Appendix 14.3

Marine Outfall Site Investigation



Arklow Sewerage Scheme - Marine Outfall Site Investigation

Client: Irish Water

Client's Representative: Byrne Looby ARUP J.V

Report No.: 17-0167

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CONTENTS

Document Control Sheet

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

1	AUTI	HORITY	4
2	SCOF	PE	4
3	DESC	CRIPTION OF SITE	4
4	SITE 4.1 4.2	OPERATIONS Summary of site works Boreholes	5 5
	4.3	4.2.1 Light cable percussion boreholes	6
5	LAB0 5.1 5.2 5.3	DRATORY WORKGeotechnical laboratory testing of soilsGeotechnical laboratory testing of rockEnvironmental laboratory testing of soils	7 7
6	GROV 6.1 6.2 6.3	UND CONDITIONS	8
7	REFE	GRENCES	9

APPENDICES

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





Document Control Sheet

Report No.:		17-0167			
Project Title:		Arklow Sewera	ge Scheme Marine	e Outfall – Ground	Investigation
Client:		Irish Water			
Client's Repres	sentative:	Byrne Looby AF	RUP J.V.		
Revision:	A00	Status:	Draft for review	Issue Date:	15 December 2017
Prepared by:		Reviewed by:		Approved by:	
Lucy Newland BSc (Hons)	Suburl.	Neil Haggan BSc(Hons) MSc	FGS	Darren O'Mahor BSc MSc MIEI	,

The works were conducted in accordance with:

UK Specification for Ground Investigation 2nd Edition, published by ICE Publishing (2012)

British Standards Institute (2015) BS 5930:2015, Code of practice for site investigations.

IS EN 1997-2:2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

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

Laboratory testing was conducted in accordance with:

British Standards Institute BS 1377-2:1990, BS EN ISO 17892-1:2014, and BS EN ISO 17892-2:2014





METHODS OF DESCRIBING SOILS AND ROCKS

Soil and rock descriptions are based on the guidance in BS5930:2015, The Code of Practice for Site Investigation.

Abbreviations used of	on exploratory hole logs
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler)
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler)
P	Nominal 100mm diameter undisturbed piston sample
В	Bulk disturbed sample
LB	Large bulk disturbed sample
D	Small disturbed sample
С	Core sub-sample (displayed in the Field Records column on the logs)
L	Liner sample from dynamic sampled borehole
W	Water sample
ES / EW	Soil sample for environmental testing / Water sample for environmental testing
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained)
SPT (c)	Standard penetration test using 60 degree solid cone
x,x/x,x,x,x	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length. The length achieved is stated (mm) for any test increment less than 75mm
N=X	SPT blow count 'N' given by the summation of the blows 'X' required to drive the full test length (300mm)
N=X/Z	Incomplete standard penetration test where the full test length was not achieved. The blows 'X' represent the total blows for the given test length 'Z' (mm)
V VR	Shear vane test (borehole) Hand vane test (trial pit) Shear strength stated in kPa V: undisturbed vane shear strength VR: remoulded vane shear strength
dd/mm/yy: 1.0 dd/mm/yy: dry	Date & water level at the borehole depth at the end of shift and the start of the following shift
Abbreviations relating	g to rock core – reference Clause 44.4.4 of BS 5930: 2015
TCR (%)	Total Core Recovery: Ratio of rock/soil core recovered (both solid and non-intact) to the total length of core run.
SCR (%)	Solid Core Recovery: Ratio of solid core to the total length of core run. Solid core has a full diameter, uninterrupted by natural discontinuities, but not necessarily a full circumference and is measured along the core axis between natural fractures.
RQD (%)	Rock Quality Designation: Ratio of total length of solid core pieces greater than 100mm to the total length of core run.
FI	Fracture Index: Number of natural discontinuities per metre over an indicated length of core of similar intensity of fracturing.
NI	Non Intact: Used where the rock material was recovered fragmented, for example as fine to coarse gravel size particles.
AZCL	Assessed zone of core loss: The estimated depth range where core was not recovered.
DIF	Drilling induced fracture: A fracture of non-geological origin brought about by the rock coring.



Arklow Sewerage Scheme Marine Outfall

1 **AUTHORITY**

On the instructions of Byrne Looby and ARUP Consulting Engineers, ("the Client's Representative"), acting on the behalf of Irish Water ("the Client"), a ground investigation was undertaken at the above location to provide geotechnical and environmental information for input to the design and construction of a proposed waste water treatment works.

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

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

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

2 SCOPE

The extent of the investigation, as instructed by the Client's Representative, included boreholes by light cable percussion and rotary boring, soil sampling, in-situ and laboratory testing, and the preparation of a factual report on the findings.

3 DESCRIPTION OF SITE

As shown on the site location plan in Appendix A, the works were conducted in two areas, the first, starting just after the Arklow bridge on the Avoca River in the town of Arklow and the second starts north of the river mouth moving east into the Irish Sea.





4 SITE OPERATIONS

4.1 Summary of site works

Site operations, which were conducted between 29th August and 7th November 2017, comprised:

- nine light cable percussion boreholes
- nine light cable percussion boreholes with rotary follow-on

The exploratory holes and in-situ tests were located as instructed by the Client's Representative, as shown on the exploratory hole location plan in Appendix A.

4.2 Boreholes

A total of eighteen boreholes were put down in a minimum diameter of 200mm through soils and rock strata to their completion depths by a combination of methods, including light cable percussion boring by Dando 3000 rigs, and rotary drilling (by a Comacchio 405 Mobile tracked rotary drilling rig).

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

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

Appendix B presents the borehole logs.

4.2.1 Light cable percussion boreholes

Nine boreholes (BH11-BH19) were put down to completion in minimum 200mm diameter using Dando 3000 light cable percussion boring rigs. All boreholes were terminated either at their scheduled completion depths, or else on encountering virtual refusal on obstructions, including large boulders and weathered bedrock.

Disturbed (bulk and small bag) samples were taken within the encountered strata. Undisturbed (U100/UT100) samples were taken where appropriate and as directed within cohesive soils. Environmental samples were taken at standard intervals, as directed by the Client's Representative.

Standard penetration tests were carried out in accordance with EC7 at standard depth intervals using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment ($SPT_{(c)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix F.



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

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

Appendix B presents the borehole logs.

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

Nine boreholes (BH01, BH02 & BH04-BH10) were put down by a combination of light cable percussion boring and rotary follow-on drilling techniques with core recovery in bedrock. Where the cable percussion borehole had not been advanced onto bedrock, rotary percussive methods were employed to advance the borehole to completion/bedrock. Symmetrix cased full-hole drilling was used.

Standard penetration tests were carried out in accordance with EC7 at standard depth intervals throughout the overburden using the split spoon sampler ($SPT_{(s)}$) or solid cone attachment ($SPT_{(c)}$). The penetrations are stated for those tests for which the full 150mm seating drive or 300mm test drive was not possible. The N-values provided on the borehole logs are uncorrected and no allowance has been made for energy ratio corrections. The SPT hammer energy measurement report is provided in Appendix F.

Where coring was carried out within bedrock strata, Geobor S Coring was used. The core was extracted in up to 1.5m lengths using a SK6L core barrel, which produced core of nominal 102mm diameter, and was placed in single channel wooden core boxes.

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

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

4.3 Surveying

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

The plan coordinates (Irish National Grid) and ground elevation (mOD Malin) at each location are recorded on the individual exploratory hole logs. The exploratory hole plan presented in Appendix A shows these asbuilt positions.





5 LABORATORY WORK

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

5.1 Geotechnical laboratory testing of soils

Laboratory testing of soils comprised:

- **soil classification:** moisture content measurement, Atterberg Limit tests and particle size distribution analysis.
- compressibility: one dimensional consolidation (oedometer)
- **shear strength** (total stress): unconsolidated undrained triaxial tests
- **direct shear:** shear box tests
- soil chemistry: pH, water soluble sulphate content, organic matter content

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

The test results are presented in Appendix D.

5.2 Geotechnical laboratory testing of rock

Laboratory testing of rock sub-samples comprised:

point load index

Test	Test carried out in accordance with
Point load index	ISRM Suggested Methods (1985) Suggested method for determining point-load strength. Int. J. Rock Mech. Min. Sci. Geomech. Abstr. 22, pp. 53–60

The test results are presented in Appendix D.

5.3 Environmental laboratory testing of soils

Environmental testing, was conducted on selected environmental soil samples by ESG/Socotec UK laboratories in Wales.



Testing was carried out for a range of determinants, including:

- specified disposal at sea suite
- specified waste acceptance criteria (WAC) testing.

Results of environmental laboratory testing are presented in Appendix E.

6 GROUND CONDITIONS

6.1 General geology of the area

Published geological mapping indicate the superficial deposits underlying the site comprise Alluvium deposits. These deposits are underlain by dark grey slate and minor pale sandstone of the Kilmacrea Formation.

6.2 Ground types encountered during investigation of the site

A summary of the ground types encountered in the exploratory holes is listed below, in approximate stratigraphic order:

- **Fluvioglacial deposits:** typically medium dense to dense sands and gravels with localised pockets of soft to firm sandy gravelly silts and clays interspersed throughout.
- **Glacial Till:** slightly sandy slightly gravelly silty clay, frequently with low or medium cobble content, typically stiff in upper horizons, becoming very stiff with increasing depth.
- **Bedrock (Amphibolite, Breccia, and Slate):** Rockhead was encountered at depths ranging from 5.3m in BH19 to about 23.5m in boreholes BH02 and BH08, showing a trend of dipping east.

6.3 Groundwater

Groundwater was encountered during percussion boring through soil as a water strike at 4.10m in borehole BH17 coincident with a layer medium to coarse gravel.

Details of the individual groundwater strikes, along with any relative changes in levels as works proceeded, are presented on the exploratory hole logs for each location.

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



7 REFERENCES

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

IS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing.

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

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

BS EN 1997-2: 2007: Eurocode 7 - Geotechnical design - Part 2 Ground investigation and testing. British Standards Institution.

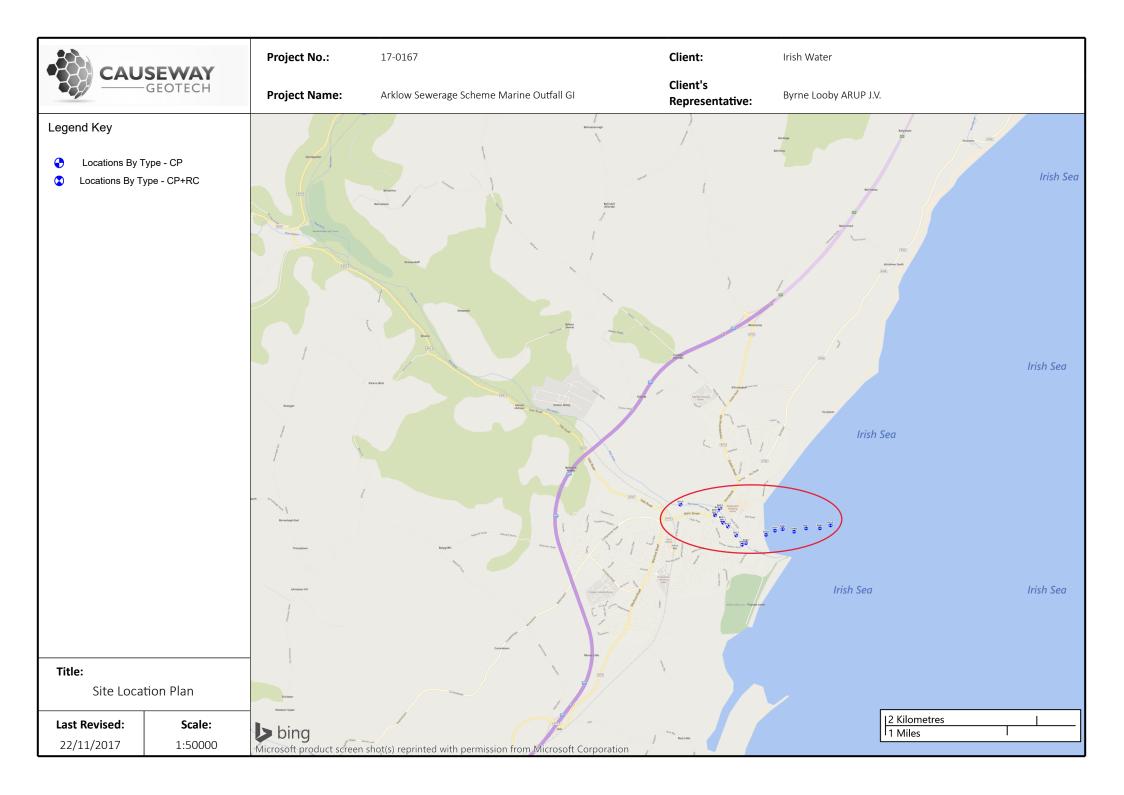
Construction Industry Research and Information Association (CIRIA). 1993. Research Project 369. The Standard Penetration Test (SPT): Methods and Use. CIRIA. London.

BS EN ISO 14688-1: 2002: Geotechnical investigation and testing - Identification and classification of soil - Part 1 Identification and description. British Standards Institution.



APPENDIX A Site and exploratory hole location plans







Project No.: 17-0167 Client:

Client's

Project Name:

Arklow Sewerage Scheme Marine Outfall GI

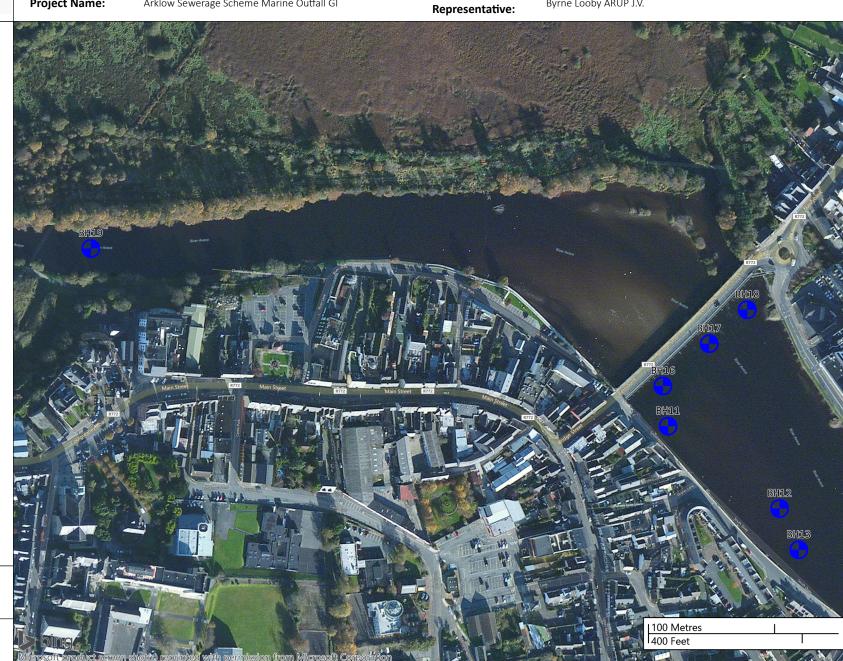
Byrne Looby ARUP J.V.

Irish Water

Legend Key

Locations By Type - CP

Locations By Type - CP+RC



Title:

Exploratory Hole Location Plan

Last Revised: Scale: 22/11/2017 1:3000



Project No.: 17-0167 Client: Irish Water

Client's

Project Name:

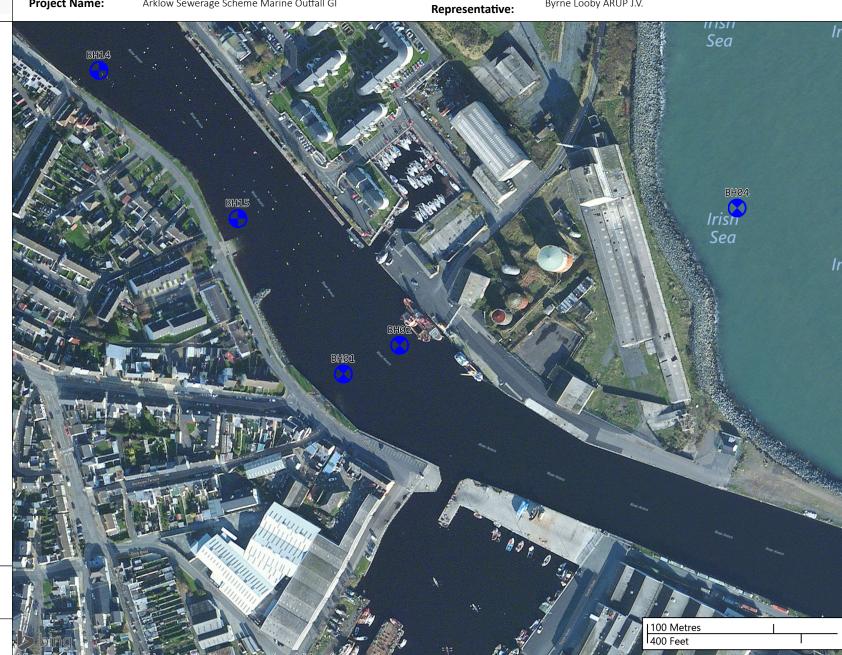
Arklow Sewerage Scheme Marine Outfall GI

Byrne Looby ARUP J.V.

Legend Key

Locations By Type - CP

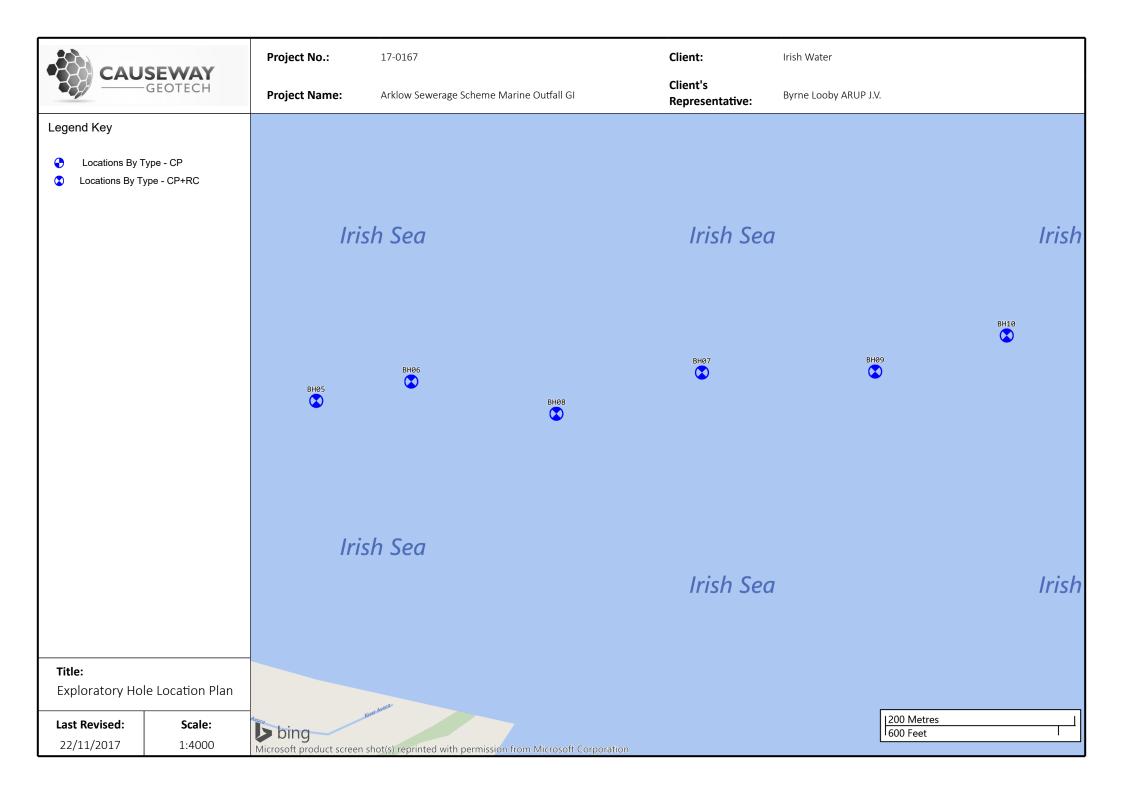
Locations By Type - CP+RC



Title:

Exploratory Hole Location Plan

Last Revised: Scale: 22/11/2017 1:3000





APPENDIX B Borehole logs



202					Projec		-	t Name:	Borehole No.:
C C C C C C C C C C C C C C C C C C C	CAL	JS	E	VAY	17-016 Coordi		Arklow Client:	Sewerage Scheme Marine Outfall GI	BH01
		— G	EC	TECH			Irish W		Sheet 1 of 3
Method	Pla	nt U	sed	Top Bas	32510 e		Client'	s Representative:	Scale: 1:50
Cable Percussion	_	ido 3	000	0.00 20.5	0	0.75 N	Byrne	Looby ARUP J.V.	Driller: CC+TA
Rotary Drilling	Coma	accini	0 405	20.50 25.0	Groun	d Level:	Dates:		
Depth	Sample /	Casing	Water		-3.8 Level	6 mOD Depth (m)		2017 - 05/09/2017 	Logger: SG
(m) 0.00 - 1.00	Tests B1	Depth (m)	Depth (m)	Field Records	(mOD)			Description Black very gravelly silty fine to coarse SAND. Gravel is subrounded fine to	Backfill
0.50	ES28				405	(1.00)		medium.	0.5
1.00 1.00 - 2.00 1.00 - 1.45 1.50	D2 B3 SPT (S) N=9 ES29	1.00	Dry	N=9 (1,2/2,2,2,3)	-4.86	1.00	× × × × × × × × × × × × × × × × × × ×	Loose to medium dense black sandy slightly silty subrounded fine to coarse GRAVEL. Sand is fine to coarse.	1.5
2.00 2.00 - 2.45 2.50	D4 SPT (S) N=12 ES30	2.00	Dry	N=12 (2,2/3,3,3,3)		(1.80)			2.0 —
2.80 - 3.50 3.00 3.00 - 3.45	B5 D6 SPT (S) N=14 ES31	3.00	Dry	N=14 (2,3/4,4,3,3)	-6.66	2.80	×	Medium dense greyish brown very gravelly slightly silty fine to coarse SAND. Gravel is subrounded fine.	3.0
3.50 3.50 - 4.50 4.00 4.00 - 4.45	D8 SPT (S)	4.00	Dry	N=18 (3,3/4,4,5,5)		(1.70)			4.0
4.50	N=18 ES32				-8.36	4.50			4.5
4.50 - 4.80 4.80 - 5.50 5.00 - 5.45	B9 B10 SPT (S) N=12	5.00	Dry	N=12 (1,2/2,3,3,4)	-8.66	(0.30) 4.80	× × × × × × × × × × × × × × × × × × ×	Firm brown slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine. Medium dense brown very sandy slightly silty subrounded fine to medium GRAVEL. Sand is fine to coarse. Locally thin bands of brown silt.	5.0
5.50	ES33					(1.10)	× × ×		5.5
5.80 - 7.00 6.00 - 6.45	B11 UT34	6.00	Dry	Ublow=37 100%	-9.76	5.90	× × × × × × × × × × × × × × × × × × ×	Very stiff greyish brown slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine to medium.	6.0
7.00 7.00 - 7.45	D12 D13 SPT (S)	7.00	Dry	N=8 (1,2/2,2,2,2)		(1.70)			6.5 — - 7.0 —
7.60 - 9.00	N=8 B14				-11.46	7.60	(Firm brownish grey slightly sandy slightly gravelly SILT. Sand is fine to	7.5
8.00 - 8.45	UT35	8.00	Dry	Ublow=59 100%		(1.10)	* * * * * * * * * * * * * * * * * * *	coarse. Gravel is subrounded fine.	8.0 —
8.50 8.70 - 10.00	D15 B16				-12.56	8.70	* * * * * * * * * * * *	Medium dense brownish grey very silty fine to coarse SAND.	8.5 — -
9.00 9.00 - 9.45	D17 SPT (S) N=12	9.00	Dry	N=12 (1,1/2,3,3,4)		(1.40)			9.0
10.00 - 10.35 10.10 - 10.50	UT36 B18	10.0	Dry	Ublow=61 80%	-13.96	10.10	× × × × × × × × × ×	Soft grey slightly sandy SILT. Sand is fine to coarse.	10.0
Remarks			<u> </u>						selling Details
Deck to Bed = 6.2	20m							Struck at (m) Casing to (m) Time (min) Rose to (m) From (m) 13.60	To (m) Time (hh:mm) 14.00 01:00
Terminated at sc	heduled	dept	h						

20					\	Project		_	t Name:							Borehole N	lo.:
XX	CAI	JS	F	WAY		17-016			Sewerage S	cheme	Marine	Outfall G	il			BH01	
		_c	EO	TECH		Coordi		Client:								Sheet 2 o	f 3
Mathad	Die	nt U	ددم -	Ton	Raca	32510	3.16 E	Irish W	ater s Representa	ative:						Scale: 1:5	
Method Cable Percussion		nt U ndo 3		Top 0.00	Base 20.50	173070	0.75 N		_ooby ARUP								
Rotary Drilling	Coma	acchi	o 405	20.50	25.00	Ground	d Level:	Dates:								Driller: CC	+TA
						-3.86	6 mOD		2017 - 05/09	9/2017						Logger: SG	i
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)				ı	Descriptio	n			ਬੇ Backfill	
10.50 10.50 - 12.00	D19 B20					-14.36	10.50	×××× × ^ ×	Soft grey sligh Medium dens					th thin bar	nds of	- 1	10.5 —
							-	x × x	greyish brown		,,						-
11.00 - 11.45	SPT (S) N=13	11.0	Dry	N=13 (1,2/3	3,3,3,4)		<u> </u>	× × ×								1	11.0 -
	11-15							× × ×									=
							(2.20)	x								1	11.5 —
12.00 - 12.45	CDT (C)	12.0	D=/	N=12 (2,3/3	2 2 2 2 1			× × ×									12.0
12.00 - 12.45	SPT (S) N=12	0	Dry	N=12 (2,3/3	3,3,3,3)			`x: × x × x									-
								××× ×××								1	12.5
12.70 - 13.50	B21					-16.56	12.70	××××	Medium dens	e to dens	e greyish	brown ver	y sandy sil	ty subrour	nded fine to		-
13.00 - 13.45	SPT (S)		Dry	N=21 (1,2/4	4,5,5,7)			× × ×	coarse GRAVE								13.0
	N=21	0						× ^ × × ×									-
							<u>-</u>	^								1	ر ن3.5 — -
								×. ×. ×									-
14.00 14.00 - 15.00	D22 B23							× × ×								1	.4.0 — - -
14.00 - 14.45	SPT (S) N=28	14.0 0	Dry	N=28 (3,4/6	5,6,7,9)			×·×·×								1	- - 14.5 —
								×·×·×									-
15.00	D24						(4.30)	×								1	15.0 —
15.00 - 16.00 15.00 - 15.45	B25 SPT (S)	15.0	Dry	N=31 (6,7/9	9,7,7,8)			^									-
	N=31	0	,	, , ,				× × ×								1	15.5 —
								× × ×									-
16.00 - 17.00 16.00 - 16.45	B26 SPT (S)	16.0	Drv	N=31 (4,6/7	7,8,8,8)		_	×·×·×								1	6.0 -
-	N=31	0		, , -, -	. , ,		-	× × × × ×									- -
								× × ×								1	.0.5 —
17.00 - 17.45	SPT (S)	17.0	Dry	N=26 (2,4/5	5,5,7,9)	-20.86	17.00	× × ×								1	- 17.0
17.30 - 18.00	N=26 B37	0			. ,				Medium dens fine to mediu					ery silty sul	orounded		-
10.00																1	L7.5 —
							Ē										-
18.00 18.00 - 19.00	D38 B39						<u></u>									1	ــــ 0.8 -
18.00 - 18.45	SPT (S) N=18	18.0 0	Dry	N=18 (2,3/4	4,4,5,5)												
	11-10						(2 EO)									1	.8.5 — - -
19.00	D40						(3.50)										- 19.0 —
19.00 - 20.00 19.00 - 19.45	B41 SPT (S)	19.0	Dry	N=32 (3,4/7	7 8 9 81												-
	N=32	0	J. y	52 (5,7/1	,5,5,01											1	19.5 —
																	-
20.00 20.00 - 20.45	D42 SPT (S)	20.0	Drv	N=29 (2,3/5	5.7.8 91		_									2	20.0 -
20.20 - 20.50	N=29 B27	0		. 25 (2,5/	. , . , ~ , ~		_										-
_0.20 20.30						-24.36	20.50	×××	Very dense gr	eyish bro	wn gravel	ly slightly	silty fine to	coarse SA	ND. Gravel	2	20.5
Remarks	TCR SCR	RQD	FI						C===	Barrel		Wate	r Strikes		Chi	selling Details	
Deck to Bed = 6.2	20m									K6L	Struck at (m)	Casing to (m		Rose to (m)		To (m) Time (I	hh:mm) 1:00
											144-1-		0	n Deta''			
									Flus	h Type	From (m)	To (m)	To (m) 15.00	Diam (mm) 250			
erminated at sc	heduled	dept	h										15.00	230			

0.0							Projec	t No.:	Projec	t Name:							Bore	hole No.:
253		N. II	ıc		A/AV		17-016	57	Arklow	/ Sewerage Sch	neme N	Marine (Dutfall G	I				BH01
$+\Box +\Box$		10	73		WAY TECH		Coordi	nates:	Client								Sh	eet 3 of 3
			G	LC	/ILCII		32510	3.16 E	Irish W	/ater							311	
Method		Plan			Тор	Base	1		Client'	s Representati	ive:						Scale	e: 1:50
Cable Percussion		Dano			0.00	20.50	17307	0.75 N	Byrne	Looby ARUP J.\	/ .						Deill	er: CC+TA
Rotary Drilling	C	oma	cchic	405	20.50	25.00	Groun	d Level:	Dates:									er. CC+IA
							-3.8			/2017 - 05/09/2	2017						Logg	er: SG
Depth (m)	TCR	SCR	RQD	FI	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legend			D	escription	ı			Water	Backfill
(111)							(IIIOD)	(Tilless)	×××	is subrounded fi	ne to m	edium.					>	
21.00 - 21.45					N=50 (6,6/7,13,1-	4,16)												21.5 - 22.0 -
23.00 - 23.40					N=50 (6,7/5 250mm)	50 for		(4.50)										23.5 - 23.5 - 24.0 -
25.00 - 25.34					50 (6,9/50 1	for	-28.86	25.00	××××									25.0
23.00 - 23.34					185mm)	101	-28.80	25.00				End of Bo	orehole at	25.00m				23.0
																		25.5 -
																		26.0 —
																		26.5 -
								E										20.3
								-										27.0 —
								E										
								E										27.5 -
								-										28.0 —
																		28.5 -
								Ė										
								<u> </u>										29.0 —
								Ė										
								Ė										29.5
								-										
								-										30.0
								[
								<u>E</u>										30.5
								<u> </u>										
								-										31.0 —
	TCR	SCR	RQD	FI									144-	Caulter -		OL:	T	Doto!!-
Remarks Deck to Bed = 6.2	20m									Core B	-	Struck at (m)		Strikes Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm
										SK6	5L					13.60	14.00	01:00
										Flush	Type		Added		g Details]		
										110311	.,,,,,	From (m)	To (m)	To (m) 24.80	Diam (mm) 200	-		
Terminated at schedu	uled d	epth																

						Project		-	t Name:					Boreh		.:
XXX	CAL	JS	E	YAY		17-016			Sewerage Scheme	iviarine Outfall G	ol .			В	H02	
		— C	EO	TECH		Coording 32514		Client: Irish W						Shee	t 1 of 3	3
Method	Pla	nt U	sed	Тор	Base	1			s Representative:					Scale:	1:50	1
Cable Percussior Rotary Drilling		ido 3	000	0.00	18.00 25.00	17309		Byrne	Looby ARUP J.V.					Driller	: CC+9	 SS
wary brilling	Come	accill	J 1 UJ	10.00	23.00	Ground		Dates:						Logge		_
Depth	Sample /	Casing Depth	Water Depth (m)	Fi-ld D	4-	-1.28	3 mOD Depth (m)		['] 2017 - 31/08/2017	Danadatio	_					_
(m) 0.00 - 1.00	Tests B1	(m)	(m)	Field Re	corus	(mOD)	(Thickness)	Legend	Black very sandy slightl	Descriptio v silty subrounded t		ne to coar	·se	Nate Bac	kfill	_
								×·×·×	GRAVEL. Sand is fine to							-
0.50	ES28						(1.00)	× ^ ×							0.5	: -
								`								
1.00 1.00 - 2.00	D14 B2					-2.28	1.00	× × × ×	Soft black slightly grave to coarse. Gravel is sub				nd is fine		1.0	,
	SPT (S) N=8	1.00		N=8 (1,2/2,	2,2,2)			× % × × × × × × × % × ×	a to course. Craver is say	angalar to sabroans		carann			1.5	
1.50	ES29						(1.30)	\times \times \times \times \times								
2.00	D15							(2.0	, -
	SPT (S) N=5	2.00		N=5 (1,1/1,:	1,1,2)	-3.58	2.30	×9/0×>	Loose black very sandy	slightly silty subrou	nded to roun	ded fine t	to coarse			
2.30 - 3.00 2.50	B3 ES30							× × × ×	GRAVEL. Sand is fine to		to roun				2.5	
3.00	D16							× × ×								
3.00 3.00 - 4.00	D16 B4	2.55		N 0 /4 5 /5				× × × × ×							3.0	
	SPT (S) N=8	3.00		N=8 (1,2/1,2	∠,∠, 3)		(0.05)	*							3.5	; -
3.50	ES31						(2.60)	× × ×								
1.00	D17 SPT (S)	4.00		N=10 /4 4 /3	2221		<u>-</u>	× × ×							4.0) —
4.00 - 4.45	N=10	4.00		N=10 (1,1/2	,2,3,3)			×·×·×								
4.50	ES32							× × × × ×							4.5	; -
4.90 - 6.00	B5					-6.18	4.90	×: • •× ^	Firm brown CLAY.					-	5.0	
5.00 - 5.45	UT24			Ublow=76 1	.00%				- Tim Brown eB II.						5.0	
5.50	ES33						(1.10)]						5.5	; –
								===	-							
6.00 6.00 - 6.40	D18 B6					-7.28	6.00		Medium dense brown		angular to sub	orounded	fine to	_	6.0	, —
6.00 - 6.45	SPT (S) N=15	6.00		N=15 (1,2/3	,3,4,5)		(0.60)		medium GRAVEL. Sand	is fine to coarse.						
6.40 - 7.00	B7					-7.88	6.60		Firm to stiff brown CLA	Υ.				_	6.5	
7.00 - 7.45	UT25			Ublow=65 1	.00%	-8.18	(0.30) 6.90		Firm brownish grey slig	htly sandy CLAY. Sar	nd is fine to m	nedium.			7.0	(
7.00 - 8.00	B8															
7.50	D19						<u> </u>		-						7.5	, -
							/2 : 2:									
8.00 - 8.45	SPT (S) N=7	8.00		N=7 (2,1/2,	1,2,2)		(2.10)		_						8.0	1
															8.5	
9.00 - 10.00	В9					-10.28	9.00		Groveilty fine CAND						9.0) —
9.00 - 9.45	UT26			Ublow=30 0	1%			××× ×××	Grey silty fine SAND.							
							(0.80)	$\times \times \times$							9.5	; -
						-11.08	9.80	x: × ×	Firm brownish grey slig	htly sandy CLAY. Sar	nd is fine to m	nedium.				
10.00 - 11.00 10.00 - 10.45	B10 SPT (S)	10.0		N=8 (1,2/2,2	2,2,2)					•					10.0	-
	N=8	0														_
Remarks	2000	1	,						Core Barrel	Wate Struck at (m) Casing to (m)	r Strikes	Rose to (m)	From (m)	elling De	Time (hh:r	
Deck to bed = 5.3	3UM											,	11.00	12.80	01:00	
									Flush Type	Water Added	Casing D					
erminated at sc	hedulad	den+	h						,,,,,	From (m) To (m) 2.50 15.00	To (m)	Diam (mm)				
arrimated at SC	rreduied	ucμι	.11													_

20						Project		_	t Name:		0 11 11 0					ole No
S S S S S S S S S S S S S S S S S S S	CAL	JS	E	VAY		17-016 Coordi		Client:	Sewerage Scheme	iviarine	оипан С	I			-	3H02
		—G	EO	TECH		32514		Irish W							Shee	et 2 of 3
Method	Pla	nt U	sed	Тор	Base	1		Client'	s Representative:						Scale:	1:50
Cable Percussion		ido 3		0.00	18.00	17309	4.73 N	Byrne	Looby ARUP J.V.						Drille	r: CC+S
Rotary Drilling	Coma	accnio	0 405	18.00	25.00	Ground		Dates:							-	
Depth	Sample /	Casing				-1.28	B mOD Depth (m)	29/08/	² 2017 - 31/08/2017						Logge	r: SG
(m)	Tests	Depth (m)	Water Depth (m)	Field Re	cords	(mOD)	(Thickness)	Legend			Description				Mater Ba	ckfill
10.50 10.50 - 10.95	D20 UT27			Ublow=59 1	100%				Firm brownish grey slig	ghtly sand	y CLAY. San	d is fine to	medium.			10.5
							(1.70)		-							
11.00 11.00 - 11.45	D21 SPT (S)	11.0		N=15 (2,2/3	3.3.3.6)		(1.70)		-							11.0
	N=15	0		- (,-,-,-,		[
11.50 - 12.50	B11					-12.78	11.50	a Pa	Medium dense brown							11.5
12.00 42.45	CDT (C)	42.0		N 22 /2 4/6				a 9 a 3	coarse GRAVEL with lo coarse. Cobbles and bo					e to		
12.00 - 12.45	SPT (S) N=23	12.0 0		N=23 (3,4/6	,5,6,6)			a ' a ' (12.0
							[12.5
							(2.25)	9 9 0								
13.00 - 14.00	B12							a 9 0								13.0
13.00 - 13.45	SPT (S) N=24	13.0 0		N=24 (2,4/5	5,6,6,7)			a								
	11-24	U						å ° ° °								13.5
						-15.02	13.75	Ů.	Dense brown sandy su	hangular	to subra	dad firs t	o coarce C	λ/\/E1:+h-		
14.00	D22						<u> </u>	000	medium cobble and bo	ulder con	itent. Sand					14.0
14.00 - 15.00 14.00 - 14.45	B13 SPT (S)	14.0		N=39 (4,6/7	7,9,10,13)		-	000	boulders are subangul	ar to subr	ounded.					
	N=39	0						\circ								14.5
								000								
15.00	D23						<u>-</u>	0.0								15.0
15.00 - 16.00 15.00 - 15.45	B35 SPT (S)	15.0		N=34 (6,9/7	7,8,8,11)		(3.15)	0.0								
	N=34	0					-									15.5
16.00 16.00 - 16.45	D34 SPT (S)			N=34 (4,6/7	7,9,8,10)		-	000	i.							16.0
	N=34							0.0								
								000								16.5
16.90 - 17.50	B37					-18.18	16.90	0.0 ××××	Dense grey sandy silty	subangula	ar to subro	unded fine	to coarse	GRAVEL.	-	17.0
17.00 17.00 - 17.45	D36 SPT (S)	17.0		N=32 (4,6/7	7,7,8,10)			^``× ××	Sand is fine to coarse.	Ü						
	N=32	0					(1.10)	× × ×								17.5
								× × ×								
18:88 - 18:85	SPT (C)	18.0	\vdash	58 (35 for 3	5mm/50	-19.27	18.00	x * ×	Amphibolite BOULDER						-	18.0
10.00		0		50 (25 for 2 50 (25 for 2 for 25 mm) for 25 mm)	S.11111/JU		(0.40)	0,0	psonic BOOLDEN							
	40					-19.68	18.40	9 99	Grey sandy silty suban cobble content. Sand is	gular to si	ubrounded	fine to co	arse GRAVE	L with low		18.5
							<u> </u>	å ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° ° °	subrounded predomin				variguidi li	-		
19.00 - 19.45 19.00				N=35 (5,6/8	3,8,9,10)			a ' a ' (19.0
							<u> </u>	a ' a ' s								
								9 9								19.5
10.00 30.45				N=20 /F 7 /0	0 10 11			, e . e .								
20.00 - 20.45				N=38 (5,7/9	,8,10,11)			a 9 0								20.0
								a ' a '								20.5
	TCP SCS	POP	FI				-	a 9 0								20.5
lemarks	TCR SCR	KQD	H			<u> </u>		<u> </u>	Core Barrel			Strikes			elling D	
eck to bed = 5.3	30m								Core Daniel	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m) 11.00	To (m) 12.80	Time (hh:m 01:00
										\A/o+o	r Added	Casin	g Details			
									Flush Type	From (m)	To (m)	To (m) 16.50	Diam (mm)			
erminated at sc	heduled	dept	h									18.00	200			

						v i	Project	: No.:	Project	t Name:	Boreho	ole No.:
RX.		Λ.	IC		M/AV		17-016	7	Arklow	Sewerage Scheme Marine Outfall GI	В	H02
$+ \bigcirc + \bigcirc +$		70	_G	FC	WAY TECH		Coordi		Client:		Shee	t 3 of 3
			·		12011		32514	7.00 L	Irish W			
Method			nt U		Тор	Base	17309	1 72 NI		s Representative:	Scale:	1:50
Cable Percussion Rotary Drilling			do 3	000 o 405	0.00 5 18.00	18.00 25.00			-	Looby ARUP J.V.	Driller	: CC+SS
	`	,,,,,,			20.00	25.00			Dates:			
Depth							-1.28	B mOD Depth (m)	29/08/	/2017 - 31/08/2017 T	Logger	: 36
(m)	TCR	SCR	RQD	FI	Field Re	cords	(mOD)	(Thickness)	Legend		>	kfill
										Grey sandy silty subangular to subrounded fine to coarse GRAVEL with lov cobble content. Sand is fine to coarse. Cobbles are subangular to	'	
21.00 - 21.45					N=43 (6,6/10,11,1	10,12)				subrounded predominantly of amphibolite.		21.0
												21.5 —
								-				
22.00 - 22.45	0				N=42 (6,7/10,10,1	11 11)		(5.10)				22.0 —
					(0),7 10,10,1	,,			9 9 0			
												22.5 —
23.00 - 23.45					N=48 (7,7/11,12,1	12 12\		<u>-</u>				23.0 —
					(,,,,,11,14,	,14]			, a , a , 0			
23.50				1			-24.78	23.50		Medium strong to strong dark bluish grey AMPHIBOLITE recovered as		23.5
								Ē		subangular to subrounded fine to coarse GRAVEL and subrounded to rounded cobbles.		
								<u> </u>				24.0
	80							(1.50)				
												24.5 —
25.00 - 25.26					50 (12,21/5	0 for	-26.28	25.00		End of Borehole at 25.00m		25.0 —
25.00					110mm)							
								<u> </u>				25.5
								_				26.0
												26.5
								Ė				
								-				27.0 —
								Ė				27.5
								<u> </u>				28.0
								E				28.5 —
								<u> </u>				
								-				29.0 —
								Ē				=
								Ē				29.5 —
								<u> </u>				30.0 —
								Ē				
								Ė				30.5
								Ė				
								_				31.0 -
	TCR	SCR	RQD	FI						Coun Rower Water Strikes Ch	iselling De	tails
Remarks Deck to bed = 5.3	30m									Core Barrel	To (m) 12.80	Time (hh:mm)
											12.00	31.00
										Flush Type Water Added Casing Details From (m) To (m) To (m) Diam (mm)		
Terminated at sched	ıled -	den+h								From (m) to (m) Diam (mm)		
reminated at Schedi	arcu (achtij										

20%					\	Project		_	t Name: Sewerage Scheme			E	Borehole No
C C C C C C C C C C C C C C C C C C C	CAL	JS	E\	VAY		17-016				BH04			
		—G	EO	TECH		Coordi 32541		Client: Irish W					Sheet 1 of
Method	Pla	nt U	sed	Тор	Base	1		Client'	s Representative:			s	Scale: 1:50
Cable Percussion		ndo 3		0.00	21.50	17321	0.90 N	Byrne l	Looby ARUP J.V.				Driller: CC/AH
Rotary Drilling	Coma	accini	J 4US	21.50	25.00	Ground		Dates:				F	
Depth	Sample /	Casing	Water			-2.21	1 mOD Depth (m)		2017 - 09/09/2017 I				ogger: SG
(m)	Tests	Depth (m)	Water Depth (m)	Field Re	ecords	(mOD)	(Thickness)	Legend		Description			Backfill
0.00 - 1.40	B13								Medium dense yellowi shell fragments. Gravel				
).50	ES27												0.!
							(1.40)						
.00	D14												1.0
.00 - 1.45	SPT (S) N=21	1.00		N=21 (3,4/5	5,5,5,6)								
.40 - 2.50 .50	B15 ES28					-3.61	1.40	×××	Medium dense yellowi				1.5
.50	L328							× × ×	SAND with occasional s medium.	nell fragments. Grave	ei is subrounded fine	to	
.00	D16							×××					2.0
.00 - 2.45	SPT (S) N=15	2.00		N=15 (2,2/3	5,4,4,4)			××× ××××					
.50	ES29						-	$\overset{\times}{\overset{\times}{\sim}}\overset{\times}{\overset{\times}{\sim}}$					2.5
							(2.80)	$\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}$					
.00 .00 - 4.00	D18 B17						_	*.** ***					3.0
	SPT (S)	3.00		N=12 (1,2/2	2,3,3,4)			*, * * * *					
.50	N=12 ES30							× × × ×					3.5
								× × ×					
.00 .00 - 4.45	D19 SPT (S)	4.00		N=17 (2,3/3	3.4.5.5)	C 41	4.30	×·×·×					4.0
	N=17			()-/-	, ,-,-,	-6.41	4.20	×	Medium dense browni				
.20 - 5.00 .50	B20 ES31							× × × × × × × × × × × × × × × × × × ×	SAND WITH SHELL Hagine	ints. Graver is subang	ulai filic to filedium	•	4.5
								× × ×					
5.00 5.00 - 5.45	D21 SPT (S)	5.00		N=23 (1,4/5	5,5,6,7)		(1.60)	^x * * * *					5.0
	N=23							××× ××××					
.50	ES32							* * * * * * *					5.5
.80 - 6.10 .00	B22 D23					-8.01	5.80 (0.30)	Ě	Firm brownish grey slig		evelly CLAY. Sand is fi	ine to	6.0
	SPT (S)	6.00		N=27 (3,4/6	5,6,7,8)	-8.31	6.10	× ^ ×	coarse. Gravel is suban Medium dense browni	sh grey very sandy slig	ghtly silty subangula	r fine to	
.10 - 7.00	N=27 B24							× × ×	coarse GRAVEL. Sand is	fine to coarse.			6.
								× × ×					
.00 - 8.00	B25							×. × . ×					7.0
7.00 - 7.45	SPT (S)	7.00		N=23 (2,3/5	5,6,6,6)		(2.40)	× × ×					
	N=23						(2.40)	× ^ × × ·					7.!
								× × ×					
3.00 - 8.45	SPT (S)	8.00		N=27 (4,6/7	7,8,7,5)			× × ×					8.0
	N=27			,				× × ×					
						-10.71	8.50	×××	Firm brownish grey slig	htly sandy gravally SII	IT Sand is fine to se	arse	8.5
							(0.50)	$\times \times \times \times$	Gravel is subangular fin		Jana is inic to to		
.00 - 9.50	B26					-11.21	9.00	$\times \times \times \times$	Medium dense browni	sh grey gravelly slight	ly silty fine to coarse	SAND.	9.(
.00 - 9.45	SPT (S) N=15	9.00		N=15 (2,3/3	3,4,4,4)			*.** * *	Gravel is subangular fin		,, 13 000100		
								*, * * * *					9.5
							(2.00)	× × ×					
0.00 - 10.45	SPT (S)	10.0		N=19 (3,3/4	1,4,5,6)		<u> </u>	* * * * * *					10.0
	N=19	0						× × ×					
emarks						<u> </u>				Water	Strikes	Chisell	ling Details
eck to Bed = 8.7	70m								Core Barrel	Struck at (m) Casing to (m)	Time (min) Rose to (m)	From (m)	To (m) Time (hh: 21.50 01:00
]	
									Flush Type	Water Added From (m) To (m)	Casing Details To (m) Diam (mm)	}	
rminated at sc	امماريا مما	dont	h										

