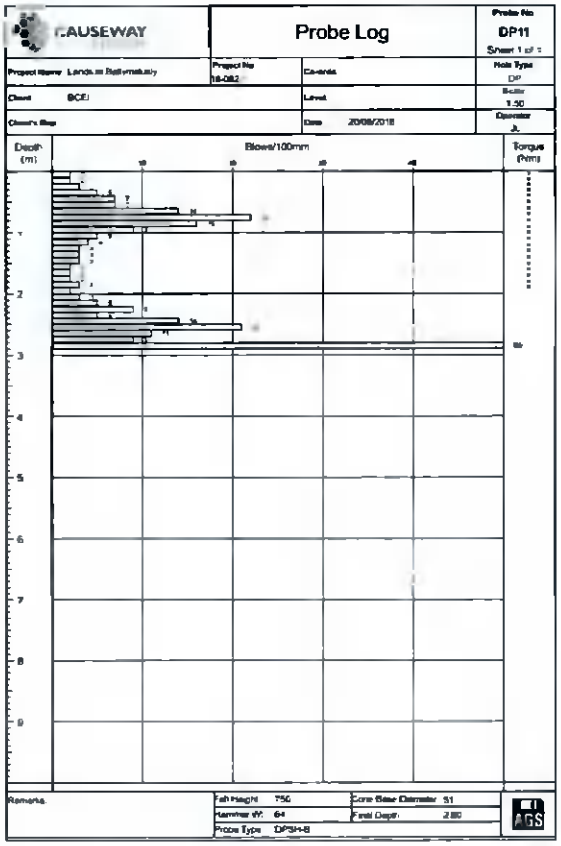
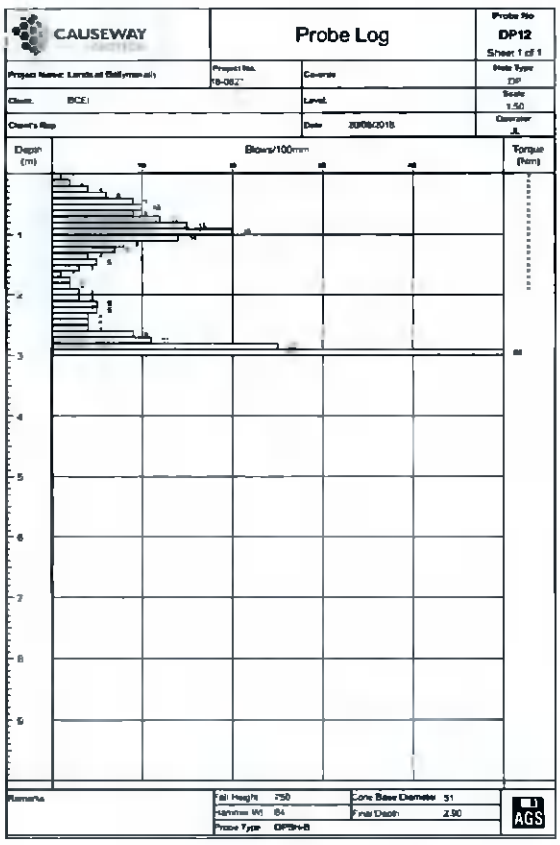
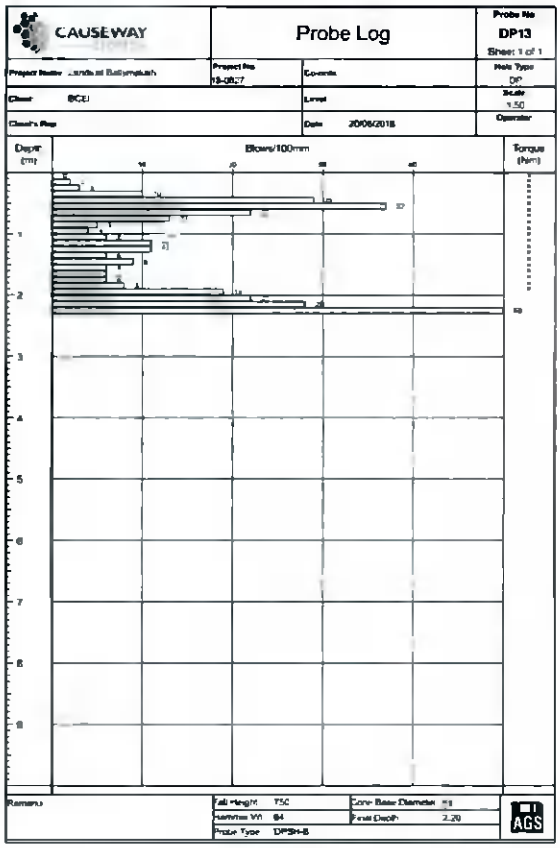
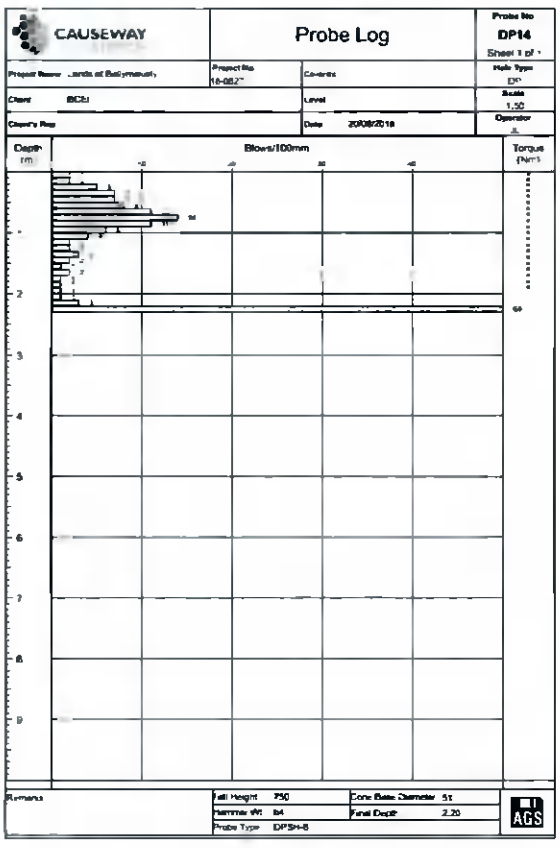
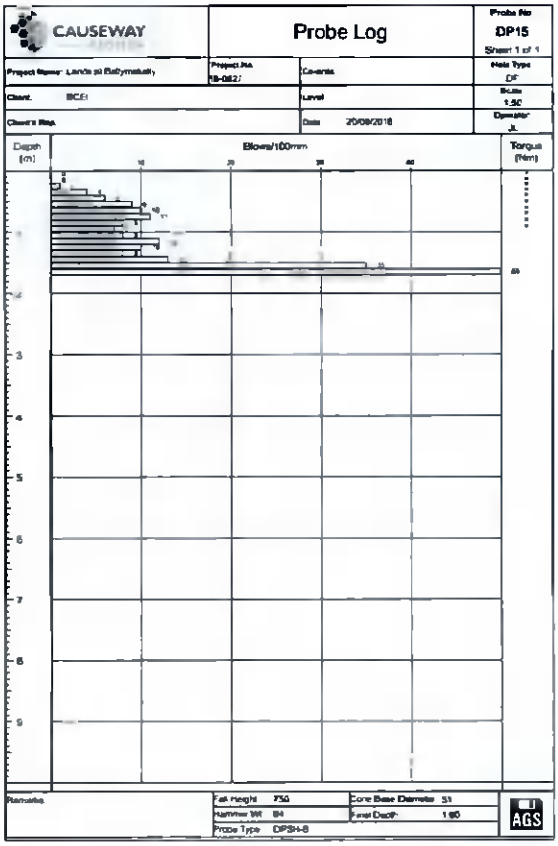
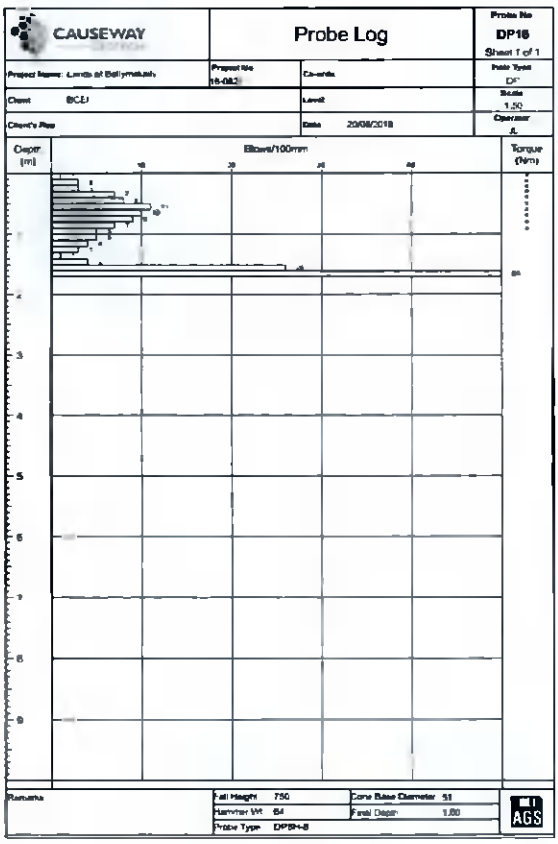

CAUSEWAY
Probe Log
DP11
Sheet 1 of 1
Project Name: Lands at Ballymakaily
Project No: 18-082
Co-ords:
Hole Type: DP
Client: BCEI
Level:
Scale: 1:50
Client's Rep:
Date: 20/06/2018
Operator: JL
Depth (m)
Blows/100mm
Torque (Nm)
Remarks:
Fall Height: 750
Cone Base Diameter: 51
Hammer Wt: 64
Final Depth: 2.80
Probe Type: DPSH-B
AGS

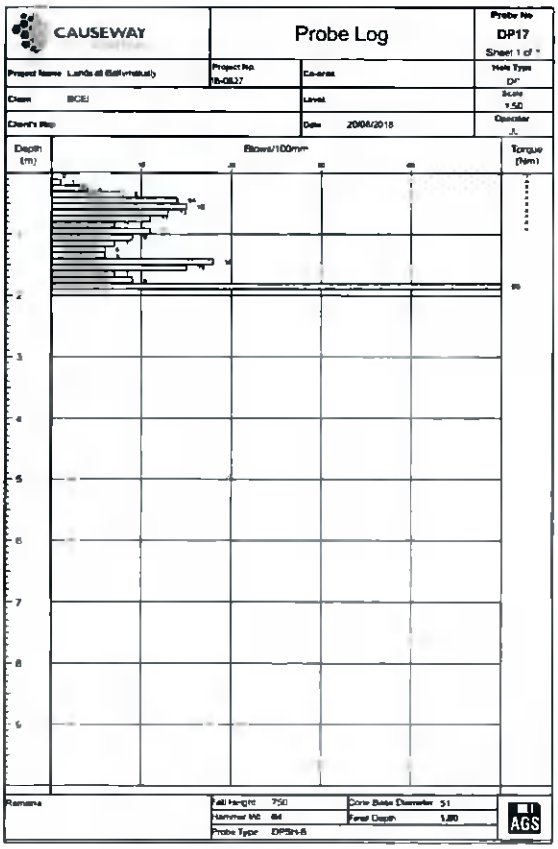

CAUSEWAY
Probe Log
DP12
Sheet 1 of 1
Project Name: Lands at Ballymakaily
Project No: 18-082
Co-ords:
Hole Type: DP
Client: BCEI
Level:
Scale: 1:50
Client's Rep:
Date: 20/06/2018
Operator: JL
Depth (m)
Blows/100mm
Torque (Nm)
Remarks:
Fall Height: 750
Cone Base Diameter: 51
Hammer Wt: 64
Final Depth: 2.90
Probe Type: DPSH-B
AGS

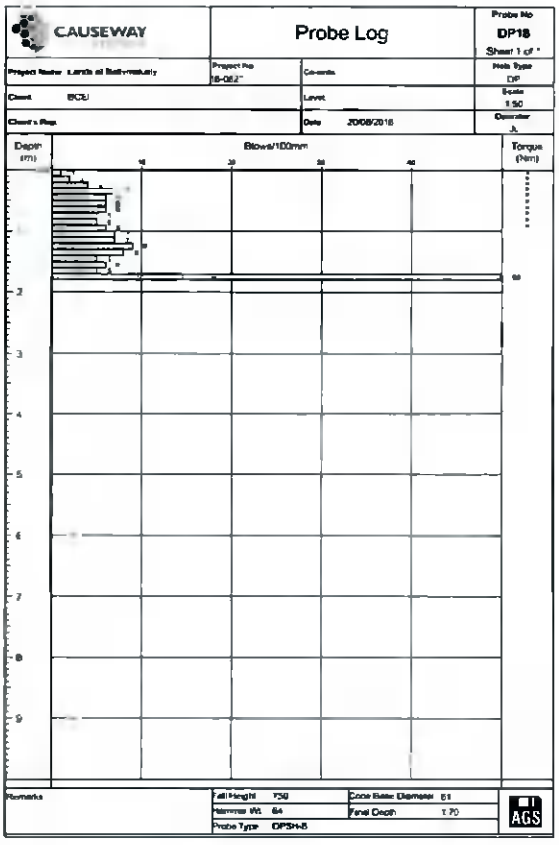

CAUSEWAY
Probe Log
Probe No
DP13
Sheet 1 of 1
Hole Type
DP
Scale
1:50
Operator
Project Ref
18-0827
Co-ords
Level
Client
BCEI
Date
20/06/2018
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter
Final Depth 2.20
AGS

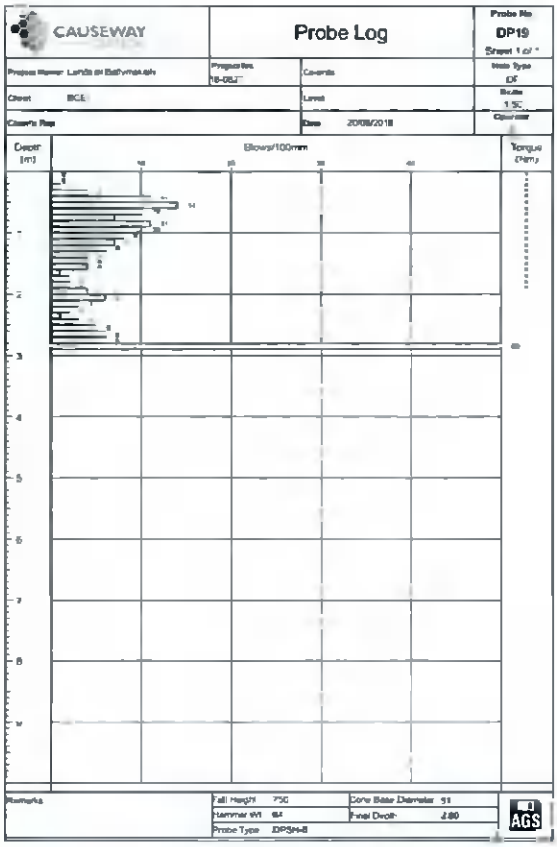

CAUSEWAY
Probe Log
Probe No
DP14
Hole Type
DP
Scale
1:50
Operator
Project Ref
18-0827
Co-ords
Level
Client
BCEI
Date
20/06/2018
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter 51
Final Depth 2.20
AGS

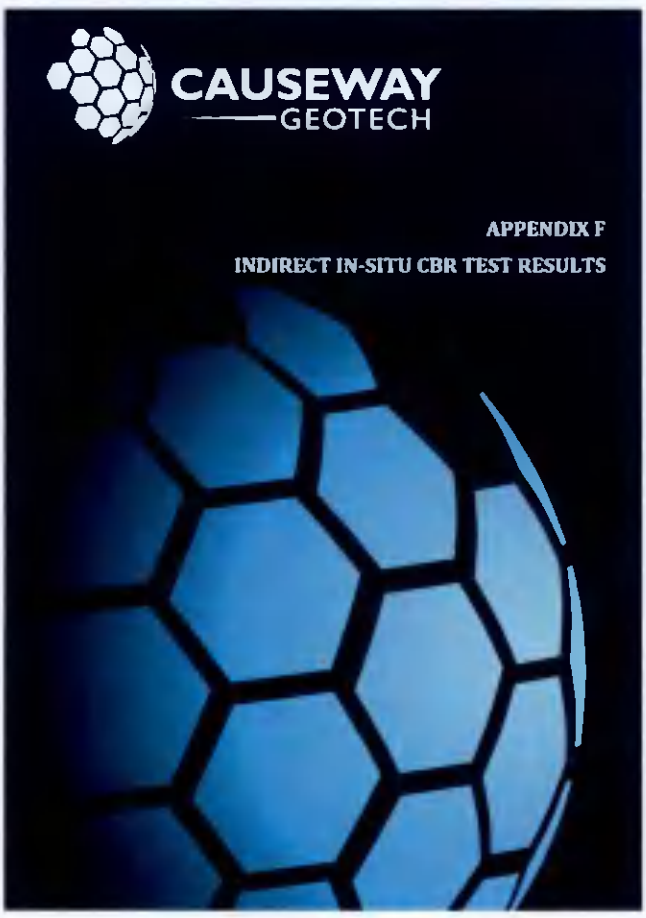

CAUSEWAY
Probe Log
DP15
Sheet 1 of 1
Client BCEI
Date 20/08/2018
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter 51
Final Depth 1.60
AGS


CAUSEWAY
Probe Log
DP16
Sheet 1 of 1
Client BCEI
Date 20/08/2018
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Cone Base Diameter 51
Final Depth 1.80
AGS


CAUSEWAY
Probe Log
Probe No
DP17
Sheet 1 of 1
Project Name Lands at Ballymakaily
Project No.
18-082
Co-ords
Hole Type
DP
Client BCEI
Level
Scale
1:50
Client's Rep
Date 20/04/2018
Operator
JL
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Hammer Wt. 64
Probe Type DPSH-B
Cone Base Diameter 51
Final Depth 1.80
AGS

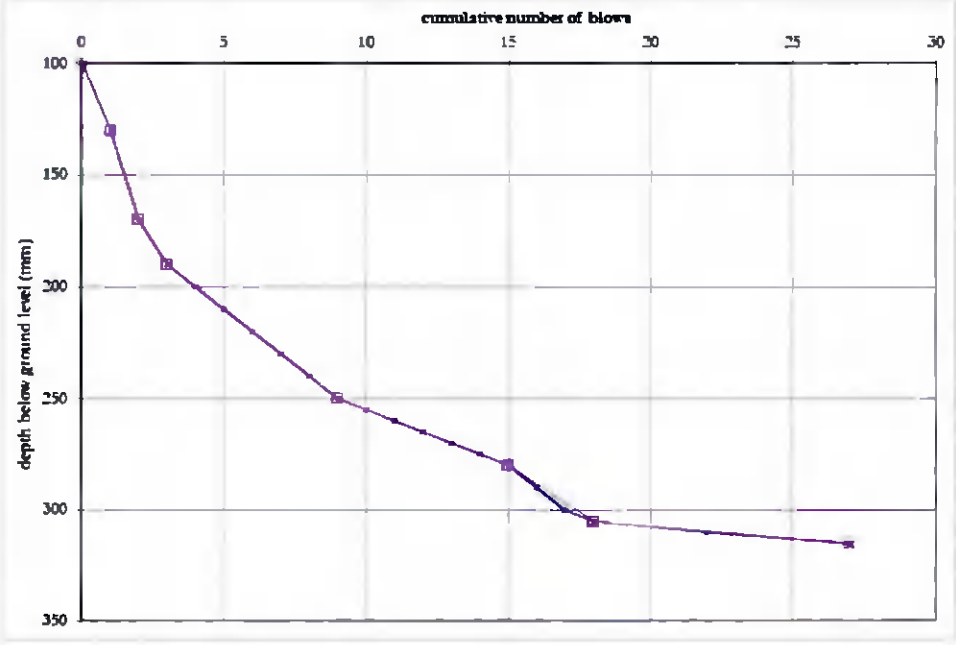

CAUSEWAY
Probe Log
Probe No
DP18
Sheet 1 of 1
Project Name Lands at Ballymakaily
Project No.
18-082
Co-ords
Hole Type
DP
Client BCEI
Level
Scale
1:50
Client's Rep
Date 20/04/2018
Operator
JL
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Hammer Wt. 64
Probe Type DPSH-B
Cone Base Diameter 51
Final Depth 1.70
AGS


CAUSEWAY
Probe Log
DP19
Client BCL
Date 20/08/2018
Depth (m)
Blows/100mm
Torque (Nm)
Remarks
Fall Height 750
Hammer Wt 64
Probe Type DPSH-B
Core Rods Diameter 51
Final Depth 2.80
AGS


CAUSEWAY
GEOTECH
APPENDIX F
INDIRECT IN-SITU CBR TEST RESULTS

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP02

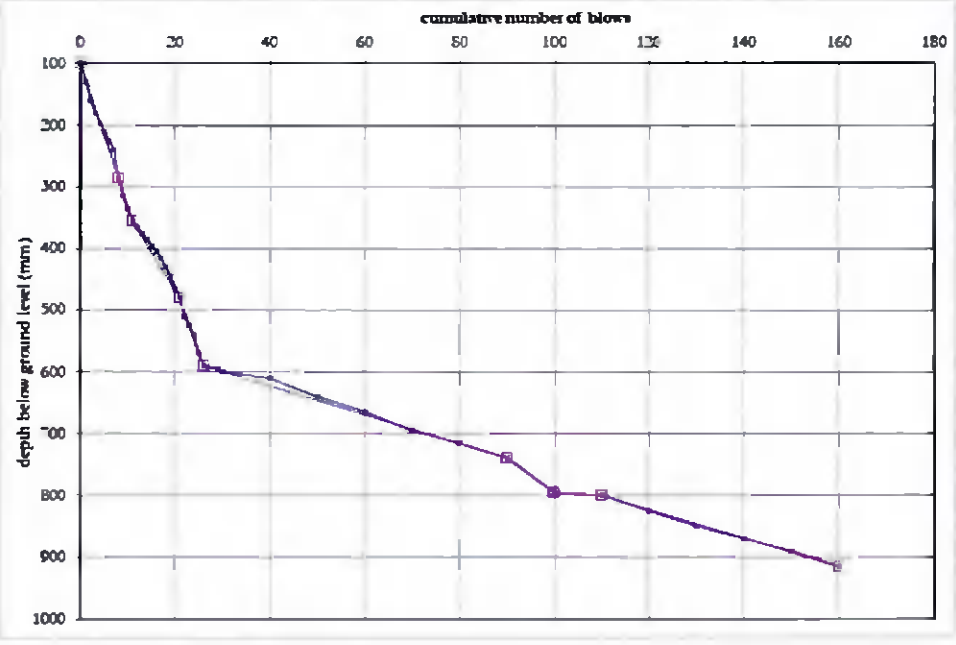
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	30	8.5
130		
130	40	6.1
170		
170	20	15
190		
190	10	26
250		
250	5	55
280		
280	8.3	32
305		
305	1.1	>100
315		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP03

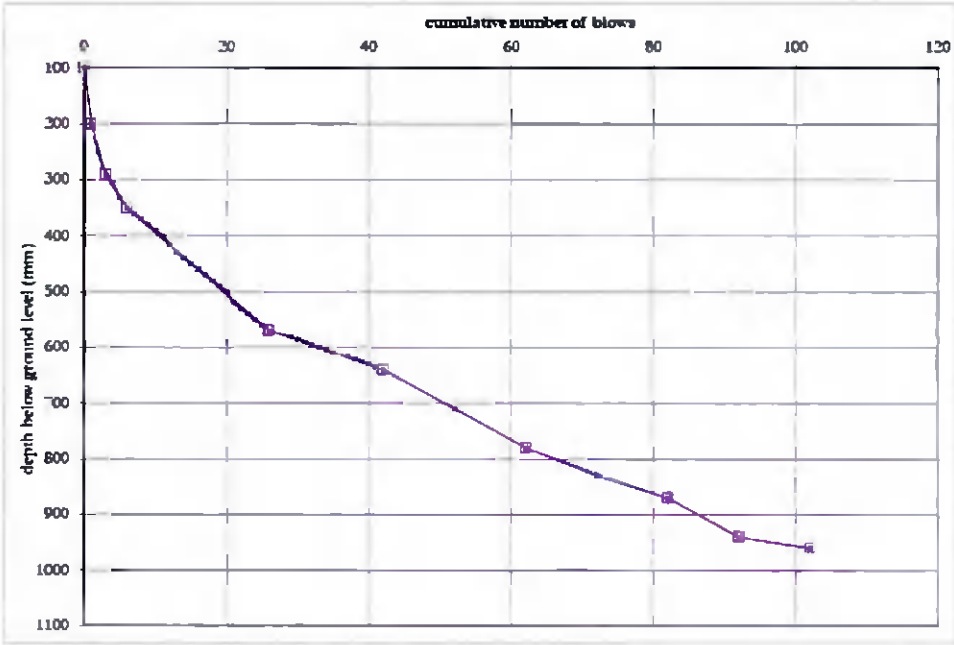
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	23	11
285		
285	23	11
355		
355	13	21
480		
480	22	12
590		
590	2.3	>100
740		
740	5.5	30
795		
795	0.5	>100
800		
800	2.3	>100
915		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP04

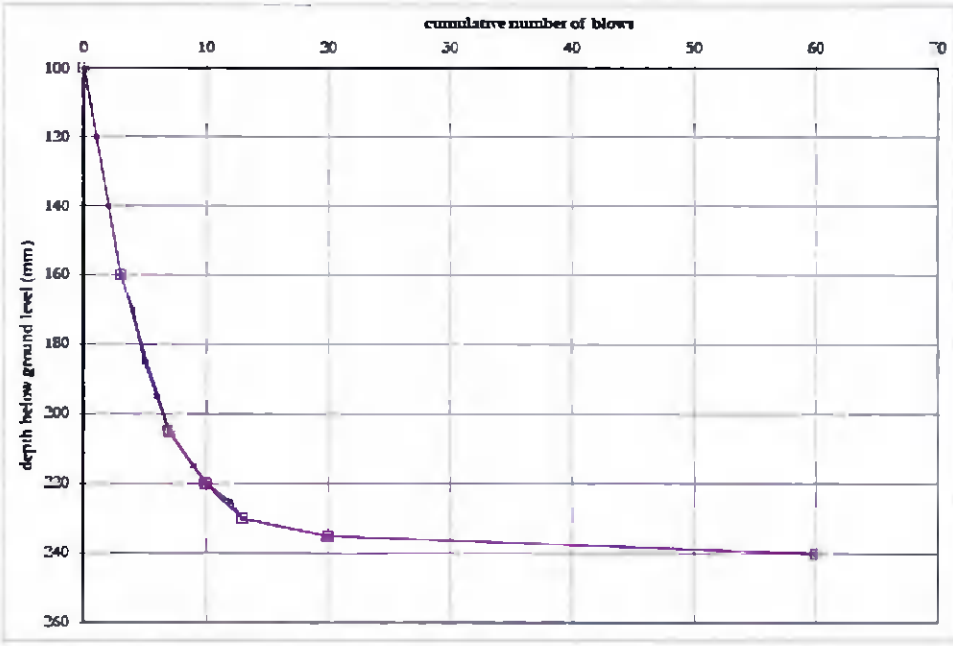
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	100	2.3
200		
200	45	5.4
290		
290	20	13
350		
350	11	24
570		
570	4.4	63
640		
640	-	39
780		
780	4.5	62
870		
870	-	39
940		
940	2	>100
960		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP05

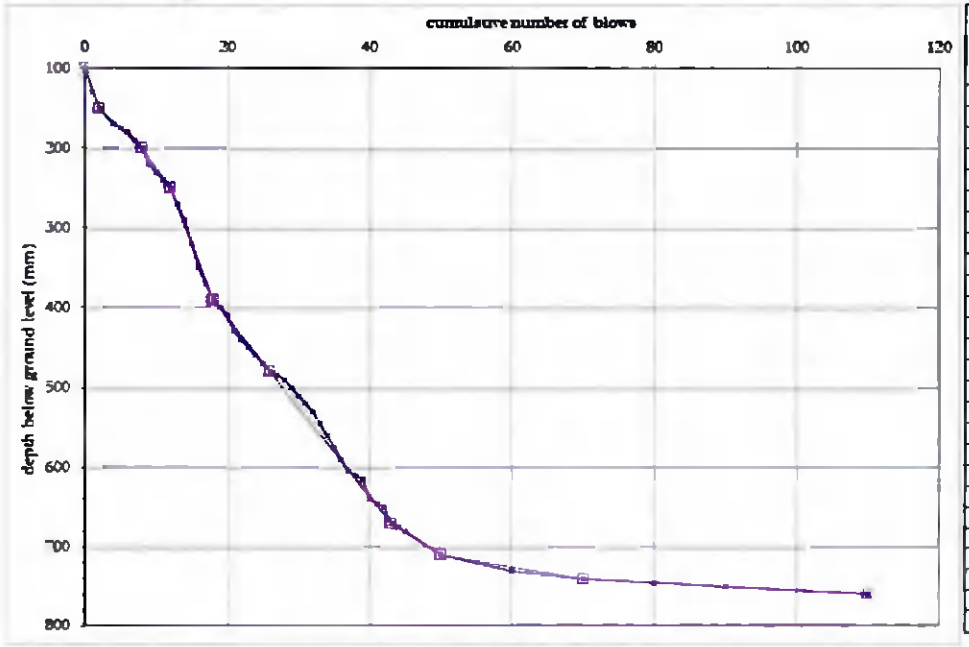
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	30	13
160		
160	11	25
205		
205	5	55
220		
220	3.3	85
230		
230	0.7	>100
235		
235	0.1	>100
240		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP06

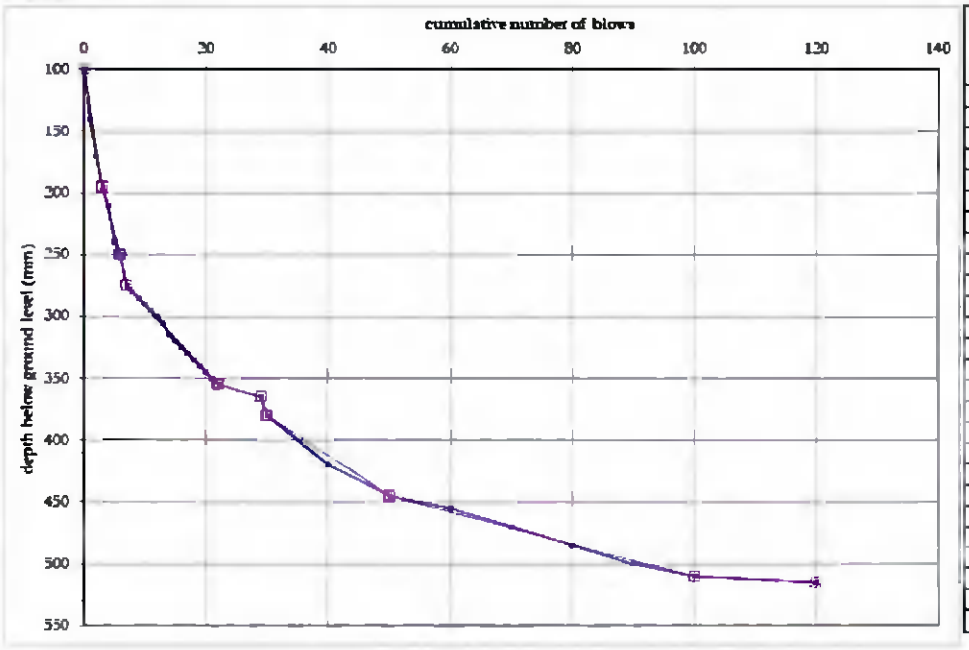
CBR estimated using TRL Road Note 8
Log CBR = 2.48-1.05* Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100 150	25	10
150 200	8.3	32
200 250	13	21
250 390	23	11
390 480	11	25
480 670	11	24
670 710	5.7	48
710 740	1.5	>100
740 759	0.5	>100

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP07

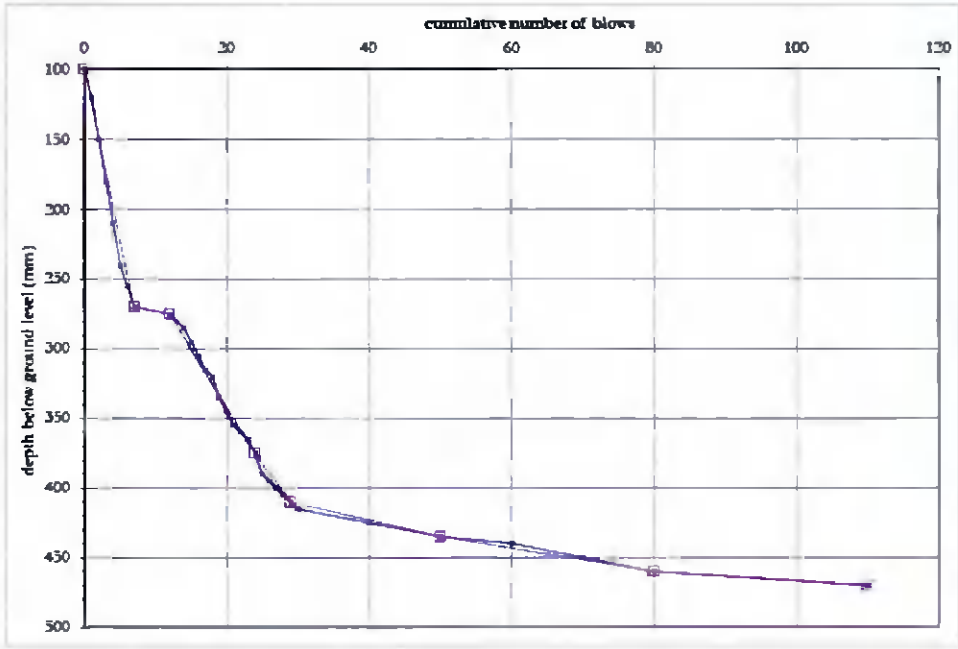
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.05* Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100 195	32	7.8
195 250	18	14
250 275	25	10
275 355	5.3	51
355 365	1.4	>100
365 380	15	17
380 445	3.3	87
445 510	1.3	>100
510 515	0.3	>100

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP08

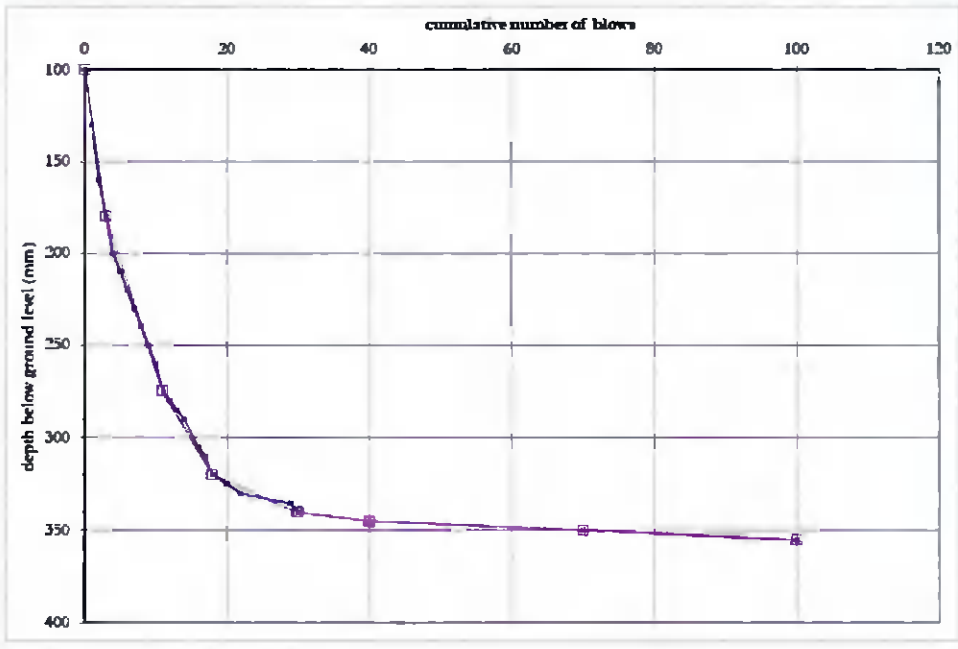
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	34	10
270		
270	1	>100
275		
275	8.3	32
375		
375	-	39
410		
410	1.2	>100
435		
435	0.8	>100
460		
460	0.3	>100
470		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP09

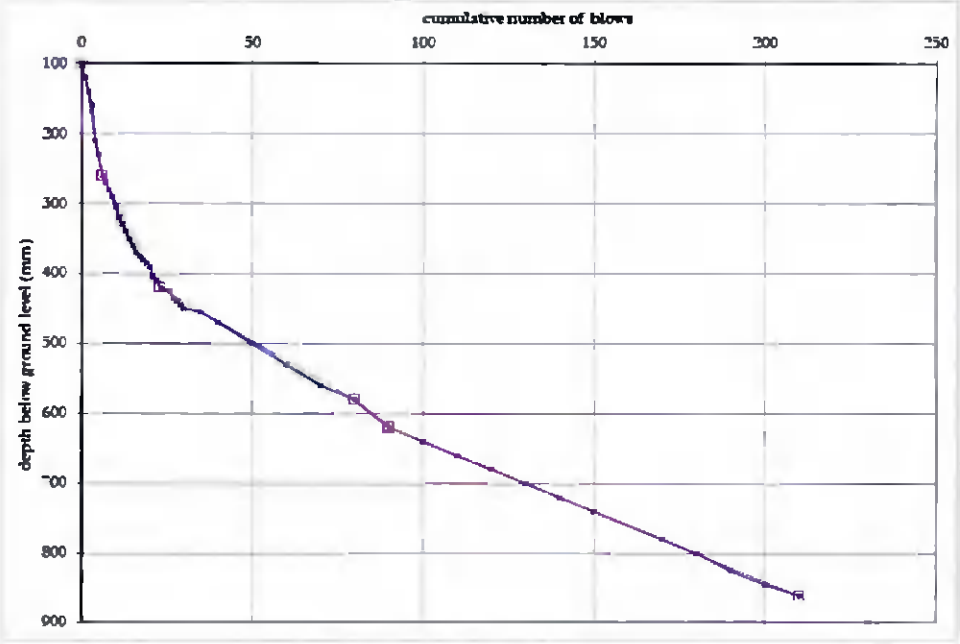
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	27	9.4
180		
180	12	22
275		
275	6.4	42
320		
320	1.7	>100
340		
340	0.5	>100
345		
345	0.2	>100
350		
350	0.2	>100
355		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP10

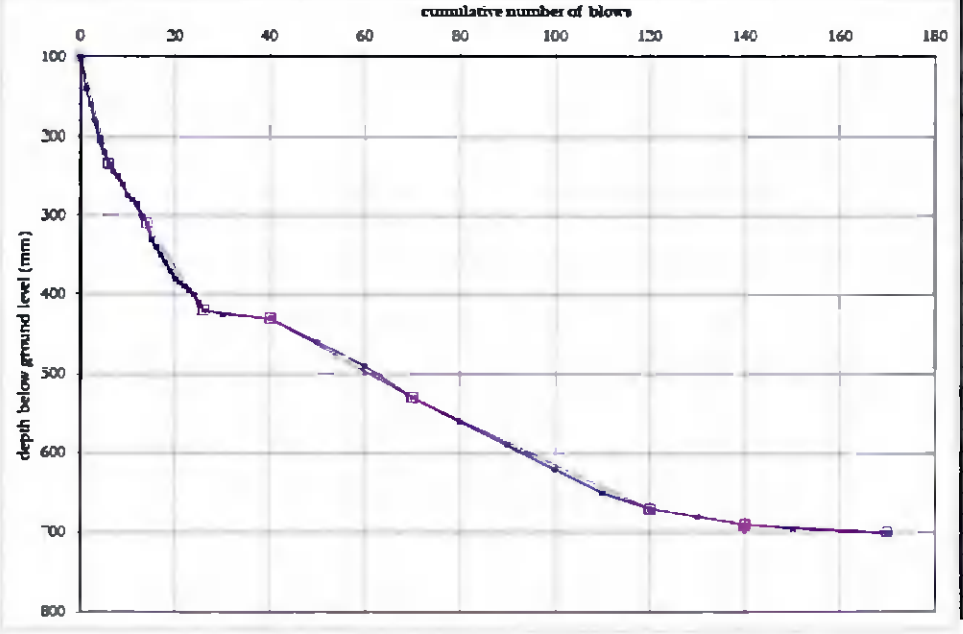
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.05* Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100		
260	27	9.4
260		
420	9.4	28
420		
580	2.8	>100
580		
620	4	70
620		
861	2	>100

