



**CAUSEWAY**  
—  
GEOTECH

**APPENDIX G**  
**ENVIRONMENTAL LABORATORY TEST RESULTS**

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## Final Report

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**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  
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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

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**Project: 18-0838A Monaghan Landfills, Killycard**

Chemtest Job No: 18-29299							Landfill Waste Acceptance Criteria		
Chemtest Sample ID: 694799							Limits		
Sample Ref:							Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill
Sample ID:									
Sample Location: TP08									
Top Depth(m): 0.50									
Bottom Depth(m):									
Sampling Date: 21-Sep-2018									
Determinand	SOP	Accred.	Units						
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.

**Project: 18-0838A Monaghan Landfills, Killycard**

Chemtest Job No: 18-29299							Landfill Waste Acceptance Criteria			
Chemtest Sample ID: 694800							Limits			
Sample Ref:							Inert Waste Landfill	Stable, Non-reactive hazardous waste in non-hazardous Landfill	Hazardous Waste Landfill	
Sample ID:										
Sample Location: TP04										
Top Depth(m): 0.50										
Bottom Depth(m):										
Sampling Date: 21-Sep-2018										
Determinand	SOP	Accred.	Units							
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	0.0017	< 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**

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- 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**

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- 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**

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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](mailto:customerservices@chemtest.com)

# Appendix III

## Groundwater & Surface Water Sampling Analysis Results

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Manor Road (off Manor Lane)  
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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

Validated

SDG: 181003-45  
Location: Killycard

Client Reference: P1724  
Order Number: Z1260

Report Number: 477957  
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.

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# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 181003-45  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477957  
**Superseded Report:** 476315

Results Legend		Customer Sample Ref.	GW01	GW02	GW03	SW1	SW2
#	ISO17025 accredited.						
M	mCERTS 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					
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	1.68	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



# CERTIFICATE OF ANALYSIS

Validated

SDG: 181003-45  
Location: Killycard

Client Reference: P1724  
Order Number: Z1260

Report Number: 477957  
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

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# CERTIFICATE OF ANALYSIS

Validated

SDG: 181003-45  
Location: Killycard

Client Reference: P1724  
Order Number: Z1260

Report Number: 477957  
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).

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**CERTIFICATE OF ANALYSIS**

Validated

**SDG:** 181003-45  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477957  
**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		

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**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

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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:**



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.  
This test report shall not be reproduced except in full or with written approval of City Analysts Limited.



## 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	-

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# = 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



# CERTIFICATE OF ANALYSIS

<b>SDG:</b>	181003-45	<b>Client Reference:</b>	P1724	<b>Report Number:</b>	477957
<b>Location:</b>	Killycard	<b>Order Number:</b>	Z1260	<b>Superseded Report:</b>	476315

## Appendix

## General

1. Results are expressed on a dry weight basis (dried at 35°C) 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 Dimethylphenol, 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
	Deviation from method
	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation 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).

Astestost 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.**



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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

Validated

SDG: 181010-49  
Location: Killycard

Client Reference: P1724  
Order Number: Z1260

Report Number: 477084  
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.**

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# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 181010-49  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477084  
**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											
					0.5l glass bottle (ALE227)	250ml BOD (ALE212)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)	Vial (ALE297)	0.5l glass bottle (ALE227)	250ml BOD (ALE212)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)		1l plastic (ALE221)	HNO3 Filtered (ALE204)	H2SO4 (ALE244)	1l plastic (ALE221)							
	18494289	GW01		0.00 - 0.00																							
	18494298	GW03		0.00 - 0.00																							
	18494307	SW1		0.00 - 0.00																							
	18494313	SW2		0.00 - 0.00																							

Alkalinity as CaCO3	All	NDPs: 0 Tests: 2																									
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 4																									
Anions by Kone (w)	All	NDPs: 0 Tests: 4																									
BOD True Total	All	NDPs: 0 Tests: 4																									
COD Unfiltered	All	NDPs: 0 Tests: 4																									
Coliforms (W)	All	NDPs: 0 Tests: 2																									
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 4																									
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 2																									
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 4																									
Dissolved Oxygen by Probe	All	NDPs: 0 Tests: 4																									
Fluoride	All	NDPs: 0 Tests: 2																									
Mercury Dissolved	All	NDPs: 0 Tests: 2																									
Mineral Oil C10-40 Aqueous (W)	All	NDPs: 0 Tests: 2																									
Nitrite by Kone (w)	All	NDPs: 0 Tests: 2																									
Organotins in Aqueous Samples	All	NDPs: 0 Tests: 2																									

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**SDG:** 181010-49  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477084  
**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								
				0.5l glass bottle (ALE227)	250ml BOD (ALE212)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)	Val (ALE297)	0.5l glass bottle (ALE227)	250ml BOD (ALE212)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)		1l plastic (ALE221)							
18494289	GW01		0.00 - 0.00	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
18494298	GW03		0.00 - 0.00	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW	GW
18494307	SW1		0.00 - 0.00	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW
18494313	SW2		0.00 - 0.00	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW	SW

Pesticides (Suite I) by GCMS	All	NDPs: 0 Tests: 2	<span style="background-color: yellow;">X</span>	<span style="background-color: yellow;">X</span>																			
Pesticides (Suite II) by GCMS	All	NDPs: 0 Tests: 2	<span style="background-color: yellow;">X</span>	<span style="background-color: yellow;">X</span>																			
Pesticides (Suite III) by GCMS	All	NDPs: 0 Tests: 2	<span style="background-color: yellow;">X</span>	<span style="background-color: yellow;">X</span>																			
pH Value	All	NDPs: 0 Tests: 4	<span style="background-color: yellow;">X</span>	<span style="background-color: yellow;">X</span>								<span style="background-color: yellow;">X</span>						<span style="background-color: yellow;">X</span>					
Phosphate by Kone (w)	All	NDPs: 0 Tests: 2	<span style="background-color: yellow;">X</span>	<span style="background-color: yellow;">X</span>																			
Silicon Dissolved by ICP-OES	All	NDPs: 0 Tests: 2					<span style="background-color: yellow;">X</span>						<span style="background-color: yellow;">X</span>										
SVOC MS (W) - Aqueous	All	NDPs: 0 Tests: 2	<span style="background-color: yellow;">X</span>	<span style="background-color: yellow;">X</span>																			
Total Organic and Inorganic Carbon	All	NDPs: 0 Tests: 2					<span style="background-color: yellow;">X</span>							<span style="background-color: yellow;">X</span>									
VOC MS (W)	All	NDPs: 0 Tests: 2								<span style="background-color: yellow;">X</span>	<span style="background-color: yellow;">X</span>												

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**SDG:** 181010-49  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477084  
**Superseded Report:** 476448

Results Legend		Customer Sample Ref.	GW01	GW03	SW1	SW2		
#	ISO17025 accredited.							
M	mCERTS 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						
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		



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**SDG:** 181010-49  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477084  
**Superseded Report:** 476448

Results Legend		Customer Sample Ref.	GW01	GW03	SW1	SW2		
#	ISO17025 accredited.							
M	mCERTS 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						
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				

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**Report Number:** 477084  
**Superseded Report:** 476448

Results Legend		Customer Sample Ref.	GW01	GW03	SW1	SW2		
#	ISO17025 accredited.							
M	mCERTS 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)							
		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						
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				
Chlorpyrifos-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				
Chlorpyrifos	<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				

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CERTIFICATE OF ANALYSIS

Validated

SDG: 181010-49
Location: Killycard

Client Reference: P1724
Order Number: Z1260

Report Number: 477084
Superseded Report: 476448

Table with columns for Results Legend, Customer Sample Ref., Depth (m), Sample Type, Date Sampled, Sample Time, Date Received, SDG Ref, Lab Sample No.(s), AGS Reference, Component, LOD/Units, Method, and data for various pesticides like Parathion, Chlorfenvinphos, Ethion, etc.

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# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 181010-49  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477084  
**Superseded Report:** 476448

## SVOC MS (W) - Aqueous

Results Legend		Customer Sample Ref.	GW01	GW03			
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00	0.00 - 0.00			
M	mCERTS accredited.		Ground Water (GW)	Ground Water (GW)			
aq	Aqueous / settled sample.		09/10/2018	09/10/2018			
diss.filt	Dissolved / filtered sample.		10/10/2018	10/10/2018			
tot.unfilt	Total / unfiltered sample.		181010-49	181010-49			
*	Subcontracted test.		18494289	18494298			
**	% 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				
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	#	#	

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# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 181010-49  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477084  
**Superseded Report:** 476448

## VOC MS (W)

Results Legend		Customer Sample Ref.	GW01	GW03			
#	ISO17025 accredited.	Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00	0.00 - 0.00			
M	mCERTS accredited.		Ground Water (GW)	Ground Water (GW)			
aq	Aqueous / settled sample.		09/10/2018	09/10/2018			
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				
Dibromofluoromethane**	%	TM208	113	116			
Toluene-d8**	%	TM208	101	101			
4-Bromofluorobenzene**	%	TM208	98.6	96.7			
Dichlorodifluoromethane	<1 µg/l	TM208	<1	<1			
Chloromethane	<1 µg/l	TM208	<1	<1			
Vinyl chloride	<1 µg/l	TM208	<1	<1			
Bromomethane	<1 µg/l	TM208	<1	<1			
Chloroethane	<1 µg/l	TM208	<1	<1			
Trichlorofluoromethane	<1 µg/l	TM208	<1	<1			
1,1-Dichloroethene	<1 µg/l	TM208	<1	<1			
Carbon disulphide	<1 µg/l	TM208	<1	<1			
Dichloromethane	<3 µg/l	TM208	<3	<3			
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1	<1			
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1	<1			
1,1-Dichloroethane	<1 µg/l	TM208	<1	<1			
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1	<1			
2,2-Dichloropropane	<1 µg/l	TM208	<1	<1			
Bromochloromethane	<1 µg/l	TM208	<1	<1			
Chloroform	<1 µg/l	TM208	<1	<1			
1,1,1-Trichloroethane	<1 µg/l	TM208	<1	<1			
1,1-Dichloropropene	<1 µg/l	TM208	<1	<1			
Carbontetrachloride	<1 µg/l	TM208	<1	<1			
1,2-Dichloroethane	<1 µg/l	TM208	<1	<1			
Benzene	<1 µg/l	TM208	<1	<1			
Trichloroethene	<1 µg/l	TM208	<1	<1			
1,2-Dichloropropane	<1 µg/l	TM208	<1	<1			
Dibromomethane	<1 µg/l	TM208	<1	<1			
Bromodichloromethane	<1 µg/l	TM208	<1	<1			
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1	<1			
Toluene	<1 µg/l	TM208	<1	<1			
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1	<1			
1,1,2-Trichloroethane	<1 µg/l	TM208	<1	<1			
1,3-Dichloropropane	<1 µg/l	TM208	<1	<1			

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# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 181010-49  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477084  
**Superseded Report:** 476448

**VOC MS (W)**

Results Legend		Customer Sample Ref.	GW01	GW03			
#	ISO17025 accredited.						
M	mCERTS 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					
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 #			

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# CERTIFICATE OF ANALYSIS

Validated

SDG: 181010-49  
Location: Killycard

Client Reference: P1724  
Order Number: Z1260

Report Number: 477084  
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

Validated

**SDG:** 181010-49  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477084  
**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		

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**Customer**

Customer Services  
ALS Life Sciences  
Hawarden Business Park  
Manor Lane  
Hawarden, Deeside  
UK  
CH5 3US

**Certificate Of Analysis**

**Job Number:** 18-47977  
**Issue Number:** 1  
**Report Date:** 11 October 2018

**Site:** Killycard: 181010-49  
**PO Number:** Not Supplied  
**Date Samples Received:** 10/10/2018

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

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:**   
Caitlin Quinn  
Deputy Quality Manager

**Authorised Date:** 11 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.  
This test report shall not be reproduced except in full or with written approval of City Analysts Limited.

