CaCO3	10-Oct-2018	10-Oct-2018	10-Oct-2018		
Ammoniacal Nitrogen	11-Oct-2018	11-Oct-2018	11-Oct-2018	11-Oct-2018	11-Oct-2018
Anions by Kone (w)	10-Oct-2018	10-Oct-2018	10-Oct-2018	11-Oct-2018	11-Oct-2018
BOD True Total				09-Oct-2018	08-Oct-2018
Coliforms (W)			08-Oct-2018		
Conductivity (at 20 deg.C)	10-Oct-2018	10-Oct-2018	10-Oct-2018	10-Oct-2018	10-Oct-2018
Cyanide Comp/Free/Total/Thiocyanate	08-Oct-2018	08-Oct-2018	08-Oct-2018		
Dissolved Metals by ICP-MS	10-Oct-2018	10-Oct-2018	10-Oct-2018	10-Oct-2018	10-Oct-2018
Dissolved Oxygen by Probe	04-Oct-2018	05-Oct-2018	04-Oct-2018	04-Oct-2018	05-Oct-2018
Fluoride	10-Oct-2018	10-Oct-2018	10-Oct-2018		
Mercury Dissolved	08-Oct-2018	08-Oct-2018	08-Oct-2018		
pH Value	10-Oct-2018	10-Oct-2018	10-Oct-2018	10-Oct-2018	10-Oct-2018
Total Organic and Inorganic Carbon	05-Oct-2018	05-Oct-2018	05-Oct-2018		

City Analysts Limited
Environmental Laboratories

City Analysts Limited,
Pigeon House Road,
Ringsend,
Dublin 4.

Tel: (01) 613 6003
Fax: (01) 613 6008

Email:
reports@cityanalysts.ie

www.cityanalysts.ie

Customer

Customer Services

ALS Environmental Ltd
Hawarden Business Park
Manor Land
Hawarden, Deeside
UK
CH5 3US

Certificate Of Analysis

Job Number: 18-47692
Issue Number: 1
Report Date: 5 October 2018

Site: Not Applicable
PO Number: 181003-45
Date Samples Received: 03/10/2018

Please find attached the results for the samples received at our laboratory on 03/10/2018.

Should you have any queries regarding the report or require any further services, we would be happy to discuss your requirements. For additional information about the company please log-on to our website at the above address.

Thank you for choosing City Analysts Limited. We look forward to assisting you again.

Authorised By: S. Reynolds

Shane Reynolds
Laboratory Manager

Authorised Date: 5 October 2018

Notes:

Results relate only to the items tested.
Information on methods of analysis and performance characteristics is available on request.
Any opinions or interpretations indicated are outside the scope of our INAB accreditation.

City Analysts Limited
Environmental Laboratories

City Analysts Limited,
Pigeon House Road,
Ringsend,
Dublin 4.

Tel: (01) 613 6003
Fax: (01) 613 6008

Email:
reports@cityanalysts.ie

www.cityanalysts.ie

Certificate Of Analysis

Customer

Customer Services

ALS Environmental Ltd
Hawarden Business Park
Manor Land
Hawarden, Deeside
UK
CH5 3US

Report Reference: 18-47692

Report Version: 1

Site: Not Applicable

Sample Description: GW03 Killycard

Sample Type: Ground

Lab Reference Number: 413443

Date of Sampling: 03/10/2018

Date Sample Received: 03/10/2018

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1201#	03/10/2018	Coliforms	> 2419.6	MPN/100ml	-

= INAB Accredited, U = UKAS Accredited, * = Subcontracted

Note:
PV Value is the parametric value, taken from European Communities, (Drinking Water) Regulations, 2014. S.I. No. 122 of 2014 and relates only to drinking water samples.
For queries on results, please contact us within two weeks of the report date to ensure that we can accommodate your query as samples cannot be stored indefinitely.
NAC & ATC - No abnormal change and acceptable to customers.
TVC - Total viable count
Site D = Analysed at City Analysts Dublin. Site S = Analysed at City Analysts Shannon

Appendix

General

1. Results are expressed on a dry weight basis (dried at 35ºC) for all soil analyses except for the following: NRA and CEN Leach tests, flash point LOI, pH, ammonium as NH4 by the BRE method, VOC TICs and SVOC TICs.

2. Samples will be run in duplicate upon request, but an additional charge may be incurred.

3. If sufficient sample is received a sub sample will be retained free of charge for 30 days after analysis is completed (e-mailed) for all sample types unless the sample is destroyed on testing. The prepared soil sub sample that is analysed for asbestos will be retained for a period of 6 months after the analysis date. All bulk samples will be retained for a period of 6 months after the analysis date. All samples received and not scheduled will be disposed of one month after the date of receipt unless we are instructed to the contrary. Once the initial period has expired, a storage charge will be applied for each month or part thereof until the client cancels the request for sample storage. ALS reserve the right to charge for samples received and stored but not analysed.

4. With respect to turnaround, we will always endeavour to meet client requirements wherever possible, but turnaround times cannot be absolutely guaranteed due to so many variables beyond our control.

5. We take responsibility for any test performed by sub-contractors (marked with an asterisk). We endeavour to use UKAS/MCERTS Accredited Laboratories, who either complete a quality questionnaire or are audited by ourselves. For some determinands there are no UKAS/MCERTS Accredited Laboratories, in this instance a laboratory with a known track record will be utilised.

6. When requested, the individual sub sample scheduled will be analysed in house for the presence of asbestos fibres and asbestos containing material by our documented in house method TM048 based on HSG 248 (2005), which is accredited to ISO17025. If a specific asbestos fibre type is not found this will be reported as “Not detected”. If no asbestos fibre types are found all will be reported as “Not detected” and the sub sample analysed deemed to be clear of asbestos. If an asbestos fibre type is found it will be reported as detected (for each fibre type found). Testing can be carried out on asbestos positive samples, but, due to Health and Safety considerations, may be replaced by alternative tests or reported as No Determination Possible (NDP). The quantity of asbestos present is not determined unless specifically requested.

7. If no separate volatile sample is supplied by the client, or if a headspace or sediment is present in the volatile sample, the integrity of the data may be compromised. This will be flagged up as an invalid VOC on the test schedule and the result marked as deviating on the test certificate.