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP11

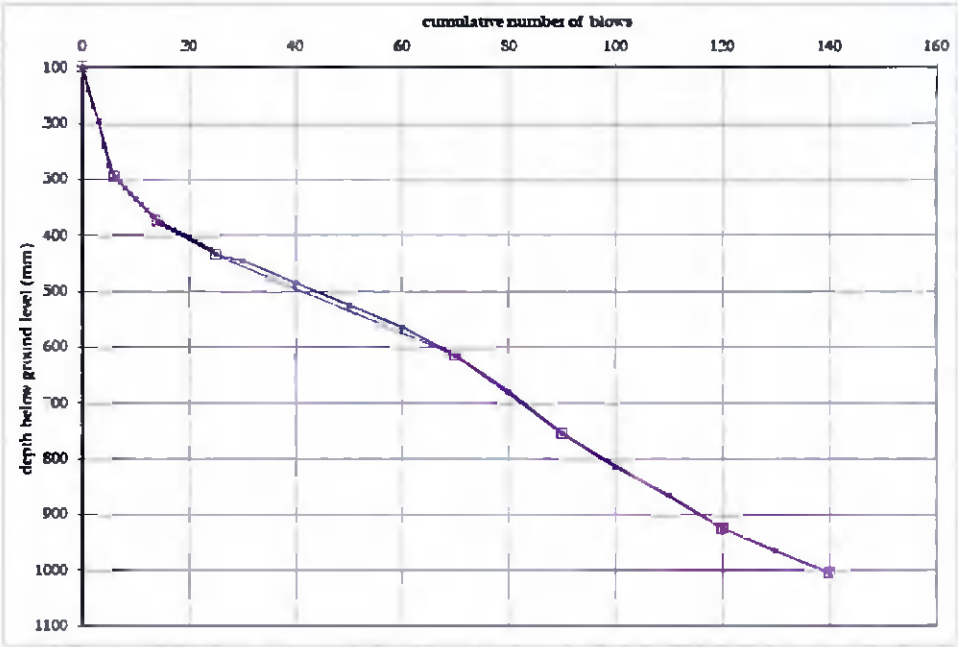
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.05* Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100		
235	23	11
235		
310	9.4	28
310		
420	9.2	29
420		
430	0.7	>100
430		
530	3.3	85
530		
670	2.8	>100
670		
690	1	>100
690		
700	0.3	>100

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP12

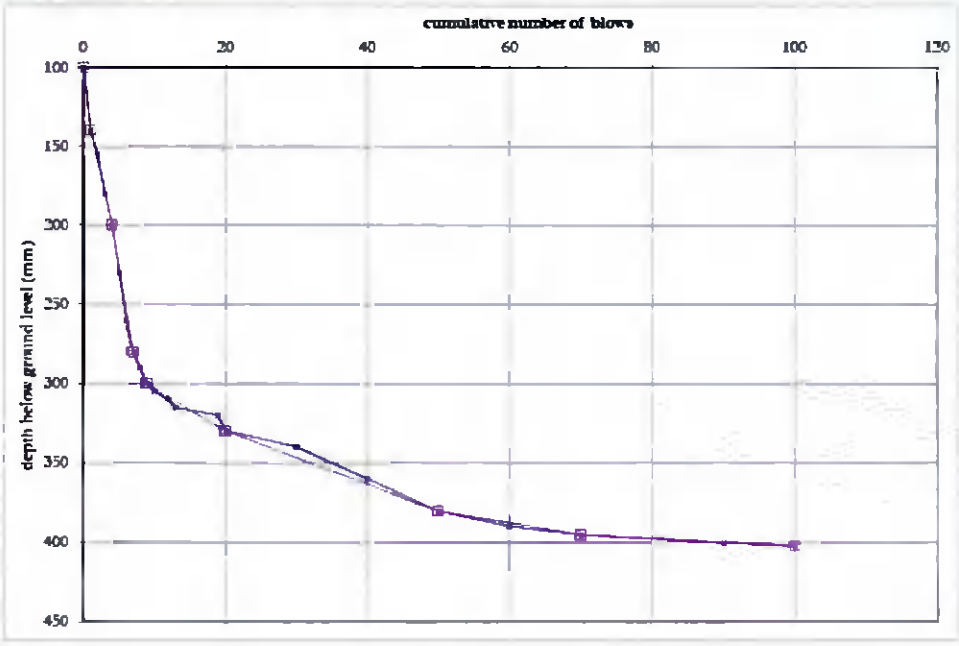
CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	33	7.6
295		
295	10	26
375		
375	5.5	50
435		
435	4	70
615		
615	7	39
755		
755	5.7	48
925		
925	4	70
1005		

Causeway Geotech Ltd
Dynamic Cone Penetrometer (DCP) test results and estimated CBR
Project: Lands at Ballymakaily
Test Number: TP13

CBR estimated using TRL Road Note 8:
Log CBR = 2.48-1.057 Log (mm/blow)
Project No: 18-0827
Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	40	6.1
140		
140	20	13
200		
200	27	9.4
280		
280	10	26
300		
300	2.7	>100
330		
330	1.7	>100
380		
380	0.8	>100
395		
395	0.2	>100
402		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: Lands at Ballymakaily

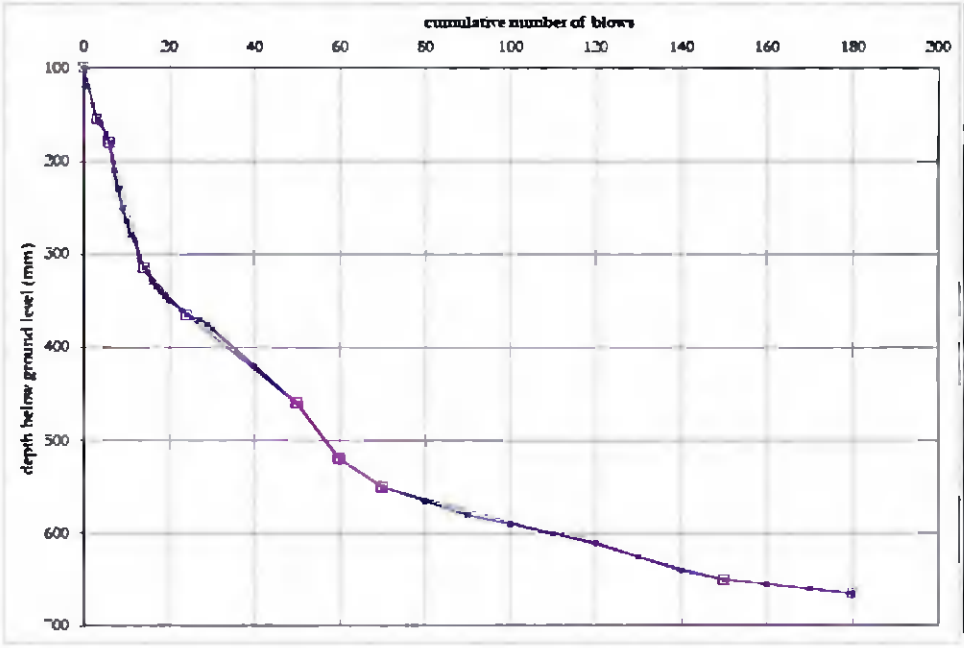
Test Number: TP14

CBR estimated using TRL Road Note 8:

Log CBR = 2.48-1.057 Log (mm/blow)

Project No: 18-0827

Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	18	14
155		
155	8.3	32
180		
180	17	15
315		
315	5	55
365		
365	3.7	—
460		
460	6	45
520		
520	3	95
550		
550	1.3	>100
650		
650	0.5	>100
665		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: Lands at Ballymakaily

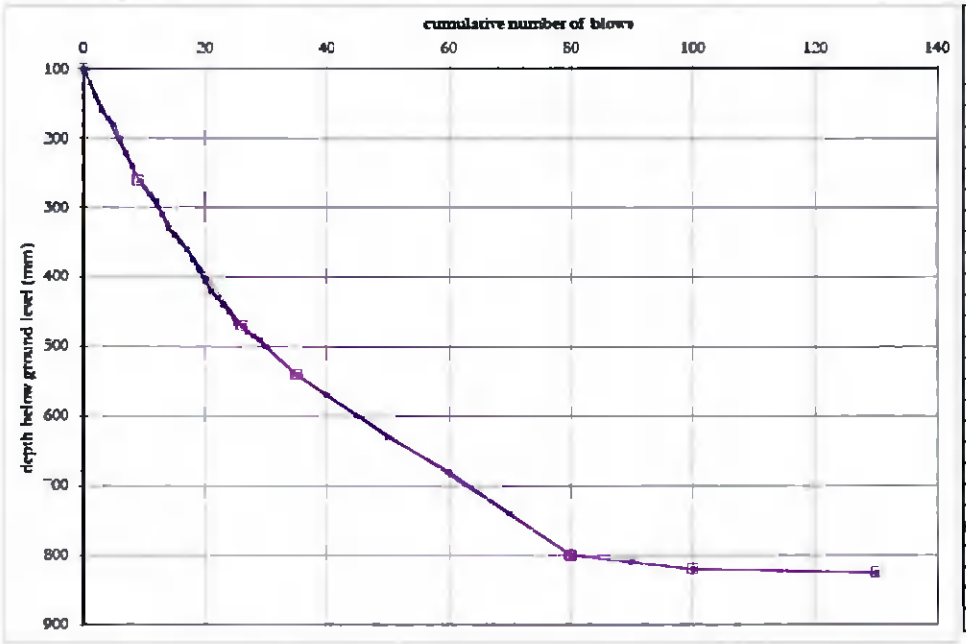
Test Number: TP15

CBR estimated using TRL Road Note 8:

Log CBR = 2.48-1.057 Log (mm/blow)

Project No: 18-0827

Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	18	14
260		
260	12	21
470		
470	7.8	35
540		
540	5.8	47
800		
800	1	>100
820		
820	0.2	>100
825		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: Lands at Ballymakaily

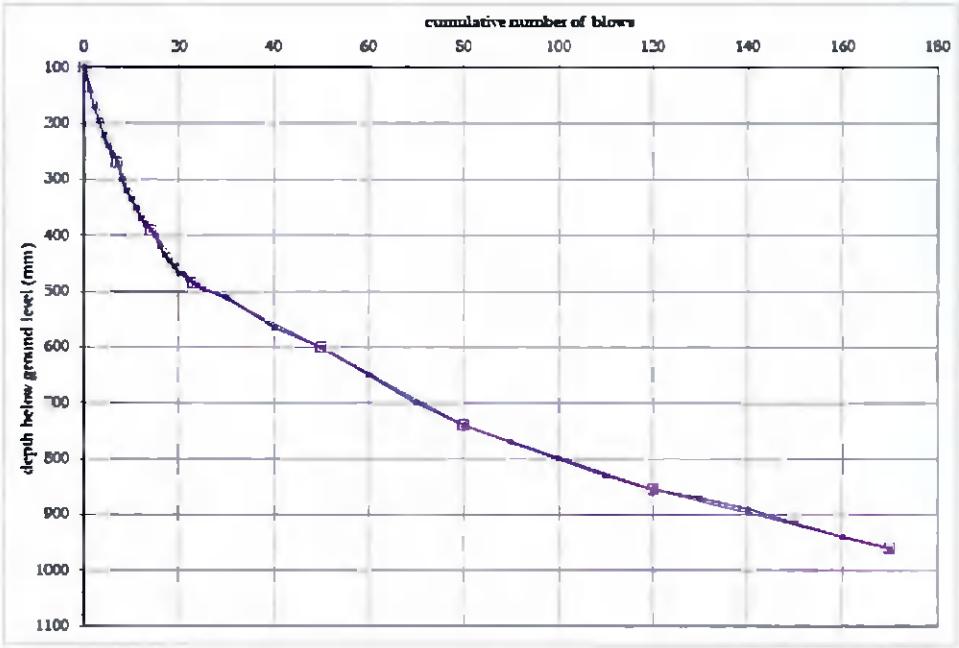
Test Number: TP16

CBR estimated using TRL Road Note 8:

Log CBR = 2.48-1.057 Log (mm/blow)

Project No: 18-0827

Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	24	10
270		
270	17	15
390		
390	11	25
485		
485	4.3	65
600		
600	4.7	59
740		
740	2.9	99
855		
855	2.1	>100
960		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: Lands at Ballymakaily

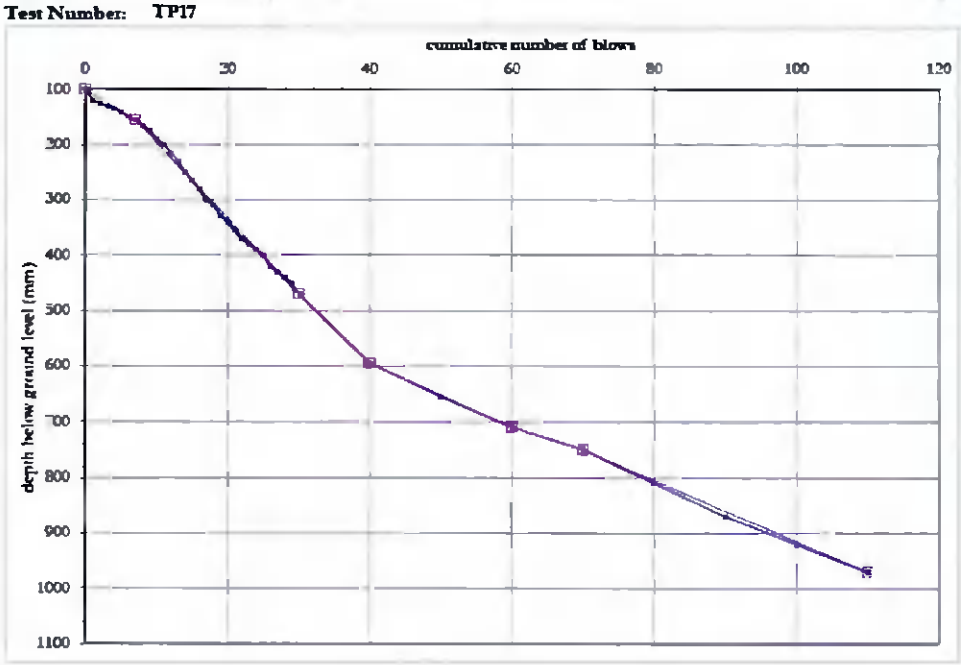
Test Number: TP17

CBR estimated using TRL Road Note 8:

Log CBR = 2.48-1.057 Log (mm/blow)

Project No: 18-0827

Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	7.9	34
155		
155	14	19
470		
470	13	21
595		
595	5.8	48
710		
710	4	70
750		
750	5.5	50
970		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: Lands at Ballymakaily

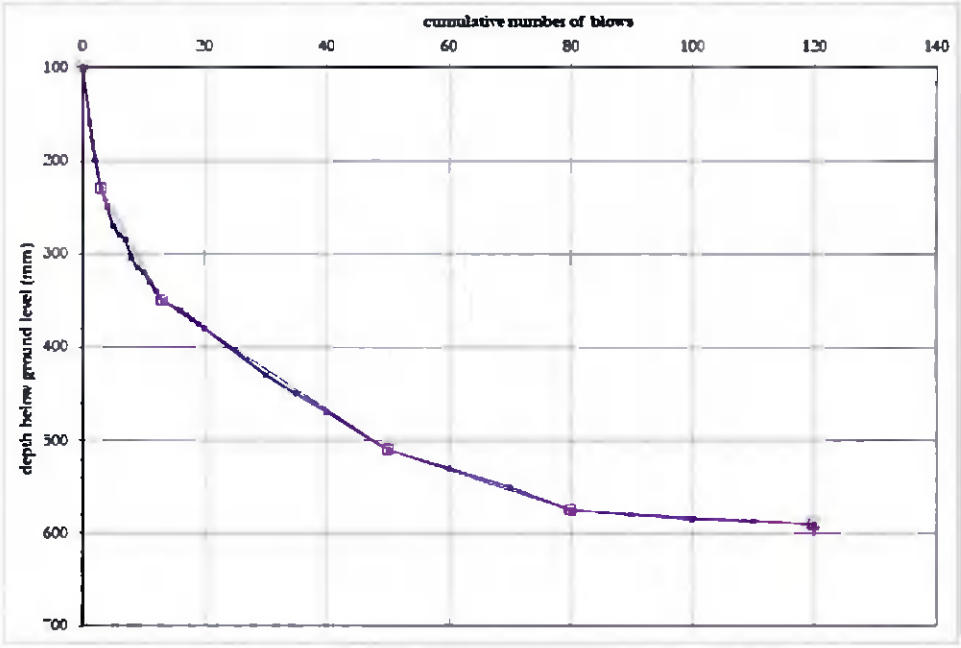
Test Number: TP18

CBR estimated using TRL Road Note 8:

Log CBR = 2.48-1.05* Log (mm/blow)

Project No: 18-0827

Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	43	5.6
230		
230	12	22
350		
350	4.3	64
510		
510	2.2	>100
575		
575	0.4	>100
590		

Causeway Geotech Ltd

Dynamic Cone Penetrometer (DCP) test results and estimated CBR

Project: Lands at Ballymakaily

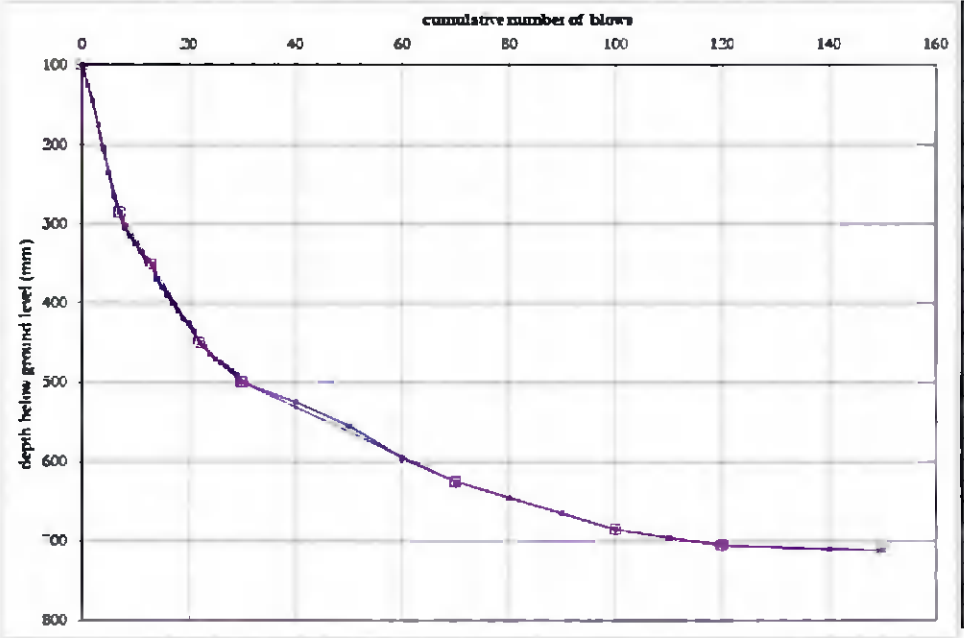
Test Number: TP19

CBR estimated using TRL Road Note 8:

Log CBR = 2.48-1.05* Log (mm/blow)

Project No: 18-0827

Date: 25-Jul-18



depth from to (mm)	mm/blow	CBR (%)
100	26	9.5
285		
285	11	24
350		
350	11	24
450		
450	6.3	44
500		
500	3.1	91
625		
625	2	>100
685		
685	1	>100
705		
705	0.2	>100
711		

CAUSEWAY GEOTECH

+44 (0)28 2766 8640
info@causewaygeotech.com
www.causewaygeotech.com

SOIL AND ROCK SAMPLE ANALYSIS
LABORATORY TEST REPORT

Project Name:	Lands at Ballymakeady
Project No.:	18-0827
Client:	BCEI
Engineer:	BCEI
Date:	15/08/18

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

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

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

Approved Signatory

Stephen Watson
Laboratory Manager

Signed for and on behalf of Causeway Geotech Ltd

Causeway Geotech Ltd
8 Drumahiney Road, Ballymoney
Co. Antrim, N. Ireland, BT53 7QL

CAUSEWAY GEOTECH

+44 (0)28 2766 8640
info@causewaygeotech.com
www.causewaygeotech.com

Project Name: Lands at Ballymakeady

Report Reference: 18-0827 – Soils Schedule 1

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

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

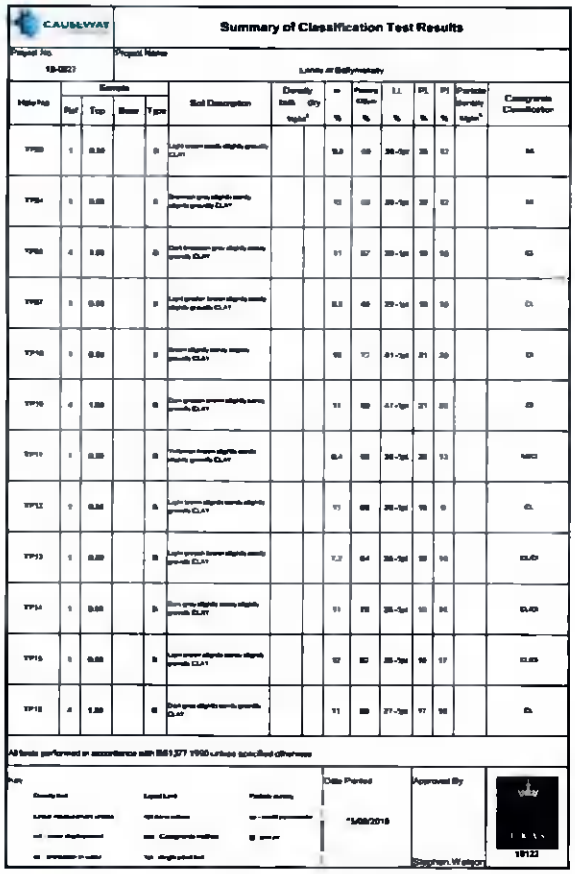
Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL	Moisture Content of Soil	BS [illegible] 1990: Cl [illegible]	16
SOIL	Liquid and Plastic Limits of soil-1 point cone penetrometer method	BS 1377-2 1990: Cl 4.4, 5.3 & 5.4	16
SOIL	Particle size distribution - wet sieving	BS 1377-2 1990: Cl 9.2	16
SOIL	Particle size distribution - sedimentation hydrometer method	BS 13[illegible]2 1990: Cl 9.5	16

SUB-CONTRACTED TESTS

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	No. of results included in the report
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	pH Value of Soil		16
SOIL – Subcontracted to Chemtest Ltd *(UKAS 2183)*	Sulphate Content water extract		16

Causeway Geotech Ltd
8 Drumahiney Road, Ballymoney
Co. Antrim, N. Ireland, BT53 7QL



CAUSEWAY

Summary of Classification Test Results

Project No.: 18-0827

Project Name: Lands at Ballymakaily

Hole No.	Sample Ref	Sample Top	Sample Base	Sample Type	Soil Description	Density bulk kg/m³	Density dry kg/m³	w %	Passing 425µm %	LL %	PL %	PI %	Particle density kg/m³	Casagrande Classification
TP03	1	0.50		B	Light brown sandy slightly gravelly CLAY			13.0	69	38 -/pl	25	13		ML
TP04	1	0.60		B	Brownish grey slightly sandy slightly gravelly CLAY			12	69	39 -/pl	22	17		ML
TP06	1	0.60		B	Dark brownish grey slightly sandy gravelly CLAY			11	67	39 -/pl	19	16		CL
TP07	1	0.50		B	Light greyish brown slightly sandy slightly gravelly CLAY			8.0	49	39 -/pl	18	19		CL
TP10	1	0.50		B	Brown slightly sandy gravelly CLAY			10	72	41 -/pl	21	20		CI
TP16	1	1.00		B	Dark greyish brown slightly sandy gravelly CLAY			11	69	41 -/pl	21	20		CI
TP11	1	0.50		B	Greyish brown slightly sandy slightly gravelly CLAY			8.4	68	36 -/pl	23	13		MICI
TP12	1	0.50		B	Light brown slightly sandy slightly gravelly CLAY			11	68	29 -/pl	18	9		CL
TP13	1	0.50		B	Light greyish brown slightly sandy gravelly CLAY			7.2	64	35 -/pl	22	13		CL/CI
TP14	1	0.50		B	Dark grey slightly sandy slightly gravelly CLAY			11	72	35 -/pl	18	24		CL/CI
TP15	1	0.50		B	Light brown slightly sandy slightly gravelly CLAY			12	80	35 -/pl	18	17		CL/CI
TP18	1	1.20		B	Dark grey slightly sandy gravelly CLAY			11	69	27 -/pl	17	10		CL

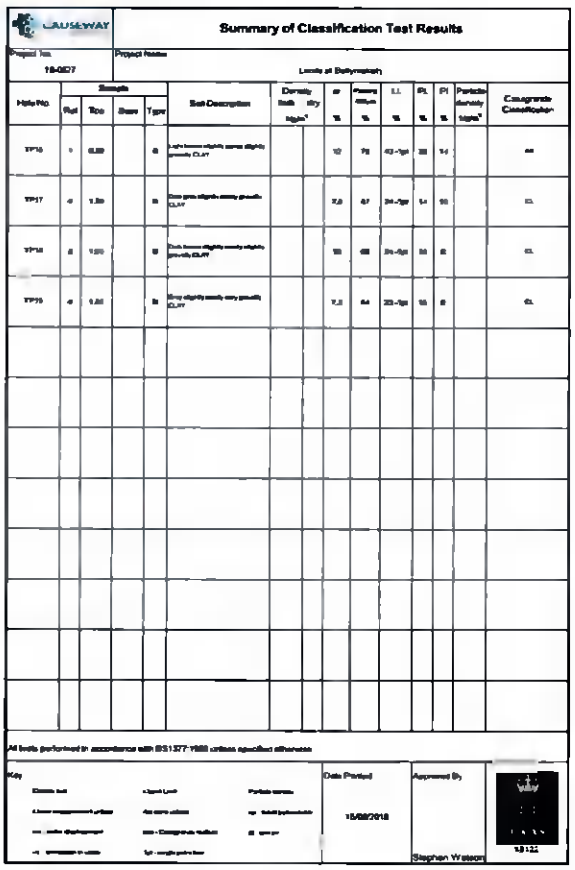
All tests performed in accordance with BS1377:1990 unless specified otherwise

Key

Date Printed: 14/08/2018

Approved By: Stephen Watson

18122



CAUSEWAY

Summary of Classification Test Results

Project No.: 18-0827

Project Name: Lands at Ballymakaily

Hole No.	Sample Ref	Sample Top	Sample Base	Sample Type	Soil Description	Density bulk kg/m³	Density dry kg/m³	w %	Passing 425µm %	LL %	PL %	PI %	Particle density kg/m³	Casagrande Classification
TP16	1	0.50		B	Light brown slightly sandy slightly gravelly CLAY			12	73	42 -/pl	28	14		CI
TP17	1	1.20		B	Dark grey slightly sandy gravelly CLAY			7.0	67	34 -/pl	14	20		CL
TP18	1	1.20		B	Dark brown slightly sandy slightly gravelly CLAY			10	68	34 -/pl	26	8		CL
TP19	1	1.20		B	Grey slightly sandy very gravelly CLAY			7.2	64	35 -/pl	18	8		CL

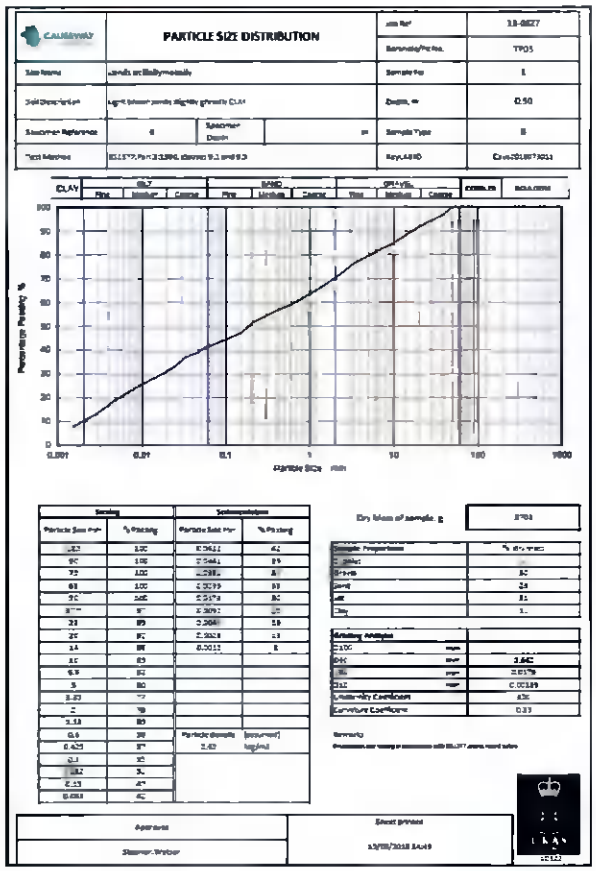
All tests performed in accordance with BS1377:1990 unless specified otherwise

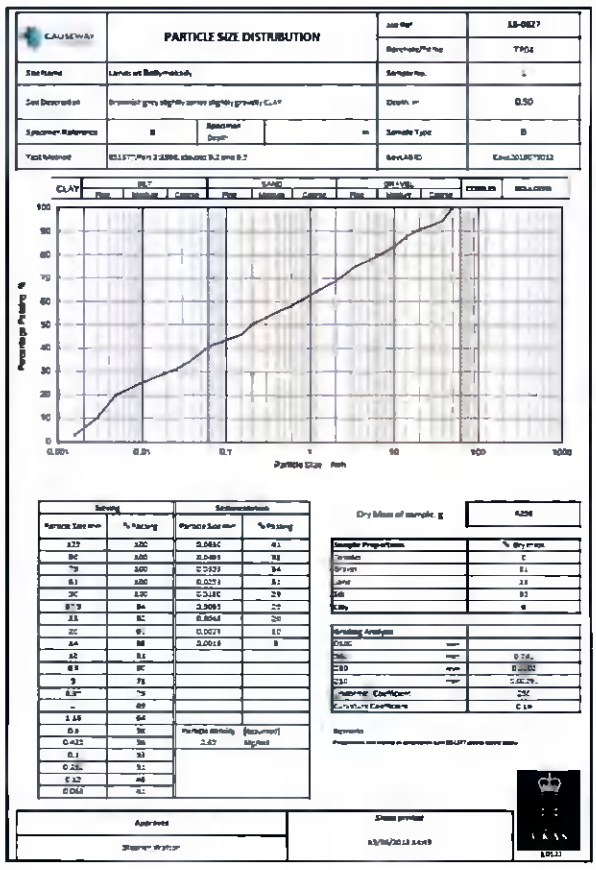
Key

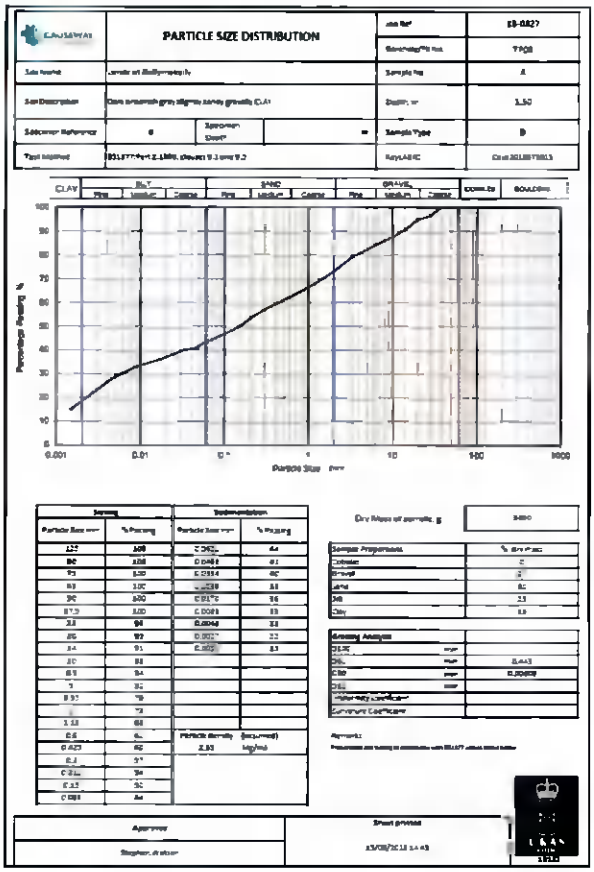
Date Printed: 15/08/2018

Approved By: Stephen Watson

18122

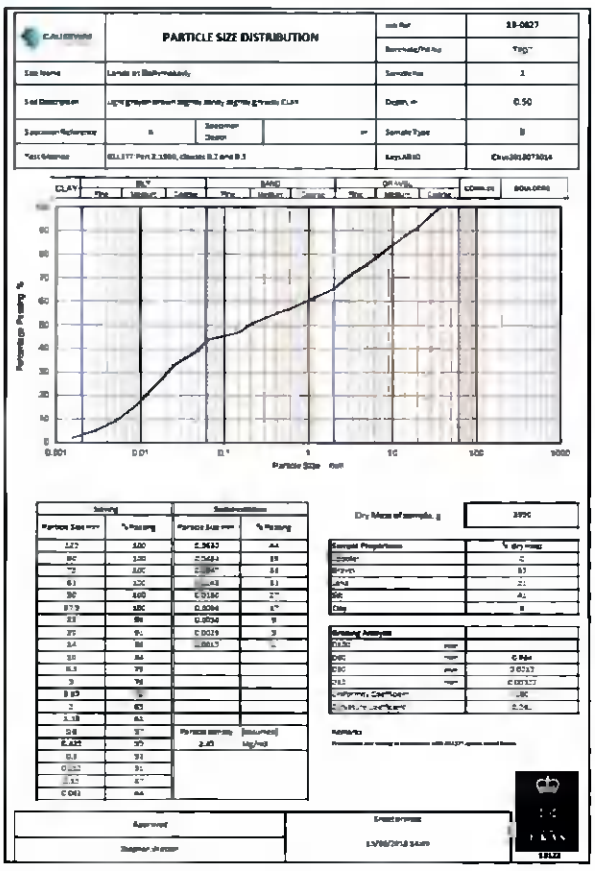

PARTICLE SIZE DISTRIBUTION
CLAY
SILT
SAND
GRAVEL
Percentage Passing %
Particle Size mm


PARTICLE SIZE DISTRIBUTION
CLAY
SILT
SAND
GRAVEL
Percentage Passing %
Particle Size mm



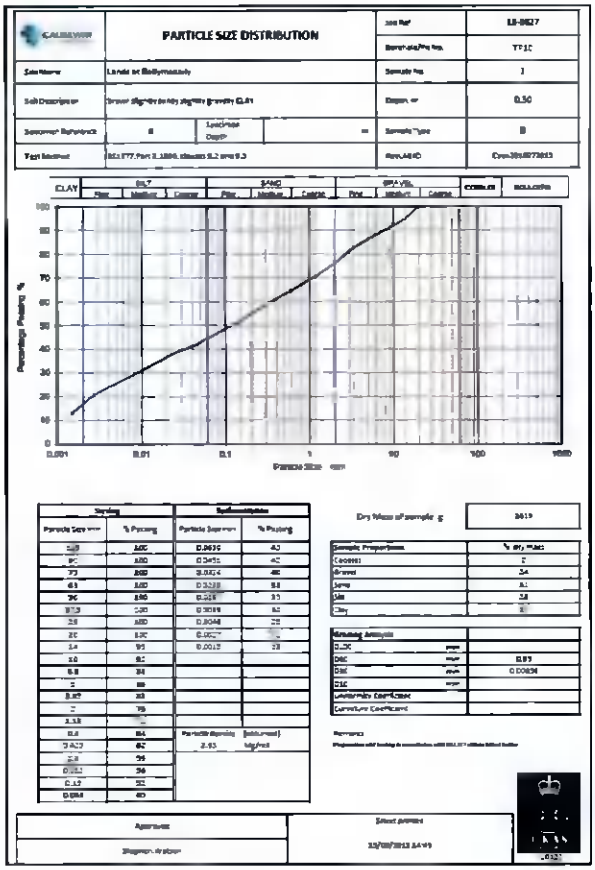
PARTICLE SIZE DISTRIBUTION

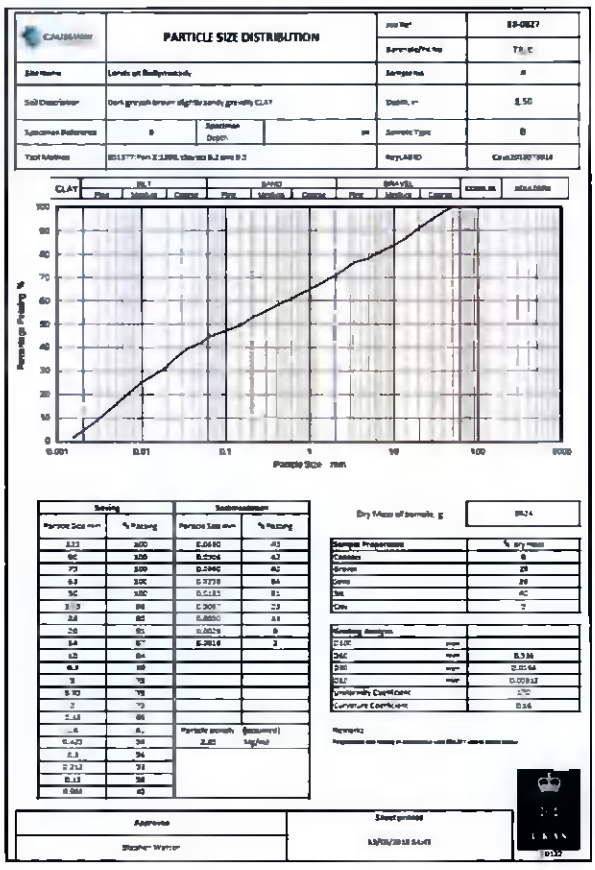
Job Ref	19-0827
Borehole/Pit No.	TP08
Sample No.	4
Depth, m	1.50
Sample Type	D
Key Lab No.	Che-20190719013