20						Project		-	t Name:							nole No.
HOH	CAL	JS	E\	VAY		17-016			Sewerage Scheme	Marine (Outfall G	l			l	BH04
		-G	EO	TECH		Coordi		Client: Irish W							She	et 2 of 3
Method	Pla	nt Us	sed	Тор	Base	32541	4.08 E		s Representative:						Scale	: 1:50
Cable Percussion	n Dan	ido 3	000	0.00	21.50	17321	0.90 N		Looby ARUP J.V.							r: CC/AH+
Rotary Drilling	Coma	acchie	o 405	21.50	25.00	Ground	d Level:	Dates:								
- · · · ·	2 1 4	1					1 mOD		2017 - 09/09/2017							er: SG
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legena			escription				Mater Ba	ackfill
	B1					-13.21	11.00	X X X X X X X X X X X X X X X X X X X	Medium dense browni: Gravel is subangular fin Medium dense to dens	ie.						10.5
	SPT (S) N=24	11.0		N=24 (3,4/5	5,6,6,7)		(1.50)	* * * * * * * * * * * * *	SAND. Gravel is subang				,			11.5
12.00 - 12.45	D8 SPT (S) N=42 B2	12.0 0		N=42 (4,5/7	7,9,11,15)	-14.71	12.50		Very stiff brownish grey	/ slightly s	andy slight	ly gravelly	silty CLAY.	Sand is		12.0 12.5
.3.00 - 13.45	UT35			Ublow=125	0%			x - x - x - x - x - x - x - x - x - x -	fine to coarse. Gravel is	subangul	ar to subro	ounded fin	e.			13.0
.3.50 - 13.92	D9 SPT (S) D10	13.5 0		N=50 (5,6/5 265mm)	50 for			× × × × × × × × × × × × × × × × × × ×								13.5
	B3 SPT (S)	14.0 0		N=50 (7,8/5 280mm)	50 for		(4.50)	x - x - x - x - x - x - x - x - x - x -								14.5
15.00 - 15.35	D11 SPT (S) B4	15.0 0		50 (6,10/50 200mm)) for			x								15.0 15.5
16.00 - 16.44	SPT (S)	16.0 0		N=50 (5,7/5 290mm)	50 for			X-:								16.0 16.5
17.00 - 17.45	B5 SPT (S) N=34	17.0 0		N=34 (3,4/6	5,8,9,11)	-19.21	17.00	X - X - X - X - X - X - X - X - X - X -	Very stiff brownish grey	/ slightly s	andy silty (CLAY. Sand	is fine to c	oarse.		17.0 17.5
	SPT (S) N=42	18.0 0		N=42 (5,8/9	9,9,11,13)		(2.60)	X_ X								18.0 18.5
19.00 - 19.45	D12 SPT (S) N=29	19.0 0		N=29 (3,4/6	5,7,8,8)			X X X X X								19.0 19.5
.9.60	B6					-21.81	19.60		Very stiff brown slightly			CLAY. Sand	l is fine to	coarse.		15.5
	SPT (S) N=32	20.0		N=32 (4,6/7	7,8,8,9)		(1.40)	× · · · · · · · · · · · · · · · · · · ·	Gravel is subrounded fi	ne to coar	rse.					20.0
temarks											Water	Strikes		Ch	iselling D	etails
Remarks Deck to Bed = 8.7	70m								Core Barrel	Struck at (m)	Casing to (m)		Rose to (m)	From (m) 21.45	To (m) 21.50	Time (hh:m 01:00
									Flush Type	Water	Added To (m)	Casing To (m) 16.50	Diam (mm)	-		

						Project		-	t Name:		0 .(!! -	.1			Bore	hole No
XX	CAL	JS	E	VAY TECH		17-016		Arklow Client:	Sewerage Scheme	warine	Outfall G	ıl				BH04
		-G	EO	TECH		Coordi 32541		Irish W							Sh	eet 3 of 3
Method		nt Us		Тор	Base	1			s Representative:						Scal	e: 1:50
Cable Percussion Rotary Drilling		do 30		0.00 21.50	21.50 25.00	173210			_ooby ARUP J.V.						Drill	er: cc/AH+
Notary Drining	Come	iccinc	3 403	21.50	25.00	Ground	l Level: L mOD	Dates:	2017 - 09/09/2017							ger: SG
Depth	Sample /	Casing Depth	Water Depth (m)	Field Re	cords	Level	Depth (m)	Lagand	2017 - 09/09/2017		Description				-	Backfill
(m)	Tests	(m)	(m)	rieiu ne	corus	(mOD)	(Thickness)	×	Very stiff brown slightly				d is fine to	coarse.	M .	ackiiii
21.00 - 21.45	B7 SPT (S) N=49	21.0 0		N=49 (6,9/11,11,1	12 14)	-23.21	21.00	* × * * * * * * * * * * * * * * * * * *	Gravel is subrounded fi Dense brown very sand cobble and boulder cor	ne to coa ly silty su	irse. brounded f	ine to coa	rse GRAVEL	with low		.21.0
	B33	U		(0,9/11,11,	13,14)			a × ° a × 8 a × ° a × 8	are subangular to subro	ounded.						21.5
	SPT (C) N=44	22.0 0		N=44 (5,7/7	7,9,13,15)			a X a X 3								22.0
								a × ° ° × ° ° × ° ° ° ° ° ° ° ° ° ° ° °								22.5
	SPT (C)	23.0		50 (6,15/50 200mm)	for		(4.00)	\$ X								23.0
3.50 - 25.00	B34							4 X 4X 9								23.5
4.00 - 24.44	SPT (C)	24.0 0		N=50 (7,6/5 295mm)	50 for		<u>-</u>	4 X								24.0
								9 X								. 24.5
25.00 - 25.44	SPT (C)	25.0 0		N=50 (8,8/5 285mm)	50 for	-27.21	25.00	a X:		End of E	Borehole at	25.00m				25.0
																25.5
																26.0
																26.5
																27.0
																27.5
																28.0
																28.5
							_									29.0
																29.5
																30.0
																30.5
																31.0
emarks									Core Barrel			Strikes				Details
eck to Bed = 8.7	70m								Core Barrer	Struck at (m)) Casing to (m)	Time (min)	Rose to (m)	From (m) 21.45	To (m 21.50	Time (hh:n
									· -	Wate	r Added	Casing	g Details	-		
									Flush Type	From (m)		To (m)	Diam (mm)	4	1	1

207	7-1				X	Project		-	t Name:			- 6 !! -					ole No.
C C C C C C C C C C C C C C C C C C C	CAL	JS	E	VAY		17-016				ge Scheme	Marine	Outfall G	· I			B	3H05
		— C	EO	TECH		Coordi		Client: Irish W								Shee	et 1 of 3
Method	Pla	nt U	sed	Тор	Base	32553			s Represe	entative:						Scale:	1:50
Cable Percussion	n Dar	ndo 3	000	0.00	19.30	17326	9.59 N		Looby AR							Drillo	r: CC/SJ+SS
Rotary Percussio Rotary Coring			o 405 o 405		22.50 24.00	Ground		Dates:									
Donath	Comple	Carina					mOD		/2017 - 21 T	1/09/2017						Logge	r: SG
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legend				Description				Mater Ba	ckfill
0.00 - 1.00	В7							×××		dense browni avel is subrou			slightly sil	ty fine to c	oarse		
0.50	ES1							*.`* *									0.5
								××××									
1.00	D13							× × × × ×									1.0 -
1.00 - 2.00 1.00 - 1.45	B8 SPT (S)	1.00		N=14 (2,3/3	3,3,4,4)		(2.70)	× × × × × × × × × × × × × × × × × × ×									
1.50	N=14 ES2							`* * ` * * * *									1.5
								$\times \times \times$									
2.00 2.00 - 2.45	D14 SPT (S)	2.00		N=19 (2,3/4	1,4,5,6)		-	$\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}$									2.0 -
2.20 - 3.50	N=19 B9			.,,				*, * . × * * *									
2.50	ES3					-7.55	2.70	* * ×									2.5
3.00	D15							× × × × ×		dense browni avel is subrou			siightly gra	velly fine to	o coarse		30-
3.00 - 3.45	SPT (S)	3.00		N=16 (1,2/3	3,4,4,5)			× × ×									
3.50	N=16 ES4							`x * * ` * * * *									3.5
								$\times \times \times$									
4.00	D16						(2.50)	$\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}$									4.0 -
1.00 - 4.45	SPT (S) N=24	4.00		N=24 (3,4/5	5,6,6,7)			*, * . × * * *									
4.50	ES5						-	$\overset{\times}{\times}\overset{\times}{\times}\overset{\times}{\times}$									4.5
								× × × × ×									
5.00 5.00 - 5.45	D17 SPT (S)	5.00		N=28 (2,3/6	5679)			× × × × ×									5.0 -
	N=28	3.00		14-20 (2,3)	,,0,1,5,	-10.05	5.20	×××		ey very sandy ne to coarse.	slightly s	ilty subrour	nded fine to	o coarse Gl	RAVEL.		
5.20 - 6.00 5.50	B10 ES6							^` . * × * .×	Sanaisin	ic to coarse.							5.5
5.00 - 6.45	CDT (C)	6.00		N-26 /4 6/3	7 0 0 11)			× × ×									
5.00 - 6.45	SPT (S) N=36	6.00		N=36 (4,6/7	,9,9,11)			× × ×									6.0 -
							(2.20)	×·×·×									6.5
								××××									
7.00 - 7.45	SPT (S)	7.00		N=43				× ^ × ×									7.0 -
	N=43			(6,9/9,10,13	1,13)			× × ×									
7.40 - 7.90	B11					-12.25	7.40	× × ×		ish brown slig					ne to		7.5
7 90 - 9 00	B12					_12.75	(0.50)	$\times \times $		ravel is suban							
7.90 - 9.00 8.00	D18					-12.75	7.90			dense browni Sand is fine to		ery sandy s	ubrounded	fine to co	arse		8.0 -
8.00 - 8.45	SPT (S) N=12	8.00		N=12 (2,2/3	3,3,3,3)		(1.10)										
							(1.10)										8.5
0.00	D10					12.25	0.00										
9.00 9.00 - 10.00	D19 B20			:= :		-13.85	9.00	a		dense browni							9.0 -
9.00 - 9.45	SPT (S) N=15	9.00		N=15 (1,2/3	3,3,4,5)			a . ° ° ° °	0	are subround			2 0 (9.5
							(2.40)		9								
10.00 - 11.00	B21							8 9 0									10.0 -
10.00 - 10.38	SPT (C)	10.0 0		N=50 (5,6/5 230mm)	60 for			9 9 0	9								
		,		=30mm)							ī	147 -	Caulte		A 1.	a a ll'a a a	-4-11-
lemarks Deck to Bed = 9.0	60m								(Core Barrel	Struck at (m) Casing to (m)	Strikes Time (min)	Rose to (m)	From (m) 19.10	To (m) 19.30	Time (hh:mi
٥.										SK6L					19.10	19.30	01:00
										Flush Type	Wate	r Added	Casing To (m)	Diam (mm)			
										••	rrom (m)	10 (M)	7.50	250	1		

200						Project		_	t Name:							ole No.:
C C C C	CAL	JS	E	VAY		17-016			Sewerage Scheme	Marine	Outfall G	l			E	3H05
		-G	EO	TECH		Coordi		Client: Irish W							Shee	et 2 of 3
Method	Pla	nt Us	sed	Тор	Base	32553			s Representative:						Scale:	1:50
Cable Percussion	n Dan	do 3	000	0.00	19.30 22.50	173269	9.59 N	Byrne	_ooby ARUP J.V.						Drille	r: CC/SJ+SS DR+SJ/CC
Rotary Coring	Coma				24.00	Ground		Dates:							Logge	
Depth	Sample /	Casing Depth	Water	F: 110		-4.85	Depth (m)		2017 - 21/09/2017 							
(m)	Tests	(m)	Water Depth (m)	Field Re	ecoras	(mOD)	(Thickness)	Legend	Medium dense brown		Description		to coarse (GRAVFI	Nater Ba	ckfill
11.00 - 11.45	B22 SPT (C) N=18	11.0 0		N=18 (2,3/4	1,4,5,5)	-16.25	11.40		with low cobble and b boulders are subround Very stiff brown slight	oulder co ded to rou	ntent. Sand nded.	is fine to o	coarse. Cob	bles and		10.5 - 11.0 -
	B23 SPT (C)	12.0 0		50 (25 for 140mm/50 150mm)	for				is subrounded fine to	coarse.						12.0
	B24 SPT (C)	13.0 0		50 (8,12/50 175mm)) for		(4.00)									13.0
	14.31 SPT (C) 14.0 50 (9,13/50 for 160mm) 15.32 SPT (C) 15.0 50 (7,11/50 for) for											14.0		
15.00 - 15.32	SPT (C)	15.0 0		50 (7,11/50 170mm)) for											15.0 —
						-20.25	15.40 (0.60)		Very stiff brown sandy subangular to subrour			s fine to co	oarse. Grave	el is		15.5 -
	B26 SPT (C)	16.0 0		50 (7,10/50 175mm)) for	-20.85	- 16.00		Dense brown very san cobble and boulder co are subrounded to rou	ntent. Sai						16.0
17.00 - 18.00	D28 B27 SPT (C)	17.0 0		50 (5,8/50 f 165mm)	for		(3.10)									17.0 —
18.00 - 18.45	D29 SPT (C) N=47	18.0 0		N=47 (4,9/9,11,1	2,15)											18.0 —
	D30 D31					-23.95	19.10 (0.20)		POHIDERS							19.0 —
	SPT (C)	19.0 0		50 (25 for 135mm/50 25mm)	for	-24.15	(0.20)	a x a x a x a x a x a x a x a x a x a x	Very dense brown san with low cobble and b boulders are subround	oulder co	ntent. Sand					19.5 -
							(1.50)									20.0 -
Remarks						ı		1	Core Barrel			Strikes			selling D	
Deck to Bed = 9.6	50m								SK6L	Struck at (m) Casing to (m)	Time (min)	Rose to (m)	From (m) 19.10	To (m) 19.30	Time (hh:mm 01:00
erminated on in									Flush Type	Wate From (m)	To (m)	To (m) 19.30	Diam (mm)]		

							Projec	t No.:	Project	t Name:	Borehole	e No.:
		۸ı	IS	E	WAY		17-016	57	Arklow	Sewerage Scheme Marine Outfall GI	ВНО)5
		-10	_G	FO	TECH		Coordi		Client:		Sheet 3	3 of 3
					712011		32553	3.31 E	Irish W	'ater		
Method			nt Us		Тор	Base	17326	9.59 N		·	Scale:	1:50
Cable Percussion Rotary Percussion			do 30	000 5 405	0.00 5 19.30	19.30 22.50				Looby ARUP J.V.	Driller:	CC/SJ+SS/
Rotary Coring				405		24.00			Dates:			
Depth	Com	ple /	Casing	Water			-4.8	5 mOD Depth (m)	19/09/		Logger:	30
(m)	Te	sts	Depth (m)	Depth (m)	Field Re	cords	(mOD)		Legend		ਬੱ Backfi	ill
20.80 - 20.92	100		0	16	50 (50 for 100mm/50 20mm)	for	-25.65 -27.35	(1.70)		Very dense brown sandy slightly silty subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded. Very dense brown gravelly silty fine to coarse SAND with low cobble and boulder content. Gravel is subrounded fine to coarse. Cobbles and boulders are subrounded to rounded. Medium strong dark bluish grey AMPHOLITE. Partially weathered with heavy orangish brown staining on surfaces. Discontinuities: 1. 0 to 20 joints, closely spaced 20/60/160, undulating rough closed with heavy orangish brown staining. 2. 70 to 90 degree joints, undulating, rough, closed with heavy orangish		21.0
				10						brown staining.		23.5 —
24.00							-28.85	24.00		End of Borehole at 24.00m	50.55	24.0
												24.5 —
								-				25.0 —
								[1 3
												25.5 —
								Ē				1 3
								<u> </u>				26.0 —
								E				1 3
								Ė				26.5
								-				
												27.0 -
								Ē				
												27.5
												28.0 —
								E				=
								[28.5
								E				
								<u> </u>				29.0 —
								E				
								E				29.5
								E				
								<u> </u>				30.0
								E				
								E				30.5
								E				
								<u> </u>				31.0 -
	TCR	SCR	RQD	FI								
Remarks Deck to Bed = 9.	60m									SK6L Struck at (m) Casing to (m) Time (min) Rose to (m) From (m) 19.10	To (m) Ti	me (hh:mm) 01:00
										From (m) To (m) To (m) Diam (mm)		
Terminated on ir	nstru	ction	of E	ngine	eer							

						Project		-	t Name:							ole No.:
CKX (CAL	JS	E	VAY		17-016			Sewerage Scheme	Marine	Outtall G	ol .			B	H06
		-G	EO	TECH		Coordi 32563		Client: Irish W							Shee	t 1 of 3
Method	Pla	nt U	sed	Тор	Base	1			s Representative:						Scale:	1:50
Cable Percussion	n Dan Coma	ido 2		0.00	17.00 25.20	17329		Byrne	Looby ARUP J.V.						Driller	: CC+SS
Rotary Drilling	Coma	accill(U 4US	17.00	25.20		d Level:	Dates:								
Depth	Sample /	Casing	Water			-5.62 Level	2 mOD Depth (m)		/2017 - 29/09/2017 						Logge	
(m)	Tests B1	Depth (m)	Water Depth (m)	Field Re	ecords	(mOD)	(Thickness)	Legend	Black very gravelly sligi	htly cilty	Description		ith shall fra	aments	N Sac	kfill –
0.00 - 1.00	ы						(0.50)	* * * * *	Gravel is subrounded f			SE SAIND W	itii sileli ile	iginients.		
0.50	ES29					-6.12	0.50	* × ×	Medium dense dark gr	ey slightl	y gravelly s	lightly silty	fine to coa	rse SAND	-	0.5 -
							<u> </u>	× × × × × ×	with occasional shell fr	ragments	. Gravel is s	ubrounded	fine to me	dium.		
II	D2 SPT (S)	1.00		N=16 (2,3/3	3,4,4,5)		<u> </u>	^x * * * ×								1.0 —
	N=16 B3			, , ,				$\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}{\overset{\times}$								
II	ES30						Ē	*. *. *.								1.5 -
2.00	D4							× × ×								2.0 —
2.00 - 3.00	B5 SPT (S)	2.00		N=17/1 2/2	2 5 6 (Ē	× × ×								
	N=17	2.00		N=17 (1,2/3	(0,د,د,		(3.90)	××××								2.5 -
2.50	ES31							^* * * * * * * * * * * * * * * * * * *								
	D6						-	* * * * .×								3.0 —
3.00 - 3.45	B7 SPT (S)	3.00		N=26 (4,5/5	5,6,7,8)		[××××								
	N=26 ES32						<u> </u>	$\overset{\circ}{\overset{\times}{\overset{\times}{\overset{\times}}{\overset{\times}{\overset{\times}}{\overset{\times}}}}{\overset{\times}{\overset{\times}}{\overset{\times}{\overset{\times}{\overset{\times}}}}}}}$								3.5 -
							<u> </u>	$\overset{\star}{\times}\overset{\times}{\times}\overset{\times}{\times}$								
	D8 SPT (S)	4.00		N=19 (1,2/3	3,5,5,6)		<u></u>	*								4.0 —
	N=19 B9					-10.02	4.40	× × ×	Medium dense dark gr	ev verv g	ravelly sligh	ntly silty fir	e to coarse	SAND	-	
II	ES33						(0.60)	^x * * * ×	with shell fragments. G					371142		4.5
5.00	D10					-10.62	5.00		NA adiama da manda da mana	-1		1:-1-41:14-		J 6: +-	_	5.0 —
	B11 SPT (S)	5.00		N=16 (2,3/3	3.4.4.5)		(0.50)	×· × ×	Medium dense browni coarse GRAVEL with oc							
	N=16 ES34			- ()-/-	-, , ,-,	-11.12	5.50	×××	Medium dense browni	ish grev s	andv subro	unded fine	to coarse	GRAVEL	-	5.5 -
5.50	2334						(0.70)	a ° a °	with low cobble conter							
	D12 SPT (S)	6.00		N=27 (4,5/6	5678)		-	a ° a °	Tourided.							6.0 —
	N=27	0.00		14-27 (4,5)	3,0,7,0,	-11.82	6.20		Stiff to very stiff brown cobble and boulder co							
0.20 - 7.00	B13						E		fine to coarse. Cobbles							6.5 -
7.00 - 7.45	U27	7.00		Ublow=175	100%											70-
7.00 - 7.43	027	7.00		ODIOW-173	100%											7.0
7.50	D14															7.5
II	B35						-									
	B36															8.0 —
	SPT (S) N=43	8.00		N=43 (5,7/9,11,1	1,12)		(6.40)									
							[8.5 -
II	B20 SPT (S)	9.00		N=46			-									9.0
I	N=46			(4,6/8,11,1	3,14)											
							-									9.5 -
10.00	D19															10.0 —
I	SPT (S)	10.0		50 (8,10/50) for											
		U		200mm)												
Remarks Deck to bed = 12	.00m								Core Barrel	Struck at (n	Waten Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm
														6.60 16.80	7.00 17.00	02:00 01:30
									Flush Type	Wate	er Added	Casing To (m)	Diam (mm)			
									1	From (m)	10 (M)	7.00	250	1		

200					\	Project		_	Name:							ole No.:
CHOCK!	CAL	JS	E\	VAY		17-016			Sewerage Scheme	Marine	Outfall G	l			В	H06
		-G	EO	TECH		Coordii		Client: Irish W	ater						Shee	t 2 of 3
Method	Pla	nt Us	ed	Тор	Base	1			Representative:						Scale:	1:50
Cable Percussion Rotary Drilling	Dan	do 20		0.00 17.00	17.00 25.20	173292	2.69 N	Byrne l	ooby ARUP J.V.						Driller	: CC+SS
notary Drilling	Come	CCITIC	7403	17.00	25.20	Ground		Dates:	2017 20/00/2017						Logger	
Depth :	Sample /	Casing	Water	F: 110		-5.62	2 mOD Depth (m)		2017 - 29/09/2017						<u> </u>	
(m) 10.50 - 11.50	Tests B18	Depth (m)	Water Depth (m)	Field Re	ecoras	(mOD)	(Thickness)	Legend	Stiff to very stiff brown		Description andy slight		silty CLAY	with low	S Bac	kfill
I	D17 SPT (S)	11.0 0		50 (7,11/50 150mm)) for				cobble and boulder cor fine to coarse. Cobbles	ntent. San	d is fine to	coarse. G	ravel is sub	rounded		10.5 11.0 -
12.00 - 12.10	U28	12.0 0		Ublow=50 (0%											: 12.0 -
2.50 - 12.72	D16 SPT (S) B15	12.0 0		50 (25 for 125mm/50 100mm)	for	-18.22	12.60	× × × × × × × × × × × × × × × × × × ×	Very dense brown very medium GRAVEL. Sand			lar to subi	rounded fir	ie to		12.5
.3.50 - 13.95	SPT (S) N=45	13.5 0		N=45 (6,8/10,10,2	11,14)	-19.12	13.50	× × × × × × × × × × × × × × × × × × ×	Dense brown sandy slig GRAVEL with low cobbl	le and bou	ulder conte	nt. Sand is			_	13.5
14.50	B26 D25 SPT (C)	14.5		N=49			(1.50)	a X	Cobbles and boulders a	are subrol	anueu (O fC	ounded.				14.0 -
.5.00 - 16.00	N=49 B24	0		(8,10/11,11	.,13,14)	-20.62	15.00	**************************************	Dense greyish brown so with low cobble and bo boulders are subround	oulder con	ntent. Sand				-	15.0
15.50 - 15.95	D23 SPT (C) N=36 B22	15.5 0		N=36 (4,6/7	7,9,9,11)		(2.00)									15.5 16.0 ·
.6.50 - 16.95	D21 SPT (C) N=47 SPT (S)	16.5 0 17.0 0		N=47 (5,8/10,11,2 50 (25 for 2 50 (25 for 2 for 30mm) for 30mm)		-22.62	17.00		Brown and dark grey vicoarse GRAVEL of mixe						=	16.5 17.0 -
	33						(1.50)									17.5 18.0 -
18.50 - 18.82 - 18.50				50 (8,12/50 170mm)) for	-24.12	18.50		NO RECOVERY							18.5
	TCB SCB	BOD	FI													19.0 · 19.5 · 20.0 · 20.5
Remarks	TCR SCR	KŲD	FI					<u> </u>	Core Barrel			Strikes			elling De	
Deck to bed = 12.	.00m								Core parrel	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m) 6.60 16.80	To (m) 7.00 17.00	7 Time (hh:mr 02:00 01:30
			า						Flush Type	Water From (m)	r Added To (m)	To (m) 17.00	Diam (mm)	1		

							Project	: No.:	Project	t Name:			В	orehole	No.:
A R		N I	IC	E	MAY		17-016	7	Arklow	Sewerage Scheme	Marine Outfall G	I		вно	6
		-10	JS –G	EO	WAY TECH		Coordi		Client:					Sheet 3	of 3
							32563	T.10 L	Irish W						
Method Cable Percussion			nt U s do 20			Base 17.00	17329	2 CO N		s Representative: Looby ARUP J.V.			S	cale:	1:50
Rotary Drilling				405		25.20	Ground		Dates:				D	riller: (CC+SS
										2017 - 29/09/2017			L	ogger: S	SG
Depth (m)	TCR	SCR	RQD	FI	Field Reco	rds	Level (mOD)	Depth (m) (Thickness)	Legend		Description	1	Water	Backfi	II
24.50 - 24.80 24.50 25.20			RQD	FI	50 (8,13/50 fo 155mm)	r	-30.12 -30.82	(6.00)		Orangish brown and grounded fine to coarse ampholite. Sand is fine	e GRAVEL of mixed litter to coarse. End of Borehole at	Strikes Time (min) Rose to (m) Fr	Chisell rom (m)	ing Detail To (m)	me (hh:mm)
Deck to bed = 12	.00n	n									Struck at (m) Casing to (m)		6.60	7.00	02:00
Terminated at sched	uled o	lepth								Flush Type	Water Added From (m) To (m)	Casing Details To (m) Diam (mm)	16.80	17.00	01:30
atea at seneu		- 111													

					Project	t No.:	Projec	: Name:	Borehole No
(KC)	CAL	IS	E	VAY	17-016	57	Arklow	Sewerage Scheme Marine Outfall GI	ВН07
		–G	EO	TECH	Coordi	nates:	Client:		Sheet 1 of
					32594		Irish W		
Method		nt Us		Top Base	17331	0.24 N		s Representative:	Scale: 1:50
Cable Percussior Rotary Coring	n Dan Coma	ido 30 acchie		0.00 12.50 12.50 18.50			-	ooby ARUP J.V.	Driller: CC+
notary comis	Come	iccinc	, 103	12.30		d Level:	Dates:		Laggary CC
5 11	<u> </u>	Casing				7 mOD		2017 - 10/10/2017	Logger: SG
Depth (m)	Sample / Tests	Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)		Description	Backfill
0.00 - 1.00	B1							Loose dark grey very sandy slightly clayey subrounded fine to coarse GRAVEL with shell fragments. Sand is fine to coarse.	
						Ē		GIVANTE MICH SHEIF HABITIERIS. Salid IS TITLE to Coalse.	
0.50	ES21					(1.00)			0.
						-			
	D11 B2				-10.27	1.00		Loose grey very sandy slightly clayey subrounded fine to coarse GRAVEL	1.
1.00 - 1.45	SPT (S)	1.00		N=6 (2,2/2,1,1,2)		Ē		with shell fragments. Sand is fine to coarse.	
II	N=6 ES22					Ė			1.
						(1.50)			
	D12					<u> </u>			2.
	SPT (S) N=9	2.00		N=9 (1,1/2,2,2,3)		Ē	<u> </u>		
2.50	ES23				-11.77	2.50		Soft to firm grey slightly sandy slightly gravelly silty CLAY. Sand is fine to	2.
2.50 - 3.00	B3					Ė	X	coarse. Gravel is subrounded fine to coarse.	
3.00	D13					(1.00)	X		3.
3.00 - 3.50	B4	3.00		N-12 /2 2/2 2 2 4\		Ė	X		
	SPT (S) N=13	3.00		N=13 (2,2/3,3,3,4)	-12.77	3.50	× ×		3.7
	ES24 B5				12.77	5.50	a X , aX ?	Medium dense grey slightly silty sandy subrounded fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse. Cobbles are	
	D14					Ė	a X , aX ?	subrounded to rounded.	4.
4.00 - 5.00	B6					Ė	a X , aX ?		
II	SPT (S) N=17	4.00		N=17 (2,3/4,4,4,5)		(1.80)	a×. ,a×.		
II	ES25					Ē	a X , aX ?		4.
						Ė	a X , a X ,		
	D15 SPT (S)	5.00		N=27 (3,4/5,7,7,8)		-	a X , a X ,		5.
	N=27			(-, , -, , , -,	-14.57	5.30	×, ×,	Medium dense brownish grey very gravelly silty fine to coarse SAND.	
	B7 ES26					Ē	`x	Gravel is subrounded fine to coarse.	5.
						(0.90)	`x * * * * * * * * * * * * * * * * * * *		
	D16 SPT (S)	6.00		N=33 (4,5/6,7,9,11)		Ė	`x		6.
	N=33	0.00		14-33 (4,3/0,7,3,11)	-15.47	6.20	. × ×	Dense greyish brown very silty slightly gravelly fine to coarse SAND. Gravel	
	B8 B9				-15.87	(0.40) 6.60	`* * `	is subrounded fine.	6.
5.00 0.00	55				15.07	0.00	×	Very stiff brown slightly sandy silty CLAY. Sand is fine to coarse.	
	D17					E	×		7.
	SPT (S) N=33	7.00		N=33 (3,6/6,8,9,10)		(1.40)	×		
						ŧ · · · ·	××		7.
						E	××		
3.00	D18				-17.27	8.00	<u>×</u>	Vany etiff brown clightly conductionable groundly siles CLAV Conditions	8.
3.00 - 8.45	SPT (S) N=37	8.00		N=37 (4,5/7,9,10,11)		Ē	×	Very stiff brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.	
	14-37					(1.00)	X		8.
						Ė	×		
9.00	D19				-18.27	9.00	×		9.
9.00 - 10.00	B10	0.5-			10.27	E 5.55		Very stiff brown slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse.	
II	SPT (S) N=47	9.00		N=47 (6,7/9,11,13,14)		Ē		Cobbles are subrounded to rounded.	9.
						(2.60)			9.
10.00	D20					Ė.			
	D20 B27					E	ا من من المنظم		10.
II	SPT (S)	10.0 0		50 (6,10/50 for 225mm)		-	చింది.		
Remarks		Įυ		<u> </u>		I	<u> </u>		elling Details
Deck to Bed = 14	.20m							Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	To (m) Time (hh 12.50 02:0
								Flush Type Water Added Casing Details From (m) To (m) To (m) Diam (mm)	
rminated after	b.Om co	re re	cover	ed on instruction of	Enginee	r due to pro	olonged	period i Table 1	1

							Project			Name:	Bor	ehole	
KX I	C	AL	JS	E١	VAY		17-016 Coordi		Arklow Client:	Sewerage Scheme Marine Outfall GI	\vdash	вно	1/
			-G	EO	TECH				Irish W	ater	Sł	neet 2	of 2
Method		Plar	nt Us	ed	Тор	Base	325942			s Representative:	Sca	le: í	1:50
Cable Percussion	ı	Dan	do 30	000	0.00	12.50	173310	0.24 N		ooby ARUP J.V.	-	ler: (
Rotary Coring	C	oma	cchic	405	12.50	18.50	Ground		Dates:				
Donath	Sam	-1- /	Carlan					7 mOD	09/09/	2017 - 10/10/2017	+	ger: S	SG
Depth (m)	Te		Casing Depth (m)	Water Depth (m)	Field Re	cords	Level (mOD)	Depth (m) (Thickness)		Description	Water	Backfi	II
11.00 - 11.35 11.00 - 11.60 11.40 11.60 - 12.50	U32 B28 D30 B29		11.0 0		Ublow=89 7	'0%	-20.87	11.60		Very stiff brown slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles are subrounded to rounded. Weathered AMPHIBOLITE bedrock. Recovered as grey slightly sandy angular fine to coarse gravel. Sand is fine to coarse.	_		10.5 11.0 11.0 11.5
12.00 12.00 - 12.14	D31 SPT	(S)	12.0 0		50 (25 for 7 for 70mm)	5mm/50		(0.90)					12.0
	87	15	0	NI 20	,		-21.77	12.50		Very weak orangish brown BRECCIA. Partially with orange staining on fracture surfaces. Discontinuities: 1. 0 to 30 degree joints very closely spaced 5/10/70 planar rough closed with orange staining 2. Subvertical joints, planar rough, with orange staining on surfaces.	=		12.5 13.0
14.00				NI									/. 14.0
15.50	100	37	27	20				(4.10)					14.5 15.0 15.5
25,50	97	13	0	NI									16.0
17.00				20			-25.87	16.60		Very weak to weak highly fractured orangish brown and dark brown occasionally bluish grey SLATE. Partially weathered with heavy dark brown and orange staining on fracture surfaces. Discontinuities:	_		16.5 17.0
	100	18	0	20				(1.90)		 0 to 30 joints very closely to closely spaced 5/10/50, planar, rough closed with heavy dark brown staining. 50 to 80 joints very closely to closely spaced, 5/60/100, planar, rough with heavy orangish brown staining. Subvertical joint, planar rough, closed with heavy orangish brown staining. 			17.5
18.50							-27.77	18.50		End of Borehole at 18.50m			18.5
Remarks Deck to Bed = 14			RQD	FI						Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	Selling To (r		20.0 20.5 ils me (hh:r
Terminated after of inclement wea					ed on instr	uction of	Enginee	due to pro	olonged	Flush Type Water Added Casing Details	16.		00

20					\	Project		_	: Name:							ole No.
HXX.	CAL	JS	E	VAY		17-016			Sewerage Scheme	Marine	Outfall G	ol			B	H08
		-G	EO	TECH		Coordi 32578		Client: Irish W	ater						Shee	et 1 of 3
Method	Pla	nt Us	sed	Тор	Base	1			Representative:						Scale:	1:50
Cable Percussion	n Dan	ido 3	000	0.00	14.50	17326	2.57 N		ooby ARUP J.V.						Driller	
Rotary Coring	Coma	acchi	405	14.50	26.50	Ground	d Level:	Dates:								: CC+S
- 1		.1					7 mOD		2017 - 09/10/2017						Logge	r: SG
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legend			Descriptio				N ate	ckfill
0.00 - 1.00	B1							× × ×	Medium dense dark gr GRAVEL with shell frag				led fine to	coarse		
0.50	FS25							×. ×. ×								0.5
3,50	2020						(1.50)	× × ×								
1.00	D16						(1.50)	×. ×. ×								1.0
1.00 - 1.45	SPT (S)	1.00		N=14 (2,3/3	3,3,4,4)		-	× × ×								
	N=14 ES26					-8.57	1.50	×·×·×			110			CA1:-		1.5
	B2						====	× × ×	Medium dense dark gr with shell fragments. G					SAND		
2.00	D17						(0.80)	* * * * * *	_							2.0
2.00 - 2.45	SPT (S)	2.00		N=17 (1,3/3	3,4,5,5)	-9.37	2.30	××××								
2.30 - 3.00	В3					-9.3/	2.30	×××	Medium dense dark gr occasional shell fragme					ID with		2.5
2.50	ES27							× × ×	, , , , , , , , , , , , , , , , , , ,	5141	,5 54610					
3.00	D18	Tests (m)				`								3.0		
	SPT (S) N=21	3.00		N=21 (2,4/4	1,5,6,6)		(1.70)	××××								
3.30 - 4.00	B4							* * * * *								3.5
3.50	ES28							× × × × ×								
	D19					-11.07	4.00	×××	Medium dense browni	ch grows	anı candı -	ubrounds	l fine to a	arco		4.0
	SPT (S)	4.00		N=28 (3,3/6	5,7,7,8)		(0.50)		GRAVEL. Sand is fine to		ery sandy s	ubrounded	i fine to co	arse		
	ES29					-11.57	4.50		Vary stiff brown slight	u cando -	lightly again	ally click*!	cilty CLAY	with low		4.5
1.50 - 5.00	B5							×	Very stiff brown slightly cobble content. Sand is	fine to c	oarse. Grav	vel is subro				
	U31			Ublow=80 (0%		-	φ <u>, ο</u>	medium. Cobbles are s	ubround	ed to round	ded.				5.0
5.00 - 6.00	B6						E	× × ×								
	D20						<u> </u>	<u> </u>								5.5
	ES30 SPT (S)	5.50		N=45			(2.50)	<u> </u>								
	N=45 B7				2,14)		-	× × •								6.0
0.00 7.00	3,							× × 0								
	D21			N. 42			-	<u> </u>								6.5
	SPT (S) N=43	6.50			1,13)		-	× × •								
7.00 - 8.00	B8					-14.07	7.00	\$ 0 0 8 0 0 8 0 0 0 0 0 0 0 0 0 0 0 0 0 0	Very stiff brown slightl	y sandy s	lightly grav	elly silty CL	AY with lov	v cobble		7.0
							F	-0.50 -0.50 -0.50	and boulder content. S medium. Cobbles and	and is fin	e to coarse	. Gravel is	subrounde			
							E	000 800 800 A	mediam. Copples and	Soulders	are subtou	ucu 10 10	anded.			7.5
							[\$ 0 8 0 9								
	D22 B9						_									8.0
3.00 - 8.45	SPT (C)	8.00		N=40 (7,7/8	3,9,11,12)			\$ \$ \$ 8 \$ \$ \$ \$ \$ \$ \$								
	N=40						-	<u>~~~</u> 0								8.5
								\$50°								
9.00 - 10.00	B10						-	~~~~ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~								9.0
							Ė	\$0 \$0 \$0								
								\$ 0 × 8								9.5
								\$ <u>0</u> 20								
	D23 B11						_	8.0×8								10.0
10.00 - 10.45	SPT (C)	10.0		N=34 (4,5/7	7,7,9,11)			~0 <u>~</u> 8								
Remarks	N=34	0									Wate	r Strikes		Chi	selling De	etails
eck to Bed = 11	1.20m								Core Barrel SK6L	Struck at (m	n) Casing to (m)		Rose to (m)	From (m) 14.40	To (m) 14.50	Time (hh:m 01:00
									SK6L							
									Flush Type	Wate	r Added	Casing To (m)	Details Diam (mm)			
			cover							()	. (***)	10.00	250	1	1	1

202					γ	Project		-	Name:	Borehole No.:
XX	CAL	JS	E	VAY		17-016			Sewerage Scheme Marine Outfall GI	BH08
		-G	EO	TECH		Coordi 32578		Client: Irish W	ater	Sheet 2 of 3
Method		nt U		Тор	Base	1			Representative:	Scale: 1:50
Cable Percussion Rotary Coring		do 3	000	0.00	14.50 26.50	17326			ooby ARUP J.V.	Driller: CC+SS
, 5011118	35,110			150	_5.50	Ground -7.0	d Level: 7 mOD	Dates: 08/10/	2017 - 09/10/2017	Logger: SG
Depth	Sample /	Casing Depth	Water Depth (m)	Field Re	cords	Level	Depth (m)	Lagand	Description	backfill Backfill
(m)	Tests	(m)	(m)			(mOD)	(Thickness)	\$ 00 B	Very stiff brown slightly sandy slightly gravelly silty CLAY with low cobble	10.5
11.00 - 12.00	B12								and boulder content. Sand is fine to coarse. Gravel is subrounded fine to medium. Cobbles and boulders are subrounded to rounded.	11.0 -
12.00 12.00 - 13.00 12.00 - 12.45	D24 B13 SPT (C) N=47	12.0 0		N=47 (8,9/11,12,	11,13)		(7.50)			12.0
13.00 - 13.60 13.00 - 14.00	U32 B14			Ublow=90 ()%			\$\frac{1}{2}\frac{1}{2		13.0
14.00 - 14.50	B15					-21.57	14.50		Very stiff brown slightly sandy slightly gravelly CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded of mixed lithologies predominantly slate. Cobbles are subrounded to angular of slate.	14.0 -
	100								predominantly state. Cobbles are subrounded to angular of state.	15.0 – 15.5
16.00	53						(3.00)			16.0 16.5 17.0
17.50	67					-24.57	17.50		Orangish brown and grey slightly sandy subangular fine to coarse GRAVEL of mixed lithologies predominantly quartz and phyllite. Sand is fine to coarse. (Low Recovery)	17.5
19.00							(4.90)			19.0 - 19.5 -
20.50	33									20.0 –
	TCR SCR	RQD	FI							inallia - D : "
Remarks Deck to Bed = 11	L.20m								Core Barrel Water Strikes Ch	To (m) Time (hh:mm 14.50 01:00
									Flush Type Water Added Casing Details From (m) To (m) To (m) Diam (mm) 15 00 200	
erminated after	3.0m co	re re	cover	ed					15.00 200	

							Project	: No.:	Project	t Name:	Boreho	le No.:
22		N I	IC		WAY		17-016	7	Arklow	Sewerage Scheme Marine Outfall GI	BH	108
		-10	_G	E	TECH		Coordi	nates:	Client:		Sheet	: 3 of 3
					/ LCII		32578	9.41 E	Irish W	ater	511000	. 5 01 5
Method		Plai	nt U	sed	Тор	Base	1		Client's	s Representative:	Scale:	1:50
Cable Percussion	- 1		do 3		0.00	14.50	17326	2.57 N	Byrne L	Looby ARUP J.V.	Duillan	CCTCC
Rotary Coring	C	oma	icchi	405	14.50	26.50	Ground	d Level:	Dates:		Driller:	CC+SS
							-7.0	7 mOD	08/10/	2017 - 09/10/2017	Logger	: SG
Depth	TCR	SCR	RQD	FI	Field Re	ecords	Level	Depth (m)	Legend	Description	Bacl	cfill
(m)							(mOD)	(Thickness)		Orangish brown and grey slightly sandy subangular fine to coarse GRAVEL	3	
										of mixed lithologies predominantly quartz and phyllite. Sand is fine to		21.0 —
										coarse. (Low Recovery)		
	20											21.5
									ο			=
22.00												22.0 —
							20.47	22.40				
							-29.47	22.40		Dark yellowish brown slightly clayey firm to coarse SAND.		22.5
	73							(0.70)				
												23.0 —
							-30.17	23.10		Dark yellowish brown and dark bluish grey subangular fine to coarse		
23.50 - 23.66					50 (25 for		-30.57	(0.40)		GRAVEL with low cobble content.		23.5
23.50					110mm/50	for	30.37	25.50		Weak highly fractured dark orangish brown SLATE. Partially weathered with weathering penetrating in from fracture surfaces.		
					55mm)			(0.90)	$\langle \hat{\chi} \hat{\chi} \hat{\chi} \hat{\chi} \hat{\chi} \hat{\chi} \hat{\chi} \hat{\chi}$	Discontinuities:		-
									\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\	1. 0 to 40 degree joints very closely spaced, 2/10/20, planar, smooth, closed wit heavy orangish brown staining.		24.0 —
	100	0	0				-31.47	24.40		2. 50 to 80 degree joints, very closely spaced 2/10/20, planar, smooth,		
				NI			31.47	24.40		closed with heavy orangish brown staining 3. Subvertical joint planar, smooth, closed with heavy orangish brown		24.5 —
										staining.		
25.00								-		Weak highly fractured dark bluish grey SLATE. Largely unweathered. Discontinuities:		25.0 —
								(2.50)		1. 0 to 20 joints very closely spaced 5/30/50, planar, smooth closed.		
										2. Subvertical joints, planar occasionally undulating smooth closed.		25.5
	100	0	0					[
	100	0										
				20								26.0
									////// //////			
26.50							-33.57	26.50	$\Delta\Delta\Delta\Delta\Delta$	End of Borehole at 26.50m		26.5 —
								-				27.0 —
								Ē				27.5 —
												28.0 —
												20.0
												=
												28.5 —
								-				29.0 —
												29.5 —
							Ì					30.0 —
												30.5
]
	TCR	SCR	RQD	FI				-				31.0
Remarks	. 511	JUN			I		I		<u> </u>		elling Det	
Deck to Bed = 11	.20r	n								Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	To (m) 14.50	Time (hh:mm) 01:00
										Flush Type Water Added Casing Details From (m) To (m) To (m) Diam (mm)		
Torminet-J.O. 00	no -		o :	4						rountiny to (m) to (m) Diam (mm)		
Terminated after 3.0	rn cor	e reco	overe	1								

20%						Project			Name:								ole No.:
CHO H	CAL	JS	E	WAY	,	17-016			Sewerage So	cheme	Marine	Outfall G				E	H09
		— C	EC	TECH		Coordi 32612		Client: Irish W								Shee	et 1 of 2
Method	Pla	nt U	sed	Тор	Base	1		Client'	Representa	ative:						Scale:	1:50
Cable Percussion Rotary Coring	n Dan Coma	ndo 3		0.00 8.90	8.90 14.30		6.13 N	Byrne l	ooby ARUP	J.V.						Drille	r: AH+SS
notary comig	Come	200111	0 103	0.50	11.50		d Level: 0 mOD	Dates:	2017 - 28/10	1/2017							r: SG+LN
Depth	Sample /	Casing Depth	Water Depth (m)	Field Re	ocords	Level	Depth (m)	Logond	2017 - 26/10	3/2017		Descriptio				-	ckfill
(m) 0.00 - 1.00	Tests B1	(m)	(m)	rieiu iki	ecorus	(mOD)	(Thickness)	Legenu	Medium dens	e grey sli		•		to coarse S	AND with	§ Ba	-
0.50	ES18								occasional lay	ers of gre	y subang	ular to sub	rounded g	rey fine to			0.5
1.00 1.00 - 2.00 1.00 - 1.45	D11 B2 SPT (S) N=19 ES19	1.00		N=19 (3,5/5	5,5,4,5)		(2.80)										1.0 -
2.00 2.00 - 3.00 2.00 - 2.45 2.50	D12 B3 SPT (S) N=18 ES20	2.00		N=18 (2,3/4	4,4,5,5)	10.50											2.0
3.00 3.00 - 4.00 3.00 - 3.45	0 - 4.00 B4 SPT (S) 3.00 N= 0 - 3.45 SPT (S) B20 SE521 0 D14 D - 5.00 B5				4,4,6,6)	-13.60	2.80		Medium dens coarse GRAVE coarse. Cobble	L with lov	v cobble	and bould	er content.	Sand is fin			3.5
4.00 4.00 - 5.00 4.00 - 4.45 4.50	0 D14 B5 A.00 N=: 0 D15			N=24 (3,5/5	5,6,7,6)		(2.40)										4.0 —
5.00 5.00 - 6.00 5.00 - 5.45 5.50	N=24 ES22 0 D15 0 - 6.00 B6 0 - 5.45 SPT (S) 5.00 N=26			N=26 (5,5/5	5,6,7,8)	-16.00	5.20		Stiff to very sti cobble conten fine to coarse.	nt. Sand is	fine to co	oarse. Grav	vel is subar				5.5 -
6.00 - 7.00 6.00 - 6.45 6.50	B7 SPT (S) N=34 D16	6.00		N=34 (5,5/	7,7,8,12)	-17.20	6.40		Very stiff light							_	6.0 - -
7.00 - 8.00 7.00 - 7.32 7.50	B8 SPT (C)	7.00	ı	50 (16,22/5 170mm)	50 for		(1.90)		cobble conten					ounded to r	ounaea		7.0 7.5 -
8.00 8.00 - 8.80	U24 B9			Ublow=75 (0%	-19.10	8.30		Limestone BO	ULDER.						_	8.0 —
8.50 - 8.75 8.80 - 8.90	SPT (C) B10	8.50		50 (22,25/5 100mm)	50 for	40 =0	(0.60) 8.90	0,00	Dorl h	ad til	on di	nde - C		DA\/E' 2	المادية .		8.5 -
	100					-19.70	(1.00)		Dark brown ar coarse. (Possib					kavel. San	a is fine to		9.0 —
9.90			20			-20.70	9.90		Weak to medi Partially weatl								10.0 —
Remarks	TCR SCR	RQD	FI						Coro	Barrel			r Strikes			selling D	
Deck to Bed = 14	1.80m								Core	: parrei	Struck at (m)	Casing to (m		Rose to (m)	From (m) 8.75	To (m) 8.90	Time (hh:mm 01:00
									Flus	h Type	Wate	r Added	Casing To (m) 8.90	g Details Diam (mm) 200	_		

							Project		Project		Во		e No.:
	C	ΔL	JS	E	VAY		Coordi		Client:	Sewerage Scheme Marine Outfall GI	+	ВН	U 3
			— C	EO	TECH		32612		Irish W	ater		Sheet	2 of 2
Method	Ī	Pla	nt U	sed	Тор В	Base	1		Client's	Representative:	Sc	ale:	1:50
Cable Percussion Rotary Coring			ido 3	000 o 405		8.90 .4.30	17331		Byrne I	ooby ARUP J.V.	Dr	iller:	AH+SS
Notary Coming		JOITIC	icciii	0 403	0.50	4.50		d Level:	Dates:	20/10/2017	-		SG+LN
Depth				T T			-10.80	Depth (m)		2017 - 28/10/2017	_		
(m)	TCR	SCR	RQE	FI	Field Recor	rds	(mOD)	(Thickness)		Description surfaces.	Water	Back	nii –
11.20	100	49	0	20 5				(2.50)		Discontinuities: 1. 0 to 20 degree joints, closely spaced (30/100/260) planar, smooth, closed with heavy black staining and patchy orange staining. 2. 50 to 70 degree joints closely to medium spaced (100/160/270) planar rough, closed with heavy black staining and patchy orange staining. 3. Sub vertical joints, planar, smooth, closed with heavy black staining an patchy orange staining.			11.0
12.40	100	81	43	_			-23.20	12.40		Medium strong to strong highly fractured bluish grey AMPHIBOLITE. Partially weathered with dark orange and black staining on fracture surfaces. Discontinuities:			12.5 — ———————————————————————————————————
13.20				川						1. 0 to 20 degree joints, closely spaced (30/100/260) planar, smooth, closed with heavy black staining and patchy orange staining.			13.0 —
				10				(1.90)		2. 50 to 70 degree joints closely to medium spaced (100/160/270) planar rough, closed with heavy black staining and patchy orange staining.			13.5
	91	77	23					-		Substituting and patchy orange staining and patchy orange staining. Substituting an patchy orange staining.	d		
				15						patcny orange stanning. 12.70m: 20 degree joint open approximately 20mm with black sand and gravel infili.			14.0 —
14.30							-25.10	14.30		End of Borehole at 14.30m			
													14.5 — — — —
													15.0 —
													15.5 — — — —
													16.0
													16.5 — — —
													17.0
													17.5 — — —
								<u> </u>					18.0 —
													18.5 —
								_					19.0 —
													19.5 — —
													20.0 —
													20.5
	TCR	SCR	RQD	FI				-					
Remarks Deck to Bed = 14	l ROr	n								Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	To		ime (hh:mm)
Jeck to beu = 14	.our									8.75		.90	01:00
										Flush Type			
Terminated 6.0m into	o bed	rock								14.30 150			