8. If appropriate preserved bottles are not received preservation will take place on receipt. However, the integrity of the data may be compromised.

9. NDP - No determination possible due to insufficient/unsuitable sample.

10. Metals in water are performed on a filtered sample, and therefore represent dissolved metals - total metals must be requested separately.

11. Results relate only to the items tested.

12. LoDs (Limit of Detection) for wet tests reported on a dry weight basis are not corrected for moisture content.

13. **Surrogate recoveries** - Surrogates are added to your sample to monitor recovery of the test requested. A % recovery is reported, results are not corrected for the recovery measured. Typical recoveries for organics tests are 70-130%. Recoveries in soils are affected by organic rich or clay rich matrices. Waters can be affected by remediation fluids or high amounts of sediment. Test results are only ever reported if all of the associated quality checks pass; it is assumed that all recoveries outside of the values above are due to matrix affect.

14. **Product analyses** - Organic analyses on products can only be semi-quantitative due to the matrix effects and high dilution factors employed.

15. Phenols monohydric by HPLC include phenol, cresols (2-Methylphenol, 3-Methylphenol and 4-Methylphenol) and Xylenols (2,3 Dimethylphenol, 2,4 Dimethylphenol, 2,5 Dimethylphenol, 2,6 Dimethylphenol, 3,4 Dimethyphenol, 3,5 Dimethylphenol).

16. Total of 5 speciated phenols by HPLC includes Phenol, 2,3,5-Trimethyl Phenol, 2-Isopropylphenol, Cresols and Xylenols (as detailed in 15).

17. Stones/debris are not routinely removed. We always endeavour to take a representative sub sample from the received sample.

18. In certain circumstances the method detection limit may be elevated due to the sample being outside the calibration range. Other factors that may contribute to this include possible interferences. In both cases the sample would be diluted which would cause the method detection limit to be raised.

19. Mercury results quoted on soils will not include volatile mercury as the analysis is performed on a dried and crushed sample.

20. For leachate preparations other than Zero Headspace Extraction (ZHE) volatile loss may occur.

21. For the BSEN 12457-3 two batch process to allow the cumulative release to be calculated, the volume of the leachate produced is measured and filtered for all tests. We therefore cannot carry out any unfiltered analysis. The tests affected include volatiles GCFID/GCMS and all subcontracted analysis.

22. We are accredited to MCERTS for sand, clay and loam/topsoil, or any of these materials - whether these are derived from naturally occurring soil profiles, or from fill/made ground, as long as these materials constitute the major part of the sample. Other coarse granular material such as concrete, gravel and brick are not accredited if they comprise the major part of the sample.

23. Analysis and identification of specific compounds using GCFID is by retention time only, and we routinely calibrate and quantify for benzene, toluene, ethylbenzenes and xylenes (BTEX). For total volatiles in the C5-C12 range, the total area of the chromatogram is integrated and expressed as ug/kg or ug/l. Although this analysis is commonly used for the quantification of gasoline range organics (GRO), the system will also detect other compounds such as chlorinated solvents, and this may lead to a falsely high result with respect to hydrocarbons only. It is not possible to specifically identify these non-hydrocarbons, as standards are not routinely run for any other compounds, and for more definitive identification, volatiles by GCMS should be utilised.

24. **Tentatively Identified Compounds (TICs)** are non-target peaks in VOC and SVOC analysis. All non-target peaks detected with a concentration above the LoD are subjected to a mass spectral library search. Non-target peaks with a library search confidence of >75% are reported based on the best mass spectral library match. When a non-target peak with a library search confidence of <75% is detected it is reported as “mixed hydrocarbons”. Non-target compounds identified from the scan data are semi-quantified relative to one of the deuterated internal standards, under the same chromatographic conditions as the target compounds. This result is reported as a semi-quantitative value and reported as Tentatively Identified Compounds (TICs). TICs are outside the scope of UKAS accreditation and are not moisture corrected.

Sample Deviations

If a sample is classed as deviated then the associated results may be compromised.

1	**Container with Headspace provided for volatiles analysis**
2	**Incorrect container received**
3	**Deviation from method**
4	**Holding time exceeded before sample received**
5	**Samples exceeded holding time before presevation was performed**
§	**Sampled on date not provided**
♦	**Sample holding time exceeded in laboratory**
@	**Sample holding time exceeded due to sampled on date**
&	**Sample Holding Time exceeded - Late arrival of instructions.**

Asbestos

Identification of Asbestos in Bulk Materials & Soils

The results for identification of asbestos in bulk materials are obtained from supplied bulk materials which have been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

The results for identification of asbestos in soils are obtained from a homogenised sub sample which has been examined to determine the presence of asbestos fibres using ALS (Hawarden) in-house method of transmitted/polarised light microscopy and central stop dispersion staining, based on HSG 248 (2005).

Asbestos Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Crocidolite	Blue Asbestos
Fibrous Actinolite	-
Fibrous Anthophyllite	-
Fibrous Tremolite	-

Visual Estimation Of Fibre Content

Estimation of fibre content is not permitted as part of our UKAS accredited test other than: - Trace - Where only one or two asbestos fibres were identified.

Further guidance on typical asbestos fibre content of manufactured products can be found in HSG 264.

The identification of asbestos containing materials and soils falls within our schedule of tests for which we hold UKAS accreditation, however opinions, interpretations and all other information contained in the report are outside the scope of UKAS accreditation.

Unit 7-8 Hawarden Business Park
Manor Road (off Manor Lane)
Hawarden
Deeside
CH5 3US
Tel: (01244) 528700
Fax: (01244) 528701
email: hawardencustomerservices@alsglobal.com
Website: www.alsenvironmental.co.uk

Fehily Timoney
3rd Floor
North Park Offices
North Park Business Park
North Road
Dublin
Dublin 11

Attention: Daniel Hayden

CERTIFICATE OF ANALYSIS

Date:	16 October 2018
Customer:	D_FTIM_DUB
Sample Delivery Group (SDG):	181010-49
Your Reference:	P1724
Location:	Killycard
Report No:	477084

This report has been revised and directly supersedes 476448 in its entirety.