## Certificate Of Analysis

### Customer

Customer Services  
ALS Life Sciences  
Hawarden Business Park  
Manor Lane  
Hawarden, Deeside  
UK  
CH5 3US

**Report Reference:** 18-47977

**Report Version:** 1

**Site:** Killycard: 181010-49

**Sample Description:** GW 01

**Date of Sampling:** 09/10/2018

**Sample Type:** Ground

**Date Sample Received:** 10/10/2018

**Lab Reference Number:** 414286

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1201#	10/10/2018	Coliforms	1986.3	MPN/100ml	-

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# = 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

## Certificate Of Analysis

### Customer

Customer Services  
ALS Life Sciences  
Hawarden Business Park  
Manor Lane  
Hawarden, Deeside  
UK  
CH5 3US

**Report Reference:** 18-47977

**Report Version:** 1

**Site:** Killycard: 181010-49

**Sample Description:** GW 03

**Date of Sampling:** 09/10/2018

**Sample Type:** Ground

**Date Sample Received:** 10/10/2018

**Lab Reference Number:** 414287

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1201#	10/10/2018	Coliforms	1119.9	MPN/100ml	-

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# = 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



# CERTIFICATE OF ANALYSIS

<b>SDG:</b> 181010-49	<b>Client Reference:</b> P1724	<b>Report Number:</b> 477084
<b>Location:</b> Killycard	<b>Order Number:</b> Z1260	<b>Superseded Report:</b> 476448

## Appendix

## General

1. Results are expressed on a dry weight basis (dried at 35°C) 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 Dimethylphenol, 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
	Deviation from method
	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation 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).

Astestost Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Coöcidolite	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.**



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Manor Road (off Manor Lane)  
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Deeside  
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Tel: (01244) 528700

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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:** 17 October 2018  
**Customer:** D\_FTIM\_DUB  
**Sample Delivery Group (SDG):** 181011-82  
**Your Reference:** P1724  
**Location:** Killycard  
**Report No:** 477251

We received 1 sample on Thursday October 11, 2018 and 1 of these samples were scheduled for analysis which was completed on Wednesday October 17, 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

Validated

SDG: 181011-82  
Location: Killycard

Client Reference: P1724  
Order Number: Z1260

Report Number: 477251  
Superseded Report:

## Received Sample Overview

Lab Sample No(s)	Customer Sample Ref.	AGS Ref.	Depth (m)	Sampled Date
18505196	GW02		0.00 - 0.00	10/10/2018

### Maximum Sample/Coolbox Temperature (°C) :

8

#### 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.

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# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 181011-82  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477251  
**Superseded Report:**

**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

<b>Lab Sample No(s)</b>	18505196						
<b>Customer Sample Reference</b>	GWM02						
<b>AGS Reference</b>							
<b>Depth (m)</b>	0.00 - 0.00						
<b>Container</b>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">Vial (ALE297)</td> <td style="width: 16.6%;">NaOH (ALE245)</td> <td style="width: 16.6%;">HNO3 Filtered (ALE204)</td> <td style="width: 16.6%;">H2SO4 (ALE244)</td> <td style="width: 16.6%;">250ml BOD (ALE212)</td> <td style="width: 16.6%;">0.5l glass bottle (ALE227)</td> </tr> </table>	Vial (ALE297)	NaOH (ALE245)	HNO3 Filtered (ALE204)	H2SO4 (ALE244)	250ml BOD (ALE212)	0.5l glass bottle (ALE227)
Vial (ALE297)	NaOH (ALE245)	HNO3 Filtered (ALE204)	H2SO4 (ALE244)	250ml BOD (ALE212)	0.5l glass bottle (ALE227)		
<b>Sample Type</b>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 16.6%;">GW</td> <td style="width: 16.6%;">GW</td> <td style="width: 16.6%;">GW</td> <td style="width: 16.6%;">GW</td> <td style="width: 16.6%;">GW</td> <td style="width: 16.6%;">GW</td> </tr> </table>	GW	GW	GW	GW	GW	GW
GW	GW	GW	GW	GW	GW		

Parameter	All	NDPs: 0 Tests: 1	0.5l glass bottle (ALE227)	250ml BOD (ALE212)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)	Vial (ALE297)
Alkalinity as CaCO3	All	NDPs: 0 Tests: 1	X					
Ammoniacal Nitrogen	All	NDPs: 0 Tests: 1			X			
Anions by Kone (w)	All	NDPs: 0 Tests: 1	X					
BOD True Total	All	NDPs: 0 Tests: 1		X				
COD Unfiltered	All	NDPs: 0 Tests: 1		X				
Coliforms (W)	All	NDPs: 0 Tests: 1		X				
Conductivity (at 20 deg.C)	All	NDPs: 0 Tests: 1	X					
Cyanide Comp/Free/Total/Thiocyanate	All	NDPs: 0 Tests: 1					X	
Dissolved Metals by ICP-MS	All	NDPs: 0 Tests: 1				X		
Dissolved Oxygen by Probe	All	NDPs: 0 Tests: 1	X					
Fluoride	All	NDPs: 0 Tests: 1	X					
Mercury Dissolved	All	NDPs: 0 Tests: 1				X		
Mineral Oil C10-40 Aqueous (W)	All	NDPs: 0 Tests: 1	X					
Nitrite by Kone (w)	All	NDPs: 0 Tests: 1					X	
Organotins in Aqueous Samples	All	NDPs: 0 Tests: 1	X					

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# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 181011-82  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477251  
**Superseded Report:**

**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

<b>Lab Sample No(s)</b>		18505196							
<b>Customer Sample Reference</b>		GW02							
<b>AGS Reference</b>									
<b>Depth (m)</b>		0.00 - 0.00							
<b>Container</b>	<table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 12.5%;"></td> <td style="width: 12.5%;">0.5l glass bottle (ALE227)</td> <td style="width: 12.5%;">250ml BOD (ALE212)</td> <td style="width: 12.5%;">H2SO4 (ALE244)</td> <td style="width: 12.5%;">HNO3 Filtered (ALE204)</td> <td style="width: 12.5%;">NaOH (ALE245)</td> <td style="width: 12.5%;">Vial (ALE297)</td> </tr> </table>		0.5l glass bottle (ALE227)	250ml BOD (ALE212)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)	Vial (ALE297)	
	0.5l glass bottle (ALE227)	250ml BOD (ALE212)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)	Vial (ALE297)			
<b>Sample Type</b>		GW							

Test Name	All	NDPs: 0 Tests: 1	0.5l glass bottle (ALE227)	250ml BOD (ALE212)	H2SO4 (ALE244)	HNO3 Filtered (ALE204)	NaOH (ALE245)	Vial (ALE297)
Pesticides (Suite I) by GCMS	All	NDPs: 0 Tests: 1	X					
Pesticides (Suite II) by GCMS	All	NDPs: 0 Tests: 1	X					
Pesticides (Suite III) by GCMS	All	NDPs: 0 Tests: 1	X					
pH Value	All	NDPs: 0 Tests: 1	X					
Phosphate by Kone (w)	All	NDPs: 0 Tests: 1	X					
Silicon Dissolved by ICP-OES	All	NDPs: 0 Tests: 1				X		
SVOC MS (W) - Aqueous	All	NDPs: 0 Tests: 1	X					
Total Organic and Inorganic Carbon	All	NDPs: 0 Tests: 1		X				
VOC MS (W)	All	NDPs: 0 Tests: 1						X

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# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 181011-82  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477251  
**Superseded Report:**

Results Legend		Customer Sample Ref.	GW02			
# ISO17025 accredited. M mCERTS 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)		Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	0.00 - 0.00 Ground Water (GW) 10/10/2018 11/10/2018 181011-82 18505196			
Component	LOD/Units	Method				
Coliforms, Total*	CFU/100ml	SUB	549			
Alkalinity, Total as CaCO3	<2 mg/l	TM043	305	#		
BOD, unfiltered	<1 mg/l	TM045	2.04	#		
Oxygen, dissolved	<0.3 mg/l	TM046	6.01			
Organic Carbon, Total	<3 mg/l	TM090	4.66	#		
Ammoniacal Nitrogen as N	<0.2 mg/l	TM099	0.414	#		
Fluoride	<0.5 mg/l	TM104	1.04	#		
COD, unfiltered	<7 mg/l	TM107	115	#		
Conductivity @ 20 deg.C	<0.005 mS/cm	TM120	0.472	#		
Antimony (diss.filt)	<1 µg/l	TM152	2.1			
Arsenic (diss.filt)	<0.5 µg/l	TM152	1.48	#		
Barium (diss.filt)	<0.2 µg/l	TM152	76.1	#		
Beryllium (diss.filt)	<0.1 µg/l	TM152	<0.1	#		
Boron (diss.filt)	<10 µg/l	TM152	28.3	#		
Cadmium (diss.filt)	<0.08 µg/l	TM152	<0.08	#		
Chromium (diss.filt)	<1 µg/l	TM152	<1	#		
Cobalt (diss.filt)	<0.5 µg/l	TM152	<0.5	#		
Copper (diss.filt)	<0.3 µg/l	TM152	1.23	#		
Lead (diss.filt)	<0.2 µg/l	TM152	11.5	#		
Manganese (diss.filt)	<3 µg/l	TM152	121	#		
Molybdenum (diss.filt)	<3 µg/l	TM152	12.2	#		
Nickel (diss.filt)	<0.4 µg/l	TM152	2.16	#		
Phosphorus (diss.filt)	<10 µg/l	TM152	23.3	#		
Selenium (diss.filt)	<1 µg/l	TM152	<1	#		
Tellurium (diss.filt)	<2 µg/l	TM152	5.87			
Thallium (diss.filt)	<2 µg/l	TM152	<2	#		
Titanium (diss.filt)	<1 µg/l	TM152	1.54	#		
Vanadium (diss.filt)	<1 µg/l	TM152	<1	#		
Zinc (diss.filt)	<1 µg/l	TM152	68.3	#		
Tin (Diss.Filt)	<1 µg/l	TM152	7.15	#		
Silver (diss.filt)	<0.5 µg/l	TM152	<0.5	#		
Sodium (Dis.Filt)	<0.076 mg/l	TM152	14.5	#		
Magnesium (Dis.Filt)	<0.036 mg/l	TM152	15.1	#		