20						Project		_	t Name:						Boreh		
HQH	CAL	JS	F	WAY		17-016			Sewerage Scheme	Marine	Outfall G	I			В	H10	
		— C	EC	TECH		Coordi		Client: Irish W							Shee	et 1 o	of 2
Method	Pla	nt U	sed	Тор	Base	32626	5./4 E		s Representative:						Scale:	1:5	 50
Cable percussion	n Dar	ndo 3	000	0.00	10.00	17335	7.99 N		_ooby ARUP J.V.						Drille		
Rotary Coring	Coma	acchi	o 405	10.00	16.00	Ground	d Level:	Dates:									
			1				7 mOD	26/10/	2017 - 27/10/2017						Logge	r: SG	+LN
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legend			Description				Mater Ba	ckfill	_
0.00 - 1.00	B1							× ×.×	Grey sandy slightly silt with low cobble conte								-
0.50	ES17						(1.10)	× × ×	subrounded.								0.5 -
							(1.10)	× × ×									
1.00	D12					-12.47	1.10	× × ×									1.0 —
1.00 - 1.45	SPT (S) N=7	1.00		N=7 (2,2/2,	1,2,2)	-12.47	1.10	× × 0	Soft grey slightly sandy Sand is fine to coarse.								
1.30 - 1.80 1.50	B2 ES18						(0.80)	× × 0	Cobbles are subangula								1.5 -
	-					-13.27	1.90	× × 0									-
2.00 2.00 - 3.00	D13 B3					13.27	1.50	× ××	Medium dense grey sa coarse GRAVEL with lo								2.0
2.00 - 2.45	SPT (S) N=11	2.00		N=11 (2,3/3	3,2,3,3)			× × ×	subangular to subroun								
2.50	ES19						-	× × ×									2.5
3.00	D14						(2.10)	× × ×									30-
3.00 - 4.00	B4	2.00		N=44/22'	2.4.4			× ^.×									5.0
3.00 - 3.45	SPT (S) N=14	3.00		N=14 (2,2/3	3,3,4,4)												3.5 -
3.50	ES20							× × ×									
1.00	D15					-15.37	4.00	×	Medium dense grey ve	ry sandy	slightly cilts	, subangu	ar to sub-	nunded fine			4.0 —
1.00 - 5.00 1.00 - 4.45	B5 SPT (S)	4.00		N=20 (3,3/5	5,4,5,6)		Ē	a X a X 1	to coarse GRAVEL with	low cobb	le and bou	lder conte	nt. Sand is				
1.50	N=20 ES21			(5,5,5	-, -,-,-,		Ē	a × , a × 0	coarse. Cobbles and bo	oulders ar	e subangul	ar to subro	ounded.				4.5
4.50	E321						(1.40)	a X , a X 8									
5.00	D16						<u>-</u>	a X , a X 8									5.0
5.00 - 5.40 5.00 - 5.45	B6 SPT (S)	5.00		N=20 (3,5/5	5,4,6,5)	-16.77	5.40	a×. , a× 8									
5.50	N=20 ES22					10.77	5.40		Stiff grey slightly sandy Gravel is subangular to				d is fine to	coarse.			5.5 -
5.50 - 6.00	B7						(1.10)										
6.00 - 6.45	SPT (S) N=27	6.00		N=27 (3,4/4	1,6,7,10)		(1.10)										6.0 —
5 50 - 7 20	B8					_17.07	6 50										6.5
5.50 - 7.20	DO					-17.87	6.50	× × 0	Very stiff light brown s cobble content. Sand is								0.5
7.00 - 7.31	SPT (C)	7.00		50 (22,21/5	0 for			× × 0	fine to coarse. Cobbles								7.0 —
-	\-,			160mm)				<u> </u>									
7.50 - 7.95	U23			Ublow=89 (0%			<u> </u>									7.5 -
7.50 - 8.00	В9						<u> </u>	<u> </u>									
8.00 - 8.31	SPT (C)	8.00		50 (21,21/5	0 for		(3.00)	~ ~ ~ ~ .									8.0 —
				160mm)				<u> </u>									
8.50 - 9.20	B10							α <u></u>									8.5 -
							Ē	× × × 0									
9.00 - 9.32	SPT (C)	9.00		50 (21,20/5 165mm)	0 for			× × ·									9.0
250 4000	D11			,		20.07	0.50	× × 0									
9.50 - 10.00	B11					-20.87	9.50		Grey BEDROCK (Slate -	drillers de	escription)						9.5 -
							(0.50) 10.00	^^^^ ^^^									10.0 —
			NI			-21.37	10.00		Weak to medium stror occasional white mine								.5.0
	TCR SCR	RQD	FI					\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\\									
Remarks Deck to Bed = 15	: 20m								Core Barrel	Struck at (m)	Water Casing to (m)	Strikes Time (min)	Rose to (m)	From (m)	elling De	Time ((hh:mm
reck to bed = 15	,.ZUIII													9.85	10.00		1:00
									Flush Type		r Added		g Details				
			_			E '	_		1.23,pc	From (m)	To (m)	To (m) 10.00	Diam (mm) 200				
erminated after	6.Um cc	re re	cove	rea on instr	ucπon of	∟nginee	Γ										

13:00 71 0 10 10 10 10 10 10 10 10 10 10 10 10								Project	No.:	Project	: Name:	Borehole	No.:
Marchael Plant Used Top Base 200 14.00 14.00 15.00 1	A A		N I	IS	E \	MAY		17-016	7	Arklow	Sewerage Scheme Marine Outfall GI	BH1	10
Method Plant Used Top			70	_G	FO	TECH		Coordi				Sheet 2	2 of 2
Cate permation Cate				Ŭ		12011		32626	J. / ¬ L				
Proceded Communication C								17225	7 00 N			Scale:	1:50
Companies Comp										-	-	Driller:	AH+SS
Depth Tota Sch Rug File Sch Rug File Sch Rug	l motary coming		· · · · · ·			20.00	20.00						
Married Section Sect	Domath							_		26/10/	2017 - 27/10/2017 I		SG+LIN
1.00 31 10 10 10 10 10 10	(m)	TCR	SCR	RQD	FI	Field Re	cords		(Thickness)		-	ਛੱ Backfi	
11.50 10.0 33 0 15 10.0													10.5
2. 70 to 90 degree joints typically medium spaced (50/500/-1000) planar. 13.00 70 71 0 0 100 100 0 100 0 100 100 100 10					16					\wedge	1. 10 to 20 degree joints closely spaced, (10,60,100) planar, smooth,		
11.30 No		100	33	0					<u> </u>	$\wedge \wedge \wedge \wedge$			11.0
11.50										/\/\/\/	smooth, closed.		
13:00 100	11.50				NI								11.5
13:00 100													
13.00 100 100 10 10 10 10 10													12.0 —
13.00 100 200 20 20 20 20 20		100	71	0									3
14.50 93 60 0 15.00 End of Borehole at 16.00m Find of Borehole at 16.00m Tore Barrel Tore									<u> </u>				12.5
14.50 93 60 0 15.00 16.00 17.73 = 16.00 End of Borehole at 16.00m End of Borehole at 16.00m 16.00 16.00 End of Borehole at 16.00m 16.00 End of Borehole at 16.00m 16.00													
14.50	13.00												13.0 —
14.50 15.00 16.00 17.00 18									(6.00)				
14.50 93 60 0 -27.37 - 16.00 End of Borehole at 16.00m End of Borehole at 16.00m 16.00 -27.37 - 16.00 End of Borehole at 16.00m 53.3 - 10.00 53.5 -													13.5 —
14.50 93 60 0 -27.37 16.00 End of Borehole at 16.00m 15.5 1		100	100	0									
16:00 End of Borehole at 16:00m End of Borehole at 16:00m End of Borehole at 16:00m 15.5 -					10								14.0
16:00 End of Borehole at 16:00m End of Borehole at 16:00m End of Borehole at 16:00m 15.5 -													
16.00 Find of Borehole at 16.00m 16.00	14.50												14.5 —
16.00 Find of Borehole at 16.00m 16.00													3
16.00 End of Borehole at 16.00m													15.0 —
16.00		93	60	0									
16.00													15.5 —
16.00													
TCR SCR RQD F1	16.00							-27.37	16.00	WW.	End of Rorehole at 16 00m		16.0 —
TOR SCR ROD F											End of Borenoic at 16.00m		1 3
TCR SCR ROD FI													16.5
TCR SCR ROD FI													1 1
TCR SCR RQD FI													17.0 -
TCR SCR RQD FI													1 3
TCR SCR RQD FI													17.5
TCR SCR RQD FI													1
TCR SCR RQD FI													18.0 —
TCR SCR RQD FI													
TCR SCR RQD FI													18.5
TCR SCR RQD FI													
TCR SCR RQD F1													19.0 —
TCR SCR RQD F1													
TCR SCR RQD F1													19.5
TCR SCR RQD FI													‡
TCR SCR RQD FI													20.0
TCR SCR RQD FI													
TCR SCR RQD FI													20.5
Core Barrel Water Strikes Chiselling Details Struck at (m) Casing to (m) Time (min) Rose to (m) From (m) Time (hin:mm) 9.85 10.00 01:00		TCP	SCP	ROD	FI								+=
Deck to Bed = 15.20m Struck at (m) Casing to (m) Time (min) Rose to (m) Time (min) Time (min) Time (min) Time (hih:mm)	Remarks	· UK	JUN	יישט	"				<u> </u>				
From (m) To (m) To (m) Diam (mm) 16.00 150		.20n	n								Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	To (m) Ti	me (hh:mm)
From (m) To (m) To (m) Diam (mm) 16.00 150													
											From (m) To (m) Diam (mm)		
	Terminated after 6.0	m cor	e reco	vered	d on in	struction of Er	ngineer				16.00 150		_ 1

20					\	Project			t Name:	Во	reho	le No.:
	CAL	JS	E\	WAY		17-016			v Sewerage Scheme Marine Outfall GI		ВН	11
		_c	GEO	TECH		Coordi		Client: Irish W		S	heet	1 of 2
Method	Pla	nt U	sed	Тор	Base	32473	0.75 E		s Representative:	Sca	ale:	1:50
Cable Percussio		ndo 3		0.00	10.70	17345	2.99 N		Looby ARUP J.V.	Dri	iller:	ΔΗ
							d Level:	Dates:				
Depth	Sample /	Casing Depth	Water			-0.33	B mOD Depth (m)	02/11,		+	gger:	\neg
(m)	Tests	Depth (m)	Depth (m)	Field Re	ecords	(mOD)	(Thickness)	Legend	Description Medium dense grey very sandy slightly silty subangular to subrounded fine	Water	Back	fill
							-	× × ×	to coarse GRAVEL. Sand is fine to coarse.			
0.50	D1							× × ×				0.5
0.80 - 1.20	ES11 B19						-	×·^·×		•		
1.00 - 1.45	SPT (S)			N=14 (3,3/3	3,4,3,4)		_	× ^ ×				1.0 -
	N=14						-	×				
1.50	D2							×				1.5
1.80 - 2.20	ES12 B20						-	×				
2.00 - 2.45	SPT (C)			N=19 (3,4/5	5,5,4,5)		(4.00)	^ ×				2.0 -
	N=19						-	×××				
2.50	D3						<u> </u>					2.5
2.80 - 3.20	ES13 B21						-					
3.00 - 3.45	SPT (C)			N=20 (4,5/5	5,5,4,6)		_	× × ×				3.0 -
	N=20						-	× × ×				
3.50	D4						-	× × ×				3.5
3.80 - 4.20	ES14 B22						-	××××				
4.00 - 4.45	SPT (C)			N=30 (5,6/7	7,8,7,8)	-4.33	4.00	×	Medium dense grey sandy subangular to subrounded fine to coarse	$\frac{1}{2}$		4.0 -
	N=30						-	, o	GRAVEL with low cobble content. Sand is medium to coarse. Cobbles are subangular to subrounded of mixed lithologies.			
4.50	D5							0 0	Subangular to subrounded of filixed lithologies.			4.5
4.80 - 5.20	ES15 B23						(1.40)	a Pa				
5.00 - 5.45	SPT (C)			N=23 (4,6/6	5,5,6,6)		_	, o o	8			5.0 -
	N=23							, o				
5.50	D6					-5.73	5.40		Stiff grey slightly sandy slightly gravelly CLAY . Sand is fine to coarse. Gravel is subangular to subrounded fine.			5.5
5.80 - 6.20	ES16 B24						-		a is subangular to subrounded fine.			
6.00 - 6.50	U17			Ublow=40	98%		(1.10)					6.0 -
							- -					
6.50	D7					-6.83	6.50	X —	Stiff grey slightly sandy slightly silty CLAY . Sand is fine to coarse.	-		6.5
6.80 - 7.20	B25						-	<u>×_×</u> _	2 , 3 , , , 3 , , , ,			
7.00 - 7.45	SPT (S)			N=27 (5,6/6	6,7,6,8)		_	<u> </u>				7.0 -
	N=27						<u>-</u>	×_×_				
7.50	D8						-	×-^-				7.5
7.80 - 8.20	B26						-	×_^-				
8.00 - 8.50	U18			Ublow=38 9	97%		(3.10)	×				8.0 -
							ŧ	X——— — ×				
8.50	D9							×				8.5
8.80 - 9.20	B27						<u> </u>	~ ×				
9.00 - 9.45	SPT (S) N=27			N=27 (5,7/6	5,6,7,8)		-	×— ×				9.0 -
	IN=2/						<u> </u>	×— ×				
9.50	D10					-9.93	9.60	^x				9.5
9.80 - 10.20	B28						[a , o ,	Dense grey sandy slightly silty subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse.			
								\$ (a) (\ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \ \				
Remarks Drilled from floa	iting nlatf	orm							Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	To		Time (hh:mm
ca nom noa		OHIL							9.60 9.60 20 0.80 0.80 10.50		.90).70	00:30 01:00
									Water Added Casing Details			
Terminated at ==	afueal an	largo	houl	dar					From (m) To (m) Diam (mm)			
Terminated at re	ausai UII	iaige	. DOUI	uci							$ \bot $	

					\	Projec	t No.:	Projec	t Name:						Во	reho	le No.:
	CAL	IS	E	WAY		17-016		Arklow	Sewerage Scheme	Marine (Outfall G	I				ВН	11
		−G	EO	TECH		Coordi	nates:	Client:		<u></u>					S	heet	2 of 2
						32473	0.75 E	Irish W							_		1.50
Method Cable Percussio		nt Us do 30		Top 0.00	Base 10.70	17345	2.99 N		s Representative: Looby ARUP J.V.						Sca	ne:	1:50
						Groun	d Level:	Dates:							Dri	ller:	АН
							3 mOD	02/11/							Lo	gger:	LN
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Re	cords	Level (mOD)	Depth (m) (Thickness)	Legend		D	escription	ı			Water	Back	fill
10.00 - 10.45	SPT (S)	(,	()	N=49	10.15)	(IIIOD)	-	.0 '9	Cobbles and boulders a	re subrou	nded to ro	unded of n	nixed lithol	ogies.	Ĺ		
	N=49			(8,9/10,12,	12,15)		(1.10)	9									
						-11.03	- - 10.70	a ° °	-								10.5
						11.05	- 10.70			End of Bo	orehole at	10.70m					
																	11.0
							-										-
																	11.5 — — —
							-										12.0
							-										12.0
							-										12.5
							-										
							[13.0 —
							-										13.5 —
																	1 3
							-										14.0 —
																	1 3
							-										14.5
							-										
							-										15.0 —
							Ė										1 3
							-										15.5 —
							-										16.0 —
							[
																	16.5 — —
							_										
							-										17.0
							-										17.5 —
							-										
							-										18.0 —
							ŧ										
							-										18.5 —
							<u> </u>										
							-										19.0 —
																	=
							<u> </u>										19.5
							-]
															\vdash		
Remarks	عداد ساط									Struck at (m)	Water Casing to (m)	Strikes Time (min)	Rose to (m)	Chis	ellin To	g Deta	ails Time (hh:mm)
Drilled from floa	ung platfe	orm												0.80 10.50	0. 10	90	00:30 01:00
										Water			Details				
Tammain et e ! . !	fue-1	a	h - '	ما ما ما						From (m)	To (m)	To (m) 10.70	Diam (mm) 200				
Terminated at re	rusar on l	arge	luou	uer													

20		- 1				\	Project			t Name:	Во		le No.:
KQK .	CAI	J	SF	V	VΔY		17-016			sewerage Scheme Marine Outfall GI		ВН	12
			GE	0	VAY TECH		Coordi		Client:		S	heet	1 of 2
							32482	1.38 E	Irish W		_		1.50
Method Cable Percussion			3000		Top 0.00	Base 10.50	17338	9.74 N		s Representative: Looby ARUP J.V.			1:50
Cable Ferensia.			5000		0.00	10.50	Ground	d Level:	Dates:		Dri	iller:	CC
								B mOD	24/08/		Log	gger:	SG
Depth	Sample /	/ Ca:	sing Wat	th	Field Re	cords	Level	Depth (m)	Legend		Water	Back	fill
(m) 0.00 - 1.00	Tests B1	(1	m) (m	1)			(mOD)	(Thickness)		Medium dense brown very sandy slightly silty subangular to subrounded	-		
										fine to medium GRAVEL. Sand is fine to coarse.			
0.50	ES21							(1.30)					0.5
								(1.30)					
1.00 1.00 - 1.45	D10 SPT (S)	1.0	00	1	NI-15 /2 2/2	2 4 4 4)		-					1.0 -
	N=15	1.0	00		N=15 (2,3/3	0,4,4,4)	-2.18	1.30		Medium dense brown sandy slightly silty subangular to subrounded fine to	-		
1.30 - 2.00 1.50	B2 ES22							- - -		medium GRAVEL. Sand is fine to coarse.			1.5
								(1.00)					
2.00	D11												2.0 —
2.00 - 2.45	SPT (S) N=11	2.0	UU		N=11 (1,1/2	2,3,3,3)	-3.18	- - 2.30		Firm to ctiff groy clightly candy CLAV Sand in fine to see the			
2.30 - 3.00 2.50	B3 ES23							- -		Firm to stiff grey slightly sandy CLAY. Sand is fine to coarse.			2.5
2.50	2323							-					
3.00 - 3.45	UT18				Ublow=89 1	100%		-					3.0 —
3.00 - 4.00	B4							- -					
3.50	D12							- -					3.5
	ES24							-					
4.00	D13							- -					4.0 —
4.00 - 5.00 4.00 - 4.45	B5 SPT (S)	4.0	00	1	N=37 (5,6/7	7 9 0 12)		- -					
	N=37	4.			14-37 (3,0/7	,6,5,13)							4.5
4.50	ES25							- -					
5.00 - 5.45	UT19			1	Ublow=83 1	100%		-					5.0 —
3.00 - 3.43	0113				Oblow-03 1	10070		-					
5.50	D14							(6.10)					5.5
	ES26							- -					5.5
5.50 - 6.50	B6							- -					
								-					6.0 —
								-					
6.50 6.50 - 6.95	D15 SPT (S)	6.	50		N=32 (5,4/6	5,8,8,10)		- -					6.5
	N=32							-					
7.00 - 8.00	В7							-					7.0 —
								-					
								-					7.5
								- -					
8.00 - 8.45	UT20				Ublow=61 1	100%		-					8.0 —
8.40 - 9.50	B8						-9.28	- - 8.40					
8.50	D16						-3.40	- 0.40	× × ×	Brown sandy silty subangular to subrounded fine GRAVEL. Sand is fine to coarse.			8.5
								<u>-</u>	× × ×				
								_ (1.10)	× × ×				9.0 —
								-	× × ×				
9.50	D17						-10.38	9.50	\$ X X	Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse.	-		9.5
9.50 - 10.50 9.50 - 9.95	B9 SPT (S)	9.	50		N=11 (2,2/2	2,3,3,3)		(1.00)		Gravel is subangular to subrounded fine to medium.			
	N=11	+		+				-			\vdash		
Remarks		<u>'</u>					1	<u> </u>	1			g Deta	
Deck to Bed = 2.	60m									Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	То	(m)	Time (hh:mm
										Mater Added Cosing Details	ii		
										Water Added Casing Details	1		
Terminated at sc	heduled	de	pth							1.50 9.50	L		

	-					Projec	t No.:	Projec	t Name:						Во	reho	le No.:
ROX.	CAI	IS	E	WAY		17-016			Sewerage Scheme	Marine (Dutfall G	l				ВН	112
		—G	EC	TECH		Coordi		Client:							S	heet	2 of 2
	T					32482	1.38 E	Irish W							-	.1	1.50
Method Cable Percussion	Plar Dan	do 3		Top 0.00	Base 10.50	17338	9.74 N		s Representative: Looby ARUP J.V.								1:50
						Groun	d Level:	Dates:							Dri	ller:	CC
							8 mOD	24/08/							Log	gger:	SG
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Re	cords	Level (mOD)	Depth (m) (Thickness)	Legend		D	escription				Water	Back	fill
,						()	-		Firm brown slightly sar Gravel is subangular to	ndy slightly	gravelly Cl	LAY. Sand is	s fine to co	arse.			
						44.20	10.50		Graver is subarigular to	Jubiounu	cu mic to i	neulum.					=
						-11.38	- 10.50 -			End of Bo	orehole at	10.50m					10.5 —
							- 										11.0 —
							-										-
							-										11.5
							-										=
							-										12.0 —
							-										-
							-										12.5
							-										13.0 —
							-										13.5 —
							-										14.0
																	14.5 —
							-										=
																	15.0
							-										15.5
							-										16.0 —
							-										16.5 — —
							:										
							-										17.0
							<u> </u>										
							-										17.5 —
							<u>-</u>										18.0 —
							-										
							-										18.5
							Ė										
							[-										19.0 —
							-										19.5
							-										
							-								+		+-
Remarks						I	1	1	1	Stand of the		Strikes	Rose to (m)			g Det	ails Time (hh:mm)
Deck to Bed = 2.6	30m									JUNER OF (M)	Casing to (m)	rune (min)	nose to (m)	From (m)	10	(m)	. me (mi.mm)
										Water	Added	Casing	Details				
										From (m)	To (m)	To (m) 10.50	Diam (mm) 200				
Terminated at sch	neduled [,]	dept	h														

202						Project		-	t Name:	Во		e No.:
	CAL	JS	E١	VAY TECH		17-016			sewerage Scheme Marine Outfall GI	_	BH:	13
		-GI	EO	TECH		Coordi		Client: Irish W		S	heet	1 of 2
Method	Dla	nt Use	- d	Тор	Base	32483	7.57 E		s Representative:	Sc	ale:	1.50
Cable Percussion		ido 30		0.00	10.50	17335	7.32 N		Looby ARUP J.V.			
						Ground	d Level:	Dates:		Dr	iller:	CC
							5 mOD	23/08/		Lo	gger:	SG
Depth (m)	Sample / Tests	Depth	Water Depth (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backf	fill
0.00 - 1.00	B1	()	(,			(IIIOD)	-		Medium dense brown sandy slightly silty subangular to subrounded fine	1	10 A 5	NA .
							[GRAVEL. Sand is fine to coarse.			
0.50	ES20						-					0.5 -
1							(1.60)					
1.00 1.00 - 1.45	D9 SPT (S)	1.00		N=17 (2,3/4	4 4 4 5)		-					1.0 —
1.00 1.45	N=17	1.00		11-17 (2,5)	,,,,,,,							
1.50 1.60 - 2.00	ES21 B2					-2.55	1.60					1.5 -
2.00	52						<u> </u>	a ° °	Medium dense brown very sandy slightly silty subangular to subrounded fine to medium GRAVEL with low cobble content. Sand is fine to coarse.			
2.00 2.00 - 2.45	D10 SPT (S)	2.00		N=23 (2 4/t	5 6 6 6)		-	9	Cobbles are subrounded.			2.0 —
2.00 - 2.43	N=23	2.00		N=23 (3,4/5	ر ۵,۵,۵,۵		(1.30)	9 9				
2.50	ES22						-	9 9				2.5 -
2.90 - 4.00	В3					-3.85	2.90	å				
3.00 - 3.45	UT17			Ublow=86	100%	-3.63	2.90		Stiff grey slightly sandy CLAY. Sand is fine to coarse.			3.0 —
							-					
3.50	D11 ES23						[3.5 -
	E323						-					
4.00	D12						-					4.0 —
4.00 - 5.00 4.00 - 4.45	B4 SPT (S)	4.00		N=43 (5,5/8	8,8,12,15)		-					
4.50	N=43 ES24											4.5 -
							-					
5.00 - 5.45	UT18			Ublow=83	100%		(4.10)					5.0 —
							-					
5.50	D13											5.5 -
5.50 - 6.50	ES25 B5						-					
												6.0 —
							-					
6.50	D14						_					6.5 -
6.50 - 6.95	SPT (S) N=37	6.50		N=37 (4,6/6	5,8,10,13)		-					
7.00 - 8.00	В6					-7.95	7.00		Stiff grey CLAY.	\dashv		7.0 —
							<u> </u>	<u> </u>	- '			
							-	<u> </u>				7.5 -
							-	<u> </u>				
8.00 - 8.45	UT19			Ublow=31	100%		(1.90)	<u> </u>				8.0 —
							-	<u> </u>				
8.50	D15						<u> </u>	<u> </u>				8.5 -
							<u> </u> -	<u> </u>				
8.90 - 9.40	B7					-9.85	8.90	× × ×	Brown sandy silty subangular to subrounded fine to coarse GRAVEL. Sand	\exists		9.0 —
							(0.50)	× × ×	is fine to coarse.			
9.40 - 10.50 9.50	B8 D16					-10.35	9.40		Firm slightly sandy CLAY. Sand is fine to coarse.	\dashv		9.5 -
9.50 - 9.95	SPT (S) N=10	9.50		N=10 (1,2/2	2,2,3,3)		(1.10)					
	14-10						-			-		
Remarks						I	ı	I .			g Deta	
Deck to Bed = 2.	50m								Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	То	(m) 1	Time (hh:mm)
									Water Added Casing Details			
									water Added Casing Details From (m) To (m) To (m) Diam (mm) 1.60 9.00 Output Output Output			
Terminated at sc	heduled	depth							3.60			

					\	Projec	t No.:	Projec	t Name:						Во	reho	le No.:
(KSK)	CAI	IS	E	WAY		17-016			Sewerage Scheme	Marine (Outfall G	I				ВН	13
		—G	EC	TECH		Coordi		Client:							S	heet	2 of 2
	T					32483	7.57 E	Irish W							-	.1	1.50
Method Cable Percussion		nt Us do 3		Top 0.00	Base 10.50	17335	7.32 N		s Representative: Looby ARUP J.V.								1:50
						Groun	d Level:	Dates:							Dri	ller:	CC
							5 mOD	23/08/							Log	gger:	SG
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Re	cords	Level (mOD)	Depth (m) (Thickness)	Legend		D	escription	ı			Water	Back	fill
(111)	16363	()	(,			(IIIOD)	-		Firm slightly sandy CLA	Y. Sand is f	ine to coar	se.			† <u> </u>		<u> </u>
									-								
						-11.45	10.50			End of Bo	orehole at	10.50m					10.5 —
							=										
							-										11.0 —
							-										-
							- -										11.5 —
							-										12.0 —
							-										-
							- - -										12.5
							-										
																	13.0 -
							- - -										
							- -										13.5 —
							-										
							-										14.0 —
							[-										
							- -										14.5
							-										
							-										15.0
							-										_
							<u> </u>										15.5 —
							<u>-</u> -										
							-										16.0 —
							= = =										
							-										16.5 — —
							-										
							-										17.0
							-										-
							-										17.5 —
							-										18.0 —
							-										
																	18.5
							-										
							- -										19.0 —
							-										19.5
							-										
															+		+-
Remarks				I		I	ı	I	ı.	Chargely at 1 11		Strikes	Pore to (···)			g Deta	ails Time (hh:mm)
Deck to Bed = 2.5	50m									JUNER OF (M)	Casing to (m)	rane (min)	Rose to (m)	From (m)	10	(m)	. me (mi.mm)
										Water	Added	Casing	Details				
										From (m)	To (m)	To (m) 10.50	Diam (mm) 200				
Terminated at scl	neduled	dept	h														

202						Project			t Name:	Вс	reho	le No).:
	CAI	JS	F	ΥΔΥ		17-016			/ Sewerage Scheme Marine Outfall GI		BH	114	
		—C	ĒΟ	VAY TECH		Coordi		Client: Irish W		9	Sheet	1 of 2	2
Method	Pla	nt U	has	Тор	Base	32490	1.92 E		s Representative:	Sc	ale:	1:50)
Cable Percussio		ndo 3		0.00	10.00	17330	7.18 N		Looby ARUP J.V.	-			
						Ground	d Level:	Dates:		-	riller:		_
5 11			Water				5 mOD	02/08/	/2017	+-	gger:	SG	
Depth (m)	Sample / Tests	Casing Depth (m)	Depth (m)	Field Re	cords	Level (mOD)	Depth (m) (Thickness)	Legend		Water	Back	dill	
0.00 - 0.90 0.25	B1 ES19						- -	× × ×	Black very sandy silty subangular to subrounded fine to medium GRAVEL. Sand is fine to coarse.				
							(0.90)	××××				0.5	5 -
0.75	ES20						-	× × ×					
0.90 - 1.50 1.00	B2 D11					-2.44	- 0.90	× × ×	Medium dense black very sandy slightly silty subangular to subrounded			1.0	o —
1.00 - 1.45	SPT (S)	1.00		N=15 (2,3/3	,4,4,4)			×·××	fine to coarse GRAVEL. Sand is fine to coarse.				
1.25	N=15 ES21						- -	× × ×				1.5	5 -
1.75	ES22						(1.60)	× × ×					
2.00	D12						- -	× ^ ×				2.0	ა —
2.00 - 2.50 2.00 - 2.45	B3 SPT (S)	2.00		N=12 (1,2/3	.3.3.3)		- - -	×					
2.25	N=12 ES23			= (±, = , 5,	, · , - <i>1=1</i>	-4.04	- - 2.50	**	Stiff grey slightly sandy CLAY. Sand is fine to coarse.	-		2.5	5 -
2.50 - 3.00	B4						_		Still grey signity sailty CLAI. Sailt is life to coarse.				
2.75 3.00 - 3.45	ES24 UT17			Ublow=83 1	.00%		-					3.0	c
							- -						
3.50	D13						_					3.5	5 -
3.50 - 4.00	B5						-						-
4.00	D14						- - -					4.0) —
4.00 - 4.45	ES25 SPT (S)	4.00		N=37 (6,6/7	,8,10,12)		-						-
4.50 - 5.00	N=37 B6						- - -					4.5	5 - -
							- -						-
5.00 5.00 - 5.45	ES26			IIblani-01 1	000/		- (5.20)					5.0) —
5.00 - 5.45	UT18			Ublow=81 1	00%		- (3 3)						-
5.50 5.50 - 6.00	D15 B7						- -					5.5	5 -
3.30 - 0.00	57						-						
							-					6.0) —
							- - -						
6.50 - 6.95	SPT (S) N=33	6.50		N=33 (4,5/6	,8,9,10)		<u>-</u>					6.5	5 -
							-						-
7.00 - 7.70	B8						_					7.0) —
							<u>-</u>						-
7.70 - 8.50	В9					-9.24	- - 7.70					7.5	; -
		0.55		N. 4 4 /2 = /-	2.4.4	3.24	5	× × ×	Medium dense brown very silty sandy subangular to subrounded fine to medium GRAVEL. Sand is fine to coarse				-
8.00 - 8.45	SPT (S) N=14	8.00		N=14 (1,2/3)	,3,4,4)		-	× ^ ×				8.0	, — -
							<u>-</u> _	× × ×					-
							-	× ^ ×				8.5	, –
9.00 - 10.00	B10						(2.30)	××××				9.0	- -
5.00 - 10.00	P10						-	(9.0	-
9.50	D16						- -	(9.5	- 5 -
9.50 - 9.95	SPT (S)	9.50		N=25 (3,4/5	,5,7,8)		-	× × ×					-
	N=25					-11.54	10.00	×××		\perp			_
Remarks						11.54	20.00		Water Strikes Chi	iselli	ng Det	ails	_
Deck to Bed = 3.	.20m								Struck at (m) Casing to (m) Time (min) Rose to (m) From (m) 2.30	To	0 (m) 2.50	Time (hh:	
									<u> </u>				
									Water Added Casing Details from (m) To (m) To (m) Diam (mm) 2.00 10.00 10.00 200				
Terminated at so	cheduled	dept	h						2.00 10.00 200				

								Project	Name:						Во	reho	le No.:
(ACK)	CAI	IS	E	WAY		17-016			Sewerage Scheme	Marine (Dutfall G					ВН	14
		<u> </u>	EO	TECH		Coordi		Client:							S	heet	2 of 2
						32490	1.92 E	Irish W									
Method Cable Percussion		nt U		Top 0.00	Base 10.00	17330	7.18 N		s Representative: Looby ARUP J.V.								1:50
						Ground	d Level:	Dates:							Dri	ller:	CC
							5 mOD	02/08/							Log	gger:	SG
Depth (m)	Sample / Tests	Casing Depth	Water Depth (m)	Field Re	cords	Level (mOD)	Depth (m) (Thickness)	Legend		D	escription				Water	Back	fill
10.00 - 10.45	SPT (S)	10.0	(,	N=30 (4,5/6	,6,9,9)	(IIIOD)	- (THICKHESS)			End of Bo	orehole at	10.00m			<u> </u>		
	N=30	0															=
																	10.5 —
							-										-
							-										11.0 —
							_										11.5
							- -										=
							-										12.0 —
							_										
							<u>-</u>										12.5
							-										
							-										13.0 -
							-										=
							<u> </u>										13.5 —
							Ė										
							-										14.0
							-										14.5 —
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							_										15.0 —
							-										
							-										15.5 — —
																	16.0 -
							-										-
							-										16.5
							-										17.0 —
							-										
							-										17.5 —
							ŧ										
							-										18.0 —
							-										
							-										18.5 —
							-										
							<u>-</u>										19.0 —
							-										
							- -										19.5 —
Remarks											Water	Strikes		Chi	ellin	g Deta	ails
Nemarks Deck to Bed = 3	.20m									Struck at (m)	Casing to (m)		Rose to (m)	From (m) 2.30	To		Time (hh:mm) 01:00
										Water From (m)	Added To (m)		Details Diam (mm)				
Terminated at so	cheduled	dept	h														

202						Project			t Name:	В		le No.:
	CAL	JS	E\	VAY TECH		17-016 Coordi		Arklow Client:	Sewerage Scheme Marine Outfall GI	-	ВН	115
		-G	EO	TECH				Irish W			Sheet	1 of 2
Method	Pla	nt Us	ed	Тор	Base	32501			s Representative:	Sc	cale:	1:50
Cable Percussio	_	do 30		0.00	12.38	17319			Looby ARUP J.V.	-		-
						Ground	d Level:	Dates:			riller:	CC
						-2.16	6 mOD	25/08/	2017	Lo	ogger:	SG
Depth (m)	Sample / Tests	Depth	Water Depth (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Back	fill
0.00 - 1.00	B1						-		MADE GROUND: Medium dense black slightly sandy slightly silty subrounded fine to medium GRAVEL with fragments of red brick and			
							-		organics. Sand is fine to coarse.			
0.50	ES28						-					0.5
							(1.50)					
1.00 1.00 - 1.45	D12 SPT (S)	1.00		N=10 (2,2/2	2,2,3,3)		_					1.0 -
	N=10						-					
1.50 1.50 - 2.00	ES29 B2					-3.66	- 1.50	×.•×.**	Grey very gravelly slightly silty fine to coarse SAND with low cobble			1.5
							(0.50)	* * * * * * *	content and occasional shells. Gravel is subrounded fine to coarse.			
2.00 2.00 - 2.50	D13 B3					-4.16	- 2.00	× *	Loose to medium dense grey fine to medium SAND.	\neg		2.0 -
2.00 - 2.45	SPT (S) N=9	2.00		N=9 (1,2/2,	2,2,3)		- -					
2.50	N=9 ES30						-					2.5
							-					
3.00 3.00 - 3.45	D14 SPT (S)	3.00		N=15 (2,3/3	3.4.4.4)		-					3.0 —
	N=15			5 (2,5/5	.,.,.,.,		(2.70)					
3.50 3.50 - 4.00	ES31 B4						-					3.5
3.30 - 4.00							-					
4.00 4.00 - 4.20	D15 B5						_					4.0 -
4.00 - 4.45	SPT (S)	4.00		N=20 (3,4/4	4,5,5,6)		-					
4.50	N=20 ES32						_					4.5
4.70 - 6.00	В6					-6.86	- 4.70 -		Stiff grey slightly sandy CLAY. Sand is fine to coarse.			
5.00 - 5.45	UT25			Ublow=92 1	100%		-					5.0 -
							-					
5.50	D16						- - -					5.5
	ES33						(2.30)					
6.00 - 7.00	В7											6.0 -
							-					
6.50	D17	C 50		NI44			[-					6.5
6.50 - 6.95	SPT (S) N=44	6.50	- 1	N=44 (7,7/8,11,1	1,14)		-					
7.00 - 8.00	B8					-9.16	7.00	×. ×. ×	Medium dense brown very sandy slightly silty subangular to subrounded	\dashv		7.0 -
							-	 	fine to coarse GRAVEL. Sand is fine to coarse.			
7.50	D18	7.50		N_4F /4 = '-			_	× × ×				7.5
7.50 - 7.95	SPT (S) N=15	7.50		N=15 (1,2/3	3,3,4,5)		(1.50)	× × ×				
							- -	× × ×				8.0 -
							-	× × ×				
8.50	D19					-10.66	8.50	****	Firm brown slightly gravelly slightly sandy CLAY. Sand is fine to coarse.	\dashv		8.5
8.50 - 9.50 8.50 - 8.95	B9 SPT (S)	8.50		N=22 (3,3/4	4,5,6,7)		- -		Gravel is subrounded fine to coarse.			
9.00 - 9.45	N=22 UT26			Ublow=57 1			(1.00)					9.0 -
2.00 3.43	"2"			55.5**-5/ 1	_5070		-					
9.50	D20					-11.66	- - 9.50		Firm to stiff thinly laminated brown slightly sandy slightly gravelly CLAY.	_		9.5
9.50 - 10.00	B10						- -		Sand is fine to coarse. Gravel is subrounded fine to medium.			
10.00 - 11.00	B11						-					
Remarks						1	ı				ng Deta	
Deck to Bed = 4.	.00m								Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)) Т	To (m)	Time (hh:mm
									Water Added Casing Details			
									Water Added Casing Details From (m) To (m) To (m) Diam (mm) 2.00 12.00 Output Output Output			
Terminated at re	efusal on	large b	oulo	der/possibl	e bedrock	k			2.00			

),	Projec			t Name:	Вс		le No.:
KXX.	CAL	JS	E	WAY		17-016			Sewerage Scheme Marine Outfall GI	\perp	BH	115
		-G	EC	TECH		Coordi 32501		Client: Irish W			Sheet	2 of 2
Method		nt Us		Тор	Base			Client'	s Representative:	Sc	ale:	1:50
Cable Percussion	n Dan	ido 30	000	0.00	12.38		2.19 N		Looby ARUP J.V.	Dı	iller:	CC
							d Level: 6 mOD	Dates: 25/08/	2017	\vdash	gger	
Depth	Sample /	Casing Depth (m)	Water Depth (m)	Field Re	cords	Level	Depth (m)	Locond	Description	Water	Baci	
(m) 10.00 - 10.45	Tests SPT (S)	(m)		N=12 (1,2/3		(mOD)	(Thickness)		Firm to stiff thinly laminated brown slightly sandy slightly gravelly CLAY.	×	Daci	
	N=12	0					-		Sand is fine to coarse. Gravel is subrounded fine to medium.			
10.50	D21						-					10.5 — —
11.00 - 11.45 11.00 - 12.00	UT27 B24			Ublow=50 1	100%		- - (2.88)					11.0 —
11.45	D22											
							-					- T
12.00	D23						-					12.0 —
12.00 - 12.38	SPT (S)	12.0 0		N=50 (2,3/5 235mm)	50 for		-					
						-14.54	12.38	<u> </u>	End of Borehole at 12.38m	1		12.5
							-					-
							-					13.0 -
							-					13.5 —
							-					
							-					14.0 —
												14.5
							-					
							[-					15.0 —
							-					15.5
							-					=
							-					16.0 —
												16.5 —
							-					-
												17.0 —
							-					17.5 —
							-					
							-					18.0 —
							-					
							-					18.5 —
							-					
							<u>-</u>					19.0 —
							<u>-</u>					
							-					19.5 —
							-			\perp		
Remarks											ng Det	
Deck to Bed = 4.	00m								Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	Ti	o (m)	Time (hh:mm)
									Water Added Casing Details			
									Water Added Casing Details			
erminated at re	fusal on	large	boul	der/possibl	e bedroc	k						

202					Project			t Name:	Bor		No.:
\mathcal{X}	CAI	JSE	WΔY		17-016			r Sewerage Scheme Marine Outfall GI		BH1	.6
		-GEC	WAY TECH		Coordi		Client:		Sł	neet 1	L of 2
		<u> </u>			32472	5.91 E	Irish W		- C	lo:	1.50
Method Cable Percussion		nt Used do 3000	Top 0.00	Base 11.50	17348	4.90 N		s Representative: Looby ARUP J.V.	sca	le:	1:20
		5000	0.50	=1.50	Groupe	d Level:	Dates:	•	Dril	ler: /	AH
						3 mOD	05/11/		Log	ger:	LN
Depth	Sample /	Casing Water Depth Depth	Field Re	ecords	Level	Depth (m)	Legend	Description	Water	Backfi	11
(m)	Tests	(m) (m)			(mOD)	(Thickness)		Grey sandy slightly silty subangular to subrounded fine to coarse GRAVEL	>	. V . V . V	7 -
						(0.80)	0 0	with medium cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded.			
0.50	D20 ES1					(0.80)	a ° a	g			0.5 —
0.80 - 1.20	B7				-5.13	0.80	9 9 9	Soft grey sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is	4		-
1.00 - 1.45	SPT (S)		N=5 (1,2/1,	1,2,1)		-		subangular to subrounded fine to medium.			1.0
	N=5					(1.00)	×				
1.50	D21					<u> </u>	×				1.5
1.80 - 2.20	ES2 B8				-6.13	1.80	X - X	Non-reference library and the COTT Co. 11 Co.			
2.00 - 2.50	UT18		Ublow=8 89	9%		-	X	, , , , , , , , , , , , , , , , , , , ,			2.0 —
						-	(
2.50	D22					<u> </u>	× × × ×				2.5
2.80 - 3.20	ES3 B9					-	×××				
3.00 - 3.45	SPT (S)		N=6 (1,1/2,	1,1,2)		-	××× ×××				3.0 —
	N=6					(2.70)	×××				
3.50	D23					-	××× ×××				3.5 —
3.80 - 4.00	ES4 B10						$\times \times $	*			
4.00 - 4.50	UT17		Ublow=10	93%		-	$\times \times $				4.0 —
						<u> </u>	$\times \times $	* -			
4.50	D24				-8.83	- 4.50	$\times \times \times \times$		<u></u>		4.5 -
	ES5					ļ		Loose grey gravelly very silty fine to coarse SAND. Gravel is subangular to subrounded fine.			
4.80 - 5.20 5.00 - 5.45	B11 SPT (S)		N=7 (5,2/2,	2,1,2)		[××××				5.0 —
35	N=7		(5,2,2,	,-, - ,		(1.40)	××××				
5.50	D25					[$\times \times \times \times$				5.5 —
	ES6					<u>-</u>	$\times \times \times \times$				
5.80 - 6.20 6.00 - 6.45	B12 SPT (C)		N=20 (3,4/4	45561	-10.23	5.90	× ×	Medium dense grey sandy slightly silty subangular to subrounded fine to	│		6.0 -
0.00 - 0.43	N=20		14-20 (3,4/4	,,,,,,,)		-	9 9	coarse GRAVEL with medium cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded.			-
6.50	D26					_	9 9	coarse. Coppies and boulders are subrounded to rounded.			6.5 –
						-	å ° å				-
6.80 - 7.20 7.00 - 7.45	B13		N-22 /4 4/	56571		Ė	9 9				7.0 —
7.00 - 7.45	SPT (C) N=23		N=23 (4,4/5	(۱,د,ن,ن		-	9 9				7.0 -
7.50	D27					-	9 9				
7.50	D27					(3.40)	å . å				7.5 — - -
7.80 - 8.20	B19			c 7 c		<u>-</u>	9 9				
8.00 - 8.45	SPT (C) N=31		N=31 (4,5/6	b,7,8,10)		-	, a a				8.0 —
						-	å . å				
8.50	D28					Ė	9 9				8.5 —
8.80 - 9.20	B14					[9 9				
9.00 - 9.45	SPT (C) N=39		N=39 (6,5/8,10,1	1.10)		-	å . å				9.0 —
	11-33		(0,3/0,10,1	-,-01	-13.63	9.30	× ×	Medium dense to dense grey slightly gravelly slightly silty fine to coarse			
9.50	D29					-	×××	SAND. Gravel is subangular to subrounded fine to medium.			9.5
9.80 - 10.20	B15					<u> </u>	× × ×				
							× × ×	<u> </u>			
Remarks	e 1.15								selling To (r		ils me (hh:mm)
Drilled from floa	ting platf	orm						and the state of t	1,011		
								Water Added Casing Details			
								From (m) To (m) To (m) Diam (mm)			
Terminated at vii	rtual refu	ısal in grar	nular mater	ial							

						Project	t No.:	Project	: Name:						Bo	rehol	e No.:
XX	CAL	IS		M/AV		17-016	57	Arklow	Sewerage Scheme	Marine (Outfall GI					BH:	16
	CAC	_G	EC	WAY TECH		Coordi	nates:	Client:							S	heet 2	2 of 2
						32472	5.91 E	Irish W									
Method		nt Us		Тор	Base	17348	4 90 N		Representative:						Sca	le:	1:50
Cable Percussion	n Dan	do 30	000	0.00	11.50				ooby ARUP J.V.						Dri	ller:	АН
							d Level:	Dates:									
Depth	Sample /	Casing	Water				3 mOD	05/11/	2017						+	ger:	
(m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Re		Level (mOD)	Depth (m) (Thickness)				escription				Water	Backf	ill
10.00 - 10.45	SPT (C) N=27			N=27 (5,6/	7,6,6,8)		-		Medium dense to dens SAND. Gravel is subang	e grey sligh	ntly gravell	y slightly s	ilty fine to lium	coarse			
10.50							-	.× × × × ×		,							
10.50	D30							.× × × × ×									10.5 —
10.80 - 11.20	B16						(2.20)	.× × × × ×									
11.00 - 11.45	SPT (C) N=45			N=45 (6,8/10,12,	11,12)		-	.× × × × ×									11.0 —
				.,,,,,	, ,												
						-15.83	- 11.50			End of Bo	rehole at	11.50m			1	10.00	11.5 —
							-										1 3
							-										12.0 —
							-										
							-										12.5
							-										
																	13.0
							-										1 1
							-										13.5 —
																	1 3
							-										14.0 —
							-										1 3
							-										14.5 —
							-										1 4
							[-										15.0 —
							-										
																	15.5 —
							-										=
							Ŀ										16.0
							-										10.0
							Ė										16.5 —
							-										10.5
							_										17.0
							-										17.0 —
							‡										=
							-										17.5 —
							-]
							_										18.0 —
																	=
							-										18.5 —
							-										
							-										19.0 —
							Ė										
							<u> </u>										19.5
							-										
															\vdash		$+$ \dashv
Remarks										Character as 4 5	Water		Poss to (a)			g Deta	
Drilled from floa	ting platf	orm								Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (, Т	ime (hh:mm)
										Water	Δημογ	Cacina	Details	-			
										From (m)	To (m)	To (m) 11.50	Diam (mm)	†			
Terminated at vi	rtual refu	sal in	grar	nular mater	ial							11.50	200				

202					Project			t Name:	Во		e No.:
XX	CAL	JSE\	WAY		17-016			v Sewerage Scheme Marine Outfall GI		BH1	L7
		-GEO	VAY TECH		Coordi		Client: Irish W		S	heet 1	1 of 2
Method	Dia	nt Used	Ton	Base	32476			s Representative:	Sca	ıle:	1.50
Cable Percussion		ido 3000	Top 0.00	12.90	17351			Looby ARUP J.V.	-		
					Ground	d Level:	Dates:	·	Dri	ller:	AH
							03/11/		Log	gger:	LN
Depth (m)	Sample / Tests	Casing Water Depth Depth (m) (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfi	iII
(111)	iests	(m) (m)			(IIIOD)	-	3 0	Medium dense brown very sandy slightly silty subangular to subrounded	>		-
						-		fine to coarse GRAVEL with medium cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded of			
0.50	D1 ES29					-	a , a	mixed lithologies.			0.5 —
0.80 - 1.20	B15					-	a , a	8			-
1.00 - 1.45	SPT (C)		N=27 (3,8/4	4,7,8,8)		-	a				1.0
	N=27					-	a ' a				-
1.50	D2					- -	a , a				1.5
1.80 - 2.20	ES30 B16					- -	a , a				
2.00 - 2.45	SPT (C)		N=20 (4,3/4	4,5,5,6)		(4.10)	a ' a				2.0 —
	N=20						a				
2.50	D3					-					2.5
2.80 - 3.20	ES31 B17					-	a , a				
3.00 - 3.45	SPT (C)		N=22 (4,5/5	5,6,6,5)		<u>-</u>	9 9				3.0 —
	N=22		, ,-,-			- -	0				
3.50	D4					-	a , c				3.5 —
	ES32					-	0				a -
3.80 - 4.20	B18		N=24 /2 4/5	·		-	a				
4.00 - 4.45	SPT (C) N=21		N=21 (3,4/5 Water strike		-5.06	4.10		Medium dense grey sandy slightly silty subangular to subrounded fine to	-		4.0 —
			4.10m			-		coarse GRAVEL with low cobble and boulder content. Sand is fine to			T -
4.50	D5 ES33					(1.10)		coarse. Cobbles and boulders are subangular to subrounded of mixed lithologies.			4.5 — , —
4.80 - 5.20	B19					-					
5.00 - 5.45	SPT (C) N=11		N=11 (3,4/5	5,2,2,2)							5.0 —
					-6.16	- 5.20 -	XXX	Very soft grey silty sandy slightly gravelly clayey SILT . Sand is fine to	7		
5.50	D7 ES34					<u>-</u>	$\times \times $				5.5
5.80 - 6.00	B20					-	$\times \times $				T -
6.00 - 6.50	UT27		Ublow=12 9	98%		(1.60)	$\times \times $				6.0
						- -	$\times \times $				
6.50	D8					- -	(6.5 —
6.80 - 7.20	B21				-7.76	- - 6.80	(×	4		-
7.00 - 7.45	SPT (S)		N=9 (2,3/2,	2,3,2)		-	(×			7.0
	N=9					-	$\times \times $	×			
7.50	D9					-	(×			7.5 —
7.80 - 8.00	B22						(×			
8.00 - 8.50	UT28		Ublow=15	98%		-	(×			8.0 —
						(2.90)	(×			-
8.50	D10					- (=.50)	(×			8.5 —
						-	(×			T -
8.80 - 9.20	B23		N=16 /2 2/	1 / / /\		- -	(×			
9.00 - 9.45	SPT (S) N=16		N=16 (3,3/4	+,4,4,4)			$(\times \times $	×			9.0 —
0.50	D14					-	(×			. -
9.50	D11				-10.66	- - 9.70	(×			9.5 — –
9.80 - 10.20	B24				-10.00	- 3.70	a ° a	Dense grey slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and	-		
									1		
Remarks Drilled from floa	ting platf	orm						Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	To		ime (hh:mm)
	o Piati							4.10 4.10 12.90	12	.90	01:00
								Water Added Casing Details			
								From (m) To (m) To (m) Diam (mm)			
Terminated at re	etusal on	iarge boul	aer								