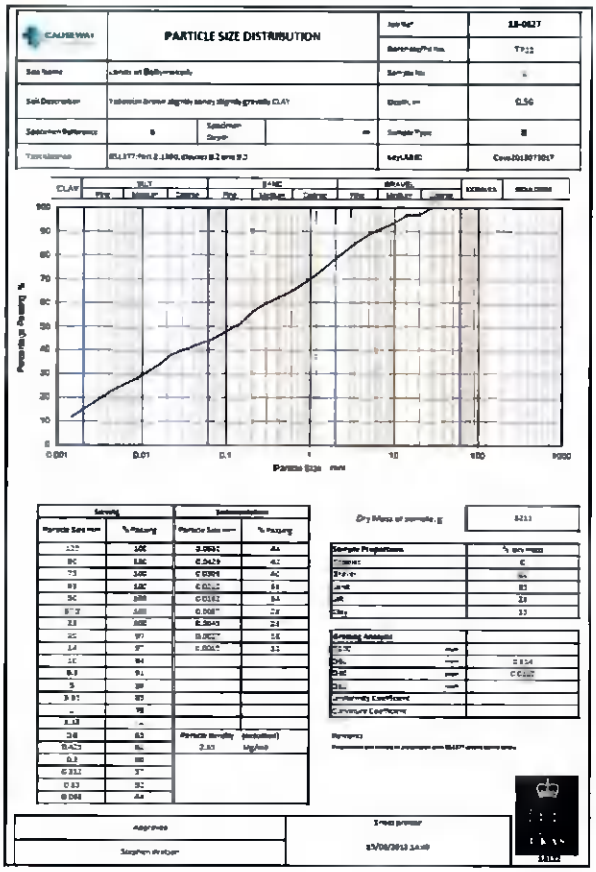


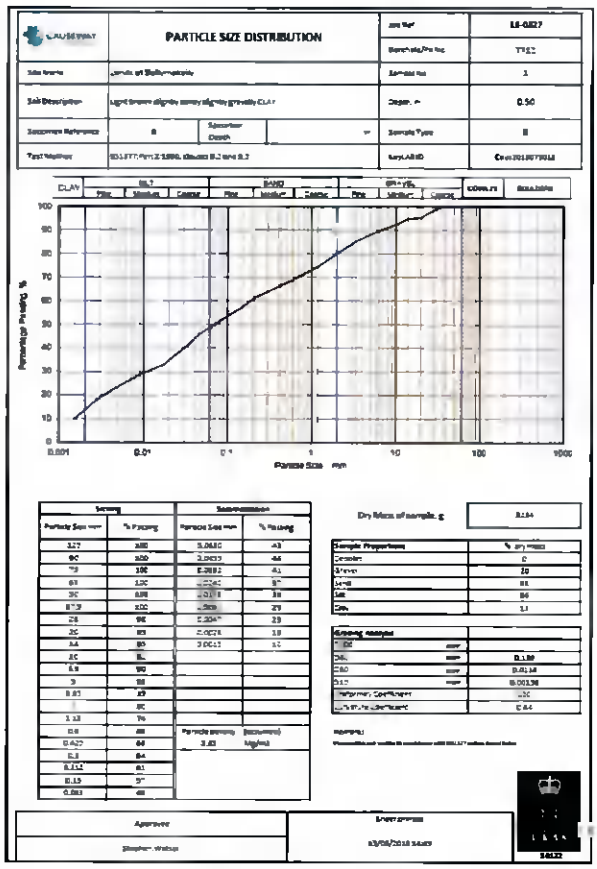
PARTICLE SIZE DISTRIBUTION

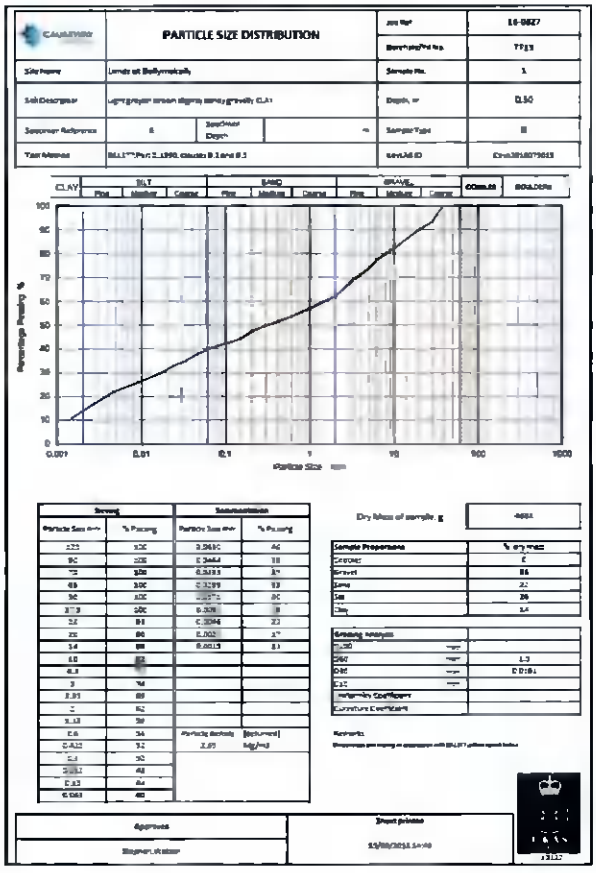
Job Ref	19-0827
Borehole/Pit No.	TP07
Sample No.	1
Depth, m	0.50
Sample Type	B
Key Lab No.	Che-20190719014


PARTICLE SIZE DISTRIBUTION
CLAY
SAND
GRAVEL
Percentage Passing %
Particle Size mm


PARTICLE SIZE DISTRIBUTION
CLAY
SAND
GRAVEL
Percentage Passing %
Particle Size mm


PARTICLE SIZE DISTRIBUTION
18-0827
TP12
0.50
B
CL
SAND
GRAVEL
Percentage Passing %
Particle Size mm


PARTICLE SIZE DISTRIBUTION
18-0827
0.50
B
CLAY
SAND
GRAVEL
Percentage Passing %
Particle Size mm



PARTICLE SIZE DISTRIBUTION

Job Ref	18-0827
Borehole/Pit No.	TP13
Site Name	Lands at Ballymakaily
Sample No.	1
Soil Description	Light grey/pale brown slightly sandy gravelly CLAY
Depth, m	0.50
Specimen Reference	1
Specimen Depth	m
Sample Type	B
Test Method	BS 1377: Part 2: 1990: Clauses 9.2 and 9.3
Key/ASFD	Ent:2018079028

CLAY | SILT: Fine, Medium, Coarse | SAND: Fine, Medium, Coarse | GRAVEL: Fine, Medium, Coarse | 63mm to 20mm | 20mm to 6mm

Percentage Passing, %

Particle Size, mm

Sieving: Particle Size mm	% Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	94
20	88
14	86
10	83
6.3	79
5	76
3.35	69
2	62
1.18	58
0.6	54
0.425	52
0.3	50
0.212	48
0.15	44
0.063	40

Sedimentation: Particle Size mm	% Passing
0.0636	40
0.0454	38
0.0325	34
0.0233	30
0.0169	27
0.0088	23
0.0063	21
0.0045	19
0.0032	17
0.0013	13

Particle density (assumed) 2.65 Mg/m3

Dry Mass of sample, g 4684

Sample Proportions	% dry mass
Cobbles	0
Gravel	24
Sand	36
Silt	26
Clay	14

Grading Analysis	
D100 mm	
D60 mm	1.3
D30 mm	0.0181
D10 mm	
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Approved

Stephen Arthur

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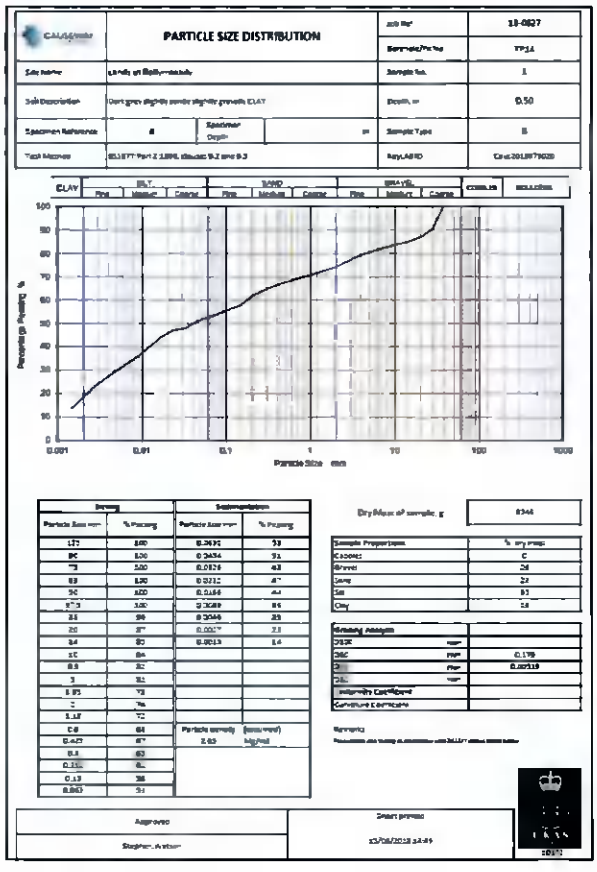

PARTICLE SIZE DISTRIBUTION

Job Ref	18-0827
Borehole/Pit No.	TP14
Site Name	Lands at Ballymakaily
Sample No.	1
Soil Description	Dark grey slightly sandy slightly gravelly CLAY
Depth, m	0.50
Specimen Reference	1
Specimen Depth	m
Sample Type	B
Test Method	BS 1377: Part 2: 1990: Clauses 9.2 and 9.3
Key/ASFD	Ent:2018079028

CLAY | SILT: Fine, Medium, Coarse | SAND: Fine, Medium, Coarse | GRAVEL: Fine, Medium, Coarse | 63mm to | 20mm to 6mm

Percentage Passing, %

Particle Size, mm

Sieving: Particle Size mm	% Passing
125	100
90	100
75	100
63	100
50	100
37.5	100
28	98
20	97
14	95
10	92
6.3	87
5	84
3.35	78
2	74
1.18	72
0.6	68
0.425	67
0.3	65
0.212	64
0.15	58
0.063	53

Sedimentation: Particle Size mm	% Passing
0.0636	53
0.0454	51
0.0326	48
0.0232	47
0.0164	44
0.0088	35
0.0063	33
0.0045	31
0.0032	29
0.0013	24

Particle density (assumed) 2.65 Mg/m3

Dry Mass of sample, g 4346

Sample Proportions	% dry mass
Cobbles	0
Gravel	28
Sand	21
Silt	37
Clay	14

Grading Analysis	
D100 mm	
D60 mm	0.179
D30 mm	0.00519
D10 mm	
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Approved

Stephen Arthur

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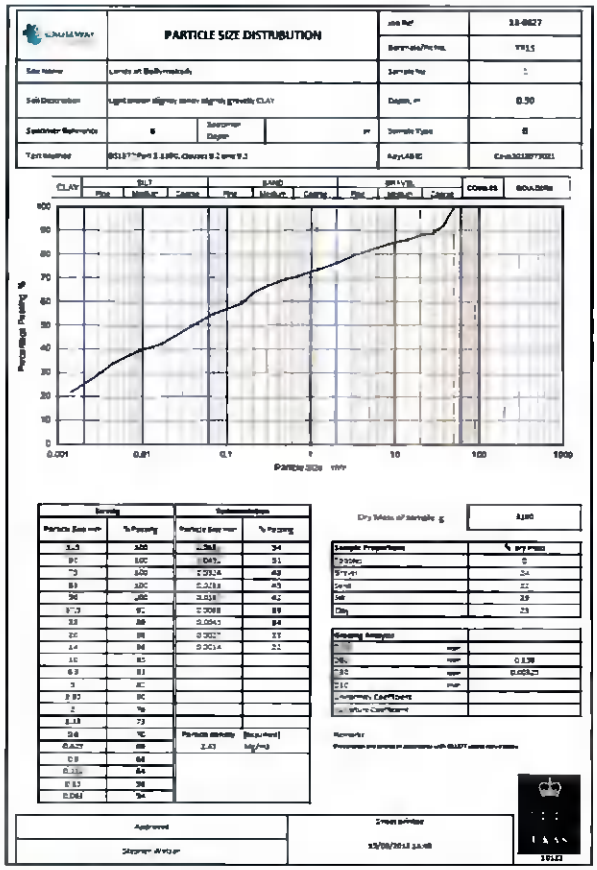
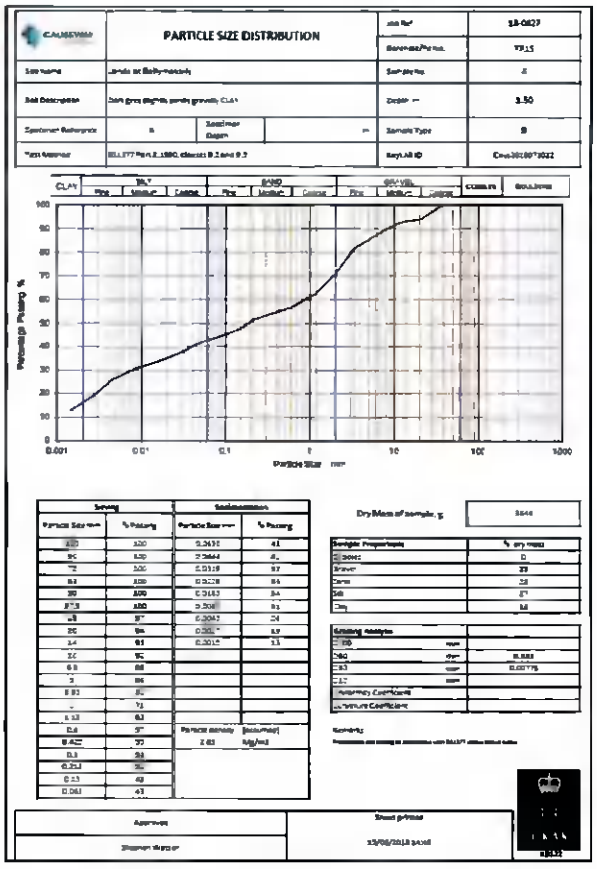
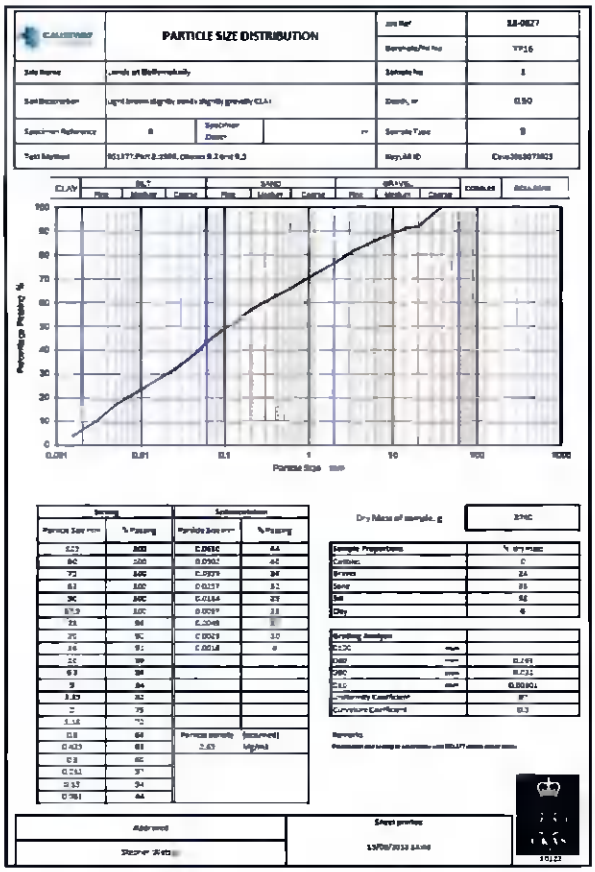

PARTICLE SIZE DISTRIBUTION
CLAY
SAND
GRAVEL
COBBLES
BOULDERS
Percentage Passing %
Particle Size mm


PARTICLE SIZE DISTRIBUTION
CLAY
SAND
GRAVEL
COBBLES
BOULDERS
Percentage Passing %
Particle Size mm



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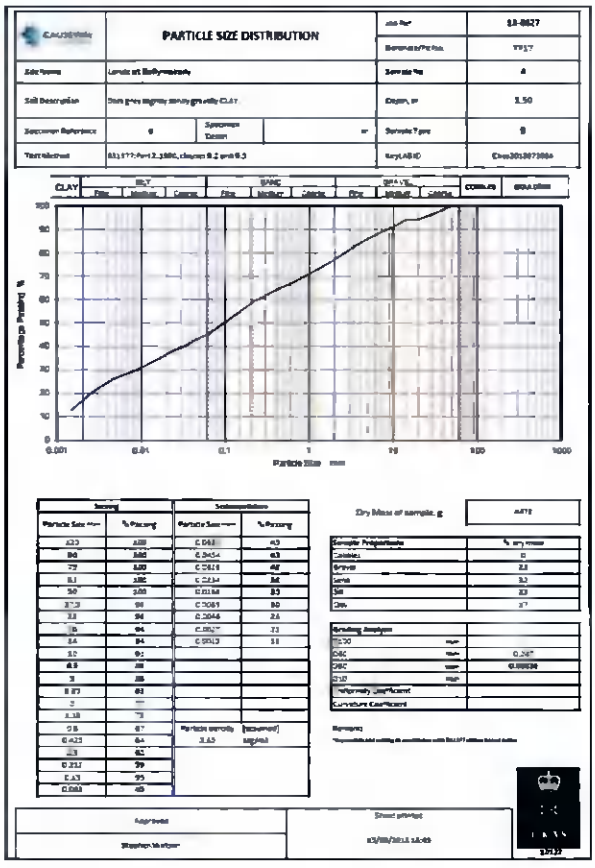
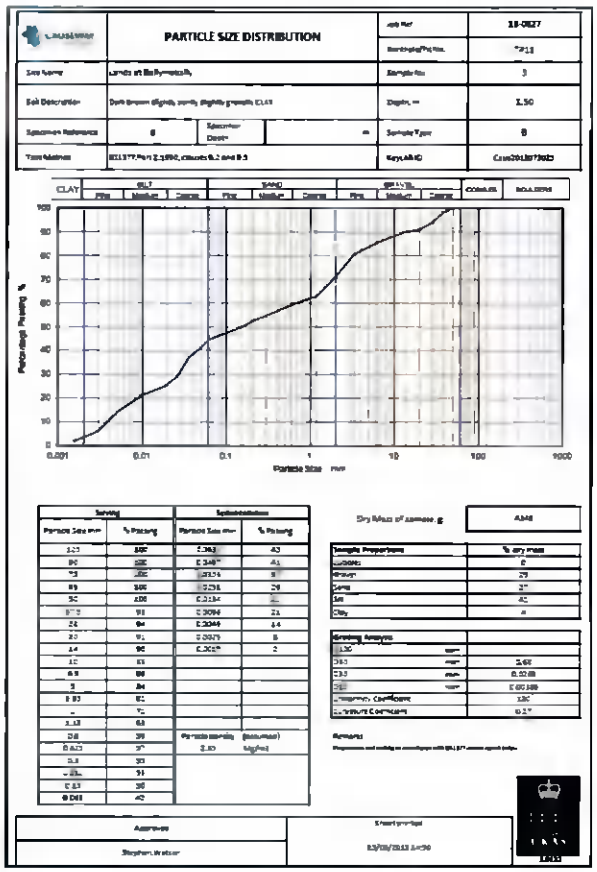
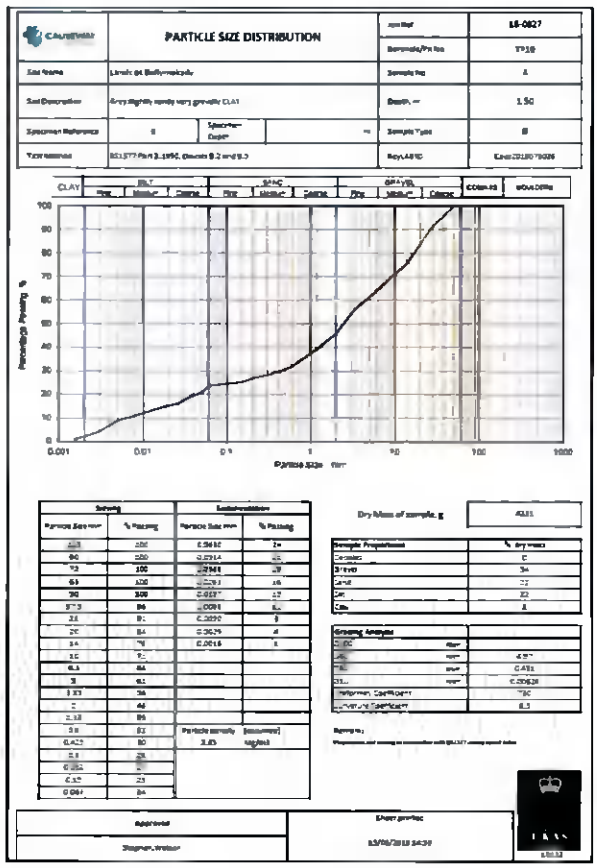


PARTICLE SIZE DISTRIBUTION


PARTICLE SIZE DISTRIBUTION
CLAY
Percentage Passing %
Particle Size mm


PARTICLE SIZE DISTRIBUTION
CLAY
Percentage Passing %
Particle Size mm

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

Final Report

Report No.:	18-23652-1
Initial Date of Issue:	10-Aug-2018
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Ballinamore Ballymoney County Antrim BT53 7QL
Contact(s):	Cann Cornwall Colm Hurley Darren O'Mahony Gabriella Horan John Cameron Lucy Newland Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Sean Ross Stephen Franey Stephen Watson Stuart Abraham
Project	18-0827 Lands at Ballymakelly
Quotation No.:	**Date Received:** 06-Aug-2018
Order No.:	**Date Instructed:** 06-Aug-2018
No. of Samples:	16
Turnaround (Wkdays):	3 **Results Due:** 10-Aug-2018
Date Approved:	10-Aug-2018
Approved By:	
Details:	Martin Dyer, Laboratory Manager

Chemtest

Results - Soil

Project: 18-0827 Lands at Ballymakelly

Client: Causeway Geotech Ltd	Chemtest Job No.:	18-23652	18-[illegible]	18-23652	18-23652	18-23652	18-23652	18-23652	18-23652
Quotation No.:	Chemtest Sample ID:	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Order No.:	Client Sample ID:	TP03	TP04	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	TP12
	Client Sample Ref:	2	2	5	2	2	5	2	2
	Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):	0.50	0.50	1.50	0.50	0.50	1.50	0.50	0.50
	Date Sampled:	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

Determinand	Accred.	SOP	Units	LOD								
Moisture	N	2030	%	0.020	7.8	11	9.2	4.4	7.8	9.6	7.7	8.3
pH	U	2010		N/A	8.4	8.6	8.5	8.5	8.5	8.6	8.3	8.1
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010

Chemtest

Results - Soil

Project: 18-0827 Lands at Ballymakeily

Client: Causeway Geotech Ltd		Chemtest Job No.	18-23632	18-23632	18-23632	18-23632	18-23632	18-23632	18-23632	18-23632
Quotation No.		Chemtest Sample ID.	667909	667912	667911	667907	667913	667914	667915	667916
Order No.		Client Location	TP13	TP14	TP15	TP15	TP16	TP17	TP18	TP19
		Client Sample Ref.	2	2	2	4	2	5	4	5
		Sample Type	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m)	0.50	0.50	0.50	1.50	0.50	1.50	1.50	1.50
		Date Sampled	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018	07-Aug-2018
Determinand	**Accred.**	**SOP**	**Units**	**LOD**							
Moisture	N	2030	%	0.020	5.7	6.7	8.0	11	10	8.5	13	5.9
pH	U	2010		N/A	8.5	8.6	8.4	8.7	8.2	8.8	8.5	8.7
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010

Chemtest

Report Information

Key

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

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

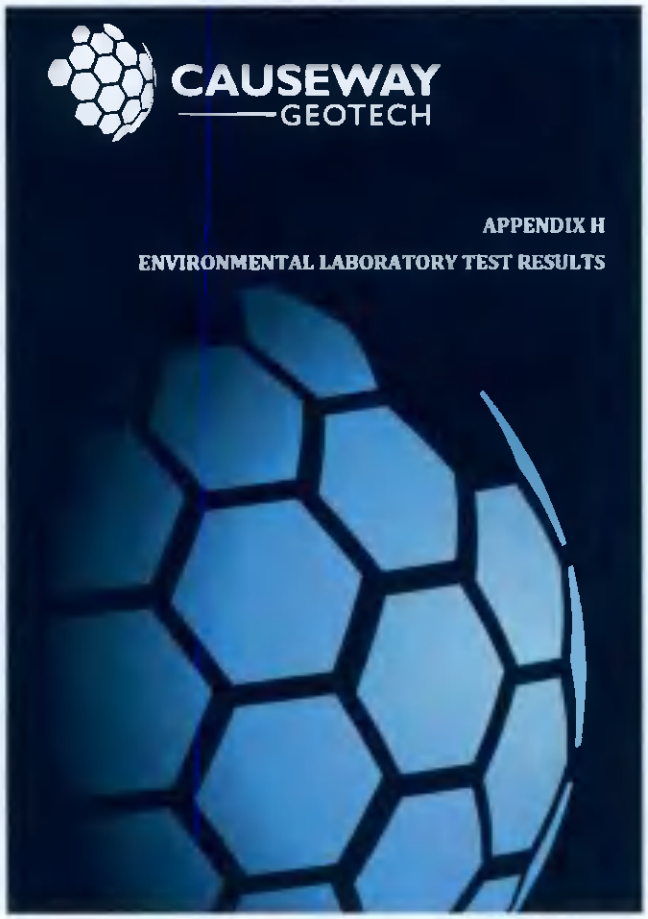
Sample Deviation Codes

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

Sample Retention and Disposal

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

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



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

Final Report

Report No.:	18-22446-1
Initial Date of Issue:	03-Aug-2018
Client	Causeway Geotech Ltd
Client Address:	8 Drumahiskey Road Balnamore Ballymoney County Antrim BT53 7QL
Contact(s):	Aisling O'Kane Colm Hurley Darren O'Mahony Gabriella Horan John Cameron Lucy Newland Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Stephen Franey Stephen Watson Sean Ross
Project	18-0827 Ballymakally
Quotation No.:	
Order No.:	
No. of Samples:	14
Turnaround (Wkdays):	3
Date Approved:	03-Aug-2018
Approved By:	
Details:	Robert Monk, Technical Manager

Date Received:	30-Jul-2018
Date Instructed:	30-Jul-2018
Results Due:	01-Aug-2018

Chemtest

Project: 18-0827 Ballymakaily

Results - Soil

Client: Causeway Geotech Ltd		Chemtest Job No.:	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446
Quotation No:		Chemtest Sample ID:	661593	661595	661597	661599	661601	661602	661603	661604	661605
Order No:		Client Sample ID:	TP03	TP04	TP10	TP11	TP12	TP08	TP09	TP07	TP06
		Client Sample Ref:	1	1	1	1	2	1	1	1	2
		Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):	1.00	1.50	0.50	0.50	1.50	0.30	0.50	0.50	1.50
		Date Sampled:	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018
		Asbestos Lab:	CONTENTS	CONTENTS	CONTENTS	CONTENTS	CONTENTS	CONTENTS	CONTENTS	CONTENTS	CONTENTS
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
ACM Type	U	2192		N/A	-	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192	%	Stat 1	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	12	9.2	6.8	5.7	14	9.7	12	4.3	7.8
pH	U	2010	pH	0.1	8.4	8.4	8.4	8.4	8.5	9.0	8.5	8.4	8.6
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	0.82	< 0.40	< 0.40	< 0.40	0.55	0.74	< 0.40	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	0.295	< 0.010	< 0.010	< 0.010
Cyanide (Free)	U	2237	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Cyanide (Total)	U	2300	mg/kg	0.5	0.76	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Thiocyanate	U	2330	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulphide (Easily Liberatable)	N	2325	mg/kg	1.00	15	35	6.3	15	12	6.2	9.1	23	16
Sulphate (Total)	U	2430	%	0.010	0.098	0.094	0.043	0.039	0.16	0.23	0.047	0.059	0.13
Arsenic	U	2450	mg/kg	1.0	34	34	31	27	31	31	31	25	31
Cadmium	U	2450	mg/kg	0.10	1.1	1.1	0.77	0.83	0.74	1.6	0.97	0.34	1.4
Chromium	U	2450	mg/kg	1.0	19	12	16	21	14	16	19	17	14
Copper	U	2450	mg/kg	0.50	25	22	32	17	30	38	16	28	26
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.11	< 0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	48	48	53	37	55	47	37	59	41
Lead	U	2450	mg/kg	0.50	26	14	20	16	38	42	18	8.8	16
Selenium	U	2450	mg/kg	0.20	< 0.20	< 0.20	< 0.20	< 0.20	0.31	0.43	< 0.20	< 0.20	0.56
Zinc	U	2450	mg/kg	0.50	85	58	74	56	93	110	60	37	72
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 2.0	< 0.50
Organic Matter	U	2625	%	0.40	1.5	0.52	3.8	0.84	1.9	5.4	0.58	0.9	1.0
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

Chemtest

Project: 18-0827 Ballymakaily

Results - Soil

Client: Causeway Geotech Ltd		Chemtest Job No.:	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446	18-22446
Quotation No:		Chemtest Sample ID:	661593	661595	661597	661599	661601	661602	661603	661604	661605
Order No:		Client Sample ID:	TP03	TP04	TP10	TP11	TP12	TP08	TP09	TP07	TP06
		Client Sample Ref:	1	1	1	1	2	1	1	1	2
		Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):	1.00	1.50	0.50	0.50	1.50	0.30	0.50	0.50	1.50
		Date Sampled:	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018
		Asbestos Lab:	CONTENTS	CONTENTS	CONTENTS	CONTENTS	CONTENTS	CONTENTS	CONTENTS	CONTENTS	CONTENTS
Determinand	**Accred.**	**SOP**	**Units**	**LOD**									
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2670	mg/kg	10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo(a)anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo(b)fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo(k)fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo(a)pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-cd)pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo(g,h,i)perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total PAH (16 PAHs)	U	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Benzene	U	2760	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Resorcinol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phenol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Cresols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Xylenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
4-Isopropyl	N	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Other Phenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

Chemtest

Results - Soil

Project: 18-0627 Ballymakeny

Client: Causeway Geotech Ltd					Chemtest Job No:	18-22446	18-22446	18-22446	18-22446	18-22446
Quotation No:					Chemtest Sample ID:	661608	661609	661611	661614	661616
Order No:					Client Location ID:	TP14	TP15	TP16	TP17	TP19
					Client Sample No:	2	1	1	2	2
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	1.50	0.50	0.50	1.50	1.50
					Date Sampled:	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018
					Asbestos Lab:	SOLENTPY	SOLENTPY	SOLENTPY	SOLENTPY	SOLENTPY
Determinand	Accred.	SOP	Units	LOD						
ACM Type	U	2192		N/A	-	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	
Moisture	N	2030	%	0.020	11	9.7	9.4	8.4	6.5	
pH	U	2010		N/A	8.5	8.2	8.2	8.5	8.5	
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	0.54	0.49	< 0.40	< 0.40	
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	
Cyanide (Free)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	
Thiocyanate	U	2300	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	12	6.3	8.0	8.9	11	
Sulphate (Total)	U	2430	%	0.010	0.063	0.083	0.071	0.14	0.051	
Arsenic	U	2450	mg/kg	1.0	28	26	40	40	34	
Cadmium	U	2450	mg/kg	0.10	1.1	1.4	1.2	2.0	1.6	
Chromium	U	2450	mg/kg	1.0	14	24	19	12	15	
Copper	U	2450	mg/kg	0.50	34	34	16	39	22	
Mercury	U	2450	mg/kg	0.10	< 0.10	0.11	< 0.10	< 0.10	< 0.10	
Nickel	U	2450	mg/kg	0.50	49	44	36	36	28	
Lead	U	2450	mg/kg	0.50	20	27	22	20	19	
Selenium	U	2450	mg/kg	0.20	0.73	0.48	< 0.20	0.76	< 0.20	
Zinc	U	2450	mg/kg	0.50	87	83	61	130	63	
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	
Organic Matter	U	2625	%	0.40	2.1	1.7	1.93	1.6	1.6	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	

Chemtest

Results - Soil

Project: 18-0627 Ballymakeny

Client: Causeway Geotech Ltd					Chemtest Job No:	18-22446	18-22446	18-22446	18-22446	18-22446
Quotation No:					Chemtest Sample ID:	661608	661609	661611	661614	661616
Order No:					Client Location ID:	TP14	TP15	TP16	TP17	TP19
					Client Sample No:	2	1	1	2	2
					Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL
					Top Depth (m):	1.50	0.50	0.50	1.50	1.50
					Date Sampled:	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018	25-Jul-2018
					Asbestos Lab:	SOLENTPY	SOLENTPY	SOLENTPY	SOLENTPY	SOLENTPY
Determinand	Accred.	SOP	Units	LOD						
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	< 10	< 10	< 10	< 10	
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo(a)anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo(b)fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo(k)fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo(a)pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Benzo(g,h,i)perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	
Total Of 16 PAHs	U	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	
Resorcinol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
Phenol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
Cresols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
Xylenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
1-Naphthol	N	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
Trimethylphenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	

Chemtest

Report Information

Key

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

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

Sample Deviation Codes

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

Sample Retention and Disposal

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

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

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

UKAS TESTING 2183

Final Report

Report No.:	18-24061-1		
Initial Date of Issue:	16-Aug-2018		
Client	Causeway Geotech Ltd		
Client Address	8 Drumahaskey Road Ballamore Ballymoney County Antrim BT53 7QL		
Contact(s):	Conn Cornwall Colm Hurley Darren O'Mahony Gabriella Horan John Cameron Lucy Newland Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Sean Ross Stephen Franey Stephen Watson Stuart Abraham		
Project	18-0827 Lands at Ballymakelly		
Quotation No.:		**Date Received:**	10-Aug-2018
Order No.:		**Date Instructed:**	13-Aug-2018
No. of Samples:	10		
Turnaround (Wkdays):	3	**Results Due:**	15-Aug-2018
Date Approved:	16-Aug-2018		
Approved By:			
Details:	Robert Monk, Technical Manager		

Chemtest

The right chemistry to deliver results

Results - Soil

Project: 18-0827 Lands at Ballymakelly

Client: Causeway Geotech Ltd				Chemtest Job No:	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061
Quotation No:				Chemtest Sample ID:	669533	669534	669535	669536	669537	669538	669539	669540
Order No:				Client Location ID:	BH05	BH08	BH11	BH11	BH12	BH13	BH14	BH14
				Client Sample Ref:	ES1	ES2	ES2	ES1	ES1	ES2	ES1	ES2
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.5	1.5	1.50	0.50	0.5	1.5	0.5	1.5
				Date Sampled:	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018
				Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
ACM Type	U	2192		N/A	-	-	-	-	-	-	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	16	8.5	13	12	6.9	[illegible]	14	[illegible]
pH	U	2010		N/A	8.6	8.6	8.4	8.4	8.6	8.6	8.[illegible]	8.5
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40	0.61	< 0.40	< 0.40	< 0.40	0.70	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010
Cyanide (Free)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Thiocyanate	U	2300	mg/kg	5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	7.9	24	17	5.1	4.3	21	1.6	6.2
Sulphate (Total)	U	2430	%	0.010	0.027	0.10	0.17	0.031	0.041	0.83	0.070	[illegible]
Arsenic	U	2450	mg/kg	1.0	11	[illegible]	[illegible]	[illegible]	[illegible]	28	[illegible]	[illegible]
Cadmium	U	2450	mg/kg	0.10	[illegible]	1.6	1.3	0.81	[illegible]	1.4	2.6	2.6
Chromium	U	2450	mg/kg	1.0	18	12	18	24	14	12	25	17
Copper	U	2450	mg/kg	0.50	11	25	25	13	[illegible]	20	23	38
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	30	45	41	48	51	48	50	60
Lead	U	2450	mg/kg	0.50	14	11	31	18	15	11	24	20
Selenium	U	2450	mg/kg	0.20	< 0.20	0.83	2.0	0.30	< 0.20	0.60	0.84	2.6
Zinc	U	2450	mg/kg	0.50	49	53	69	73	54	50	96	90
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50	< 0.50
Organic Matter	U	2625	%	0.40	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.5	[illegible]	1.6
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	16	65	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	16	65	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0

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Chemtest

The right chemistry to deliver results

Results - Soil

Project: 18-0827 Lands at Ballymakelly

Client: Causeway Geotech Ltd				Chemtest Job No:	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061	18-24061
Quotation No:				Chemtest Sample ID:	669533	669534	669535	669536	669537	669538	669539	669540
Order No:				Client Location ID:	BH05	BH08	BH11	BH11	BH12	BH13	BH14	BH14
				Client Sample Ref:	ES1	ES2	ES2	ES1	ES1	ES2	ES1	ES2
				Sample Type:	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
				Top Depth (m):	0.5	1.5	1.50	0.50	0.5	1.5	0.5	1.5
				Date Sampled:	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018	09-Aug-2018
				Asbestos Lab:	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**								
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	25	95	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	25	95	< 5.0	< 5.0	< 5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10.0	< 10	41	160	< 10	< 10	< 10	< 10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.32	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	0.66	< 0.10
Benzo[a]anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[b]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[k]fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[a]pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Indeno(1,2,3-c,d)Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Benzo[g,h,i]perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10	< 0.10
Total Of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0	< 2.0
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0	< 1.0
Resorcinol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Phenol	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Cresols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Xylenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
1-Naphthol	N	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Trimethylphenols	U	2920	mg/kg	0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050	< 0.050
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30	< 0.30

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Chemtest

Results - Soil

Project: 18-0827 Lands at Balhmakelly

Client: Causeway Geotech Ltd		Chemtest Job No.:			18-24061	18-24061
Quotation No.:		Chemtest Sample ID:			669841	669842
Order No:		Client Location ID:			BH15	BH15
		Client Sample Ref:			ES1	ES2
		Sample Type:			SOIL	SOIL
		Top Depth (m):			0.5	1.5
		Date Sampled:			06-Aug-2018	06-Aug-2018
		Asbestos Lab:			COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
ACM Type	U	2192		N/A	-	-
Asbestos Identification	U	2192	%	0.001	No Asbestos Detected	No Asbestos Detected
Moisture	N	2030	%	0.020	9.5	7.9
pH	U	2010		N/A	8.4	8.6
Boron (Hot Water Soluble)	U	2120	mg/kg	0.40	< 0.40	< 0.40
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010
Cyanide (Free)	U	2300	mg/kg	0.50	< 0.50	< 0.50
Cyanide (Total)	U	2300	mg/kg	0.50	< 0.50	< 0.50
Thiocyanate	U	2300	mg/kg	5.0	< 5.0	< 5.0
Sulphide (Easily Liberatable)	N	2325	mg/kg	0.50	0.1	10
Sulphate (Total)	U	2430	%	0.010	0.024	0.13
Arsenic	U	2450	mg/kg	1.0	44	35
Cadmium	U	2450	mg/kg	0.10	1.7	2.0
Chromium	U	2450	mg/kg	1.0	30	15
Copper	U	2450	mg/kg	0.50	23	32
Mercury	U	2450	mg/kg	0.10	< 0.10	< 0.10
Nickel	U	2450	mg/kg	0.50	54	56
Lead	U	2450	mg/kg	0.50	16	18
Selenium	U	2450	mg/kg	0.20	0.79	2.2
Zinc	U	2450	mg/kg	2.50	58	75
Chromium (Hexavalent)	N	2490	mg/kg	0.50	< 1.50	< 1.50
Organic Matter	U	2625	%	0.40	0.56	1.6
Aliphatic TPH >C5-C6	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C6-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aliphatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Aromatic TPH >C5-C7	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C7-C8	N	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C8-C10	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C10-C12	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C12-C16	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C16-C21	U	2680	mg/kg	1.0	< 1.0	< 1.0

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Chemtest

Results - Soil

Project: 18-0827 Lands at Balhmakelly

Client: Causeway Geotech Ltd		Chemtest Job No.:			18-24061	18-24061
Quotation No.:		Chemtest Sample ID:			669841	669842
Order No:		Client Location ID:			BH15	BH15
		Client Sample Ref:			ES1	ES2
		Sample Type:			SOIL	SOIL
		Top Depth (m):			0.5	1.5
		Date Sampled:			06-Aug-2018	06-Aug-2018
		Asbestos Lab:			COVENTRY	COVENTRY
Determinand	**Accred.**	**SOP**	**Units**	**LOD**		
Aromatic TPH >C21-C35	U	2680	mg/kg	1.0	< 1.0	< 1.0
Aromatic TPH >C35-C44	N	2680	mg/kg	1.0	< 1.0	< 1.0
Total Aromatic Hydrocarbons	N	2680	mg/kg	5.0	< 5.0	< 5.0
Total Petroleum Hydrocarbons	N	2680	mg/kg	10	< 10	< 10
Naphthalene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Acenaphthylene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Acenaphthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Fluorene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Phenanthrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benz(a)anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Chrysene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo(b)fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo(k)fluoranthene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo(a)pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Indeno(1,2,3-cd)pyrene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Dibenz(a,h)Anthracene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Benzo(g,h,i)perylene	U	2700	mg/kg	0.10	< 0.10	< 0.10
Total of 16 PAH's	U	2700	mg/kg	2.0	< 2.0	< 2.0
Benzene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Toluene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Ethylbenzene	U	2760	µg/kg	1.0	< 1.0	< 1.0
m & p-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0
o-Xylene	U	2760	µg/kg	1.0	< 1.0	< 1.0
Resorcinol	U	2920	mg/kg	0.050	< 0.050	< 0.050
Phenol	U	2920	mg/kg	0.050	< 0.050	< 0.050
Cresols	U	2920	mg/kg	0.050	< 0.050	< 0.050
Xylenols	U	2920	mg/kg	0.050	< 0.050	< 0.050
1-Naphthol	N	2920	mg/kg	0.050	< 0.050	< 0.050
Trimethylphenol	U	2920	mg/kg	0.050	< 0.050	< 0.050
Total Phenols	U	2920	mg/kg	0.30	< 0.30	< 0.30

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Chemtest

Report Information

Key

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

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

Sample Deviation Codes

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

Sample Retention and Disposal

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

If you require extended retention of samples, please email your requirements to
[redacted]

Page 6 of 6

CAUSEWAY GEOTECH

APPENDIX H

SPT HAMMER ENERGY MEASUREMENT REPORT

Southern Testing

SPT Hammer Energy Test Report

In accordance with BSEN ISO 22476-3:2005

Neil Burrows
Southern Testing Laboratories
Unit 3.1
Charlwoods Road
East Grinstead
RH19 2HU

SPT Hammer Ref: T10267
Test Date: 14/04/2018
Report Date: 15/04/2018
File Name: T10267.spt
Test Operator: CAUSEWAY