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# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 181011-82  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477251  
**Superseded Report:**

<b>Results Legend</b> # ISO17025 accredited. M mCERTS 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)		<b>Customer Sample Ref.</b>  Depth (m) Sample Type Date Sampled Sample Time Date Received SDG Ref Lab Sample No.(s) AGS Reference	GW02	0.00 - 0.00	Ground Water (GW)	10/10/2018	-	11/10/2018	181011-82	18505196
Component	LOD/Units	Method								
Potassium (Dis.Filt)	<0.2 mg/l	TM152	3.49	#						
Calcium (Dis.Filt)	<0.2 mg/l	TM152	71.2	#						
Iron (Dis.Filt)	<0.019 mg/l	TM152	0.0546	#						
Mineral oil >C10 C40 (aq)	<100 µg/l	TM172	181							
Mercury (diss.filt)	<0.01 µg/l	TM183	<0.01	#						
Phosphate (Ortho as PO4)	<0.05 mg/l	TM184	<0.05	#						
Chloride	<2 mg/l	TM184	15.2	#						
Nitrite as N	<0.0152 mg/l	TM184	<0.0152	#						
Total Oxidised Nitrogen as N	<0.1 mg/l	TM184	0.203	#						
Sulphate (soluble) as S	<1 mg/l	TM184	4.4	#						
Cyanide, Total	<0.05 mg/l	TM227	<0.05	#						
Cyanide, Free	<0.05 mg/l	TM227	<0.05	#						
pH	<1 pH Units	TM256	7.27	#						
Silicon (diss.filt)	<0.05 mg/l	TM284	2.61							
Dibutyl tin	<5 ng/l	TM328	<5							
Tributyl tin	<1 ng/l	TM328	<1							
Tetrabutyl tin	<2 ng/l	TM328	<2							
Triphenyl tin	<1 ng/l	TM328	<1							
Surrogate	%	TM328	51.9							
Trifluralin	<0.01 µg/l	TM343	<0.01							
alpha-HCH	<0.01 µg/l	TM343	<0.01							
gamma-HCH (Lindane)	<0.01 µg/l	TM343	<0.01							
Heptachlor	<0.01 µg/l	TM343	<0.01							
Aldrin	<0.01 µg/l	TM343	<0.01							
beta-HCH	<0.01 µg/l	TM343	<0.01							
Isodrin	<0.01 µg/l	TM343	<0.01							
Heptachlor epoxide	<0.01 µg/l	TM343	<0.01							
o,p'-DDE	<0.01 µg/l	TM343	<0.01							
Endosulphan I	<0.01 µg/l	TM343	<0.01							
trans-Chlordane	<0.01 µg/l	TM343	<0.01							
cis-Chlordane	<0.01 µg/l	TM343	<0.01							
p,p'-DDE	<0.01 µg/l	TM343	<0.01							

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# CERTIFICATE OF ANALYSIS

Validated

**SDG:** 181011-82  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477251  
**Superseded Report:**

Results Legend		Customer Sample Ref.	GW02			
#	ISO17025 accredited.					
M	mCERTS 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)					
		Depth (m)	0.00 - 0.00			
		Sample Type	Ground Water (GW)			
		Date Sampled	10/10/2018			
		Sample Time	-			
		Date Received	11/10/2018			
		SDG Ref	181011-82			
		Lab Sample No.(s)	18505196			
		AGS Reference				
Component	LOD/Units	Method				
Dieldrin	<0.01 µg/l	TM343	<0.01			
o,p'-DDD (TDE)	<0.01 µg/l	TM343	<0.01			
Endrin	<0.01 µg/l	TM343	<0.01			
o,p'-DDT	<0.01 µg/l	TM343	<0.01			
p,p'-DDD (TDE)	<0.01 µg/l	TM343	<0.01			
Endosulphan II	<0.02 µg/l	TM343	<0.02			
p,p'-DDT	<0.01 µg/l	TM343	<0.01			
p,p'-Methoxychlor	<0.01 µg/l	TM343	<0.01			
Endosulphan Sulphate	<0.02 µg/l	TM343	<0.02			
Permethrin I	<0.01 µg/l	TM343	<0.01			
Permethrin II	<0.01 µg/l	TM343	<0.01			
Dichlorvos	<0.01 µg/l	TM344	<0.01			
Mevinphos	<0.01 µg/l	TM344	<0.01			
Tecnazene	<0.01 µg/l	TM344	<0.01			
Hexachlorobenzene	<0.01 µg/l	TM344	<0.01			
Diazinon	<0.01 µg/l	TM344	0.419			
Triallate	<0.01 µg/l	TM344	<0.01			
Atrazine	<0.01 µg/l	TM344	<0.01			
Simazine	<0.01 µg/l	TM344	<0.01			
Disulfoton	<0.01 µg/l	TM344	<0.01			
Propetamphos	<0.01 µg/l	TM344	<0.01			
Chlorpyrifos-methyl	<0.01 µg/l	TM344	<0.01			
Dimethoate	<0.01 µg/l	TM344	<0.01			
Pirimiphos-methyl	<0.01 µg/l	TM344	<0.01			
Chlorpyrifos	<0.01 µg/l	TM344	<0.01			
Methyl Parathion	<0.01 µg/l	TM344	<0.01			
Malathion	<0.01 µg/l	TM344	<0.01			
Fenthion	<0.01 µg/l	TM344	<0.01			
Fenitrothion	<0.01 µg/l	TM344	<0.01			
Triadimefon	<0.01 µg/l	TM344	<0.01			
Pendimethalin	<0.01 µg/l	TM344	<0.01			
Parathion	<0.01 µg/l	TM344	<0.01			

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CERTIFICATE OF ANALYSIS

Validated

SDG: 181011-82
Location: Killycard

Client Reference: P1724
Order Number: Z1260

Report Number: 477251
Superseded Report:

Table with columns: Results Legend, Customer Sample Ref., Depth (m), Sample Type, Date Sampled, Sample Time, Date Received, SDG Ref, Lab Sample No.(s), AGS Reference, Component, LOD/Units, Method. Rows include Chlorfenvinphos, Ethion, Carbophenothion, Triazophos, Phosalone, Azinphos methyl, Azinphos ethyl, Quintozene (PCNB), Telodrin, Chlorothalonil, Etrimphos.

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# CERTIFICATE OF ANALYSIS

Validated

SDG: 181011-82  
Location: Killycard

Client Reference: P1724  
Order Number: Z1260

Report Number: 477251  
Superseded Report:

## SVOC MS (W) - Aqueous

Results Legend		Customer Sample Ref.	GW02			
#	ISO17025 accredited.					
M	mCERTS 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	Depth (m)	0.00 - 0.00			
(F)	Trigger breach confirmed	Sample Type	Ground Water (GW)			
1-5&*\$@	Sample deviation (see appendix)	Date Sampled	10/10/2018			
		Sample Time				
		Date Received	11/10/2018			
		SDG Ref	181011-82			
		Lab Sample No.(s)	18505196			
		AGS Reference				
Component	LOD/Units	Method				
1,2,4-Trichlorobenzene (aq)	<1 µg/l	TM176	<1	#		
1,2-Dichlorobenzene (aq)	<1 µg/l	TM176	<1	#		
1,3-Dichlorobenzene (aq)	<1 µg/l	TM176	<1	#		
1,4-Dichlorobenzene (aq)	<1 µg/l	TM176	<1	#		
2,4,5-Trichlorophenol (aq)	<1 µg/l	TM176	<1	#		
2,4,6-Trichlorophenol (aq)	<1 µg/l	TM176	<1	#		
2,4-Dichlorophenol (aq)	<1 µg/l	TM176	<1	#		
2,4-Dimethylphenol (aq)	<1 µg/l	TM176	<1	#		
2,4-Dinitrotoluene (aq)	<1 µg/l	TM176	<1	#		
2,6-Dinitrotoluene (aq)	<1 µg/l	TM176	<1	#		
2-Chloronaphthalene (aq)	<1 µg/l	TM176	<1	#		
2-Chlorophenol (aq)	<1 µg/l	TM176	<1	#		
2-Methylnaphthalene (aq)	<1 µg/l	TM176	<1	#		
2-Methylphenol (aq)	<1 µg/l	TM176	<1	#		
2-Nitroaniline (aq)	<1 µg/l	TM176	<1	#		
2-Nitrophenol (aq)	<1 µg/l	TM176	<1	#		
3-Nitroaniline (aq)	<1 µg/l	TM176	<1	#		
4-Bromophenylphenylether (aq)	<1 µg/l	TM176	<1	#		
4-Chloro-3-methylphenol (aq)	<1 µg/l	TM176	<1	#		
4-Chloroaniline (aq)	<1 µg/l	TM176	<1	#		
4-Chlorophenylphenylether (aq)	<1 µg/l	TM176	<1	#		
4-Methylphenol (aq)	<1 µg/l	TM176	<1	#		
4-Nitroaniline (aq)	<1 µg/l	TM176	<1	#		
4-Nitrophenol (aq)	<1 µg/l	TM176	<1	#		
Azobenzene (aq)	<1 µg/l	TM176	<1	#		
Acenaphthylene (aq)	<1 µg/l	TM176	<1	#		
Acenaphthene (aq)	<1 µg/l	TM176	<1	#		
Anthracene (aq)	<1 µg/l	TM176	<1	#		
bis(2-Chloroethyl)ether (aq)	<1 µg/l	TM176	<1	#		
bis(2-Chloroethoxy)methane (aq)	<1 µg/l	TM176	<1	#		
bis(2-Ethylhexyl) phthalate (aq)	<2 µg/l	TM176	<2	#		
Butylbenzyl phthalate (aq)	<1 µg/l	TM176	<1	#		
Benzo(a)anthracene (aq)	<1 µg/l	TM176	<1	#		