					\	Project			t Name:	Во		e No.:
CHO H	CAL	JS	E	WAY		17-016			Sewerage Scheme Marine Outfall GI		BH	17
		−G	EC	TECH		Coordi		Client: Irish W		S	heet	2 of 2
Method	Pla	nt U	sed	Тор	Base	32476			s Representative:	Sca	ale:	1:50
able Percussion		do 3		0.00	12.90	17351	9.44 N	Byrne I	Looby ARUP J.V.	Dri	iller:	ΔΗ
							d Level:	Dates:	2017		gger:	
Depth	Sample /	Casing Depth	Water	Field D		-0.9	6 mOD Depth (m)	03/11/		+		
(m) 0.00 - 10.45	Tests SPT (C)	Depth (m)	Water Depth (m)	Field Re		(mOD)			Description boulders are subrounded to rounded of mixed lithologies.	Water	Backi	111
200 20113	N=36			30 (0,770	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,		-	a °a	sociates are subscanded to surface of this earlies agrees.			
0.50	D12							, a , a ,				10.5
0.80 - 11.20	B25						(2.00)					
1.00 - 11.45	SPT (C) N=40			N=40 (8,7/8,10,10	0,12)		-	a °° 8				11.0 -
. 50					-		-					
50	D13					-12.66	11.70					11.5
1.80 - 12.20 2.00 - 12.45	B26 SPT (S)			N=36 (7,8/8	2 2 2 11)				Very stiff grey slightly sandy slightly gravelly silty CLAY with low cobble and boulder content. Sand is fine to coarse. Gravel is subangular to			12.0 -
12.43	N=36			.1-30 (7,6/6	,,,,,,,11		(1 30)		subrounded fine. Cobbles and boulders are subangular to subrounded of mixed lithologies.			
2.50	D14						- (1.20) -					12.5
							-					
						-13.86	12.90	12 NO 1	End of Borehole at 12.90m			13.0 -
							-					
							-					13.5
							-					
							-					14.0 -
							-					
							-					14.5
							-					15.0 -
							-					15.0
												15.5
							-					
							-					16.0 -
												16.5
							-					
							-					17.0 -
							-					
							-					17.5
							-					18.0 -
							-					10.0
							-					18.5
							-					
							_					19.0 -
							-					
							-					19.5
							ŧ					
marks illed from floa	ting platf	orm							Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	To		Γime (hh:mr
cu iioiii iiod	mig hiarii	OHILL							12.90	12.	.90	01:00
									Water Added Casing Details From (m) To (m) To (m) Diam (mm)			
									From (m) To (m) To (m) Diam (mm) 12.90 200			

202					Project		-	t Name:	Boı		e No.:
XX	CAL	JSE	VAY TECH		17-016			sewerage Scheme Marine Outfall GI		BH1	18
		-GEO	TECH		Coordi		Client: Irish W		SI	neet 1	1 of 2
					32479	1.47 E			S	le:	1.50
Method Cable Percussion		nt Used do 3000	Top 0.00	Base 11.30	17354	7.27 N		s Representative: Looby ARUP J.V.			
					Ground	d Level:	Dates:		Dri	ller:	AH
						2 mOD	06/11/		Log	ger:	LN
Depth (m)	Sample / Tests	Casing Water Depth Depth (m) (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backf	ill
(111)	iests	(m) (m)			(IIIOD)	-	×	Medium Dense greyish black sandy slightly silty subangular to subrounded	_		7
						-	× ^ ×	fine to coarse GRAVEL with medium cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded of			
0.50	D18 ES9					- -	× × ×	mixed lithologies.			0.5 -
0.80 - 2.20	B1					- -	× · · · ×	*			
1.00 - 1.45	SPT (C) N=11		N=11 (3,4/3	3,3,2,3)		_	×.	*			1.0 —
	IN-11					-					8
1.50	D19					(3.00)	×.	*			1.5 -
	ES10					<u>-</u> -					
2.00 - 2.50	UT15		Ublow=11	98%							2.0 —
						<u>-</u>					
2.50	D20					-		•			2.5 -
2.80 - 4.20	ES11 B2					-	. × ×				
	SPT (S)		N=7 (1,1/1,	2,2,2)	-3.72	- - 3.00	× o	Soft grey slightly sandy silty CLAY with occasional bands of grey SAND	4		3.0 —
	N=7					- -	XX	throughout. Sand is fine to coarse.			
3.50	D21					-	×_×_				3.5 -
	ES12					-	×_×_				
4.00 - 4.50	UT16		Ublow=14 9	97%		<u>-</u>	×_×_				4.0 —
						-	×_×_				
4.50	D22					-	×				7. 4.5 -
	ES13					-	×				
4.80 - 6.20 5.00 - 5.45	B3 SPT (S)		N=9 (1,1/2,	2 2 21		(3.80)	×_^_). 5.0 —
5.00 - 5.45	N=9		IN-3 (1,1/∠,	رد,۷,۵		-	×				3.U — A
F F0	רכי					-	×				4
5.50	D23 ES14					<u> </u>	×				5.5 -
				2001		-	X				
6.00 - 6.50	UT17		Ublow=16 8	88%		_	X				6.0 —
						-	X——				
6.50	D24					<u>-</u> -	×-^-				6.5
6.80 - 7.20	B4				-7.52	6.80	<u>×</u>	Soft to firm grey slightly sandy slightly gravelly silty CLAY with occasional	+ $ $		
7.00 - 7.45	SPT (S) N=7		N=7 (2,2/1,	2,2,2)		-	×	bands of grey SAND throughout. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium			7.0 —
	/					- -	X—X	suvangular to subrounded lifte to medium			
7.50	D25					(1.50)	X				7.5 -
7.80 - 8.20	B5					-	X				
8.00 - 8.45	SPT (C)		N=24 (2,3/4	4,5,7,8)		_	X				8.0 —
	N=24				-9.02	- - 8.30	X	Ponco grovyony candy clightly cithy cubangular to cube and of fine to	4		
8.50	D26					-	4 X	Dense grey very sandy slightly silty subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to			8.5 -
8.80 - 9.20	В6					- -	a X	coarse. Cobbles and boulders are subrounded to rounded of mixed lithologies.			
9.00 - 9.45	SPT (C)		N=41			-	a X: 9 a X				9.0 —
	N=41		(6,8/8,10,1	0,13)		(3.00)	X X				
9.50	D27					-	4 X). 9.5 -
9.80 - 10.20	В7					-	å X				
J.00 - 1U.ZU	וט					-	X X		\perp		
Remarks					İ	<u> </u>	L			g Deta	
Drilled from float	ting platfo	orm						Struck at (m) Casing to (m) Time (min) Rose to (m) From (m)	To (ime (hh:mm
İ											
								Water Added Casing Details From (m) To (m) To (m) Diam (mm)			
Terminated at vir	rtual refu	ısal in gran	nular mater	ial							
acca ac vii		bi ai							1		

						Project		Project	: Name:						Bor	hole I	No.:
(KCK)	CAI	IS	E	WAY		17-016			Sewerage Scheme	Marine (Outfall G	l				BH18	
5		-G	EC	TECH		Coordi		Client:			_			_	Sh	eet 2 d	of 2
NA - Al I	DI-	-4.11		T	D	32479	1.47 E	Irish W							Capi	. 1.	E0
Method Cable Percussion		nt Us do 30		Top 0.00	Base 11.30	17354	7.27 N		s Representative: Looby ARUP J.V.							e: 1:	
						Ground	d Level:	Dates:	71101 3.4.						Dril	er: Al	1
							2 mOD	06/11/	2017						Log	ger: LN	١
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legend		D	escription	ı			Water	Backfill	
10.00 - 10.45	SPT (C)	,,	(,	N=49	12.44\	(05)	-	ο X . σ X 8	Dense grey very sandy	slightly silt	y subangu	lar to subr	ounded fin	e to			
	N=49			(7,7/10,12,	13,14)		-	a × , a × 9	coarse GRAVEL with lov coarse. Cobbles and bo								
10.50	D28						-	a × , a × 8	lithologies.								10.5 —
10.80 - 11.20	B8			50 10 17 150			-	a									=
11.00 - 11.20	SPT (C)			50 (8,17/50 50mm)) for		-	a × , a × 0									11.0 —
						-12.02	11.30	******		End of Bo	orehole at	11.30m			▎▐		11.5 —
							-										=
																	12.0 -
							-										=
							-										12.5
							E										1
							-										13.0 —
							-]
							-										13.5 —
																	=
							_										14.0 —
							-										=
							-										14.5
							-										1
							-										15.0 —
																	=
							Ē										15.5 —
							-										100
																	16.0 —
							_										16.5
							-										=
							-										17.0 -
							<u> </u>										
							<u> </u>										17.5
							-]
							_										18.0 —
							_										
							-										18.5 —
							_										
							-										19.0 —
							-										=
							-										19.5 — —
							-										=
D											\A/ata-	Strikes		Chia	allina	Details	Щ
Remarks Drilled from floa	ting platf	orm								Struck at (m)	Casing to (m)		Rose to (m)	From (m)	To (m		(hh:mm)
										Water From (m)	Added To (m)	To (m)	Diam (mm)				
Terminated at vi	rtual refu	ısal in	n grar	nular mater	ial							11.30	200				

20				\	Project			t Name:	Во		e No.:
TXX (CAL	JSE	WAY TECH		17-016 Coordi		Arklow Client:	v Sewerage Scheme Marine Outfall GI	-	BH:	19
		-GEO	TECH				Irish W		5	Sheet :	1 of 1
Method	Plan	nt Used	Тор	Base	32426	6.57 E		's Representative:	Sc	ale:	1:50
Cable Percussion	_	do 3000	0.00	6.50	17358	2.51 N		Looby ARUP J.V.			
					Ground	d Level:	Dates:		Dr	iller:	AH
						0 mOD	07/11/		Lo	gger:	LN
Depth (m)	Sample / Tests	Casing Water Depth Depth (m) (m)	Field Re	ecords	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backf	ill
(111)	iests	()			(IIIOD)	- (TITICKTIESS)		Medium dense grey very sandy slightly silty subangular to subrounded fine			Z.
1.00 - 1.45	D15 ES7 B1 SPT (S) N=24		N=24 (4,6/5	5,8,6,5)		(1.80)		to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded of mixed lithologies.			0.5 -
1.50	D16 ES8					-					1.5 -
1.80 - 2.20	B2				-3.00	1.80	ale. ×	Very soft greyish brown sandy organic silty CLAY. Sand is fine to coarse.	-		
2.00 - 2.50	UT13		Ublow=12 1	100%		(0.80)	2ης <u>×</u> 2ης <u>×</u> 2ης <u>×</u> ×——7η				2.0 —
2.50	D17				-3.80	2.60	× <u>sh</u>				2.5 -
	ES9 B3					<u> </u>	.×. × ×. ×. ×	Loose grey slightly gravelly very silty fine to coarse SAND. Gravel is subangular to subrounded fine to medium.			
3.00 - 3.45	SPT (S) N=8		N=8 (2,1/2,	2,2,2)		(0.90)	× × × × × × × ×				3.0 —
3.50	D18 ES10				-4.70	3.50	× × • × × × × × ×	Very soft greyish brown sandy slightly gravelly clayey SILT. Sand is fine to	$\frac{1}{2}$		3.5 -
3.80 - 4.20	B4					-	× × × × × ×	coarse. Gravel is subangular to subrounded fine.			
4.00 - 4.50	UT14		Ublow=15 1	100%		-	X X X				4.0 —
						(1.80)	× × × × × ×				
4.50	D19 ES11					- (2.00)	X X X X X X				4.5 -
4.80 - 5.20	B5					Ė	(× × × × × ×				
	SPT (S) N=17		N=17 (2,2/4	4,3,5,5)		-	X X X X X X				5.0 —
	IN-17				-6.50	5.30	×××	Weathered grey AMPHIBOLITE recovered as sandy slightly silty angular to	-		
	D20 ES12					- - -		subangular medium to coarse GRAVEL and low cobble content. Sand is fine to coarse. Gravel is composed exclusively of amphibolite. Cobbles are			5.5 -
6.00 - 6.45	B6 SPT (C)		N=45			(1.20)		angular to subangular of amphibolite.			6.0 —
	N=45		(4,5/8,10,1	2,15)		-					
					-7.70	6.50					6.5
					7.70	0.30		End of Borehole at 6.50m			0.5
						_					7.0
						_					7.0
						<u> </u>					
											7.5 -
						‡					
						-					8.0 —
						-					
						Ė					8.5 -
						[
						-					9.0 —
						[
						-					9.5 -
						[
									\pm		
Remarks										ng Deta	ils Time (hh:mm
Drilled from float	ing platfo	orm						and the state of t			
								Water Added Casing Details			
								From (m) To (m) Diam (mm) 6.50 200			
erminated on la	rge bould	der/weath	nered bedro	ock							



APPENDIX C
Core photographs





BH02 18.00m to 19.00m



BH02 23.50m to 25.00m



BH05 22.50m to 24.10m



BH06 17.00m to 18.50m



BH06 24.50m to 25.20m





BH07 12.50m to 14.00m



BH07 14.00m to 15.50m



BH07 15.50m to 17.00m



BH07 17.00m to 18.50m





BH08 14.50m to 16.00m



BH08 16.00m to 17.50m



BH08 17.50m to 19.00m



BH08 19.00m to 20.50m



BH08 20.50m to 22.00m





BH08 22.00m to 23.50m



BH08 23.50m to 25.00m

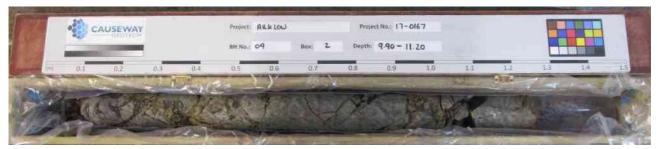


BH08 25.00m to 26.50m





BH09 8.90m to 9.90m



BH09 9.90m to 11.20m



BH09 11.20m to 12.40m



BH09 12.40m to 13.20m



BH09 13.20m to 14.30m





BH10 10.00m to 11.50m



BH10 11.50m to 13.00m



BH10 13.00m to 14.50m



BH10 14.50m to 16.00m





APPENDIX D Geotechnical laboratory test results





SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

Client:	Irish Water
Engineer:	Byrne Looby ARUP J.V.
From:	Stephen Watson
	Laboratory Manager
	Causeway Geotech Ltd
Tel:	+44(0)2827666640
E-mail:	stephen.watson@causewaygeotech.com
Date:	26/09/17
Ref:	17-0167 - Schedule 1 - Issue 2

Arklow Sewerage Scheme Marine Outfall GI

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

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 60 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





Project Name Arklow Sewerage Scheme Marine Outfall GI

Report Reference. 17-0167 - Schedule 1 - Issue 2

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report
SOIL	Moisture content - oven drying method	BS 1377-2:1990	16
SOIL	Liquid limit - cone penetrometer	BS 1377-2:1990	10
SOIL	Liquid limit - cone penetrometer - one point	BS 1377-2:1990	10
SOIL	Plastic limit	BS 1377-2:1990	10
SOIL	Plasticity index and liquidity index	BS 1377-2:1990	10
SOIL	Particle size distribution - wet sieving	BS 1377-2:1990	25
SOIL	Particle size distribution - dry sieving	BS 1377-2:1990	25
SOIL	Particle size distribution -sedimentation hydrometer method	BS 1377-2:1990	16
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS 1377- 7:1990	8
SOIL	Shear strength by direct shear	BS1377: Part 7: Clause 4: 1990	5
SOIL	pH Value of Soil		6
SOIL	Sulphate Content water extract		6



Summary of Classification Test Results

Project No.

Project Name

17-0167

Arklow Sewerage Scheme Marine Outfall GI

17-0					7 410	low Sewi	orago	•		io Galiai				
	L.,	Sar	nple			Dens		w	Passing	LL	PL	PΙ	Particle	Casagrande
Hole No.	Ref	Тор	Base	Туре	Soil Description	bulk	dry		425µm				density	Classification
		·				Mg/m	n3	%	%	%	%	%	Mg/m3	
BH12	3	2.30		В	Grey slightly sandy silty CLAY.			23.0	96	50 -1pt	21	29		СН
DU12	4	2.00			Grey slightly sandy slightly			27.0						
BH12	4	3.00		В	gravelly silty CLAY.			37.0						
BH12	12	3.50		D	Grey slightly sandy slightly gravelly silty CLAY.			26.0						
BH12	13	4.00		D	Grey slightly sandy slightly gravelly silty CLAY.			23.0	90	50 -1pt	21	29		CI
BH12	14	5.50		D	Grey slightly sandy slightly gravelly silty CLAY.			24.0						
BH12	15	6.50		D	Grey slightly sandy silty CLAY.			20.0	91	49 -1pt	22	27		CI
BH12	17	9.50		D	Brown slightly sandy slightly gravelly silty CLAY.			24.0	91	49 -1pt	21	28		CI
BH13	11	3.50		D	Grey slightly sandy silty CLAY.			23.0	89	50 -1pt	20	30		CI
BH13	12	4.00		D	Grey slightly sandy silty CLAY.			22.0						
BH13	13	5.50		D	Grey slightly sandy silty CLAY.			23.0	91	46 -1pt	21	25		CI
BH13	14	6.50		D	Grey slightly sandy silty CLAY.			22.0						
BH13	15	8.50		D	Grey slightly sandy silty CLAY.			30.0	94	46 -1pt	21	25		CI
BH13	16	9.50		D	Grey slightly sandy silty CLAY.			26.0	87	47 -1pt	20	27		CI
All tests perfo	ormed	in acco	rdance v	vith BS	\$1377:1990 unless specifie	d otherwi	ise	-			ē.	-	.	
Key								Date F	rinted		Appr	oved	Ву	Table
Density t		mont		Liquid L		e density	oto-	,	2/00/22	17				1
ud - wat		ment unles acement	5 .		e unless : sp - sn asagrande method gj - ga	nall pyknom s jar	есег	4	22/09/20	17				sheet
wi - imm					ngle point test						Step	hen.	Watson	



Summary of Classification Test Results

Project No.

Project Name

17-0167

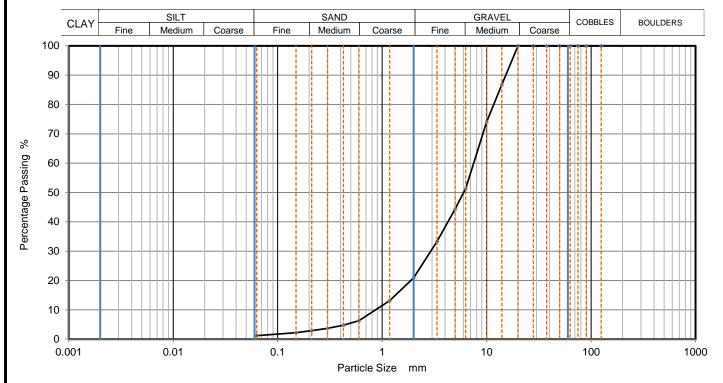
1pt - single point test

Arklow Sewerage Scheme Marine Outfall GI

17-0	17-0167 Arklow Sewerage Scheme Marine Outfall GI													
Hole No.	Ref	Sar Top	mple Base	Туре	Soil Description	Dens bulk	ity	W	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Kei	rop	Dase	туре		Mg/m	n3	%	%	%	%	%	Mg/m3	
BH14	13	3.50		D	Grey slightly sandy silty CLAY.			21.0	80	45 -1pt	22	23		CI
BH14	14	4.00		D	Grey slightly sandy silty CLAY.			22.0						
BH14	15	5.50		D	Grey slightly sandy silty CLAY.			24.0	89	47 -1pt	25	22		CI
Il tests perfe	ormed	l in acco	rdance v	l vith BS	 S1377:1990 unless specifie	d otherw	ise							
wd - wat	neasure ter displ	ment unles acement in water	ss:	cas - C		e density nall pyknom s jar	neter	Date F	Printed 22/09/20			oved		Table 1 sheet 2

Stephen.Watson

CAUSEWAY	DADTI	CLE SIZE DIST	Job Ref	17-0167	
GEOTECH	PANII	Borehole/Pit No.	BH12		
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	1
Soil Description	Brown slightly sandy suba	angular to subround	Depth, m	0.00	
Specimen Reference	3 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, claus	se 9.2	KeyLAB ID	Caus201709070	



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	87		
10	74		
6.3	51		
5	44		
3.35	33		
2	21		
1.18	13		
0.6	6		
0.425	5		
0.3	4		
0.212	3		
0.15	2		
0.063	1		

Dry Mass of sample, g	3045

Sample Proportions	% dry mass
Cobbles	0
Gravel	79
Sand	20
Fines < 0.063mm	1

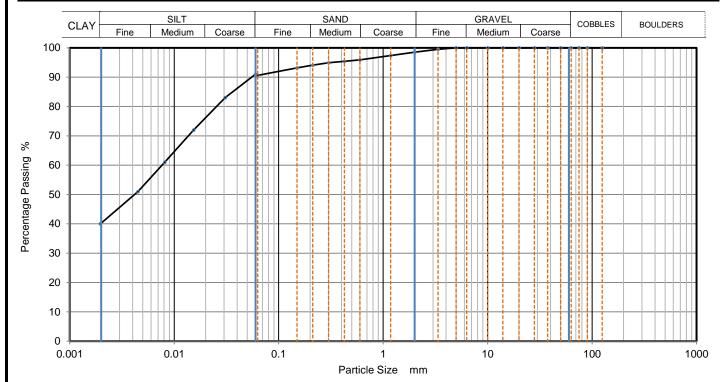
Grading Analysis		
D100	mm	
D60	mm	7.52
D30	mm	2.92
D10	mm	0.865
Uniformity Coefficient		8.7
Curvature Coefficient		1.3

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved		Fig	1
Stephen.Watson	22/09/2017 15:23	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH .	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH12
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	3
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	2.30
Specimen Reference	7 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus201709072



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0599	91
90	100	0.0307	83
75	100	0.0153	72
63	100	0.0081	61
50	100	0.0045	51
37.5	100	0.0020	40
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	97		
0.6	96	Particle density	(assumed)
0.425	95	2.65	Mg/m3
0.3	95		_
0.212	94		
0.15	93		
0.063	91		

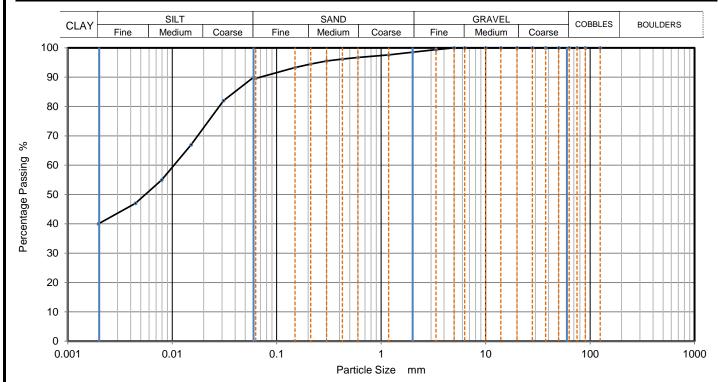
Dry Mass of sample, g	1815
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Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	8
Silt	50
Clay	40

Grading Analysis		
D100	mm	
D60	mm	0.00754
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen.Watson	22/09/2017 15:23	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH .	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH12
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	5
Soil Description	Grey slightly sandy slightly gravelly silty CLAY.		Depth, m	4.00
Specimen Reference	Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus201709077



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0603	90
90	100	0.0310	82
75	100	0.0152	67
63	100	0.0079	55
50	100	0.0044	47
37.5	100	0.0020	40
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	99		
2	99		
1.18	98		
0.6	97	Particle density	(assumed)
0.425	96	2.65	Mg/m3
0.3	96		_
0.212	95		
0.15	93		
0.063	90		

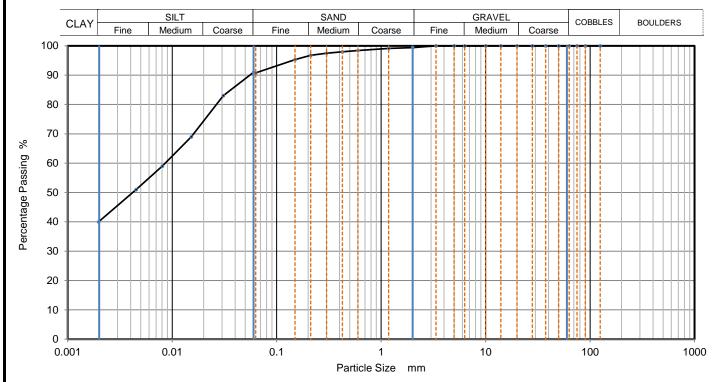
Dry Mass of sample, g	1270

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	9
Silt	50
Clay	40

Grading Analysis		
D100	mm	
D60	mm	0.0104
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen.Watson	22/09/2017 15:23	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH12	
Site Name	urklow Sewerage Scheme Marine Outfall GI			Sample No.	6
Soil Description	Grey slightly sandy slightly gravelly silty CLAY.		Depth, m	5.50	
Specimen Reference	Specimen m Depth			Sample Type	В
Test Method	SS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201709079



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0600	91
90	100	0.0308	83
75	100	0.0152	69
63	100	0.0080	59
50	100	0.0045	51
37.5	100	0.0020	40
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	99		
0.6	98	Particle density	(assumed)
0.425	98	2.65	Mg/m3
0.3	98		_
0.212	97		
0.15	95		
0.063	91		

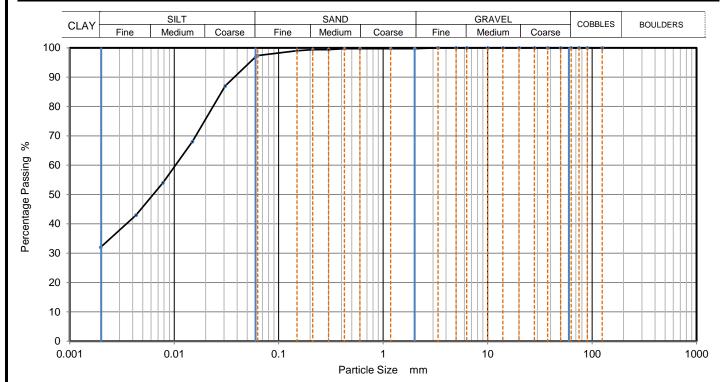
Dry Mass of sample, g 1245	Dry Mass of sample, g	1245
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Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	9
Silt	51
Clay	40

Grading Analysis		
D100	mm	
D60	mm	0.00867
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen.Watson	22/09/2017 15:23	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH .			Borehole/Pit No.	BH12	
Site Name	urklow Sewerage Scheme Marine Outfall GI			Sample No.	7
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	7.00	
Specimen Reference	3 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	S1377:Part 2:1990, clauses 9.2 and 9.5			Caus2017090712



Sieving		Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0603	97
90	100	0.0307	87
75	100	0.0149	68
63	100	0.0078	54
50	100	0.0043	43
37.5	100	0.0020	32
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	2.65	Mg/m3
0.3	99		
0.212	99		
0.15	99		
0.063	97		

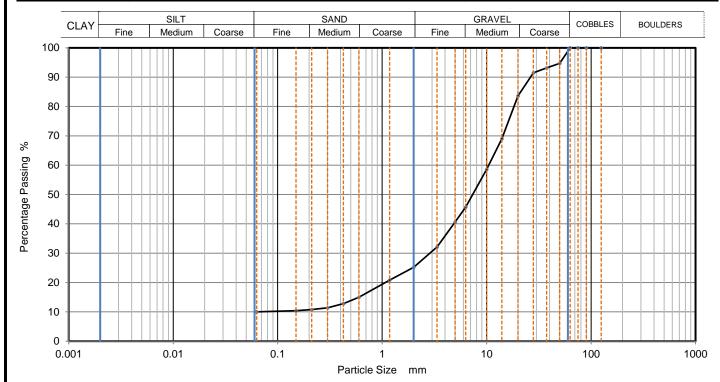
Dry Mass of sample, g	1275
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	0	
Sand	2	
Silt	65	
Clay	33	

Grading Analysis		
D100	mm	
D60	mm	0.0103
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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Stephen.Watson	22/09/2017 15:23	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH				Borehole/Pit No.	BH12
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	8
Soil Description	Brown slightly sandy subangular to subrounded fine to coarse GRAVEL.		Depth, m	8.40	
Specimen Reference	3 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090714	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	95		
37.5	93		
28	92		
20	84		
14	69		
10	59		
6.3	46		
5	41		
3.35	32		
2	25		
1.18	21		
0.6	15		
0.425	13		
0.3	11		
0.212	11		
0.15	10		
0.063	10		

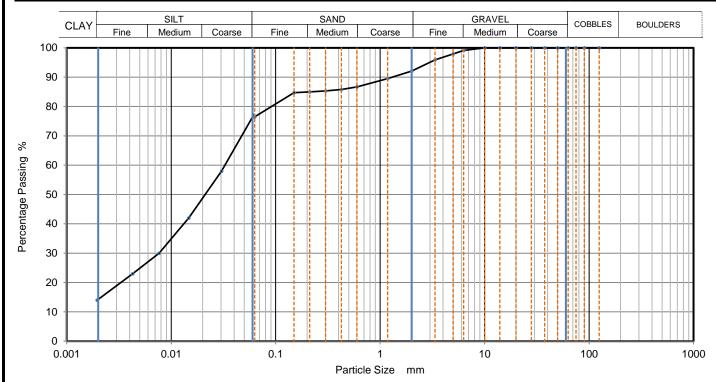
Dry Mass of sample, g	6465

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	75	
Sand	15	
Fines < 0.063mm	10	

Grading Analysis		
D100	mm	
D60	mm	10.5
D30	mm	2.86
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

		Fig	1
Stephen.Watson	22/09/2017 15:23	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH .				Borehole/Pit No.	BH12
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	9	
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		Depth, m	9.50	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090716	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0614	77
90	100	0.0303	58
75	100	0.0147	42
63	100	0.0076	30
50	100	0.0043	23
37.5	100	0.0020	14
28	100		
20	100		
14	100		
10	100		
6.3	99		
5	98		
3.35	96		
2	92		
1.18	90		
0.6	87	Particle density	(assumed)
0.425	86	2.65	Mg/m3
0.3	85		
0.212	85		
0.15	85		
0.063	77		

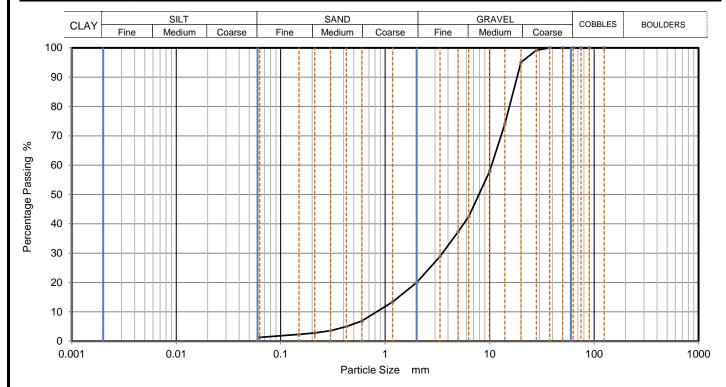
Dry Mass of sample, g	1790
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Sample Proportions	% dry mass
Cobbles	0
Gravel	8
Sand	16
Silt	62
Clay	14

Grading Analysis		
D100	mm	
D60	mm	0.0328
D30	mm	0.00756
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	DARTI	PARTICLE SIZE DISTRIBUTION			17-0167
GEOTECH	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	BH13
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	1
Soil Description	Brown slightly sandy subangular to subrounded fine to coarse GRAVEL.		Depth, m	0.00	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090717	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	99		
20	95		
14	74		
10	58		
6.3	42		
5	37		
3.35	29		
2	20		
1.18	13		
0.6	7		
0.425	5		
0.3	4		
0.212	3]	
0.15	2]	
0.063	1		

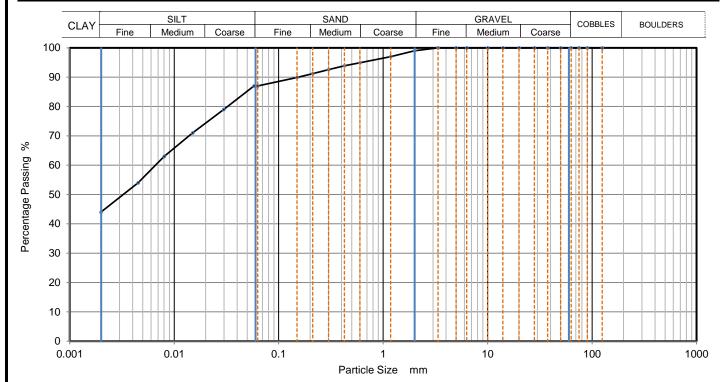
Dry Mass of sample, g	3755
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	80	
Sand	19	
Fines < 0.063mm	1	

Grading Analysis		
D100	mm	
D60	mm	10.4
D30	mm	3.53
D10	mm	0.83
Uniformity Coefficient		13
Curvature Coefficient		1.4

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH .				Borehole/Pit No.	BH13
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI			3
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	2.90	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090719	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0579	87	
90	100	0.0298	79	
75	100	0.0150	71	
63	100	0.0080	63	
50	100	0.0045	54	
37.5	100	0.0020	44	
28	100			
20	100			
14	100			
10	100			
6.3	100			
5	100			
3.35	100			
2	99			
1.18	97			
0.6	95	Particle density	(assumed)	
0.425	94	2.90	Mg/m3	
0.3	93			
0.212	91			
0.15	90			
0.063	87			

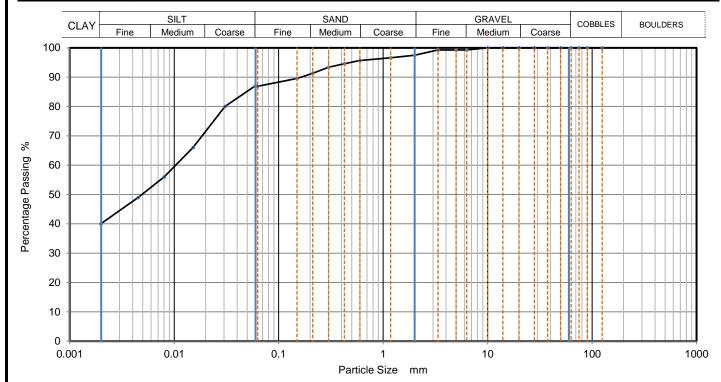
Dry Mass of sample, g	1300

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	12
Silt	43
Clay	44

Grading Analysis		
D100	mm	
D60	mm	0.00672
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Stephen.Watson 22/09/2017 15:24 Sheet	Approved	Sheet printed	Fig	1
	Stephen.Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH .				Borehole/Pit No.	BH13
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	4
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	4.00	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090723	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0594	87	
90	100	0.0306	80	
75	100	0.0151	66	
63	100	0.0080	56	
50	100	0.0045	49	
37.5	100	0.0020	40	
28	100			
20	100			
14	100			
10	100			
6.3	99			
5	99			
3.35	99			
2	98			
1.18	97			
0.6	96	Particle density	(assumed)	
0.425	95	2.90	Mg/m3	
0.3	93			
0.212	91			
0.15	90			
0.063	87			

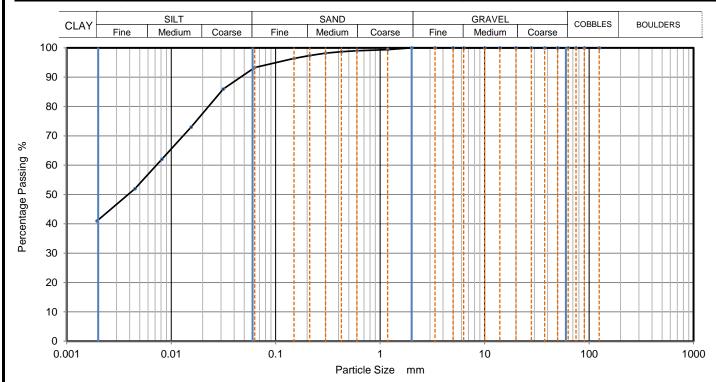
Dry Mass of sample, g	1435
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Sample Proportions	% dry mass
Cobbles	0
Gravel	3
Sand	11
Silt	47
Clay	40

Grading Analysis		
D100	mm	
D60	mm	0.0102
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH .				Borehole/Pit No.	BH13
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	5
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	5.50	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090725	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0615	93
90	100	0.0315	86
75	100	0.0155	73
63	100	0.0081	62
50	100	0.0045	52
37.5	100	0.0020	41
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	99	Particle density	(assumed)
0.425	99	2.90	Mg/m3
0.3	98		
0.212	97		
0.15	96		
0.063	93		

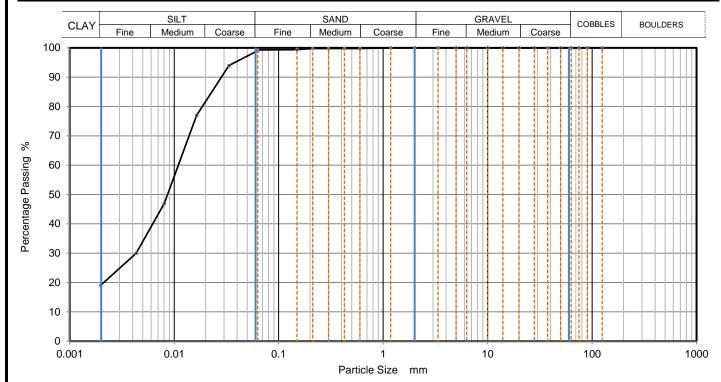
Dry Mass of sample, g	1075
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Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	7
Silt	52
Clay	42

Grading Analysis		
D100	mm	
D60	mm	0.00718
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	DARTICLE CIZE DISTRIBUTION			Job Ref	17-0167
PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH13		
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	6
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	7.00	
Specimen Reference	3 Specimen m Depth m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090728	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0630	99	
90	100	0.0334	94	
75	100	0.0164	77	
63	100	0.0081	47	
50	100	0.0043	30	
37.5	100	0.0020	19	
28	100			
20	100			
14	100			
10	100			
6.3	100			
5	100			
3.35	100			
2	100			
1.18	100			
0.6	100	Particle density	(assumed)	
0.425	100	2.90	Mg/m3	
0.3	100			
0.212	100			
0.15	99			
0.063	99			

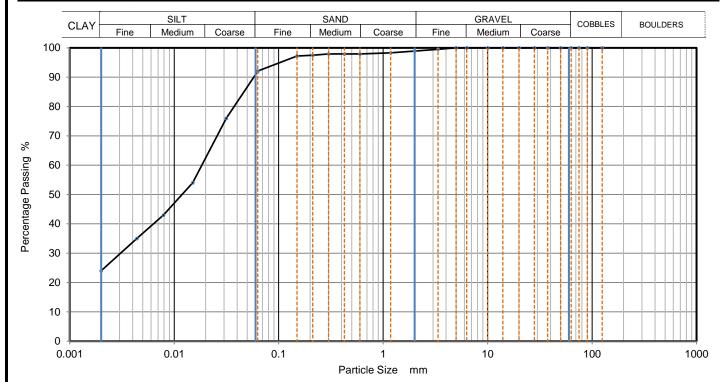
1580
1

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	1
Silt	80
Clay	20

Grading Analysis		
D100	mm	
D60	mm	0.011
D30	mm	0.00423
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	DARTICLE CIZE DISTRIBUTION			Job Ref	17-0167
PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH13		
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	8
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	9.40	
Specimen Reference	3 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090731	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0630	92	
90	100	0.0315	76	
75	100	0.0150	54	
63	100	0.0079	43	
50	100	0.0044	35	
37.5	100	0.0020	24	
28	100			
20	100			
14	100			
10	100			
6.3	100			
5	100			
3.35	100			
2	99			
1.18	98			
0.6	98	Particle density	(assumed)	
0.425	98	2.90	Mg/m3	
0.3	98			
0.212	98			
0.15	97			
0.063	92			

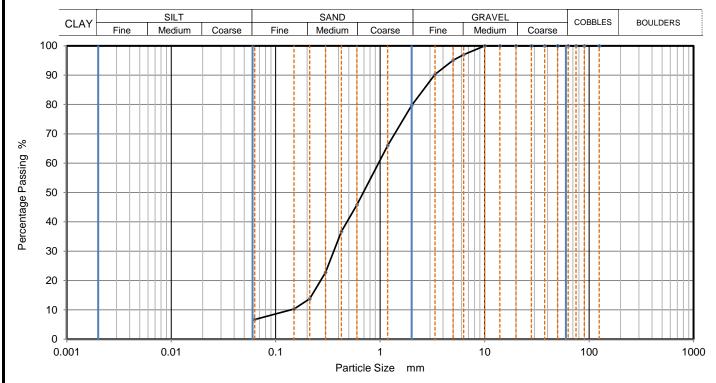
-	
Dry Mass of sample, g	1420

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	7
Silt	68
Clay	24

Grading Analysis		
D100	mm	
D60	mm	0.0183
D30	mm	0.003
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	AUSEWAY PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	BH14
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI		Sample No.	1
Soil Description	Black slightly gravelly subangular fine to coarse GRAVEL.		Depth, m	0.00	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017091222	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	97		
5	95		
3.35	90		
2	80		
1.18	66		
0.6	46		
0.425	37		
0.3	23		
0.212	14		
0.15	10		
0.063	7		

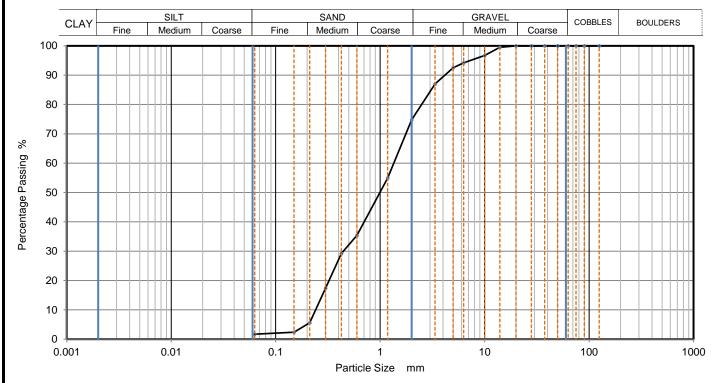
Dry Mass of sample, g	730

Sample Proportions	% dry mass
Cobbles	0
Gravel	20
Sand	73
Fines < 0.063mm	7

Grading Analysis		
D100	mm	
D60	mm	0.965
D30	mm	0.359
D10	mm	0.141
Uniformity Coefficient	·	6.8
Curvature Coefficient		0.95

Stephen.Watson 22/09/2017 15:24 Sheet	Approved	Sheet printed	Fig	1
	Stephen.Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	SEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	BH14
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI		Sample No.	3
Soil Description	Black slightly sandy silty subangular to subrounded fine GRAVEL.		Depth, m	2.00	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090733	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	97		
6.3	94		
5	93		
3.35	87		
2	75		
1.18	55		
0.6	35		
0.425	29		
0.3	17		
0.212	6		
0.15	2		
0.063	2		

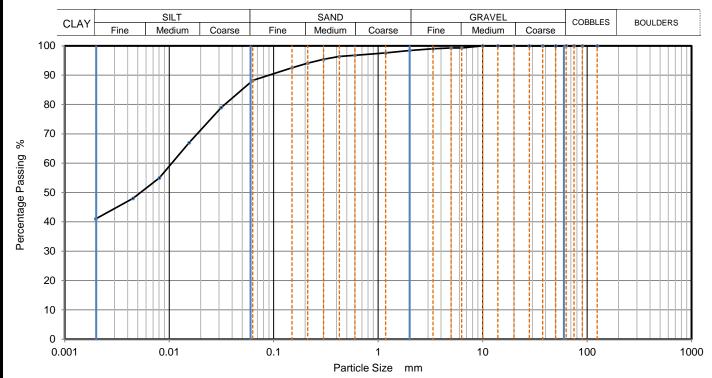
Dry Mass of sample, g	2660
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Sample Proportions	% dry mass
Cobbles	0
Gravel	25
Sand	73
Fines < 0.063mm	2

Grading Analysis		
D100	mm	
D60	mm	1.35
D30	mm	0.445
D10	mm	0.241
Uniformity Coefficient		5.6
Curvature Coefficient		0.61

Stephen.Watson 22/09/2017 15:24 Sheet	Approved	Sheet printed	Fig	1
	Stephen.Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
- GEOTECH				Borehole/Pit No.	BH14
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	4
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	2.50	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090734	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0620	88	
90	100	0.0315	79	
75	100	0.0155	67	
63	100	0.0081	55	
50	100	0.0045	48	
37.5	100	0.0020	41	
28	100			
20	100			
14	100			
10	100			
6.3	99			
5	99			
3.35	99			
2	98			
1.18	98			
0.6	97	Particle density	(assumed)	
0.425	96	2.90	Mg/m3	
0.3	95			
0.212	94			
0.15	93			
0.063	88			

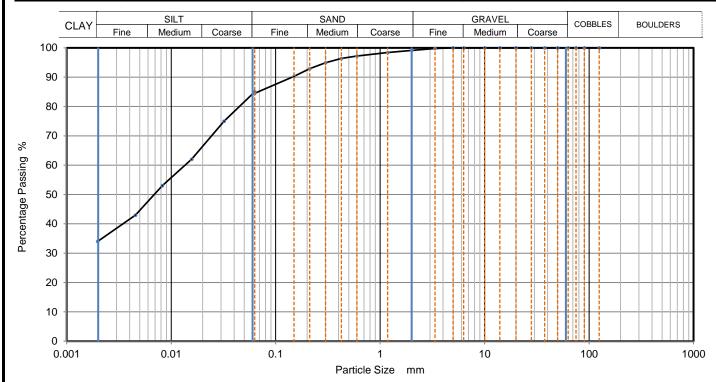
Dry Mass of sample, g 1120	Dry Mass of sample, g	1120
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Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	10
Silt	48
Clay	41

Grading Analysis		
D100	mm	
D60	mm	0.0107
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH				Borehole/Pit No.	BH14
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	5	
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	3.50	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090737	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	85
90	100	0.0320	75
75	100	0.0157	62
63	100	0.0082	53
50	100	0.0045	43
37.5	100	0.0020	34
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	98		
0.6	97	Particle density	(assumed)
0.425	96	2.90	Mg/m3
0.3	95		
0.212	93		
0.15	90		
0.063	85		

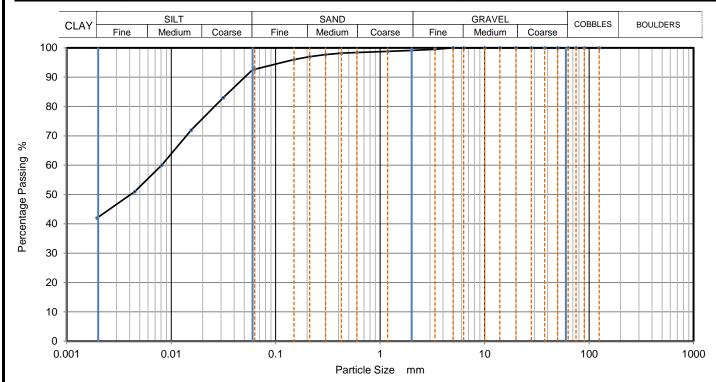
Dry Mass of sample, g	1325
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Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	15
Silt	50
Clay	34

Grading Analysis		
D100	mm	
D60	mm	0.0139
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH .				Borehole/Pit No.	BH14
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	6
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	4.50	
Specimen Reference	3 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090739	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0619	93
90	100	0.0315	83
75	100	0.0156	72
63	100	0.0081	60
50	100	0.0045	51
37.5	100	0.0020	42
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	99		
0.6	98	Particle density	(assumed)
0.425	98	3.00	Mg/m3
0.3	98		
0.212	97		
0.15	96		
0.063	93		

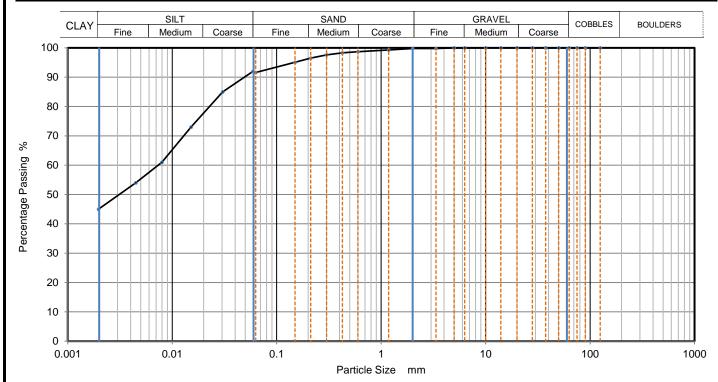
Dry Mass of sample, g	1415
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	1	
Sand	6	
Silt	51	
Clay	42	

Grading Analysis		
D100	mm	
D60	mm	0.00798
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH				Borehole/Pit No.	BH14
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	7	
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	5.50	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090742	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0592	92	
90	100	0.0305	85	
75	100	0.0151	73	
63	100	0.0080	61	
50	100	0.0045	54	
37.5	100	0.0020	45	
28	100			
20	100			
14	100			
10	100			
6.3	100			
5	100			
3.35	100			
2	100			
1.18	99			
0.6	99	Particle density	(assumed)	
0.425	98	2.90	Mg/m3	
0.3	98		_	
0.212	97			
0.15	95			
0.063	92			

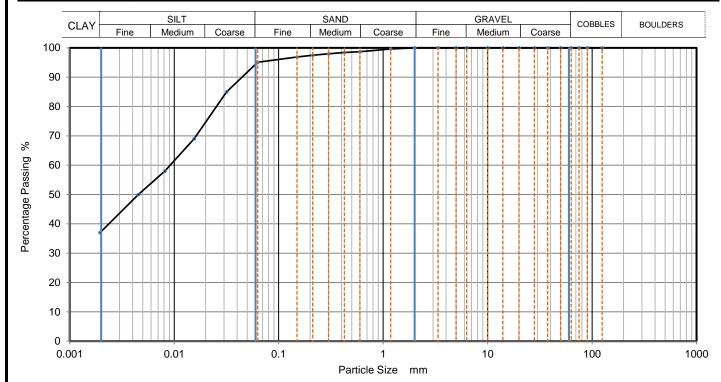
Dry Mass of sample, g	1335

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	8
Silt	47
Clay	45

Grading Analysis		
D100	mm	
D60	mm	0.0073
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH				Borehole/Pit No.	BH14
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	8	
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	7.00	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090743	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0625	95	
90	100	0.0318	85	
75	100	0.0155	69	
63	100	0.0081	58	
50	100	0.0045	50	
37.5	100	0.0020	37	
28	100			
20	100			
14	100			
10	100			
6.3	100			
5	100			
3.35	100			
2	100			
1.18	100			
0.6	99	Particle density	(assumed)	
0.425	98	2.90	Mg/m3	
0.3	98			
0.212	98]		
0.15	97]		
0.063	95			

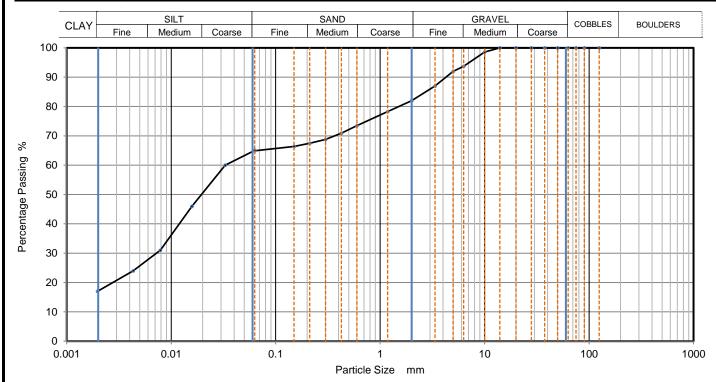
Dry Mass of sample, g 1240	Dry Mass of sample, g	1240
----------------------------	-----------------------	------

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	0	
Sand	5	
Silt	58	
Clay	37	

Grading Analysis		
D100	mm	
D60	mm	0.00913
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH .				Borehole/Pit No.	BH14
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	9	
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		Depth, m	7.70	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090744



Sieving		Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	65
90	100	0.0329	60
75	100	0.0158	46
63	100	0.0079	31
50	100	0.0043	24
37.5	100	0.0020	17
28	100		
20	100		
14	100		
10	99		
6.3	94		
5	92		
3.35	87		
2	82		
1.18	78		
0.6	74	Particle density	(assumed)
0.425	71	2.90	Mg/m3
0.3	69		
0.212	68		
0.15	66		
0.063	65		

Dry Mass of sample, g	2085
-----------------------	------

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	18	
Sand	17	
Silt	48	
Clay	17	

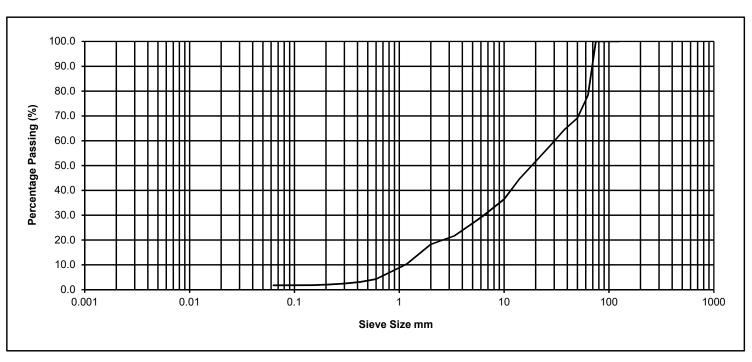
Grading Analysis		
D100	mm	
D60	mm	0.0338
D30	mm	0.00738
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
Stephen. Watson	22/09/2017 15:24	Sheet	

% Sieve Size mm Passing 125.000 100.0 75.000 100.0 63.000 78.3 50.000 69.1 37.500 64.4 28.000 58.4 20.000 51.6 14.000 44.6 10.000 36.5 6.300 29.7 5.000 26.7 3.350 21.7 2.000 18.2 1.180 10.3 4.3 0.600 0.425 3.1 0.300 2.5 0.212 2.1 1.8 0.150 0.063 1.8 0.045 0.032 0.020 0.012 0.009 0.006 0.004 0.003 0.002 0.001

Determination of Particle Size Distribution

BS 1377: 1990: Part 2: Clauses 9.2 & 9.5



Percentage Particle Size

Clay	Fine Medium Coarse	Fine Medium Coarse	Fine Medium Coarse	Cobbles	Boulder
	Silt	Sand	Gravel		
	1.8	16.5	60.1	0.0	0.0

VS

Approved

Checked

Operator

Sample DescriptionSandy GRAVELProject No.17-0167BH/TP No.BH/12ProjectArklow sewerage SchemeSample No.