We received 4 samples on Wednesday October 10, 2018 and 4 of these samples were scheduled for analysis which was completed on Tuesday October 16, 2018. Accredited laboratory tests are defined within the report, but opinions, interpretations and on-site data expressed herein are outside the scope of ISO 17025 accreditation.

Should this report require incorporation into client reports, it must be used in its entirety and not simply with the data sections alone.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

Approved By:

Sonia McWhan
Operations Manager

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
18494289	GW01		0.00 - 0.00	09/10/2018
18494298	GW03		0.00 - 0.00	09/10/2018
18494307	SW1		0.00 - 0.00	09/10/2018
18494313	SW2		0.00 - 0.00	09/10/2018

Maximum Sample/Coolbox Temperature (°C) : **13.0**

ISO5667-3 Water quality - Sampling - Part3 -

During Transportation samples shall be stored in a cooling device capable of maintaining a temperature of (5±3)°C.

ALS have data which show that a cool box with 4 frozen icepacks is capable of maintaining pre-chilled samples at a temperature of (5±3)°C for a period of up to 24hrs.

Only received samples which have had analysis scheduled will be shown on the following pages.

Validated

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

Results Legend

X Test

N No Determination Possible

Sample Types -

S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

			Lab Sample No(s)	Customer Sample Reference	AGS Reference	Depth (m)	Container	Sample Type
			18494289	GW01		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
							250ml BOD (ALE212)	GW
							H2SO4 (ALE244)	GW
							HNO3 Filtered (ALE204)	GW
							NaOH (ALE245)	GW
							Vial (ALE297)	GW
			18494298	GW03		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
							250ml BOD (ALE212)	GW
							H2SO4 (ALE244)	GW
							HNO3 Filtered (ALE204)	GW
							NaOH (ALE245)	GW
			18494307	SW1		0.00 - 0.00	1plastic (ALE221)	SW
							250ml BOD (ALE212)	SW
							H2SO4 (ALE244)	SW
							HNO3 Filtered (ALE204)	SW
			18494313	SW2		0.00 - 0.00	1plastic (ALE221)	SW
							250ml BOD (ALE212)	SW
							H2SO4 (ALE244)	SW
							HNO3 Filtered (ALE204)	SW
Alkalinity as CaCO3	All	NDPs: 0 Tests: 2	X				X	
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 4			X			X				X			X	
Anions by Kone (w)	All	NDPs: 0 Tests: 4	X				X				X			X		
BOD True Total	All	NDPs: 0 Tests: 4		X				X				X			X	
COD Unfiltered	All	NDPs: 0 Tests: 4		X				X				X			X	
Coliforms (W)	All	NDPs: 0 Tests: 2		X				X								
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 4	X				X				X			X		
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 2				X							X			
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 4				X				X				X		X
Dissolved Oxygen by Probe	All	NDPs: 0 Tests: 4	X				X				X			X		
Fluoride	All	NDPs: 0 Tests: 2	X				X									
Mercury Dissolved	All	NDPs: 0 Tests: 2				X				X						
Mineral Oil C10-40 Aqueous (W)	All	NDPs: 0 Tests: 2	X				X									
Nitrite by Kone (w)	All	NDPs: 0 Tests: 2				X						X				
Organotins in Aqueous Samples	All	NDPs: 0 Tests: 2	X				X									

Validated

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

Results Legend

X Test

N No Determination Possible

Sample Types -
S - Soil/Solid
UNS - Unspecified Solid
GW - Ground Water
SW - Surface Water
LE - Land Leachate
PL - Prepared Leachate
PR - Process Water
SA - Saline Water
TE - Trade Effluent
TS - Treated Sewage
US - Untreated Sewage
RE - Recreational Water
DW - Drinking Water Non-regulatory
UNL - Unspecified Liquid
SL - Sludge
G - Gas
OTH - Other

			Lab Sample No(s)	Customer Sample Reference	AGS Reference	Depth (m)	Container	Sample Type
Pesticides (Suite I) by GCMS	All	NDPs: 0 Tests: 2	18494289	GW01		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494298	GW03		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494307	SW1		0.00 - 0.00	1lplastic (ALE221)	SW
			18494313	SW2		0.00 - 0.00	1lplastic (ALE221)	SW
Pesticides (Suite II) by GCMS	All	NDPs: 0 Tests: 2	18494289	GW01		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494298	GW03		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494307	SW1		0.00 - 0.00	1lplastic (ALE221)	SW
			18494313	SW2		0.00 - 0.00	1lplastic (ALE221)	SW
Pesticides (Suite III) by GCMS	All	NDPs: 0 Tests: 2	18494289	GW01		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494298	GW03		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494307	SW1		0.00 - 0.00	1lplastic (ALE221)	SW
			18494313	SW2		0.00 - 0.00	1lplastic (ALE221)	SW
pH Value	All	NDPs: 0 Tests: 4	18494289	GW01		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494298	GW03		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494307	SW1		0.00 - 0.00	1lplastic (ALE221)	SW
			18494313	SW2		0.00 - 0.00	1lplastic (ALE221)	SW
Phosphate by Kone (w)	All	NDPs: 0 Tests: 2	18494289	GW01		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494298	GW03		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494307	SW1		0.00 - 0.00	1lplastic (ALE221)	SW
			18494313	SW2		0.00 - 0.00	1lplastic (ALE221)	SW
Silicon Dissolved by ICP-OES	All	NDPs: 0 Tests: 2	18494289	GW01		0.00 - 0.00	HNO3 Filtered (ALE204)	GW
			18494298	GW03		0.00 - 0.00	HNO3 Filtered (ALE204)	GW
			18494307	SW1		0.00 - 0.00	HNO3 Filtered (ALE204)	SW
			18494313	SW2		0.00 - 0.00	HNO3 Filtered (ALE204)	SW
SVOC MS (W) - Aqueous	All	NDPs: 0 Tests: 2	18494289	GW01		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
			18494298	GW03		0.00 - 0.00	0.5l glass bottle (ALE227)	GW
Total Organic and Inorganic Carbon	All	NDPs: 0 Tests: 2	18494289	GW01		0.00 - 0.00	H2SO4 (ALE244)	GW
			18494298	GW03		0.00 - 0.00	H2SO4 (ALE244)	GW
VOC MS (W)	All	NDPs: 0 Tests: 2	18494289	GW01		0.00 - 0.00	Vial (ALE297)	GW
			18494298	GW03		0.00 - 0.00	0.5l glass bottle (ALE227)	GW