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# CERTIFICATE OF ANALYSIS

Validated

SDG: 181011-82  
Location: Killycard

Client Reference: P1724  
Order Number: Z1260

Report Number: 477251  
Superseded Report:

## SVOC MS (W) - Aqueous

Results Legend		Customer Sample Ref.	GW02				
#	ISO17025 accredited.	Depth (m) 0.00 - 0.00 Sample Type Ground Water (GW) Date Sampled 10/10/2018 Sample Time - Date Received 11/10/2018 SDG Ref 181011-82 Lab Sample No.(s) 18505196 AGS Reference					
M	mCERTS 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				
Benzo(b)fluoranthene (aq)	<1 µg/l		TM176	<1	#		
Benzo(k)fluoranthene (aq)	<1 µg/l		TM176	<1	#		
Benzo(a)pyrene (aq)	<1 µg/l		TM176	<1	#		
Benzo(g,h,i)perylene (aq)	<1 µg/l		TM176	<1	#		
Carbazole (aq)	<1 µg/l		TM176	<1	#		
Chrysene (aq)	<1 µg/l	TM176	<1	#			
Dibenzofuran (aq)	<1 µg/l	TM176	<1	#			
n-Dibutyl phthalate (aq)	<1 µg/l	TM176	5.53	#			
Diethyl phthalate (aq)	<1 µg/l	TM176	<1	#			
Dibenzo(a,h)anthracene (aq)	<1 µg/l	TM176	<1	#			
Dimethyl phthalate (aq)	<1 µg/l	TM176	<1	#			
n-Dioctyl phthalate (aq)	<5 µg/l	TM176	<5	#			
Fluoranthene (aq)	<1 µg/l	TM176	<1	#			
Fluorene (aq)	<1 µg/l	TM176	<1	#			
Hexachlorobenzene (aq)	<1 µg/l	TM176	<1	#			
Hexachlorobutadiene (aq)	<1 µg/l	TM176	<1	#			
Pentachlorophenol (aq)	<1 µg/l	TM176	<1	#			
Phenol (aq)	<1 µg/l	TM176	<1	#			
n-Nitroso-n-dipropylamine (aq)	<1 µg/l	TM176	<1	#			
Hexachloroethane (aq)	<1 µg/l	TM176	<1	#			
Nitrobenzene (aq)	<1 µg/l	TM176	<1	#			
Naphthalene (aq)	<1 µg/l	TM176	<1	#			
Isophorone (aq)	<1 µg/l	TM176	<1	#			
Hexachlorocyclopentadiene (aq)	<1 µg/l	TM176	<1	#			
Phenanthrene (aq)	<1 µg/l	TM176	<1	#			
Indeno(1,2,3-cd)pyrene (aq)	<1 µg/l	TM176	<1	#			
Pyrene (aq)	<1 µg/l	TM176	<1	#			

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# CERTIFICATE OF ANALYSIS

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**SDG:** 181011-82  
**Location:** Killycard

**Client Reference:** P1724  
**Order Number:** Z1260

**Report Number:** 477251  
**Superseded Report:**

## VOC MS (W)

Results Legend		Customer Sample Ref.	GW02				
#	ISO17025 accredited.						
M	mCERTS 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	Depth (m)	0.00 - 0.00				
(F)	Trigger breach confirmed	Sample Type	Ground Water (GW)				
1-5&*\$@	Sample deviation (see appendix)	Date Sampled	10/10/2018				
		Sample Time					
		Date Received	11/10/2018				
		SDG Ref	181011-82				
		Lab Sample No.(s)	18505196				
		AGS Reference					
Component	LOD/Units	Method					
Dibromofluoromethane**	%	TM208	113				
Toluene-d8**	%	TM208	101				
4-Bromofluorobenzene**	%	TM208	96.6				
Dichlorodifluoromethane	<1 µg/l	TM208	<1	#			
Chloromethane	<1 µg/l	TM208	<1	#			
Vinyl chloride	<1 µg/l	TM208	<1	#			
Bromomethane	<1 µg/l	TM208	<1	#			
Chloroethane	<1 µg/l	TM208	<1	#			
Trichlorofluoromethane	<1 µg/l	TM208	<1	#			
1,1-Dichloroethene	<1 µg/l	TM208	<1	#			
Carbon disulphide	<1 µg/l	TM208	<1	#			
Dichloromethane	<3 µg/l	TM208	<3	#			
Methyl tertiary butyl ether (MTBE)	<1 µg/l	TM208	<1	#			
trans-1,2-Dichloroethene	<1 µg/l	TM208	<1	#			
1,1-Dichloroethane	<1 µg/l	TM208	<1	#			
cis-1,2-Dichloroethene	<1 µg/l	TM208	<1	#			
2,2-Dichloropropane	<1 µg/l	TM208	<1	#			
Bromochloromethane	<1 µg/l	TM208	<1	#			
Chloroform	<1 µg/l	TM208	<1	#			
1,1,1-Trichloroethane	<1 µg/l	TM208	<1	#			
1,1-Dichloropropene	<1 µg/l	TM208	<1	#			
Carbontetrachloride	<1 µg/l	TM208	<1	#			
1,2-Dichloroethane	<1 µg/l	TM208	<1	#			
Benzene	<1 µg/l	TM208	<1	#			
Trichloroethene	<1 µg/l	TM208	<1	#			
1,2-Dichloropropane	<1 µg/l	TM208	<1	#			
Dibromomethane	<1 µg/l	TM208	<1	#			
Bromodichloromethane	<1 µg/l	TM208	<1	#			
cis-1,3-Dichloropropene	<1 µg/l	TM208	<1	#			
Toluene	<1 µg/l	TM208	<1	#			
trans-1,3-Dichloropropene	<1 µg/l	TM208	<1	#			
1,1,2-Trichloroethane	<1 µg/l	TM208	<1	#			
1,3-Dichloropropane	<1 µg/l	TM208	<1	#			

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SDG: 181011-82  
Location: Killycard

Client Reference: P1724  
Order Number: Z1260

Report Number: 477251  
Superseded Report:

## VOC MS (W)

Results Legend		Customer Sample Ref.	GW02			
#	ISO17025 accredited.					
M	mCERTS 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)					
		Depth (m)	0.00 - 0.00			
		Sample Type	Ground Water (GW)			
		Date Sampled	10/10/2018			
		Sample Time	-			
		Date Received	11/10/2018			
		SDG Ref	181011-82			
		Lab Sample No.(s)	18505196			
		AGS Reference				
Component	LOD/Units	Method				
Tetrachloroethene	<1 µg/l	TM208	<1	#		
Dibromochloromethane	<1 µg/l	TM208	<1	#		
1,2-Dibromoethane	<1 µg/l	TM208	<1	#		
Chlorobenzene	<1 µg/l	TM208	<1	#		
1,1,1,2-Tetrachloroethane	<1 µg/l	TM208	<1	#		
Ethylbenzene	<1 µg/l	TM208	<1	#		
m,p-Xylene	<1 µg/l	TM208	<1	#		
o-Xylene	<1 µg/l	TM208	<1	#		
Styrene	<1 µg/l	TM208	<1	#		
Bromoform	<1 µg/l	TM208	<1	#		
Isopropylbenzene	<1 µg/l	TM208	<1	#		
1,1,2,2-Tetrachloroethane	<1 µg/l	TM208	<1	#		
1,2,3-Trichloropropane	<1 µg/l	TM208	<1	#		
Bromobenzene	<1 µg/l	TM208	<1	#		
Propylbenzene	<1 µg/l	TM208	<1	#		
2-Chlorotoluene	<1 µg/l	TM208	<1	#		
1,3,5-Trimethylbenzene	<1 µg/l	TM208	<1	#		
4-Chlorotoluene	<1 µg/l	TM208	<1	#		
tert-Butylbenzene	<1 µg/l	TM208	<1	#		
1,2,4-Trimethylbenzene	<1 µg/l	TM208	<1	#		
sec-Butylbenzene	<1 µg/l	TM208	<1	#		
4-iso-Propyltoluene	<1 µg/l	TM208	<1	#		
1,3-Dichlorobenzene	<1 µg/l	TM208	<1	#		
1,4-Dichlorobenzene	<1 µg/l	TM208	<1	#		
n-Butylbenzene	<1 µg/l	TM208	<1	#		
1,2-Dichlorobenzene	<1 µg/l	TM208	<1	#		
1,2-Dibromo-3-chloropropane	<1 µg/l	TM208	<1	#		
1,2,4-Trichlorobenzene	<1 µg/l	TM208	<1	#		
Hexachlorobutadiene	<1 µg/l	TM208	<1	#		
tert-Amyl methyl ether (TAME)	<1 µg/l	TM208	<1	#		
Naphthalene	<1 µg/l	TM208	<1	#		
1,2,3-Trichlorobenzene	<1 µg/l	TM208	<1	#		

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## 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).



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## Test Completion Dates

Lab Sample No(s)	18505196
Customer Sample Ref.	GW02
AGS Ref.	
Depth	0.00 - 0.00
Type	Ground Water

Alkalinity as CaCO3	15-Oct-2018
Ammoniacal Nitrogen	17-Oct-2018
Anions by Kone (w)	16-Oct-2018
BOD True Total	16-Oct-2018
COD Unfiltered	12-Oct-2018
Coliforms (W)	12-Oct-2018
Conductivity (at 20 deg.C)	12-Oct-2018
Cyanide Comp/Free/Total/Thiocyanate	15-Oct-2018
Dissolved Metals by ICP-MS	17-Oct-2018
Dissolved Oxygen by Probe	12-Oct-2018
Fluoride	17-Oct-2018
Mercury Dissolved	17-Oct-2018
Mineral Oil C10-40 Aqueous (W)	17-Oct-2018
Nitrite by Kone (w)	16-Oct-2018
Organotins in Aqueous Samples	16-Oct-2018
Pesticides (Suite I) by GCMS	17-Oct-2018
Pesticides (Suite II) by GCMS	17-Oct-2018
Pesticides (Suite III) by GCMS	17-Oct-2018
pH Value	12-Oct-2018
Phosphate by Kone (w)	15-Oct-2018
Silicon Dissolved by ICP-OES	16-Oct-2018
SVOC MS (W) - Aqueous	15-Oct-2018
Total Organic and Inorganic Carbon	13-Oct-2018
VOC MS (W)	15-Oct-2018

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**Customer**

Customer Services  
ALS Life Sciences  
Hawarden Business Park  
Manor Lane  
Hawarden, Deeside  
UK  
CH5 3US

**Certificate Of Analysis**

**Job Number:** 18-48075  
**Issue Number:** 1  
**Report Date:** 12 October 2018

**Site:** Killycard  
**PO Number:** Not Supplied  
**Date Samples Received:** 11/10/2018

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Please find attached the results for the samples received at our laboratory on 11/10/2018.