Date sample tested

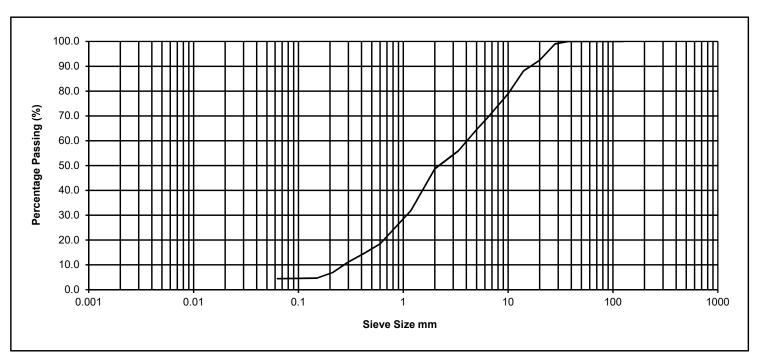
25/09/2017 Depth

1.3m

% Sieve Size mm Passing 125.000 100.0 75.000 100.0 63.000 100.0 50.000 100.0 37.500 100.0 28.000 99.0 20.000 92.4 14.000 88.1 10.000 78.9 6.300 69.1 5.000 64.5 3.350 55.9 2.000 48.7 1.180 31.8 0.600 18.5 0.425 14.6 0.300 11.2 0.212 6.9 0.150 4.6 0.063 4.4 0.045 0.032 0.020 0.012 0.009 0.006 0.004 0.003 0.002 0.001

Determination of Particle Size Distribution

BS 1377: 1990: Part 2: Clauses 9.2 & 9.5



Percentage Particle Size

Clay	Fine Medium Coarse	Fine Medium Coarse	Fine Medium Coarse	Cobbles	Boulder
	Silt	Sand	Gravel		
	4.4	44.3	51.3	0.0	0.0

Date sample tested

VS

Sample Description Sandy GRAVEL

Operator

Project No. BH/TP No. 17-0167 BH13

1.6m

Project Arklow sewerage Scheme
SS Checked VS Approved

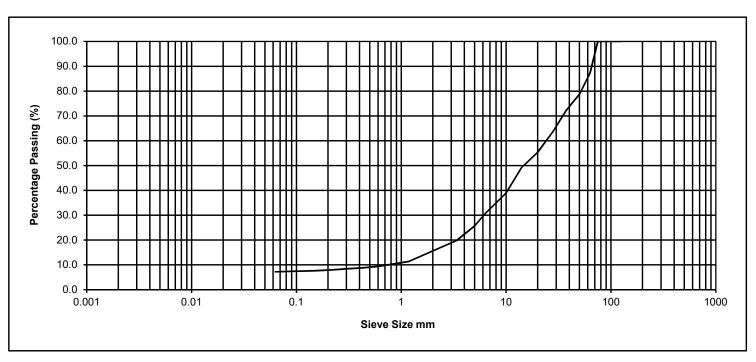
Sample I 25/09/2017 Depth

Sample No.

% Sieve Size mm Passing 125.000 100.0 75.000 100.0 63.000 87.2 78.7 50.000 37.500 72.3 28.000 63.7 20.000 55.4 14.000 49.1 10.000 39.0 6.300 30.6 5.000 25.7 3.350 19.7 2.000 15.6 1.180 11.4 0.600 9.4 0.425 8.8 0.300 8.4 0.212 7.9 7.7 0.150 0.063 7.2 0.045 0.032 0.020 0.012 0.009 0.006 0.004 0.003 0.002 0.001

Determination of Particle Size Distribution

BS 1377: 1990: Part 2: Clauses 9.2 & 9.5



Percentage Particle Size

Clay	Fine Medium Coarse	Fine Medium Coarse	Fine Medium Coarse	Cobbles	Boulder
	Silt	Sand	Gravel		
	7.2	8.4	71.6	0.0	0.0

Date sample tested

VS

Sample Description Silty sandy GRAVEL

Operator

Project No. BH/TP No.

17-0167 BH13

8.9m

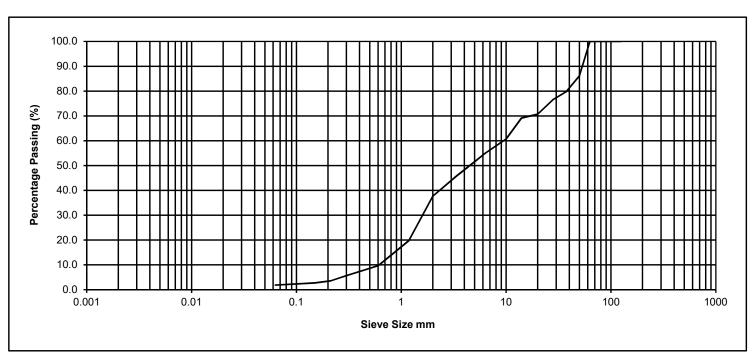
Project Arklow sewerage Scheme Checked Approved

Sample No. 25/09/2017 Depth

% Sieve Size mm Passing 125.000 100.0 75.000 100.0 63.000 100.0 50.000 86.1 37.500 79.8 28.000 76.5 20.000 70.7 14.000 69.1 10.000 60.7 6.300 55.0 5.000 51.6 3.350 45.7 2.000 37.7 1.180 19.7 0.600 9.6 0.425 7.6 0.300 5.7 0.212 3.6 2.7 0.150 0.063 1.8 0.045 0.032 0.020 0.012 0.009 0.006 0.004 0.003 0.002 0.001

Determination of Particle Size Distribution

BS 1377: 1990: Part 2: Clauses 9.2 & 9.5



Percentage Particle Size

Clay	Fine Medium Coarse	Fine Medium Coarse	Fine Medium Coarse	Cobbles	Boulder
	Silt	Sand	Gravel		
	1.8	35.8	62.3	0.0	0.0

17-0167

BH14

Sample Description Sandy GRAVEL Project No. BH/TP No.

	Project	t	Arklow sewera	age Scheme				Sample No.	
Operator	SS	Checked	VS	Approved	VS	Date sample tested	25/09/2017	Depth	0.9m

CAUSEWAY	Unconsolidate Compression		ed Triaxial ut measurement	Job Ref	17-0167
GEOTECH	of pore pressu			Borehole/Pit No.	BH12
Site Name	Arklow Sewerage Sc	heme Marine Ou	utfall GI	Sample No.	18
Soil Description	Grey slightly sandy slightly gravelly silty CLAY.			Depth	3.00
Specimen Reference	3	Specimen Depth	m	Sample Type	UT
Specimen Description	Stiff grey slightly sandy slightly gravelly silty CLAY.			KeyLAB ID	Caus201709074
Test Method	BS1377 : Part 7 : 19	90, clause 8, sin	gle specimen	Date of test	19/09/2017

Test Number Length Diameter **Bulk Density** Moisture Content Dry Density

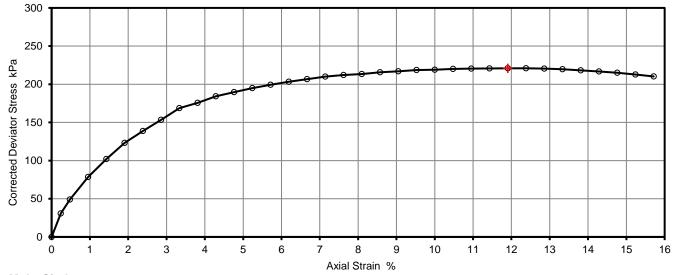
Rate of Strain Cell Pressure At failure

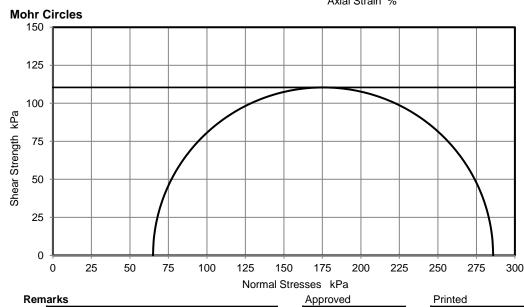
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

1	
210.0	mm
105.2	mm
2.02	Mg/m3
23.9	%
1.63	Mg/m3

	I, .
	%/min
65	kPa
11.9	%
221	kPa
110	kPa ½(σ1 - σ3)f
Brittle	

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for

information only.

Remarks

Lab Sheet Reference:

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377

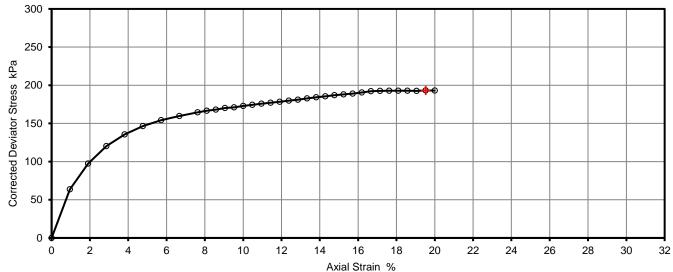
Stephen.Watson

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Fig. No. 1 Sheet

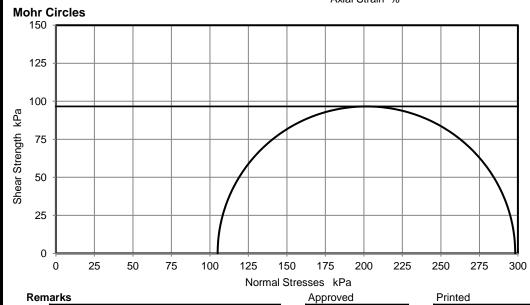
CAUSEWAY	Unconsolidat		ed Triaxial ut measuremen	•	Job Ref	17-0167
GEOTECH .	of pore press				Borehole/Pit No.	BH12
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	19	
Soil Description	Grey slightly sandy slightly gravelly silty CLAY.				Depth	5.00
Specimen Reference	3	Specimen Depth		m	Sample Type	UT
Specimen Description	Stiff grey slightly sandy slightly gravelly silty CLAY.			KeyLAB ID	Caus201709078	
Test Method	BS1377 : Part 7 : 1	990, clause 8, sin	igle specimen		Date of test	19/09/2017
	Test Number				1	٦
	Length				210.0	mm
	Diameter				105.2	mm
	Bulk Density				2.01	Mg/m3
	Moisture Content				22.4	%
	Dry Density				1.64	Mg/m3
	Rate of Strain				2.0	%/min
	Cell Pressure				105	kPa
	At failure	Axial Strain			19.5	%
		Deviator Stress	s, (σ1 - σ3)f		193	kPa

Deviator Stress v Axial Strain



Undrained Shear Strength, cu

Mode of Failure



Deviator stress corrected for area change and membrane effects

kPa ½(σ1 - σ3)f

Mohr circles and their interpretation is not covered by BS1377. This is provided for

information only.

Remarks

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97

Brittle

Fig. No. 1 Sheet

CAUSEWAY		ated Undrained		Job Ref	17-0167
—— GEOTECH	Compression Test without measurement of pore pressure - single specimen			Borehole/Pit No.	BH12
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	20
Soil Description	Grey slightly sandy silty CLAY.			Depth	8.00
Specimen Reference	3	Specimen Depth	m	Sample Type	UT
Specimen Description	Firm grey slightly sandy silty CLAY.			KeyLAB ID	Caus2017090713
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	19/09/2017

Test Number Length Diameter **Bulk Density** Moisture Content Dry Density

Rate of Strain Cell Pressure At failure

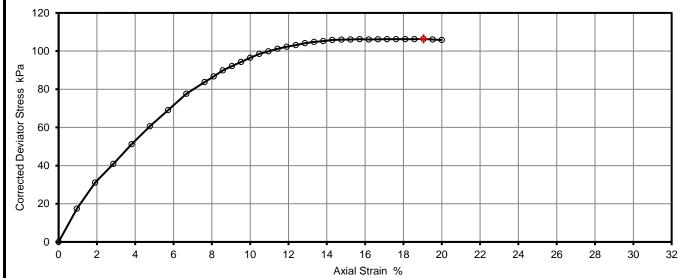
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

1	
210.0	mm
105.2	mm
2.03	Mg/m3
21.9	%
1.66	Mg/m3

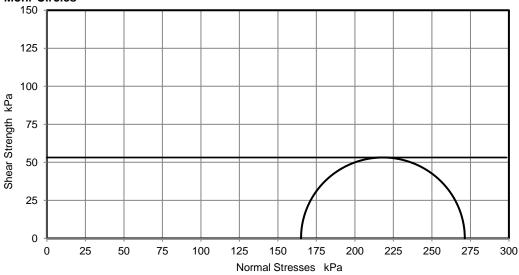
2.0	%/min
165	kPa
19.0	%
106	kPa
53	kPa ½(o
Brittle	

σ1 - σ3)f

Deviator Stress v Axial Strain







Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377 Approved

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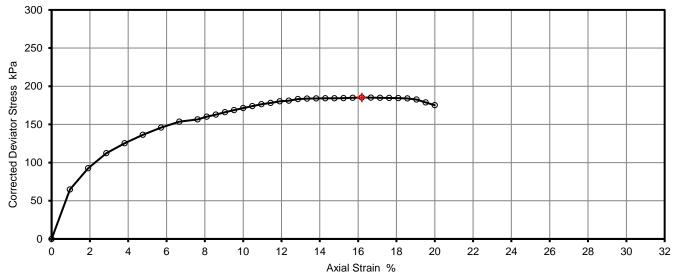
Fig. No. 1 Sheet

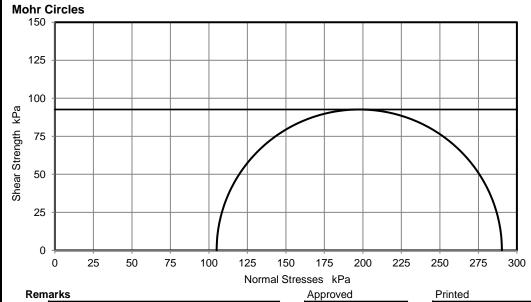
Lab Sheet Reference:

	•							ı		
CAUSEWAY	Unconsolidate Compression	nt	Job Ref		17-0167					
GEOTECH	of pore pressu					Borehole/Pit	No.		BH13	
Site Name	Arklow Sewerage Sc	heme Marine Ou	ıtfall GI			Sample No.			17	
Soil Description	Grey slightly sandy s					Depth		3.00		
Specimen Reference	3	Specimen Depth			m	Sample Type)		UT	
Specimen Description	Stiff grey slightly san	dy silty CLAY.				KeyLAB ID		Caus2	2017090720	
Test Method										コ
	Test Number Length Diameter Bulk Density Moisture Content Dry Density					1 210.0 105.2 2.07 26.9 1.63		mm mm Mg/m3 % Mg/m3		
	Rate of Strain				[2.0		%/min		
	Cell Pressure At failure	Axial Strain			-	65 20.0		kPa %		
		Deviator Stress			ļ	214		kPa	4 -0 \f	
		Undrained Shea Mode of Failure	-	cu	ŀ	107		kPa ½(σ	1 - 03)ī	
Deviator Stress v A	Axial Strain									
300]
250							+-			-
ъ				2000		•				
တ္တ 200 •		- 								1
ග් 150 •										
Deviator Stress kPa										
Corrected I										1
S 50										
, /										
0 2	4 6 8	10 12		16 18	3 2	20 22	24	26 28	3 30 3	32
Mohr Circles			Axiai S	Strain %						
125								Deviator str for area cha membrane		
							4			
ව <u>අ</u>									on is not covere	ed
45 75 H								by BS1377 This is prov	vided for	
Stren								information	only.	
Shear Strength kPa										
25						 	-			
0										
0 25	50 75 100	125 150		200 22	5 2	250 275	300			
Remarks		Normal Stres	Approved		-	Printed		•	_	
Testing termina	ated at 20% strain		Stephen.	.Watson		22/09/2017 1	4:55		Fig. No.	
Lab Sheet Referenc	e :	,	-					•	Sheet 4	

CAUSEWAY	Unconsolida		ed Triaxial ut measurement		Job Ref	17-0167	
—— GEOTECH	of pore press			Borehole/Pit No.	BH13		
Site Name	Arklow Sewerage S	Scheme Marine Ou	utfall GI		Sample No.	18	
Soil Description	Grey slightly sandy	silty CLAY.			Depth	5.00	
Specimen Reference	3	Specimen Depth	r	n	Sample Type	UT	
Specimen Description	Stiff grey slightly sa	andy silty CLAY.			KeyLAB ID	Caus2017090724	
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	19/09/2017	
	Test Number			Г	1	7	
	Length			F	210.0	mm	
	Diameter			-	105.2	mm	
	Bulk Density			r	2.01	Mg/m3	
	Moisture Content			T	23.0	%	
	Dry Density				1.64	Mg/m3	
	Rate of Strain			Г	2.0	%/min	
	Cell Pressure				105	kPa	
	At failure	Axial Strain			16.2	%	
		Deviator Stress	, (σ1 - σ3)f		185	kPa	
		Undrained Shea	ar Strength, cu	L	93	kPa ½(σ1 - σ3)f	
		Mode of Failure			Brittle		

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Lab Sheet Reference :

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377 Stephen.Watson

22/09/2017 14:55

Fig. No. 1 Sheet

CAUSEWAY	Compression	lated Undraine on Test withou ssure - single	Job Ref Borehole/Pit No.	17-0167 BH13		
Site Name		e Scheme Marine Ou	Sample No.	19		
Soil Description	Grey slightly san	dy silty CLAY.	Depth	8.00		
Specimen Reference	1	Specimen Depth	m	Sample Type	UT	
Specimen Description	Stiff grey slightly	sandy silty CLAY.		KeyLAB ID	Caus201709190	
Test Method	BS1377 : Part 7	: 1990, clause 8, sing	Date of test	20/09/2017		
	Test Number			1	٦	
	Length		210.0	-lmm		
	Diameter		105.2	mm		
	Bulk Density		2.03	Mg/m3		
	Moisture Content	t	21.8	%		
	Dry Density			1.67	Mg/m3	
	Data of Strain			2.0	70/ /min	

Rate of Strain Cell Pressure At failure

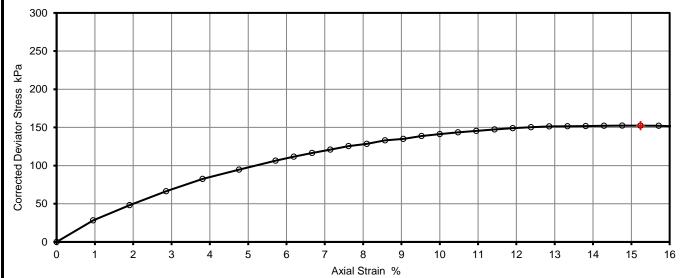
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

2.0	%/min
165	kPa
15.2	%
152	kPa
76	kPa ½

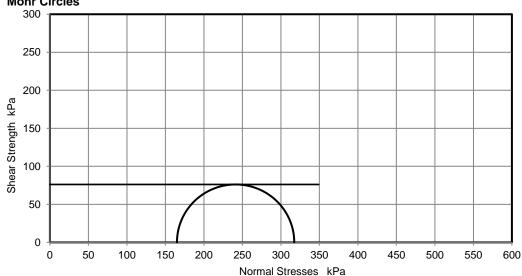
Brittle

½(σ1 - σ3)f

Deviator Stress v Axial Strain







Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for

information only.

Remarks

Lab Sheet Reference :

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377

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Fig. No. 1 Sheet

	Unconsolidated Undrained Triaxial		Job Ref	17-0167
CAUSEWAY GEOTECH	Compression Test without measurer	nent	Borehole/Pit No.	BH14
	of pore pressure - single specimen			DITI4
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	17
Soil Description	Grey slightly sandy silty CLAY.		Depth	3.00
Specimen Reference	3 Specimen Depth	m	Sample Type	UT
Specimen Description	Stiff grey slightly sandy silty CLAY.		KeyLAB ID	Caus2017090735
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		Date of test	20/09/2017
	Test Number Length		1 210.0	lmm
	Diameter		105.2	mm
	Bulk Density		2.05	Mg/m3
	Moisture Content		23.4	%
	Dry Density		1.66	Mg/m3
	Rate of Strain		2.0	%/min
	Cell Pressure		105	kPa o/
	At failure Axial Strain Deviator Stress, (σ 1 - σ 3)f		20.0 258	% kPa
	Undrained Shear Strength, cu		129	kPa ½(σ1 - σ3)f
	Mode of Failure			
Deviator Stress v A	xial Strain			
300				
250		مم ا		
250	200000	•		
д				
ss 200 •	appeared l			
Str				
Deviator Stress KPa				
o 100 €				
octed [
Corrected to the second				
/				
0 2	4 6 8 10 12 14 16	18	20 22 24	26 28 30 32
Mohr Circles	Axial Strain	%		
300				Deviator stress corrected
250				for area change and
250				membrane effects
200				Mohr circles and their
				interpretation is not covered
Shear Strength k-Pa				by BS1377. This is provided for
trenç				information only.
to 100 €				
She				
50				
0 50	100 150 200 250 300 350 400	450	500 550 600	
0 50	Normal Stresses kPa	-1 00	550 550 600	
Remarks	Approved		Printed	
Testing termina	ated at 20% strain Stephen.Wats	son	22/09/2017 14:55	Fig. No.
Lab Sheet Reference				Sheet
				7

CAUSEWAY	Unconsolida Compression					ent	Job I	Ref		17-0167			
GEOTECH	of pore press						Bore	hole/Pit I	No.		BH14		
Site Name	Arklow Sewerage S	Scheme Marine	Outfall	GI			Sam	ple No.			18		
Soil Description	Grey slightly sandy						Dept	h		5.00			
Specimen Reference	3	Specimen Depth				m	Sam	ple Type		UT			
Specimen Description	Stiff grey slightly sa	andy silty CLAY					KeyL	AB ID		Caus	s2017090	740	
Test Method	BS1377 : Part 7 : 1	990, clause 8, s	single s	pecime	n		Date	of test		2	0/09/201	7	
	Test Number Length Diameter Bulk Density Moisture Content Dry Density							1 210.0 105.2 2.00 23.5 1.62		mm mm Mg/m3 % Mg/m3			
	Rate of Strain					ſ		2.0		%/min			
	Cell Pressure 65								kPa				
	At failure	Axial Strain Deviator Stre	ess, (c	σ1 - σ3))f	ŀ		16.2 247		% kPa			
	Undrained Shear Strength, cu 123 Mode of Failure Brittle								kPa ½(≀	σ1 - σ3)f	-		
		wode or r am	uie			L		Dittic		l			
viator Stress v /	Axiai Strain												
250		- 004			 	9000	•						

200													
150													
100									+				
50													
» //													
0 2	4 6 8	10 12	1.	4 1	↓ 6 1	18 2	20	22	24	26 2	28 3	_ 0 32	
hr Circles		.0 .2	·		Strain %		_0			20 2	.0 0	0 02	
300									٦	Deviator s	trace cor	rected	
250										for area cl	nange an		
250										membrane	e effects		
200									4	Mohr circle	es and th	neir	
										interpretate by BS137		t covered	
150									1	This is pro	vided for	r	
100										informatio	n only.		
50		\longrightarrow							4				
			\										
0 50	100 150 200	250 300) 3 ¹	ļ 50 4	00 4	150 5	500	550	⊒ 600				
	.50 100 200	Normal St			7				200				
Remarks		e and		proved		— r	Printed			1	Fig.	No	
Strengths corre	ected for area chang				Watson			9/2017 1				44.7.	

Arklow	Sewerage :	Scheme					
AIRIOW	ocwerage .	Concine					
Ref:	17-0167		Size mm		100	Initial wet mass g	674
ВН	BH12		Thickness	mm	35.25	Bulk Density mg/m3	1912
Depth m	1.3m						
Our Ref	Q			σ' _ν kPa			
Soil type	Sandy GRAV	EL					
Rate of sh	earing mm/mi	in	0.5	30			
>10 mm remo	ved			60			
				120			
Peak		Ultimate					
σ' _n kPa	τ kPa	σ' _n kPa	τ kPa				
30	34	30	28				
60	59	60	48				
120	108	120	101				

Peak angle of internal friction 42
Cohesion kPa
Ultimate angle of internal friction 39

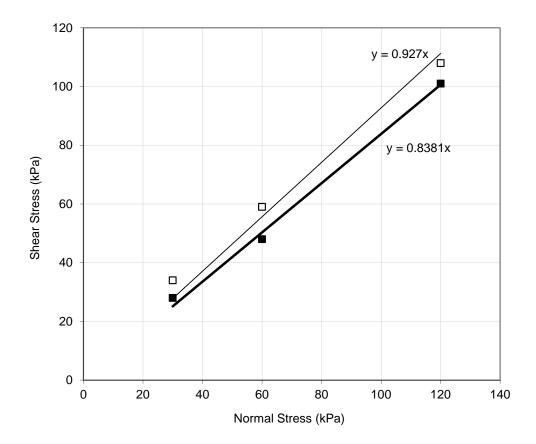


Figure 1 Failure Envelope

Arklow Sewerage Scheme

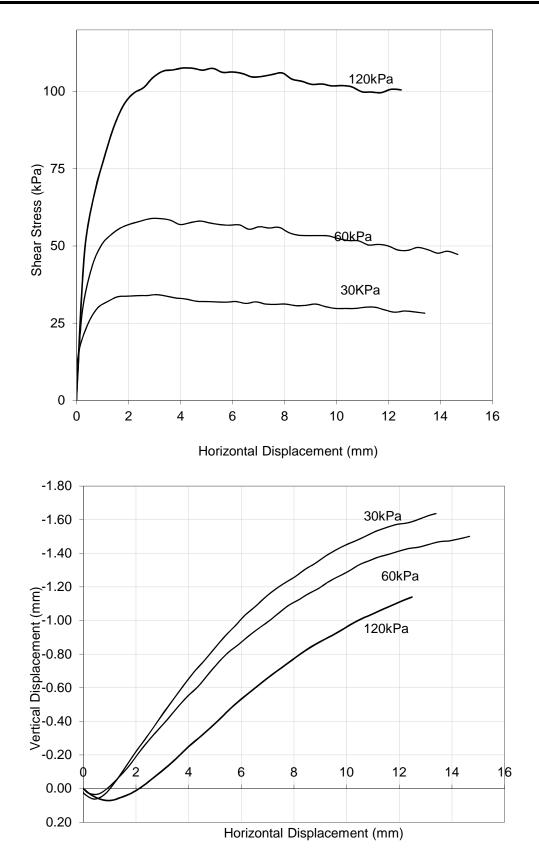
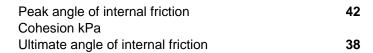


Figure 2 Stress-strain behaviour

Arklow	Sewerage	Scheme					
				-			
Ref:	17-0167		Size mm		100	Initial wet mass g	712
ВН	BH13		Thickness	mm	35.25	Bulk Density mg/m3	2020
Depth m	1.3m			-			
Our Ref	R			σ' _ν kPa			
Soil type	Sandy GRAV	EL					
Rate of sh	earing mm/m	in	0.5	30			
>10 mm remo	ved			60			
				120			
Peak		Ultimate					
σ' _n kPa	τ kPa	σ' _n kPa	τ kPa				
30	30	30	27				
60	56	60	50				
120	109	120	93				



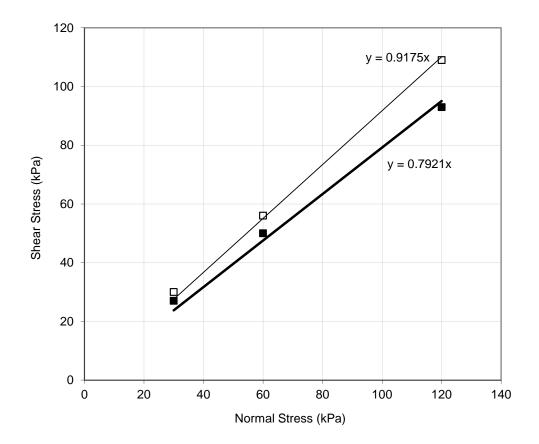


Figure 1 Failure Envelope

Arklow Sewerage Scheme

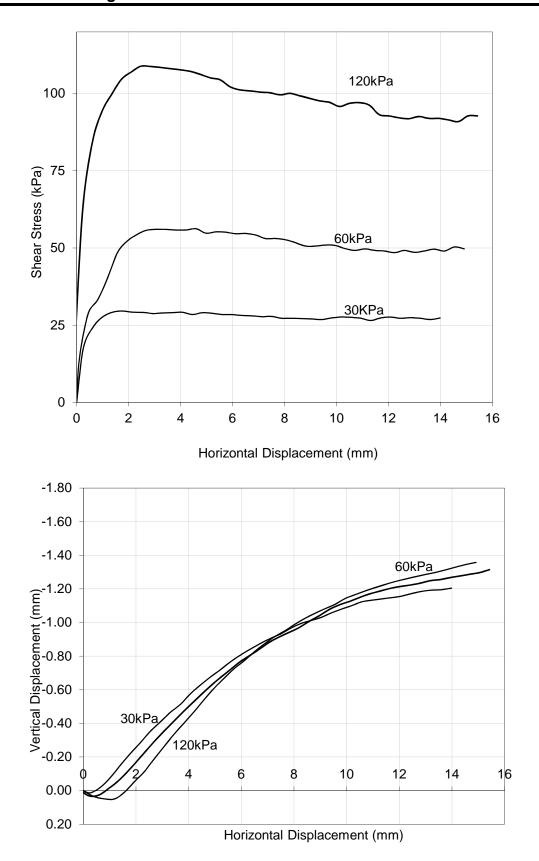


Figure 2 Stress-strain behaviour

Arklow	Sewerage	Scheme					
Ref:	17-0167		Size mm		100	Initial wet mass g	820
BH	BH13		Thickness	mm	36.75	Bulk Density mg/m3	2231
Depth m	8.9m			-			
Our Ref	R			σ' _ν kPa			
Soil type	Sandy GRA\	/EL					
Rate of sh	nearing mm/m	nin	0.5	40			
>10 mm remo	oved			80			
Peak		Ultimate		160			
σ' _n kPa	τ kPa	σ' _n kPa	τ kPa				
40	0	40	39				
80	O	80	81				
160	0	160	154				

Peak angle of internal friction Cohesion kPa Ultimate angle of internal friction

44

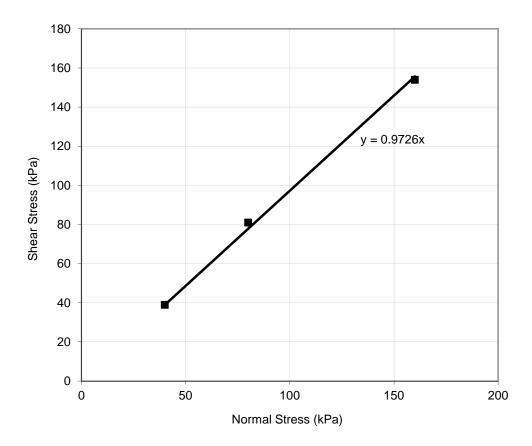


Figure 1 Failure Envelope

Arklow Sewerage Scheme

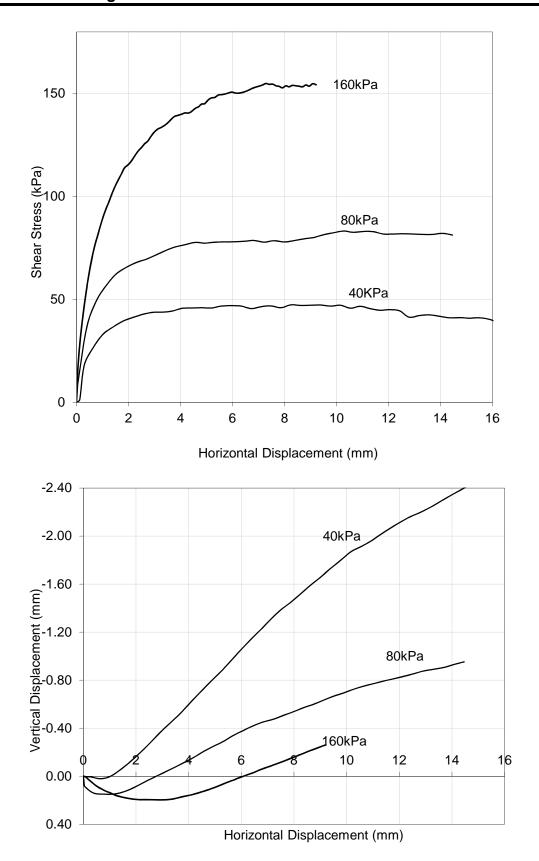


Figure 2 Stress-strain behaviour

Arklow	Sewerage :	Scheme					
7	oon olago						
Ref:	17-0167		Size mm		100	Initial wet mass g	662
ВН	BH14		Thickness	mm	34.75	Bulk Density mg/m3	1905
Depth m	0.9m						-
Our Ref	Р			σ' _v kPa			
Soil type	Sandy GRAV	EL					
Rate of sh	earing mm/m	in	0.5	30			
>10 mm remo	ved			60			
				120			
Peak	I I D	Ultimate	I D				
σ' _n kPa	τ kPa	σ' _n kPa	τ kPa				
30	36	30	30				
60							
120	104	120	96				

Peak angle of internal friction 41
Cohesion kPa
Ultimate angle of internal friction 39

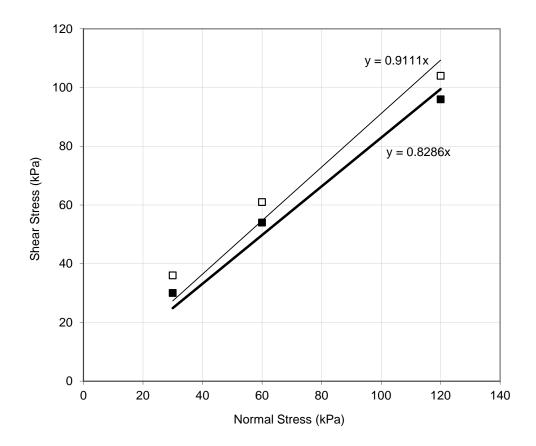


Figure 1 Failure Envelope

Arklow Sewerage Scheme

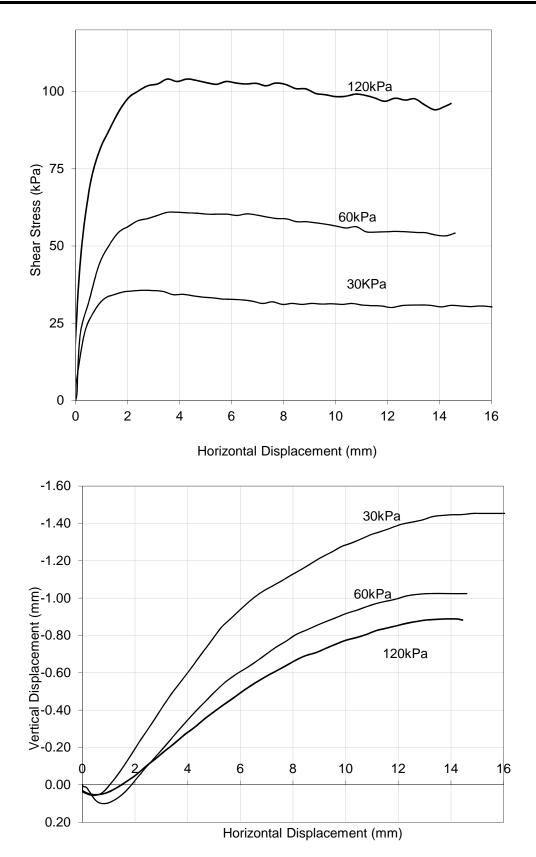
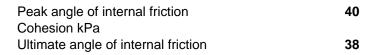


Figure 2 Stress-strain behaviour

Arklow	Sewerage	Scheme					
Ref:	17-0167		Size mm		100	Initial wet mass g	680
ВН	BH14		Thickness	mm	35.25	Bulk Density mg/m3	1929
Depth m	9.0m						
Our Ref	Т			σ' _v kPa			
Soil type	Sandy GRAV	EL					
Rate of sh	nearing mm/m	in	0.5	40			
>10 mm remo	oved			80			
				160			
Peak	I I B	Ultimate	- I D -				
σ' _n kPa	τ kPa	σ' _n kPa	τ kPa				
4(
80							
160	136	160	124				



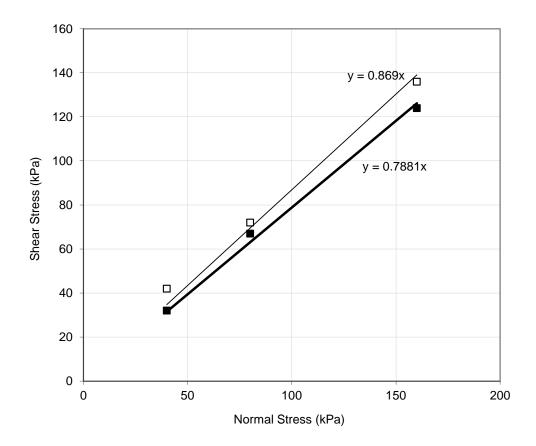


Figure 1 Failure Envelope

Arklow Sewerage Scheme

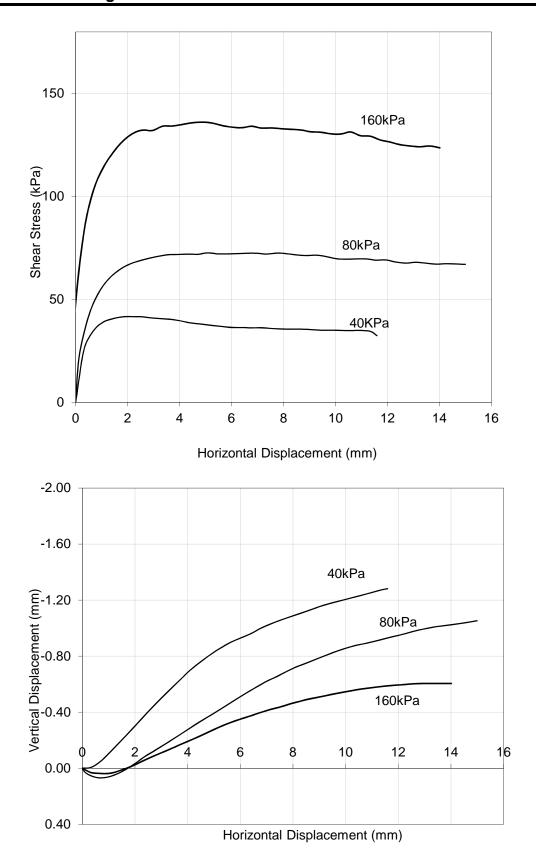


Figure 2 Stress-strain behaviour





Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070

Email: info@chemtest.co.uk

Final Report

Report No.: 17-24130-1

Initial Date of Issue: 18-Sep-2017

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 John Cameron John Duggan Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Stephen Curtis Stephen Franey Stephen Watson

Project 17-0167 Arklow Sewerage Scheme

Marine Outfall GI

Quotation No.: Date Received: 13-Sep-2017

Order No.: Date Instructed: 13-Sep-2017

No. of Samples: 6

Turnaround (Wkdays): 5 Results Due: 19-Sep-2017

Date Approved: 18-Sep-2017

Approved By:

Details: Keith Jones, Technical Manager



Results - Soil

Project: 17-0167 Arklow Sewerage Scheme Marine Outfall GI

Client: Causeway Geotech Ltd	Chemtest Job No.:		17-24130	17-24130	17-24130	17-24130	17-24130	17-24130		
Quotation No.:	Chemtest Sample ID.:			510601	510602	510603	510604	510605	510606	
Order No.:		Clie	nt Locat	tion ID.:	D10	D12	D9	D12	D1	D11
		Clier	nt Samp	le Ref.:	BH12	BH12	BH13	BH13	BH14	BH14
	Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	
	Top Depth (m):			1.00	3.50	1.00	4.00	0.00	1.00	
		Bot	tom De _l	oth (m):					0.90	
			Date Sa	ampled:	12-Sep-2017	12-Sep-2017	12-Sep-2017	12-Sep-2017	12-Sep-2017	12-Sep-2017
Determinand	Accred.	SOP	Units	LOD						
Moisture	N	2030	%	0.020	12	18	12	16	48	18
рН	U	2010		N/A	9.0	8.3	8.5	8.5	7.4	6.7
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.21	0.12	0.15	0.077	1.7	0.71



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

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



SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

Client:	Irish Water
Engineer:	Byrne Looby ARUP J.V.
From:	Stephen Watson
	Laboratory Manager
	Causeway Geotech Ltd
Tel:	+44(0)2827666640
E-mail:	stephen.watson@causewaygeotech.com
Date:	26/09/17
Ref:	17-0167 Schedule 2 - Issue 2

Arklow Sewerage Scheme Marine Outfall GI

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

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 60 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





Project Name Arklow Sewerage Scheme Marine Outfall GI

Report Reference. 17-0167 - Schedule 2 - Issue 2

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report
SOIL	Moisture content - oven drying method	BS 1377-2:1990	15
SOIL	Liquid limit - cone penetrometer	BS 1377-2:1990	6
SOIL	Liquid limit - cone penetrometer - one point	BS 1377-2:1990	6
SOIL	Plastic limit	BS 1377-2:1990	6
SOIL	Plasticity index and liquidity index	BS 1377-2:1990	6
SOIL	Particle size distribution - wet sieving	BS 1377-2:1990	23
SOIL	Particle size distribution - dry sieving	BS 1377-2:1990	23
SOIL	Particle size distribution -sedimentation hydrometer method	BS 1377-2:1990	12
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS 1377-7:1990	5
SOIL	Shear strength by direct shear	BS1377: Part 7: Clause 4: 1990	4
SOIL	pH Value of Soil		1
SOIL	Sulphate Content water extract		1
SOIL	Organic Matter Content		1



Summary of Classification Test Results

Project No.

Project Name

17-0167

Arklow Sewerage Scheme Marine Outfall GI

17-0	7107				AIK	low Sewe	erage	Schen	ie iviaili	e Ouliai	ıGı	_		
		Sar	mple			Dens		w	Passing	LL	PL	PΙ	Particle	Casagrande
Hole No.	Ref	Тор	Base	Туре	Soil Description	bulk	dry		425µm				density	Classification
	1101	ТОР	Base	Турс		Mg/m	13	%	%	%	%	%	Mg/m3	
BH02	14	1.00		D	Black slightly silty slightly gravelly fine to coarse SAND.			76.0	56	72 -1pt	57	15		MV
BH02	15	2.00		D	Black slightly silty slightly gravelly fine to coarse SAND.			60.0						
BH02	16	3.00		D	Black slightly sandy subrounded to rounded fine to coarse GRAVEL.			11.0						
BH02	17	4.00		D	Brown slightly sandy silty CLAY.			26.0						
BH02	19	7.50		D	Brown slightly sandy slightly gravelly silty CLAY.			21.0	91	30 -1pt	15	15		CL
BH02	20	10.50		D	Brownish grey slightly sandy silty CLAY.			32.0	86	30 -1pt	15	15		CL
BH02	21	11.00		D	Brownish grey slightly sandy silty CLAY.			21.0						
BH02	36	17.00		D	Grey slightly sandy subangular to subrounded fine to coarse GRAVEL.			12.0						
BH15	12	1.00		D	MADE GROUND: Black slightly sandy slightly silty subrounded fine to medium GRAVEL with fragments of red brick.			11.0						
BH15	16	5.50		D	Grey slightly sandy silty CLAY.			25.0	86	49 -1pt	15	34		CI
BH15	17	6.50		D	Grey slightly sandy silty CLAY.			24.0						
BH15	20	9.50		D	Brown slightly sandy slightly gravelly silty CLAY.			21.0	94	49 -1pt	21	28		CI
BH15	21	10.50		D	Brown slightly sandy slightly gravelly silty CLAY.			30.0						
All tests perfo	ormed	in acco	rdance v	vith BS	S1377:1990 unless specifie	d otherwi	ise							
Key								Date F	Printed		Appr	oved	Ву	Table
Density t		ment unles	s ·	Liquid I		e density nall pyknom	eter	,	23/09/20	17				1
wd - wat			٠.		asagrande method gj - ga:				-0/03/20	.,				sheet
wi - imm					ngle point test						Step	hen.	Watson	1



Summary of Classification Test Results

Project No.