Validated

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Customer Sample Ref.	GW01	GW03	SW1	SW2
Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Sample Type	Ground Water (GW)	Ground Water (GW)	Surface Water (SW)	Surface Water (SW)
Date Sampled	09/10/2018	09/10/2018	09/10/2018	09/10/2018
Sample Time	.	.	.	.
Date Received	10/10/2018	10/10/2018	10/10/2018	10/10/2018
SDG Ref	181010-49	181010-49	181010-49	181010-49
Lab Sample No.(s)	18494289	18494298	18494307	18494313
AGS Reference				

Component	LOD/Units	Method						
Coliforms, Total*	CFU/100ml	SUB	1990	1120				
Alkalinity, Total as CaCO3	<2 mg/l	TM043	377 #	357 #				
BOD, unfiltered	<1 mg/l	TM045	2.7 #	<1 #	3.73 #	<1 #		
Oxygen, dissolved	<0.3 mg/l	TM046	7.76	8.6	9.9	10.2		
Organic Carbon, Total	<3 mg/l	TM090	12.3 #	<3 #				
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	19.2 #	1.17 #	<0.2 #	<0.2 #		
Fluoride	<0.5 mg/l	TM104	<0.5 #	<0.5 #				
COD, unfiltered	<7 mg/l	TM107	48.7 #	9.93 #	35.5 #	20.8 #		
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120	0.702 #	0.657 #	0.405 #	0.427 #		
Antimony (diss.filt)	<1 µg/l	TM152	6.43	17.8				
Arsenic (diss.filt)	<0.5 µg/l	TM152	8.73 #	1.22 #				
Barium (diss.filt)	<0.2 µg/l	TM152	294 #	119 #				
Beryllium (diss.filt)	<0.1 µg/l	TM152	<0.1 #	<0.1 #				
Boron (diss.filt)	<10 µg/l	TM152	106 #	15.4 #				
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08 #	<0.08 #				
Chromium (diss.filt)	<1 µg/l	TM152	<1 #	<1 #				
Cobalt (diss.filt)	<0.5 µg/l	TM152	2.93 #	0.565 #				
Copper (diss.filt)	<0.3 µg/l	TM152	<0.3 #	1.34 #				
Lead (diss.filt)	<0.2 µg/l	TM152	0.208 #	58.6 #				
Manganese (diss.filt)	<3 µg/l	TM152	1920 #	360 #				
Molybdenum (diss.filt)	<3 µg/l	TM152	17.5 #	9.08 #				
Nickel (diss.filt)	<0.4 µg/l	TM152	7.65 #	1.9 #				
Phosphorus (diss.filt)	<10 µg/l	TM152	24.8 #	<10 #				
Selenium (diss.filt)	<1 µg/l	TM152	18.2 #	26.7 #				
Tellurium (diss.filt)	<2 µg/l	TM152	<2	<2				
Thallium (diss.filt)	<2 µg/l	TM152	<2 #	<2 #				
Titanium (diss.filt)	<1 µg/l	TM152	13.1 #	7.86 #				
Uranium (diss.filt)	<0.5 µg/l	TM152	1.73 #	5.32 #				
Vanadium (diss.filt)	<1 µg/l	TM152	<1 #	<1 #				
Zinc (diss.filt)	<1 µg/l	TM152	10.6 #	4.8 #				
Tin (Diss.Filt)	<1 µg/l	TM152	<1 #	<1 #				
Silver (diss.filt)	<0.5 µg/l	TM152	<0.5 #	<0.5 #				
Sodium (Dis.Filt)	<0.076 mg/l	TM152	59.4 #	64.8 #	29.1 #	29.5 #		

17:28:39 16/10/2018

Validated

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW01	GW03	SW1	SW2		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Ground Water (GW)	Ground Water (GW)	Surface Water (SW)	Surface Water (SW)		
			Date Sampled	09/10/2018	09/10/2018	09/10/2018	09/10/2018		
			Sample Time	-	-	-	-		
			Date Received	10/10/2018	10/10/2018	10/10/2018	10/10/2018		
			SDG Ref	181010-49	181010-49	181010-49	181010-49		
			Lab Sample No.(s)	18494289	18494298	18494307	18494313		
			AGS Reference						
Magnesium (Dis.Filt)	<0.036 mg/l	TM152		20.2 #	19.8 #				
Potassium (Dis.Filt)	<0.2 mg/l	TM152		15.6 #	2.99 #	4.67 #	5.07 #		
Calcium (Dis.Filt)	<0.2 mg/l	TM152		115 #	73.8 #				
Iron (Dis.Filt)	<0.019 mg/l	TM152		6.22 #	0.0936 #				
Mineral oil >C10 C40 (aq)	<100 µg/l	TM172		<100	<100				
Mercury (diss.filt)	<0.01 µg/l	TM183		<0.01 #	<0.01 #				
Phosphate (Ortho as PO4)	<0.05 mg/l	TM184		<0.05 #	<0.05 #				
Chloride	<2 mg/l	TM184		42.3 #	15.5 #	46.3 #	46.6 #		
Nitrite as N	<0.0152 mg/l	TM184		<0.0152 #	<0.0152 #				
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184		0.102 #	<0.1 #				
Sulphate (soluble) as S	<1 mg/l	TM184		5.5 #	15.3 #	7.57 #	7.4 #		
Cyanide, Total	<0.05 mg/l	TM227		<0.05 #	<0.05 #				
Cyanide, Free	<0.05 mg/l	TM227		<0.05 #	<0.05 #				
pH	<1 pH Units	TM256		7.66 #	7.59 #	7.6 #	7.43 #		
Silicon (diss.filt)	<0.05 mg/l	TM284		8.26	5.37				
Dibutyl tin	<5 ng/l	TM328		<5	<5				
Tributyl tin	<1 ng/l	TM328		<1	<1				
Tetrabutyl tin	<2 ng/l	TM328		<2	<2				
Triphenyl tin	<1 ng/l	TM328		<1	<1				
Surrogate	%	TM328		61.3	61.3				
Trifluralin	<0.01 µg/l	TM343		<0.01	<0.01				
alpha-HCH	<0.01 µg/l	TM343		<0.01	<0.01				
gamma-HCH (Lindane)	<0.01 µg/l	TM343		<0.01	<0.01				
Heptachlor	<0.01 µg/l	TM343		<0.01	<0.01				
Aldrin	<0.01 µg/l	TM343		<0.01	<0.01				
beta-HCH	<0.01 µg/l	TM343		<0.01	<0.01				
Isodrin	<0.01 µg/l	TM343		<0.01	<0.01				
Heptachlor epoxide	<0.01 µg/l	TM343		<0.01	<0.01				
o,p'-DDE	<0.01 µg/l	TM343		<0.01	<0.01				
Endosulphan I	<0.01 µg/l	TM343		<0.01	<0.01				
trans-Chlordane	<0.01 µg/l	TM343		<0.01	<0.01				
cis-Chlordane	<0.01 µg/l	TM343		<0.01	<0.01				