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:**



Shane Reynolds  
Laboratory Manager

**Authorised Date:** 12 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.  
This test report shall not be reproduced except in full or with written approval of City Analysts Limited.

## Certificate Of Analysis

### Customer

Customer Services  
ALS Life Sciences  
Hawarden Business Park  
Manor Lane  
Hawarden, Deeside  
UK  
CH5 3US

**Report Reference:** 18-48075

**Report Version:** 1

**Site:** Killycard

**Sample Description:** GW02

**Date of Sampling:** 10/10/2018

**Sample Type:** Ground

**Date Sample Received:** 11/10/2018

**Lab Reference Number:** 414589

Site / Method Ref.	Analysis Start Date	Parameter	Result	Units	PV Value (Drinking Water Only)
D/D1201#	11/10/2018	Coliforms	549.3	MPN/100ml	-

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# = 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



# CERTIFICATE OF ANALYSIS

<b>SDG:</b> 181011-82	<b>Client Reference:</b> P1724	<b>Report Number:</b> 477251
<b>Location:</b> Killycard	<b>Order Number:</b> Z1260	<b>Superseded Report:</b>

## Appendix

## General

1. Results are expressed on a dry weight basis (dried at 35°C) 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 Dimethylphenol, 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
	Deviation from method
	Holding time exceeded before sample received
5	Samples exceeded holding time before preservation 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).

Astestost Type	Common Name
Chrysotile	White Asbestos
Amosite	Brown Asbestos
Coisidolite	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.**



# Appendix IV

## SITE WALKOVER CHECKLIST AND PHOTOGRAPHIC LOG

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## Killycard Walkover Survey Checklist – 12<sup>th</sup> June 2018

Information	Checked	Comment (include distances from site boundary)
1. What is the current land use?		The majority of the site is vegetated and used for agriculture. Derelict mushroom buildings and industrial units are also present to the east of the site.
2. What are the neighbouring land uses?		Primarily agricultural with some residential buildings to the southwest of the site.
3. What is the size of the site?		The site occupies approximately 2 Hectares
4. What is the topography?		The site is relatively flat throughout.
5. Are there potential receptors (if yes, give details)?		Yes, leachate to west of site
Houses		Yes
Surface water features (if yes, distance and direction of flow)		Corrinsingo lake borders the site to the west. Surface water ditches border the site to the southwest and north.
Any wetland or protected areas		No
Public water supplies		No
Private wells		Not evident
Services		Overhead wires along the southeast of the site connecting to industrial units.
Other buildings		Derelict mushroom buildings onsite. Farm buildings to east and south of the site. Residential buildings within 100m to the southwest of the site.
Other		No
6. Are there any potential sources of contamination (if yes, give details)?		Yes – Waste from former landfill
Surface waste (if yes, what type?)		Waste found protruding through soil cover throughout the site. Generally residual inert domestic and C&D waste.
Surface ponding of leachate		No
Leachate seepage		No
Landfill gas odours		No
7. Are there any outfalls to surface water? (If yes, are there discharges and what is the nature of discharge?)		Yes, lake to west of site/ Receptors north and SW of site

Information	Checked	Comment (include distances from site boundary)
8. Are there any signs of impact on the environment? (If yes, take photographic evidence)		Yes, waste depositing into lake
Vegetation die off, bare ground		No
Leachate seepages		No
Odours		No
Litter		Yes, waste found protruding through soil cover throughout the site.
Gas bubbling through water		No
Signs of settlement		No
Subsidence, water logged areas		No
Drainage or hydraulic issues		No
Downstream water quality appears poorer than upstream water quality		No
9. Are there any indications of remedial measures? (Provide details)		No
Capping		No
Landfill gas collection		No
Leachate collection		No
10. Describe fences and security features (if any)		Fencing and walls around buildings, ditches around most of site, wall along the road
Any other relevant information?		

# PHOTOGRAPHIC LOG

Consultants in Engineering  
and Environmental Sciences

www.fehilytimoney.ie



**Client Name:**  
Monaghan Co. Council

**Site Location:** Killycard

**Project Number:** P1655

**Photo No.**

**Date:**

1

12/06/18

**Description:**

Site entrance to  
industrial units



**Photo No.**

**Date:**

2

12/06/18

**Description:**

Grassed areas near  
industrial units carpark





# PHOTOGRAPHIC LOG

Consultants in Engineering  
and Environmental Sciences

www.fehilytimoney.ie



**Client Name:**  
Monaghan Co. Council

**Site Location:** Killycard

**Project Number:** P1655

**Photo No.**  
3

**Date:**  
12/06/18

**Description:**

Old gas well near  
industrial unit  
carpark



**Photo No.**  
4

**Date:**  
12/06/18

**Description:**

Site entrance to  
derelict mushroom  
buildings





# PHOTOGRAPHIC LOG

Consultants in Engineering  
and Environmental Sciences

www.fehilytimoney.ie



**Client Name:**  
Monaghan Co. Council

**Site Location:** Killycard

**Project Number:** P1655

**Photo No.**  
5

**Date:**  
12/06/18

**Description:**

Area in front of  
derelict mushroom  
buildings

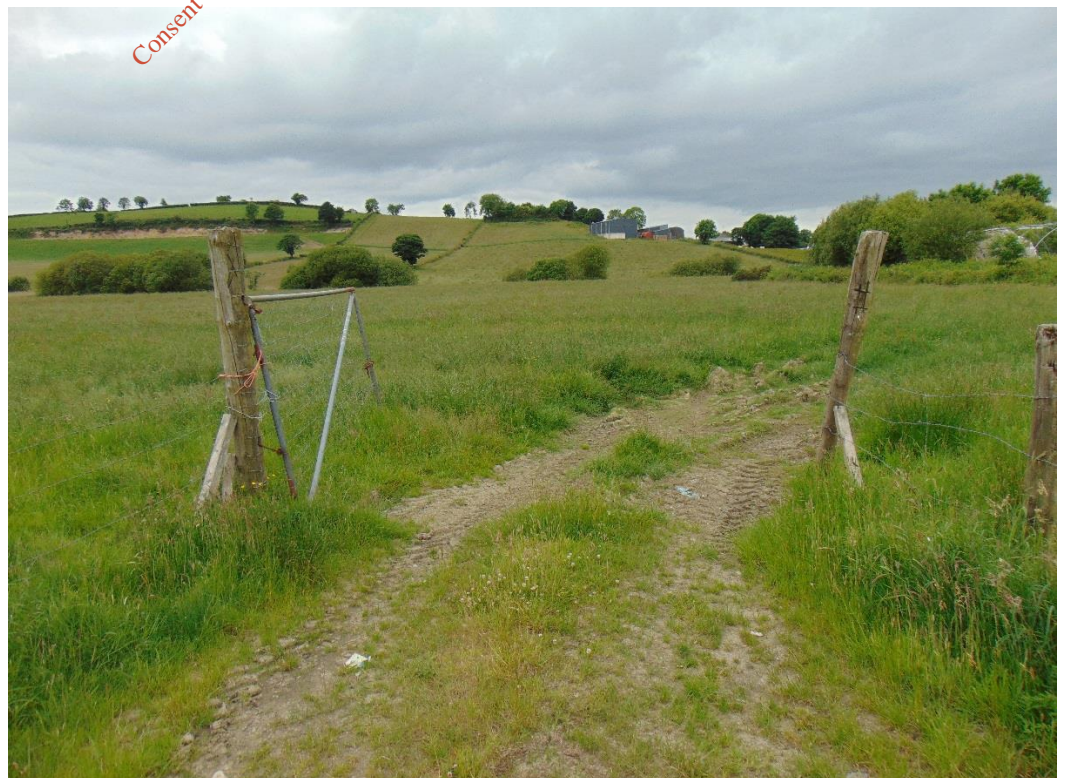


**Photo No.**  
6

**Date:**  
12/06/18

**Description:**

Site entrance to  
vegetated field





# PHOTOGRAPHIC LOG

Consultants in Engineering  
and Environmental Sciences

www.fehilytimoney.ie



**Client Name:**  
Monaghan Co. Council

**Site Location:** Killycard

**Project Number:** P1655

**Photo No.**  
7

**Date:**  
12/06/18

**Description:**

Southern section of vegetated field



**Photo No.**  
8

**Date:**  
12/06/18

**Description:**

Area west of industrial units, north of derelict mushroom buildings





# PHOTOGRAPHIC LOG

Consultants in Engineering  
and Environmental Sciences

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**Client Name:**  
Monaghan Co. Council

**Site Location:** Killycard

**Project Number:** P1655

**Photo No.**  
9

**Date:**  
12/06/18

**Description:**

Northern section of site, looking westwards



**Photo No.**  
10

**Date:**  
12/06/18

**Description:**

Waste material protruding from northern boundary adjacent to surface water ditch





# PHOTOGRAPHIC LOG

Consultants in Engineering  
and Environmental Sciences

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**Client Name:**  
Monaghan Co. Council

**Site Location:** Killycard

**Project Number:** P1655

**Photo No.**  
11

**Date:**  
12/06/18

**Description:**

Exposed waste material at western boundary of Corrinshigo lake



**Photo No.**  
12

**Date:**  
12/06/18

**Description:**

Exposed waste material and Japanese Knotweed at western boundary of Corrinshigo lake





# PHOTOGRAPHIC LOG

Consultants in Engineering  
and Environmental Sciences

www.fehilytimoney.ie



**Client Name:**  
Monaghan Co. Council

**Site Location:** Killycard

**Project Number:** P1655

**Photo No.**  
13

**Date:**  
12/06/18

**Description:**

Waste material  
protruding from soil  
surface



**Photo No.**  
14

**Date:**  
12/06/18

**Description:**

Waste material  
protruding from soil  
surface



# Appendix V

## APEX GEOSERVICES GEOPHYSICAL REPORT

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**AGL18164\_01**

**REPORT  
ON THE  
GEOPHYSICAL SURVEY  
AT  
KILLYCARD, CASTLEBLAYNEY  
Co. MONAGHAN  
FOR  
FEHILLY TIMONEY & Co.**

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**14TH NOVEMBER 2018**



## **PRIVATE AND CONFIDENTIAL**

THE FINDINGS OF THIS REPORT ARE THE RESULT OF A GEOPHYSICAL SURVEY USING NON-INVASIVE SURVEY TECHNIQUES CARRIED OUT AT THE GROUND SURFACE. INTERPRETATIONS CONTAINED IN THIS REPORT ARE DERIVED FROM A KNOWLEDGE OF THE GROUND CONDITIONS, THE GEOPHYSICAL RESPONSES OF GROUND MATERIALS AND THE EXPERIENCE OF THE AUTHOR. APEX GEOSERVICES LTD. HAS PREPARED THIS REPORT IN LINE WITH BEST CURRENT PRACTICE AND WITH ALL REASONABLE SKILL, CARE AND DILIGENCE IN CONSIDERATION OF THE LIMITS IMPOSED BY THE SURVEY TECHNIQUES USED AND THE RESOURCES DEVOTED TO IT BY AGREEMENT WITH THE CLIENT. THE INTERPRETATIVE BASIS OF THE CONCLUSIONS CONTAINED IN THIS REPORT SHOULD BE TAKEN INTO ACCOUNT IN ANY FUTURE USE OF THIS REPORT.