Project Name

17-0167

wi - immersion in water

1pt - single point test

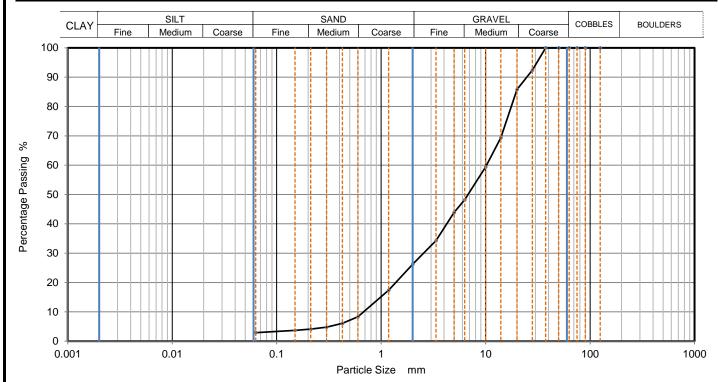
Arklow Sewerage Scheme Marine Outfall GI

17-	0167	Arklow Sewerage Scheme Marine Outfall GI												
Hole No.	Ref	Sar Top	mple Base	Type	Soil Description	Dens bulk	ity dry	W	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	1761	ιυρ	Dase	Туре		Mg/m	13	%	%	%	%	%	Mg/m3	
BH15	22	11.45		D	Brown slightly sandy slightly gravelly silty CLAY.			31.0	100	49 -1pt	20	29		CI
BH15	23	12.00		D	Brown slightly sandy slightly gravelly silty CLAY.			24.0						
II tests perf	ormed	in acco	rdance v	l vith BS	S1377:1990 unless specifie	d otherwi	se		<u> </u>					
	neasure ter displ	ment unles acement	s:	cas - C		e density nall pyknom s jar	eter	Date F	Printed 23/09/20	17		oved		Table 1 sheet

Stephen.Watson

2

CAUSEWAY	DARTI	CLE SIZE DIST	DIDITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	ВН02
Site Name	Arklow Sewerage Sche	me Marine Outfa	Sample No.	1	
Soil Description	Black slightly sandy subro	unded to rounded f	Depth, m	0.00	
Specimen Reference	2	2 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, claus	se 9.2		KeyLAB ID	Caus2017090745



Sievi	ing	Sedimen	Sedimentation				
Particle Size mm	% Passing	Particle Size mm	% Passing				
125	100						
90	100						
75	100						
63	100						
50	100						
37.5	100						
28	92						
20	86						
14	69						
10	59						
6.3	48						
5	44						
3.35	34						
2	26						
1.18	17						
0.6	8						
0.425	6						
0.3	5						
0.212	4						
0.15	4						
0.063	3						

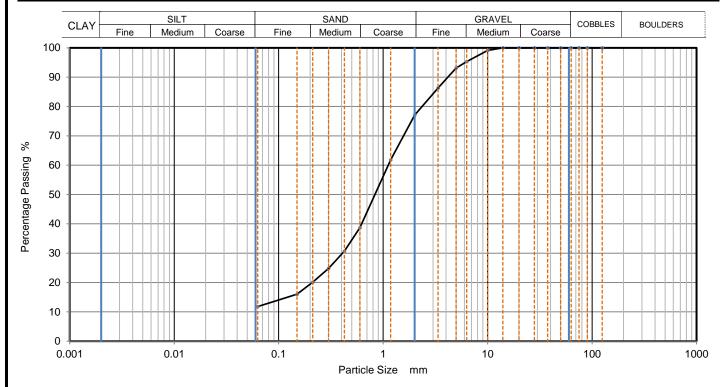
Dry Mass of sample, g	9059
-----------------------	------

Sample Proportions	% dry mass				
Cobbles	0				
Gravel	74				
Sand	23				
Fines < 0.063mm	3				

Grading Analysis		
D100	mm	
D60	mm	10.2
D30	mm	2.55
D10	mm	0.68
Uniformity Coefficient		15
Curvature Coefficient		0.94

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		Sheet	

CAUSEWAY PARTICIF SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PANII	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	ВНО2
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	2
Soil Description	Black slightly silty slightly gravelly fine to coarse SAND.		Depth, m	1.00	
Specimen Reference	2 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090746	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	99		
6.3	95		
5	93		
3.35	86		
2	77		
1.18	62		
0.6	39		
0.425	31		
0.3	25		
0.212	20		
0.15	16		
0.063	12		

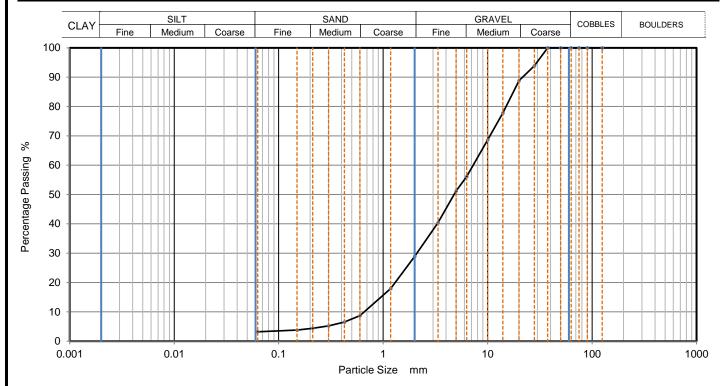
Dry Mass of sample, g	745

Sample Proportions	% dry mass
Cobbles	0
Gravel	23
Sand	65
Fines < 0.063mm	12

Grading Analysis		
D100	mm	
D60	mm	1.12
D30	mm	0.407
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно2	
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	3
Soil Description	Black slightly sandy subrounded to rounded fine to coarse GRAVEL.		Depth, m	2.30	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090749	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	94		
20	89		
14	78		
10	69		
6.3	56		
5	51		
3.35	40		
2	29		
1.18	18		
0.6	9		
0.425	7		
0.3	5		
0.212	4]	
0.15	4		
0.063	3		

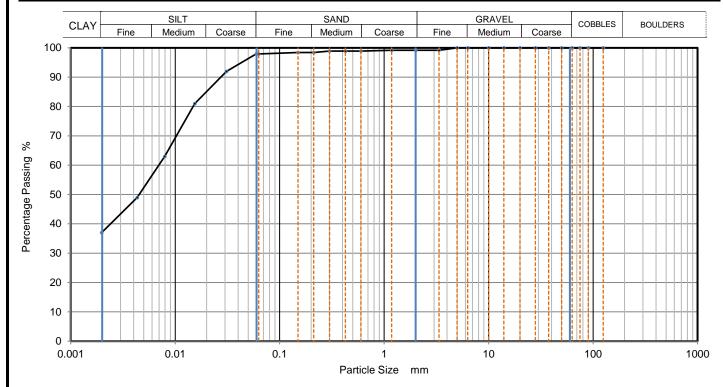
Dry Mass of sample, g	8232

Sample Proportions	% dry mass
Cobbles	0
Gravel	71
Sand	26
Fines < 0.063mm	3

Grading Analysis		
D100	mm	
D60	mm	7.29
D30	mm	2.11
D10	mm	0.659
Uniformity Coefficient		11
Curvature Coefficient		0.92

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CAUSEWAY PARTICIF SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	ВНО2	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	5
Soil Description	Brown slightly sandy silty CLAY.		Depth, m	4.90	
Specimen Reference	2 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090752	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0599	98
90	100	0.0310	92
75	100	0.0154	81
63	100	0.0079	63
50	100	0.0043	49
37.5	100	0.0020	37
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	99		
2	99		
1.18	99		
0.6	99	Particle density	(assumed)
0.425	99	3.00	Mg/m3
0.3	99		
0.212	98		
0.15	98		
0.063	98		

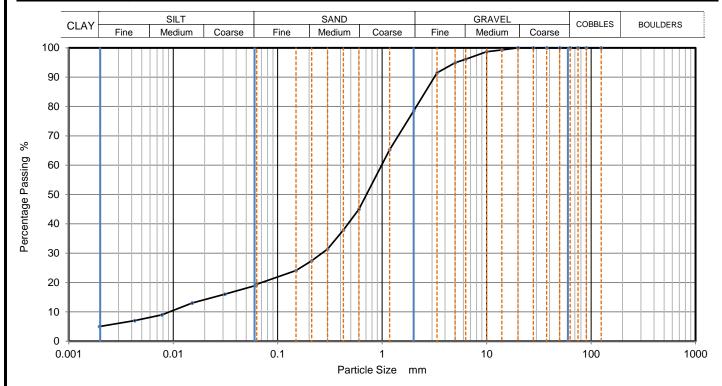
Dry Mass of sample, g	514
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Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	1
Silt	60
Clay	38

Grading Analysis		
D100	mm	
D60	mm	0.00689
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY PARTICIF SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	вно2	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	6
Soil Description	Brown sandy slightly gravelly silty CLAY.		Depth, m	6.00	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090754	



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0620	19
90	100	0.0312	16
75	100	0.0152	13
63	100	0.0078	9
50	100	0.0043	7
37.5	100	0.0020	5
28	100		
20	100		
14	99		
10	99		
6.3	96		
5	95		
3.35	92		
2	79		
1.18	65		
0.6	45	Particle density	(assumed)
0.425	38	2.90	Mg/m3
0.3	31		_
0.212	27		
0.15	24		
0.063	19		

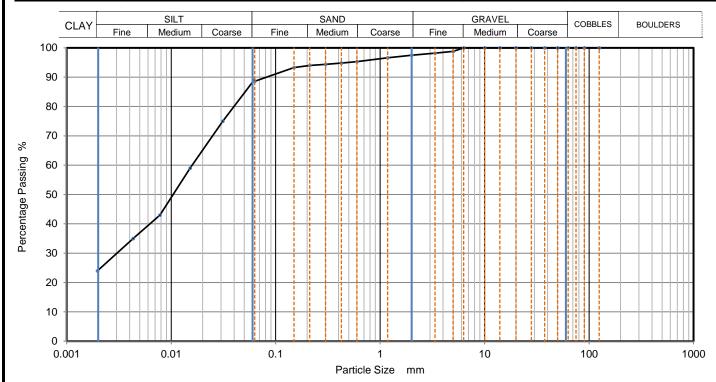
Dry Mass of sample, g	4095

Sample Proportions	% dry mass
Cobbles	0
Gravel	22
Sand	59
Silt	14
Clay	5

Grading Analysis		
D100	mm	
D60	mm	0.989
D30	mm	0.266
D10	mm	0.00871
Uniformity Coefficient		110
Curvature Coefficient		8.2

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	23/10/2017 17:19		
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CAUSEWAY PARTICIF SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	вно2	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	7
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		Depth, m	6.40	
Specimen Reference	2 Specimen m Depth m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090755	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0620	89
90	100	0.0312	75
75	100	0.0152	59
63	100	0.0078	43
50	100	0.0043	35
37.5	100	0.0020	24
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	99		
3.35	98		
2	98		
1.18	97		
0.6	95	Particle density	(assumed)
0.425	95	2.90	Mg/m3
0.3	94		
0.212	94	1	
0.15	93	1	
0.063	89	1	

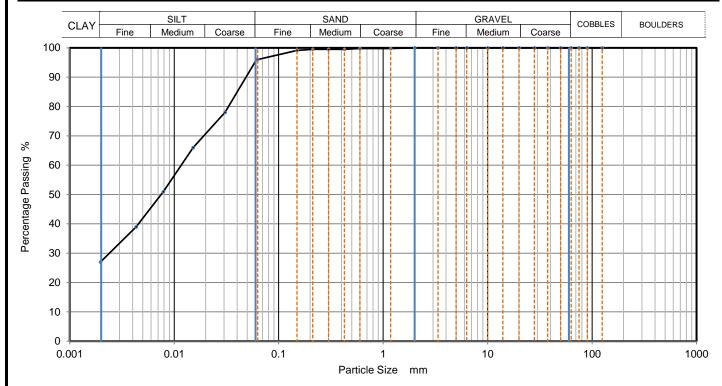
Dry Mass of sample, g	1392
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Sample Proportions	% dry mass
Cobbles	0
Gravel	3
Sand	9
Silt	64
Clay	24

Grading Analysis		
D100	mm	
D60	mm	0.0158
D30	mm	0.00302
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY PARTICIF SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	вно2	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	8
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		Depth, m	7.00	
Specimen Reference	2 Specimen m Depth m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090756	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0615	96
90	100	0.0306	78
75	100	0.0152	66
63	100	0.0079	51
50	100	0.0043	39
37.5	100	0.0020	27
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	2.90	Mg/m3
0.3	100		
0.212	100		
0.15	99		
0.063	96		

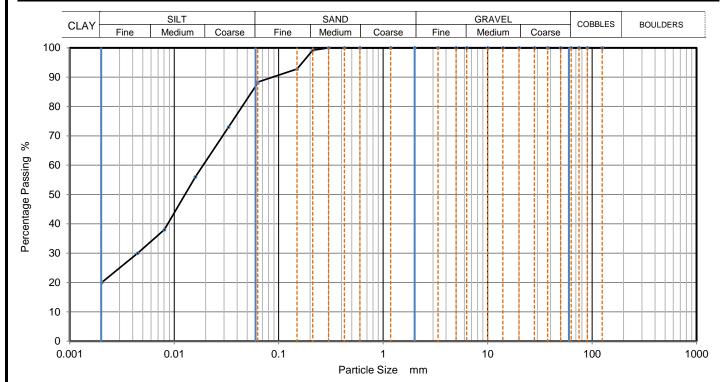
Dry Mass of sample, g	896
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Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	4
Silt	69
Clay	27

Grading Analysis		
D100	mm	
D60	mm	0.0117
D30	mm	0.0024
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно2
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	9
Soil Description	Brownish grey slightly sandy silty CLAY.		Depth, m	9.00
Specimen Reference	Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090759



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	88
90	100	0.0332	73
75	100	0.0160	56
63	100	0.0080	38
50	100	0.0045	30
37.5	100	0.0020	20
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	2.65	Mg/m3
0.3	100		
0.212	99		
0.15	93		
0.063	88		

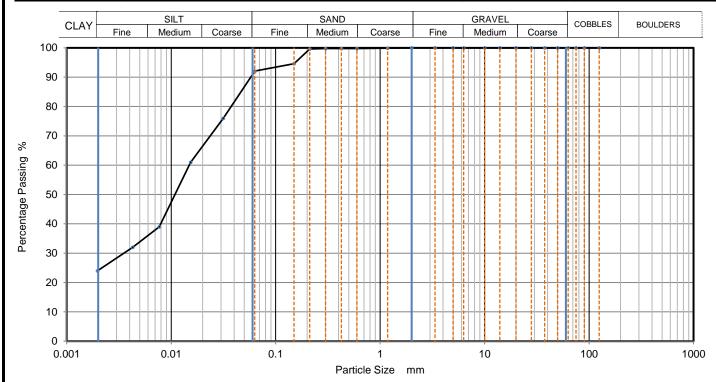
Dry Mass of sample, g	1520
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Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	12
Fines < 0.063mm	88

Grading Analysis		
D100	mm	
D60	mm	0.0192
D30	mm	0.00437
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	ВН02
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	10
Soil Description	Brownish grey slightly sandy silty CLAY.		Depth, m	10.00
Specimen Reference	2 Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090761



Sievi	ing	Sedim	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	92
90	100	0.0315	76
75	100	0.0153	61
63	100	0.0077	39
50	100	0.0043	32
37.5	100	0.0020	24
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	2.90	Mg/m3
0.3	100		
0.212	100	1	
0.15	95	1	
0.063	92	1	

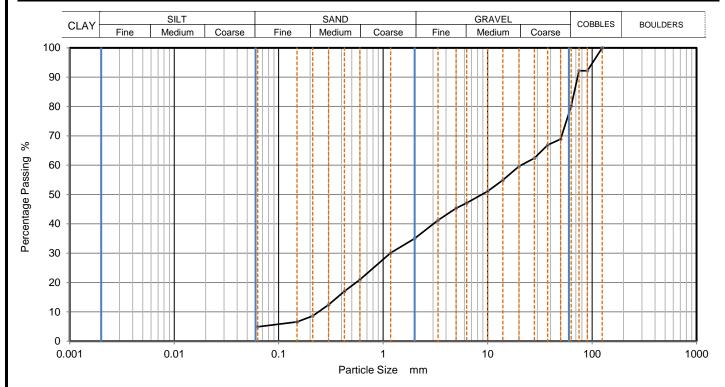
Dry Mass of sample, g	1527
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Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	8
Silt	68
Clay	24

Grading Analysis		
D100	mm	
D60	mm	0.0151
D30	mm	0.00366
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	ВН02	
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	11
Soil Description	Brown sandy subangular to subrounded fine to coarse GRAVEL with low cobble content.		Depth, m	11.50	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090765	



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	92		
75	92		
63	80		
50	69		
37.5	67		
28	62		
20	60		
14	55		
10	51		
6.3	47		
5	45		
3.35	41		
2	35		
1.18	30		
0.6	21		
0.425	17		
0.3	12		
0.212	9		
0.15	7		
0.063	5		

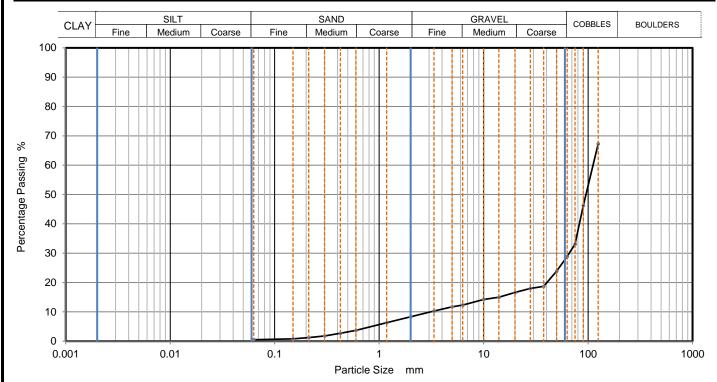
Dry Mass of sample, g	17913
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Sample Proportions	% dry mass
Cobbles	20
Gravel	45
Sand	30
Fines < 0.063mm	5

Grading Analysis		
D100	mm	125
D60	mm	21
D30	mm	1.17
D10	mm	0.241
Uniformity Coefficient		87
Curvature Coefficient		0.27

Approved	Sheet printed	Fig	1
	23/10/2017 17:19	Chast	
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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PANII	PARTICLE SIZE DISTRIBUTION –		Borehole/Pit No.	ВН02
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	12
Soil Description	Grey brown subangular to subrounded COBBLES with some grey slightly sandy subangular to subrounded fine to coarse GRAVEL.		Depth, m	13.00	
Specimen Reference	2 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090766	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	67		
90	46		
75	33		
63	29		
50	24		
37.5	19		
28	18		
20	17		
14	15		
10	14		
6.3	12		
5	12		
3.35	10		
2	8		
1.18	6		
0.6	4		
0.425	3		
0.3	2		
0.212	1		
0.15	1		
0.063	1		

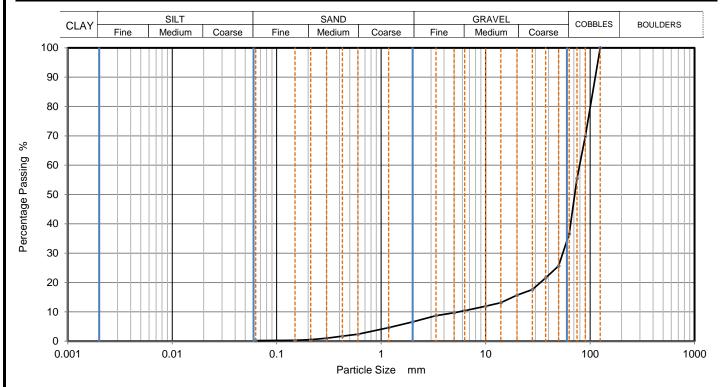
Dry Mass of sample, g	25400

Sample Proportions	% dry mass
Cobbles	71
Gravel	21
Sand	8
Fines < 0.063mm	1

Grading Analysis		
D100	mm	
D60	mm	112
D30	mm	65.9
D10	mm	3.13
Uniformity Coefficient		36
Curvature Coefficient		12

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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	вно2	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	35
Soil Description	Grey brown subangular to subrounded COBBLES with some grey slightly sandy subangular to subrounded fine to coarse GRAVEL		Depth, m	15.00	
Specimen Reference	2	Specimen Depth	m	Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090767	



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	70		
75	56		
63	37		
50	26		
37.5	22		
28	18		
20	16		
14	13		
10	12		
6.3	10		
5	10		
3.35	9		
2	7		
1.18	5		
0.6	2		
0.425	2		
0.3	1		
0.212	1]	
0.15	0]	
0.063	0		

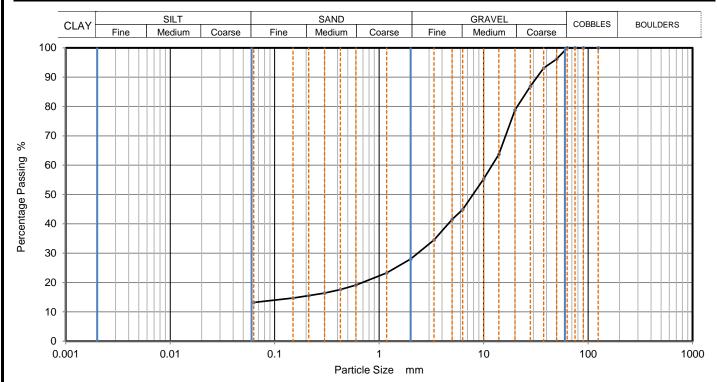
16434

Sample Proportions	% dry mass
Cobbles	63
Gravel	30
Sand	6
Fines < 0.063mm	0

Grading Analysis		
D100	mm	125
D60	mm	79.4
D30	mm	54.8
D10	mm	5.49
Uniformity Coefficient		14
Curvature Coefficient		6.9

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно2	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	37
Soil Description	Grey slightly sandy subangular to subrounded fine to coarse GRAVEL.		Depth, m	16.90	
Specimen Reference	2	Specimen Depth	m	Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090768	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	96		
37.5	93		
28	87		
20	79		
14	64		
10	55		
6.3	45		
5	42		
3.35	35		
2	28		
1.18	23		
0.6	19		
0.425	18		
0.3	16		
0.212	16		
0.15	15		
0.063	13		

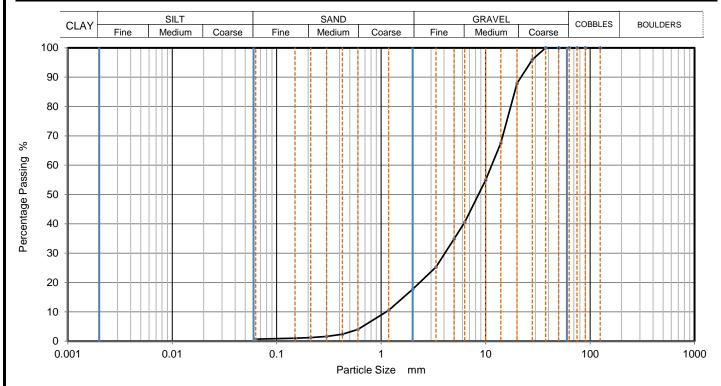
Dry Mass of sample, g	10636

Sample Proportions	% dry mass
Cobbles	0
Gravel	72
Sand	15
Fines < 0.063mm	13

Grading Analysis		
D100	mm	
D60	mm	12.1
D30	mm	2.34
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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		23/10/2017 17:19	Sheet	
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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH15	
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	1
Soil Description	MADE GROUND: Black slightly sandy slightly silty subrounded fine to medium GRAVEL with fragments of red brick.		Depth, m	0.00	
Specimen Reference	2 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090770	



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	96		
20	88		
14	68		
10	55		
6.3	41		
5	35		
3.35	25		
2	18		
1.18	11		
0.6	4		
0.425	2		
0.3	2		
0.212	1]	
0.15	1		
0.063	1		

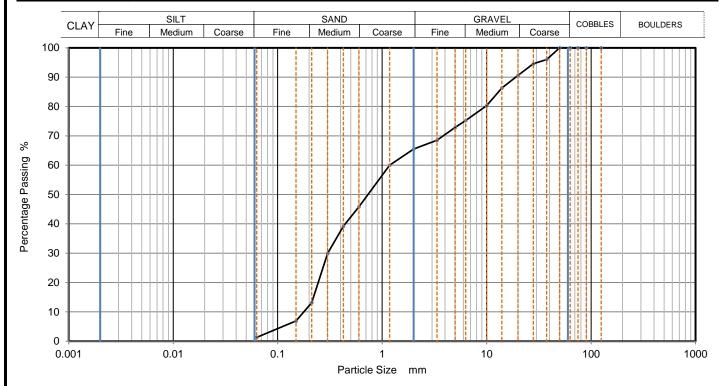
Dry Mass of sample, g	5806
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Sample Proportions	% dry mass
Cobbles	0
Gravel	82
Sand	17
Fines < 0.063mm	1

Grading Analysis		
D100	mm	
D60	mm	11.4
D30	mm	4.08
D10	mm	1.12
Uniformity Coefficient		10
Curvature Coefficient		1.3

Approved	Sheet printed	Fig	1
	23/10/2017 17:19	Chast	
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CAUSEWAY PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH15	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	2
Soil Description	Grey slightly gravelly fine to coarse SAND.		Depth, m	1.50	
Specimen Reference	2	2 Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090772	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	96		
28	95		
20	91		
14	86		
10	80		
6.3	75		
5	73		
3.35	69		
2	66		
1.18	60		
0.6	46		•
0.425	39		
0.3	30		
0.212	13		
0.15	7		
0.063	1		

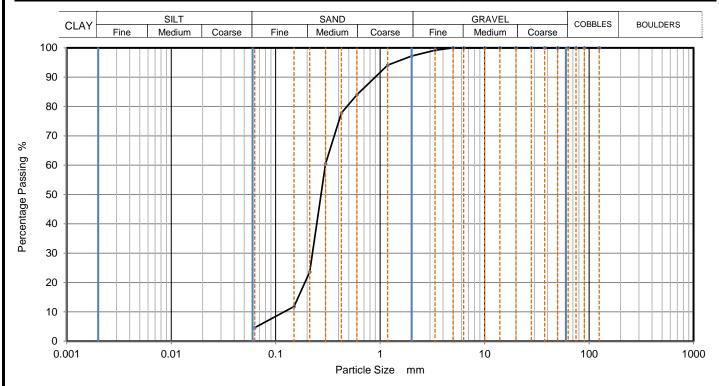
Dry Mass of sample, g	3989

Sample Proportions	% dry mass
Cobbles	0
Gravel	35
Sand	64
Fines < 0.063mm	1

Grading Analysis		
D100	mm	
D60	mm	1.18
D30	mm	0.301
D10	mm	0.179
Uniformity Coefficient	·	6.6
Curvature Coefficient		0.43

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PANII	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH15
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	3
Soil Description	Grey slightly gravelly fine to medium SAND.		Depth, m	2.00	
Specimen Reference	2 Specimen m Depth m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090773	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	99		
2	97		
1.18	94		
0.6	84		
0.425	78		
0.3	61		
0.212	24]	
0.15	12		
0.063	5		

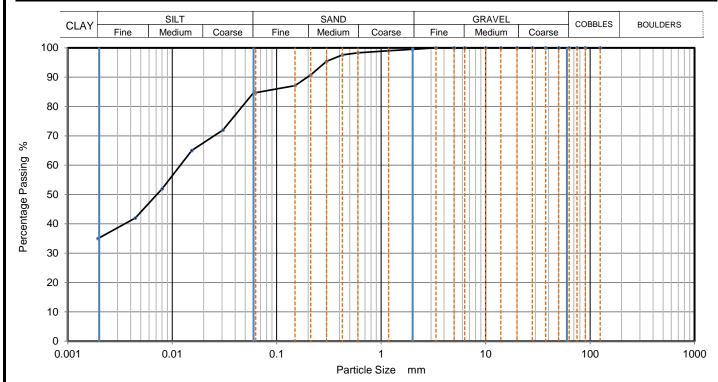
Dry Mass of sample, g	2743
Dry Iviass of Sample, g	2743

Sample Proportions	% dry mass
Cobbles	0
Gravel	3
Sand	93
Fines < 0.063mm	5

Grading Analysis		
D100	mm	
D60	mm	0.299
D30	mm	0.225
D10	mm	0.12
Uniformity Coefficient		2.5
Curvature Coefficient		1.4

Approved	Sheet printed	Fig	1
	23/10/2017 17:19	Chast	
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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PANII	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH15
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	6
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	4.70	
Specimen Reference	2 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090775	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0609	85
90	100	0.0307	72
75	100	0.0154	65
63	100	0.0080	52
50	100	0.0044	42
37.5	100	0.0020	35
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	98	Particle density	(assumed)
0.425	98	3.00	Mg/m3
0.3	95		_
0.212	91		
0.15	87		
0.063	85		

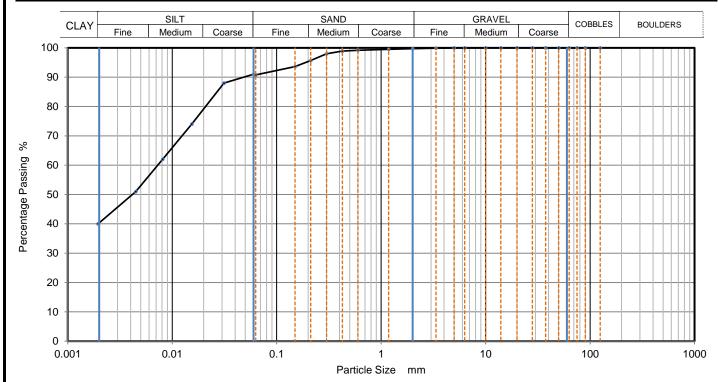
Dry Mass of sample, g	1903
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Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	15
Silt	50
Clay	35

Grading Analysis		
D100	mm	
D60	mm	0.012
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CALISEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH15	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	7
Soil Description	Grey slightly sandy silty CLAY.		Depth, m	6.00	
Specimen Reference	2 Specimen m Depth m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090778	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0599	91
90	100	0.0312	88
75	100	0.0154	74
63	100	0.0081	62
50	100	0.0045	51
37.5	100	0.0020	40
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99	Particle density	(assumed)
0.425	99	3.00	Mg/m3
0.3	98		_
0.212	96		
0.15	94		
0.063	91		

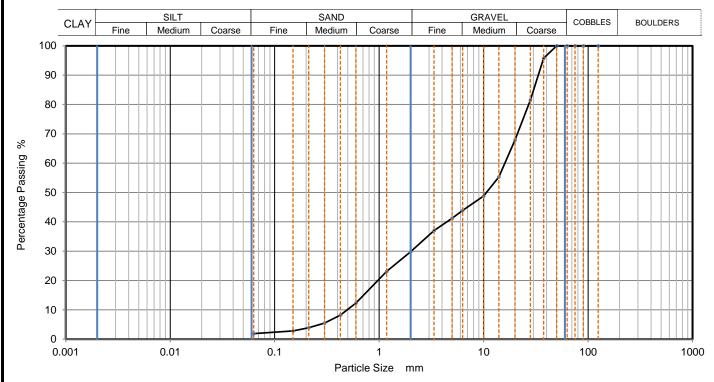
Dry Mass of sample, g	1572

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	9
Silt	51
Clay	40

Grading Analysis		
D100	mm	
D60	mm	0.00714
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved	Sheet printed	Fig	1
	23/10/2017 17:19		
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH15	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	8
Soil Description	Brown sandy subangular to subrounded fine to coarse GRAVEL.		Depth, m	7.00	
Specimen Reference	2 Specimen m Depth m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017090780	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	96		
28	82		
20	68		
14	55		
10	49		
6.3	44		
5	41		
3.35	37		
2	30		
1.18	23		
0.6	12		
0.425	8		
0.3	6		
0.212	4		
0.15	3		
0.063	2		

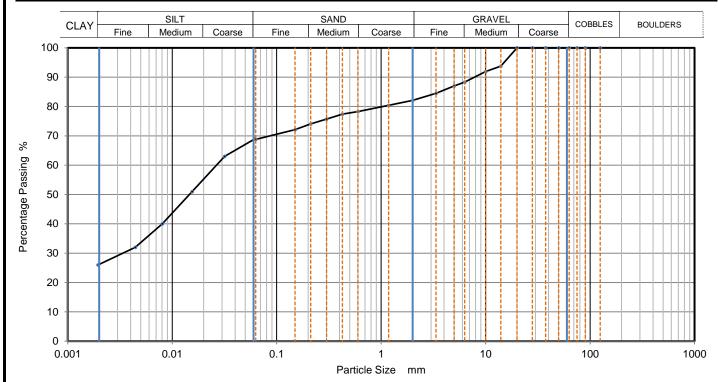
Dry Mass of sample, g	9967

Sample Proportions	% dry mass
Cobbles	0
Gravel	70
Sand	28
Fines < 0.063mm	2

Grading Analysis		
D100	mm	
D60	mm	16
D30	mm	2.03
D10	mm	0.493
Uniformity Coefficient		32
Curvature Coefficient		0.52

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	BH15
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	9
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		Depth, m	8.50
Specimen Reference	2 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090781



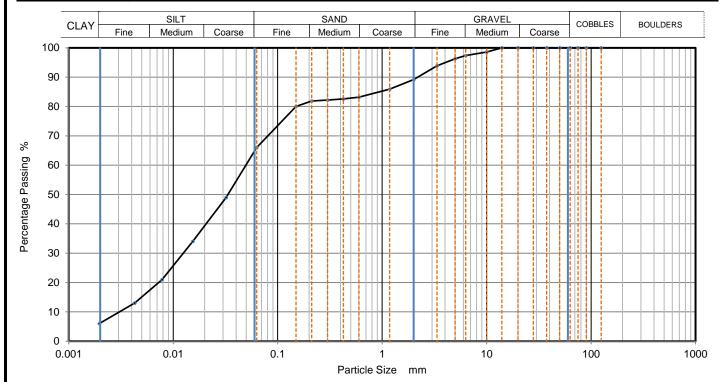
Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0620	69	
90	100	0.0318	63	
75	100	0.0155	51	
63	100	0.0081	40	
50	100	0.0044	32	
37.5	100	0.0020	26	
28	100			
20	100			
14	94			
10	92			
6.3	88			
5	87			
3.35	85			
2	82			
1.18	80			
0.6	78	Particle density	(assumed)	
0.425	77	2.90	Mg/m3	
0.3	76			
0.212	74			
0.15	72			
0.063	69			

Sample Proportions	% dry mass
Cobbles	0
Gravel	18
Sand	13
Silt	42
Clay	27

Grading Analysis		
D100	mm	
D60	mm	0.027
D30	mm	0.00322
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	BH15
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	10
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		Depth, m	9.50
Specimen Reference	2 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017090783



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	66
90	100	0.0320	49
75	100	0.0154	34
63	100	0.0078	21
50	100	0.0043	13
37.5	100	0.0020	6
28	100		
20	100		
14	100		
10	99		
6.3	97		
5	96		
3.35	94		
2	89		
1.18	86		
0.6	83	Particle density	(assumed)
0.425	83	2.70	Mg/m3
0.3	82		
0.212	82		
0.15	80		
0.063	66		

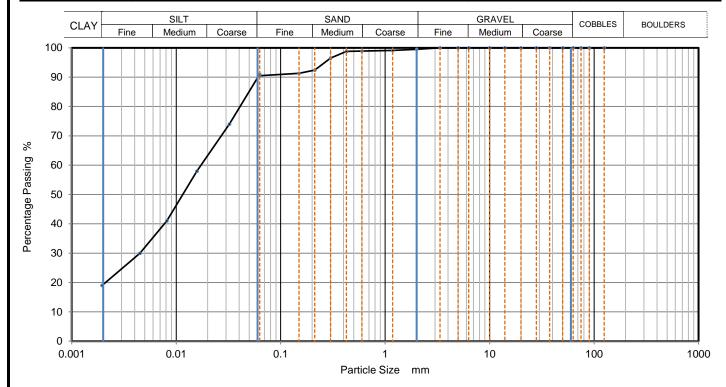
Dry Mass of sample, g	1713
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Sample Proportions	% dry mass
Cobbles	0
Gravel	11
Sand	23
Silt	60
Clay	7

Grading Analysis		
D100	mm	
D60	mm	0.0496
D30	mm	0.0124
D10	mm	0.00305
Uniformity Coefficient		16
Curvature Coefficient		1

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION –		Borehole/Pit No.	BH15	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	11
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		Depth, m	10.00	
Specimen Reference	2 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2017090785



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	91
90	100	0.0323	74
75	100	0.0158	58
63	100	0.0081	41
50	100	0.0045	30
37.5	100	0.0020	19
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	99	Particle density	(assumed)
0.425	99	2.90	Mg/m3
0.3	97		_
0.212	92		
0.15	91		
0.063	91		

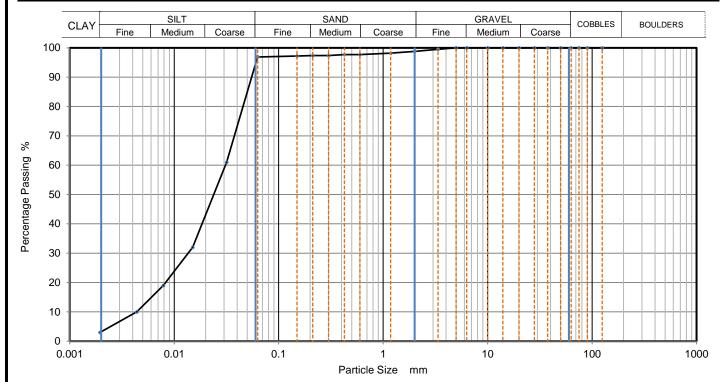
Dry Mass of sample, g	1785
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Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	9
Silt	71
Clay	20

Grading Analysis		
D100	mm	
D60	mm	0.0176
D30	mm	0.00444
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY PARTICIF SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	BH15	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	24
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		Depth, m	11.00	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	3S1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2017090788



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	97
90	100	0.0318	61
75	100	0.0150	32
63	100	0.0079	19
50	100	0.0044	10
37.5	100	0.0020	3
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	98		
0.6	98	Particle density	(assumed)
0.425	98	2.90	Mg/m3
0.3	97		
0.212	97		
0.15	97		
0.063	97		

Dry Mass of sample, g	939
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Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	2
Silt	94
Clay	3

Grading Analysis		
D100	mm	
D60	mm	0.0307
D30	mm	0.0134
D10	mm	0.00447
Uniformity Coefficient		6.9
Curvature Coefficient		1.3

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200	Unconsolidated Undrained Triaxial		Job Ref	17-0167		
CAUSEWAY	Compression Test without measurem	ent	Borehole/Pit No.	BH02		
Site Name	of pore pressure - single specimen Arklow Sewerage Scheme Marine Outfall GI		Sample No.	24		
Soil Description	Brown slightly sandy silty CLAY.		Depth	5.00		
Specimen	Coopimon		Sample Type	UT		
Reference Specimen	Depth	2 Depth m				
Description Test Method	Firm brown slightly sandy silty CLAY. BS1377: Part 7: 1990, clause 8, single specimen		KeyLAB ID Date of test	Caus2017090753 21/09/2017		
Test Method				21/09/2017		
	Test Number Length		1 210.0	mm		
	Diameter		105.2	mm		
	Bulk Density Moisture Content		2.00 27.1	Mg/m3 %		
	Dry Density		1.58	Mg/m3		
	Rate of Strain		2.0	%/min		
	Cell Pressure At failure Axial Strain		105 20.0	kPa %		
	Deviator Stress, (σ 1 - σ 3)f		102	kPa		
	Undrained Shear Strength, cu		51	kPa ½(σ1 - σ3)f		
	Mode of Failure]		
viator Stress v A	xial Strain					
120						
100		-	+			
		300				
80	- Accepted					
	200000000000000000000000000000000000000					
60						
40						
20						
0 2	4 6 8 10 12 14 16	18	20 22 24	26 28 30 32		
ohr Circles	Axial Strain	%				
150 Toles				Deviator stress corrected		
405				for area change and		
125				membrane effects		
100				Mohr circles and their		
75				interpretation is not covered by BS1377.		
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0						
		225	250 275 300			
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0 25 Rem arks	Normal Stresses kPa Approved		Printed			
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	CAL	JSEWA GEOTEC	Park .		-								ureme	ent	В	Borehole/Pit No.				BH02				
Sit	e Nam	ne							of pore pressure - single specimen Borehole/Pit No. Arklow Sewerage Scheme Marine Outfall GI Sample No.				Sample No.			2	5							
So	il Des	cription	1	3rown	slight	ly sa	ndy	sligh	ntly gra	avelly	silty	CLAY.			D	epth					7.0	00		_
	ecime ferenc				2				pecim epth	en				m	S	ampl	е Туре)			U	Т		
Sp	ecime scripti	n	-	-irm br	own :	sligh	tly sa			ly gra	velly	silty C	LAY.		К	eyLA	B ID			Caus2017090757				
	st Met		E	3S137	7 : Pa	art 7	: 199	90. c	lause	8, sind	ale s	pecime	en		D	ate o	f test		+	21/09/2017				
			L E N C	Test Nu Length Diamet Bulk De Moistur Dry De Rate of Cell Pre At failu	er ensity re Co nsity f Strai	, nten in		Dev Und		Stress d Shea	ar St	·1 - σ3 rength,					1 210.0 105.2 1.98 18.7 1.67 2.0 140 20.0 105 53		%	n /m3 /m3 min a	·(σ1 - ·	σ3)f		
ato 20	or Str	ess v	Ax	ial St	rain																			
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nr (Circle	es T			\top									Τ				٦	De	viator	stress	s cori	rected	Ŀ
125	-																	_			chang ine effe		d	
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Remarks_

Lab Sheet Reference :

Testing terminated at 20% strain

GEOTECH		ated Undraine on Test withou	Job Ref	17-0167	
		ssure - single		Borehole/Pit No.	BH02
Site Name	Arklow Sewerage	Scheme Marine Out	tfall GI	Sample No.	27
Soil Description	Brownish grey sli	ghtly sandy silty CLA	Υ.	Depth	10.50
Specimen Reference	2	Specimen Depth	m	Sample Type	UT
Specimen Description	Firm brownish gre	ey slightly sandy silty	CLAY.	KeyLAB ID	Caus2017090763
Test Method	BS1377 : Part 7 :	1990, clause 8, sing	le specimen	Date of test	21/09/2017

Test Number Length Diameter **Bulk Density** Moisture Content Dry Density

Rate of Strain Cell Pressure At failure

Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

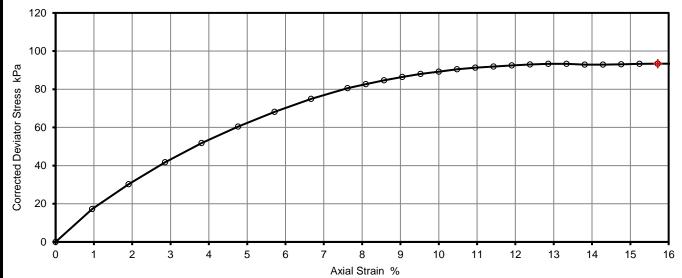
1	
210.0	mm
105.2	mm
1.96	Mg/m3
28.9	%
1.52	Mg/m3

2.0	%/min
205	kPa
15.7	%
93	kPa
47	kPa ½

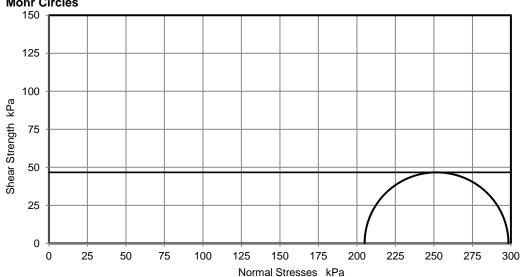
Plastic

½(σ1 - σ3)f

Deviator Stress v Axial Strain







Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for

information only.

Remarks

Lab Sheet Reference:

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377

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CAUSEWAY		ated Undraine on Test withou	Job Ref	17-0167		
GEOTECH GEOTECH	•	ssure - single	Borehole/Pit No.	BH15		
Site Name	Arklow Sewerage	Sample No.	25			
Soil Description	Grey slightly sand	Depth	5.00			
Specimen Reference	2	Specimen Depth	m	Sample Type	UT	
Specimen Description	Stiff grey slightly	sandy silty CLAY.	KeyLAB ID	ID Caus2017090776		
Test Method	BS1377 : Part 7 :	1990, clause 8, sing	Date of test 21/09/2017			
	Test Number			1		
	Length		210.0	mm		
	Diameter			105.2	mm	
	Bulk Density			1.99	Mg/m3	
	Moisture Content			23.9	%	
	Dry Density		1.61	Mg/m3		
	Rate of Strain			2.0	%/min	
	Cell Pressure			100	kPa	

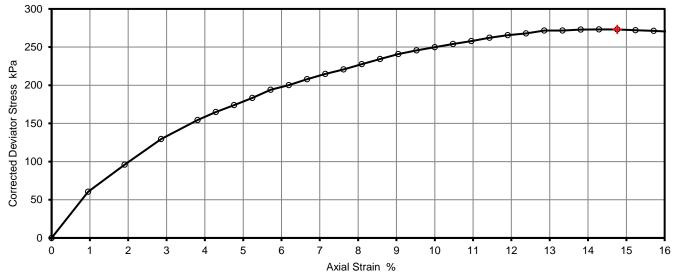
At failure

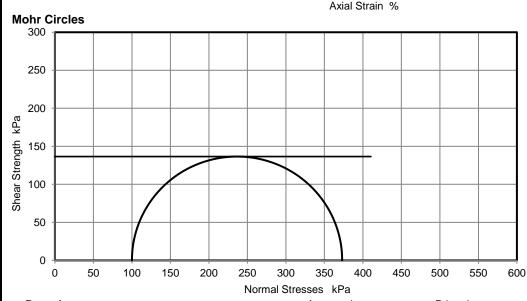
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

1.61	Mg/m3
2.0	%/min
100	kPa
14.8	%
273	kPa
137	kPa ½(σ1 - σ3)f

Brittle

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks

Lab Sheet Reference :

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377 Approved

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CAUSEWAY		ated Undrained on Test withou	Job Ref	17-0167		
GEOTECH GEOTECH		ssure - single s	Borehole/Pit No.	BH15		
Site Name	Arklow Sewerage	Scheme Marine Out	all GI	Sample No. 26		
Soil Description	Brown slightly sar	ndy slightly gravelly s	Depth	9.00		
Specimen Reference	2	Specimen Depth	Sample Type	UT		
Specimen Description	Firm brown slight	ly sandy slightly grave	KeyLAB ID	Caus2017090782		
Test Method	BS1377 : Part 7 :	1990, clause 8, singl	Date of test	21/09/2017		

Test Number Length Diameter **Bulk Density** Moisture Content Dry Density

Rate of Strain Cell Pressure At failure

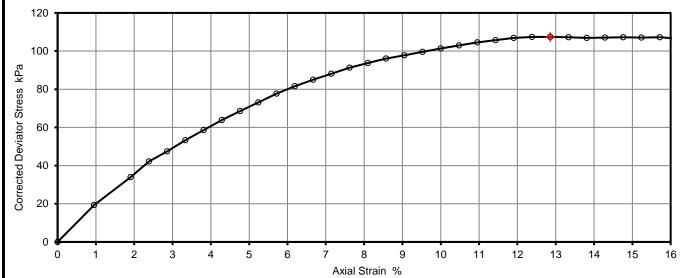
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

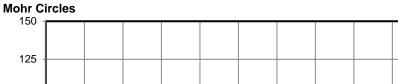
1	
210.0	mm
105.2	mm
2.05	Mg/m3
30.4	%
1.57	Mg/m3

2.0	%/min
185	kPa
12.9	%
107	kPa
54	kPa ½(
Brittle	

 σ 1 - σ 3)f

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for

information only.