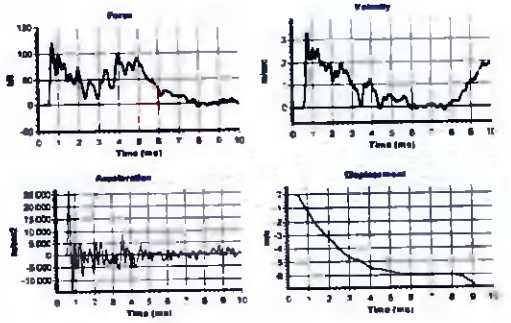
Instrumented Rod Data

Diameter d. (mm)	54
Wall Thickness t_r (mm)	6.0
Assumed Modulus E_a (GPa)	200
Accelerometer No.1	8458
Accelerometer No.2	9607

SPT Hammer Information

Hammer Mass m (kg):	63.5
Falling Height h (mm)	760
SPT String Length L (m):	10.5

Comments / Location
Causeway Yard



Calculations

Area of Rod A (mm2):	905
Theoretical Energy E_{theor} (J):	473
Measured Energy E_{meas} (J):	351
Energy Ratio E_r (%):	**74**

Signed: N P Burrows
Title: Field Operations Manager

The recommended calibration interval is 12 months

Appendix 7.3 Soil chemical test analysis results

element

Element Materials Technology
Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

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F +44 (0) 1244 833781
W: www.element.com

AWN Consulting
Tecpro Building
Clonshaugh Business & Technology Park
Dublin
Dublin 17
Ireland

Attention :	Colm Driver
Date :	4th December, 2020
Your reference :	
Our reference :	Test Report 20/16584 Batch 1
Location :	Edgeconnex, Grangecastle
Date samples received :	26th November, 2020
Status :	Final report
Issue :	1

Four samples were received for analysis on 26th November, 2020 of which four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected

Authorised By:

Phil Sommerton BSc
Senior Project Manager

Please include all sections of this report if it is reproduced

Element Materials Technology Environmental UK Limited
Registered in England and Wales
Registered Office: 10 Lower Grosvenor Place, London, SW1W 0EN
Company Registration No: 11371415

Element Materials Technology

Client Name: AWN Consulting
Reference:
Location: Edgeconnex Grangecastle
Contact: Colm Driver
EMT Job No: 20/16584

Report : Liquid

Liquids/products: V=40ml vial G=glass bottle P=plastic bottle
H=H_2SO_4 Z=ZnAc, N=NaOH HN=HNO_3

Please see attached notes for all abbreviations and acronyms

EMT Sample No.	1-6	7-12	13-18	19-24							LOD/LOR	Units	Method No
Sample ID	BH05	BH10	BH11	BH15									
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G									
Sample Date	25/11/2020 19:00	25/11/2020 16:30	25/11/2020 18:30	26/11/2020 11:20									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	26/11/2020	26/11/2020	26/11/2020	26/11/2020									
Dissolved Arsenic [#]	<2.5	<2.5	<2.5	<2.5							<2.5	ug/l	TM30/PM14
Dissolved Boron	13	<12	13	14							<12	ug/l	TM30/PM14
Dissolved Cadmium [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM30/PM14
Total Dissolved Chromium [#]	<1.5	<1.5	<1.5	<1.5							<1.5	ug/l	TM30/PM14
Dissolved Copper [#]	<7	<7	<7	<7							<7	ug/l	TM30/PM14
Dissolved Lead [#]	<5	<5	<5	<5							<5	ug/l	TM30/PM14
Dissolved Mercury [#]	<1	<1	<1	<1							<1	ug/l	TM30/PM14
Dissolved Nickel [#]	4	<2	3	4							<2	ug/l	TM30/PM14
Dissolved Selenium [#]	<3	<3	<3	<3							<3	ug/l	TM30/PM14
Dissolved Zinc [#]	<3	<3	<3	7							<3	ug/l	TM30/PM14
PAH MS													
Naphthalene [#]	<0.1	<0.1	<0.1	<0.1							<0.1	ug/l	TM4/PM30
Acenaphthylene [#]	<0.013	<0.013	<0.013	<0.013							<0.013	ug/l	TM4/PM30
Acenaphthene [#]	<0.013	<0.013	<0.013	<0.013							<0.013	ug/l	TM4/PM30
Fluorene [#]	<0.014	<0.014	<0.014	<0.014							<0.014	ug/l	TM4/PM30
Phenanthrene [#]	<0.011	<0.011	<0.011	<0.011							<0.011	ug/l	TM4/PM30
Anthracene [#]	<0.013	<0.013	<0.013	<0.013							<0.013	ug/l	TM4/PM30
Fluoranthene [#]	<0.012	<0.012	<0.012	<0.012							<0.012	ug/l	TM4/PM30
Pyrene [#]	<0.013	<0.013	<0.013	<0.013							<0.013	ug/l	TM4/PM30
Benzo(a)anthracene [#]	<0.015	<0.015	<0.015	<0.015							<0.015	ug/l	TM4/PM30
Chrysene [#]	<0.011	<0.011	<0.011	<0.011							<0.011	ug/l	TM4/PM30
Benzo(bk)fluoranthene [#]	<0.018	<0.018	<0.018	<0.018							<0.018	ug/l	TM4/PM30
Benzo(a)pyrene [#]	<0.016	<0.016	<0.016	<0.016							<0.016	ug/l	TM4/PM30
Indeno(123cd)pyrene [#]	<0.011	<0.011	<0.011	<0.011							<0.011	ug/l	TM4/PM30
Dibenzo(ah)anthracene [#]	<0.01	<0.01	<0.01	<0.01							<0.01	ug/l	TM4/PM30
Benzo(ghi)perylene [#]	<0.011	<0.011	<0.011	<0.011							<0.011	ug/l	TM4/PM30
PAH 16 Total [#]	<0.195	<0.195	<0.195	<0.195							<0.195	ug/l	TM4/PM30
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	<0.01							<0.01	ug/l	TM4/PM30
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	<0.01							<0.01	ug/l	TM4/PM30
PAH Surrogate % Recovery	86	85	88	77							<0	%	TM4/PM30
Methyl Tertiary Butyl Ether [#]	<0.1	<0.1	<0.1	<0.1							<0.1	ug/l	TM15/PM10
Benzene [#]	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM15/PM10
Toluene [#]	<5	<5	<5	<5							<5	ug/l	TM15/PM10
Ethylbenzene [#]	<1	<1	<1	<1							<1	ug/l	TM15/PM10
m/p-Xylene [#]	<2	<2	<2	<2							<2	ug/l	TM15/PM10
o-Xylene [#]	<1	<1	<1	<1							<1	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	97	96	96	96							<0	%	TM15/PM10
Surrogate Recovery 4-Bromofluorobenzene	94	96	95	95							<0	%	TM15/PM10

Element Materials Technology

Client Name: AWN Consulting
Reference:
Location: Edgeconnex Grangecastle
Contact Colm Driver
EMT Job No. 20/16584

Report : Liquid

Liquids/products: V=40ml vial G=glass bottle P=plastic bottle H=H_2SO_4 Z=ZnAc N=NaOH HN=HNO_3

EMT Sample No.	1-6	7-12	13-18	19-24							LOD/LOR	Units	Method No.
Sample ID	BH09	BH10	BH11	BH15									
Depth													
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G									
Sample Date	[redacted]	[redacted]	[redacted]	[redacted]									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	26/11/2020	26/11/2020	26/11/2020	26/11/2020									
TPH CWG													
Aliphatics													
>C5-C6*	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>C6-C8*	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>C8-C10*	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>C10-C12*	<5	<5	<5	<5							<5	ug/l	[redacted]
>C12-C16*	<10	<10	<10	<10							<10	ug/l	[redacted]
>C16-C21*	<10	<10	<10	<10							<10	ug/l	[redacted]
>C21-C35*	<10	<10	<10	<10							<10	ug/l	[redacted]
Total aliphatics C5-35*	<10	<10	<10	<10							<10	ug/l	[redacted]
Aromatics													
>C5-EC7*	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>EC7-EC8*	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>EC8-EC10*	<10	<10	<10	<10							<10	ug/l	TM36/PM12
>EC10-EC12*	<5	<5	<5	<5							<5	ug/l	[redacted]
>EC12-EC16*	<10	<10	<10	<10							<10	ug/l	[redacted]
>EC16-EC21*	<10	<10	<10	<10							<10	ug/l	[redacted]
>EC21-EC35*	<10	<10	<10	<10							<10	ug/l	[redacted]
Total aromatics C5-35*	<10	<10	<10	<10							<10	ug/l	[redacted]
Total aliphatics and aromatics(C5-35)*	<10	<10	<10	<10							<10	ug/l	[redacted]
PCBs (Total vs Aroclor 1254)	<0.2	<0.2	<0.2	<0.2							<0.2	ug/l	TM17/PM30
Chloride*	60.6	25	14.9	15.0							<0.3	mg/l	TM38/PM0
Ortho Phosphate as PO4*	<0.06	<0.06	<0.06	<0.06							<0.06	mg/l	TM38/PM0
Total Oxidised Nitrogen as N*	<0.2	0.6	0.4	0.2							<0.2	mg/l	TM38/PM0
Ammoniacal Nitrogen as N*	0.10	0.03	0.05	0.04							<0.03	mg/l	TM38/PM0
Electrical Conductivity @25C*	541	339	422	356							<2	uS/cm	TM76/PM0
pH*	7.60	7.66	7.66	7.75							<0.01	pH units	TM73/PM0
Total Nitrogen	5.4	5.6	5.0	3.2							<0.5	mg/l	[redacted]

Please see attached notes for all abbreviations and acronyms

Element Materials Technology

Client Name: AWN Consulting **SVOC Report:** Liquid
Reference:
Location: Edgeconnex, Grangecastle
Contact: Colm Driver
EMT Job No: 20/16584

EMT Sample No.	1-6	7-12	13-18	19-24									
Sample ID	BH05	BH10	BH11	BH15									
Depth											Please see attached notes for all abbreviations and acronyms		
COC No / misc													
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G									
Sample Date	25/11/2020 10:00	25/11/2020 10:30	25/11/2020 10:30	25/11/2020 11:00									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	26/11/2020	26/11/2020	26/11/2020	26/11/2020							LOD/LOR	Units	Method No
SVOC MS													
Phenols													
2-Chlorophenol#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
2-Methylphenol#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
2-Nitrophenol	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
2,4-Dichlorophenol#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
2,4-Dimethylphenol	<1	<1	<1	<1							<1	ug/l	TM16/PM30
2,4,5-Trichlorophenol#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
2,4,6-Trichlorophenol	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Chloro-3-methylphenol#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
4-Methylphenol	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Nitrophenol	<10	<10	<10	<10							<10	ug/l	TM16/PM30
Pentachlorophenol	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Phenol	<1	<1	<1	<1							<1	ug/l	TM16/PM30
PAHs													
2-Chloronaphthalene#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
2-Methylnaphthalene#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Phthalates													
Bis(2-ethylhexyl) phthalate	<5	<5	<5	<5							<5	ug/l	TM16/PM30
Butylbenzyl phthalate	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Di-n-butyl phthalate#	<1.5	<1.5	<1.5	<1.5							<1.5	ug/l	TM16/PM30
Di-n-Octyl phthalate	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Diethyl phthalate#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Dimethyl phthalate	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Other SVOCs													
1,2-Dichlorobenzene#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
1,2,4-Trichlorobenzene#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
1,3-Dichlorobenzene#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
1,4-Dichlorobenzene#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
2-Nitroaniline	<1	<1	<1	<1							<1	ug/l	TM16/PM30
2,4-Dinitrotoluene#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
2,6-Dinitrotoluene	<1	<1	<1	<1							<1	ug/l	TM16/PM30
3-Nitroaniline	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Bromophenylphenylether#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Chloroaniline	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Chlorophenylphenylether#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
4-Nitroaniline	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Azobenzene#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Bis(2-chloroethoxy)methane#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Bis(2-chloroethyl)ether#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Carbazole#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Dibenzofuran#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Hexachlorobenzene#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Hexachlorobutadiene#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Hexachlorocyclopentadiene	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Hexachloroethane#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Isophorone#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
N-nitrosodi-n-propylamine#	<0.5	<0.5	<0.5	<0.5							<0.5	ug/l	TM16/PM30
Nitrobenzene#	<1	<1	<1	<1							<1	ug/l	TM16/PM30
Surrogate Recovery 2-Fluorobiphenyl	76	63 SV	70	118							<0	%	TM16/PM30
Surrogate Recovery p-Terphenyl-d14	72	62 SV	68	114							<0	%	TM16/PM30

Element Materials Technology

Client Name: AWN Consulting **VOC Report :** Liquid
Reference:
Location: Edgeconnex, Grangecastle
Contact: Colm Dnver
EMT Job No: 20/16584

EMT Sample No.	1-6	7-12	13-16	19-24							
Sample ID	BH05	BH10	BH11	BH13						Please see attached notes for all abbreviations and acronyms	
Depth											
COC No / misc											
Containers	V H HN P G	V H HN P G	V H HN P G	V H HN P G							
Sample Date	26/11/2020 10:00	25/11/2020 10:30	25/11/2020 10:30	24/11/2020 11:00							
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water							
Batch Number	1	1	1	1							
Date of Receipt	26/11/2020	26/11/2020	26/11/2020	26/11/2020						LOD/LOR	Units	Method No.
VOC MS												
Dichlorodifluoromethane	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Methyl Tertiary Butyl Ether*	<0.1	<0.1	<0.1	<0.1						<0.1	ug/l	TM15/PM10
Chloromethane*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
Vinyl Chloride*	<0.1	<0.1	<0.1	<0.1						<0.1	ug/l	TM15/PM10
Bromomethane	<1	<1	<1	<1						<1	ug/l	TM15/PM10
Chloroethane*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
Trichlorofluoromethane*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,1-Dichloroethene (1,1 DCE)*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
Dichloromethane (DCM)*	<5	<5	<5	<5						<5	ug/l	TM15/PM10
trans-1-2-Dichloroethene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,1-Dichloroethane*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
cis-1-2-Dichloroethene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
2,2-Dichloropropane	<1	<1	<1	<1						<1	ug/l	TM15/PM10
Bromochloromethane*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Chloroform*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
1,1,1-Trichloroethane*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
1,1-Dichloropropene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
Carbon tetrachloride*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
1,2-Dichloroethane*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Benzene*	<0.5	<0.5	<0.5	<0.5						<0.5	ug/l	TM15/PM10
Trichloroethene (TCE)*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,2-Dichloropropane*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Dibromomethane*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
Bromodichloromethane*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
cis-1,3-Dichloropropene	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Toluene*	<5	<5	<5	<5						<5	ug/l	TM15/PM10
trans-1,3-Dichloropropene	<2	<2	<2	<2						<2	ug/l	TM15/PM10
1,1,2-Trichloroethane*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Tetrachloroethene (PCE)*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,3-Dichloropropane*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Dibromochloromethane*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
1,2-Dibromoethane*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Chlorobenzene*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
1,1,1,2-Tetrachloroethane*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Ethylbenzene*	<1	<1	<1	<1						<1	ug/l	TM15/PM10
m/p-Xylene*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
o-Xylene*	<1	<1	<1	<1						<1	ug/l	TM15/PM10
Styrene	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Bromoform*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
Isopropylbenzene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,1,2,2-Tetrachloroethane	<4	<4	<4	<4						<4	ug/l	TM15/PM10
Bromobenzene*	<2	<2	<2	<2						<2	ug/l	TM15/PM10
1,2,3-Trichloropropane*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
Propylbenzene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
2-Chlorotoluene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,3,5-Trimethylbenzene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
4-Chlorotoluene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
tert-Butylbenzene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,2,4-Trimethylbenzene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
sec-Butylbenzene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
4-Isopropyltoluene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,3-Dichlorobenzene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,4-Dichlorobenzene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
n-Butylbenzene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,2-Dichlorobenzene*	<3	<3	<3	<3						<3	ug/l	TM15/PM10
1,2-Dibromo-3-chloropropane	<2	<2	<2	<2						<2	ug/l	TM15/PM10
1,2,4-Trichlorobenzene	<3	<3	<3	<3						<3	ug/l	TM15/PM10
Hexachlorobutadiene	<3	<3	<3	<3						<3	ug/l	TM15/PM10
Naphthalene	<2	<2	<2	<2						<2	ug/l	TM15/PM10
1,2,3-Trichlorobenzene	<3	<3	<3	<3						<3	ug/l	TM15/PM10
Surrogate Recovery Toluene D8	97	96	96	96						<0	%	TM15/PM10
Surrogate Recovery 4-BromoFluorobenzene	94	96	95	95						<0	%	TM15/PM10

Element Materials Technology **Notification of Deviating Samples**

Client Name: AWN Consulting
Reference:
Location: Edgeconnex, Grangecastle
Contact: Colm Driver

EMT Job No	Batch	Sample ID	Depth	EMT Sample No.	Analysis	Reason
No deviating sample report results for job 20[illegible]						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 20/16584

SOILS

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overesitimate when other sulphides such as Barite (Barium Sulphate) are present.

WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory.

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

EMT Job No.: 20/16584

REPORTS FROM THE SOUTH AFRICA LABORATORY

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

Measurement Uncertainty

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

ABBREVIATIONS and ACRONYMS USED

#	ISO17025 (UKAS Ref No. 4225) accredited - UK
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher, this result is not accredited.
^	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

Element Materials Technology **Method Code Appendix**

EMT Job No. 20/16584

Test Method No	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM4	Modified USEPA 8270D v5 2014 method for the solvent extraction and determination of PAHs by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex				
TM4	Modified USEPA 8270D v5 2014 method for the solvent extraction and determination of PAHs by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex	Yes			
TM5	Modified 8015B v2 1996 method for the determination of solvent Extractable Petroleum hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present	PM15/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex	Yes			
TM5/TM36	please refer to TM5 and TM36 for method details	PM12/PM15/PM30	please refer to PM15/PM30 and PM12 for method details	Yes			
TM15	Modified USEPA 8260B v2 1996 Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS	PM10	Modified US EPA method 5021A v2 2014 Preparation of solid and liquid samples for GC headspace analysis				
TM15	Modified USEPA 8260B v2 1996 Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS	PM10	Modified US EPA method 5021A v2 2014 Preparation of solid and liquid samples for GC headspace analysis	Yes			
TM16	Modified USEPA 8270D v5 2014 Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex				
TM16	Modified USEPA 8270D v5 2014 Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex	Yes			
TM17	Modified US EPA method 8270D v5 2014 Determination of specific Polychlorinated Biphenyl congeners by GC-ME	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex				
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry). WATERS by Modified USEPA Method 200.7 Rev. 4.4 1994. Modified EPA Method 6010B Rev.2 Dec 1996. Modified BS EN ISO 11885:2009 SOILS by Modified USEP	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals and remain unfiltered for Total metals then acidified				

Element Materials Technology **Method Code Appendix**

EMT Job No. 20/16584

Test Method No	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM30	Determination of Trace Metals by ICP-OES (Inductively Coupled Plasma – Optical Emission Spectrometry). WATERS by Modified USEPA Method 200.7 Rev. 4.4 1994. Modified EPA Method 6010B Rev.2 Dec 1996. Modified BS EN ISO 11885:2009 SOILS by Modified USEP	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals and remain unfiltered for Total metals then acidified	Yes			
TM36	Modified US EPA method 8015B v2 1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check when requested	PM12	Modified US EPA method 5021A v2 2014 Preparation of solid and liquid samples for GC headspace analysis	Yes			
TM38	Soluble ion analysis using Discrete Analyser. Modified US EPA methods Chloride 325.2 (1978) Sulphate 375.4 (Rev.2 1993); ortho-Phosphate 365.2 (Rev.2 1993); TON 353.1 (Rev.2 1993); Nitrite 354.1 (1971); Hach Cr 7196A (1992); NH4+ 350.1 (Rev.2 1993) compatible	PM0	No preparation is required	Yes			
TM38/TM125	Total Nitrogen/Organic Nitrogen by calculation	PM0	No preparation is required				
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 2004 and BS1377 3 1990 Determination of pH by Metrohm automated probe analyser	PM0	No preparation is required	Yes			
TM76	Modified US EPA method 120.1 (1982) Determination of Specific Conductance by Metrohm automated probe analyser	PM0	No preparation is required	Yes			

CHAPTER 8 - HYDROLOGY

Appendix 8.1 Criteria for rating Site Attributes - Estimation of Importance of Hydrology Attributes (NRA)

Importance	Criteria	Typical Examples
Extremely High	Attribute has a high quality or value on an international scale	River, wetland or surface water body ecosystem protected by EU legislation e.g. 'European sites' designated under the Habitats Regulations or 'Salmonid waters' designated pursuant to the European Communities (Quality of Salmonid Waters) Regulations, 1988.
Very High	Attribute has a high quality or value on a regional or national scale	River, wetland or surface water body ecosystem protected by national legislation – NHA status Regionally important potable water source supplying >2500 homes Quality Class A (Biotic Index Q4, Q5) Flood plain protecting more than 50 residential or commercial properties from flooding Nationally important amenity site for wide range of leisure activities
High	Attribute has a high quality or value on a local scale	Salmon fishery Locally important potable water source supplying >1000 homes Quality Class B (Biotic Index Q3-4) Flood plain protecting between 5 and 50 residential or commercial properties from flooding Locally important amenity site for wide range of leisure activities
Medium	Attribute has a medium quality or value on a local scale	Coarse fishery Local potable water source supplying >50 homes Quality Class C (Biotic Index Q3, Q2- 3) Flood plain protecting between 1 and 5 residential or commercial properties from flooding
Low	Attribute has a low quality or value on a local scale	Locally important amenity site for small range of leisure activities Local potable water source supplying <50 homes Quality Class D (Biotic Index Q2, Q1) Flood plain protecting 1 residential or commercial property from flooding Amenity site used by small numbers of local people

Estimation of magnitude of impact on hydrology attribute (NRA)

Magnitude of Impact	Criteria	Typical Examples
Large Adverse	Results in loss of attribute	Loss or extensive change to a waterbody or water dependent habitat. Increase in predicted peak flood level >100mm. Extensive loss of fishery. Calculated risk of serious pollution incident >2% annually. Extensive reduction in amenity value.
Moderate Adverse	Results in impact on integrity of attribute or loss of part of attribute	Increase in predicted peak flood level >50mm. Partial loss of fishery. Calculated risk of serious pollution incident >1% annually. Partial reduction in amenity value.
Small Adverse	Results in minor impact on integrity of attribute or loss of small part of attribute	Increase in predicted peak flood level >10mm. Minor loss of fishery. Calculated risk of serious pollution incident >0.5% annually. Slight reduction in amenity value.
Negligible	Results in an impact on attribute but of insufficient magnitude to affect either use or integrity	Negligible change in predicted peak flood level. Calculated risk of serious pollution incident <0.5% annually.
Minor Beneficial	Results in minor improvement of attribute quality	Reduction in predicted peak flood level >10mm. Calculated reduction in pollution risk of 50% or more where existing risk is <1% annually.
Moderate Beneficial	Results in moderate improvement of attribute quality	Reduction in predicted peak flood level >50mm. Calculated reduction in pollution risk of 50% or more where existing risk is >1% annually.
Major Beneficial	Results in major improvement of attribute quality	Reduction in predicted peak flood level >100mm

Rating of Significant Environmental Impacts at EIS Stage (NRA)

Importance of Attribute	Magnitude of Importance			
	Negligible	Small Adverse	Moderate Adverse	Large Adverse
Extremely High	Imperceptible	Significant	Profound	Profound
Very High	Imperceptible	Significant/moderate	Profound/Significant	Profound
High	Imperceptible	Moderate/Slight	Significant/moderate	Profound/Significant
Medium	Imperceptible	Slight	Moderate	Significant
Low	Imperceptible	Imperceptible	Slight	Slight/Moderate

CHAPTER 9 - NOISE AND VIBRATION

Appendix 9.1 Glossary of acoustic terminology (prepared by AWN Consulting Ltd.)

ambient noise	The totally encompassing sound in a given situation at a given time, usually composed of sound from many sources, near and far.
background noise	The steady existing noise level present without contribution from any intermittent sources. The A-weighted sound pressure level of the residual noise at the assessment position that is exceeded for 90 per cent of a given time interval, T ($L_{AF90,T}$).
broadband	Sounds that contain energy distributed across a wide range of frequencies.
dB	Decibel - The scale in which sound pressure level is expressed. It is defined as 20 times the logarithm of the ratio between the RMS pressure of the sound field and the reference pressure of 20 micro-pascals (20 μPa).
dB L_{pA}	An 'A-weighted decibel' - a measure of the overall noise level of sound across the audible frequency range (20 Hz – 20 kHz) with A-frequency weighting (i.e. 'A'–weighting) to compensate for the varying sensitivity of the human ear to sound at different frequencies.
Hertz (Hz)	The unit of sound frequency in cycles per second.
impulsive noise	A noise that is of short duration (typically less than one second), the sound pressure level of which is significantly higher than the background.
$L_{Aeq,T}$	This is the equivalent continuous sound level. It is a type of average and is used to describe a fluctuating noise in terms of a single noise level over the sample period (T). The closer the L_{Aeq} value is to either the L_{AF10} or L_{AF90} value indicates the relative impact of the intermittent sources and their contribution. The relative spread between the values determines the impact of intermittent sources such as traffic on the background.
L_{AFN}	The A-weighted noise level exceeded for N% of the sampling interval. Measured using the "Fast" time weighting.
L_{AFmax}	is the instantaneous slow time weighted maximum sound level measured during the sample period (usually referred to in relation to construction noise levels).
$L_{Ar,T}$	The Rated Noise Level, equal to the L_{Aeq} during a specified time interval (T). plus specified adjustments for tonal character and impulsiveness of the sound.
L_{AF90}	Refers to those A-weighted noise levels in the lower 90 percentile of the sampling interval: it is the level which is exceeded for 90% of the measurement period. It will therefore exclude the intermittent features of traffic and is used to estimate a background level. Measured using the "Fast" time weighting.
L_{AT}(DW)	equivalent continuous downwind sound pressure level.
L_{fT}(DW)	equivalent continuous downwind octave-band sound pressure level.
L_{day}	L_{day} is the average noise level during the daytime period of 07:00hrs to 19:00hrs
L_{night}	L_{night} is the average noise level during the night-time period of 23:00hrs to 07:00hrs.
low frequency noise	LFN - noise which is dominated by frequency components towards the lower end of the frequency spectrum.
noise	Any sound, that has the potential to cause disturbance, discomfort or psychological stress to a person exposed to it, or any sound that could cause

actual physiological harm to a person exposed to it, or physical damage to any structure exposed to it, is known as noise.

noise sensitive location NSL – Any dwelling house, hotel or hostel, health building, educational establishment, place of worship or entertainment, or any other facility or other area of high amenity which for its proper enjoyment requires the absence of noise at nuisance levels.

octave band A frequency interval, the upper limit of which is twice that of the lower limit. For example, the 1,000Hz octave band contains acoustical energy between 707Hz and 1,414Hz. The centre frequencies used for the designation of octave bands are defined in ISO and ANSI standards.

rating level See $L_{Ar,T}$.

sound power level The logarithmic measure of sound power in comparison to a referenced sound intensity level of one picowatt (1pW) per m^2 where:

$$Lw = 10Log\frac{P}{P_0}\ \text{dB}$$

Where: p is the rms value of sound power in pascals; and
P_0 is 1 pW.

sound pressure level The sound pressure level at a point is defined as:

$$Lp = 20Log\frac{P}{P_0}\ \text{dB}$$

specific noise level A component of the ambient noise which can be specifically identified by acoustical means and may be associated with a specific source. In BS 4142, there is a more precise definition as follows: 'the equivalent continuous A-weighted sound pressure level at the assessment position produced by the specific noise source over a given reference time interval ($L_{Aeq,T}$)'.

tonal Sounds which cover a range of only a few Hz which contains a clearly audible tone i.e. distinguishable, discrete or continuous noise (whine, hiss, screech, or hum etc.) are referred to as being 'tonal'.

$^1/_3$ octave analysis Frequency analysis of sound such that the frequency spectrum is subdivided into bands of one–third of an octave each.

Appendix 9.2 Noise monitoring details (AWN Consulting Ltd.)

A series of environmental noise surveys were conducted in order to quantify the existing noise environment. The survey was conducted in accordance with *ISO/DIS 1996-2 Acoustics - Description, measurement and assessment of environmental noise -- Part 2: Determination of sound pressure levels (2015)*. Specific details are set out below.

Choice of noise monitoring locations

Noise measurements were conducted at three positions on the site boundary that are reflective of noise levels at the nearest noise sensitive locations and the common boundary with the Cuisine de France facility to the west. Details for the particular locations are outlined below:

Location S01 Located in the north western corner of the site in line with the common boundary of the nearest noise sensitive locations at the junction of the R102 and the Grand Canal.

Location S02 Located on the south western corner of the site along with the common boundary of a nearby noise sensitive location. The location is representative of the row of noise sensitive locations that along the R102 beyond the western boundary of the proposed development.

Location S03 Located in the vicinity of the nearest residential location to the north east of the proposed development site. The property is located on the boundary of the Grangecastle Business Park and is immediately adjacent a number of commercial activities.

Location S04 Located in the north eastern concern of the development lands. This location is considered to be representative of noise levels currently experienced in the vicinity of the residential properties on the Royal Canal to the north.

Location S05 Located in the south western concern of the development lands. The location is considered to be representative of noise levels currently experienced in the vicinity of the halting site located to the south west at some 200 m distance.

Figure A Noise monitoring locations (Source: Bing Maps)

Survey periods
Measurements were conducted over the course of the following survey periods:

Table A Noise monitoring periods

Locations	Period	Start Time/Date	End Time/Date
S01, S02, S03	Day	09:50hrs 9 April 2016	12:40hrs 9 April 2016
	Evening	21:40hrs 9 April 2016	22:50hrs 9 April 2016
	Night	23:00hrs 9 April 2016	01:40hrs 10 April 2016
S04, S05	Unattended	15:00hrs 4 November 2020	11:45hrs 10 November 2020

Personnel & Instrumentation
Leo Williams (AWN) conducted the noise level measurements during the various survey periods. The measurements were performed using Brüel & Kjær Type 2260 Modular Precision Sound Analysers. Before and after the survey the measurement apparatus was check calibrated using a Brüel & Kjær Type 4231 Sound Level Calibrator. Donogh Casey installed and removed the noise meters on site in the 2020 unattended survey.

Table B Instrumentation details

Meter	Serial Number
Brüel & Kjær 2260	2248262
Rion NL-42	575802
Rion NL-52	186670

Procedure
During each of the daytime, evening and night-time periods, measurements were conducted on a continuous basis over the stated time periods. Sample periods were 15 minutes during all surveys. The results were saved to the instrument memory for later analysis where appropriate. Survey personnel noted all primary noise sources contributing to noise build-up. In terms of the various locations the following significant noise sources (in subjective order of influence) were noted:

Table C Significant noise sources

Location	
S01	S02
• R120 road traffic noise. • Water running in a nearby canal in absence of traffic. • Site work and plant noise associated with existing sites. • During evening period noise dominated by traffic and water noise associated with the canal. • During night time plant noise from existing facilities (to the East and South) is the dominant background source.	• Plant noise from facility to the south. • Noise from existing site including impulsive noise (bangs) and reverse alarms. • Dogs barking and birdsong. • During the evening distant traffic noise and plant noise noted. • During night time existing plant noise from southern existing facilities is the dominant source. Distant traffic also noted.
Location	
S03	S04
• Noise dominated by existing plant noise from adjacent facility. • Occasional bus passing by. • Water flow from nearby watercourse. • Reverse alarms and construction noise from nearby site. • As above for evening period with the exception of construction noise. • During night time plant noise from the adjacent facility and water flow from nearby watercourse.	• R120 road traffic noise. • Water flow from nearby watercourse. • During night time plant noise from the adjacent facility and water flow from nearby watercourse noted.
Location	
S05	
• R120 road traffic noise. • Water flow from nearby watercourse. • During night time plant noise from the adjacent facility and water flow from nearby watercourse noted.	

Noise Monitoring Results

The noise data collated during the current noise survey is extensive in nature. It is not produced in full here however is available on request.

Table D presents average daytime and night time noise levels measured at the monitoring location over the period of the noise monitoring programme.

Table D Noise monitoring results

Location	Date	Period	Start Time	Measured Noise Levels (dB re. $2x10^{-5}$ Pa)		
				$L_{Aeq,15min}$	L_{AFMax}	$L_{A90,15min}$
S01	9 April	Day	09:51	58	71	44
	9 April	Day	11:15	61	76	47
	9 April	Evening	21:46	53	63	45
	10 April	Night	00:01	48	61	42
	10 April	Night	00:58	49	67	43
S02	9 April	Day	10:23	48	65	42
	9 April	Day	11:37	48	73	41
	9 April	Day	12:47	49	65	43
	9 April	Evening	22:04	44	61	41
	9 April	Night	23:38	41	63	39
	10 April	Night	01:20	40	61	38
S03	9 April	Day	10:50	53	76	47
	9 April	Day	12:05	53	73	48
	9 April	Day	12:21	52	72	48
	9 April	Evening	22:35	51	68	49
	9 April	Night	23:00	51	70	48
	9 April	Night	23:16	49	54	48

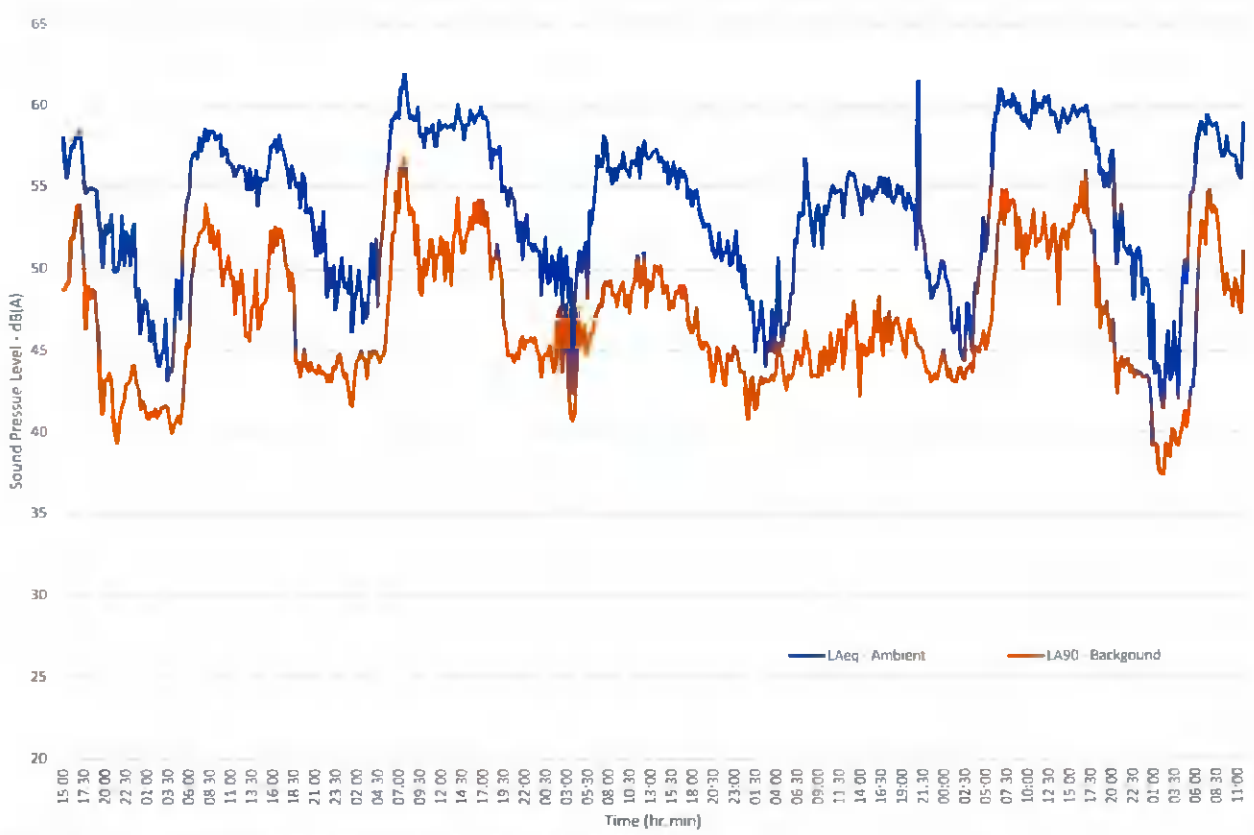


Figure B Unattended Noise Monitoring – Location S04

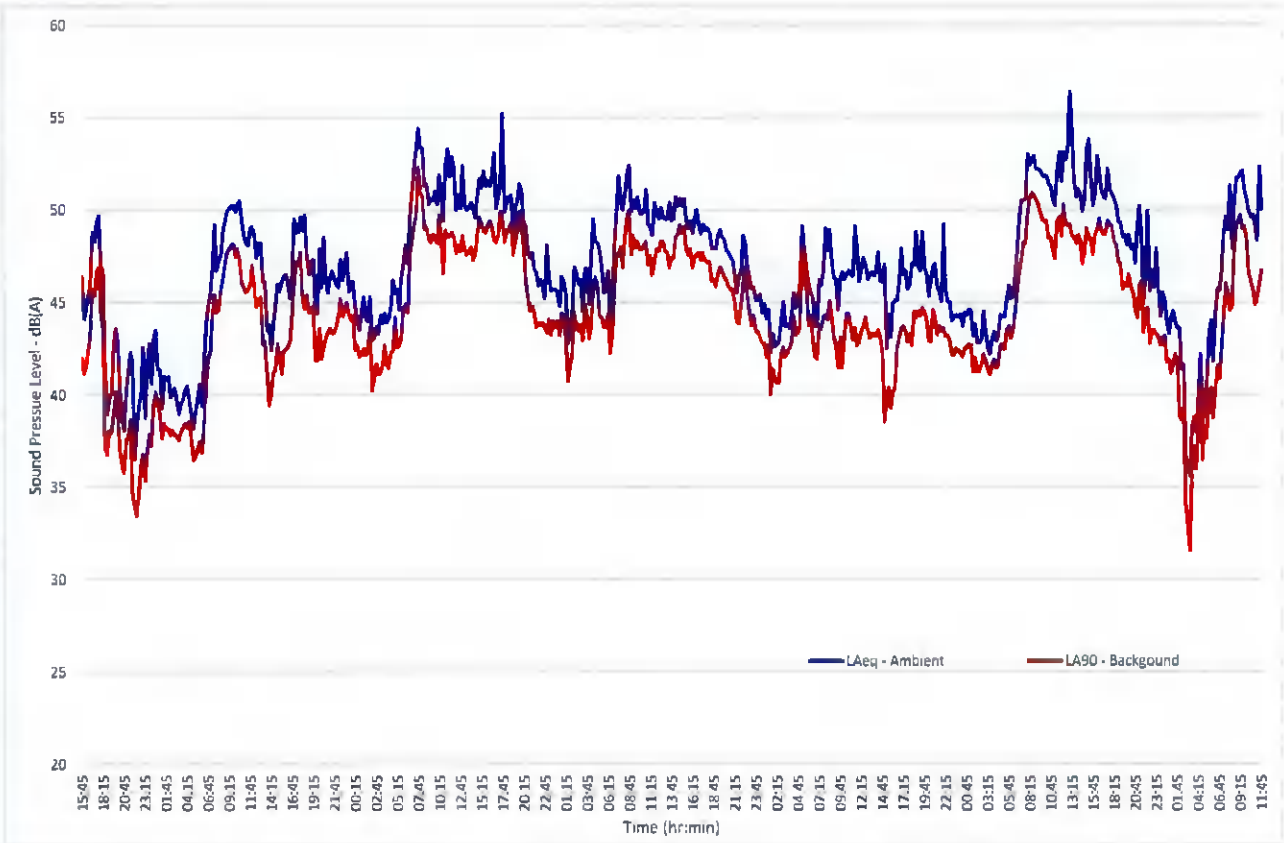


Figure C Unattended Noise Monitoring – Location S05

Appendix 9.3 Indicative construction noise & vibration management plan

This Noise and Vibration Management Plan (NVMP) details a *'Best Practice'* approach to dealing with potential noise and vibration emissions during the construction phase of the development. The Plan should be adopted by all contractors and sub-contractors involved in construction activities on the site. The Site Manager should ensure that adequate instruction is provided to contractors regarding the noise and vibration control measures contained within this document.