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<b>PROJECT NUMBER</b>	AGL18164		
<b>AUTHOR</b>	<b>CHECKED</b>	<b>REPORT STATUS</b>	<b>DATE</b>
EURGEOL PETER O'CONNOR M.Sc. (GEOPHYSICS), P.GEO. DIP EIA MGT.	TONY LOMBARD M.Sc. (GEOPHYSICS)	V1 DRAFT	14 <sup>TH</sup> NOVEMBER 2018

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## 1. EXECUTIVE SUMMARY

APEX Geoservices Ltd. was requested by Fehilly Timoney & Co. to carry out a geophysical survey at a landfill site in Killycard, County Monaghan. The purpose of the investigation is to determine the extent, thickness, type and volume of imported material across the site. The site area covers approximately 2.2Ha of which approximately 0.9 Ha is covered in buildings and hardstands.

The site is underlain by cut away peat, with Lower Palaeozoic glacial till on the more elevated ground to the north and south.

The rock type locally is black pyritic, occasionally graptolitic, shale-schist of the Oghill Formation. Depth to rock is shallow and a number of old quarry workings occur in the vicinity.

Trial pit logs from a previous investigation show thin topsoil over mixed waste over soft peat and clay/silt. A number of the trial pit logs record 'black waste' on the logs.

The geophysical investigation consisted of EM ground conductivity mapping with follow-up Electrical Resistivity Tomography (ERT), Seismic Refraction profiling and MASW.

Both the elevated EM conductivity readings and the trial pit logs show waste to be present across the all of the survey area. Two zones with different types of waste have been outlined:

**Zone A** - TOPSOIL over MADE GROUND/WASTE (Predominantly organic) over very soft PEAT/CLAY with LEACHATE extending between 2 and 5m into the underlying peat, clay and silt layers. This area corresponds well with the location of those trial pits where 'black waste' was encountered.

**Zone B** - TOPSOIL over MADE GROUND/WASTE (mixed with CLAY/SILT) over very soft PEAT/CLAY.

As electrical contrasts between waste, leachate and soils are low the most reliable waste thickness information comes from the trial pit and MASW data. The average thickness of the Zone A waste is 2.1m and the average thickness of the Zone B waste is 2.4m.

The S-wave velocities for the survey area indicate soft to very soft waste and underlying soils and some **long term settlement** can be expected.

The volumes of waste calculated are as follows:

Zone	Extent (sq. m.)	Thickness (m.)	Volume (cu. m.)	Tonnes (@ 1.4 tonnes/cu.m.)
A	6743	2.1	14,160	19,824
B	6473	2.4	15,535	21,750
Totals	13,216		29,695	41,574

Bedrock elevation is around 85-90 mOD increasing to around 88-90 mOD to the south of the survey area. Combined waste and soil thicknesses range from around 5m to 10m.

Boreholes are recommended to confirm the findings of the geophysical report.

The geophysical report should be reviewed after the completion of any further direct investigation.

## 2. INTRODUCTION

APEX Geoservices Ltd. was requested by Fehilly Timoney & Co. to carry out a geophysical survey at a landfill site in Killycard, County Monaghan. A Tier 2 environmental risk assessment is being carried out at the site. As part of the risk assessment there is a requirement for a geophysical investigation. The purpose of the investigation is to determine the extent, thickness and type of imported material across the site.

### 2.1 Project Objectives

The objectives of the survey were to provide information on:

- The extent of the waste body
- The type of waste present
- The thickness of the waste and presence of any anomalous features
- A volume calculation
- Depth to bedrock (if within limits of the survey)
- Proposed location of direct investigation points.

### 2.2 Site Background

The historic landfill is located approximately 1.7km to the north-west of Castleblayney Town on the R-183 Castleblayney to Ballybay regional road. A Tier 1 environmental risk assessment (ERA) was conducted by Fehilly Timoney & Co. in June 2018 which included a detailed desk study and site walkover. The ERA concluded that a high risk classification (Class A) can be assigned to the site and that further investigation was warranted. The area to be investigated covers approximately 2.2Ha of which approximately 0.9 Ha is covered in buildings and hardstands (Fig. 2.1).

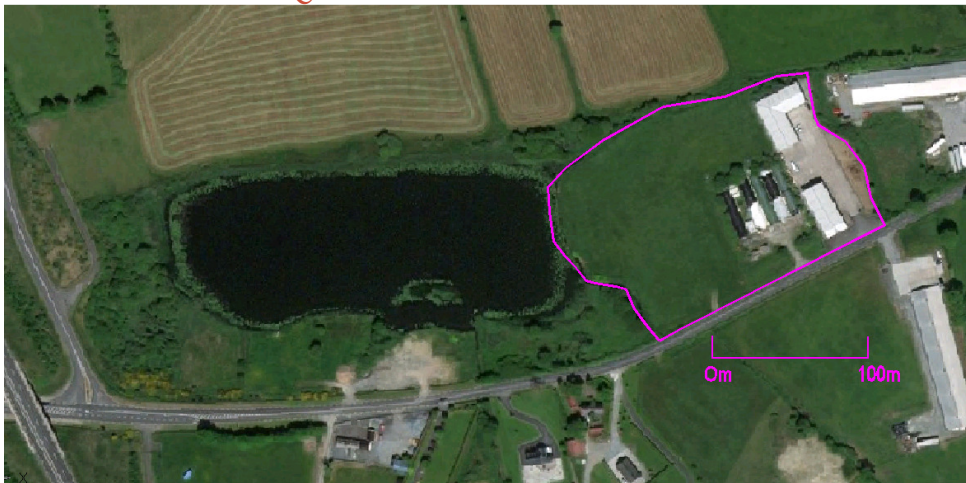


Figure 2.1. Site location indicated by magenta boundary.

The site is bounded to the north by agricultural land, to the west by Corrinshigo Lough and to the east and south by farmland and farm buildings. The site is relatively flat lying at an elevation of c. 94 mOD.

### 2.3 Geology & Soils

The Teagasc soils map for the area (Fig. 2.2) indicates that the site is originally underlain by cut away peat, with Lower Palaeozoic glacial till on the more elevated ground to the north and south.



Figure 2.2: Brown = cut-away peat, red = glacial till.

The Geological Survey of Ireland (GSI) 1:100,000 Bedrock Geology map for the area (Figure 2.3) indicates that the site is underlain by the Oghill Formation, which consists of grey to grey-green massive sandstone (greywacke), microconglomerate and amalgamated beds with subordinate thin to thick-bedded greywacke and locally infaulted dark grey or black pyritic, occasionally graptolitic shale-mudstone.

Examination of the GSI 6" geology sheet for the site shows the rock in the immediate vicinity of the site to be dark fissile, pyritic shale with occasional schists and white quartz veins. Depth to rock is shallow and a number of old quarry workings occur in the vicinity.



Figure 2.3. Bedrock geological map for the survey area.



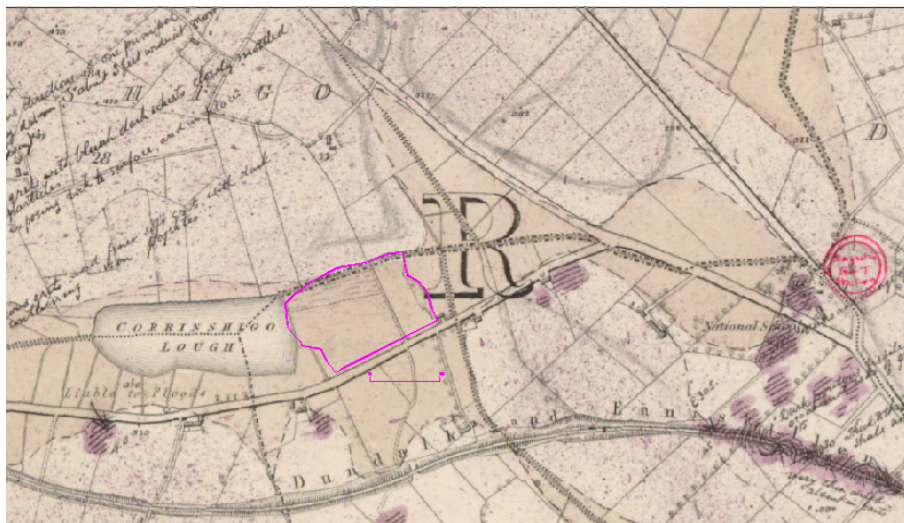


Figure 2.4. Geological Survey of Ireland 6" sheet for the area.

## 2.4 Site Investigation

Thirteen trial pits and 3 monitoring wells were completed at the site in a previous investigation. The trial pit logs show the following general stratigraphy; thin topsoil (0.1m) over made ground consisting of mixed waste material to between 1.1 and 3.4m bgl. The waste is underlain by between 0.8 and 1.6m of soft peat which in turn overlies soft to firm clay. The trial pit data have been incorporated into the geophysical interpretation presented in this report.

The location of the trial pits are shown on AGL18164\_01. A number of trial pits record 'black waste' on the logs. These locations are designated with a 'K' after the Trial Pit number.

## 2.5 Survey Rationale

The investigation consisted of reconnaissance EM ground conductivity mapping with follow-up Electrical Resistivity Tomography (ERT), Seismic Refraction profiling and MASW:

**EM** ground conductivity mapping operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). This technique will provide information on the shallow (0-6m below ground level) variation of the superficial deposits and outline the extent of any shallow bedrock.

**ERT** soundings image the resistivity of the materials in the subsurface along a profile to produce a pseudo-section showing the variation in resistivity to depths dependent on the length of the profile. Each pseudo-section is interpreted to determine the material type along the profile based on the typical resistivities returned for Irish ground materials.

**Seismic Refraction Profiling** measures the P-wave velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. This method profiles the depth to the top of the stiff soils and bedrock, and provides information on the quality/strength of the bedrock.