	150 1		_											—
	125 -		_											
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Shear Strength kPa	75 -													-
ear Stre	50 -											\rightarrow		=
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	0 -	<u> </u>	25	50	75	100	125	150	175	200	225	250	275	300
	,	,	20	50	, 5	100			sses kF		220	230	215	300
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Lab Sheet Reference :

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377 Stephen.Watson

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Arklow	Sewerage	Schomo					
AIKIOW	Sewerage	Scheine					
Ref:	17-0167	7-0167 Size mm			100	Initial wet mass g	781
ВН	BH02		Thickness	mm	35.25	Bulk Density mg/m3	2215
Depth m	3.0m			-			
Our Ref	Υ			σ' _ν kPa			
Soil type	Sandy GRA	/EL					
	earing mm/n	nin	0.5	30			
>10 mm remo	oved			30			
				120			
Peak		Ultimate					
σ' _n kPa	τ kPa	σ' _n kPa	τ kPa				
30	D	30	38				
30)	30	38				
120	O	120	108				

Peak angle of internal friction Cohesion kPa Ultimate angle of internal friction

43

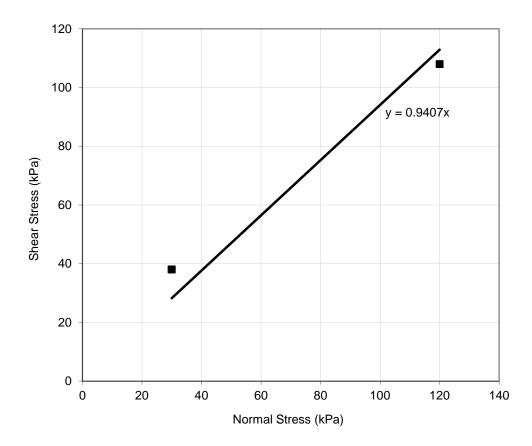


Figure 1 Failure Envelope

Arklow Sewerage Scheme

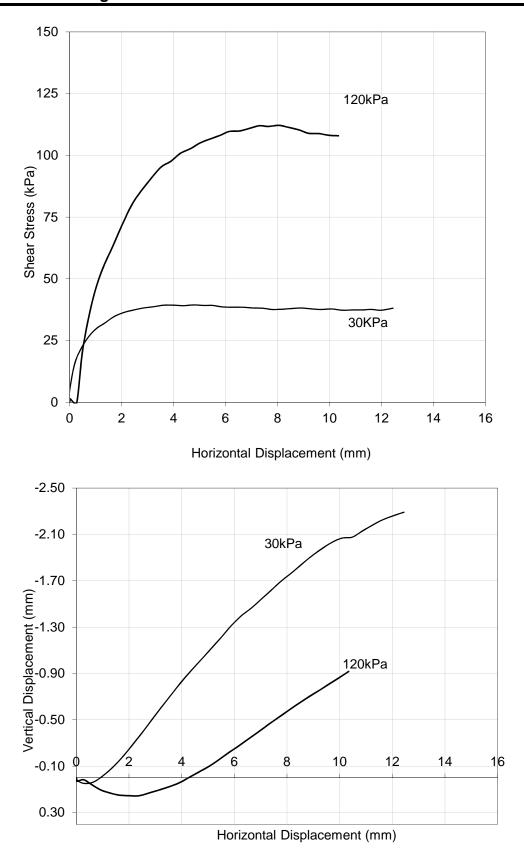


Figure 2 Stress-strain behaviour

Arklow	Sewerage	Scheme					
	_		Loading 30 kPa				
Ref:	Ref: 17-0167		Size mm 100			Initial wet mass g	719
ВН	BH02		Thickness	mm	35.75	Bulk Density mg/m3	1804
Depth m	9.0m					Final wet mass g	685
Our Ref	Z			σ' _ν kPa		Dry mass g	615
Soil type	Clayey sand	ly SILT				Initial water content %	16.9
Rate of sh	earing mm/n	nin	0.015	30		Final water content %	11.4
_				80		Loading 80 kPa	
				160		Initial wet mass g	793
Peak		Ultimate				Bulk Density mg/m3	1804
σ' _n kPa	τ kPa	σ' _n kPa τ	t kPa			Final wet mass g	751
30)	30	22	1		Dry mass g	641
80)	80	53	1		Initial water content %	23.7
160)	160	106			Final water content %	17.2
				-		Loading 160 kPa	
						Initial wet mass g	771
						Bulk Density mg/m3	1804
						Final wet mass g	714
Peak angl	e of internal	friction				Dry mass g	601
Cohesion	kPa			0		Initial water content %	28.3
Ultimate angle of internal friction 33					Final water content %	18.8	

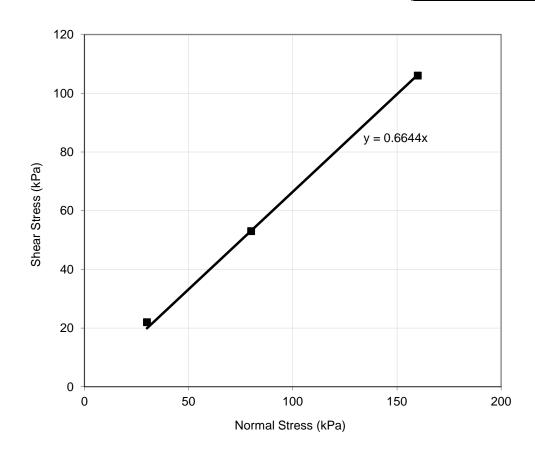


Figure 1 Failure Envelope

Arklow Sewerage Scheme

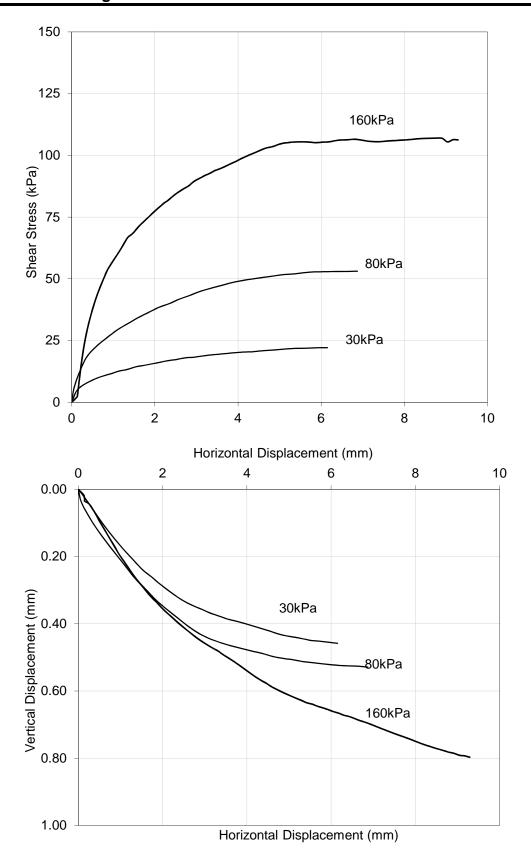


Figure 2 Stress-strain behaviour

Ref:	17-0167		Size mm		100	Initial wet mass g	688
BH	BH02		Thickness	mm	33.75	Bulk Density mg/m3	2038
Depth m	14.0m						
Our Ref	W			σ' _ν kPa			
Soil type	SAND	•					
Rate of sh	nearing mm/m	nin	0.5	70			
>10 mm remo	oved			140			
Peak		Ultimate		210			
σ' _n kPa	τ kPa	σ' _n kPa	τ kPa	1			
70	0	70	59				
140	0	140	124	1			
210	0	210	180				

Peak angle of internal friction Cohesion kPa Ultimate angle of internal friction

40

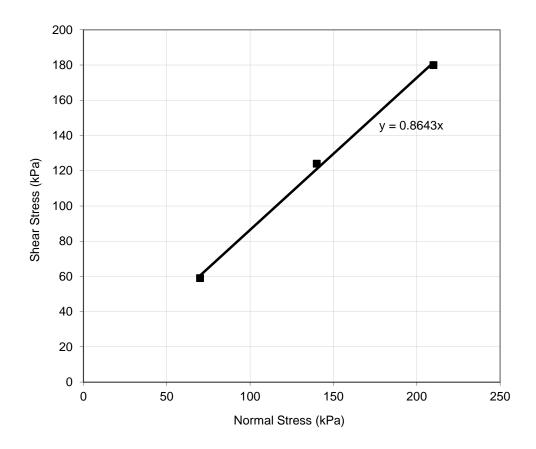


Figure 1 Failure Envelope

Arklow Sewerage Scheme

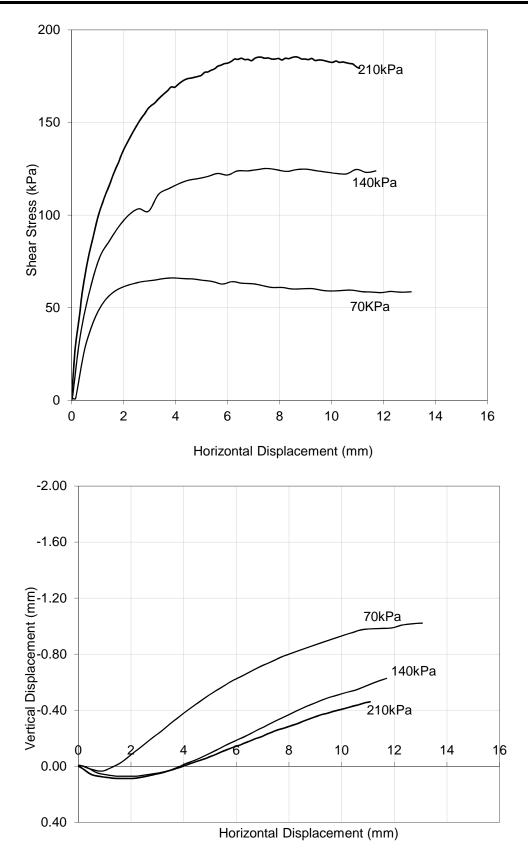
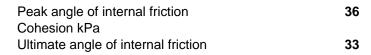


Figure 2 Stress-strain behaviour

Arklow	Sewerage	Scheme					
7 ti kiow	Contorago	001101110					
Ref:	17-0167		Size mm		100	Initial wet mass g	616
ВН	BH15		Thickness	mm	33.25	Bulk Density mg/m3	1852
Depth m	3.5m						
Our Ref	U			σ' _v kPa			
Soil type	SAND	-					
Rate of sh	nearing mm/m	in	0.5	30			
>10 mm remo	oved			60			
		To access		120			
Peak	LuDe	Ultimate	- IrDo				
σ' _n kPa	τ kPa	σ' _n kPa	τ kPa				
30							
60							
120	86	120	77				



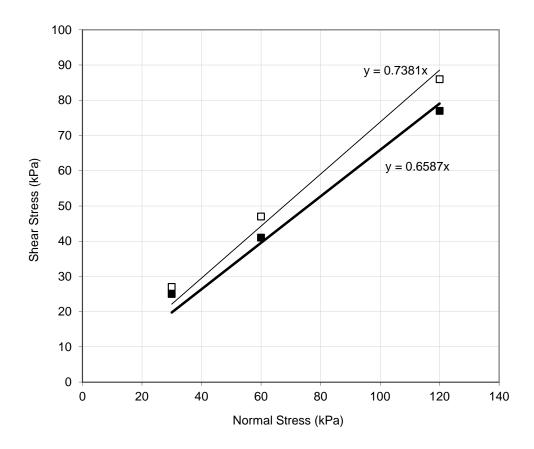


Figure 1 Failure Envelope

Arklow Sewerage Scheme

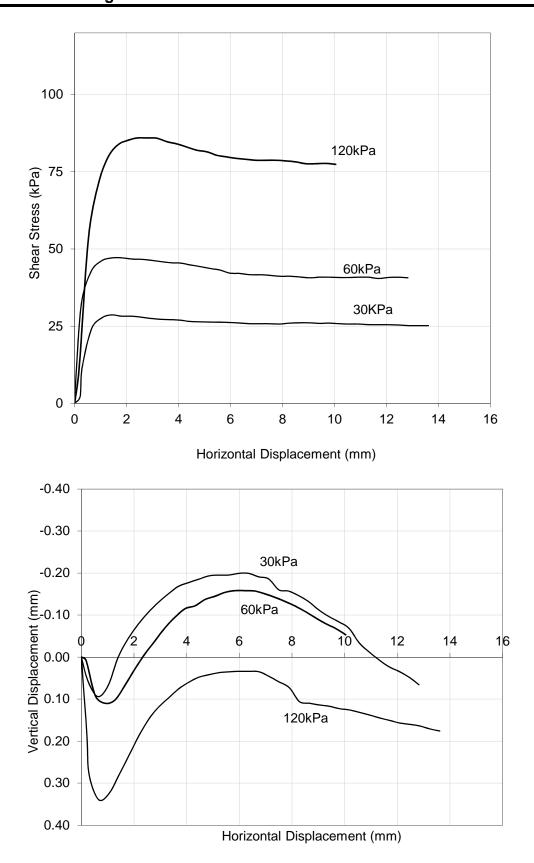


Figure 2 Stress-strain behaviour





Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070

Email: info@chemtest.co.uk

Final Report

Report No.: 17-24593-1

Initial Date of Issue: 22-Sep-2017

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 John Cameron John Duggan Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Stephen Curtis Stephen Franey Stephen Watson

Project 17-0167 - Arklow Sewerage Scheme

Marine Outfall GI

Quotation No.: Date Received: 18-Sep-2017

Order No.: Date Instructed: 18-Sep-2017

No. of Samples: 2

Turnaround (Wkdays): 5 Results Due: 22-Sep-2017

Date Approved: 22-Sep-2017

Approved By:

Details: Keith Jones, Technical Manager



Project: 17-0167 - Arklow Sewerage Scheme Marine Outfall GI

Client: Causeway Geotech Ltd	Chemtest Job No.:				17-24593	17-24593
Quotation No.:	(Chemte	st Sam	ple ID.:	512740	512741
Order No.:		Clie	nt Locat	ion ID.:	BH02	BH02
		Clie	nt Samp	le Ref.:	14	15
			Sample	е Туре:	SOIL	SOIL
	Top Depth (m):				1.00	2.00
			Date Sa	ampled:	15-Sep-2017	15-Sep-2017
Determinand	Accred.	SOP	Units	LOD		
Moisture	N	2030	%	0.020	41	35
рН	U 2010 N/A			N/A		8.7
Sulphate (2:1 Water Soluble) as SO4	U 2120 g/l 0.010					0.85
Organic Matter	U	2625	%	0.40	4.7	



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: <u>customerservices@chemtest.co.uk</u>

LABORATORY RESTRICTION REPORT

Project Reference	17-0167		То	Darren O'Mahony	
Project Name	Arklow Sewerage Scheme M	Position	Project Manager		
,				From	Stephen Watson
TR reference	17-0167	17-0167 / 2			Laboratory Manager

The following sample(s) and test(s) are restricted as detailed below.

Hole	5	Sample		Test		
Number	Number	Depth	Туре	Type	Reason for Restriction	Required Action
BH02	16	(m) 3	D	Atterberg Limits	GRAVEL - Scheduled testing not suitable.	Cancelled
BH02	36	17	D	Atterberg Limits	GRAVEL - Scheduled testing not suitable.	Cancelled
BH15	12	1	D	Atterberg Limits	GRAVEL - Scheduled testing not suitable.	Cancelled
BH15	5	4.00- 4.20	В	PSD Shearbox	No suitable test specimen. Sample damaged in transit to laboratory.	Cancelled
BH15	27	11.00- 11.45	UT	QUICK triaxial	No sample located	Cancelled

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

Darren O'Mahony
Date 25 September 2017



TEST RESTRICTION FORM

Issue No. 1 Page 1 of 1 Date 25/09/2017



SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

Client:	Irish Water
Engineer:	Byrne Looby ARUP J.V.
From:	Stephen Watson
	Laboratory Manager
	Causeway Geotech Ltd
Tel:	+44(0)2827666640
E-mail:	stephen.watson@causewaygeotech.com
Date:	26/09/17
Ref:	17-0167 Schedule 3

Arklow Sewerage Scheme Marine Outfall GI

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

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 60 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





Project Name Arklow Sewerage Scheme Marine Outfall GI

Report Reference. 17-0167 - Schedule 3

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report		
SOIL	Moisture content - oven drying method	BS 1377-2:1990	4		
SOIL	Liquid limit - cone penetrometer	BS 1377-2:1990	3		
SOIL	Liquid limit - cone penetrometer - one point	BS 1377-2:1990	3		
SOIL	Plastic limit	BS 1377-2:1990	3		
SOIL	Plasticity index and liquidity index	BS 1377-2:1990	3		
SOIL	Particle size distribution - wet sieving	BS 1377-2:1990	13		
SOIL	Particle size distribution - dry sieving	BS 1377-2:1990	13		
SOIL	Particle size distribution -sedimentation hydrometer method	BS 1377-2:1990	8		
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS 1377-7:1990	3		
SOIL	Shear strength by direct shear	BS1377: Part 7: Clause 4: 1990	2		
SOIL	pH Value of Soil		3		
SOIL	Sulphate Content water extract		3		
SOIL	Organic Matter Content		0		



Summary of Classification Test Results

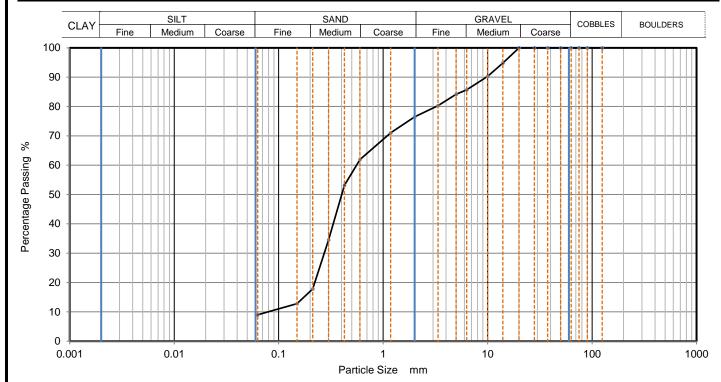
Project No. Project Name

17-0167

Arklow Sewerage Scheme Marine Outfall GI

17 (Alklow Sewerage Scheme Manne Oddan Gr													
		Sar	mple			Dens		W	Passing	LL	PL	ΡI	Particle	Casagrande
Hole No.	Ref	Тор	Base	Туре	Soil Description	bulk	dry		425µm	۵,	ā.		density	Classification
	\vdash			<u> </u>		Mg/m	n3	%	%	%	%	%	Mg/m3	
BH01	12	6.50		D	Brown slightly sandy clayey SILT.			21.0	96	25 -1pt	20	5		ML
BH01	13	7.00		D	Brown slightly sandy clayey SILT.			20.0						
					Brownish grey slightly sandy									
BH01	15	8.50		D	clayey SILT.			23.0	96	25 -1pt	20	5		ML
					Brownish grey slightly sandy									
BH01	19	10.50		D	clayey SILT.			28.0	100	25 -1pt	21	4		ML
								<u> </u>						
All tests perfo	ormed	I in acco	rdance v	vith BS	S1377:1990 unless specifie	d otherwi	ise							
Key								Date F	Printed		Annr	oved	Bv	Table
Density	test			Liquid I	_imit Particl	e density					, τρρι	JVGU	- y	1
		ment unles	s:			nall pyknom	eter	2	26/09/20	17				
wa - wat wi - imn		acement in water			asagrande method gj - ga ngle point test	o jai					Step	<u>hen</u> .	Watson	sheet 1
	_						_				_	_		

CAUSEWAY	DARTI	CLE SIZE DIST	DIDI ITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	BH01
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	1
Soil Description	Black slightly gravelly fine	to coarse SAND.		Depth, m	0.00
Specimen Reference	3	Specimen Depth	m	Sample Type	В
Test Method	BS1377:Part 2:1990, clau	se 9.2		KeyLAB ID	Caus201709120



Sievi	ing	Sedimen	tation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	95		
10	90		
6.3	86		
5	84		
3.35	80		
2	77		
1.18	71		
0.6	62		
0.425	53		
0.3	35		_
0.212	18		
0.15	13		
0.063	9		

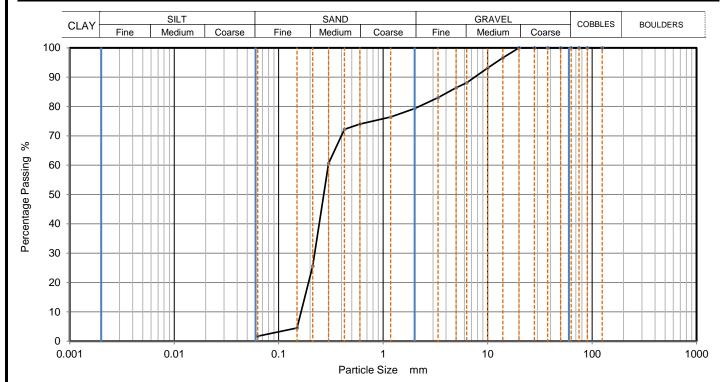
Dry Mass of sample, g	1077
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Sample Proportions	% dry mass		
Cobbles	0		
Gravel	24		
Sand	68		
Fines < 0.063mm	9		

Grading Analysis		
D100	mm	
D60	mm	0.557
D30	mm	0.273
D10	mm	0.0792
Uniformity Coefficient		7
Curvature Coefficient		1.7

Approved		Fig	1
Stephen. Watson	26/09/2017 11:48	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH01	
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	5	
Soil Description	Greyish brown slightly gravelly fine to medium SAND.		Depth, m	2.80	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus201709121



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	97		
10	93		
6.3	88		
5	86		
3.35	83		
2	79		
1.18	76		
0.6	74		
0.425	72		
0.3	61		
0.212	26]	
0.15	5]	
0.063	2		

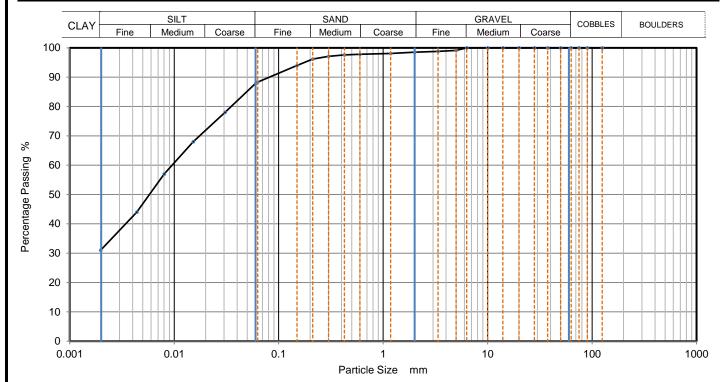
Dry Mass of sample, g	5121
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Sample Proportions	% dry mass		
Cobbles	0		
Gravel	21		
Sand	78		
Fines < 0.063mm	2		

Grading Analysis		
D100	mm	
D60	mm	0.298
D30	mm	0.222
D10	mm	0.164
Uniformity Coefficient		1.8
Curvature Coefficient		1

Approved		Fig	1
Stephen. Watson	26/09/2017 11:48	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH01	
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	9	
Soil Description	Brown slightly sandy clayey SILT.		Depth, m	4.50	
Specimen Reference	3 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201709122



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0604	88
90	100	0.0307	78
75	100	0.0153	68
63	100	0.0080	57
50	100	0.0044	44
37.5	100	0.0020	31
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	99		
3.35	99		
2	99		
1.18	98		
0.6	98	Particle density	(assumed)
0.425	98	3.00	Mg/m3
0.3	97		
0.212	96		
0.15	94		
0.063	88		

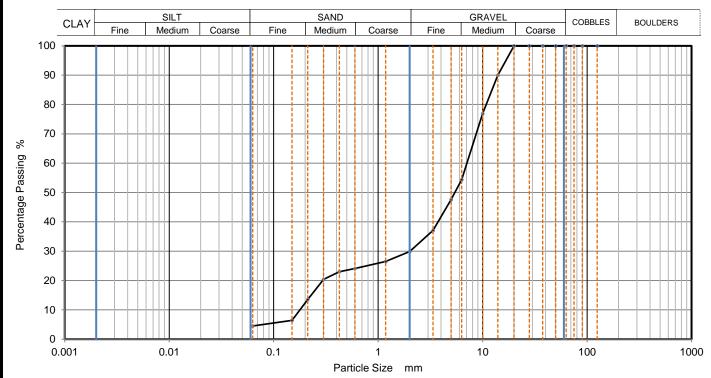
Dry Mass of sample, g	1447
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	2	
Sand	10	
Silt	57	
Clay	31	

Grading Analysis		
D100	mm	
D60	mm	0.00958
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH	PANII	TARTICLE SIZE DISTRIBUTION			BH01
Site Name	Arklow Sewerage Sche	klow Sewerage Scheme Marine Outfall GI			10
Soil Description	Brown slightly sandy subrounded fine to coarse GRAVEL.		Depth, m	4.80	
Specimen Reference	3	Specimen Depth	m	Sample Type	В
Test Method	BS1377:Part 2:1990, claus	se 9.2		KeyLAB ID	Caus201709123



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	90		
10	77		
6.3	54		
5	48		
3.35	37		
2	30		
1.18	27		
0.6	24		
0.425	23		
0.3	20		
0.212	14		
0.15	6		
0.063	5		

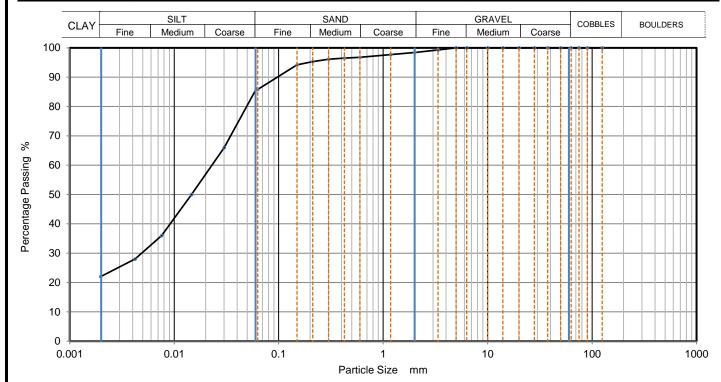
_	
Dry Mass of sample, g	10339

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	70	
Sand	25	
Fines < 0.063mm	4	

Grading Analysis		
D100	mm	
D60	mm	7.06
D30	mm	2.02
D10	mm	0.179
Uniformity Coefficient		39
Curvature Coefficient		3.2

Stephen.Watson 26/09/2017 11:48	Approved	Sheet printed	Fig	1
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION –		Job Ref	17-0167	
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	BH01
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI		Sample No.	11
Soil Description	Brown slightly sandy clayey SILT.		Depth, m	5.80	
Specimen Reference	3	Specimen Depth	m	Sample Type	В
Test Method	BS1377:Part 2:1990, clau	ses 9.2 and 9.5		KeyLAB ID	Caus201709124



Siev	ving	Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0609	86
90	100	0.0301	66
75	100	0.0146	50
63	100	0.0076	36
50	100	0.0042	28
37.5	100	0.0020	22
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	99		
2	98		
1.18	98		
0.6	97	Particle density	(assumed)
0.425	97	3.00	Mg/m3
0.3	96		
0.212	95		
0.15	94		
0.063	86		

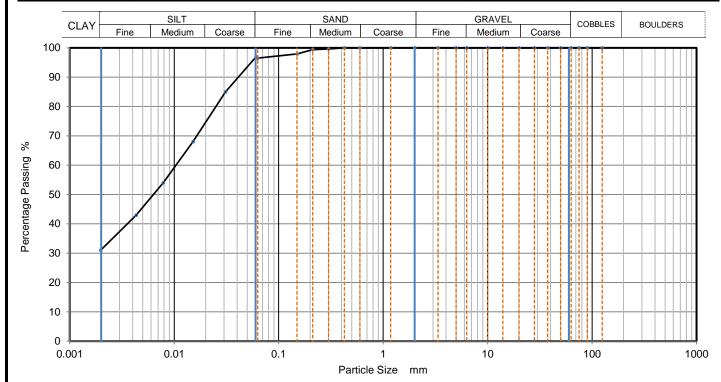
Dry Mass of sample, g 1107	Dry Mass of sample, g	1107
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	2	
Sand	13	
Silt	64	
Clay	22	

Grading Analysis		
D100	mm	
D60	mm	0.0228
D30	mm	0.00497
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen. Watson	26/09/2017 11:48	Sheet	

CAUSEWAY	DARTI	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167
GEOTECH	PANII			Borehole/Pit No.	BH01
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	14
Soil Description	Brownish grey slightly sandy clayey SILT.		Depth, m	7.60	
Specimen Reference	Specimen m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201709127



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0609	97
90	100	0.0310	85
75	100	0.0151	68
63	100	0.0079	54
50	100	0.0043	43
37.5	100	0.0020	31
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	3.00	Mg/m3
0.3	100		
0.212	99]	
0.15	98		
0.063	97		

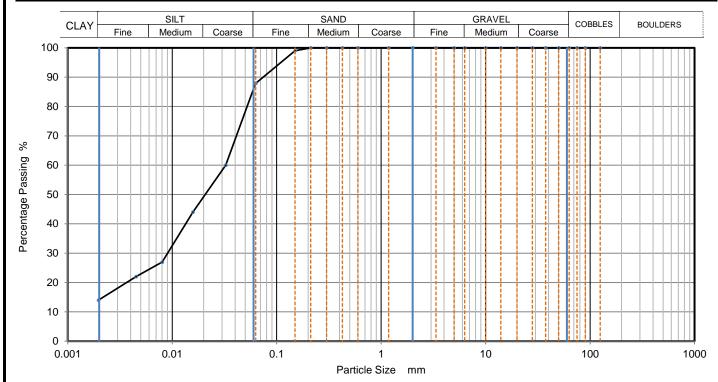
Dry Mass of sample, g	994
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	0	
Sand	4	
Silt	65	
Clay	31	

Grading Analysis		
D100	mm	
D60	mm	0.0104
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen. Watson	26/09/2017 11:48	Sheet	

CAUSEWAY	DADTI	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167
GEOTECH	PANII			Borehole/Pit No.	BH01
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	16
Soil Description	Brownish grey slightly sandy clayey SILT.		Depth, m	8.70	
Specimen Reference	Specimen m Depth			Sample Type	В
Test Method	Method BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2017091210



Sievi	ng	Sedim	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	88
90	100	0.0326	60
75	100	0.0158	44
63	100	0.0080	27
50	100	0.0045	22
37.5	100	0.0020	14
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	3.00	Mg/m3
0.3	100		
0.212	100	7	
0.15	99		
0.063	88]	

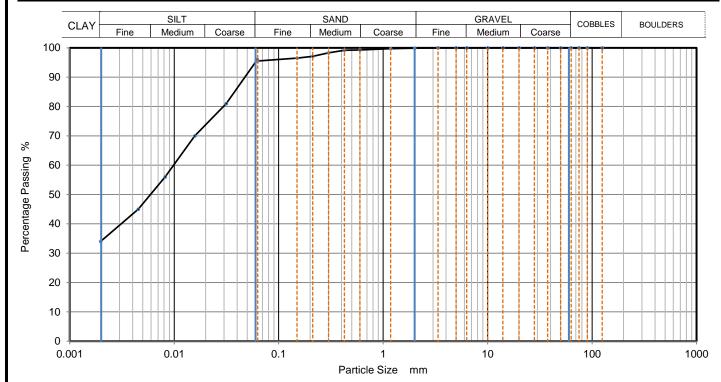
Dry Mass of sample, g	1561
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	0	
Sand	12	
Silt	74	
Clay	14	

Grading Analysis		
D100	mm	
D60	mm	0.032
D30	mm	0.0089
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen. Watson	26/09/2017 11:48	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH01
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	18
Soil Description	Brownish grey slightly sandy clayey SILT.		Depth, m	10.10
Specimen Reference	Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017091212



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0624	96
90	100	0.0315	81
75	100	0.0157	70
63	100	0.0082	56
50	100	0.0045	45
37.5	100	0.0020	34
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99	Particle density	(assumed)
0.425	99	3.00	Mg/m3
0.3	98		
0.212	97		
0.15	97		
0.063	96		

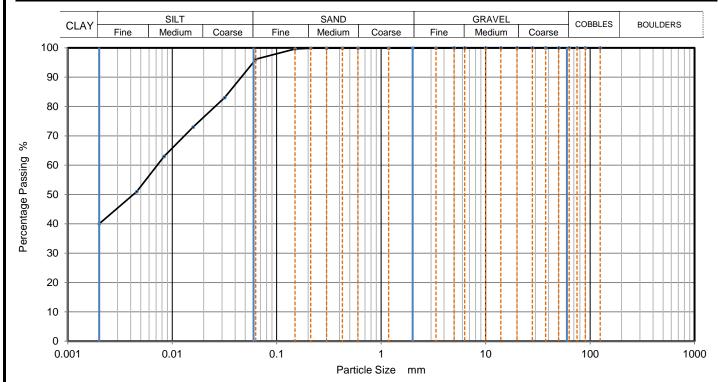
Dry Mass of sample, g	989
-----------------------	-----

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	0	
Sand	4	
Silt	62	
Clay	34	

Grading Analysis		
D100	mm	
D60	mm	0.00978
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen. Watson	26/09/2017 11:48	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	OTECH PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH01
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	20
Soil Description	Brownish grey slightly sandy clayey SILT		Depth, m	10.50
Specimen Reference	Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017091214



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0629	96
90	100	0.0318	83
75	100	0.0158	73
63	100	0.0084	63
50	100	0.0046	51
37.5	100	0.0020	40
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	3.00	Mg/m3
0.3	100		_
0.212	100		
0.15	100		
0.063	96		

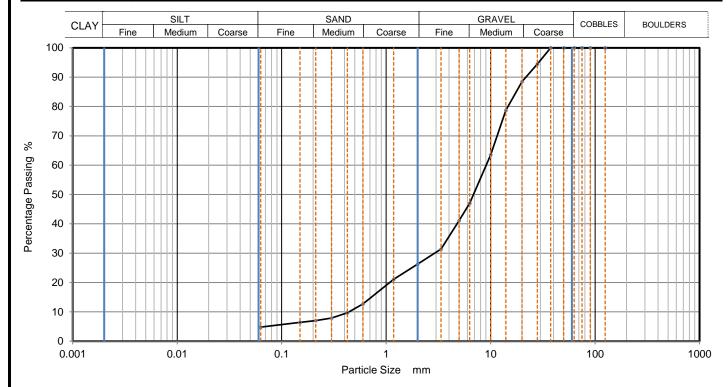
Dry Mass of sample, g	1114
-----------------------	------

Sample Proportions	% dry mass		
Cobbles	0		
Gravel	0		
Sand	4		
Silt	56		
Clay	41		

Grading Analysis		
D100	mm	
D60	mm	0.00717
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen. Watson	26/09/2017 11:48	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH01	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	21
Soil Description	Greyish brown slightly sandy subrounded fine to coarse GRAVEL.			Depth, m	12.70
Specimen Reference	3 Specimen m Depth m			Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017091215



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	95		
20	89		
14	79		
10	64		
6.3	47		
5	41		
3.35	31		
2	26		
1.18	21		
0.6	13		
0.425	10		
0.3	8		
0.212	7]	
0.15	6		
0.063	5		

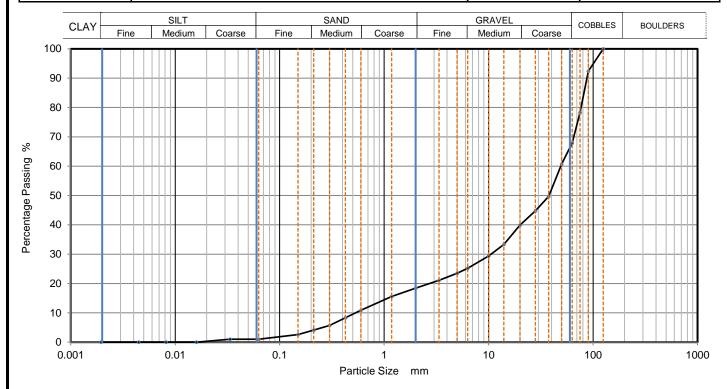
Dry Mass of sample, g	10542
-----------------------	-------

Sample Proportions	% dry mass		
Cobbles	0		
Gravel	74		
Sand	22		
Fines < 0.063mm	5		

Grading Analysis		
D100	mm	
D60	mm	9.07
D30	mm	2.91
D10	mm	0.441
Uniformity Coefficient		21
Curvature Coefficient		2.1

Approved		Fig	1
Stephen. Watson	26/09/2017 11:48	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH01	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	25
Soil Description	Greyish brown slightly sandy subrounded fine to coarse GRAVEL with medium cobble content.			Depth, m	15.00
Specimen Reference	Specimen m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2017091216



Siev	/ing	Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0630	1	
90	92	0.0335	1	
75	78	0.0160	0	
63	68	0.0082	0	
50	61	0.0045	0	
37.5	50	0.0020	0	
28	45			
20	40			
14	33			
10	29			
6.3	25			
5	24			
3.35	21			
2	18			
1.18	16			
0.6	11	Particle density	(assumed)	
0.425	8	2.65	Mg/m3	
0.3	6			
0.212	4			
0.15	3			
0.063	1			

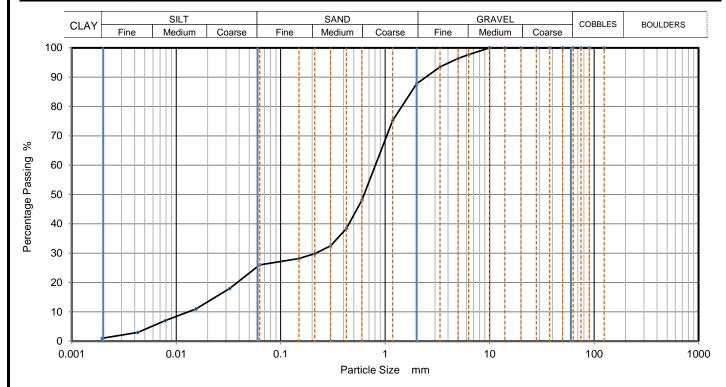
Dry Mass of sample, g	18464
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Sample Proportions	% dry mass	
Cobbles	32	
Gravel	49	
Sand	18	
Silt	1	
Clay	0	

Grading Analysis		
D100	mm	125
D60	mm	49.1
D30	mm	10.5
D10	mm	0.533
Uniformity Coefficient		92
Curvature Coefficient		4.2

Approved		Fig	1
Stephen. Watson	26/09/2017 11:48	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH01	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	37
Soil Description	Brownish grey slightly gravelly silty fine to coarse SAND.		Depth, m	17.30	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2017091217



Siev	/ing	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	26
90	100	0.0325	18
75	100	0.0154	11
63	100	0.0078	7
50	100	0.0043	3
37.5	100	0.0020	1
28	100		
20	100		
14	100		
10	100		
6.3	98		
5	96		
3.35	94		
2	88		
1.18	75		
0.6	48	Particle density	(assumed)
0.425	38	2.65	Mg/m3
0.3	33		
0.212	30		
0.15	28		
0.063	26		

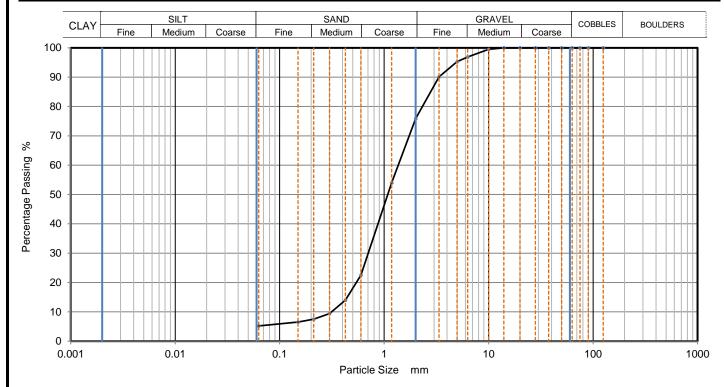
Dry Mass of sample, g	5626
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Sample Proportions	% dry mass		
Cobbles	0		
Gravel	12		
Sand	62		
Silt	25		
Clay	1		

Grading Analysis		
D100	mm	
D60	mm	0.807
D30	mm	0.217
D10	mm	0.0127
Uniformity Coefficient		63
Curvature Coefficient		4.6

Approved		Fig	1
Stephen. Watson	26/09/2017 11:48	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH01	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	39
Soil Description	Brownish grey slightly gravelly fine to coarse SAND.		Depth, m	18.00	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017091218



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	97		
5	95		
3.35	90		
2	76		
1.18	54		
0.6	23		
0.425	14		
0.3	9		
0.212	8		
0.15	7		
0.063	5		

Dry Mass of sample, g	4248

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	24	
Sand	71	
Fines < 0.063mm	5	

Grading Analysis		
D100	mm	
D60	mm	1.36
D30	mm	0.704
D10	mm	0.314
Uniformity Coefficient		4.3
Curvature Coefficient		1.2

Stephen.Watson 26/09/2017 11:49 Sheet	Approved	Sheet printed	Fig	1
	Stephen.Watson	26/09/2017 11:49	Sheet	

202	Unconsolidated Undrained Triaxial	Job Ref	17-0167
CAUSEWAY GEOTECH	Compression Test without measurement of pore pressure - single specimen	Borehole/Pit No.	BH01
Site Name	Arklow Sewerage Scheme Marine Outfall GI	Sample No.	34
Soil Description Specimen	Brown slightly sandy clayey SILT. Specimen	Depth	6.00
Reference	1 Depth m	Sample Type	UT
Specimen Description	Stiff brown slightly sandy clayey SILT.	KeyLAB ID	Caus201709260
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen	Date of test	22/09/2017
	Test Number Length Diameter Bulk Density Moisture Content Dry Density	1 210.0 105.2 2.21 20.8 1.83	mm mm Mg/m3 % Mg/m3
		2.0	
	Rate of Strain Cell Pressure At failure Axial Strain Deviator Stress, (\sigma 1 - \sigma 3)f Undrained Shear Strength, cu Mode of Failure	2.0 145 20.0 323 162	%/min kPa % kPa kPa ½(σ1 - σ3)f
Deviator Stress v A	Axial Strain		
600			
500			
s 400 •			
400 • Seving of the seving of	20000000	•	
neviati			
	200000000000000000000000000000000000000		
200			
0 2	4 6 8 10 12 14 16 18	20 22 24	26 28 30 32
Nohr Circles	Axial Strain %		
300 Total			Deviator stress corrected
250			for area change and membrane effects
200			Mohr circles and their
Z			interpretation is not covered by BS1377.
150			This is provided for
100			information only.
150 - 100 -			
50			
0 50	100 150 000 050 000 050	500 550 305	
0 50	100 150 200 250 300 350 400 450 : Normal Stresses kPa	500 550 600	
Remarks	Approved	Printed	Fig No
	ated at 20% strain Stephen.Watson	26/09/2017 11:53	Fig. No.
Lab Sheet Referenc	e:		Sheet 1

	Unconsolidate	ed Undraine	ed Triavial		Into De C		7.0407
CAUSEWAY	Unconsolidated Undrained Triaxial Compression Test without measurement			Job Ref		7-0167	
deorech	of pore pressure - single specimen			Borehole/Pit No		BH01	
Site Name	Arklow Sewerage So	cheme Marine O	utfall GI		Sample No.		35
Soil Description	Brownish grey slight		SILT.		Depth		8.00
Specimen Reference	3	Specimen Depth		m	Sample Type		UT
Specimen Description	Firm brownish grey s				KeyLAB ID		201709128
Test Method	BS1377 : Part 7 : 19	90, clause 8, sin	gle specimen		Date of test	22	/09/2017
	Test Number Length Diameter Bulk Density Moisture Content Dry Density Rate of Strain Cell Pressure At failure	Axial Strain Deviator Stress	s, (σ1 - σ3)f		1 210.0 105.2 1.99 19.4 1.67 2.0 160 20.0	mm mm Mg/m3 % Mg/m3 %/min kPa % kPa	
		Undrained She	ar Strength, cu	ı	48	kPa ½(σ	1 - σ3)f
		Mode of Failure)	l			
Deviator Stress v A	Axial Strain						
120							
100				000000	•		
80 kPa		20000	,00000				
Stress							
Deviator Stress kPa							
Corrected 20							
0 2	4 6 8	10 12	14 16	_	20 22 24	26 28	3 30 32
Mohr Circles			Axial Str	ain %			
150 125 100						for area ch membrane Mohr circle	effects
Shear Strength kPa						by BS1377 This is pro- information	vided for
25 - 25 -							
0 0 25	50 75 100	125 150 Normal Stre	175 200 sses kPa		250 275 30	0	
Remarks	-1-1-1-000/		Approved		Printed	-0	Fig. No.
Testing termina Lab Sheet Reference	ated at 20% strain		Stephen.W	atson	26/09/2017 11:	o3	1 Sheet
							2

CAUSEWAY	CAUSEWAY CEOTECH Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen		Job Ref	17-0167	
—— GEOTECH			Borehole/Pit No.	BH01	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	36
Soil Description	Brownish grey slightly sandy clayey SILT.		Depth	10.00	
Specimen Reference	3	Specimen Depth	m	Sample Type	UT
Specimen Description	Firm brownish grey slightly sandy clayey SILT.			KeyLAB ID	Caus2017091211
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		Date of test	22/09/2017	
	Test Number Length Diameter Bulk Density			1 210.0 105.2 1.92	mm mm Mg/m3
	Moisture Content			24.4	%

Dry Density

Rate of Strain Cell Pressure At failure

Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

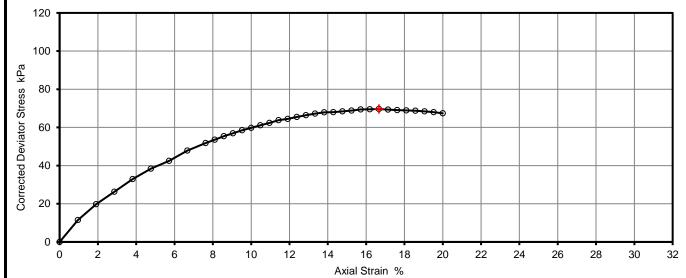
1	
210.0	mm
105.2	mm
1.92	Mg/m3
24.4	%
1.54	Mg/m3

2.0	%/min
195	kPa
16.7	%
70	kPa
35	kPa ¹

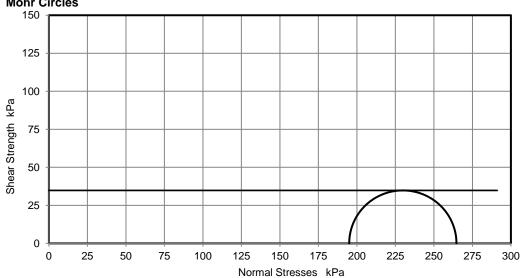
Brittle

½(σ1 - σ3)f

Deviator Stress v Axial Strain







Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for

information only.