Validated

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW01	GW03	SW1	SW2		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Ground Water (GW)	Ground Water (GW)	Surface Water (SW)	Surface Water (SW)		
			Date Sampled	09/10/2018	09/10/2018	09/10/2018	09/10/2018		
			Sample Time	-	-	-	-		
			Date Received	10/10/2018	10/10/2018	10/10/2018	10/10/2018		
			SDG Ref	181010-49	181010-49	181010-49	181010-49		
			Lab Sample No.(s)	18494289	18494298	18494307	18494313		
			AGS Reference						
p,p'-DDE	<0.01 µg/l	TM343		<0.01	<0.01				
Dieldrin	<0.01 µg/l	TM343		<0.01	<0.01				
o,p'-DDD (TDE)	<0.01 µg/l	TM343		<0.01	<0.01				
Endrin	<0.01 µg/l	TM343		<0.01	<0.01				
o,p'-DDT	<0.01 µg/l	TM343		<0.01	<0.01				
p,p'-DDD (TDE)	<0.01 µg/l	TM343		<0.01	<0.01				
Endosulphan II	<0.02 µg/l	TM343		<0.02	<0.02				
p,p'-DDT	<0.01 µg/l	TM343		<0.01	<0.01				
p,p'-Methoxychlor	<0.01 µg/l	TM343		<0.01	<0.01				
Endosulphan Sulphate	<0.02 µg/l	TM343		<0.02	<0.02				
Permethrin I	<0.01 µg/l	TM343		<0.01	<0.01				
Permethrin II	<0.01 µg/l	TM343		<0.01	<0.01				
Dichlorvos	<0.01 µg/l	TM344		<0.01	<0.01				
Mevinphos	<0.01 µg/l	TM344		<0.01	<0.01				
Tecnazene	<0.01 µg/l	TM344		<0.01	<0.01				
Hexachlorobenzene	<0.01 µg/l	TM344		<0.01	<0.01				
Diazinon	<0.01 µg/l	TM344		<0.01	<0.01				
Triallate	<0.01 µg/l	TM344		<0.01	<0.01				
Atrazine	<0.01 µg/l	TM344		<0.01	<0.01				
Simazine	<0.01 µg/l	TM344		<0.01	<0.01				
Disulfoton	<0.01 µg/l	TM344		<0.01	<0.01				
Propetamphos	<0.01 µg/l	TM344		<0.01	<0.01				
Chlorpyriphos-methyl	<0.01 µg/l	TM344		<0.01	<0.01				
Dimethoate	<0.01 µg/l	TM344		<0.01	<0.01				
Pirimiphos-methyl	<0.01 µg/l	TM344		<0.01	<0.01				
Chlorpyriphos	<0.01 µg/l	TM344		<0.01	<0.01				
Methyl Parathion	<0.01 µg/l	TM344		<0.01	<0.01				
Malathion	<0.01 µg/l	TM344		<0.01	<0.01				
Fenthion	<0.01 µg/l	TM344		<0.01	<0.01				
Fenitrothion	<0.01 µg/l	TM344		<0.01	<0.01				
Triadimefon	<0.01 µg/l	TM344		<0.01	<0.01				
Pendimethalin	<0.01 µg/l	TM344		<0.01	<0.01				

Validated

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW01	GW03	SW1	SW2		
			Depth (m)	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00		
			Sample Type	Ground Water (GW)	Ground Water (GW)	Surface Water (SW)	Surface Water (SW)		
			Date Sampled	09/10/2018	09/10/2018	09/10/2018	09/10/2018		
			Sample Time	-	-	-	-		
			Date Received	10/10/2018	10/10/2018	10/10/2018	10/10/2018		
			SDG Ref	181010-49	181010-49	181010-49	181010-49		
			Lab Sample No.(s)	18494289	18494298	18494307	18494313		
			AGS Reference						
Parathion	<0.01 µg/l	TM344		<0.01	<0.01				
Chlorfenvinphos	<0.01 µg/l	TM344		<0.01	<0.01				
Ethion	<0.01 µg/l	TM344		<0.01	<0.01				
Carbophenothion	<0.01 µg/l	TM344		<0.01	<0.01				
Triazophos	<0.01 µg/l	TM344		<0.01	<0.01				
Phosalone	<0.01 µg/l	TM344		<0.01	<0.01				
Azinphos methyl	<0.02 µg/l	TM344		<0.02	<0.02				
Azinphos ethyl	<0.02 µg/l	TM344		<0.02	<0.02				
Quintozene (PCNB)	<0.01 µg/l	TM345		<0.01	<0.01				
Telodrin	<0.01 µg/l	TM345		<0.01	<0.01				
Chlorothalonil	<0.01 µg/l	TM345		<0.01	<0.01				
Etrimphos	<0.01 µg/l	TM345		<0.01	<0.01				