The environmental impact assessment report conducted for the construction activity has highlighted that the construction noise and vibration levels can be controlled to within the adopted criteria. However, mitigation measures should be implemented, where necessary, in order to control impacts to nearby sensitive areas within acceptable levels.

Nearby sensitive properties in the vicinity of the proposed development are summarised in Figure A overleaf:

Figure A Sensitive receptors

Construction Noise Criteria

As referenced in the EIS prepared for the site, appropriate criteria relating to permissible construction noise levels for a development of this scale may be found in the National Roads Authority (NRA) publication *Guidelines for the Treatment of Noise and Vibration in National Road Schemes*[1] which indicates the following criteria and hours of operation.

Table A Construction noise limit values

Days and Times	Noise Levels (dB re. 2x10-5 Pa)	
	$L_{Aeq(1hr)}$	L_{Amax}
Monday to Friday 07:00hrs to 19:00hrs	70	80
Monday to Friday 19:00 to 22:00hrs	60*	65*
Saturdays 08:00hrs to 14:00hrs	65	75

Note * Construction activity at these times, other than that required for emergency works, will normally require the explicit permission of the relevant local authority.

[1] *Guidelines for the Treatment of Noise and Vibration in National Road Schemes, Revision 1, 25 October 2004* , National Roads Authority.

Construction Vibration Criteria

It is recommended in the EIS that vibration from construction activities to off-site residences be limited to the values set out in Table B. It should be noted that these limits are not absolute, but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage these limits may need to be reduced by up to 50%.

Table B Construction vibration limit values

Allowable vibration (in terms of peak particle velocity) at the closest part of sensitive property to the source of vibration, at a frequency of		
Less than 10 Hz	10 to 50 Hz	50 to 100 Hz (and above)
8 mm/s	12.5 mm/s	20 mm/s

Hours of Work

The proposed general construction hours are 07:00 to 19:00hrs, Monday to Friday and 08:00 to 13:00 on Saturdays. However, there are also weekday evening works proposed (19:00 to 23:00hrs).

Weekday evening activities should be significantly reduced and generally only involve internal activities and concrete pouring which will be required during certain phases of the development. As a result, noise emissions from evening activities are expected to be significantly lower than for other general daytime activities.

Best Practice Guidelines for the Control of Noise & Vibration

BS5228 includes guidance on several aspects of construction site mitigation measures, including, but not limited to:

- selection of quiet plant;
- control of noise sources;
- screening;
- hours of work;
- liaison with the public, and;
- monitoring.

Detailed comment is offered on these items in the following paragraphs. Noise and vibration control measures that will be considered include the selection of suitable plant, enclosures and screens around noise sources, limiting the hours of work and monitoring.

Selection of Quiet Plant

This practice is recommended in relation to sites with static plant such as compressors and generators. It is recommended that these units be supplied with manufacturers' proprietary acoustic enclosures where possible. The potential for any item of plant to generate noise will be assessed prior to the item being brought onto the site. The least noisy item should be selected wherever possible. Should a particular item of plant already on the site be found to generate high noise levels, the first action should be to identify whether or not said item can be replaced with a quieter alternative.

General Comments on Noise Control at Source

If replacing a noisy item of plant is not a viable or practical option, consideration should be given to noise control "at source". This refers to the modification of an item of plant or the application of improved sound reduction methods in consultation with the supplier. For example, resonance effects in panel work or cover plates can be reduced through stiffening or application of damping compounds; rattling and grinding noises can often be controlled by fixing resilient materials in between the surfaces in contact.

BS5228 states that *"as far as reasonably practicable sources of significant noise should be enclosed"*. In applying this guidance, constraints such as mobility, ventilation, access and safety must be taken into account. Items suitable for enclosure include pumps and generators. Demountable enclosures will also be used to screen operatives using hand tools and will be moved around site as necessary.

In practice, a balance may need to be struck between the use of all available techniques and the resulting costs of doing so. As with Ireland's Environmental Protection Act legislation, we propose that the concept of

"best available techniques not entailing excessive cost" (BATNEEC) be adopted. Furthermore, proposed noise control techniques should be evaluated in light of their potential effect on occupational safety etc.
BS5228 makes a number of recommendations in relation to "use and siting of equipment". These are all directly relevant and hence are reproduced in full. These recommendations will be adopted on site.

"Plant should always be used in accordance with manufacturers' instructions. Care should be taken to site equipment away from noise-sensitive areas. Where possible, loading and unloading should also be carried out away from such areas. Special care will be necessary when work has to be carried out at night.

Circumstances can arise when night-time working is unavoidable. Bearing in mind the special constraints under which such work has to be carried out, steps should be taken to minimise disturbance to occupants of nearby premises.

Machines such as cranes that may be in intermittent use should be shut down between work periods or should be throttled down to a minimum. Machines should not be left running unnecessarily, as this can be noisy and waste energy.

Plant known to emit noise strongly in one direction should, when possible, be orientated so that the noise is directed away from noise-sensitive areas. Attendant operators of the plant can also benefit from this acoustical phenomenon by sheltering, when possible, in the area with reduced noise levels.

Acoustic covers to engines should be kept closed when the engines are in use and idling. The use of compressors that have effective acoustic enclosures and are designed to operate when their access panels are closed is recommended.

Materials should be lowered whenever practicable and should not be dropped. The surfaces on to which the materials are being moved could be covered by resilient material."

All items of plant should be subject to regular maintenance. Such maintenance can prevent unnecessary increases in plant noise and can serve to prolong the effectiveness of noise control measures.

Screening

Typically screening is an effective method of reducing the noise level at a receiver location and can be used successfully as an additional measure to all other forms of noise control. The effectiveness of a noise screen will depend on the height and length of the screen and its position relative to both the source and receiver.

The length of the screen should in practice be at least five times the height, however, if shorter sections are necessary then the ends of the screen should be bent around the source. The height of any screen should be such that there is no direct line of sight between the source and the receiver.

BS5228 states that on level sites the screen should be placed as close as possible to either the source or the receiver. The construction of the barrier should be such that there are no gaps or openings at joints in the screen material. In most practical situations the effectiveness of the screen is limited by the sound transmission over the top of the barrier rather than the transmission through the barrier itself. In practice screens constructed of materials with a mass per unit of surface area greater than 7 kg/m^2 will give adequate sound insulation performance.

In addition, careful planning of the site layout should also be considered. The placement of site buildings such as offices and stores and in some instances materials such as topsoil or aggregate can provide a degree of noise screening if placed between the source and the receiver.

Vibration

The vibration from construction activities will be limited to the values set out in Table 2. It should be noted that these limits are not absolute, but provide guidance as to magnitudes of vibration that are very unlikely to cause cosmetic damage. Magnitudes of vibration slightly greater than those in the table are normally unlikely to cause cosmetic damage, but construction work creating such magnitudes should proceed with caution. Where there is existing damage, these limits may need to be reduced by up to 50%.

Liaison with the Public

The Contractor will provide proactive community relations and will notify the public and sensitive premises before the commencement of any works forecast to generate appreciable levels of noise or vibration, explaining the nature and duration of the works. The Contractor will distribute information circulars informing people of the progress of works and any likely periods of significant noise and vibration.

A designated noise liaison should be appointed to site during construction works. Any complaints should be logged and followed up in a prompt fashion. In addition, prior to particularly noisy construction activity, e.g. rock breaking, piling, etc., the site contact should inform the nearest noise sensitive locations of the time and expected duration of the works.

Noise Monitoring

During the construction phase consideration should be given to noise monitoring at the nearest sensitive locations.

Noise monitoring should be conducted in accordance with the International Standard ISO 1996: 2007: *Acoustics – Description, measurement and assessment of environmental noise* and be located a distance of greater than 3.5m away from any reflective surfaces, e.g. walls, in order to ensure a free-field measurement without any influence from reflected noise sources.

Vibration Monitoring

During the construction phase consideration should be given to vibration monitoring at the nearest sensitive locations.

Vibration monitoring should be conducted in accordance with BS7385-1 (1990) *Evaluation and measurement for vibration in buildings — Part 1: Guide for measurement of vibrations and evaluation of their effects on buildings* or BS6841 (1987) *Guide to measurement and evaluation of human exposure to whole-body mechanical vibration and repeated shock.*

The mounting of the transducer to the vibrating structure should comply with BS ISO 5348:1998 *Mechanical vibration and shock – Mechanical mounting of accelerometers.* In summary, the following ideal mounting conditions apply:

- the transducer and its mountings are as rigid as possible;
- the mounting surfaces should be as clean and flat as possible;
- simple symmetric mountings are best, and;
- the mass of the mounting should be small in comparison to that of the structure under test.

In general the transducer will be fixed to the floor of a building or concrete base on the ground using expansion bolts. In instances where the vibration monitor will be placed outside of a building a flat and level concrete base with dimensions of approximately 1m x 1m x 0.1m will be required.

Appendix 9.4 Noise modelling details

Noise model

A 3D computer-based prediction model has been prepared in order to quantify the noise level associated with the operation of the proposed building. This section discusses the methodology behind the noise modelling process.

Brüel & Kjær Type 7810 Predictor

Proprietary noise calculation software has been used for the purposes of this modelling exercise. The selected software, DGMR iNoise, calculates noise levels in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996.*

DGMR iNoise is a proprietary noise calculation package for computing noise levels in the vicinity of noise sources. Predictor calculates noise levels in different ways depending on the selected prediction standard. In general, however, the resultant noise level is calculated taking into account a range of factors affecting the propagation of sound, including:

- the magnitude of the noise source in terms of A weighted sound power levels (L_{WA});
- the distance between the source and receiver;
- the presence of obstacles such as screens or barriers in the propagation path;
- the presence of reflecting surfaces;
- the hardness of the ground between the source and receiver;
- Attenuation due to atmospheric absorption; and
- Meteorological effects such as wind gradient, temperature gradient and humidity (these have significant impact at distances greater than approximately 400m).

Brief description of ISO9613-2: 1996

ISO9613-2:1996 calculates the noise level based on each of the factors discussed previously. However, the effect of meteorological conditions is significantly simplified by calculating the average downwind sound pressure level, $L_{AT}(DW)$, for the following conditions:

- wind direction at an angle of ±45° to the direction connecting the centre of the dominant sound source and the centre of the specified receiver region with the wind blowing from source to receiver, and;
- wind speed between approximately 1 ms^{-1} and 5 ms^{-1}, measured at a height of 3 m to 11 m above the ground.

The equations and calculations also hold for average propagation under a well-developed moderate ground based temperature inversion, such as commonly occurs on clear calm nights.

The basic formula for calculating $L_{AT}(DW)$ from any point source at any receiver location is given by:

$$L_{fT}(DW) = L_W + D_C - A \qquad \textbf{Eqn. A}$$

Where:

$L_{fT}(DW)$ is an octave band centre frequency component of $L_{AT}(DW)$ in dB relative to $2x10^{-5}$Pa;
L_W is the octave band sound power of the point source;
D_C is the directivity correction for the point source;
A is the octave band attenuation that occurs during propagation, namely attenuation due to geometric divergence, atmospheric absorption, ground effect, barriers and miscellaneous other effects.

The estimated accuracy associated with this methodology is shown in Table A below:

Table A Estimated accuracy for broadband noise of L_{AT}(DW)

Height, h*	Distance, d†	
	0 < d < 100 m	100 m < d < 1,000 m
0<h<5m	±3dB	±3dB
5m<h<30m	±1dB	±3dB

* h is the mean height of the source and receiver. † d is the mean distance between the source and receiver.
N.B. These estimates have been made from situations where there are no effects due to reflections or attenuation due to screening.

Input data and assumptions
The noise model has been constructed using data from various source as follows:

Site Layout The general site layout has been obtained from the drawings forwarded by Henry J Lyons Architects.

Local Area The location of noise sensitive locations has been obtained from a combination of site drawings provided by Henry J Lyons Architects and others obtained from Ordinance Survey Ireland (OSI).

Heights The heights of buildings on site have been obtained from site drawings forwarded by Henry J Lyons Architects. Off-site buildings have been assumed to be 6m high with the exception of industrial buildings where a default height of 15 m has been assumed.

Contours Site ground contours/heights have been obtained from site drawings forwarded by Henry J Lyons Architects where available.

The final critical aspect of the noise model development is the inclusion of the various plant noise sources. Details are presented in the following section.

Source sound power data
BCEI Engineering has provided noise emission data for the significant external mechanical plant and emergency generators. The information provided is review in Table B below.

Table B Source noise data assumed for assessment (DUB05)

Item	Sound Power Levels dB								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Condenser Left Side	86	83	74	70	64	62	61	55	73
Condenser Right Side	86	83	74	70	64	62	61	55	73
Condenser Front (Evaporator)	84	81	72	68	62	60	59	53	71
Condenser Rear (Condenser)	86	83	74	70	65	62	61	55	73
Condenser Top	90	87	78	74	69	66	65	59	77
Gen. Front Note B	100.8	108.7	92.4	90.2	78.9	73	73.7	67.8	64
Gen. Rear Note B	99	107	90.7	88.5	77.2	71.3	72	66.1	62.3
Gen. Sides Note B	102.5	105.3	89	86.8	75.5	69.6	70.3	64.4	60.6
Gen. Exhaust Note B	86	103	86.7	84.5	73.2	67.3	68	62.1	58.3
Transformer Note C	72	40	70	63	66	50	39	36	36

Note A Maximum permissible Sound Power Level Per unit
Note B Dub 05 generators are assumed to be attenuated to achieve max. 75dB(A) at 1m.
Note C Transformer noise level advised by Ethos Engineering and typical transformer spectrum from AWN database has been assumed for assessment purposes.

It has been advised that significant noise emissions are not associated with the proposed substations related to the development.

Figure A presents a 3D render of the developed site noise model.

Figure A Images of Developed Noise Model – View of Site

Note in relation to the emergency diesel generators screening to these elements of plant are to be formed from an acoustic louvre which offers the following sound insertion loss. The height of the screen is at least 0.5m above the top of the generator installations.

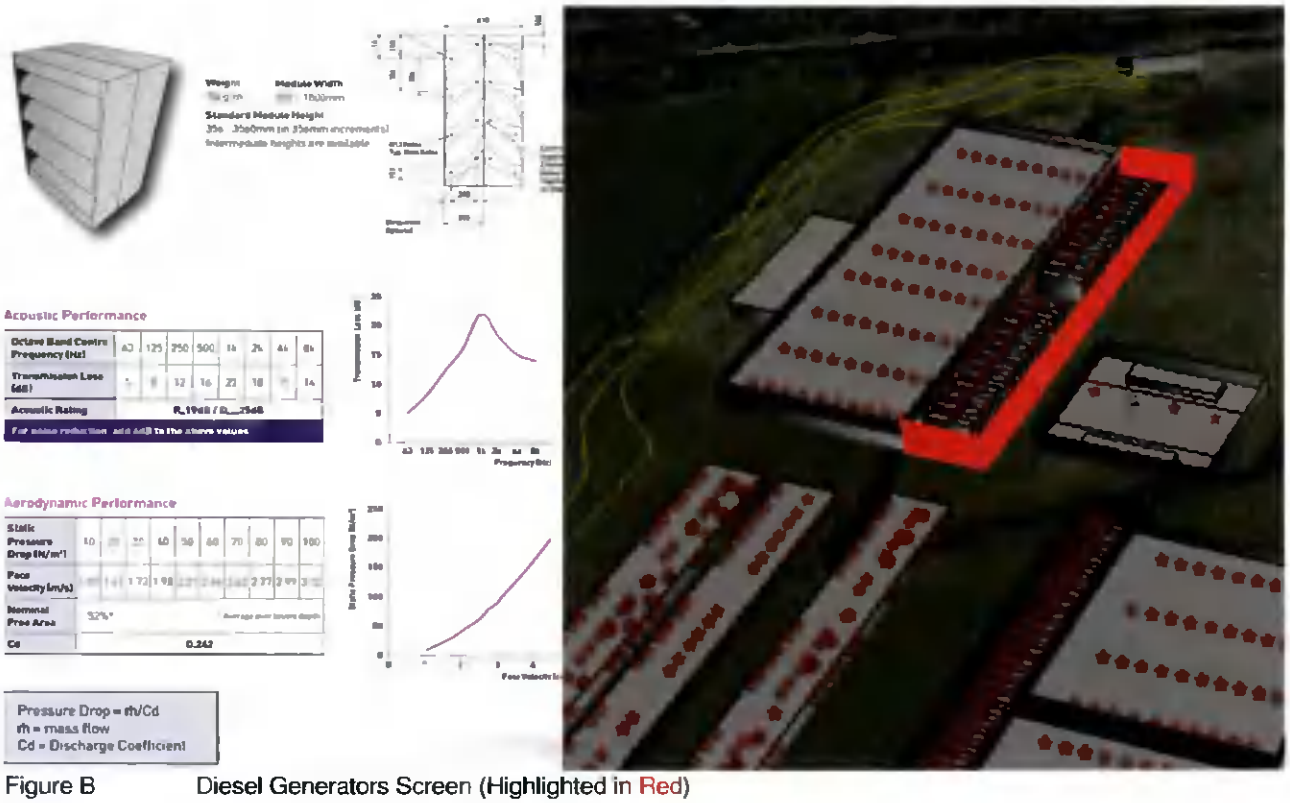


Figure B Diesel Generators Screen (Highlighted in Red)

In terms of the gas generator buildings that are proposed the following assumptions have been made:

A 75dB(A) at 1m containerised gas generator unit is proposed. We have assumed the following sound power level associated with an individual unit.

Table C Sound Power Levels assumed for DUB05 Internal Gas Generator Units

Item	Sound Power Levels dB								dB(A)
	63	125	250	500	1000	2000	4000	8000	
75dB(A) at 1m Gen Set	108	105	98	94	90	86	81	79	97

Based on the generator hall volumes obtained from drawings, considering the number of units in a typical hall, assuming a reverberation time of ≤1.5s in the spaces the predicted reverberant noise levels within the buildings has been calculated and assumed not to exceed the following:

Table D Reverberant Sound Pressure Levels assumed for DUB05 Generator Halls

Item	Sound Pressure Levels dB								dB(A)
	63	125	250	500	1000	2000	4000	8000	
Sound Pressure Level in Hall	101	98	91	86	82	79	73	71	89

It has been advised that intake and exhaust louvres to the building will be some 3.5m wide and 5m high (i.e. some 15m^2).

The following insertion loss has been assumed for acoustic attenuation applied to these louvered sections:

Table E Sound Insulation Performance Requirements Walls, SRI (dB) – Louvres

Source	L_w - Octave Band Centre Frequency							
	63	125	250	500	1k	2k	4k	8k
Intake / Exhaust per Louvre	8	11	21	30	28	25	15	10

Based on this knowledge and the extent of the buildings shown on masterplan drawings developed to date the following maximum sound power levels for the louvres opens have been estimated:

Table F Assumed Louvre Sound Power Level – Reverse Engineered

Source	L_w - Octave Band Centre Frequency								dB (A)
	63	125	250	500	1k	2k	4k	8k	
Intake / Exhaust per Louvre	71	76	66	58	59	60	64	65	78

The above noise level equates to a level of some **50dB(A) at a distance of 10m**.

We have assumed that walls and roof of the generator rooms offer the following minimum sound insulation performance:

Table G Sound Insulation Performance Requirements Walls, SRI (dB) – Walls

Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
38	43	45	55	60	70	70	70

A typical construction that can achieve this performance is a 200mm RC wall with insulated cladding or 2 layers of 100mm dense concrete blocks with a 50mm cavity between them.

Table H Sound Insulation Performance Requirements Walls, SRI (dB) – Roof

Octave Band Centre Frequency (Hz)							
63	125	250	500	1k	2k	4k	8k
41	39	43	51	57	62	62	67

A typical roof construction capable of achieve this performance is a 250mm thick hollowcore concrete plank.

In terms of the walls and roof of the generator halls is assumed detailed design will result in sound power levels per m^2 of the element as detailed in Table I.

Table I Assumed Louvre Sound Power Level – Walls & Roof per m^2

Source	L_W - Octave Band Centre Frequency								dB (A)
	63	125	250	500	1k	2k	4k	8k	
Wall / Roof per m^2	50	50	50	40	30	20	20	20	45

A radiator is located 1.5m above the roof of the building with the following noise rating associated with it as extracted from the supplied data sheet[2]:

Table J Assumed Radiator L_{WA} Level – Gas Generation (Cummings Data)

Source	L_{WA} - Octave Band Centre Frequency								dB (A)
	63	125	250	500	1k	2k	4k	8k	
Radiators	62	69	72	78	80	76	70	61	83

It is advised generator exhaust stacks will need to be attenuated to achieve a sound pressure level of no more than 65 dB(A) at 1 m. Based on this we have assumed a sound power level of some 76 dB(A) in relation to these sources. Solid screens to the radiator units are assumed. These screens will be are assumed to be at least 1m above the top of the radiator plant. Figure 2 illustrates the principle and location of the screening assumed here.

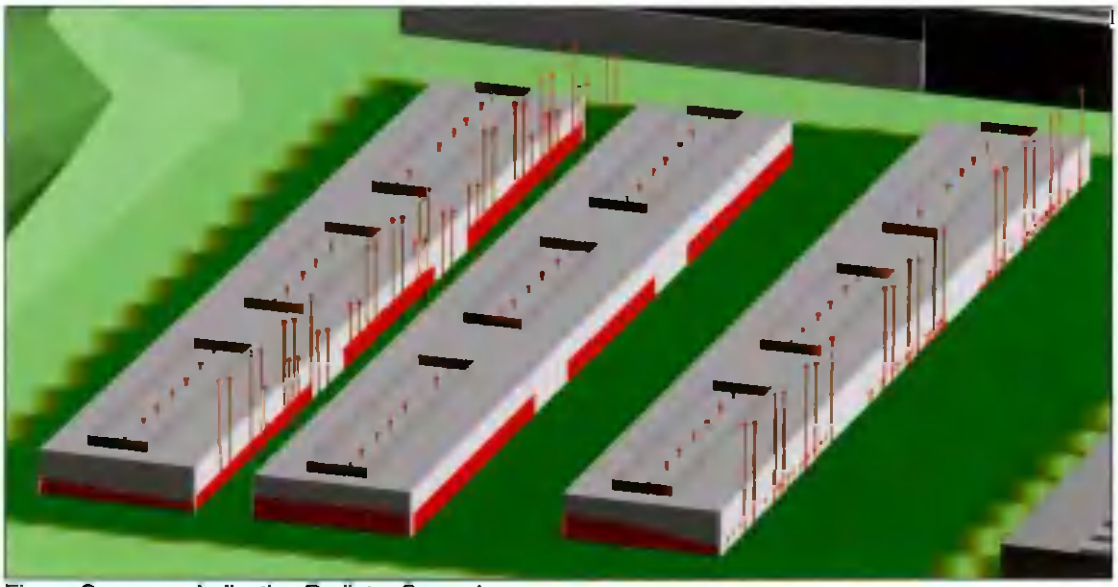


Figure C Indicative Radiator Screening

Note that as part of detailed design the above assumptions will be given due consideration and any alternate proposals would be designed such that the relevant noise conditions are satisfied.

Modelling calculation parameters

Prediction calculations for plant noise have been conducted in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996.* Ground attenuation factors of 0.8 have been assumed. No metrological corrections were assumed for the calculations. The atmospheric attenuation outlined in Table K has been assumed for all calculations.

Table K Atmospheric attenuation assumed for noise calculations (dB per km)

Temp (ºC)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4

[2] Radiator Technical Information – Finning/CAT – 25ºC ambient level

Appendix 9.5 – Modelling calculation parameters

Prediction calculations for noise emissions have been conducted in accordance with *ISO 9613: Acoustics – Attenuation of sound during propagation outdoors, Part 2: General method of calculation, 1996.* The following are the main aspects that have been considered in terms of the noise predictions presented in this instance.

Directivity Factor: The directivity factor (D) allows for an adjustment to be made where the sound radiated in the direction of interest is higher than that for which the sound power level is specified. In this case the sound power level is measures in a down wind direction, corresponding to the worst case propagation conditions and needs no further adjustment.

Ground Effect: Ground effect is the result of sound reflected by the ground interfering with the sound propagating directly from source to receiver. The prediction of ground effects is inherently complex and depend on source height receiver height propagation height between the source and receiver and the ground conditions. The ground conditions are described according to a variable defined as G, which varies between 0.0 for hard ground (including paving, ice concrete) and 1.0 for soft ground (includes ground covered by grass trees or other vegetation) Our predictions have been carried out using various source height specific to each plant item, a receiver heights of 1.6m for single storey properties and 4m for double. An assumed ground factor of G = 0.8 has been applied off site. Noise contours presented in the assessment have been predicted to a height of 4m in all instances.

Geometrical Divergence This term relates to the spherical spreading in the free-field from a point sound source resulting in attenuation depending on distance according to the following equation:

$$A_{geo} = 20 \times \log(\text{distance from source in meters}) + 11$$

Atmospheric Absorption Sound propagation through the atmosphere is attenuated by the conversion of the sound energy into heat. This attenuation is dependent on the temperature and relative humidity of the air through which the sound is travelling and is frequency dependent with increasing attenuation towards higher frequencies. In these predictions a temperature of 10°C and a relative humidity of 70% have been used, which give relativity low levels of atmosphere attenuation and corresponding worst case noise predictions.

Table A Atmospheric Attenuation Assumed for Noise Calculations (dB per km)

Temp (°C)	% Humidity	Octave Band Centre Frequencies (Hz)							
		63	125	250	500	1k	2k	4k	8k
10	70	0.12	0.41	1.04	1.92	3.66	9.70	33.06	118.4

Barrier Attenuation The effect of any barrier between the noise source and the receiver position is that noise will be reduced according to the relative heights of the source, receiver and barrier and the frequency spectrum of the noise.

CHAPTER 10 – AIR QUALITY AND CLIMATE

Appendix 10.1 Description of the AERMOD model

The AERMOD dispersion model has been developed in part by the U.S. Environmental Protection Agency (USEPA, 2004a). The model is a steady-state Gaussian model used to assess pollutant concentrations associated with industrial sources. The model is an enhancement on the Industrial Source Complex-Short Term 3 (ISCST3) model which has been widely used for emissions from industrial sources.

Improvements over the ISCST3 model include the treatment of the vertical distribution of concentration within the plume. ISCST3 assumes a Gaussian distribution in both the horizontal and vertical direction under all weather conditions. AERMOD with PRIME, however, treats the vertical distribution as non-Gaussian under convective (unstable) conditions while maintaining a Gaussian distribution in both the horizontal and vertical direction during stable conditions. This treatment reflects the fact that the plume is skewed upwards under convective conditions due to the greater intensity of turbulence above the plume than below. The result is a more accurate portrayal of actual conditions using the AERMOD model. AERMOD also enhances the turbulence of night-time urban boundary layers thus simulating the influence of the urban heat island.

In contrast to ISCST3, AERMOD is widely applicable in all types of terrain. Differentiation of the simple versus complex terrain is unnecessary with AERMOD. In complex terrain, AERMOD employs the dividing-streamline concept in a simplified simulation of the effects of plume-terrain interactions. In the dividing-streamline concept, flow below this height remains horizontal, and flow above this height tends to rise up and over terrain. Extensive validation studies have found that AERMOD (precursor to AERMOD with PRIME) performs better than ISCST3 for many applications and as well or better than CTDMPLUS for several complex terrain data sets (USEPA, 1999).

Due to the proximity to surrounding buildings, the PRIME (Plume Rise Model Enhancements) building downwash algorithm has been incorporated into the model to determine the influence (wake effects) of these buildings on dispersion in each direction considered. The PRIME algorithm takes into account the position of the stack relative to the building in calculating building downwash. In the absence of the building, the plume from the stack will rise due to momentum and/or buoyancy forces. Wind streamlines act on the plume leads to the bending over of the plume as it disperses. However, due to the presence of the building, wind streamlines are disrupted leading to a lowering of the plume centreline.

When there are multiple buildings, the building tier leading to the largest cavity height is used to determine building downwash. The cavity height calculation is an empirical formula based on building height, the length scale (which is a factor of building height & width) and the cavity length (which is based on building width, length and height). As the direction of the wind will lead to the identification of differing dominant tiers, calculations are carried out in intervals of 10 degrees.

In PRIME, the nature of the wind streamline disruption as it passes over the dominant building tier is a function of the exact dimensions of the building and the angle at which the wind approaches the building. Once the streamline encounters the zone of influence of the building, two forces act on the plume. Firstly, the disruption caused by the building leads to increased turbulence and enhances horizontal and vertical dispersion. Secondly, the streamline descends in the lee of the building due to the reduced pressure and drags the plume (or part of) nearer to the ground, leading to higher ground level concentrations. The model calculates the descent of the plume as a function of the building shape and, using a numerical plume rise model, calculates the change in the plume centreline location with distance downwind.

The immediate zone in the lee of the building is termed the cavity or near wake and is characterised by high intensity turbulence and an area of uniform low pressure. Plume mass captured by the cavity region is re-emitted to the far wake as a ground-level volume source. The volume source is located at the base of the lee wall of the building, but is only evaluated near the end of the near wake and beyond. In this region, the disruption caused by the building downwash gradually fades with distance to ambient values downwind of the building.

AERMOD has made substantial improvements in the area of plume growth rates in comparison to ISCST3 (USEPA, 2004a, 2009). ISCST3 approximates turbulence using six Pasquill-Gifford-Turner Stability Classes and bases the resulting dispersion curves upon surface release experiments. This treatment, however, cannot explicitly account for turbulence in the formulation. AERMOD is based on the more realistic modern planetary boundary layer (PBL) theory which allows turbulence to vary with height. This use of turbulence-based plume growth with height leads to a substantial advancement over the ISCST3 treatment.

Improvements have also been made in relation to mixing height (USEPA, 2004a, 2009). The treatment of mixing height by ISCST3 is based on a single morning upper air sounding each day. AERMOD, however, calculates mixing height on an hourly basis based on the morning upper air sounding and the surface energy balance, accounting for the solar radiation, cloud cover, reflectivity of the ground and the latent heat due to evaporation from the ground cover. This more advanced formulation provides a more realistic sequence of the diurnal mixing height changes.

AERMOD also has the capability of modelling both unstable (convective) conditions and stable (inversion) conditions. The stability of the atmosphere is defined by the sign of the sensible heat flux. Where the sensible heat flux is positive, the atmosphere is unstable whereas when the sensible heat flux is negative the atmosphere is defined as stable. The sensible heat flux is dependent on the net radiation and the available surface moisture (Bowen Ratio). Under stable (inversion) conditions, AERMOD has specific algorithms to account for plume rise under stable conditions, mechanical mixing heights under stable conditions and vertical and lateral dispersion in the stable boundary layer.

AERMOD also contains improved algorithms for dealing with low wind speed (near calm) conditions. As a result, AERMOD can produce model estimates for conditions when the wind speed may be less than 1 m/s, but still greater than the instrument threshold.

Appendix 10.2 Description of AERMET

AERMOD incorporates a meteorological pre-processor AERMET PRO (USEPA 2004b). AERMET PRO allows AERMOD to account for changes in the plume behaviour with height. AERMET PRO calculates hourly boundary layer parameters for use by AERMOD, including friction velocity, Monin-Obukhov length, convective velocity scale, convective (CBL) and stable boundary layer (SBL) height and surface heat flux. AERMOD uses this information to calculate concentrations in a manner that accounts for changes in dispersion rate with height, allows for a non-Gaussian plume in convective conditions, and accounts for a dispersion rate that is a continuous function of meteorology.

The AERMET PRO meteorological pre-processor requires the input of surface characteristics, including surface roughness (z_0), Bowen Ratio and albedo by sector and season, as well as hourly observations of wind speed, wind direction, cloud cover, and temperature. A morning sounding from a representative upper air station, latitude, longitude, time zone, and wind speed threshold are also required.

Two files are produced by AERMET PRO for input to the AERMOD dispersion model. The surface file contains observed and calculated surface variables, one record per hour. The profile file contains the observations made at each level of a meteorological tower, if available, or the one-level observations taken from other representative data, one record level per hour.

From the surface characteristics (i.e. surface roughness, albedo and amount of moisture available (Bowen Ratio)) AERMET PRO calculates several boundary layer parameters that are important in the evolution of the boundary layer, which, in turn, influences the dispersion of pollutants. These parameters include the surface friction velocity, which is a measure of the vertical transport of horizontal momentum; the sensible heat flux, which is the vertical transport of heat to/from the surface; the Monin-Obukhov length which is a stability parameter relating the surface friction velocity to the sensible heat flux; the daytime mixed layer height; the nocturnal surface layer height and the convective velocity scale which combines the daytime mixed layer height and the sensible heat flux. These parameters all depend on the underlying surface.

The values of albedo, Bowen Ratio and surface roughness depend on land-use type (e.g., urban, water, cultivated land etc) and vary with seasons and wind direction. The assessment of appropriate land-use type was carried out to a distance of 10km from the location of the meteorological station in line with USEPA recommendations (USEPA 2005) for albedo and Bowen ratio with a 1km geometric determination undertaken for the surface roughness. In relation to wind direction, a minimum sector arc of 30 degrees is recommended.

Surface roughness

Surface roughness length is the height above the ground at which the wind speed goes to zero. Surface roughness length is defined by the individual elements on the landscape such as trees and buildings. In order to determine surface roughness length, the USEPA recommends that a representative length be defined for each sector. based on geometric mean of the inverse distance area-weighted land use within the sector. by using the eight land use categories outlined by the USEPA. The area-weighted surface roughness length derived from the land use classification within a radius of 1km from Casement Aerodrome is shown in Table A.10.1.

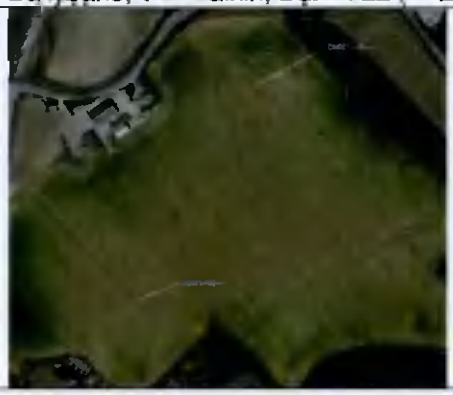
Table A.10.1 Surface Roughness based on an inverse distance area-weighted average of the land use within a 1km radius of Casement Aerodrome.

Sector	Area Weighted Land Use Classification	Spring	Summer	Autumn	Winter[Note 1]
0-360	100% Grassland	0.050	0.100	0.010	0.010

Note 1: Winter defined as periods when surfaces covered permanently by snow whereas autumn is defined as periods when freezing conditions are common, deciduous trees are leafless and no snow is present (Iqbal (1983)). Thus for the current location autumn more accurately defines "winter" conditions at the proposed facility.

Albedo

Noon-time Albedo is the fraction of the incoming solar radiation that is reflected from the ground when the sun is directly overhead. Albedo is used in calculating the hourly net heat balance at the surface for calculating hourly values of Monin-Obuklov length. The area-weighted arithmetic mean albedo derived from the land use classification over a 10km x 10km area centred on Casement Aerodrome is shown in Table A.10.2.

	ringfort type enclosure. No internal features were recorded (Stirland 2016, 10).
Sources	RMP Google Maps. Stirland, J. (ACS) 2016 Archaeological testing at Grange Castle South Business Park Ballybane, Clondalkin, Dublin 22 (16E0531).
Images	

Appendix 13.2 Archaeological Finds

The recorded archaeological finds in the vicinity of the proposed development, are listed below, all noted in the National Museum of Ireland files, Kildare Street, Dublin 2, or in other published catalogues of prehistoric material: Raftery (1983 - iron age antiquities), Eogan (1965; 1993; 1994 - bronze swords, Bronze Age hoards and goldwork), Harbison (1968; 1969a; 1969b - bronze axes, halberds and daggers) and the Irish Stone Axe Project Database. The following townlands were assessed Adamstown, Aungierstown & Ballybane, Ballybane, Ballymakaily, Clutterland, Finnstown, Gollierstown, Grange, Kilmactalway, Kilmahuddrick, Kishoge, Milltown and Nangor.

NMI 1994:20 IA/28/1994	**Kishoge**
Bronze Flat Axe Possible Derryniggin type bronze flat axe. Bronze disease covering both surfaces. Found with metal detector.	

In addition to the above, a large number of archaeological artefacts have been recorded from excavations in the study area (see Appendix H.3).

Finally, in the course of archaeological testing and excavations at the site in 2019 (License No. 19E0038), a 115 archaeological finds were discovered. These predominantly comprised pottery, stone. iron and glass dating to the medieval period, but also included a stone axehead of Neolithic date.

Appendix 13.3 Previous excavations

Previously published archaeological excavations in the area from 1969 to 2018 (www.excavations.ie) are summarised below. The following townlands were assessed Adamstown, Aungierstown & Ballybane, Ballybane, Ballymakaily, Clutterland, Finnstown, Gollierstown, Grange, Kilmactalway, Kilmahuddrick, Kishoge, Milltown and Nangor.

Dublin
1996:068
Nangor Castle, Clondalkin
Medieval
O045312
96E273
Trial-trenching in the vicinity of the now-demolished castle and eighteenth-century house produced evidence for a substantial ditch and an associated shallower linear feature. Neither feature produced any datable artefacts but had silted up with a series of organic-rich clays with animal bone, shell and matted grass-possibly bedding material.
Trial-trenching continued in the field bounding the castle site to its south, after an extensive geophysical survey had been carried out. Results from these cuttings suggest widespread archaeology surviving below the ploughsoil. Several lignite cores and slivers, early medieval pottery and metal slag were all retrieved both from the trenches and from field-walking, suggesting a date in at least the early medieval period-twelfth/thirteenth century. Several trenches cut through a large ditch located on both the east and west of the field, which apparently substantiated the impression, given from the overall lie of the land, that the field had contained a ploughed-our rath or ring-ditch. Human skeletal remains were also uncovered, as were numerous charcoal-flecked irregular features. Other than some cutting into the ditch, the trench went no deeper once in situ archaeology was reached.
Cia McConway, Archaeological Development Services Ltd. Power House, Pigeon House Harbour, Dublin 4.

Dublin
1997:086
NANGOR CASTLE/GRANGE CASTLE, KILMAHUDDRICK, CLONDALKIN
Medieval?
O045312
SMR 17:34 and 17:37
97E0116
Test-trenching was carried out along the line of a proposed road leading northwards from the vicinity of the now-demolished Nangor Castle to Grange Castle, within the area of a proposed industrial park. This was the second phase of testing, the first phase having concentrated on the field to the immediate south of Nangor Castle and its general vicinity.
An intensive geophysical survey had been carried out along the line of the proposed road and several anomalies were identified. This testing specifically examined the areas of anomalies, as agreed on with the relevant authorities within the National Monuments Service. Trenching was carried out by machine, and halted once in situ archaeological deposits were encountered. However, as experienced before, only subsoil-cut features survived-years of ploughing the fairly shallow ploughsoil had completely removed any potential archaeological stratigraphy.
Seven trenches were opened. Of these, only three, all located in Grange Field 3, to the east of Grange Castle, produced any significant archaeology. Two linear features 0.5-0.8m wide, of unknown date and function, ran in a north-south direction. However, their proximity both to the 15th-century castle and to one another could suggest substantial archaeological potential. Some spreads of brown soil had 20th-century pottery inclusions in their upper surface, while other areas, a mix of brown soil and broken slate subsoil, were probably the result of the dragging action of the plough.

This licence was taken over by Richard O'Brien to carry out monitoring and excavation along the line of the road (No. 87 below).
Cia Mc Conway, Archaeological Development Services Ltd, Windsor House, 11 Fairview Strand, Fairview, Dublin 3.