---

The **MASW** method is used to estimate shear-wave velocities ( $V_s$ ) in the ground material. Overburden material with a  $V_s < 175$  m/s is generally classified as soft/loose.

As with all geophysical methods the results are based on indirect readings of the subsurface properties. The effectiveness of the proposed approach will be affected by variations in the ground properties. By combining a number of techniques it is possible to provide a higher quality interpretation and reduce any ambiguities which may otherwise exist. Further information on the detailed methodology of each geophysical method employed in this investigation is given in **APPENDIX A: DETAILED METHODOLOGY.**

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### 3 RESULTS & INTERPRETATION

The geophysical survey locations are indicated on Drawing AGL18164\_01 (Appendix B). The survey area to the west of the yards and buildings extends to approximately 1.32 Ha.

#### 3.1 EM Ground Conductivity Mapping

The EM31 conductivity survey locations are shown on Drawing AGL18164\_01. The recorded EM31 conductivity values are contoured on Drawing AGL18164\_02. The conductivity values range from 25-125 milliSiemens/metre (mS/m). The conductivity values have been interpreted as follows:

Conductivity (mS/m)	Interpretation
25 - 60	TOPSOIL over MADE GROUND/WASTE (mixed with CLAY/SILT) over very soft PEAT/CLAY
60 - 125	TOPSOIL over MADE GROUND/WASTE (Predominantly organic) over very soft PEAT/CLAY <b>with LEACHATE</b>

Note: EM31 measurements refer to the bulk electrical conductivity of the upper 6m of ground.

#### 3.2 Electrical Resistivity Tomography

Five resistivity profiles were recorded across the site (Profiles R1 to R5). The locations are shown on Drawing AGL18164\_01. Interpreted cross sections were compiled for the profiles and are presented on Drawings AGL18164\_R1-R5.

In determining the various types of imported material present from the resistivity sections R1-R5 it should be noted that:

- typical resistivities of Irish soils range from 20 ohm-m (clays) to around 3000 Ohm-m (dry gravel),
- the resistivity generally increases as the sand/gravel content increases,
- silt/clay typically has values in the range 30-50 Ohm-m ,
- silty gravelly clay typically has resistivity values in the range 50-100 Ohm-m,
- deposits of predominantly organic waste such as those occurring in municipal landfills typically have resistivities in the range 5-30 Ohm-m.
- leachate saturated soils originating from predominantly organic waste have a similar resistivity range to organic waste, but will be influenced by the resistivities of the host material and the degree of dilution and dispersion of the leachate,
- inert C & D waste such as concrete, brick and mixed rock fill, stone and clay will usually have resistivities similar to gravelly material (50-500 Ohm-m).

The resistivity values recorded at this site ranged from 5-150 Ohm-m and have been interpreted as follows:

Resistivity (Ohm-m)	Interpretation
5-24	MADE GROUND/WASTE (Predominantly organic) over very soft PEAT/CLAY <b>with LEACHATE</b>
24-34	MADE GROUND/WASTE (mixed with CLAY/SILT) over very soft PEAT/CLAY
34-48	CLAY/SILT
48-150	PYRITIC SHALE/SCHIST BEDROCK

### 3.3 Seismic Refraction Profiling

Three seismic refraction profiles (S1-S3) were recorded across the site. The locations are shown on Drawing AGL18164\_01 and the results are included on the interpreted cross sections in Drawings AGL18164\_R1-R5 and in Appendix C.

The P-wave seismic velocities have been interpreted as follows:

Layer	Velocity (m/s)	Interpretation
1	300-350	Soft/loose MADE GROUND/WASTE/PEAT
2	700-800	Firm/medium dense or semi-saturated CLAY/SILT
3	2500-3200	Weak to occasionally moderately strong, cleaved SHALE/SCHIST

### 3.4 MASW

Shear wave (S-wave) velocity ( $V_s$ ) and  $G_{max}$  values were determined for the made ground/waste and underlying soil material.  $V_s$  velocities and corresponding soil cohesion ranges are summarised in Figure 3.1.

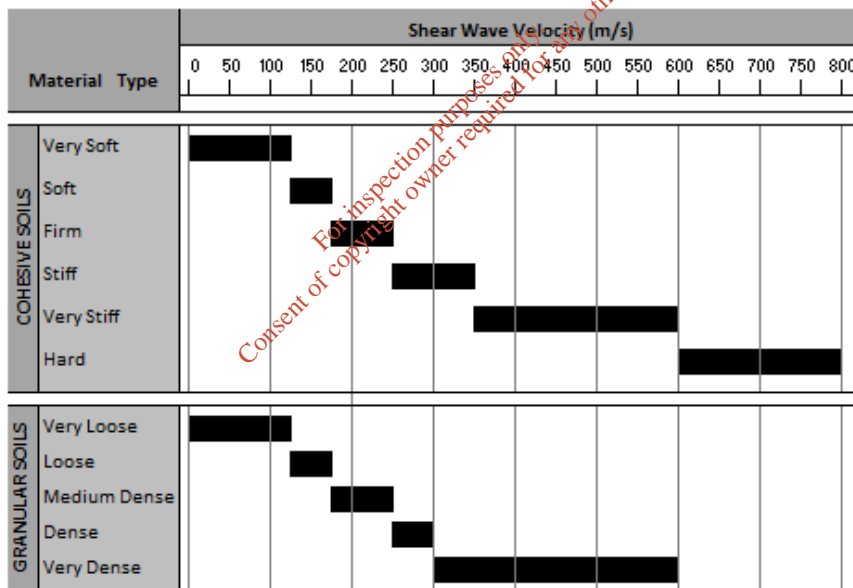


Fig 3.1:  $V_s$  velocities and corresponding soil cohesion ranges

The S-wave seismic velocities from this site have been interpreted as follows:

Layer	Velocity (m/s)	Interpretation
1	125 - 145	Soft/Loose MADE GROUND/WASTE (mixed with CLAY/SILT)
2	80 - 90	Very soft/Loose MADE GROUND/WASTE (Predominantly organic)
3	65 - 100	Very soft PEAT/CLAY

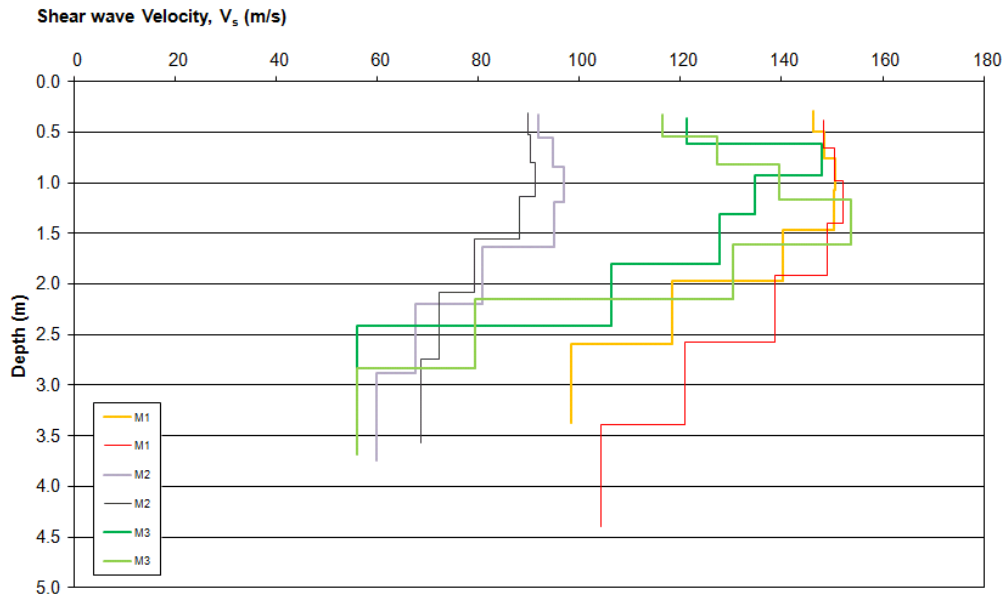


Fig 3.2: Vs velocities across site (M1-M3)

### 3.5 Discussion

The interpretation of the geophysical data is plotted on Drawings AGL18164\_R1 to AGL18164\_R5 and summarised on Drawings AGL18164\_03.

#### 3.5.1 Extent of the waste

Both the elevated EM conductivity readings and the trial pit logs show the waste to be present across the all of the survey area.

#### 3.5.2 Type of waste

Both the EM Conductivity and the ERT profiles have outlined two types of waste present across the site:

The high EM conductivity and low ERT resistivity values have outlined an area of **0.67 Ha** which has been interpreted as TOPSOIL over MADE GROUND/WASTE (Predominantly organic) over very soft PEAT/CLAY with LEACHATE (**Zone A**). This area corresponds well with the location of trial pits where 'black waste' was encountered.

The lower EM conductivity and higher ERT resistivity values have outlined an area of **0.65 Ha** which has been interpreted as TOPSOIL over MADE GROUND/WASTE (mixed with CLAY/SILT) over very soft PEAT/CLAY (**Zone B**). This area corresponds well with the location of trial pits where brown or grey-black waste mixed with clay or silt was encountered.

#### 3.5.3 Thickness of waste and other information.

Electrical contrasts between both waste types and the underlying peat and clay are poor and the best thickness information comes from the trial pit and MASW data. The average thickness of the Zone A waste is 2.1m and the average thickness of the Zone B waste is 2.4m.

All of the ERT profiles in Zone A show the low resistivity zone to extend between 2 and 5m below the bottom of the waste as found on the trial pit logs. This has been interpreted as a zone of **leachate** beneath the waste body extending into the underlying peat, clay and silt layers.

The S-wave velocities for the waste layer indicate that it is slightly more compacted/stiffer/denser than the softer underlying peat/clay/silt material on which it sits. Some **long term settlement** can be expected on this basis.

### 3.5.4 Volume calculation

The volumes of waste calculated using the extents and thicknesses shown above are as follows:

Zone	Extent (sq. m.)	Thickness (m.)	Volume (cu. m.)	Tonnes (@ 1.4 tonnes/cu.m.)
A	6743	2.1	14,160	19,824
B	6473	2.4	15,535	21,750
Totals	13,216		29,695	41,574

### 3.5.5 Bedrock

The unusually low resistivity and the low seismic velocity for rock are both typical of what is expected from a fissile pyritic shale/schist of the type indicated on the GSI 6" sheet for the area. Bedrock elevation is around 85-90 mOD increasing to around 88-90 mOD to the south. Combined waste and soil thicknesses range from around 5m to 10m. Due to the poor resistivity and seismic velocity contrasts between the pyritic shale/schist and overlying clays, silts, peat and waste, the exact bedrock profile is difficult to interpret with certainty.