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

SVOC MS (W) - Aqueous

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW01	GW03
			Depth (m)	0.00 - 0.00	0.00 - 0.00
			Sample Type	Ground Water (GW)	Ground Water (GW)
			Date Sampled	09/10/2018	09/10/2018
			Sample Time	.	.
			Date Received	10/10/2018	10/10/2018
			SDG Ref	181010-49	181010-49
			Lab Sample No.(s)	18494289	18494298
			AGS Reference		
1,2,4-Trichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #
1,2-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #
1,3-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #
1,4-Dichlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #
2,4,5-Trichlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #
2,4,6-Trichlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #
2,4-Dichlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #
2,4-Dimethylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #
2,4-Dinitrotoluene (aq)	<1 µg/l	TM176		<1 #	<1 #
2,6-Dinitrotoluene (aq)	<1 µg/l	TM176		<1 #	<1 #
2-Chloronaphthalene (aq)	<1 µg/l	TM176		<1 #	<1 #
2-Chlorophenol (aq)	<1 µg/l	TM176		<1 #	<1 #
2-Methylnaphthalene (aq)	<1 µg/l	TM176		<1 #	<1 #
2-Methylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #
2-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #
2-Nitrophenol (aq)	<1 µg/l	TM176		<1 #	<1 #
3-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #
4-Bromophenylphenylether (aq)	<1 µg/l	TM176		<1 #	<1 #
4-Chloro-3-methylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #
4-Chloroaniline (aq)	<1 µg/l	TM176		<1	<1
4-Chlorophenylphenylether (aq)	<1 µg/l	TM176		<1 #	<1 #
4-Methylphenol (aq)	<1 µg/l	TM176		<1 #	<1 #
4-Nitroaniline (aq)	<1 µg/l	TM176		<1 #	<1 #
4-Nitrophenol (aq)	<1 µg/l	TM176		<1	<1
Azobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #
Acenaphthylene (aq)	<1 µg/l	TM176		<1 #	<1 #
Acenaphthene (aq)	<1 µg/l	TM176		<1 #	<1 #
Anthracene (aq)	<1 µg/l	TM176		<1 #	<1 #
bis(2-Chloroethyl)ether (aq)	<1 µg/l	TM176		<1 #	<1 #
bis(2-Chloroethoxy)methane (aq)	<1 µg/l	TM176		<1 #	<1 #
bis(2-Ethylhexyl) phthalate (aq)	<2 µg/l	TM176		<2 #	<2 #
Butylbenzyl phthalate (aq)	<1 µg/l	TM176		<1 #	<1 #
Benzo(a)anthracene (aq)	<1 µg/l	TM176		<1 #	<1 #

Validated

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

SVOC MS (W) - Aqueous

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW01	GW03
			Depth (m)	0.00 - 0.00	0.00 - 0.00
			Sample Type	Ground Water (GW)	Ground Water (GW)
			Date Sampled	09/10/2018	09/10/2018
			Sample Time	-	-
			Date Received	10/10/2018	10/10/2018
			SDG Ref	181010-49	181010-49
			Lab Sample No.(s)	18494289	18494298
			AGS Reference		
Benzo(b)fluoranthene (aq)	<1 µg/l	TM176		<1 #	<1 #
Benzo(k)fluoranthene (aq)	<1 µg/l	TM176		<1 #	<1 #
Benzo(a)pyrene (aq)	<1 µg/l	TM176		<1 #	<1 #
Benzo(g,h,i)perylene (aq)	<1 µg/l	TM176		<1 #	<1 #
Carbazole (aq)	<1 µg/l	TM176		<1 #	<1 #
Chrysene (aq)	<1 µg/l	TM176		<1 #	<1 #
Dibenzofuran (aq)	<1 µg/l	TM176		<1 #	<1 #
n-Dibutyl phthalate (aq)	<1 µg/l	TM176		<1 #	<1 #
Diethyl phthalate (aq)	<1 µg/l	TM176		5.93 #	<1 #
Dibenzo(a,h)anthracene (aq)	<1 µg/l	TM176		<1 #	<1 #
Dimethyl phthalate (aq)	<1 µg/l	TM176		<1 #	<1 #
n-Dioctyl phthalate (aq)	<5 µg/l	TM176		<5 #	<5 #
Fluoranthene (aq)	<1 µg/l	TM176		<1 #	<1 #
Fluorene (aq)	<1 µg/l	TM176		<1 #	<1 #
Hexachlorobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #
Hexachlorobutadiene (aq)	<1 µg/l	TM176		<1 #	<1 #
Pentachlorophenol (aq)	<1 µg/l	TM176		<1	<1
Phenol (aq)	<1 µg/l	TM176		<1	<1
n-Nitroso-n-dipropylamine (aq)	<1 µg/l	TM176		<1 #	<1 #
Hexachloroethane (aq)	<1 µg/l	TM176		<1 #	<1 #
Nitrobenzene (aq)	<1 µg/l	TM176		<1 #	<1 #
Naphthalene (aq)	<1 µg/l	TM176		<1 #	<1 #
Isophorone (aq)	<1 µg/l	TM176		<1 #	<1 #
Hexachlorocyclopentadiene (aq)	<1 µg/l	TM176		<1	<1
Phenanthrene (aq)	<1 µg/l	TM176		<1 #	<1 #
Indeno(1,2,3-cd)pyrene (aq)	<1 µg/l	TM176		<1 #	<1 #
Pyrene (aq)	<1 µg/l	TM176		<1 #	<1 #