Dublin
1997:087
GRANGE CASTLE BUSINESS PARK, KILMAHUDDRICK, CLONDALKIN
Medieval
O045312
SMR 17:34 and 17:37

97E0116ext.
Monitoring and excavation were undertaken in advance of the construction of an access road and the excavation of foul sewers for a Business Park at Grange Castle. The excavation work continued until February 1998. Documentary evidence is scarce for Nangor Castle, but it is known that a castle stood on the site in the 16th century. Grange Castle is an upstanding 15th-century tower-house. It is proposed to develop an industrial park in this area.
Previous archaeological assessment by Cia Mc Conway (Excavations 1996, 17, 96E273, and above, No. 86) and geophysical survey by A. Mc Cleary, ADS Ltd, in February 1997 established that the area was archaeologically sensitive.
In advance of construction of a site access road topsoil was stripped from a 24m-wide area by mechanical excavator, under archaeological supervision, for a distance of 480m northwards from the Nangor Road. A further strip, 6m wide and 1300m long, was excavated for the sewers. The full 24m-wide strip was excavated in the field adjacent to Grange Castle.
All archaeological features uncovered had been truncated by deep ploughing, resulting in the removal of all but subsurface features cut into natural boulder clay.
A curving ditch was identified in Field 1; it terminated at Nangor Road, and was orientated north-east/south-west. It was 30m in length, 0.8-0.9m deep, and 1.2-2.4m wide. The eastern terminus continued beyond the limits of the excavation. The upper fills contained charcoal, mortar, flint and animal bones, and were aceramic. A decorated bone comb, stick-pin and knife gave the later ditch phase a terminus ante quem of from the 12th to the 13th century AD.
A stone causeway, 0.5-0.6m wide and 0.06-0.1m deep, crossed the ditch. The existence of this ditch had been shown in Mc Conway's assessment.
Field 7 is located between Grange Castle and the Kilmahuddrick Housing Estate. Two curving ditches were identified in this field. One was found under a post-medieval stone and brick trackway. It was 51m in length and varied in width from 1.1m to 1.4m, and in depth from 0.3m to 0.4m. A stone causeway, 0.6-0.84m wide, crossed it towards the western side of Field 7. No datable finds came from the primary fills of the ditch, but the secondary fills consisted of charcoal-rich clays with animal bones. It continued beyond the limits of the excavation at its western end.
A second ditch was found 1.6m east of the eastern terminus of the first. No archaeological features or deposits were found in this gap. The second ditch closely resembled the first; it was 22m long, 2m wide and 0.5-0.6m deep. The primary fills were sterile apart from some animal bone. The secondary fills consisted of charcoal-rich clays in which were found animal bones, mortar, two metal knives, and a fragment of worked lignite. An incomplete one-sided decorated bone comb and fragments of another in the upper fills gave a terminus ante quem of the 12th to 13th century AD. This ditch continued beyond the limits of excavation at its eastern end. The evidence from Field 7 suggests that extensive early medieval and post-medieval activity survives in this area; the ditches can be interpreted as medieval field boundaries.
A pit that contained a deposit of iron slag was found in Field 2, north of the site of Nangor Castle; it was associated with post-holes and stake-holes, though no structural pattern could be discerned.
Elsewhere various pits, hearths, furrows and field drains were recorded; some of the hearths may be prehistoric in date.
Richard N. O'Brien, Archaeological Development Services Ltd, Windsor House, 11 Fairview Strand, Fairview, Dublin 3.

Dublin
1998:129
KILCARBERRY DISTRIBUTION PARK, NANGOR, CLONDALKIN
Monitoring
98E0572
The development is for the provision of infrastructural works to serve an industrial distribution park. Monitoring was requested as a condition to any planning permission. Reference to the SMR reveals the presence of a number of recorded monuments within the general landscape, although there are no known sites within the proposed development area.
Monitoring, ongoing at time of writing, has failed to note any archaeological features on the site, with the exception of one 1m-wide north-south modern field drain. Finds have been restricted to the north-west corner of the site but include only sherds of post-medieval pottery along with several sherds of modern pottery, all recovered from the topsoil.
Removal of topsoil has revealed limestone bedrock across the site, with occasionally a natural layer of friable, mid-grey, fine, silty clay with moderate stone inclusions sealing the bedrock layer and sealed by topsoil.
Dermot Nelis, Irish Archaeological Consultancy Ltd, 8 Dungar Terrace, Dun Laoghaire, Co. Dublin.

Dublin
1999:170
KILCARBERRY DISTRIBUTION PARK, NANGOR, CLONDALKIN
Adjacent to monuments
SMR 17:37 (vicinity of)
98E0572
Archaeological monitoring at this site was ongoing when the summaries published in Excavations 1998 (42) were written. A further three days' monitoring was required in January 1999 to bring this project to completion.
The development is for the provision of roads, sewers, water mains and other ancillary infrastructural works to serve an Industrial Distribution Park. Because of the presence of recorded archaeological remains within the general landscape, Dúchas The Heritage Service recommended that archaeological monitoring be requested as a condition to any planning permission. Reference to the Sites and Monuments Record reveals the presence of a number of monuments within the general landscape, although there are no known archaeological sites within the proposed development area. A 15th-century tower-house (SMR 17:34), recorded on the Down Survey of c. 1655, is 600m north of the development site. Nangor Castle (SMR 17:37), a castle incorporated into a 19th-century mansion, is 500m east of the development area. All buildings on the site have now been demolished, however, leaving no surface trace of the earlier building. The site of Kilbride Castle (SMR 21:4) is 600m south of the proposed development, although again no visible surface remains are present. An unplastered wall is extant, but it does not contain any cut stone, although it was probably constructed using material from the castle. Slightly to the south-east of this are a church and graveyard (SMR 21:00501), a ringfort (21:00502) and earthworks (21:00503). The church is in ruins and stands in a circular raised graveyard at the edge of a broad-bottomed valley. It is possible that this is the site of an early ecclesiastical enclosure.
Monitoring has failed to reveal any archaeological features on the site, with the exception of one 1m-wide north-south modern field drain. Finds have been restricted to the north-west corner of the site, but these include only several small sherds of post-medieval pottery, along with several sherds of modern pottery, all recovered from the topsoil.
Removal of topsoil has revealed naturally deposited limestone bedrock across the site, with occasionally a c. 0.5m-thick natural layer of friable, mid-grey, fine, silty clay with moderate stone inclusions, 30-70mm, evenly distributed, sealing the bedrock layer and sealed by topsoil.
Dermot Nelis, IAC Ltd, 8 Dungar Terrace, Dun Laoghaire, Co. Dublin.

Dublin
2000:0223
GRANGE/KILMAHUDDRICK/NANGOR (GRANGE CASTLE INTERNATIONAL BUSINESS PARK), CLONDALKIN
Various
O043318
00E0263
The Grange Castle International Business Park is located to the west of Clondalkin village and incorporates part of the townlands of Grange, Kilmahuddrick, and Nangor. Wyeth Medica Ireland intends to construct a biotechnology campus on this site. The area, of c. 100 acres (40ha), was used for agricultural purposes until recently. The site is bounded to the north by the Grand Canal, to the south by the New Nangor Road, to the east by a new housing estate and land reservation for the proposed Dublin Outer Ring Road (linking the N4 and N7 roads), and to the west by the Grange Castle International Business Park access road.
Two medieval occupation sites are adjacent to the boundary of the Business Park. Grange Castle (SMR 17:34) is a fine late medieval tower-house, while Nangor Castle (SMR 17:37), to the south of the development site, appears to have been demolished during the 1970s. Geophysical survey and excavation were previously carried out by Cia McConway and Richard N. O'Brien (Excavations 1996, 17, 96E0273; Excavations 1997, 26–7, 97E0116). This work revealed that plough-truncated medieval and prehistoric features do survive within the confines of the Business Park.
Archaeological assessment by the writer consisted of the excavation of test-trenches during April and May 2000 in Fields 105, 106, 109, 110 (EIS field reference numbers) and in the northern part of Field 111. This was followed by the test-trenching of anomalies detected through geophysical survey carried out by Geophysical Surveys Bradford (GSB) in Fields 104, 107, 108, 111 (southern part), 112, 113 and 114. This assessment took place during June and July 2000.
A ring-barrow was detected through geophysical survey and follow-up test-trenching in Kilmahuddrick townland (Field 108). The remains of field boundaries were revealed close to this ring-barrow. Approximately 50m to the east of the ring-barrow two cobbled surfaces, a charcoal spread and a series of linear features were revealed (see below No. 225).
Other truncated archaeological features were detected in Field 110 to the south of the Grange Castle tower-house. In the other areas that were tested a number of features were detected, the majority of which can be

explained by ploughing or by the presence of spreads of dumped redbrick debris. Much of this redbrick debris appears to have been over-fired and reduced to a vitreous slag. There was no evidence for in situ burning or oxidation of the natural subsoil adjacent to these features. These redbrick features were only detected in Field 112.

To the south of Kilmahuddrick townland, in Nangor townland, several features of archaeological potential were detected. In Field 111 a small, undated, charcoal-rich pit was revealed. This contained a small quantity of cremated bone. In the central part of Field 111 a cluster of small, undated pits and charcoal stains was detected. A trench in the south-eastern corner of the field revealed a large cut into natural, containing 19th/20th-century cultural material. This cut corresponds with the location of an 'Old Gravel Pit' marked on the 1864 1:2500 OS map.

Field 112 is located to the north of Nangor Castle and is adjacent to the Business Park access road. In the south-eastern corner of this field a cluster of cobbled surfaces, pits and gullies, associated with medieval pottery, was revealed. Some 60m to the west of this complex a narrow ditch on a south-east/north-west axis was detected. No cultural material that could date this feature was retrieved (see below No. 226).

Further medieval material was uncovered in Field 113. Here, a trench contained a series of linear ditches directly associated with medieval ceramics (see below No. 226). A short stretch of ditch was also revealed in the north of Field 113. This length of ditch was undated but contained frequent inclusions of charcoal at the base. The ditch proved difficult to trace, but the location and orientation correspond with an anomaly detected in the geophysical survey carried out by GSB. Trenches excavated in the south-eastern portion of this field revealed a series of concrete yard surfaces and modern buildings associated with recent occupation of Nangor Castle. These remains had been covered over by spoil derived from nearby construction activity in the recent past.

Test-trenching in Field 114, a narrow field immediately north of Nangor Castle, revealed modern ground disturbance to a depth of 1.4m below the ground level. This field appears to have been associated with the Nangor Castle gardens.

None of the areas of archaeological potential have any visible, above-ground, expression. Archaeological features, where detected, were present in a truncated form, cut into subsoil and were only apparent when ploughsoil was removed.

Excavation of the ring-barrow and adjacent features commenced under licence 00E0448, while the medieval remains in Nangor townland were excavated under licence 00E0754. Topsoil-stripping during construction was monitored under licence 00E0718.

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Dublin
2000:0224
GRANGE/KILMAHUDDRICK/NANGOR (GRANGE CASTLE INTERNATIONAL BUSINESS PARK), CLONDALKIN
Monitoring
O043318
00E0718

Monitoring of topsoil-stripping commenced in early September 2000. In Nangor townland, in the northern part of Field 111, the remains of a small fulacht fiadh were revealed. This consisted of a small pit or trough, a spread of heat-cracked stone and a linear feature to the south-west of the trough.

The pit/trough consisted of a subcircular cut into natural, 0.56m by 1.25m. The cut was steep-sided, leading to a flat base. It was filled with a mix of silt and compact, stony clays.

A spread of heat-shattered sandstone was located some 0.9m to the west of the trough. This spread consisted of a moderately compact, dark grey, sandy clay with frequent inclusions of heat-shattered sandstone fragments, pieces of burnt clay and charcoal. This spread measured 1.92m north–south x 1.18m with a maximum depth of 0.05m.

Approximately 6m to the west of the spread a linear gully feature was revealed. This gully consisted of a cut into natural boulder clay measuring 2.57m north–south x 0.28–0.54m. This had a depth of 0.16m with sharply sloping sides and a flat base. The cut was filled with a moderately compact, mid-brown clay containing frequent pieces of oxidised clay and occasional flecks of charcoal. Infrequent fragments of burnt bone were noted in the fill. Some 4m to the south of the heat-shattered sandstone spread, a small linear gully feature was excavated. This measured c. 1m north-east/south-west x 0.12m with a depth of 0.14m. The fill of this comprised a mid-brown, sandy clay with frequent charcoal flecking. No archaeological objects were recovered.

To the south of the fulacht fiadh, a backfilled field boundary was revealed by topsoil-stripping. The alignment of this boundary possibly corresponds with a similar ditch encountered in Field 113 (see above No. 223).

Topsoil-stripping is set to continue in 2001.

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Dublin
2000:0225
KILMAHUDDRICK (GRANGE CASTLE INTERNATIONAL BUSINESS PARK), CLONDALKIN
Ring barrow
304420 231665
00E0448

The initial detection of this ring-barrow by geophysical survey was confirmed by archaeological assessment under licence 00E0263 (See above No. 223). Excavation commenced in July for a period of eight weeks, during which time the ring-barrow and several adjacent features were excavated.

The ring-barrow was located in Field 108, a large field at the centre of the area designated for the biotechnology campus buildings. The topography is generally level at c. 68m OD. However, the south-eastern corner of the field contains a natural raised area measuring c. 60m east–west x 150m. This area is generally 2m higher than the surrounding topography. The ring-barrow was sited in this slightly elevated position.

The ring-barrow was not visible prior to the geophysical survey or archaeological testing. Following stripping, a dark, circular band of charcoal-rich, black, ditch fill was visible, with a spread of cremated bone in the interior. A series of linear features skirted the eastern side of the ditch. Excavation of the ditch fills revealed a well-stratified sequence of deposits in a ditch 2.5m wide at the top and 0.25–0.3m wide at the base. The ditch cut had a depth of 1.6m below the level of natural subsoil and measured c. 13m in external diameter.

The uppermost fills of the ditch, F4 and F5, contained occasional fragments of burnt bone, charcoal and mollusc shells. Although occasional fragments of burnt bone were recovered from these ditch fills, no coherent or discrete cremation deposits were detected. Fragments of a human skull were recovered from the upper fill. A central fill of mid-brown, silty clay in the ditch sealed a series of stone features. F15 and F16, in the western quadrant, were large limestone blocks resting in the base of the ditch. Charcoal deposits were present on the flat upper surfaces of these stones. Oxidised clay patches against the sides of the ditch, adjacent to these stones, indicate that fires had been lit on these boulders in the ditch.

In the northern quadrant of the ditch, at the base, a stone 'cist-like' structure with a capstone was revealed. This was composed of medium-to-large angular stones leaning inwards at an angle of c. 45o. A large, angular capstone was positioned at the apex of the inward-leaning stones. Several of the stones comprising this small structure were fire-reddened, though there were no indications of in situ burning. When excavated, this structure was empty. Some 2m to the east of this structure, at the base of the ditch, a limestone pillar was revealed. This stood upright to a height of 0.62m and had a width of 0.44m.

Within the circular area enclosed by the barrow ditch, several deposits of cremated bone were visible. A small spread of cremated bone was initially apparent, and this may indicate disturbance. Upon excavation this was found to seal a shallow depression filled with frequent inclusions of powdered cremated bone fragments. To the north-west of this, a pit measuring some 2.1m north–south x 0.6m was revealed. This pit contained occasional fragments of cremated bone and appeared to cut an irregularly shaped cremation pit (F87), which measured 1.3m east–west x 0.5m and had a depth of 0.8–0.9m. The upper fill of this was a hard, compact, grey clay with occasional stones. This fill sealed a layer of cremated bone and charcoal. A sherd of pottery was recovered from this material, the characteristics of which all point to an Early Bronze Age date for its manufacture, specifically a Beaker or Food Vessel background (Anna Brindley, pers. comm.). What appears to be a small black bead was retrieved, during sieving, from this deposit.

Two undated pits were excavated adjacent to the barrow. A series of linear features was also revealed in the area surrounding the ring-barrow. These are interpreted as the remains of field boundaries and were found to enclose the ring-barrow in a subrectangular field system. These remain undated. A geological seam was traced running from the north side of the barrow.

Some 50m to the east of the ring-barrow a trench was reopened in Field 109 to examine features originally detected during assessment 00E0263 (see above No. 223). A northern return of the field system found to enclose the ring-barrow was revealed. This places the ring-barrow in a rectangular enclosure measuring c. 50m east–west x 100m (minimum). A metalled surface was found to seal the field boundary in this trench. While the field boundary system remains undated at the time of writing, it is likely to post-date the ring-barrow. A hearth was also excavated.

Analysis of the soil samples from the ring-barrow has recovered evidence of cereal production. Charred remains of barley, wheat and oats were identified in the ditch fills and cremation deposits. Traces of hazel, haw and sloe were also found. Post-excavation analysis of the human remains, the faunal remains and the charcoal samples is ongoing.

A cluster of ring-barrows is located on the upland area of Saggart Hill and Verschoyles Hill, approximately 6km to the south of the Kilmahuddrick site. Within this group, the Lugg monument complex, which contained a ring-barrow, was excavated by Kilbride-Jones in the late 1930s. The Kilmahuddrick barrow may be a northern element of this distributional cluster, or, alternatively, its presence in a heavily ploughed lowland area may indicate a greater survival rate and higher level of visibility in the upland areas.

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Dublin
2000:0226
NANGOR (GRANGE CASTLE INTERNATIONAL BUSINESS PARK), CLONDALKIN
Medieval field complex
30440 23117
00E0754
Excavations commenced in this area of the Grange Castle International Business Park in October 2000 and are continuing at the time of writing (January 2001). The site of Nangor Castle (SMR 17:37) is located immediately outside the southern boundary of the Wyeth Medica Ireland biotechnology campus. There are no upstanding remains of Nangor Castle—demolition appears to have happened in the 1970s. Cartographic evidence and test-trenching carried out close to this area (see above No. 223) indicate that a complex of agricultural buildings and concrete surfaces existed in the area. To the west of the Nangor Castle site, mid-19th-century OS maps depict a well-designed garden. The unkempt remains of this garden exist today to the south of the biotechnology campus.
The place name Nangor appears to be of old French origin. In 1307 there is a reference to the tenements of 'Kilbryde and the Naungre', which were held by Walter de Kenley from William, son of John de Galbarry, for a rent of 20 pounds (Mills 1914, 356). Test-trenching carried out by Cia McConway in 1996 at Nangor Castle revealed at least one substantial ditch and a shallow linear feature to the west of the castle site (Excavations 1996, 17, 96E0273).
The present phase of excavation was designed to resolve any archaeological material in Fields 112 and 113 within the southern boundary of the biotechnology campus. In addition to this, excavation is ongoing to the south of the boundary in a corridor through the Nangor Castle gardens (South Dublin County Council land) to enable a gas pipeline and access road to serve the Wyeth Medica Ireland site.
To date, a complex of intercutting medieval ditches and gullies has been excavated. Some 1500 sherds of locally manufactured medieval pottery (Dublin-type wares, Leinster cooking ware) have been recovered. A complete iron sickle was found in a ditch associated with sherds of medieval pottery. Further details will be provided for Excavations 2001.

Reference
Mills, J. (ed.) 1914 Calendar of the Justiciary Rolls or Proceedings in the Court of the Justiciar of Ireland, Edward I. Part 2. Dublin.
Ian W. Doyle, Margaret Gowen & Co. Ltd, 2 Killiney View, Albert Road Lower, Glenageary, Co. Dublin.

Dublin
2001:427
Grange Castle International Business Park, Grange and Kishoge
Various
204230 232120
00E0061
Test-trenching was carried out at Grange Castle International Business Park, Clondalkin, Dublin 22, on a site owned by South Dublin County Council, during February 2001. The greater part of this site is currently under development as a business park by Wyeth Medica Ireland.
The assessment was concerned with the area immediately south of the Grand Canal in Grange and Kishoge townlands. It is intended to construct an attenuation lake in this area, which will aid drainage. The lake structure will measure approximately 250m north-west/south-east by 90m. An underground 110kV electricity cable will run through this area and towards the west for a length of approximately 1.5km. The terrain in the areas to be affected is relatively low-lying and the land has been used for agricultural purposes. The centre of the area intended for the attenuation lake was subjected to ground disturbance in the recent past. This disturbance appears to have been associated with the diversion of a stream and ground was stripped to bedrock in places.
Sixteen trenches were opened by mechanical excavator. These were placed in the areas which would be subjected to disturbance by the attenuation lake and the electricity cable way-leave.
Trench 1 was located at the western end of the lake and associated roadway. It revealed a long linear feature cutting natural subsoil. Where sectioned, the cut for this feature, which measured 2.6m east–west by 16.5m with a depth of 0.35m, comprised a sloping-sided flat-bottomed gulley. The upper fill consisted of a moderately compact light brown clay silt with occasional inclusions of mollusc shells and small pebbles. The lower fill comprised a moderately compact grey clay with occasional mollusc shell inclusions. A small undated hearth was revealed in Trench 4, which was also located to the west of the lake.
Trench 13 was opened on the line of the electricity cable way-leave, at a point where a mound and masonry wall were observed in the extreme north-eastern corner of the field. What is likely to be a modern agricultural feature was revealed, comprised of a mound, a stone wall and a metalled surface. This is likely to represent a watering-hole for livestock formed by excavating a depression, placing the upcast to the west into a

mound, which was then revetted with a low masonry wall. A metalled surface was then placed at the point of animal access.
Monitoring of topsoil-stripping was recommended and was later carried out (see below, No. 428).
Ian W. Doyle for Margaret Gowen & Co. Ltd, 2 Killiney View, Albert Road Lower, Glenageary, Co. Dublin.

Dublin
2001:428
Grange Castle International Business Park, Grange/Nangor/Kilmahuddrick
Monitoring
304420 231665
01E0718
Monitoring continued in the townlands of Grange, Nangor and Kilmahuddrick. Wyeth Medica Ireland commenced construction of a biotechnology campus in this area in September 2000.
The campus area is located west of Clondalkin village and incorporates parts of the townlands of Grange, Kishoge, Kilmahuddrick and Nangor. It is bounded to the north by the Grand Canal, to the south by New Nangor Road, to the east by a new housing estate and reservation for the South Dublin Outer Ring Road and, finally, to the west by the Grange Castle International Business Park access road. The Wyeth Medica Ireland site is approximately 90 acres in extent.
Previously, during 2000, excavation in Kilmahuddrick townland concentrated on a prehistoric ring-barrow, which was resolved in advance of construction (Excavations 2000, No. 225, 00E0448). Monitoring of topsoil-stripping in October 2000 led to the identification and excavation of a small fulacht fiadh in Nangor townland. The monitoring of topsoil-stripping within these townlands continued during January 2001. No additional archaeological material was detected.
Ian W. Doyle for Margaret Gowen & Co. Ltd, 2 Killiney View, Albert Road Lower, Glenageary, Co. Dublin.

Dublin
2001:429
Grange Castle International Business Park, Grange and Kishoge
Post-medieval
20423 23212
01E0718 ext.
The archaeological assessment carried out in this area during February 2001 (see below, No. 438) recommended that an archaeologist be present to monitor the stripping of topsoil.
The initial recognition of archaeological features was compromised somewhat by the contractor stripping a quantity of topsoil before informing the archaeologist. However, several metalled surfaces, field drains, pits and gullies of post-medieval and modern date were recognised during the stripping when an archaeological presence was maintained.
In Kishoge townland, to the south-west of the area intended for the attenuation lake, the remains of a subrectangular structure, which appears to have burnt down, were detected. This consisted of what appeared to be the remains of slot-trenches cut into natural boulder clay with a fill of oxidised clay and charcoal. The feature measured 5.8m east–west by 4.6m and appeared to have been truncated through intensive ploughing. Access to this area was not available at the time of the assessment owing to dumping and storage of building materials. This area was later excavated by Edmond O'Donovan (see below, No. 438).
Ian W. Doyle for Margaret Gowen & Co. Ltd, 2 Killiney View, Albert Road Lower, Glenageary, Co. Dublin.

Dublin
2001:438
Kishoge
Prehistoric house
30423 23212
01E0061
The remains of a truncated burnt Neolithic wooden house were identified in Kishoge, Dublin 22, halfway between Clondalkin and Newcastle. Ploughing in antiquity had led to the truncation of the structure, and no occupation surfaces survived. However, cut features, such as post-holes, pits and foundation trenches, were identified at the site.
The house was originally roughly rectangular in shape, although the walls were slightly curved at the south-western end. The structure measured 6.05m (north-east/south-west) by 4.5m. The archaeological remains consisted of foundation trenches cut into the glacial boulder clay and bedrock. The house walls and the support for the building's superstructure were constructed from timber posts augmented by planking. All of

the posts and planks identified in the house were of oak. The foundation trenches varied between 0.25m and 0.3m in width and were excavated to a depth of 0.08–0.21m. The foundation trenches at the north-eastern end of the house originally housed upright timber planks that formed the house walls. A break in one of these linear features (house wall) was visible in the north-eastern foundation trench; this was interpreted as an entrance. The south-western end of the house was predominantly post-built. The south-western house walls curved, with an open entrance at the southern end of the building.

Only two features were identified in the interior of the structure: the truncated remains of two internal timber roof supports, suggesting some kind of internal division within the house into two spaces at the north-east and south-west ends. The house appeared to have burnt down in antiquity, with little evidence for repair or reoccupation.

Pits and charcoal were identified both to the south and north-west of the house. These features are likely to represent contemporary domestic activity around the dwelling. A small number of artefacts were retrieved from these features, including a number of crude round scrapers, waste flint and a single poorly preserved fragment of prehistoric pottery.

Rough flint scraping tools and flint waste flakes were retrieved from the features excavated on the site, but none of these were obviously diagnostic. The complete absence of prehistoric pottery from the house is curious. The morphological comparison with other Neolithic houses excavated in Ireland suggests that the structure dates from this period. This was confirmed by the results of the radiocarbon dating programme. The Centrum voor Isotopen Onderzoek, Groningen, processed three samples to date the house (GrN-26770, 4880+40 BP; GrN-26771, 5020+40 BP; and GrN-26789, 4990+50 BP). The 2-sigma-calibrated results indicate that the house was built and occupied between 3941 and 3659 BC. A fourth Middle Bronze Age date (GrN-26772, 3120+75 BP) was obtained from a large pit to the south of the house (1595–1131 BC), suggesting that not all of the peripheral archaeological activity is contemporary with the structure.

Edmond O'Donovan, Margaret Gowen & Co. Ltd, 2 Killiney View, Albert Road Lower, Glenageary, Co. Dublin.

Dublin
2001:455
Grange Castle International Business Park, Nangor
Medieval field system
304400 231170
01E0754

Excavations were carried out in Nangor townland, west of Clondalkin, Dublin 22, during October 2000–January 2001. The excavations revealed a medieval ditch complex. The northern area of the site is presently under development as a biotechnology campus.

Construction of the campus commenced in September 2000. The area excavated in Nangor is south of the construction site and outside the immediate area of impact. No detailed development is presently intended for the greater part of this area. However, additional excavation was undertaken to mitigate the impact of a gas pipeline and associated access road in part of the area formerly occupied by the Nangor Castle gardens. Nangor Castle (RMP 17:37) is located immediately outside the southern boundary of the Wyeth Medica Ireland site. References to a castle at this site date from the 15th–16th centuries. All buildings on the site were demolished during the 1970s, but an area of archaeological potential surrounds the site.

Trench 1, which measured 60m north–south by 33m, was located some 90m to the north-west of the castle site. Geophysical survey and subsequent test-trenching had suggested that the area of Trench 1 held archaeological potential. Excavation in Trench 1 commenced in October 2000 and continued until December 2000. Activity assigned to Phase I in this trench consisted of a linear feature and a pit, both of which cut natural subsoil. These features did not produce pottery or finds. The pit consisted of a rectangular cut into natural subsoil, which contained a series of ash deposits. Areas of oxidised or fire-reddened soil present on the north-east and south-west sides are indicative of in situ burning. This cut was filled with a series of sterile silty layers and dumps of ash.

The Phase I activity was succeeded by a medieval phase of activity which consisted of further linear features, pits and cobbled surfaces. These were assigned to a single general phase which is capable of further subdivision based on stratigraphic grounds. Finds retrieved from the fills of these features include approximately 1000 sherds of Leinster Cooking Ware and Dublin-type wares, and assorted iron finds including nails, an armour-piercing arrowhead, a buckle, a key and an intact iron sickle.

Trench 2, located to the east, detected a similar sequence of linear features, which contained sherds of medieval pottery in their fills. Trench 3, to the south of Trench 1, detected shallow linear features running on an east–west axis. These linear features were succeeded by a pit and a metalled surface, both of which were directly associated with medieval pottery.

Trench 4, located to the west, was excavated to examine a ditch encountered during an earlier assessment. A ditch orientated north-west/south-east with steep sloping sides and a rounded U-shaped base was revealed. It was 1.05m wide, narrowing to 0.3m at the base, with a maximum depth of 1.1m. Its fill contained occasional fragments of animal bone, from which a radiocarbon date of cal. AD 601–883 was obtained.

Trench 5, located to the south-east of Trench 4, uncovered further medieval linear features. A narrow ditch which ran across the trench on a south-east/north-west axis is likely to represent a continuation of a similar feature encountered in Trench A to the south. A series of post-medieval field boundaries was also detected in Trench 5.
Trench A was excavated to the south of Trench 5 on the line of the gas pipeline and associated roadway. Excavation in this area revealed an undated metalled surface and a series of ditches/gullies. Excavation of these commenced in January 2001. Although there were relatively few finds from these features, their stratigraphic relationship indicates that there were five phases of ditches and gullies in the trench dating from medieval to modern times.
The excavation of Trench B, an extension of Trench A, revealed one feature of interest, a substantial medieval ditch which cut into natural subsoil. This was found in the extreme eastern end of the trench. The ditch ran through Trench B, outside the northern and southern limits of excavation. The cut measured 10m north–south by 2.5m, with a depth of 1.1m as exposed, and had sloping sides and a rounded base. The ditch ran on a north–south axis with a slight curve towards the north-east. In overall plan the ditch appears to have been subcircular, enclosing an area to the east of Trench B. The fills of the ditch comprised black sticky silts with organic content. The lower and upper fills contained medieval pottery. No trace of an enclosing bank was detected in the area opened for examination; however, the depth of overburden, composed of cultivated soils, in this area may be in part composed of a levelled bank.
Trench C to the north-east of Trench B did not detect the ditch. No archaeological material was detected in Trench C, where it was found that modern disturbance had removed the old ground surface.
In total, some 1600 sherds of native medieval pottery were recovered from the Nangor excavations. It is of some interest that only two sherds of imported medieval pottery were recovered. The excavated linear features at Nangor may represent the remains of medieval field boundaries with associated water-management gullies. The presence of such linear features, which can be dated to the medieval period by the presence of Leinster Cooking Ware and Dublin-type wares, argues for land enclosure during the medieval period. That cereal production was the purpose of such enclosures may be suggested by evidence from pollen and macro-plant analysis. The examination of a wide range of medieval samples from the Nangor excavations has shown a predominance of wheat over other plant remains.
Ian W. Doyle for Margaret Gowen & Co. Ltd, 2 Killiney View, Albert Road Lower, Glenageary, Co. Dublin.

Dublin
2002:0448
Adamstown
No archaeological significance
ITM E 702819m, N 732976m
Latitude, Longitude (decimal degrees): 53.337018, -6.456151
01E1147
Test excavation before the construction of a housing development was carried out in the townland of Adamstown, adjacent to the Newcastle Road, west Dublin. The greenfield site measured c. 200m by 200m. Testing was required because of the proximity of the site to that of Adamstown Castle, SMR 17:29. Seven trenches, 30–50m long, were excavated by mechanical digger. In no trench were finds, features or structures of archaeological significance uncovered.
Georgina Scally, 81 Upper Leeson Street, Dublin 4, for Margaret Gowen & Co. Ltd.

Dublin
2002:0612
Kishoge
Monitoring
O042325
02E1808
Monitoring before the construction of a temporary haul road associated with the construction of the South Dublin Outer Ring Road was undertaken in November and December 2002. The temporary haul road is in the vicinity of Lynches Lane, in the townland of Kishoge, west Dublin. All subsurface works associated with the construction of the road were monitored, and no finds, features or structures of archaeological significance were uncovered. The licence has since been extended to include monitoring of the full length of the roadway, which will extend c. 5.7km from Kingwood in Tallaght to Lynche's Lane. This work will continue in 2003.
Georgina Scally, 81 Upper Leeson Street, Dublin 4, for Margaret Gowen & Co. Ltd.

Dublin
2003:0604
Grange
Mill
03E1210
The site was excavated because it was directly threatened by the realignment of the Griffeen River within the precincts of the Grange Industrial Park. Surface evidence for the mill was in the form of the north wall, surviving as part of the boundary fence separating the Beattie farm from the Grand Canal towpath. Some 19th-century pottery was found on the surface and some fragments of floor tiles from an industrial drying kiln. Testing and subsequent excavation revealed the extent of the building as a single block, 13m west–east by 8.5m. Wall thickness was between 0.8 and 0.9m. The wall structure was of coursed rubble with opes defined by brick dressings. The dressings allowed for the identification of two window opes in the north-east corner of the building. Flanking the main block to the west was a wheel pit, 2.2m in width and 1.6–1.7m in depth. The wheel pit is delimited on the west by a wall 0.85m thick, widening to 1.1m where the axle bearing was mounted. The wheel pit was partially lined with red brick. The upper courses, forming the downslope of the wheel pit, are formed of brick with headers presented, while the lower part of the pit and its base are lined with brick, stretchers presented.
The flanking walls show evidence for wheel wear in the stonework, and this suggests that the wheel had a diameter in the region of 3m. The wheel was breast shot fed from a headrace to the south. The headrace either emanated from a penstock to the south or was linked back to the Griffeen further upstream. There was no evidence for a race in the field south of the mill site. The confluence of the headrace and the wheel pit is again lined with red brick in a rough English bond pattern.
Within the mill structure, the pit for the pit wheel was identified. No machinery was present on the site. Artefacts within the mill structure were largely of 19th-century date, although some sherds of post-medieval imported ware were found in the topsoil but do not appear to be contemporary with the mill. It is possible that the mill has its origin in the later 18th century and served as a gristmill for flour milling. The general water supply would make such a mill difficult to operate. With the inauguration of the Grand Canal, a constant head of water became available and so the mill relocated to the Lock area at Adamstown. It is likely that the machinery was taken from the old mill and tweaked to function within the new mill. The old mill may well have served a later function as a cereal-drying kiln, as suggested by the quantities of kiln tiles found on the northern part of the site.
Red Tobin, Margaret Gowen & Co. Ltd, 2 Killiney View, Albert Road Lower, Glenageary, Co. Dublin.

Dublin
2003:0607
Grange Castle
Monitoring
030335 23200
SMR 17:29; 17:34; 17:37
03E0025
Monitoring of topsoil-stripping for a pharmaceutical plant and associated services located at Grange Castle International Business Park was carried out from 8 January to 2 February 2003. The development consisted of a 20-acre greenfield site, of which c. twelve acres were stripped of topsoil by a mechanical excavator equipped with a toothless bucket. The only subsoil cut features uncovered dated to recent times. These consisted of refuse pits, field drains and areas of burning. The field boundary and watercourse that were revealed had been backfilled in the 19th century. All the finds recovered were either post-medieval or modern in date.
John O'Connor, 2 Walnut Rise, Courtlands, Dublin 9, for Archaeological Development Services Ltd.

Dublin
2003:1918
Grange International Business Park, Dublin
No archaeological significance
SMR DU017-034
03E1846
Monitoring of works took place within the constraint area of Grange Castle, RMP 17:34, at Grange International Business Park, Clondalkin. South Dublin County Council required tat the site be cleared of debris and secured with a fence and ground-beams. The site was being vandalised and used as a dumping ground. A method statement was agreed with the client and with the National Monuments Service. This involved a low-impact solution involving lightweight plant, with the majority of the work being carried out in dry weather to further reduce the surface damage.
The clearance work was carried out without disturbing any archaeological deposits and without the recovery of any artefacts. The fencing required the excavation of a series of holes for the fence posts. These

excavations were monitored and no archaeological deposits were disturbed. The ground slab required some excavation but was secured within the depth of the topsoil and remaining debris field. The work has now been completed satisfactorily.

Red Tobin for Margaret Gowen & Co. Ltd, 2 Killiney View, Albert Road Lower, Glenageary, Co. Dublin.

Dublin
2004:0602
GRANGE INTERNATIONAL BUSINESS PARK, GRANGE
Burnt mounds
04E0299

Excavations were carried out during works on the Griffeen River realignment, part of ongoing infrastructure works within the precincts of the Grange International Business Park. The works are principally aesthetic in purpose. designed to enhance the appearance of the park and to highlight the river, which otherwise would have flowed behind the Takeda Pharmaceuticals complex. The area stripped will also accommodate the extended road network that will serve the business park when it is fully occupied.

Topsoil-stripping for this realignment commenced in early December 2003 and continued intermittently until May 2004. Topsoil-stripping revealed the locations of three burnt mounds. Of these three features, two were excavated, as the development was likely to have a total impact on them. The third mound was preserved in situ. as it was located outside the development area.

The first mound was excavated between 16 and 18 February 2004 and the second was excavated from 5 April 2004.

Burnt Mound 1. 303279.542 231522.602

During the monitoring of the topsoil removal this site was identified as an irregularly shaped deposit of firing material (heat-shattered stone and blackened soil). The burnt-mound material extended 28m east-west along the northern edge of the stripped corridor and extended to the south by 8m from the northern baulk. The feature lay c. 25m to the west of the Griffeen River on gently undulating pasture sloping to the south. The evidence from initial survey work and subsequent excavation suggests that the main spread of this site remains preserved in situ to the south of this location.

The nature and extent of the mound material was exaggerated by plough action, which had dragged it from its original focal point to extend over 28m in length. After the removal of topsoil, etc., the F2 mound of firing material extended little more than 0.5m from the limit of the excavation. From this southern extremity, the mound rose to the north to a maximum height of 0.65m at the northern limit of the excavation. No cut features were exposed during the excavation.

Burnt Mound 2, 303104.7 231270.2

The realigned Griffeen crosses the course of the old river at two locations. To allow for the excavation of the first of these crossings it was necessary to divert the Griffeen into a third channel. During stripping prior to this channel being dug the second burnt mound was found. During the topsoil removal this site was identified as an irregularly shaped deposit of firing material (heat-shattered stone and blackened soil).

The area of excavation measured 13m east-west by 17.5m. A silted-up streambed abutted the southern part of the mound. The stream appears originally to have flowed from east-north-east to south-west. It had a width of 3-5m, but the length could not be discerned as it extended beyond the limit of excavation. The stream fill contained water-rolled stones, pebbles and a dark-grey silt with a minimum depth of 0.1m. Wood residue, possibly alder, was in evidence here and was probably indicative of remnants of fen woodland. This stream system is likely to have been the reason for siting the burnt mound at this location.

One of the earliest features on the site was a grouping of stake-holes cut into the clayey peat. These formed a semicircular band. All were comparable in shape and size and all contained the same fill. They ranged in depth from 5mm to 2mm with a diameter of 6-12mm. Small amounts of heat-affected pebbles and small stones around the sides of the stake-holes may be evidence for packing material. The function of the complex is not clear. Some stake-holes are vertical, while others have been driven into the ground at an angle. They follow a vague northeast to south-west pattern, but the angled stakes do not appear to offer support to each other or to any possible structure.

The burnt mound was situated on the northern bank of the silted up stream. The bank was steepsided. The main concentration of firing material is in the west. No evidence for a trough was found and the only evidence of activity associated with the burnt mound appears to be the stake-hole complex. The mound measured 11m east-west by 4.5m. It is more likely that the original east-west dimensions were closer to being 6m, with a depth of 0.12-0.25m.

Covering and surrounding the burnt mound was a layer of peat measuring 4.64m from north to south by 14.7m, with a surviving depth of 0.2-0.45m. This was a moist dark-reddish-brown peat of moderate compaction that contained inclusions of sphagnum moss, plants and wood. It was most pronounced to the south of the burnt mound, sloping downwards to the stream. A third burnt mound was recorded during the course of the topsoil-strip. The site was not fully exposed but was identified by a number of concentrations of

the characteristic firing material. This site was not impacted on by the development and it was possible to preserve it in situ. It was first sealed using a double layer of geotextile material and then covered by a soil bund forming the boundary between the business park and the pitch-and-putt course.
Red Tobin, Margaret Gowen & Co. Ltd, 27 Merrion Square, Dublin 2.

Dublin
2004:0616
FINNSTOWN (Finnstown House, Newcastle Road, Lucan)
No archaeological significance
ITM: E
04E0522
An assessment including testing was carried out at Finnstown House, Lucan, Co. Dublin. The development plans included the demolition of a single-storey building and the erection of a two-storey building, with a pedestrian link at ground level and stairs/lift enclosure abutting an existing two-storey building. The plans also include the renovation of existing two-storey outbuildings/coach houses. A medieval tower-house was noted within Finnstown House during the course of this assessment. This tower-house will not be impacted upon by the development.
Testing was carried out in the walled garden area and within the footprint of the proposed new building. The north-eastern end of the trench comprised 1m of infill material. This material was dumped during recent construction work and was then levelled out. It comprised wood, stone, plastic and modern ceramics. This material lay on the natural subsoil, which was light-brown to yellow clay. The south-western extent of the trench comprised c. 0.3m of topsoil, which consisted of stony light-brown clay with a grey hue. Some red brick and willow-pattern pottery was noted in this topsoil layer. The natural subsoil lay under the topsoil and appeared to be consistent throughout the site. No features or finds or archaeological significance were uncovered in this trench.