#### 4 RECOMMENDATIONS

To confirm the findings of the geophysical report the following boreholes are recommended:

No.	Easting	Northing	Comment
PBH1	680891.2	820416.5	to investigate predominantly organic waste and underlying leachate
PBH2	680948.3	820403.1	to investigate waste mixed with CLAY/SILT

The geophysical report should be reviewed after the completion of any direct investigation.

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## REFERENCES

- Bell F.G., 1993;  
'Engineering Geology', Blackwell Scientific Press.
- Davies & Schulteiss, 1980;  
'Seismic signal processing in Engineering Site Investigation – a case history', Ground Engineering, May 1980.
- Deere, D. U., Hendron, A. J., Patton, F.D., and Cording, E.J. 1967;  
Design of surface and near surface construction in rock. Failure and breakage of rocks, proceedings 8<sup>th</sup> U.S. symposium rock mechanics, New York: Soc. Min Engrs, Am. Inst. Min Metall. Petrolm Engrs.
- Geotomo Software, 2006;  
'RES2DINV Users Manual', Malaysia.
- Fehilly Timoney & Co. June 2018; Tier 1 Environmental Risk Assessment Historic Landfill at Killycard Landfill, Co. Monaghan,.
- GSI, 2017; Bedrock Geology 1:100,000 Shapefile. <http://www.gsi.ie/Mapping.htm>
- GSI, 2017; GSI Quaternary Deposits Shapefile. <http://www.gsi.ie/Mapping.htm>
- GSI, 2017; Groundwater Vulnerability Shapefile. <http://www.gsi.ie/Mapping.htm>
- Hagedoorn, J.G., 1959;  
'The plus - minus method of interpreting seismic refraction sections', Geophysical Prospecting, 7, 158 - 182.
- Heerden, van H. 1987.  
'Relation between Static and Dynamic moduli of rocks', Int. Journal of Rock Mech. Min. Sci. and Geomech Abs Vol. 24, No. 6 pp 381-385, Pergamon.
- KGS, 2000;  
Surfseis Users Manual, Kansas Geological Survey.
- Palmer, D., 1980;  
'The Generalized Reciprocal Method of seismic refraction interpretation', SEG.
- Park, C.B., Miller, R.D., and Xia, J., 1998;  
Ground roll as a tool to image near-surface anomaly:SEG Expanded Extracts, 68th Annual Meeting, New Orleans, Louisiana, 874-877.
- Park, C.B., Miller, R.D., and Xia, J., 1999;  
Multi-channel analysis of surface waves (MASW): Geophysics, May-June issue.
- Redpath, B.B., 1973;  
'Seismic refraction exploration for engineering site investigations', NTIS, U.S. Dept. of Commerce



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## APPENDIX A: DETAILED METHODOLOGY

A combination of a number of geophysical techniques was used to provide the high quality interpretation and reduce any ambiguities, which may otherwise exist.

### A.1 EM Ground Conductivity Mapping

#### Principles

This method operates on the principle of inducing currents in conductive substrata and measuring the resultant secondary electro-magnetic field. The strength of this secondary EM field is calibrated to give apparent ground conductivity in milliSiemens/metre (mS/m). Readings over material such as organic waste and peat give high conductivity values while readings over dry materials with low clay mineral content such as gravels, limestone or quartzite give low readings. The EM31 survey technique determines the apparent conductivity of the ground material from 0-6m bgl depending on the dipole mode used. Depending on the dipole mode used, the measured conductivity is a function of the different overburden layers and/or rock from 0 to 6m below ground level.

#### Data collection

The EM31 equipment used was a GF CMD-4 conductivity meter equipped with data logger. This instrument features a real time graphic display of the previous 20 measurement points to monitor data quality and results. Conductivity and in-phase values were recorded across the site. Local conditions and variations were recorded.

#### Data processing

The conductivity and in-phase field readings were downloaded, contoured and plotted using the SURFER 9 program (Golden Software, 2009). Data which was affected by metallic objects was removed. Assignment of material types and possible anomaly sources was carried out, with cross-reference to other data.

### A.2 Electrical Resistivity Tomography

#### Principles

This surveying technique makes use of the Wenner resistivity array. The 2D-resistivity profiling method records a large number of resistivity readings in order to map lateral and vertical changes in material types. The 2D-resistivity profiling method involves the use of electrodes connected to a resistivity meter, using computer software to control the process of data collection and storage.

#### Data Collection

The data were recorded using a Tigre resistivity meter, imaging software, a 32 takeout multicore cables and 32 stainless steel electrodes. Saline solution was used at the electrode\ground interface in order to gain a good electrical contact required for the technique to work effectively. The recorded data were processed and viewed immediately after the survey.

#### Data Processing

The field readings were stored in computer files and inverted using the RES2DINV package (Campus Geophysical Instruments, 1997) with up to 5 iterations of the measured data carried out for each profile to obtain a 2D-Depth model of the resistivities.

The inverted 2D-Resistivity models and corresponding interpreted geology are displayed on the accompanying drawings. Distance is indicated along the horizontal axis of the profiles. Profiles have been contoured using the same contour intervals and colour codes.

### A.3 Seismic Refraction Profiling

#### Principles

The seismic refraction profiling method measures the velocity of refracted seismic waves through the overburden and rock material and allows an assessment of the thickness and quality of the materials present to be made. Stiffer and stronger materials usually have higher seismic velocities while soft, loose or fractured materials have lower velocities. Readings are taken using geophones connected via multi-core cable to a seismograph.

#### Data Collection

Seismic spreads were recorded using a Geode high-resolution 24 channel digital seismograph with geophone spacings of 2 m and 3 m. The source of the seismic waves was a sledgehammer. Records from up to seven different positions were taken on each spread (2 x off-end, 2 x end, 3 x middle) to ensure optimum coverage of all refractors.

#### Data Processing

First break picking in digital format was carried out using the FIRSTPIX software program to construct traveltimes plots for each spread. The recorded data was processed and interpreted using the intercept-time and plus-minus methods, to acquire depths to boundaries and the P-wave velocities of these layers, using the GREMIX programme from INTERPEX

Approximate errors for velocities are estimated to be +/- 10%. Errors for the calculated layer thicknesses are of the order of +/-20%. Possible errors due to the "hidden layer" and "velocity inversion" effects may also occur (Soske, 1959).

### A.4 Multichannel Analysis of Surface Waves

#### Principles

The Multi-channel Analysis of Surface Waves (MASW) (Park et al., 1998, 1999) utilizes Surface waves (Rayleigh waves) to determine the elastic properties of the shallow subsurface (<15m). Surface waves carry up to two-thirds of the seismic energy but are usually considered as noise in conventional body wave reflection and refraction seismic surveys.

The penetration depth of surface waves changes with wavelength, i.e. longer wavelengths penetrate deeper. When the elastic properties of near surface materials vary with depth, surface waves then become dispersive, i.e. propagation velocity changes with frequency. The propagation (or phase) velocity is determined by the average elastic property of the medium within the penetration depth. Therefore the dispersive nature of surface waves may be used to investigate changes in elastic properties of the shallow subsurface.

The MASW method employs the multi-channel recording and processing techniques (Sheriff and Geldart, 1982) that have similarities to those used in a seismic reflection survey and which allow

better waveform analysis and noise elimination. The following procedure is followed to produce a shear wave velocity ( $V_s$ ) profile and a stiffness profile of the subsurface using surface waves:

- (i) A point source (eg. a sledgehammer) is used to generate vertical ground motions,
- (ii) the ground motions are measured using low frequency geophones, which are deposited along a straight line directed toward the source,
- (iii) the ground motions are recorded using a seismograph,
- (iv) a dispersion curve is produced from spectral analysis of the data showing the variation of surface wave velocity with wavelength,
- (v) the dispersion curve is inverted using a modelling and least squares minimization process to produce a subsurface profile of the variation of shear wave velocity with depth.

#### Data Collection

The recording equipment consisted of a Geode 24 channel digital seismograph, 24 no. 4HZ vertical geophones, hammer energy source with mounted trigger and a 24 take-out cable, with geophone spacings of 2 m and 3 m.

#### Data Processing

MASW processing was carried out using the SURFSEIS processing package developed by Kansas Geological Survey (KGS, 2000). SURFSEIS data processing involves three steps:

- (i) Preparation of the acquired multichannel record. This involves converting data file into the processing format.
- (ii) Production of a dispersion curve from a spectral analysis of the data showing the variation of Raleigh wave phase velocity with wavelength. Confidence in the dispersion curve can be estimated through a measure of signal to noise ratio (S/N), which is obtained from a coherency analysis. Noise includes both body waves and higher mode surface waves. To obtain an accurate dispersion curve the spectral content and phase velocity characteristics are examined through an overtone analysis of the data.
- (iii) Inversion of the dispersion curve is then carried out to produce a subsurface profile of the variation of shear wave velocity with depth. The bedrock P-wave velocities were converted to S-wave velocities using the following equation:

$$V_s = \left( \frac{(V_p^2) - 2 \cdot v \cdot (V_p^2)}{(1 - v) \cdot 2} \right)^{0.5}$$

Where  $V_s$  = S-wave velocity in m/s,  $V_p$  = P-wave velocity in m/s and  $v$  = Poisson's ratio.

### A.5 Spatial Relocation

All the geophysical investigation locations were acquired using Trimble Geo 7X high-accuracy GNSS handheld GPS system using the settings listed below. This system allows collecting GPS data with c.20mm accuracy.

<b>Projection:</b>	Irish National Grid
<b>Datum:</b>	Ordnance
<b>Coordinate units:</b>	Meters
<b>Altitude units:</b>	Meters
<b>Survey altitude reference:</b>	MSL
<b>Geoid model:</b>	Republic of Ireland

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## APPENDIX B: DRAWINGS

The information derived from the geophysical investigation as well as correlation with the available direct investigation is presented in the following drawings:

AGL18164_01	Geophysical Investigation Locations	Scale 1:1000 @ A4
AGL18164_02	EM Conductivity Contours (mS/m)	Scale 1:1000 @ A4
AGL18164_03	Summary Interpretation Map	Scale 1:1000 @ A4

The ERT and seismic refraction data with geological interpretations are presented in the following drawings:

Drawing AGL18164_R1	Results and Interpretation R1	Scale 1:750 @ A4
Drawing AGL18164_R2	Results and Interpretation R2	Scale 1:750 @ A4
Drawing AGL18164_R3	Results and Interpretation R3	Scale 1:750 @ A4
Drawing AGL18164_R4	Results and Interpretation R4	Scale 1:750 @ A4
Drawing AGL18164_R5	Results and Interpretation R5	Scale 1:750 @ A4

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