Validated

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

VOC MS (W)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW01	GW03
			Depth (m)	0.00 - 0.00	0.00 - 0.00
			Sample Type	Ground Water (GW)	Ground Water (GW)
			Date Sampled	09/10/2018	09/10/2018
			Sample Time	.	.
			Date Received	10/10/2018	10/10/2018
			SDG Ref	181010-49	181010-49
			Lab Sample No.(s)	18494289	18494298
			AGS Reference		
Dibromofluoromethane**	%	TM208		113	116 1
Toluene-d8**	%	TM208		101	101 1
4-Bromofluorobenzene**	%	TM208		98.6	96.7 1
Dichlorodifluoromethane	<1 µg/l	TM208		<1 #	<1 1 #
Chloromethane	<1 µg/l	TM208		<1 #	<1 1 #
Vinyl chloride	<1 µg/l	TM208		<1 #	<1 1 #
Bromomethane	<1 µg/l	TM208		<1 #	<1 1 #
Chloroethane	<1 µg/l	TM208		<1 #	<1 1 #
Trichlorofluoromethane	<1 µg/l	TM208		<1 #	<1 1 #
1,1-Dichloroethene	<1 µg/l	TM208		<1 #	<1 1 #
Carbon disulphide	<1 µg/l	TM208		<1 #	<1 1 #
Dichloromethane	<3 µg/l	TM208		<3 #	<3 1 #
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208		<1 #	<1 1 #
trans-1,2-Dichloroethene	<1 µg/l	TM208		<1 #	<1 1 #
1,1-Dichloroethane	<1 µg/l	TM208		<1 #	<1 1 #
cis-1,2-Dichloroethene	<1 µg/l	TM208		<1 #	<1 1 #
2,2-Dichloropropane	<1 µg/l	TM208		<1	<1 1
Bromochloromethane	<1 µg/l	TM208		<1 #	<1 1 #
Chloroform	<1 µg/l	TM208		<1 #	<1 1 #
1,1,1-Trichloroethane	<1 µg/l	TM208		<1 #	<1 1 #
1,1-Dichloropropene	<1 µg/l	TM208		<1 #	<1 1 #
Carbontetrachloride	<1 µg/l	TM208		<1 #	<1 1 #
1,2-Dichloroethane	<1 µg/l	TM208		<1 #	<1 1 #
Benzene	<1 µg/l	TM208		<1 #	<1 1 #
Trichloroethene	<1 µg/l	TM208		<1 #	<1 1 #
1,2-Dichloropropane	<1 µg/l	TM208		<1 #	<1 1 #
Dibromomethane	<1 µg/l	TM208		<1 #	<1 1 #
Bromodichloromethane	<1 µg/l	TM208		<1 #	<1 1 #
cis-1,3-Dichloropropene	<1 µg/l	TM208		<1 #	<1 1 #
Toluene	<1 µg/l	TM208		<1 #	<1 1 #
trans-1,3-Dichloropropene	<1 µg/l	TM208		<1 #	<1 1 #
1,1,2-Trichloroethane	<1 µg/l	TM208		<1 #	<1 1 #
1,3-Dichloropropane	<1 µg/l	TM208		<1 #	<1 1 #

17:28:39 16/10/2018

Validated

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

VOC MS (W)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW01	GW03				
			Depth (m)	0.00 - 0.00	0.00 - 0.00				
			Sample Type	Ground Water (GW)	Ground Water (GW)				
			Date Sampled	09/10/2018	09/10/2018				
			Sample Time	-	-				
			Date Received	10/10/2018	10/10/2018				
			SDG Ref	181010-49	181010-49				
			Lab Sample No.(s)	18494289	18494298				
			AGS Reference						
Tetrachloroethene	<1 µg/l	TM208		<1 #	<1 1 #				
Dibromochloromethane	<1 µg/l	TM208		<1 #	<1 1 #				
1,2-Dibromoethane	<1 µg/l	TM208		<1 #	<1 1 #				
Chlorobenzene	<1 µg/l	TM208		<1 #	<1 1 #				
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208		<1 #	<1 1 #				
Ethylbenzene	<1 µg/l	TM208		<1 #	<1 1 #				
m,p-Xylene	<1 µg/l	TM208		<1 #	<1 1 #				
o-Xylene	<1 µg/l	TM208		<1 #	<1 1 #				
Styrene	<1 µg/l	TM208		<1 #	<1 1 #				
Bromoform	<1 µg/l	TM208		<1 #	<1 1 #				
Isopropylbenzene	<1 µg/l	TM208		1.02 #	<1 1 #				
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208		<1 #	<1 1 #				
1,2,3-Trichloropropane	<1 µg/l	TM208		<1 #	<1 1 #				
Bromobenzene	<1 µg/l	TM208		<1 #	<1 1 #				
Propylbenzene	<1 µg/l	TM208		2.51 #	<1 1 #				
2-Chlorotoluene	<1 µg/l	TM208		<1 #	<1 1 #				
1,3,5-Trimethylbenzene	<1 µg/l	TM208		8.43 #	<1 1 #				
4-Chlorotoluene	<1 µg/l	TM208		<1 #	<1 1 #				
tert-Butylbenzene	<1 µg/l	TM208		<1 #	<1 1 #				
1,2,4-Trimethylbenzene	<1 µg/l	TM208		23.5 #	<1 1 #				
sec-Butylbenzene	<1 µg/l	TM208		<1 #	<1 1 #				
4-iso-Propyltoluene	<1 µg/l	TM208		2.15 #	<1 1 #				
1,3-Dichlorobenzene	<1 µg/l	TM208		<1 #	<1 1 #				
1,4-Dichlorobenzene	<1 µg/l	TM208		<1 #	<1 1 #				
n-Butylbenzene	<1 µg/l	TM208		<1 #	<1 1 #				
1,2-Dichlorobenzene	<1 µg/l	TM208		<1 #	<1 1 #				
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208		<1	<1 1				
1,2,4-Trichlorobenzene	<1 µg/l	TM208		<1 #	<1 1 #				
Hexachlorobutadiene	<1 µg/l	TM208		<1 #	<1 1 #				
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208		<1 #	<1 1 #				
Naphthalene	<1 µg/l	TM208		<1 #	<1 1 #				
1,2,3-Trichlorobenzene	<1 µg/l	TM208		<1 #	<1 1 #				

Validated

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

VOC MS (W)

Results Legend	
#	ISO17025 accredited.
M	*m*CERTS accredited.
aq	Aqueous / settled sample.
diss.filt	Dissolved / filtered sample.
tot.unfilt	Total / unfiltered sample.
*	Subcontracted test.
**	% recovery of the surrogate standard to check the efficiency of the method. The results of individual compounds within samples aren't corrected for the recovery
(F)	Trigger breach confirmed
1-5&+§@	Sample deviation (see appendix)

Component	LOD/Units	Method	Customer Sample Ref.	GW01	GW03				
			Depth (m)	0.00 - 0.00	0.00 - 0.00				
			Sample Type	Ground Water (GW)	Ground Water (GW)				
			Date Sampled	09/10/2018	09/10/2018				
			Sample Time	-	-				
			Date Received	10/10/2018	10/10/2018				
			SDG Ref	181010-49	181010-49				
			Lab Sample No.(s)	18494289	18494298				
			AGS Reference						
1,3,5-Trichlorobenzene	<1 µg/l	TM208		<1	<1				
					1				