Dublin
2005:379
ADAMSTOWN
Urban burial ground
ITM: E 703029m, N 732827m
Latitude, Longitude (decimal degrees): 53.335639, -6.453048
-
05E1295
Human remains were located within the road-take of the Adamstown link road (ALR) at the rear of the old Lucan train station adjacent to the Ascon compound in Adamstown, Dublin. The investigations involved the excavation of human remains uncovered during the course of topsoil-stripping in advance of the construction of the ALR. The excavations entailed the lifting of 36 full or partial skeletons and eight disarticulated skeletons. Two linear features and two deposits were also excavated at the site.
The skeletal remains were primarily orientated in a west–east direction, with heads to the west, but a number were aligned slightly along a south-west/north-east axis and two along a north-west/south-east axis. All were in simple graves, with no traces of any coffins or grave-markers. They appeared to represent 43 adults and one infant. A single find uncovered with a burial was a fragment of plastic rosary beads found in the pelvic region of Skeleton 10. This find may not suggest a modern date for the burials, as they were disturbed and truncated by the railway wall, which appears to date to the 1950s. It is possible that the rosary beads were interred when the burial was disturbed during the demolition of Lucan station or the construction of the wall that divided the site from the Dublin/Kildare railway line. Removal of the wall and build-up on its southern side revealed that skeletal remains did not extend over the northern side of the existing railway wall.
It is hoped that further post-excavation and osteoarchaeological analysis of the remains will indicate a possible date for the site.
Ellen O'Carroll, The Archaeology Company, 17 Castle Street, Dalkey, Co. Dublin.

Dublin
2006:581
New IAWS HQ, Grange Castle Business Park, Clondalkin
No archaeological significance.
30280 23110
06E1161
The Grange Castle Business Park has witnessed several archaeological investigations since 2000 (O'Donovan 2004; Doyle 2005). These investigations resulted in the discovery and excavation of several prehistoric sites in the area of the Grange Castle Business Park. The Record of Monuments and Places records two castles located within the grounds of Grange Castle Business Park, namely Grange Castle DU(017–134) and Nangor Castle DU(017–037). The new IAWS HQ has an area of 9.3ha and is located at

the south-west corner of Grange Castle Business Park, being bordered on the west by the R120 (Lucan road). The site was part of an extensive geophysical survey carried out by Margaret Gowen & Co. Ltd in October 2005, which revealed that the south-west corner of the site had a distinct magnetic disturbance indicative of a spread of material, possibly rubble.
All groundworks associated with the development were monitored during December 2006. The excavation of the site access road resulted in the discovery of a modern pit, a modern linear spread of angular stone, a small spread of red brick mixed with shells and several modern land drains. No features of archaeological significance were encountered during the stripping of topsoil. The programme for the monitored stripping of topsoil at the eastern portion of the site will resume in January 2007.
References
Doyle, I. 2005 Excavation of a prehistoric ring barrow at Kilmahuddrick, Clondalkin, Dublin 22. The Journal of Irish Archaeology 14, 43–75.
O'Donovan, E. 2004 A Neolithic house at Kishoge, Co. Dublin. The Journal of Irish Archaeology 12 and 13, 1–27.
Eoin Sullivan, for Margaret Gowen & Co. Ltd, 27 Merrion Square, Dublin 2.

Dublin
2006:659
Grange Castle Business Park (Grange, Milltown and Clutterland)
No archaeological significance
06E0777
Monitoring of ground-disturbance activities associated with the construction of a link road within Grange Castle Business Park was undertaken in July and August 2006. The link road was constructed in the west of the business park from the Takeda Factory to the Nangor Road; 1250m of single carriageway was constructed parallel to the course of the Griffeen River. The majority of the route of the link road was disturbed by the previous realignment of the Griffeen River (see Red Tobin in Excavations 2003, No. 604, 03E1210). No features or stratigraphy of an archaeological nature were identified.
Emer Dennehy, Margaret Gowen & Co. Ltd, 27 Merrion Square, Dublin 2.

Dublin
2007:515
Gollierstown, Dublin
No archaeological significance
SMR N/A
07E0671
Testing was carried out in compliance with a planning condition for enabling works to facilitate the construction of the district centre at Adamstown, Lucan, Co. Dublin. The proposed development lands were in use as a compound for the railway development and, as such, the topsoil had been stripped from some of the area. A bridge has also been constructed across the lands at the western side. There are no known monuments in the development lands for the district centre and cartographic research indicates that the development site was always laid out in open fields.
Eleven test-trenches were excavated across the development site with a 1.8m-wide toothless bucket. The stratigraphy consisted of c. 0.2m of topsoil underlying subsoil on to natural stony marly soils. Nothing of archaeological significance was recorded during the testing.
Ellen O'Carroll, 8 Cumberland Street, Dún Laoghaire, Co. Dublin.

Dublin
2007:530
NANGOR
Medieval, post-medieval
30459 23122
DU017–037
07E0588
Monitoring and testing took place between August and October 2007 within and adjacent to the Nangor Castle, Clondalkin, Co. Dublin.
The monitoring of a service trench, 400m in length, 1m in depth and 0.5–0.55m in width, revealed several archaeological features that have been tentatively identified as part of the landscaped gardens, located to the west of the RMP site and associated with the now demolished 18th-century Queen Anne house that was built on the site of the earlier Nangor Castle. The initial stage of the service trench, which was parallel to an existing access road to a gas pumping station, ran through heavily disturbed ground that contained redeposited topsoil, subsoil and road-making materials. As the monitoring trench approached the gas pumping station, a series of small stone walls, averaging 0.5m in width, separated in some instances by low banks of stone-free soil, were revealed. The walls, six in all, were located at a depth of 0.5m below the

present ground surface. They consisted of stones, c. 0.2m by 0.15m or smaller, bonded together in some instances with creamy gritty mortar with fragments of red brick. One wall, F9, lay at a depth of 1m; it was 0.5m in width and appeared to be bordered by narrow pieces of wood on each side. All the walls ran in a north-west to south-east direction across the monitoring trench.

As the service trench ran to the south of the pumping station it cut through concrete floors, possibly associated with farm and cattle yards. The foundation for the floors consisted of loose stone, stone blocks and mortar and lay directly on the subsoil. Two further stone walls were revealed at the extreme eastern portion of the service trench in this area. Both ran north–south across the service trench. The walls were just under 1m in width and were revealed 0.6m beneath disturbed topsoil and fill.

As the service trench turned southwards and ran parallel with the site boundary for 120m, there was a marked difference in the ground conditions. The ground here was undisturbed. However, nothing of any significance was revealed in this area.

It should be noted that, while the monitoring did reveal landscape features possibly associated with the Queen Anne house, the rubble foundation that underlay the concrete floors in the northern portion of the site contained a considerable amount of stonework, which may be related to the 18th-century house and possibly to Nangor Castle itself. The incidence of red brick and large blocks of stone may indicate this to be the case. Areas with the constraint zone for Nangor Castle are strewn with large rough-hewn limestone blocks, possibly relating to the castle structure, although the dumping of construction waste and other waste within the area masks this to quite a degree. There was no evidence for in situ remains of the Queen Anne house or Nangor Castle revealed during monitoring.

Two phases of testing took place on the site. The initial phase took place within the RMP site and one test-trench was located across the possible remains of the Queen Anne house and the castle. It had been hoped to insert a series of test-trenches over possible subsurface remains of the Queen Anne house and castle site, but, due to a very large and unstable overburden and the desire not to impact unnecessarily on the RMP site, only one test-trench was completed.

This test-trench, located across possible structural remains in the western portion of the site, was cut through a very large deposit of construction debris, general dumping and waste, averaging between 3m and 4m in places. This overburden was extremely loose and unsound. Consequently a test-trench 6m in width was cut through this overburden and battered back for safety. Within this a slightly narrower test-trench revealed the remains of a modern concrete building at the western end of the test-trench, 3m below the original overburden. The modern structural remains were abutted by a portion of a large stone structure, over 1m in height and 1.75m in width, with a rubble core, suggesting it may be associated with or be part of Nangor Castle. The true depth of the wall was not ascertained. It appeared to run in a southwards direction from the test-trench. Further to the east, possible remains associated with the Queen Anne house were revealed. These consisted of stone walls plastered on one side, walls of red brick and painted walls. They were revealed to be up to 1m or more in depth. Red brick from this area was identified as being very early in date. No further work was done in the area due to the instability of the overburden.

A second phase of testing took place to the south, south-east and south-west of the RMP site. A series of three test-trenches were excavated. This testing took place within a possible Early Christian 90m diameter enclosure previously identified. An area to the south-east of the RMP site and the Early Christian enclosure was also tested. The two test-trenches to the south-east revealed a redeposit of disturbed modern fill, within which lay garden features such as low banks of stone-free soil, for trees or shrubs, which may have been associated with the avenue which led up to the Queen Anne house, which was located to the immediate west. The third test-trench, which was 150m in length, ran across the previously identified Early Christian enclosure to the south-west of the RMP.

This long test-trench cut across the entire width of the enclosure, at the northern extremity, and confirmed the previous investigations and geophysical survey. The presence of a large enclosure with ditches up to 2.7m in width and over 0.7m in depth, with the possible remains of a second ditch in the western portion of the enclosure, were revealed. Previous investigations had revealed a cemetery and possible structures within the enclosure. There was considerable evidence for occupation levels, areas of burning within the test-trench and features such as pits and linear features. Finds from the original investigations by Cia McConway (Excavations 1996, No. 68, 96E0273; Excavations 1997, No. 86, 97E0116) included lignite slivers and cores, metal slag, animal bone, medieval pottery and human remains. Additional medieval pottery, green-glazed, was recovered from this second phase of testing, together with large quantities of animal bone.

The monitoring of the service trench and the two phases of testing has confirmed that this is an area of considerable archaeological activity. The location of such a large enclosure, Early Christian in date, with evidence for a cemetery and interior occupation, may have given the site considerable importance, marking it out as a significant place in the landscape. The second phase of activity, to the north and north-east of the enclosure, that of the medieval Nangor Castle, also attests to the importance of this site, as does the erection of the later Queen Anne house. The layout of the Queen Anne gardens is still clearly visible on the ground, although heavily overgrown, and the testing has shown that subsurface features associated with the gardens still exist. Possible substantial remains of Nangor Castle itself and the Queen Anne house, under a

deep overburden of unstable construction fill, were also revealed, although further investigations would be necessitated to confirm this.
Sylvia Desmond, Margaret Gowen & Co. Ltd, 27 Merrion Square, Dublin 2.

Dublin
2008:363
Gollierstown, Adamstown
Urban
ITM: E 701516m, N 732303m
08E0197
An assessment and associated testing were in compliance with a planning condition for the construction of a post-primary school and a community centre. The proposed development is to be located to the south of the SDZ lands and adjoins the railway line. Previous testing was carried out by the author at the adjoining site for the Adamstown District Centre. There are no known monuments in the development lands for the District Centre and cartographic research indicates that the development site was always laid out in open fields.
The proposed development site is located on a brownfield site at the western edges of the Adamstown development. The lands were in use as a compound for the railway development and other developments in the surrounding area and therefore topsoil had been stripped from most of the site. Two large holding tanks at the north-west of the site, a small access road at the south and housing developments to the north-east had already been constructed in the part of the areas proposed for development prior to the author arriving on-site.
Seven test-trenches were excavated across the site with a 1.8m wide toothless bucket. The stratigraphy consisted of c. 0.2–0.4m of topsoil intermixed with debris and overlying subsoil onto natural stony marl soils at the western portion of the site where the proposed community centre is to be located. There was very little topsoil remaining at the eastern end of the development site and the stratigraphy comprised of orange/brown subsoil overlying natural marl subsoil with veins of stone/slate running south-east/north-west across the development lands.
Nothing of archaeological significance was recorded during testing.
Ellen O'Carroll, 8 Cumberland Street, Dun Laoghaire, Co. Dublin.

Dublin
2013:043
Grange/Ballybane/Nangor, Dublin
Furnace pit (monitoring)
ITM: E 703978. N 703391m
13E0435
Monitoring of a proposed central carriageway at Grange Castle Business Park, Co. Dublin was carried out from 1-8 November 2013. Monitoring followed an archaeological appraisal carried out in September 2013 and geophysical survey was previously carried out throughout the entire area of Grange Castle Business Park.
Two features of archaeological interest were identified during monitoring of topsoil stripping in the east of the development area in Nangor townland. These features comprised a small bowl furnace (0.36m x 0.33m x 0.15m) filled with charcoal-rich soil and slag, and a shallow oval pit (0.97m x 0.69m x 0.1m) filled with charcoal, thought to be a charcoal clamp. These features were located approximately 35m apart and may have been associated with each other.
It is anticipated that specialist analyses in the form of charcoal analysis, radiocarbon dating and metallurgical analysis will be carried out on the material retrieved from the features excavated at the site
Courtney Deery Heritage Consultancy, 65 Mountain View Drive, Boghall Road, Bray, Co. Wicklow

Dublin
2013:196
Grange, Dublin
No archaeology found
SMR N/A
13E0459
Testing was carried out at the site of a proposed biopharmaceutical plant in Grange Castle Industrial Park, Co. Dublin. The entire development site is approximately 11ha in size however the proposed plant will be built on the southern 7.5ha of the site, leaving the northern portion available for future expansion. Only the southern 7.5ha was subject to testing. A total of 15 trenches, measuring 2,585 linear metres, were excavated across the area of proposed development over the course of four days from 9 December 2013. Nothing of archaeological significance was identified during this programme of testing.
Fintan Walsh for IAC Ltd, Unit G1, Network Enterprise Park, Kilcoole, Co. Wicklow

Dublin
2013:521
Grange/Ballybade/Nangor, Co. Dublin
Iron Age smelting pit and early medieval charcoal clamp
ITM: E 703873m, N 731566m
13E0435
Archaeological monitoring of a proposed central carriageway at Grange Castle Business Park, Co. Dublin was carried out from 1-8 November 2013 (east of Pfizer Ireland). Monitoring followed an archaeological appraisal carried out in September 2013 and geophysical survey was previously carried out throughout the entire area of Grange Castle Business Park.
Two features of archaeological interest were identified during monitoring of topsoil stripping in the east of the development area in Nangor townland. These features comprised a small bowl furnace (0.36m x 0.33m x 0.15m) filled with charcoal rich soil and slag, and a shallow oval charcoal clamp (0.97m x 0.69m x 0.1m). These features were located approximately 35m apart and it was initially thought that they could have been associated, however the dating evidence has indicated otherwise.
The furnace pit contained 1.26kg of metalworking residues and constituted the base of a typical slag-pit furnace. A sample of oak charcoal from fill C3 of the furnace pit returned a radiocarbon date of 2403+/-30 BP (UBA 25347), which was calibrated to 732-400 BC (2 Sigma) dating this feature to the early Iron Age. This radiocarbon date is one of the earliest to come from an Irish iron smelting context to date (Rondelez, 2014). (ITM 703873E 731566N).
A sample of oak charcoal from fill C7 in the charcoal clamp returned a radiocarbon date of 1256+/-32 BP (UBA 25348). The 2 Sigma calibrated result for this was 671-867 AD dating this deposit to the early medieval period. (ITM 703843E 731580N).
The features discovered at the site have been excavated and "preserved by record" and as such no further mitigation measures are necessary in relation to this development, however future development of the adjacent areas have the potential for further isolated small features to be discovered.
Courtney Deery Heritage Consultancy, Lynwood House, Ballinteer Road, Dublin 16

Dublin
2015:268
Grange Castle Access Road, Grange Castle, Dublin
No archaeology found
SMR N/A
15E0392
An archaeological assessment was undertaken for a site at Grange Castle Access Road, Grange, Dublin 22, on a 2.02 ha site. The site was a green field area within an industrial estate off the Nangor Road. The site of a tower-house (Grange Castle) lies 400m to the south. No archaeological features were recorded in the course of the assessment.
Aidan O'Connell for Archer Heritage Planning Ltd, 8 Beat Centre, Stephenstown, Balbriggan, Co. Dublin

Dublin
2016:049
Gollierstown, Aungierstown, Ballybane, Dublin
No archaeology found
ITM: E 763222m, N 730681m
15E0551
MOORE GROUP undertook a programme of archaeological testing at two sites in West Dublin as part of the development of a 220/110 kV Substation in a green field site at Ballybane/Aungierstown and the development of an interface compound at nearby Kishoge, South County Dublin. Earthsound Archaeological Geophysics carried out surveys of the proposed development works at both sites in October 2015 (detection Device no. 15R0116). At the interface site in Kishoge dipolar anomalies detected suggested that the land has been used for the deposition of debris or imported soils, causing the magnetic interference. This interference appeared to be truncated by a number of possible ditches which, it was suggested, relate to underlying features or may be an artefact of the deposition of the debris or imported soils. At Ballybane, the proposed sub-station site, a series of circular and sub-circular trends were detected across the northern survey area. These were interpreted as representing archaeological ditches or geological trends. Testing involving the mechanical excavation of twelve trenches was carried out from 22-24 February 2016 in bright and dry conditions.
Ballybane Site
The proposed substation site was accessed via a new business park access road south of the New Nangor Road (R134). The site consists of an improved tillage field to the north, cut by a ditch to the south. The field was originally subdivided into a smaller sub-triangular plot, the boundary of which has in recent years been

cleared away. Due to regular ploughing the site was relatively even underfoot. The test trenches were excavated by a 15-tonne backhoe excavator using a 1.2m-wide ditching bucket. All the test trenches were deliberately sited to target sub-surface anomalies identified during the geo-physical survey. These anomalies were variously interpreted as possible pits, ditches or relict boundaries. Trench 1 was located in the north-west corner of the site in relativity even ground. The trench measured 24m in length and was dug to an average depth of 0.5m. The topsoil was a rich humic material and the subsoil contained a high inclusion of angular stones. The only notable feature was a drainage channel at the west of the trench and was orientated north to south.

Kishoge Site

The proposed interface compound at Kishoge is located to the south-east of a roundabout at the junction of the R136 and the Ninth Lock Road. The field contains a high voltage tower with power lines overhead; the ground is of rough pasture with evidence of previous infill. This infilling was confirmed by the geophysical results, frequent 'iron spikes' were interpreted as relating to the importation of soils/debris. Three trenches were excavated across this area. Groundworks exposed a disturbed stratigraphy of imported builders' rubble and topsoil that had been dumped on the site. Subsoil, a boulder clay, was exposed at 1m in depth. There were no finds or features of archaeological potential.

Moore Archaeological and Environmental Services Ltd. Corporate House, Ballybrit, Business Park, Ballybrit, Galway.

Dublin

2016:083

Dub06 Data Centre, Grange Castle Business Park, Ballybane, Dublin 22, Dublin

Bronze Age - Early Medieval

SMR N/A

13E0471

The initial excavation comprised extensive test trenches over a large area within Grange Castle Business Park, County Dublin, on behalf of Microsoft Operations (Ireland) Ltd. in advance of a Data Centre complex. Test trenching began in January 2014, confirming the results of a geophysical survey carried out in 2004, identifying a circular enclosure in one portion of the site, known as Area 11, and two burnt mounds in another portion, known as Area 9. The excavation of Area 11 began in May 2014 and additional, associated, enclosures came to light leading to a prolonged excavation continuing on an intermittent basis until January 2016. The excavations in Area 9 took place in July 2014. Monitoring continued elsewhere in lands impacted by the construction works, with the subsequent recovery of more isolated features.

Area 11

The excavation of Area 11 revealed a series of associated enclosures aligned north-south. The earliest enclosure, Site 3, comprised a circular penannular ditch, with a maximum diameter of 48m, and maximum depth of 1m. Finds within the ditch included iron knives, a pair of mismatched quernstones, and a cluster of cow skulls. An upended cow skull, with human femur, provided an AMS date 656-727 and 737-768 CAL AD. The ditch was encircled by the penannular Site 4 ditch, maximum diameter 86m, which also contained cow skulls. Both Site 3 & 4 enclosures shared a south-western entrance way. The Site 4 ditch was preceded by a linear, and more shallow, east-west ditch running across the north end of the site for a distance of 86m. The large D-shaped Site 2 enclosure, 40m x 32m, attached itself to the southern arc of the Site 4 ditch. Much reworked and augmented, the ditch cut through the underlying limestone bedrock to a maximum of 0.9m.

A portion of the old ground surface was recovered within this enclosure as well as the burial of a male and female, within a shallow grave, aligned north-south. Other finds included an articulated sheep or goat within a shallow pit, and a complete horse pelvis and femur.

The smaller Site 1 enclosure comprises two concentric ditches, 14.7m diameter maximum. An occupation surface of redeposited clay set it apart from the larger ritual enclosures, as did the numerous stake-holes, post-holes, and kiln, within the interior. A wattle fence survived in what appears to be a later recut ditch within the enclosure. Much of the clay deposits were characterised by large amounts of charcoal, both in the fills of internal pits, and the ditches. Cremated bone was also recovered, raising the possibility of ritual feasting and / or a funeral pyre being situated here.

A significant feature of the enclosures is the deliberate linking of each ditch to one another. In the case of Sites 3 & 4, a shallow ditch provides the connection. Site 2 was then physically attached to the Site 4 ditch. In the case of Site 1, a ditch emanates from its outer enclosure almost to the lip of the Site 2 ditch.

The burial of two individuals within a shallow grave, the cluster of cow skulls, the deposition of a cow skull with human femur, as well as the insertion of mismatched quernstones, all indicate substantial ritual and ceremonial uses, probably including animal sacrifice. The continuation of pre-Christian rituals is not unprecedented but is stark in view of the nearby presence of Clondalkin monastic settlement.

Several post-1169 medieval ditches ran up to, aligned themselves to the enclosures.

Area 9

Two fulacht fiadh were situated in a waterlogged field. The remains to the west comprised a shallow unlined trough, a well and several pits, including a recut pit indicating a second phase of use, as well as a spread of heat-shattered stones. Finds included fragments of human bone in a deep pit.
Thirty metres to the east, another fulacht fiadh comprised troughs, pits, numerous stake-holes and an elongated gully. The stake-holes, and an associated deep trough, appear to belong to a second phase of use. The findings tend to support the hypothesis of intermittent communal feasting.
Other archaeological sites have since been excavated within the Data Centre complex, although none to the same scale as those described above. They include a Bronze Age structure, and a possible Neolithic structure. A summary will be submitted in due course.
Excavations were also carried out in an adjacent associated site under licence 14E0453 in the townland of Nangor revealing a corn-drying kiln, medieval field boundaries as well as two clusters of cremations pits.
Neil O'Flanagan, Botanic Court, 30-32 Botanic Road, Glasnevin

Dublin
2016:084
DSF, Grange Castle Business Park, Dublin 22, Dublin
Bronze Age cremation pits & medieval corn-drying kiln
SMR N/A
14E0453
Excavations were carried out on behalf of Sisk & Sons Ltd during the course of 2015-16, yielding a corn-drying kiln, medieval field boundaries, and two clusters of cremation pits.
The kiln was dumbbell shaped, 6.06m in length, 1.4m wide across its flue, and cut to a depth of 0.48m. The fill included clays that appear to have originally formed part of the roofing of the kiln, indicating that the roof collapsed after its use, to be followed by a gradual natural accumulation.
The kiln lay adjacent to a pair of parallel ditches, one of which extended to 38m within the monitored area, with a depth of 0.25m maximum.
Some distance to the south, a cluster of 5 cremation pits came to light, with burnt bone within the pits evident from the surface. The pits were cut to a depth of 0.32m maximum, and a diameter of 0.37m maximum. Further to the south, another cluster of 4 cremation pits, including a shallow oval-shaped pit, measuring 0.57m in length, and 0.07 in depth, and another circular pit 0.48m in diameter, and 0.14m in depth. Some of the pits appear to have been 'capped', or sealed.
Neil O'Flanagan, Botanic Court, 30-32 Botanic Road, Glasnevin, Dublin 9

Dublin
2016:094
Ballybane and Aungierstown, Dublin (South County), Dublin
No archaeology found
SMR 250m from 'the zones of notification' for RMP's DU021-108 & DU021-109 a concentric enclosure and an enclosure
16E0030
Archaeological testing at the site of a proposed substation site at Ballybane and an interface compound at Kishoge, Co. Dublin was undertaken between the 22nd and 24th of February 2016. The test trenches were purposely sited on both sites to provide coverage for the new development and to investigate geophysical anomalies identified in an earlier survey. The trenches exposed a number of modern drainage channels across the site and a natural sterile stratigraphy elsewhere. The anomalies can be accounted for by modern disturbance, drains and geology. There was no evidence for any features of archaeological potential.
Billy Quinn for Moore Archaeological and Environmental Services, 3 Gort na Ri, Athenry, Co. Galway

Dublin
2016:147
Grange Castle Business Park, Clondalkin, Dublin
Early modern agricultural activity
ITM: E 703773m, N 732160m
15E0394
Testing and monitoring were carried out at Grange Castle Business Park, Clondalkin, Dublin 22, on behalf of Interxion Ireland in advance of the construction of a new data centre. Testing (followed by monitoring as a extension to the existing licence in January 2016) was required as a condition to grant of planning (SD15A/0034: Condition 11 b) from South Dublin County Council.
The 7 test trenches (totaling 229m) were aligned to investigate a faint geophysical trend (c. 23m in diameter) that was identified during geophysical survey of the site in January 2015. The trenching did not reveal any features of considered archaeological significance but did identify a furrow, some oxidised soil, brick waste and evidence of modern ploughing.

The testing report recommended monitoring of the soil strip – due to the wider archaeological/historical significance of the surrounding landscape and the small percentage of the development's footprint that was assessed through the initial testing.
Monitoring was undertaken over two days in January 2016 and exposed evidence for agriculture (furrows) and land improvement (drains) on the site in the early modern to modern period; isolated spreads of burnt clay. brick and charcoal (which were also frequently contained in the backfill of the agricultural features) indicate contemporary light industrial in the vicinity of the site – the brick inferring such activity may have been associated with a brickfield/brick firing and/or the demolition of brick buildings. However, no features of considered archaeological significance were recorded. The site was fully reduced to the level of natural subsoil under archaeological supervision.
Number 1, Brendan Street, Birr, County Offaly

Dublin
2016:340
Adamstown Road (R120) and Nangor Road (R134) Improvement Scheme, Ballybane, Ballymakaily, Clutterland, Grange and Milltown townlands
Post-medieval structure
16E0520
702670, 731650
The development is intended to improve the standard of the existing carriageway on both the Adamstown Road and Nangor Road, and will provide footpaths, cycle tracks, pedestrian crossing facilities, public lighting and two new signalised junctions. The overall length of the scheme is 2.45km. The excavation of six test trenches located throughout the proposed development area failed to reveal any archaeological features or artefacts.
Test trenching in Milltown townland. immediately west of Adamstown Road, revealed two associated mortar-bonded stone walls. The walls appeared parallel, and were 25m apart, forming the gables of a structure that was orientated north-east/south-west. A concrete floor was continuous throughout the structure at a depth of 0.4m below the existing ground level. A structure is depicted in this location on the First Edition Ordnance Survey map.
Dermot Nelis, 36 Fingal Street, Dublin 8

Dublin
2016:464
Grange Castle South Business Park, Ballybane, Clondalkin, Dublin 22.
Early medieval/medieval enclosures
DU021:108 & DU021:109
16E0531
703029, 730829
The areas tested were identified initially from studies of aerial photography and geophysical survey results and a very close correlation between the test trenching results and the results of the geophysical survey was noted.
AH1 represented a recorded concentric enclosure (DU021-108) with an internal ditched enclosure measuring c.50m east to west and 60m north to south and an outer ditched enclosure measuring c.90m in diameter. The test trenching confirmed the presence of extensive and well preserved internal and external ditches measuring 4m wide and 1.80m in depth below the current ground level. Numerous internal features were identified which comprised a group of linear type features and pits all of which are suggestive of domestic activity within the enclosure. The enclosure is likely to represent an early medieval settlement site.
AH2 was located 100m to the south of AH1 and represented a probable circular enclosure measuring 25m in diameter. The test trenching clearly identified the presence of a single – ditched circular enclosure measuring between 20m to 25m in diameter, with the ditch averaging 3m in width. The ditch was present within three test trenches and probably represents a ringfort or similar enclosure.
AH3 was described in the geophysical survey as a negative band of data oriented southwest-northeast and extending into the adjacent field which may represent a former track-way. The test trenching of this feature recorded two linear parallel ditches both measuring 3m wide by 1.60m deep that appear to form an old abandoned road or track. Both ditches contained old terracotta land drainage pipes suggestive of a relatively modern date for these two features.
AH4 was located in the east of the northern most field and was identified in the geophysical survey as a cluster of isolated responses which may represent a spread of burnt material or cluster of small pits and larger, isolated pit-type features. Archaeological test trenching in this area failed to identify any features of an archaeological nature. The ground was quite disturbed in this part of the site and it would appear to have been subject to test trenching previously.
AH5 represented an enclosure (DU021-109) located in the southern field, measuring c.44m with a probable entranceway in the east. The archaeological test trenching confirmed the presence of a single-ditched

circular enclosure, 44m in diameter with the ditch measuring 3m wide and 1.60m deep. The general appearance of this feature is suggestive of a possible ringfort type enclosure. No internal features were recorded.
AH6 represented a circular internal ditched enclosure measuring c. 37m in diameter encompassed by a larger oval-shaped enclosure measuring c.75m x 42m. The test trenching confirmed the presence of the large elongated oval enclosure measuring approximately 75m north-south by 42m east-west with a smaller associated internal enclosure c. 37m in width containing features suggestive of occupation. The external ditch of this enclosure measured on average 2.60m wide and 1.60m deep. The site is likely to represent a multi-phased early medieval settlement site.
AH7 was identified in the geophysical survey as a series of circular and sub-circular trends and five possible pits which may be archaeological or agricultural in origin. The test trenching failed to identify any features of an archaeological nature. A field boundary was recorded containing old terracotta land drainage pipes suggestive of a relatively modern date.
AH8 was identified in the geophysical survey as a series of linear negative magnetic trends which were suggestive of archaeology. The test trenching of this area failed to identify any features of an archaeological nature. A field boundary was recorded containing old terracotta land drainage pipes suggestive of a relatively modern date.
Within Field 1. two sections of a possible linear double ditched type feature were recorded with curving u-shaped termini (AH 9-10). These two parallel ditches may form a linear boundary and one of the ditches was clearly identified by the geophysical survey. An archaeological section excavated through one of these ditches recorded its width as 2.5m and depth as 1.45m in depth. The deposits recorded within this section appear similar to that recorded within area AH1 and contain no modern materials suggestive of modern field boundaries.
The geophysical survey and the results of archaeological test trenching clearly indicate that the site contains significant archaeological remains including four separate enclosure sites, two of which are scheduled for inclusion in the next revision of the Record of Monuments & Places. Although preservation in situ of archaeological remains should always be the preferred option, where such can be accommodated within any proposed development, the present site is located with a partly developed business park and any future development here is likely to extend to the entirety of the two fields resulting in an inevitable impact on all identified archaeological features. Any proposed development of this site should take into account the surviving archaeological remains and where possible the development should be designed to avoid the archaeology.
Jon Stirland Will O'Siorain Robert Breen, Archaeological Consultancy Services Unit, Unit 21 Boyne **Business Park, Greenhills, Drogheda, Co Louth**

Dublin
2016:495
Grifols Phase 2 site #B201, Grange Castle Business Park, Grange
Testing, monitoring and excavation (Isolated pits)
13E0459
703500, 731930
Testing (Phase 2) was undertaken within the footprint of a proposed biopharmaceutical plant at Grange Castle Business Park, Nangor Road, Grange, Dublin 22 in 2016. This testing followed from a previous phase (Phase 1) of testing undertaken in the southern half of the development site (2013:196), under an extension to licence 13E0459. A total of 13 test trenches were excavated within the Phase 2 development area.
One archaeological feature (AA 1: a pit filled with charcoal-rich soils) was identified. Subsequent monitoring of the Phase 2 development area in late 2016 identified an additional six archaeological areas (AA 2–7) all of which are individual pits/spreads similar to AA1. These areas were excavated under an extension to 13E0459 in December 2016.
Fintan Walsh, IAC Ltd, Unit G1, Network Enterprise Park, Kilcoole, Co. Wicklow

Dublin
2016:530
Grange Castle
Tower-house
DU017-034
16E0510
703859, 731879
Site investigation works associated with a programme of conservation at Grange Castle, Clondalkin, Dublin 22 (OS Sheet 17) by South Dublin County Council took place in October 2016. IAC Ltd monitored these groundworks.
The original structure of Grange Castle (DU017-034) dates from c. 1580 and has an 18th-century, two-storey addition attached to its western elevation. The overall footprint is 6m x 16m. While the buildings were

inhabited until the 1970s, they are now in a state of dilapidation. There is significant build-up of vegetation including tree and shrub growth to the external walls of the castle as well as to the internal floors at ground floor level and at first floor level over a deep arch to the original castle.
Monitoring was carried out in October 2016 and a total of eight pits were excavated. The pits revealed that both the Georgian house and the earlier tower-house possess shallow foundations. Nothing of archaeological significance was identified within the pits surrounding the house and tower-house.
Paul Duffy, IAC Ltd, Unit G1, Network Enterprise Park, Kilcoole, Co. Wicklow

Dublin
2017:042
Adamstown Road (R120) and Nangor Road (R134) Improvement Scheme, Ballybane and Milltown townlands
No archaeology found
16E0520 Ext.
702620, 731140
The development is intended to improve the standard of the existing carriageway on both the Adamstown Road and Nangor Road, and will provide footpaths, cycle tracks, pedestrian crossing facilities, public lighting and two new signalised junctions. The overall length of the scheme is 2.45km. Test trenching in Milltown townland, immediately west of Adamstown Road, in 2016 (Licence No. 16E0520) revealed two associated mortar-bonded stone walls. The walls appeared parallel and were 25m apart, forming the gables of a structure that was orientated north-east/south-west. A concrete floor was continuous throughout the structure at a depth of 0.4m below the existing ground level. A structure is depicted in this location on the First Edition Ordnance Survey map.
Additional test trenching in April 2017 confirmed the structure to be built directly on geologically deposited strata, and no associated or earlier phases of activity were noted. A test trench was also excavated in Ballybane townland in April 2017, and no archaeological features or artefacts were noted.
Dermot Nelis, 36 Fingal Street, Dublin 8

Appendix 13.4 National Inventory of Architectural Heritage

The recorded archaeological sites within c. 1km of the development are listed below, all noted in the National Inventory of Architectural Heritage (NIAH) for Co. Dublin (www.archaeology.ie; www.buildingsofireland.ie).

Milltown, South Dublin County

Reg. No.	**11208005**
Date	1850 - 1900
Previous Name	N/A
Townland	MILLTOWN (NE. BY.)
County	South Dublin County
Coordinates	302185, 230870
Categories of Special Interest	ARTISTIC SOCIAL TECHNICAL
Rating	Regional
Original Use	gates/railings/walls
In Use As	gates/railings/walls

Description

Pair of cylindrical rendered gate piers, c.1870, of squared limestone with conical cement capping. Five-bar wrought-iron gate with arched bar. Former entrance to farm house beyond, now demolished.

Appraisal

A fine intact example of a type of vernacular gateway peculiar to this area of County Dublin. Preserves the old road line and is now set back from the re-aligned section.

Milltown, South Dublin County

Reg. No.	**11208006**
Date	1840 - 1860
Previous Name	N/A
Townland	MILLTOWN (NE. BY.)
County	South Dublin County
Coordinates	302518, 230958
Categories of Special Interest	ARCHITECTURAL
Rating	Regional
Original Use	outbuilding
In Use As	outbuilding

Description
Detached two-storey farm outbuilding. c.1850. with two-bay gable ends. Rendered walls. Blind wall to street with chamfered corners. Timber sash and casement windows. Corrugated aluminium pitched roof. Adjoining rubble stone walls of demolished outbuildings to south-east and ruinous cottages to north-east.
Appraisal
The chamfered corners of this outbuilding indicate the volume of horse-drawn traffic originally passing into the farm complex. Such buildings following the road line sheltered the farm yard and were a characteristic feature of Irish agriculture. This farm was associated with the now-demolished Milltown House.

Milltown, South Dublin County

Reg. No.	**11208008**
Date	1840 - 1870
Previous Name	N/A
Townland	GRANGE (BA. W BY.)
County	South Dublin County
Coordinates	302752, 231546
Categories of Special Interest	ARCHITECTURAL
Rating	Regional
Original Use	farm house
In Use As	farm house

Description
Detached four-bay two-storey farm house, c.1850. Roughcast rendered walls. uPVC door and casement windows. Replacement pitched slate roof with terracotta ridge tiles and gable coping. Two central brick chimney stacks. Later drip moulding over northern front window. Lean-to extension to the rere, and shed to side.
Appraisal
A tidy detached farm house which retains its original form and an unusually formal front garden, still serving the farm to the rere.

Grange Castle, GRANGE (BA. W BY.), Milltown, DUBLIN

Reg No	**11208013**
Rating	Regional
Categories of Special Interest	Archaeological, Architectural, Historical
Original Use	Castle/fortified house

Date	1740 - 1760
Coordinates	303928, 231851
Date Recorded	12/06/2002
Date Updated	--/--/--

Description

Ruinous remains of detached multiple-bay three-storey over vaulted basement former tower house, remodelled c. 1750 by addition of two-bay two-storey domestic wing attached to the west, with large supporting wall buttresses to the south. All openings blocked in roughcast walls leading to partially roofless wallheads. Earlier house, built c.1580, retains slender projecting square tower and garderobe. Large chimneybreast exposed where buildings have been demolished in the east.

Appraisal

Despite its ruinous state, many features of the two building phases can be clearly discerned, and the building remains a prominent landmark in the area.

Gollierstown Bridge, GOLLIERSTOWN, Milltown, DUBLIN

Reg No	**11208014**
Rating	Regional
Categories of Special Interest	Architectural, Social, Technical
Original Use	Bridge
In Use As	Bridge
Date	1770 - 1790
Coordinates	301517, 231971
Date Recorded	10/06/2002
Date Updated	--/--/--

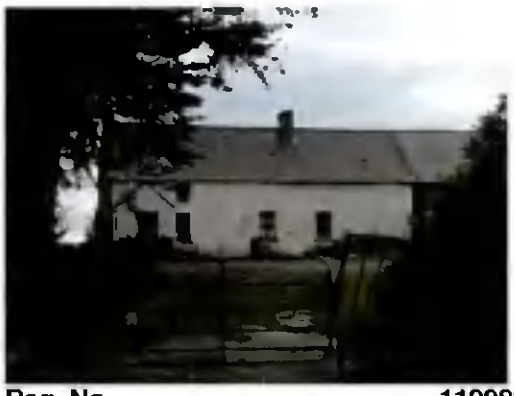
Description

Single-arch road bridge over canal, c.1780. Coursed ashlar piers and dressed voussoirs to semi-circular arch. Rubble parapets with coping terminating in curves to canal banks. Deep rope grooves cut into north pier adjacent to walkway/towpath.

Appraisal

This noticeably elevated bridge is a fine example of the canal bridges to be found on the Grand Canal. It is all the more stunning due to its remote location and idyllic setting amongst the lush natural environment.

Milltown, South Dublin County



Reg. No.	**11208015**
Date	1750 - 1770

Previous Name	N/A
Townland	MILLTOWN (NE. BY.)
County	South Dublin County
Coordinates	302520, 231041
Categories of Special Interest	ARCHITECTURAL
Rating	Regional
Original Use	farm house
In Use As	farm house

Description

Detached four-bay two-storey farm house, c.1760, with attached outbuildings. Rendered rubble stone walls. Glazed timber door in gabled porch. Timber sash windows. Some openings blocked. Possible traces of carriage arch to central bay. Pitched slate roof with two rendered chimney stacks. House possibly originally single-storey. Adjoining outbuildings to north with hayloft, and enlarged openings inserted recently. Partial tubular iron sunburst gate. Original fir tree stand to south.

Appraisal

A fine example of an eighteenth-century farm cottage and barn, demonstrating a classic sequence of vernacular evolution. Retains many period features.

Polly Hop's, Milltown, South Dublin County

Reg. No.	**11208016**
Date	1780 - 1810
Previous Name	N/A
Townland	MILLTOWN (NE. BY.)
County	South Dublin County
Coordinates	302591, 231012
Categories of Special Interest	ARCHITECTURAL SOCIAL
Rating	Regional
Original Use	house
In Use As	public house

Description

Formerly detached four-bay two-storey former house, c.1790, in use as public house. Roughcast rendered walls with parallel render quoins. Timber casement windows. Timber door with iron fittings. Pitched slate roof with single rendered chimney stack. Series of nineteenth- and twentieth-century extensions to south and west.

Appraisal

This site has long been in use as a public house as shown by the extensions surrounding the original modest rural house. Its presence gives a focus to this important and formerly more developed junction.

R120, ADAMSTOWN (NE. BY.), DUBLIN

Reg No	**11204051**
Rating	Regional
Categories of Special Interest	Architectural, Technical
Original Use	Bridge
In Use As	Bridge
Date	1900 - 1930
Coordinates	303016, 232768
Date Recorded	16/05/2002
Date Updated	--/--/--

Description

Single-arch road bridge over railway, c.1915. Three-centred arch with dressed voussoir stones. Coursed limestone parapets with granite coping at road level. Coursed limestone retaining walls either side of bridge.

Appraisal

This handsome road bridge is an integral part of the railway network, built to a standard design with well-executed stonework and a graceful arch.

12th Lock Bridge, R120, BALLYMAKAILY, DUBLIN

Reg No	**11204052**
Rating	Regional
Categories of Special Interest	Architectural, Technical
Original Use	Bridge
In Use As	Bridge
Date	1760 - 1780
Coordinates	302981, 232234
Date Recorded	16/05/2002
Date Updated	--/--/--

Description

Single-arch road bridge over canal, c.1770. Segmental arch with painted dressed voussoir stones set into smooth rendered west elevation. Roughcast rendered parapet with semi-circular coping stones and roughcast rendered pier faced with dressed granite blocks to each end. Bridge widened and refurbished, 1932.

Appraisal

This bridge, though widened, retains much original fabric and remains a valuable element in this group of canal structures including the lock gates and mill buildings.

12th Lock, R120, BALLYMAKAILY, DUBLIN


Reg No	**1204053**
Rating	Regional
Categories of Special Interest	Architectural, Technical
Original Use	Lock
In Use As	Lock
Date	1760 - 1780
Coordinates	302957, 232232
Date Recorded	16/05/2002
Date Updated	--/--/--

Description

Single-stage canal lock, c.1770. Lock gates are of timber and iron construction with coursed granite inner walls. Painted timber mooring post at intervals between gates.

Appraisal

A good example of a standard-type eighteenth-century canal lock, enhanced by its setting among such a rich group of canal structures.

BALLYMAKAILY, DUBLIN

Reg No	**11204054**
Rating	Regional
Categories of Special Interest	Architectural, Technical
Original Use	Mill (water)
In Use As	Office
Date	1850 - 1870
Coordinates	302938, 232247
Date Recorded	16/05/2002
Date Updated	--/--/--

Description

Detached seven-bay two-storey over basement former mill building, c.1860, now in use as offices. Random coursed rubble stone walls with roughly dressed limestone quoins. Replacement timber windows. Ground

floor windows have a modern concrete surround with the original red brick relieving arches still visible. Seven large oval cast-iron building ties are located on the south front. Segmental profile corrugated iron roof.

Appraisal

Despite alteration and conversion, this former mill building associated with the Flour Mill still retains its elegance and dominance over the Twelfth Lock and bridge, and is a valuable reminder of the former variety of functions associated with the canal network.

BALLYMAKAILY, DUBLIN

Reg No	**11204055**
Rating	Regional
Categories of Special Interest	Architectural, Technical
Original Use	Mill (water)
Date	1850 - 1870
Coordinates	302907, 232242
Date Recorded	16/05/2002
Date Updated	--/--/--

Description

Detached multiple-bay three-storey over basement former mill building, c.1860, now derelict. Roughcast rendered walls. Smooth render to the centre bays on the ground floor showing outline of former extension, now removed. A mix of boarded-up and steel-framed windows. Large door openings to ground floor of front elevation and west gable. Pitched corrugated asbestos roof.

Appraisal

This substantial former mill building fronting onto the canal, though in poor condition, retains its imposing volume and some materials, and is a valuable document of the diversity of building functions and types associated with the canal network.

Lock Keeper's Cottage, BALLYMAKAILY, DUBLIN

Reg No	**11204056**
Rating	Regional
Categories of Special Interest	Architectural, Social, Technical
Original Use	Lock keeper's house
In Use As	House
Date	1750 - 1780
Coordinates	302847, 232228

Date Recorded	16/05/2002
Date Updated	--/--/--

Description

Detached three-bay two-storey gable-fronted classical style former lock keeper's house, c.1765, now in use as a detached house. Timber sash windows. Roughcast rendered walls with cut stone architrave and string courses, with a round-arched blind recess to the gable front. Pitched slate roof with red brick chimney stacks to each gable. Annexe to east has a hipped slate roof, timber sash windows and timber panelled door with overlight.

Appraisal

This attractive former lock-keeper's house of a standard design retains much of its original architectural impact and style. The plain string courses and classical detail contrast with the roughcast walls to a very pleasing effect. Possibly designed by Thomas Omer, it is a fine addition to the varied group surrounding the twelfth lock.

Grange Cottage, GRANGE (BA. W BY.), DUBLIN

Reg No	**11204057**
Rating	Regional
Categories of Special Interest	Architectural
Original Use	Farm house
In Use As	Farm house
Date	1800 - 1830
Coordinates	303291, 232228
Date Recorded	16/05/2002
Date Updated	-/--/--

Description

Detached six-bay single-storey farm house, c.1810. Roughcast rendered walls with smooth rendered base course. Timber sash windows. Two projecting canted bays with hipped roofs to the front elevation flanking an enclosed glazed porch with a lean-to roof of corrugated iron. Pitched slate roof with four brick chimney stacks. Corrugated iron shed with a lean-to roof and another small modern flat-roofed extension attached to rear.

Appraisal

This house, though appearing initially quite modest, possesses an elegant and balanced design which lends it a grander air than is usual for houses of this size. It is beautifully sited along the canal towpath and retains many original materials.

GRANGE (BA. W BY.), DUBLIN

Reg No	**11204058**
Rating	Regional
Categories of Special Interest	Architectural
Original Use	Outbuilding
In Use As	Outbuilding
Date	1800 - 1830
Coordinates	303302, 232257
Date Recorded	16/05/2002
Date Updated	--/--/--

Description

Detached multiple-bay single-storey farm buildings set around a courtyard, c.1820, now in a dilapidated site. Random coursed stone rubble construction with large corrugated iron doors. Pitched roof of corrugated iron and slate. Breeze-block wall to south.

Appraisal

A simple range of farm outbuildings which enhances the setting and history of the nearby house, and adds further variety of type to this stretch of canal.

Hayden's Lane, ADAMSTOWN (NE. BY.), DUBLIN

Reg No	**11204059**
Rating	Regional
Categories of Special Interest	Architectural, Technical
Original Use	Bridge
In Use As	Bridge
Date	1900 - 1930
Coordinates	303406, 232767
Date Recorded	16/05/2002
Date Updated	--/--/--

Description

Single-arch road bridge over railway, c.1915. Three-centred arch with dressed voussoir stones. Coursed limestone parapets with granite coping at road level. Coursed limestone retaining walls either side of bridge. Long embankments to each approach to bridge with walls of limestone rubble having vertically set stone coping.

Appraisal

This handsome road bridge is an integral part of the railway network, built to a standard design with well-executed stonework and a graceful arch. The embankment approaches necessitated by the level ground in the vicinity make this a very prominent feature in the landscape.

Appendix 13.5 Archaeological figures

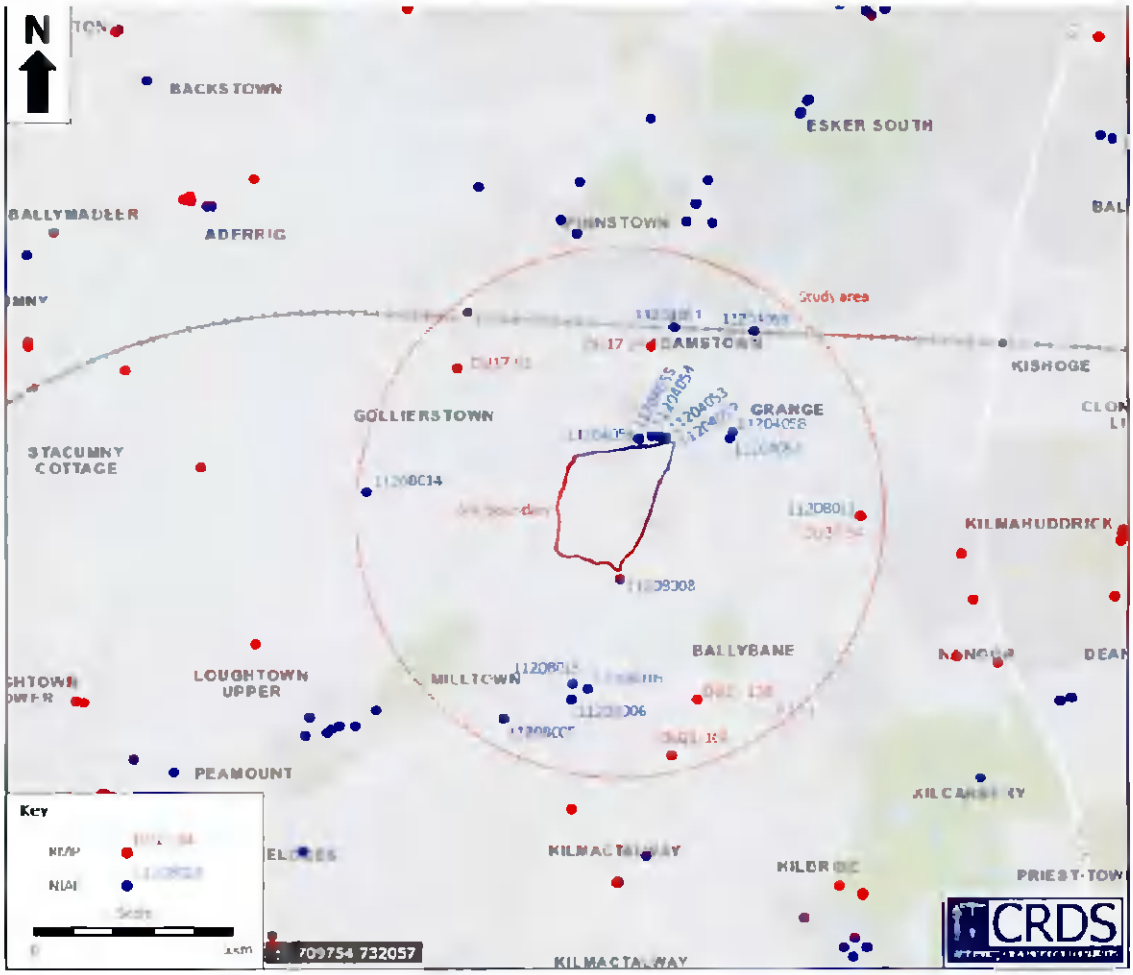


Figure 1 Recorded archaeological monuments and architectural heritage sites within c. 1km of the proposed development (source http://archaeology.ie).

Figure 2 Down Survey Barony map showing Grange Castle, 1656 (http://downsurvey.tcd.ie/down-survey-maps.php).

Figure 3 OS First Edition showing 12th Lock and quarry site (source http//.archaeology.ie)

Figure 4 Aerial Photographic extract showing site and field numbers noted in field survey.

Figure 5 Field 1 looking west.

Figure 6 Field 1. townland boundary between Ballymakaily and Grange.

Figure 7 Field 1, townland boundary between Ballymakaily and Gollierstown.

Figure 8 Field 2, looking north.

Figure 9 Field 2, townland boundary between Ballymakaily and Gollierstown.

Figure 10 Field 3, looking north.

Figure 11 Field 3, embankment at site of old quarry.

Figure 12 Field 4, looking north.

Figure 13 Field 5, looking south.

Figure 14 Field 6, looking south.

Figure 15 Nineteenth century farm building, located to north-west corner of Field 6.

Figure 16 Leck Bridge (RPS ref. no. 127/ NIAH ref. no. 11204052) and the 12th Lock (RPS ref. no. 125 / NIAH ref. no. 11204053)

Figure 17 Two-storey former mill building (RPS ref. no. 118 / NIAH ref. no. 1120405).

Figure 18 Lock Keeper's House (RPS ref. no. 119 / NIAH 11204056).

Figure 19 Former mill building (NIAH ref. no. 11204055).

Figure 20 View south over site from north side of Grand Canal.

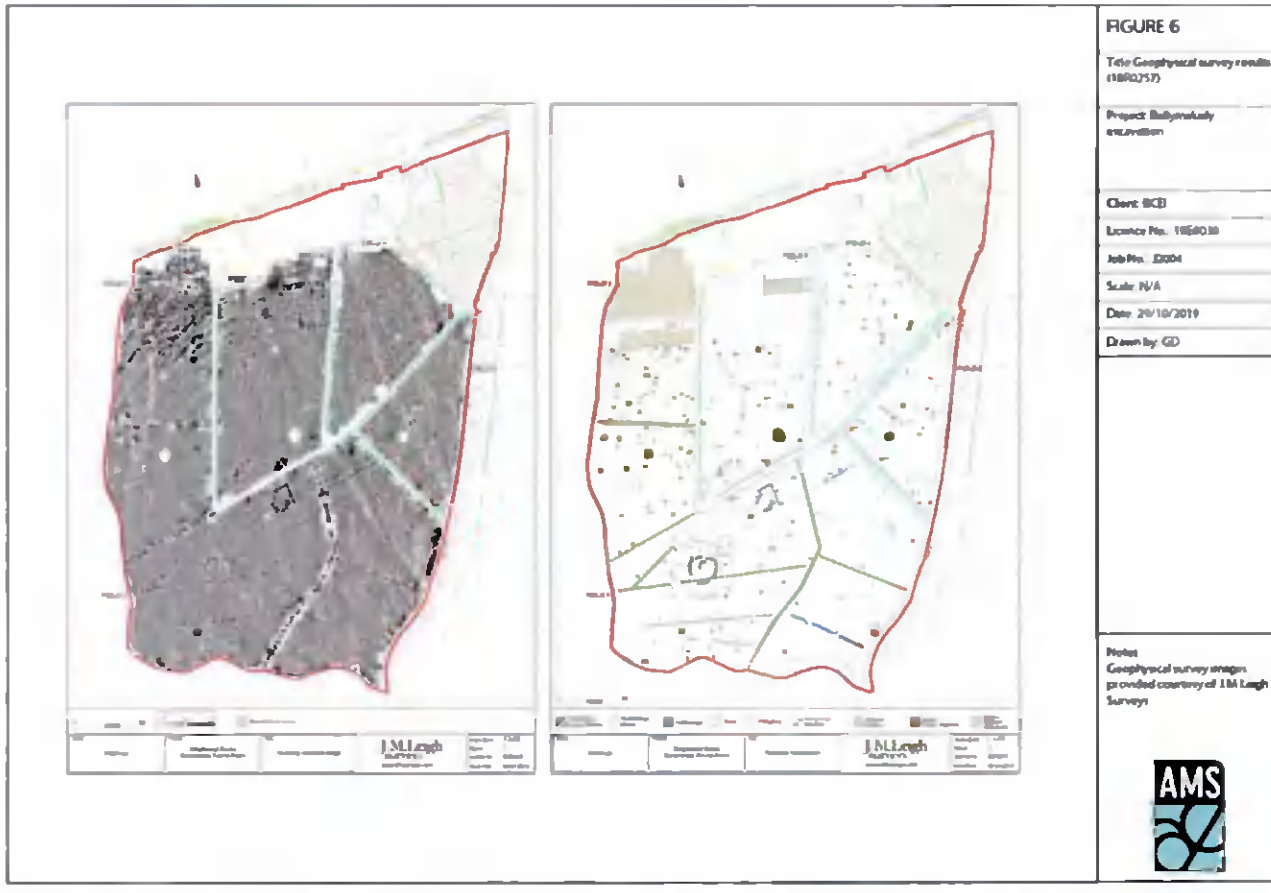


Figure 21 Results of Geophysical Survey of the site (undertaken by JM Leigh Surveys; license no 18R0257)

Figure 22 Archaeological testing of the site (undertaken by AMS Ltd; license no 19E0038)

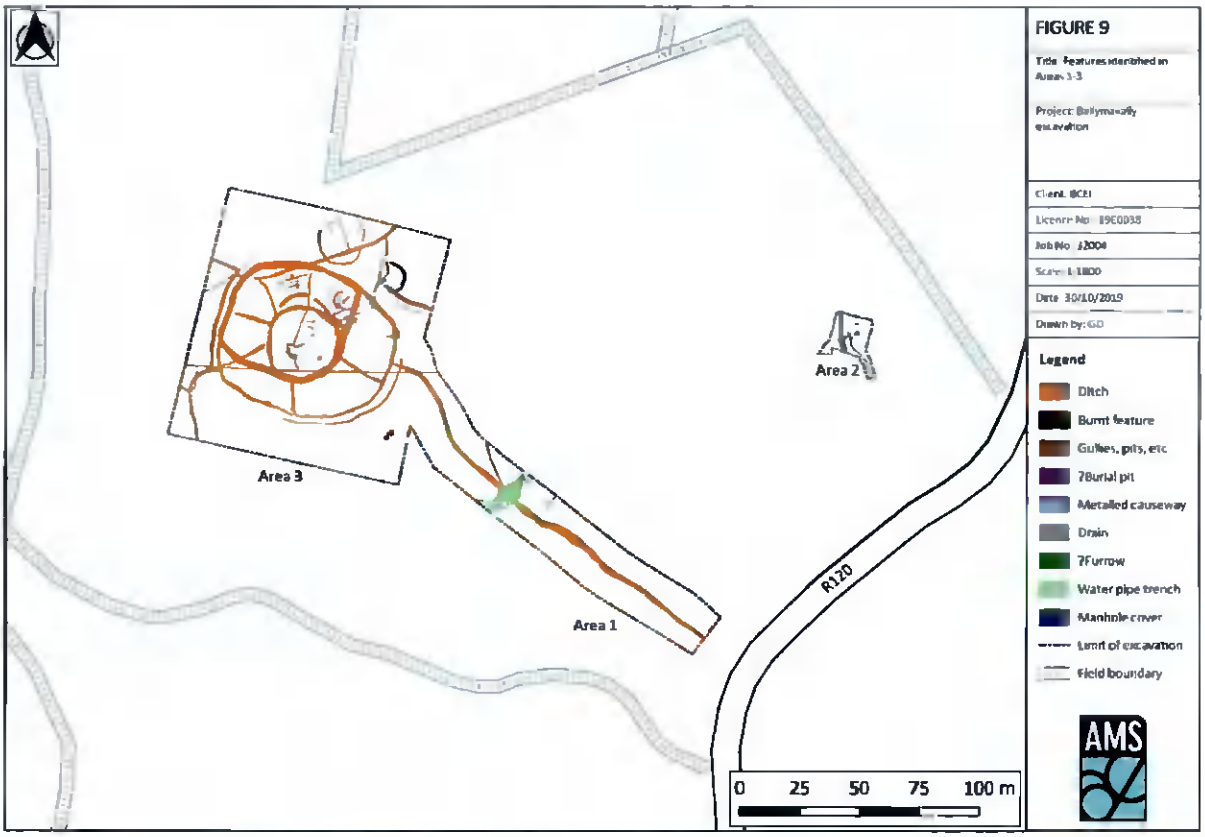


Figure 23 Archaeological features identified in Areas 1-3 (undertaken by AMS Ltd; license no 19E0038)

Figure 24 Area photograph of archaeological features identified in Areas 1-3 under excavation (undertaken by AMS Ltd; license no 19E0038)

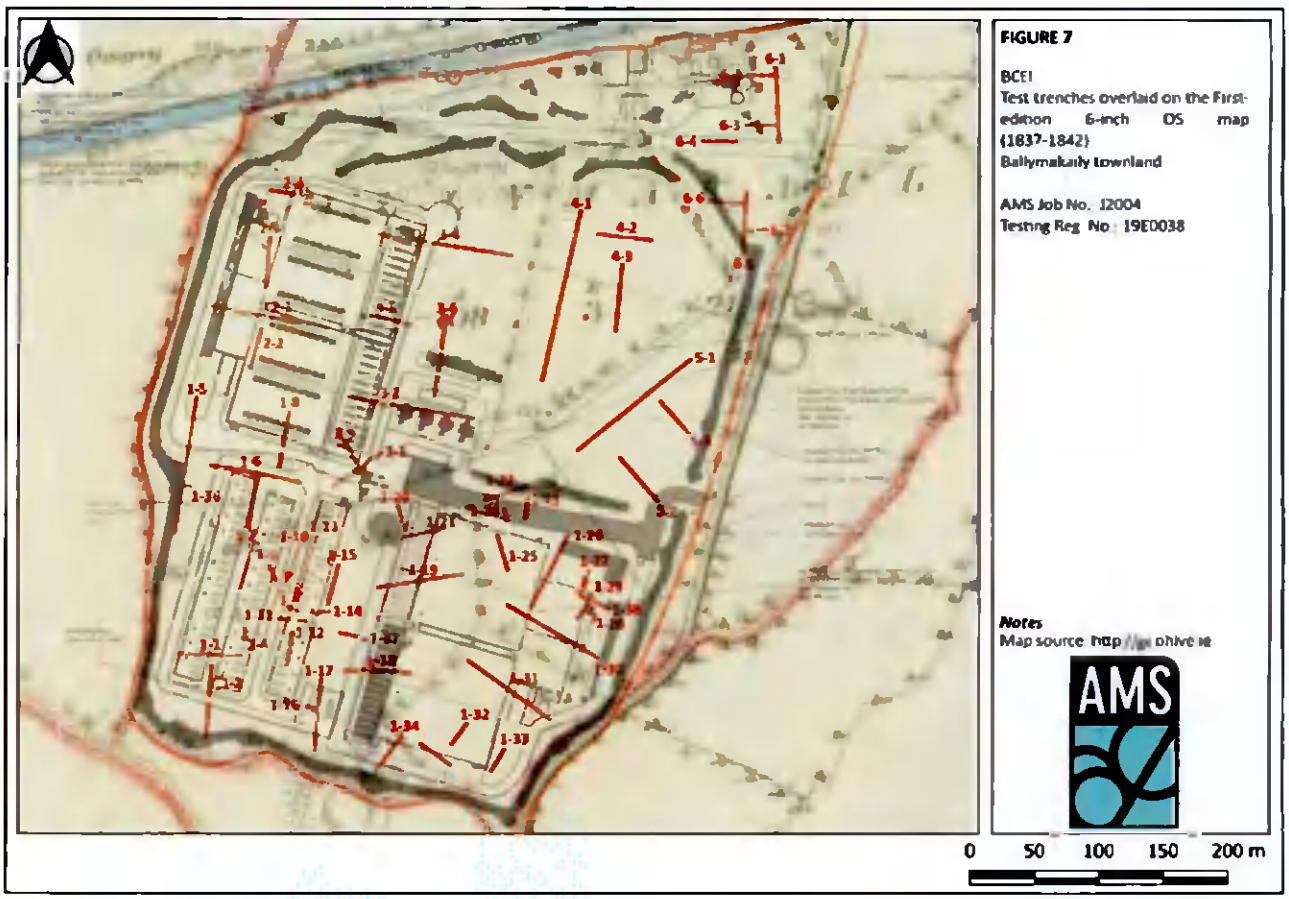


Figure 25 Archaeological testing of the site overlain by proposed development layout (undertaken by AMS Ltd; license no 19E0038)

CHAPTER 14 – WASTE MANAGEMENT

Appendix14.1 Outline Construction and Demolition Waste Management Plan

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APPENDIX 14.1 CONSTRUCTION & DEMOLITION WASTE MANAGEMENT PLAN FOR A DATA CENTRE, GRANGECASTLE BUSINESS PARK, DUBLIN 22

Technical Report Prepared For

EdgeConnex Ireland

Report Prepared By

Jonathan Gauntlett, Environmental Consultant

Our Reference

JG/20/11309WMR01

Date of Issue

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Signature		
Name	Jonathan Gauntlett	Chonaill Bradley
Title	Environmental Consultant	Senior Environmental Consultant
Date	26 January 2021	26 January 2021

Contents **Page**

1.0 INTRODUCTION

AWN Consulting Ltd (AWN) has prepared this Construction and Demolition (C&D) Waste Management Plan (WMP) for the proposed data centre and 3 no. power generation plant at Ballymakaily, Co. Dublin.

This C&D WMP includes information on the legal and policy framework for C&D waste management in Ireland, estimates of the type and quantity of waste to be generated by the proposed development and makes recommendations for management of different waste streams.

The purpose of this report is to provide information necessary to ensure that the management of C&D waste at the site is undertaken in accordance with current legal and industry standards including the *Waste Management Acts 1996-2011* and associated Regulations[1]. *Protection of the Environment Act 2003* as amended[2], *Litter Pollution Act 1997* as amended[3] and the *Eastern-Midlands Region Waste Management Plan 2015-2021*[4]. In particular, this report aims to ensure maximum recycling, re-use and recovery of waste with diversion from landfill, where possible. It also seeks to provide guidance on the appropriate collection and transport of waste to prevent issues associated with litter or more serious environmental pollution (e.g. contamination of soil or water resources).

In the preparation of this report consideration has been given to the requirements of National and Regional waste policy, legislation, and other guidelines (referred to in Section 2.0). However, in determining the structure and content of the document, the following two publications have been referenced in particular:

- Department of the Environment, Heritage and Local Government (DoEHLG), Best Practice Guidelines on the Preparation of Waste Management Plans for Construction and Demolition Projects (2006)[5].
- FÁS and the Construction Industry Federation (CIF), Construction and Demolition Waste Management – a handbook for Contractors and Site Managers, (2002)[6].

The above guidance documents are considered to define best practice for C&D projects in Ireland and describe how C&D projects are to be undertaken such that environmental impacts and risks are minimised and maximum levels of waste recycling are achieved.

2.0 CONSTRUCTION & DEMOLITION WASTE MANAGEMENT IN IRELAND

2.1 NATIONAL LEVEL

The Irish Government issued a policy statement in September 1998 titled as *'Changing Our Ways'*[7] which identified objectives for the prevention, minimisation, reuse, recycling, recovery and disposal of waste in Ireland. The target for C&D waste in this Strategy was to recycle at least 50% of C&D waste within a five-year period (by 2003), with a progressive increase to at least 85% over fifteen years (by 2013).

In response to the *Changing Our Ways* report, a task force (Task Force B4) representing the waste sector of the already established Forum for the Construction Industry, released a report titled *Recycling of Construction and Demolition Waste*[8] concerning the

development and implementation of a voluntary construction industry programme to meet the governments objectives for the recovery of construction and demolition waste.

In September 2020 the government released a new policy document outlining a new action plan for Ireland to cover the period of 2020-2025. This plan *'A Waste Action Plan for a Circular Economy*[9] was prepared in response to the 'European Green Deal' which sets a roadmap for a transition to a new economy, where climate and environmental challenges are turned into opportunities.

It aims to fulfil the commitment in the Programme for Government to publish and start implementing a new National Waste Action Plan. It is intended that this new national waste policy will inform and give direction to waste planning and management in Ireland over the coming years. It will be followed later this year by an All of Government Circular Economy Strategy. The policy document shifts focus away from waste disposal and moves it back up the production chain. To support the policy, regulation is already being used (Circular Economy Legislative Package) or in the pipeline (Single Use Plastics Directive). The policy document contains over 200 measures across various waste areas including Circular Economy, Municipal Waste, Consumer Protection & Citizen Engagement, Plastics and Packaging, Construction and Demolition, Textiles, Green Public Procurement and Waste Enforcement.

The National Construction and Demolition Waste Council (NCDWC) was launched in June 2002, as one of the recommendations of the Forum for the Construction Industry, in the Task Force B4 final report. The NCDWC subsequently produced *Best Practice Guidelines for the Preparation of Waste Management Plans for Construction and Demolition Projects* in July 2006 in conjunction with the Department of the Environment, Heritage and Local Government (DoEHLG).

The guidelines outline the issues that need to be addressed at the pre-planning stage of a development all the way through to its completion. These guidelines have been followed in the preparation of this document and include the following elements:

- Predicted construction and demolition wastes;
- Procedures to prevent and minimise wastes;
- Options for reuse/recycling/recovery/disposal of construction and demolition wastes;
- Provision of training for Waste Manager and site crew;
- Details of proposed record keeping system;
- Details of waste audit procedures and plan; and
- Details of proposed consultation with relevant bodies i.e. waste recycling companies, Local Authority, etc.

Section 3 of the Guidelines identifies thresholds above which there is a requirement for the preparation of a C&D Waste Management Plan for developments. This development requires a C&D WMP under the following criterion:

- New developments other than (1) above, including institutional, educational, health and other public facilities, with an aggregate floor area in excess of 1,250 m^2; and
- Demolition/renovation/refurbishment projects generating in excess of 100m^3 in volume, of C&D waste

Other guidelines followed in the preparation of this report include *'Construction and Demolition Waste Management – a handbook for Contractors and Site Managers'* published by FÁS and the Construction Industry Federation in 2002.

These guidance documents are considered to define best practice for C&D projects in Ireland and describe how C&D projects are to be undertaken such that environmental impacts and risks are minimised and maximum levels of waste recycling are achieved.

2.2 REGIONAL LEVEL

The proposed development is located in the Local Authority area of South Dublin County Council (SDCC).

The *EMR Waste Management Plan 2015 – 2021* is the regional waste management plan for the SDCC area published in May 2015. The regional plan sets out the following strategic targets for waste management in the region:

- A 1% reduction per annum in the quantity of household waste generated per capita over the period of the plan;
- Achieve a recycling rate of 50% of managed municipal waste by 2020: and
- Reduce to 0% the direct disposal of unprocessed residual municipal waste to landfill (from 2016 onwards) in favour of higher value pre-treatment processes and indigenous recovery practices.

Municipal landfill charges in Ireland are based on the weight of waste disposed. In the Leinster Region, charges are approximately €130 - €150 per tonne of waste which includes a €75 per tonne landfill levy specified in the *Waste Management (Landfill Levy) Regulations 2015.*

The *South Dublin County Council Development Plan 2016 – 2022*[10] sets out a number of objectives and actions for the South Dublin area in line with the objectives of the waste management plan.

Waste objectives and actions with a particular relevance to the proposed development are as follows:

Objectives:

- **IE5 Objective 1:** To support the implementation of the Eastern–Midlands Region Waste Management Plan 2015-2021 by adhering to overarching performance targets, policies and policy actions.
- **IE5 Objective 2:** To support waste prevention through behavioural change activities to de-couple economic growth and resource use.
- **IE5 Objective 3:** To encourage the transition from a waste management economy to a green circular economy to enhance employment and increase the value recovery and recirculation of resources.
- **IE5 Objective 8:** To secure appropriate provision for the sustainable management of waste within developments, including the provision of facilities for the storage, separation and collection of such waste.

Actions:

- Support and facilitate the separation of waste at source into organic and non-organic streams or other waste management systems that divert waste from landfill and maximise the potential for each waste type to be re-used and recycled or composted and divert organic waste from landfill, in accordance with the National Strategy on Biodegradable Waste (2006).
- Implement the objectives of the National Waste Prevention Programme at a local level with businesses, schools, householders, community groups and within the Council's own activities.
- Promote an increase in the amount of waste re-used and recycled consistent with the Regional Waste Management Plan and Waste Hierarchy and facilitate recycling of waste through adequate provision of facilities and good design in new developments.
- Implement the South Dublin Litter Management Plan 2015 - 2019.

In terms of physical waste infrastructure, three municipal solid waste landfills remain operational in the Eastern Midlands Region (EMR) and are all operated by the private sector. There are a number of other licensed and permitted facilities in operation in the EMR including waste transfer stations, hazardous waste facilities and integrated waste management facilities. There are two existing thermal treatment facilities, one in Duleek, Co. Meath and a second facility in Poolbeg in Dublin.

2.3 LEGISLATIVE REQUIREMENTS

The primary legislative instruments that govern waste management in Ireland and applicable to the project are:

- Waste Management Act 1996 (No. 10 of 1996) as amended, as well as sub-ordinate legislation[1].
- Environmental Protection Act 1992 (No. 7 of 1992) as amended[2].
- Litter Pollution Act 1997 (No. 12 of 1997) as amended[3].
- Planning and Development Act 2000 (No. 30 of 2000) as amended.

These Acts and subordinate Regulations enable the transposition of relevant European Union Policy and Directives into Irish law.

One of the guiding principles of European waste legislation, which has in turn been incorporated into the Waste Management Acts 1996 – 2011 and subsequent Irish legislation, is the principle of *"Duty of Care"*. This implies that the waste producer is responsible for waste from the time it is generated through until its legal reuse, recycling, recovery and/or disposal (including its method of reuse, recycling, recovery and/or disposal). As it is not practical in most cases for the waste producer to physically transfer all waste from where it is produced to the final destination, waste contractors will be employed to physically transport waste to the final waste reuse, recycling, recovery and/or disposal site. Following on from this is the concept of *"Polluter Pays"* whereby the waste producer is liable to be prosecuted for pollution incidents, which may arise from the incorrect management of waste produced, including the actions of any contractors engaged (e.g. for transportation and disposal/recovery/recycling of waste).

It is therefore imperative that the appointed construction contractor(s) are legally compliant with respect to waste transportation, reuse, recycling, recovery and disposal. This includes the requirement that a contractor handle, transport and reuse/recycle/recover/dispose of waste in a manner that ensures that no adverse environmental impacts occur as a result of any of these activities.

A collection permit to transport waste must be held by each waste contractor which is issued by the National Waste Collection Permit Office (NWCPO). Waste receiving facilities must also be appropriately permitted or licensed. Operators of such facilities cannot receive any waste, unless in possession of a Certificate of Registration (COR) or waste permit granted by the relevant Local Authority under the *Waste Management (Facility Permit & Registration) Regulations 2007* as amended, or a waste or Industrial Emissions (IE) licence granted by the EPA. The COR/permit/licence held will specify the type and quantity of waste able to be received, stored, sorted, recycled, recovered and/or disposed of at the specified site.

3.0 DESCRIPTION OF THE PROJECT

3.1 LOCATION, SIZE AND SCALE OF THE DEVELOPMENT

The Proposed Development is described in detail in Chapter 2 (Description of the Proposed Development) of this EIA Report. It proposes the demolition of existing farm dwelling and associated garage and other farm buildings located to the north of the site and the construction of a pair of single storey data centre buildings (4 data halls) of c. 13,000sqm. The development will also include c. 2,400sqm office space. It is to be located within the north-western part of the overall lands that will include a generator yard of c. 5000sqm with 24 no. standby emergency generators with associated flues (each 25m high) to the east of the buildings. The data centres will be served by 37 car parking spaces of which 4 no. spaces will be disabled spaces. It is intended that 2 of these spaces will be provided for electrical charging vehicles. The data centre and associated elements will require a slight adjustment to the landscaping along the western boundary.

The application will also include the construction of a 3 no. gas powered generation plant in the form of 3 no. single storey buildings with a gross floor area of c., 9,000sqm that will contain 61 gas generators within all of the buildings with associated flues that will be 25m in height, and grouped in pairs. The development will also include an AGI Plant (c. 970 sqm) centrally along the southern boundary of the site. See Chapter 2 for a comprehensive description of the developmentA description of the characteristics of the development relevant to waste are described in Section 14.22 – 14.41 of Chapter 14 (Waste Management).

3.2 OVERVIEW OF THE NON-HAZARDOUS WASTES TO BE PRODUCED

The project engineers (Pinnacle) have estimated that c. 15,034 m^3 of soil, subsoil and stones will be excavated, with c. 9,159 m^3 reused on site. The remaining c. 5,875 m^3 soil, subsoil and stones will require removal from the site. In addition c. 16,117 m^3 of topsoil is to be excavated, it is currently proposed that the majority of this excavated topsoil will be reused on site for landscaping.

The main buildings at the site will be constructed from structural steel. It is expected that throughout the construction phase, waste will be produced from surplus steel and other metal materials and broken/off-cuts of timber, plasterboard, concrete, tiles, bricks, etc. Waste from packaging (cardboard, plastic, timber) and oversupply of materials are also likely to be generated. The contractor will be required to ensure that oversupply of materials is kept to a minimum and opportunities for reuse of suitable materials is maximised.

Waste will also be generated from construction workers e.g. organic/food waste, dry mixed recyclables (wastepaper, newspaper, plastic bottles, packaging, aluminium cans, tins and Tetra Pak cartons), mixed non-recyclables and potentially sewage sludge from temporary welfare facilities provided onsite during the construction phase. Waste printer/toner cartridges, waste electrical and electronic equipment (WEEE) and waste batteries may also be generated infrequently from site offices.

3.3 POTENTIAL HAZARDOUS WASTES ARISING

3.3.1 Contaminated Soil

Geotechnical and environmental site investigations were carried out by Causeway Geotech in September 2018 during the preparation of the EIAR for the permitted development under South Dublin County Council Reg. Ref. SD19A/0042 / An Bord Pleanála Ref. ABP-305948-19.

During the site investigation a number of samples taken from a select number of trial pits and boreholes were analysed to identify and possible contamination on site. Samples were analysed for hydrocarbons (mineral oils, BTEX), PAHs, metals and phenols. There are no legislative thresholds for soil in Ireland and therefore results were compared with the Land Quality Management (LQM)/Chartered Institute of Environmental Health (CIEH) Suitable for Use Levels (S4ULs) for Human Health Risk Assessment (Nathanial et al. 2015) which allow assessment based on health risk and use of the site. A review of the representative 24 no. soil quality analysis results EIAR Chapter 7 (Land Soil, Geology and Hydrogeology) does not indicate any notable contamination across the site.

All excavations should still be carefully monitored by a suitably qualified person to ensure that, if encountered, potentially contaminated soil is identified and segregated from clean/inert material. In the event that any potentially contaminated material is encountered, it will need to be tested and classified as either non-hazardous or hazardous in accordance with the EPA publication entitled *'Waste Classification: List of Waste & Determining if Waste is Hazardous or Non-Hazardous"*[1] using the *HazWasteOnline* application (or similar approved classification method). The material will then need to be classified as clean, inert, non-hazardous or hazardous in accordance with the *Decision 2003/33/EC*.

Excavation works will be carefully monitored by a suitably qualified person to ensure any potentially contaminated soil is identified and segregated in accordance with the above procedure.

If asbestos or asbestos containing material (ACMs) are identified in any further soil samples or during excavation, the removal will only be carried out by a suitably permitted waste contractor, in accordance with *S.I. No. 386 of 2006 Safety, Health and Welfare at*

Work (Exposure to Asbestos) Regulations 2006-2010. All asbestos will be taken to a suitably licensed or permitted facility.

3.3.2 Fuel/Oils

As fuels and oils are classed as hazardous materials, any on-site storage of fuel/oil, all storage tanks and all draw-off points will be bunded and located in a dedicated, secure area of the site. Provided that these requirements are adhered to and the site crew are trained in the appropriate refuelling techniques, it is not expected that there will be any fuel/oil waste generated at the site.

3.3.3 Invasive Species

Ecological site surveys have been undertaken by Scott Cawley (SC) at this site and in the surrounding area as part of the site ecological assessment in 2021 as part of the EIAR. This included walkover surveys of the entire site and the perimeter of the site. There were no Schedule 3 non-native invasive species were recorded during baseline surveys.

3.3.4 Other Known Hazardous Substances

Paints, glues, adhesives and other known hazardous substances will be stored in designated areas. They will generally be present in small volumes only and associated waste volumes generated will be kept to a minimum. Wastes will be stored in appropriate receptacles pending collection by an authorised waste contractor.

In addition, waste electrical and electronic equipment (WEEE) containing hazardous components, printer/toner cartridges and batteries (Lead, Ni-Cd or Mercury) may be generated from the temporary site offices during construction works. These wastes will be stored in appropriate receptacles in designated areas of the site pending collection by an authorised waste contractor.

3.4 MAIN CONSTRUCTION AND DEMOLITION WASTE CATEGORIES

The main non-hazardous and hazardous waste streams that may typically be generated by the construction activities at the proposed site are presented in Table 1. The List of Waste code (also referred to as the European Waste code or EWC) for each waste stream is also shown.

Table 3.1 *Typical waste types generated and LoW codes (individual waste types may contain hazardous substances)*

Waste Material	List of Waste Code
Concrete, bricks, tiles, ceramics	17 01 01-03 & 07
Wood, glass and plastic	17 02 01-03
Treated wood, glass, plastic, containing hazardous substances	17-02-04*
Bituminous mixtures, coal tar and tarred products	17 03 01*, 02 & 03*
Metals (including their alloys) and cable	17 04 01-11
Soil and stones	17 05 03* & 04
Gypsum-based construction material	17 08 01* & 02
Paper and cardboard	20 01 01