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

Table of Results - Appendix

Method No	Reference	Description
SUB		Subcontracted Test
TM043	Method 2320B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part109 1984	Determination of alkalinity in aqueous samples
TM045	MEWAM BOD5 2nd Ed.HMSO 1988 / Method 5210B, AWWA/APHA, 20th Ed., 1999; SCA Blue Book 130	Determination of BOD5 (ATU) Filtered by Oxygen Meter on liquids
TM046	Method 4500G, AWWA/APHA, 20th Ed., 1999	Measurement of Dissolved Oxygen by Oxygen Meter
TM061	Method for the Determination of EPH,Massachusetts Dept.of EP, 1998	Determination of Extractable Petroleum Hydrocarbons by GC-FID (C10-C40)
TM090	Method 5310, AWWA/APHA, 20th Ed., 1999 / Modified: US EPA Method 415.1 & 9060	Determination of Total Organic Carbon/Total Inorganic Carbon in Water and Waste Water
TM099	BS 2690: Part 7:1968 / BS 6068: Part2.11:1984	Determination of Ammonium in Water Samples using the Kone Analyser
TM104	Method 4500F, AWWA/APHA, 20th Ed., 1999	Determination of Fluoride using the Kone Analyser
TM107	ISO 6060-1989	Determination of Chemical Oxygen Demand using COD Dr Lange Kit
TM120	Method 2510B, AWWA/APHA, 20th Ed., 1999 / BS 2690: Part 9:1970	Determination of Electrical Conductivity using a Conductivity Meter
TM152	Method 3125B, AWWA/APHA, 20th Ed., 1999	Analysis of Aqueous Samples by ICP-MS
TM172	Analysis of Petroleum Hydrocarbons in Environmental Media – Total Petroleum Hydrocarbon Criteria	EPH in Waters
TM176	EPA 8270D Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of SVOCs in Water by GCMS
TM183	BS EN 23506:2002, (BS 6068-2.74:2002) ISBN 0 580 38924 3	Determination of Trace Level Mercury in Waters and Leachates by PSA Cold Vapour Atomic Fluorescence Spectrometry
TM184	EPA Methods 325.1 & 325.2,	The Determination of Anions in Aqueous Matrices using the Kone Spectrophotometric Analysers
TM208	Modified: US EPA Method 8260b & 624	Determination of Volatile Organic Compounds by Headspace / GC-MS in Waters
TM227	Standard methods for the examination of waters and wastewaters 20th Edition, AWWA/APHA Method 4500.	Determination of Total Cyanide, Free (Easily Liberatable) Cyanide and Thiocyanate
TM256	The measurement of Electrical Conductivity and the Laboratory determination of pH Value of Natural, Treated and Wastewaters. HMSO, 1978. ISBN 011 751428 4.	Determination of pH in Water and Leachate using the GLpH pH Meter
TM284		
TM328		
TM343	EPA 8270D - Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of Selected Pesticides (Suite I) in Liquids by GCMS
TM344	EPA 8270D – Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of selected pesticides (Suite II) by GCMS
TM345	EPA 8270D – Semi-Volatile Organic Compounds by Gas Chromatography/Mass Spectrometry (GC/MS)	Determination of selected pesticides (Suite III) by GCMS

NA = not applicable.

Chemical testing (unless subcontracted) performed at ALS Life Sciences Ltd Hawarden (Method codes TM) or ALS Life Sciences Ltd Aberdeen (Method codes S).

CERTIFICATE OF ANALYSIS

SDG:	181010-49	**Client Reference:**	P1724	**Report Number:**	477084
Location:	Killycard	**Order Number:**	Z1260	**Superseded Report:**	476448

Test Completion Dates

Lab Sample No(s)	18494289	18494298	18494307	18494313
Customer Sample Ref.	GW01	GW03	SW1	SW2
AGS Ref.				
Depth	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00	0.00 - 0.00
Type	Ground Water	Ground Water	Surface Water	Surface Water
Alkalinity as CaCO3	16-Oct-2018	16-Oct-2018		
Ammoniacal Nitrogen	15-Oct-2018	15-Oct-2018	15-Oct-2018	15-Oct-2018
Anions by Kone (w)	16-Oct-2018	16-Oct-2018	15-Oct-2018	15-Oct-2018
BOD True Total	16-Oct-2018	15-Oct-2018	16-Oct-2018	16-Oct-2018
COD Unfiltered	12-Oct-2018	12-Oct-2018	12-Oct-2018	12-Oct-2018
Coliforms (W)	11-Oct-2018	11-Oct-2018		
Conductivity (at 20 deg.C)	11-Oct-2018	11-Oct-2018	11-Oct-2018	11-Oct-2018
Cyanide Comp/Free/Total/Thiocyanate	12-Oct-2018	12-Oct-2018		
Dissolved Metals by ICP-MS	12-Oct-2018	12-Oct-2018	12-Oct-2018	12-Oct-2018
Dissolved Oxygen by Probe	12-Oct-2018	12-Oct-2018	12-Oct-2018	12-Oct-2018
Fluoride	16-Oct-2018	16-Oct-2018		
Mercury Dissolved	12-Oct-2018	12-Oct-2018		
Mineral Oil C10-40 Aqueous (W)	16-Oct-2018	16-Oct-2018		
Nitrite by Kone (w)	16-Oct-2018	16-Oct-2018		
Organotins in Aqueous Samples	16-Oct-2018	16-Oct-2018		
Pesticides (Suite I) by GCMS	15-Oct-2018	15-Oct-2018		
Pesticides (Suite II) by GCMS	15-Oct-2018	15-Oct-2018		
Pesticides (Suite III) by GCMS	15-Oct-2018	15-Oct-2018		
pH Value	15-Oct-2018	15-Oct-2018	15-Oct-2018	15-Oct-2018
Phosphate by Kone (w)	15-Oct-2018	15-Oct-2018		
Silicon Dissolved by ICP-OES	16-Oct-2018	16-Oct-2018		
SVOC MS (W) - Aqueous	15-Oct-2018	15-Oct-2018		
Total Organic and Inorganic Carbon	11-Oct-2018	12-Oct-2018		
VOC MS (W)	11-Oct-2018	16-Oct-2018		