Remarks

Lab Sheet Reference :

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377 Approved

Stephen.Watson

Printed

26/09/2017 11:53

Arklow	Sewerage	Scheme					
Ref:	17-0167		Size mm		100	Initial wet mass g	708
ВН	BH01		Thickness	mm	35.25	Bulk Density mg/m3	2008
Depth m	1.0m			-			
Our Ref	W			σ' _v kPa			
Soil type	SAND	•					
Rate of sh	nearing mm/m	nin	0.5	30			
>10 mm remo	oved			60			
				120			
Peak		Ultimate					
σ' _n kPa	τ kPa	σ' _n kPa	τ kPa				
30	0	30	30				
60	0	60	50				
120	0	120	97				

Peak angle of internal friction Cohesion kPa Ultimate angle of internal friction

39

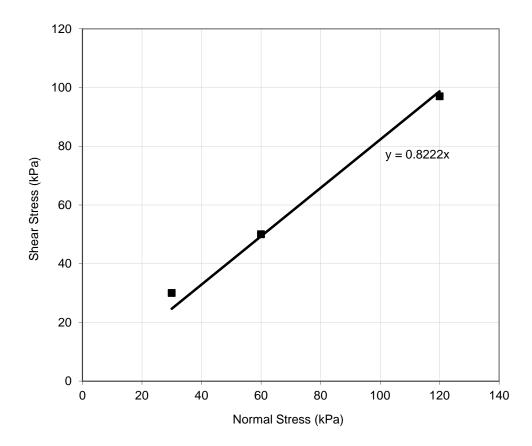


Figure 1 Failure Envelope

Arklow Sewerage Scheme

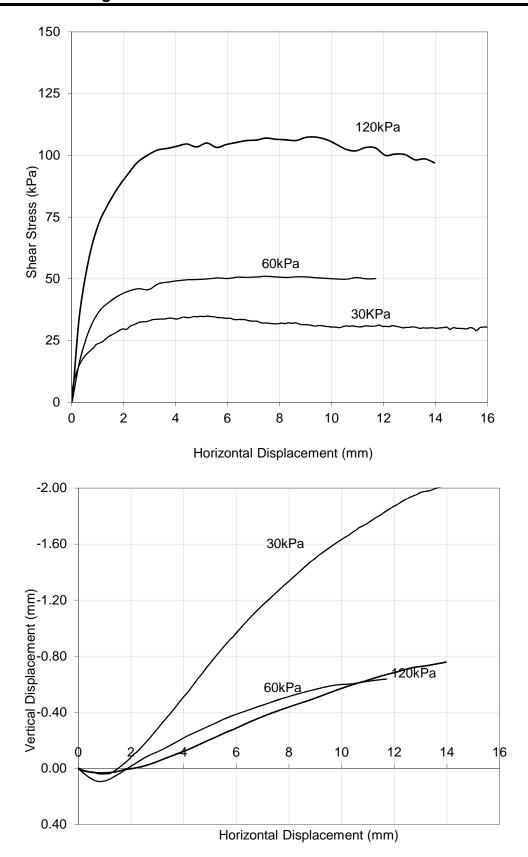
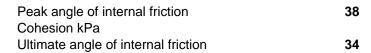


Figure 2 Stress-strain behaviour

QUB	Geotechnical Testing Laboratory

	_						
Arklow	Sewerage :	Scheme					
Ref:	17-0167		Size mm		100	Initial wet mass g	683
ВН	BH01		Thickness r	mm	33.25	Bulk Density mg/m3	2054
Depth m	3.5m			-			
Our Ref	V			σ' _v kPa			
Soil type	SAND						
Rate of sh	earing mm/mi	n	0.5	30			
>10 mm remo	ved			60			
				120			
Peak		Ultimate					
σ' _n kPa	τ kPa	σ' _n kPa	τ kPa				
30	27	30	25				
60	46	60	42				
120	96	120	82				



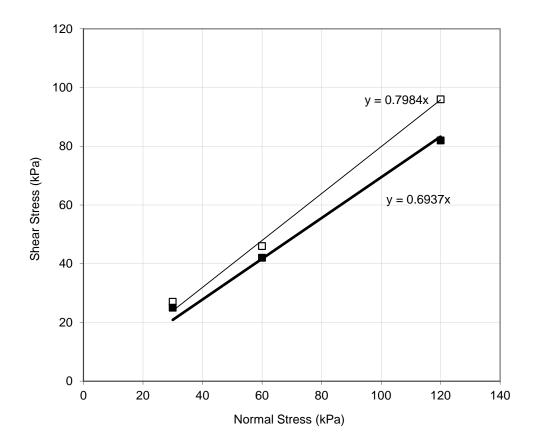


Figure 1 Failure Envelope

Arklow Sewerage Scheme

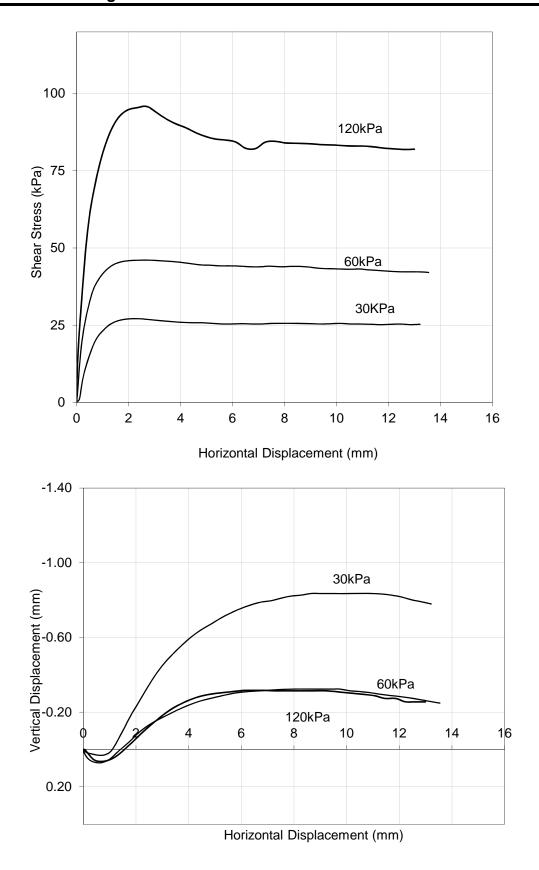


Figure 2 Stress-strain behaviour





Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070

Email: info@chemtest.co.uk

Final Report

Report No.: 17-24692-1

Initial Date of Issue: 25-Sep-2017

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 John Cameron John Duggan Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Stephen Curtis Stephen Franey Stephen Watson

Project 17-0167 Arklow Sewerage Scheme

Marine Outfall GI

Quotation No.: Date Received: 19-Sep-2017

Order No.: Date Instructed: 19-Sep-2017

No. of Samples: 3

Turnaround (Wkdays): 5 Results Due: 25-Sep-2017

Date Approved: 25-Sep-2017

Approved By:

Details: Keith Jones, Technical Manager



Project: 17-0167 Arklow Sewerage Scheme Marine Outfall GI

Client: Causeway Geotech Ltd		Chemtest Job No.:			17-24692	17-24692	17-24692
Quotation No.:	(Chemte	st Sam	ple ID.:	513162	513163	513164
Order No.:	Client Location ID.:			D2	D4	D8	
		Clie	nt Samp	le Ref.:	BH01	BH01	BH01
		Sample Type:				SOIL	SOIL
	Top Depth (m):				1.00	2.00	4.00
			Date Sa	ampled:	18-Sep-2017	18-Sep-2017	18-Sep-2017
Determinand	Accred.	SOP	Units	LOD			
Moisture	N	2030	%	0.020	9.4	14	17
рН	U	2010		N/A	8.5	8.4	8.5
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	0.20	0.38	0.34



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: <u>customerservices@chemtest.co.uk</u>



SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

Client:	Irish Water
Engineer:	Byrne Looby ARUP J.V.
From:	Stephen Watson
	Laboratory Manager
	Causeway Geotech Ltd
Tel:	+44(0)2827666640
E-mail:	stephen.watson@causewaygeotech.com
Date:	30/10/17
Ref:	17-0167 - Schedules 4 & 5

Arklow Sewerage Scheme Marine Outfall GI

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

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 60 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





Project Name Arklow Sewerage Scheme Marine Outfall GI

Report Reference. 17-0167 - Schedules 4 & 5

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report		
SOIL	Moisture Content of Soil	BS1377: Part 2: Clause 3.2: 1990	26		
SOIL	Liquid and Plastic Limits of soil -1-point cone penetrometer method	BS1377: Part 2: Clauses 4.4, 5.3 & 5.4 1990	7		
SOIL	Bulk and dry density by Linear Measurement Method	BS1377: Part 2: Clause 7.2	2		
SOIL	Particle size distribution - wet sieving	BS1377: Part 2: Clause 9.2: 1990	18		
SOIL	Particle size distribution -sedimentation hydrometer method	BS1377: Part 2: Clause 9.5: 1990	7		



Summary of Classification Test Results

Project No.

Project Name

17-0167

wd - water displacement

wi - immersion in water

cas - Casagrande method

1pt - single point test

Arklow Sewerage Scheme Marine Outfall GI

17-0167 Arklow Sewerage Scheme Marine Outtail Gi														
Hole No.	Ref	Sai Top	mple Base	Туре	Soil Description		dry	w	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
				, , , , , , , , , , , , , , , , , , ,		Mg/m	13	%	%	%	%	%	Mg/m3	
BH04	14	1.00		D	Grey brown fine to coarse SAND with shell fragments.			6.7						
BH04	16	2.00		D	Grey brown slightly gravelly fine to coarse SAND with shell fragments.			15.0						
BH04	18	3.00		D	Grey brown slightly gravelly fine to medium SAND with shell fragments.			16.0						
BH04	19	4.00		D	Grey brown slightly gravelly fine to medium SAND with shell fragments.			20.0						
BH04	20	4.20		В	Grey brown slightly gravelly fine to medium SAND with shell fragments.			20.0						
BH04	22	5.80		В	Grey brown sandy slightly gravelly silty CLAY.			25.0	96	23 -1pt	13	10		CL
BH04	23	6.00		D	Grey brown sandy slightly gravelly silty CLAY.			12.0						
BH04	25	7.00		В	Grey brown gravelly fine to coarse SAND.			6.2						
BH04	26	9.00		В	Grey brown slightly gravelly fine to coarse SAND.			12.0						
BH04	9	13.50		D	Grey brown slightly sandy silty CLAY.			19.0	99	23 -1pt	12	11		CL
BH04	10	14.00		D	Grey brown slightly sandy silty CLAY.			21.0						
BH04	3	14.00		В	Grey brown slightly sandy silty CLAY.			22.0	99	23 -1pt	13	10		CL
BH04	5	17.00		В	Grey brown slightly sandy silty CLAY.			28.0	99	29 -1pt	19	10		CL
All tests perf	ormed	l in acco	rdance v	vith BS	S1377:1990 unless specifie	d otherw	ise	·						
Кеу								Date F	rinted		Appr	oved	Ву	Table
	neasure	ment unles	ss:	•		e density nall pyknom	neter	3	30/10/20	17				1

sheet

Stephen.Watson

gj - gas jar



Summary of Classification Test Results

Project No.

Project Name

17-0167

wd - water displacement

wi - immersion in water

cas - Casagrande method

1pt - single point test

gj - gas jar

Arklow Sewerage Scheme Marine Outfall GI

17-0167 Arklow Sewerage Scheme Marine Ouπali Gi														
Hole No.	Ref	Sar Top	mple Base	Туре	Soil Description	Dens bulk	ity dry	w	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Kei	тор	Dase	туре		Mg/m	13	%	%	%	%	%	Mg/m3	Gladomoation
BH04	12	19.00		D	Grey brown slightly sandy silty CLAY.			11.0						
BH04	6	19.60		В	Grey brown sandy slightly gravelly silty CLAY.			21.0	81	29 -1pt	19	10		CL
BH04	34	23.50		В	Brown slightly sandy slightly silty subrounded fine to coarse GRAVEL with high cobble content.			10.0						
BH05	13	1.00		D	Grey brown gravelly fine to coarse SAND.			20.0						
BH05	15	3.00		D	Grey brown gravelly fine to coarse SAND.			31.0						
BH05	16	4.00		D	Grey brown gravelly fine to coarse SAND.			22.0						
BH05	10	5.20		В	Grey brown slightly sandy fine to coarse subangular fine to coarse GRAVEL.			7.7						
BH05	11	7.40		В	Grey brown slightly sandy slightly gravelly silty CLAY.			31.0						
BH05	19	9.00		D	Grey brown slightly sandy subrounded fine to coarse GRAVEL.			12.0						
BH05	23	12.00		В	Brown sandy gravelly silty CLAY.			13.0	53	30 -1pt	17	13		CL
BH05	25	14.00		В	Brown sandy gravelly silty CLAY.			14.0	57	29 -1pt	16	13		CL
BH05	28	17.00		D	Brown slightly sandy subrounded fine to coarse GRAVEL.			10.0						
BH05	31	19.00		D	Brown slightly sandy subrounded fine to coarse GRAVEL.			13.0						
All tests perf	ormed	in acco	rdance v	vith BS	S1377:1990 unless specifie	d otherw	ise							
Key Density Linear r		ment unles	s:	Liquid I		e density nall pyknom	neter	Date F	Printed 80/10/20	17	Appr	oved	Ву	Table 1

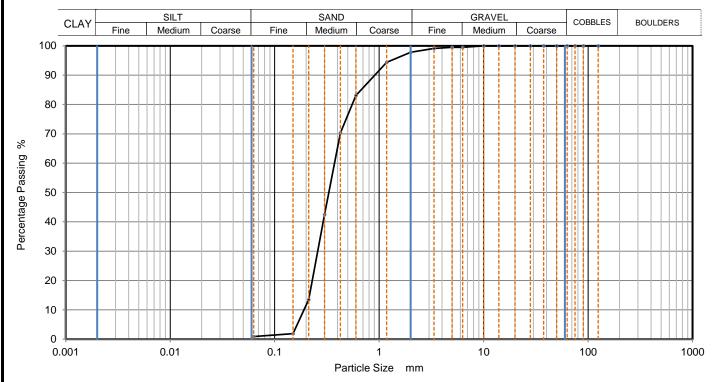
sheet

2

Stephen.Watson

CAUSEWAY GEOTECH		VAY TECH				Dens	ity Te	ests -	Sum	mary	of R	esult	s		
Project No.			Project	t Nam	ne										
17-0)167			Arklow Sewerage Scheme Marine Outfall GI											
		Sar	nple			Linea	Linear Measurement Immersion in wate			water	Wate	r displac	ement		
Hole No.	Ref	Тор	Base	Туре	Soil Description	Bulk density Mg/m3	Dry density Mg/m3	w %		Dry density Mg/m3	w %	Bulk density Mg/m3	Dry density Mg/m3	w %	Remarks
BH04	13	0.00		В	Grey brown fine to coarse SAND with shell fragments.	1.79	1.56	14.6	IVIG/III3	IVIG/IIIS	76	IVIG/III3	IWIG/IIIS	76	
BH04	15	1.40		В	Grey brown slightly gravelly fine to coarse SAND with shell fragments.	1.98	1.73	14.1							
Legend	W	moisture	content	of the	density test specimen										
Notes									Date I	Printed		Appro	ved By	,	Table
Tests carried of BS1377:Part2: clauses unless	1990 :	and the fo	ollowing		Linear measurement Immersion in water Water displacement	clause clause clause	7.3		30)/10/20	17	Step	hen.W	atson	1 sheet 1

CAUSEWAY	DADTI	CLE SIZE DIST	DIBLITION	Job Ref	17-0167	
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	BH04	
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	13	
Soil Description	Grey brown fine to coarse	e SAND with shell fr	Depth, m	0.00		
Specimen Reference	4 Specimen m		Sample Type	В		
Test Method	BS1377:Part 2:1990, claus	se 9.2		KeyLAB ID	Caus201710039	



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	99		
2	98		
1.18	94		
0.6	83		
0.425	70		
0.3	43		
0.212	14]	
0.15	2]	
0.063	1		

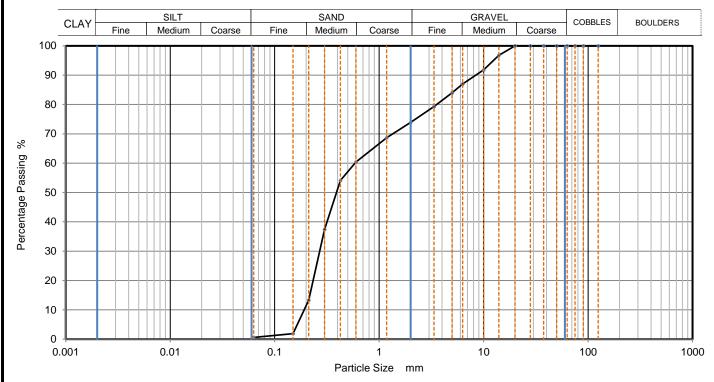
Dry Mass of sample, g	2023
, , , ,	

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	2	
Sand	97	
Fines < 0.063 mm	1	

Grading Analysis		
D100	mm	
D60	mm	0.373
D30	mm	0.258
D10	mm	0.191
Uniformity Coefficient		2
Curvature Coefficient		0.93

		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	вн04	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	15
Soil Description	Grey brown slightly gravelly fine to coarse SAND with shell fragments.		Depth, m	1.40	
Specimen Reference	6 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017100311



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	97		
10	92		
6.3	87		
5	84		
3.35	79		
2	74		
1.18	69		
0.6	60		
0.425	54		
0.3	37		
0.212	13]	
0.15	2]	
0.063	1		

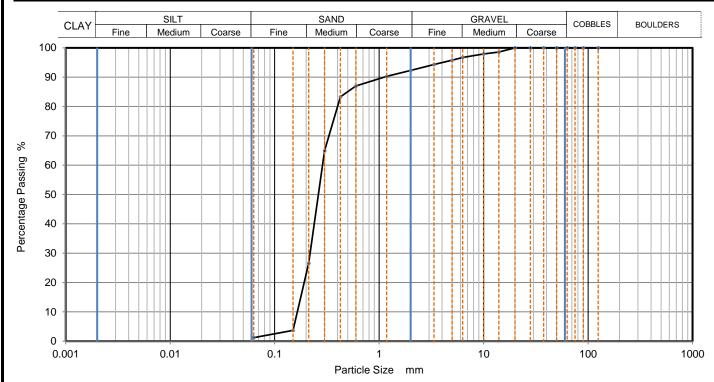
Dry Mass of sample, g	3213

Sample Proportions	% dry mass
Cobbles	0
Gravel	26
Sand	73
Fines <0.063mm	1

Grading Analysis		
D100	mm	
D60	mm	0.588
D30	mm	0.27
D10	mm	0.192
Uniformity Coefficient		3.1
Curvature Coefficient		0.64

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167
GEOTECH			Borehole/Pit No.	вн04
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	17
Soil Description	Grey brown slightly gravelly fine to medium SAND with shell fragments.		Depth, m	3.00
Specimen Reference	Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017100313



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	99		
10	98		
6.3	97		
5	96		
3.35	94		
2	92		
1.18	90		
0.6	87		
0.425	83		
0.3	65		
0.212	27]	
0.15	4		
0.063	1		

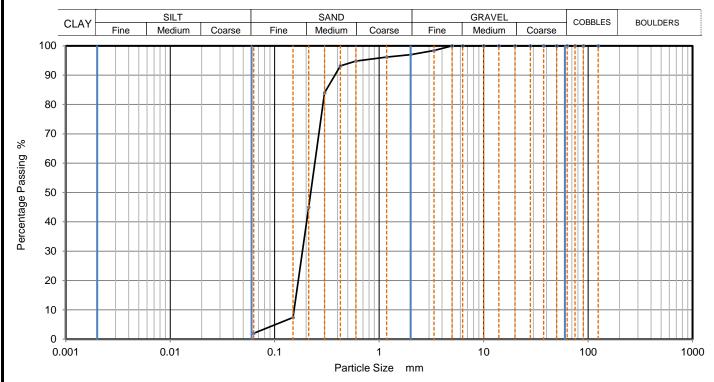
Dry Mass of sample, g	2462

Sample Proportions	% dry mass
Cobbles	0
Gravel	8
Sand	91
Fines < 0.063mm	1

Grading Analysis		
D100	mm	
D60	mm	0.287
D30	mm	0.219
D10	mm	0.165
Uniformity Coefficient		1.7
Curvature Coefficient		1

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167
GEOTECH			Borehole/Pit No.	ВН04
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	20
Soil Description	Grey brown slightly gravelly fine to medium SAND with shell fragments.		Depth, m	4.20
Specimen Reference	7 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017100316



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	98		
2	97		
1.18	96		
0.6	95		
0.425	93		
0.3	84		
0.212	45		
0.15	7		
0.063	2		

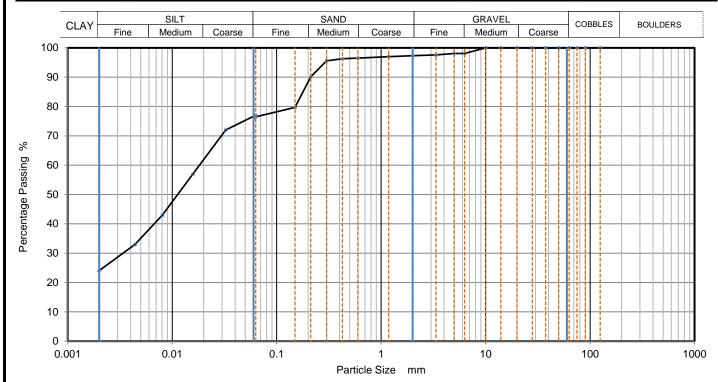
Dry Mass of sample, g	2339

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	3	
Sand	95	
Fines < 0.063mm	2	

Grading Analysis		
D100	mm	
D60	mm	0.242
D30	mm	0.185
D10	mm	0.154
Uniformity Coefficient	·	1.6
Curvature Coefficient		0.92

		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	ВН04	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	22
Soil Description	Grey brown sandy slightly gravelly silty CLAY.		Depth, m	5.80	
Specimen Reference	7 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017100317	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	77
90	100	0.0325	72
75	100	0.0158	57
63	100	0.0080	43
50	100	0.0044	33
37.5	100	0.0020	24
28	100		
20	100		
14	100		
10	100		
6.3	98		
5	98		
3.35	98		
2	97		
1.18	97		
0.6	97	Particle density	(assumed)
0.425	96	2.65	Mg/m3
0.3	96		
0.212	90		
0.15	80		
0.063	77		

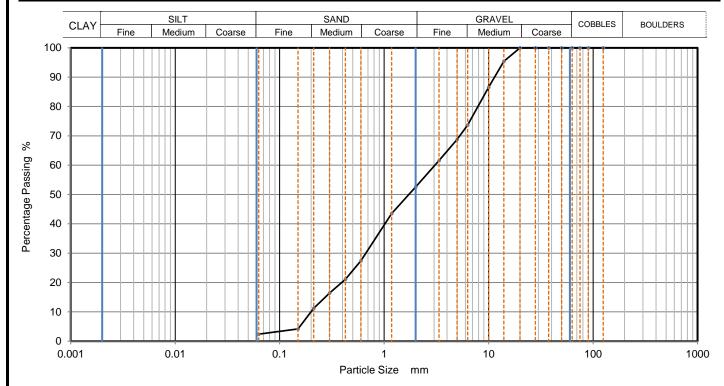
Dry Mass of sample, g	2132

Sample Proportions	% dry mass
Cobbles	0
Gravel	3
Sand	21
Silt	53
Clay	24

Grading Analysis		
D100	mm	
D60	mm	0.018
D30	mm	0.0033
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	ВН04	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI			25
Soil Description	Grey brown gravelly fine to coarse SAND.		Depth, m	7.00	
Specimen Reference	5 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017100319



Siev	/ing	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	95		
10	87		
6.3	74		
5	69		
3.35	62		
2	53		
1.18	44		
0.6	27		
0.425	21		
0.3	16		
0.212	11]	
0.15	4]	
0.063	2		

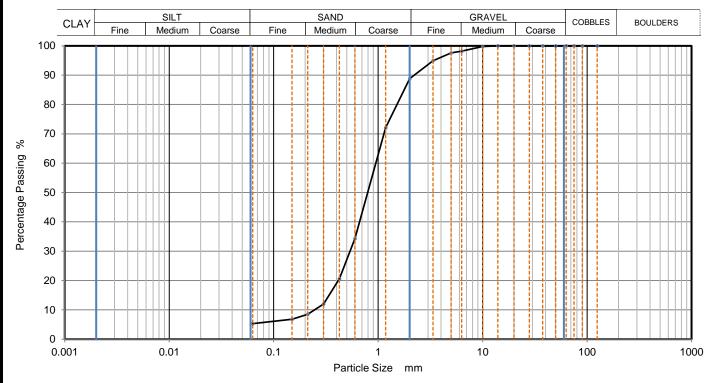
Dry Mass of sample, g	4446
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	47	
Sand	50	
Fines < 0.063mm	2	

Grading Analysis		
D100	mm	
D60	mm	3.05
D30	mm	0.67
D10	mm	0.2
Uniformity Coefficient		15
Curvature Coefficient		0.74

20/40/2047 45 27	
Stephen.Watson 30/10/2017 16:27 Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	вно4	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI			26
Soil Description	Grey brown slightly gravelly fine to coarse SAND.		Depth, m	9.00	
Specimen Reference	5	Specimen Depth	m	Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017100320



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	98		
5	98		
3.35	95		
2	89		
1.18	72		
0.6	34		
0.425	21		
0.3	12		
0.212	9]	
0.15	7]	
0.063	5		

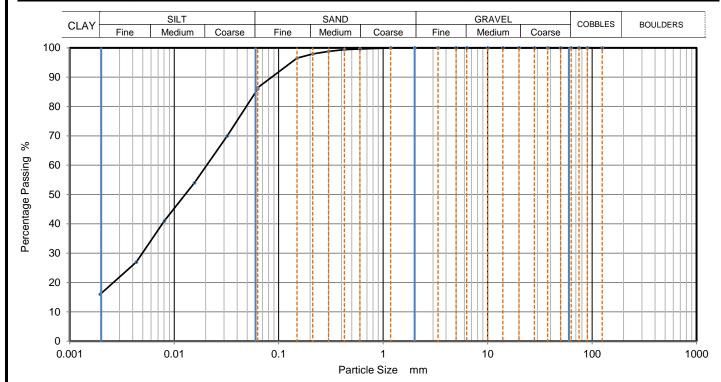
Dry Mass of sample, g	2553
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Sample Proportions	% dry mass
Cobbles	0
Gravel	11
Sand	84
Fines < 0.063 mm	5

Grading Analysis		
D100	mm	
D60	mm	0.95
D30	mm	0.539
D10	mm	0.246
Uniformity Coefficient	·	3.9
Curvature Coefficient		1.2

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167
GEOTECH			Borehole/Pit No.	ВН04
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	3
Soil Description	Grey brown slightly sandy silty CLAY.		Depth, m	14.00
Specimen Reference	7 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017100323



Sieving		Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	86
90	100	0.0322	70
75	100	0.0156	54
63	100	0.0080	41
50	100	0.0043	27
37.5	100	0.0020	16
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	99	2.65	Mg/m3
0.3	99		
0.212	98]	
0.15	97]	
0.063	86		

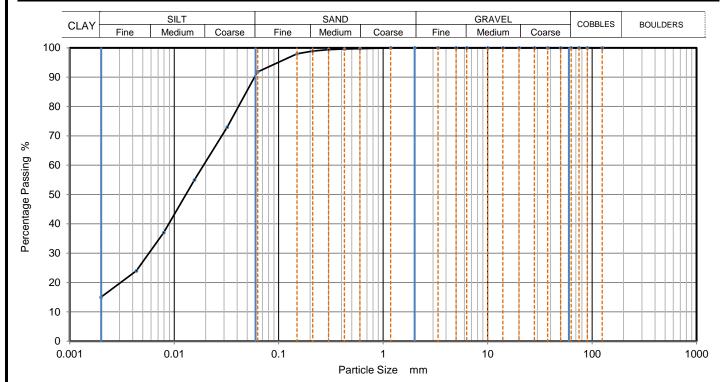
Dry Mass of sample, g	1656
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Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	14
Silt	70
Clay	17

Grading Analysis		
D100	mm	
D60	mm	0.0204
D30	mm	0.00498
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167
GEOTECH			Borehole/Pit No.	ВН04
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	5
Soil Description	Grey brown slightly sandy silty CLAY.		Depth, m	17.00
Specimen Reference	7 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017100324



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	92
90	100	0.0322	73
75	100	0.0156	55
63	100	0.0079	37
50	100	0.0043	24
37.5	100	0.0020	15
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	2.65	Mg/m3
0.3	99		
0.212	99		
0.15	98		
0.063	92		

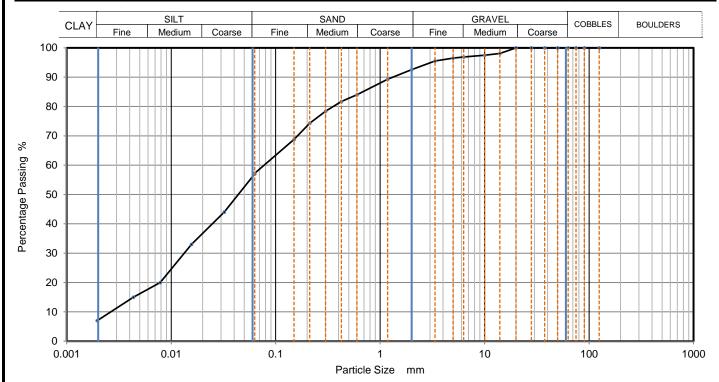
Dry Mass of sample, g	2564

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	8
Silt	76
Clay	15

Grading Analysis		
D100	mm	
D60	mm	0.0189
D30	mm	0.0057
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167
GEOTECH			Borehole/Pit No.	ВН04
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	6
Soil Description	Grey brown sandy slightly gravelly silty CLAY.		Depth, m	19.60
Specimen Reference	7 Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017100326



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	57
90	100	0.0322	44
75	100	0.0156	33
63	100	0.0078	20
50	100	0.0043	15
37.5	100	0.0020	7
28	100		
20	100		
14	98		
10	98		
6.3	97		
5	97		
3.35	96		
2	93		
1.18	89		
0.6	84	Particle density	(assumed)
0.425	82	2.65	Mg/m3
0.3	78		
0.212	74		
0.15	69		
0.063	57		

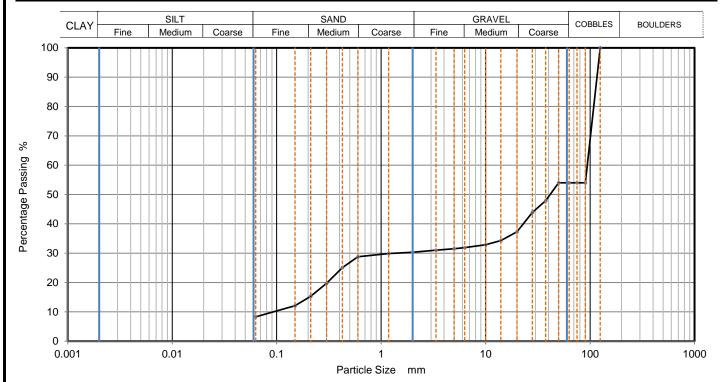
Dry Mass of sample, g	2397
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Sample Proportions	% dry mass
Cobbles	0
Gravel	7
Sand	35
Silt	50
Clay	8

Grading Analysis		
D100	mm	
D60	mm	0.0775
D30	mm	0.0131
D10	mm	0.0026
Uniformity Coefficient		30
Curvature Coefficient		0.86

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167
GEOTECH			Borehole/Pit No.	ВН04
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	34
Soil Description	Brown slightly sandy slightly silty subrounded fine to coarse GRAVEL with high cobble content.		Depth, m	23.50
Specimen Reference	Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017100327



Siev	/ing	Sedimer	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	54		
75	54		
63	54		
50	54		
37.5	48		
28	44		
20	37		
14	34		
10	33		
6.3	32		
5	32		
3.35	31		
2	30		
1.18	30		
0.6	29		
0.425	25		
0.3	20		
0.212	15		
0.15	12		
0.063	8		

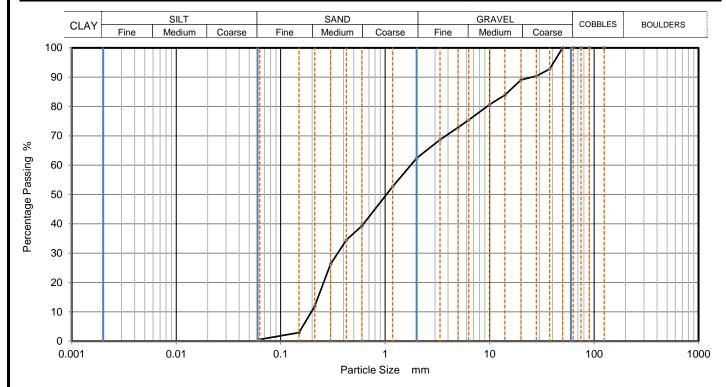
Dry Mass of sample, g	9970
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Sample Proportions	% dry mass		
Cobbles	46		
Gravel	24		
Sand	22		
Fines < 0.063mm	8		

Grading Analysis		
D100	mm	125
D60	mm	93.9
D30	mm	1.38
D10	mm	0.0925
Uniformity Coefficient		1000
Curvature Coefficient		0.22

		Fig	1
Stephen.Watson	30/10/2017 16:27		

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	ВН05	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	7
Soil Description	Grey brown gravelly fine to coarse SAND.			Depth, m	0.00
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017100328



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	93		
28	90		
20	89		
14	84		
10	81		
6.3	75		
5	73		
3.35	69		
2	62		
1.18	53		
0.6	39		
0.425	35		
0.3	26		
0.212	12		
0.15	3		
0.063	1		

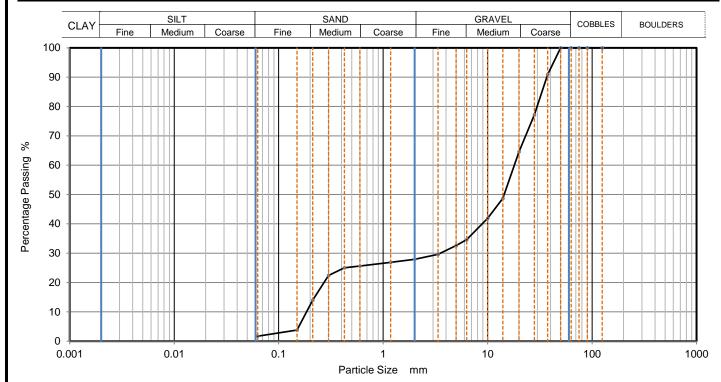
Dry Mass of sample, g	3475

Sample Proportions	% dry mass		
Cobbles	0		
Gravel	38		
Sand	62		
Fines < 0.063mm	1		

Grading Analysis		
D100	mm	
D60	mm	1.75
D30	mm	0.351
D10	mm	0.197
Uniformity Coefficient		8.9
Curvature Coefficient		0.36

20/40/2047 45 27	
Stephen.Watson 30/10/2017 16:27 Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	вн05	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	10
Soil Description	Grey brown slightly sandy fine to coarse subangular fine to coarse GRAVEL.		Depth, m	5.20	
Specimen Reference	5 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017100332



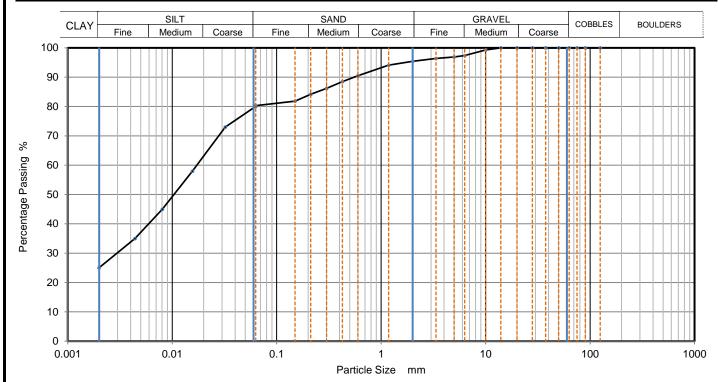
Sieving		Sedimer	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	91		
28	77		
20	65		
14	49		
10	42		
6.3	35		
5	33		
3.35	30		
2	28		
1.18	27		
0.6	26		
0.425	25		
0.3	22		
0.212	14		
0.15	4		
0.063	2		

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	72	
Sand	26	
Fines < 0.063mm	2	

Grading Analysis		
D100	mm	
D60	mm	18
D30	mm	3.55
D10	mm	0.185
Uniformity Coefficient		97
Curvature Coefficient		3.8

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167
GEOTECH			Borehole/Pit No.	ВН05
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	11
Soil Description	Grey brown slightly sandy slightly gravelly silty CLAY.		Depth, m	7.40
Specimen Reference	5 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017100333



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	80
90	100	0.0322	73
75	100	0.0156	58
63	100	0.0080	45
50	100	0.0044	35
37.5	100	0.0020	25
28	100		
20	100		
14	100		
10	99		
6.3	97		
5	97		
3.35	96		
2	95		
1.18	94		
0.6	91	Particle density	(assumed)
0.425	89	2.65	Mg/m3
0.3	86		
0.212	84		
0.15	82		
0.063	80		

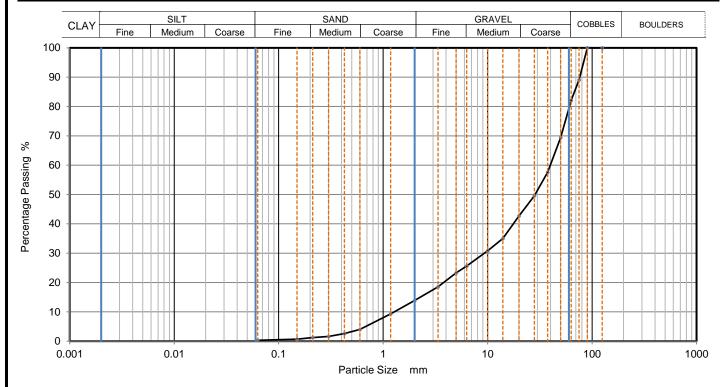
Dry Mass of sample, g	1400

Sample Proportions	% dry mass
Cobbles	0
Gravel	5
Sand	15
Silt	55
Clay	25

Grading Analysis		
D100	mm	
D60	mm	0.0174
D30	mm	0.00293
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167
GEOTECH			Borehole/Pit No.	ВН05
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	20
Soil Description	Grey brown slightly sandy subrounded fine to coarse GRAVEL with low cobble content.		Depth, m	9.00
Specimen Reference	3 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017100335



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	89		
63	82		
50	69		
37.5	58		
28	50		
20	43		
14	35		
10	31		
6.3	26		
5	23		
3.35	19		
2	14		
1.18	9		
0.6	4		
0.425	3		
0.3	2		
0.212	1		
0.15	1		
0.063	0		

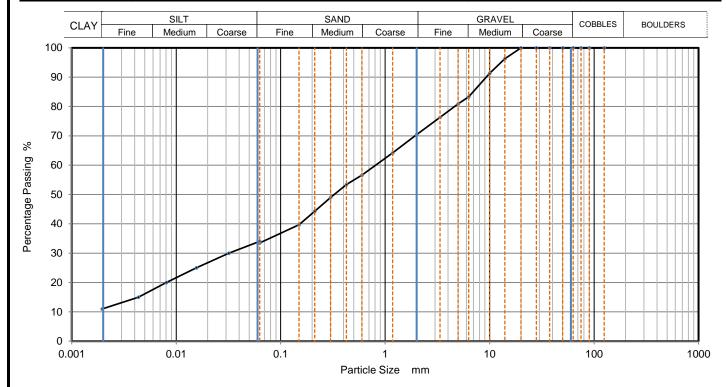
Dry Mass of sample, g	11671

Sample Proportions	% dry mass	
Cobbles	18	
Gravel	68	
Sand	14	
Fines < 0.063mm	0	

Grading Analysis		
D100	mm	
D60	mm	39.8
D30	mm	9.29
D10	mm	1.28
Uniformity Coefficient	·	31
Curvature Coefficient		1.7

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	вн05	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	23
Soil Description	Brown sandy gravelly silty CLAY.		Depth, m	12.00	
Specimen Reference	7 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017100336	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	34
90	100	0.0319	30
75	100	0.0156	25
63	100	0.0080	20
50	100	0.0043	15
37.5	100	0.0020	11
28	100		
20	100		
14	96		
10	91		
6.3	83		
5	81		
3.35	76		
2	70		
1.18	64		
0.6	57	Particle density	(assumed)
0.425	53	2.65	Mg/m3
0.3	49		_
0.212	44		
0.15	40		
0.063	34		

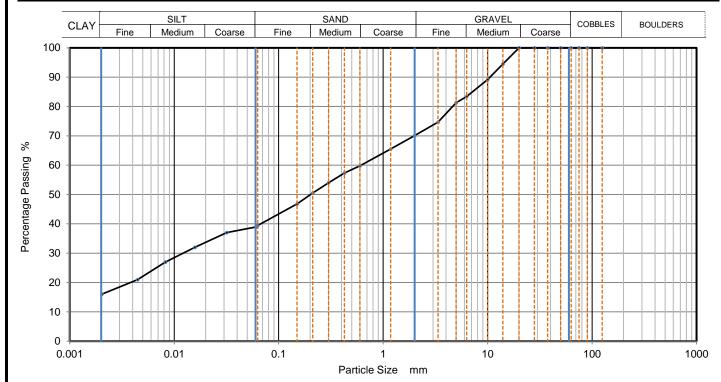
3292

Sample Proportions	% dry mass
Cobbles	0
Gravel	30
Sand	37
Silt	23
Clay	11

Grading Analysis		
D100	mm	
D60	mm	0.81
D30	mm	0.0344
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

**		Fig	1
Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	ВН05	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	25
Soil Description	Brown sandy gravelly silty CLAY.		Depth, m	14.00	
Specimen Reference	7 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017100337	



Sieving		Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0619	39
90	100	0.0319	37
75	100	0.0158	32
63	100	0.0083	27
50	100	0.0045	21
37.5	100	0.0020	16
28	100		
20	100		
14	95		
10	89		
6.3	83		
5	81		
3.35	75		
2	70		
1.18	66		
0.6	60	Particle density	(assumed)
0.425	57	2.65	Mg/m3
0.3	54		
0.212	51		
0.15	47		
0.063	39		

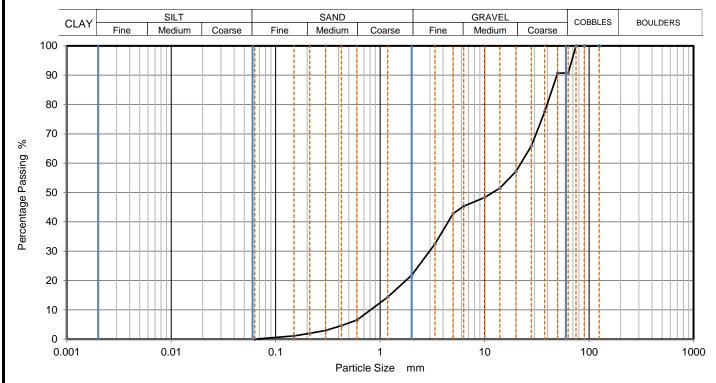
Dry Mass of sample, g	3474
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Sample Proportions	% dry mass		
Cobbles	0		
Gravel	30		
Sand	31		
Fines < 0.063mm	39		

Grading Analysis		
D100	mm	
D60	mm	0.613
D30	mm	0.0121
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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Stephen.Watson	30/10/2017 16:27	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION –			Job Ref	17-0167
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вн05	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI			27
Soil Description	Brown slightly sandy subrounded fine to coarse GRAVEL with low cobble content.			Depth, m	17.00
Specimen Reference	3 Specimen m			Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017100338



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	91		
50	91		
37.5	78		
28	66		
20	57		
14	52		
10	48		
6.3	45		
5	43		
3.35	33		
2	22		
1.18	14		
0.6	7		
0.425	5		
0.3	3		
0.212	2		
0.15	1		
0.063	0		

Dry Mass of sample, g	9857
Dry Iviass of Sample, g	9037

Sample Proportions	% dry mass		
Cobbles	9		
Gravel	69		
Sand	22		
Fines < 0.063mm	0		

Grading Analysis		
D100	mm	
D60	mm	22.3
D30	mm	2.97
D10	mm	0.81
Uniformity Coefficient		28
Curvature Coefficient		0.49

	Fig 1	
Stephen. Watson 30/10/2017 16:28	Sheet	

LABORATORY RESTRICTION REPORT

Project Reference	17-0167	То	Neil Haggan
Project Name	Arklow Sewerage Scheme Marine Outfall GI	Position	Project Manager
.,		From	Stephen Watson
TR reference	17-0167 / 4 & 5	Position	Laboratory Manager

The following sample(s) and test(s) are restricted as detailed below.

Hole		Sample		Test		
Number	Number	Depth	Туре	Type	Reason for Restriction	Required Action
		(m)				
BH04	20	4.20- 5.00	В	Atterberg Limits	SAND - Scheduled testing not suitable.	Cancelled

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

Laboratory Signature Stephen Watson	Project Manager Signature Neil Haggan
Date	Date
30 October 2017	30 January 2017



TEST RESTRICTION FORM

Issue No. 1
Page 1 of 1
Date 30/10/2017



SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

Client:	Irish Water
Engineer:	Byrne Looby ARUP J.V.
From:	Stephen Watson
	Laboratory Manager
	Causeway Geotech Ltd
Tel:	+44(0)2827666640
E-mail:	stephen.watson@causewaygeotech.com
Date:	09/11/17
Ref:	17-0167 - Schedule 6

Arklow Sewerage Scheme Marine Outfall GI

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

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 60 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





Project Name Arklow Sewerage Scheme Marine Outfall GI

Report Reference. 17-0167 - Schedule 6

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report
SOIL	Moisture Content of Soil	BS1377: Part 2: Clause 3.2: 1990	10
SOIL	Liquid and Plastic Limits of soil -1-point cone penetrometer method	BS1377: Part 2: Clauses 4.4, 5.3 & 5.4 1990	2
SOIL	Particle size distribution - wet sieving	BS1377: Part 2: Clause 9.2: 1990	10
SOIL	Particle size distribution -sedimentation hydrometer method	BS1377: Part 2: Clause 9.5: 1990	2



Summary of Classification Test Results

Project No.

Project Name

Liquid Limit

4pt cone unless:

cas - Casagrande method

1pt - single point test

Linear measurement unless:

wd - water displacement

wi - immersion in water

17-0167

Arklow Sewerage Scheme Marine Outfall GI

17-0	7167				AIK	iow Sewe	erage	Scrien	ie iviaili	ie Outiai	GI			
Hole No.	Ref	Sar Top	nple Base	Туре	Soil Description	Dens bulk	ity dry	W	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Kei	тор	Dase	туре		Mg/m	13	%	%	%	%	%	Mg/m3	Oldoniodion
BH06	1	0.00		В	Dark grey gravelly fine to medium SAND.			14.0						
BH06	3	1.30		В	Dark grey slightly gravelly fine medium SAND.			20.0						
BH06	7	3.00		В	Dark grey slightly gravelly fine to medium SAND.			19.0						
BH06	9	4.40		В	Dark grey gravelly fine to medium SAND.			14.0						
BH06	11	5.00		В	Brownish grey slightly sandy subrounded fine to coarse GRAVEL.			6.2						2222
BH06	13	6.20		В	Brown slightly sandy slightly gravelly silty CLAY.			16.0	68	34 -1pt	16	18		CL
BH06	20	9.00		В	Brown slightly sandy slightly gravelly silty CLAY.			18.0	67	34 -1pt	17	17		CL
BH06	15	12.60		В	Brown sandy subangular to subrounded fine to coarse GRAVEL.			8.6						
BH06	26	14.00		В	Brown slightly sandy subangular to subrounded fine to coarse GRAVEL.			5.1						
BH06	22	16.00		В	Brown slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble content.			3.8						
All tests perfe	ormed	in acco	rdance v	vith BS	S1377:1990 unless specifie	d otherwi	se							
Key								Date F	Printed		Appr	oved	Ву	Table

Particle density

gj - gas jar

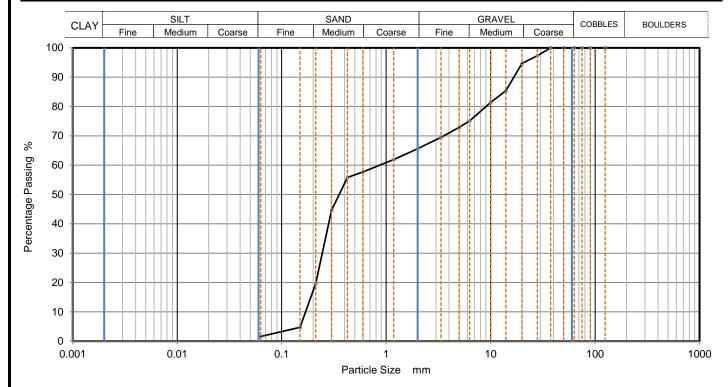
sp - small pyknometer

11/09/2017 00:00

sheet

Stephen.Watson

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH				Borehole/Pit No.	вно6
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	1
Soil Description	Dark grey gravelly fine to medium SAND.			Depth, m	0.00
Specimen Reference	6	Specimen Depth	m	Sample Type	В
Test Method	BS1377:Part 2:1990, claus	se 9.2		KeyLAB ID	Caus201710090



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	97		
20	95		
14	85		
10	81		
6.3	75		
5	73		
3.35	70		
2	66		
1.18	62		
0.6	58		
0.425	56		
0.3	45		
0.212	20]	
0.15	5		
0.063	2		

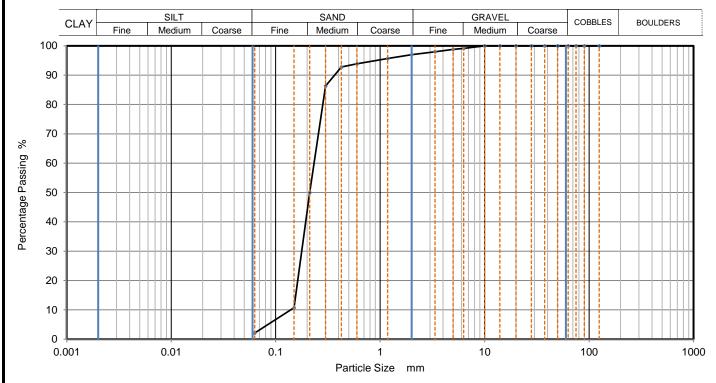
Dry Mass of sample, g	5255

Sample Proportions	% dry mass		
Cobbles	0		
Gravel	34		
Sand	64		
Fines < 0.063mm	2		

Grading Analysis		
D100	mm	
D60	mm	0.868
D30	mm	0.245
D10	mm	0.17
Uniformity Coefficient		5.1
Curvature Coefficient		0.41

09/11/2017 08:13	Approved	Sheet printed	Fig	1
Sheet Sheet	Stephen.Watson	09/11/2017 08:13	Sheet	

CAUSEWAY	CAUSEWAY PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH FARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	вно6	
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	3
Soil Description	Dark grey slightly gravelly fine medium SAND.			Depth, m	1.30
Specimen Reference	6 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau:	BS1377:Part 2:1990, clause 9.2			Caus201710091



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	99		
5	99		
3.35	98		
2	97		
1.18	96		
0.6	94		
0.425	93		
0.3	86		
0.212	50		
0.15	11		
0.063	2		

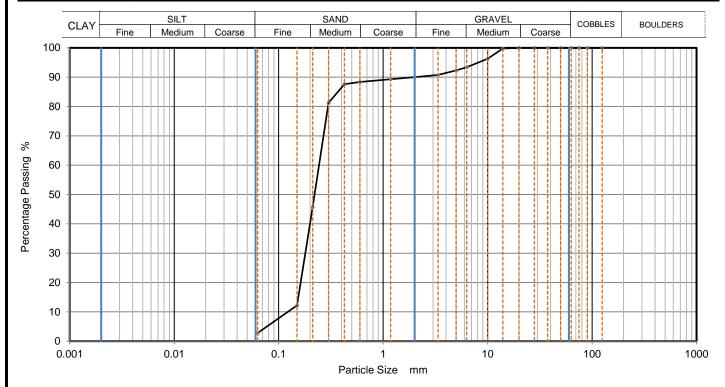
Dry Mass of sample, g	3067

Sample Proportions	% dry mass
Cobbles	0
Gravel	3
Sand	95
Fines < 0.063mm	2

Grading Analysis		
D100	mm	
D60	mm	0.233
D30	mm	0.178
D10	mm	0.139
Uniformity Coefficient		1.7
Curvature Coefficient		0.97

Approved	Sheet printed	Fig	1
Stephen.Watson	09/11/2017 08:13	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно6	
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	7	
Soil Description	Dark grey slightly gravelly fine to medium SAND.		Depth, m	3.00	
Specimen Reference	6 Specimen m Depth		Sample Type	В	
Test Method	3S1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus201710092	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	96		
6.3	93		
5	92		
3.35	91		
2	90		
1.18	89		
0.6	88		
0.425	88		
0.3	81		
0.212	46]	
0.15	12		
0.063	3		

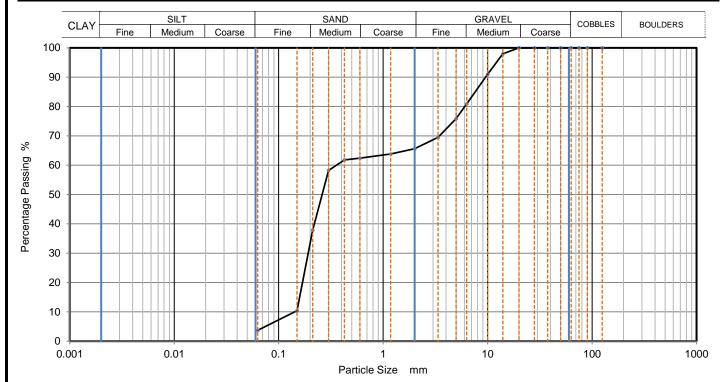
Dry Mass of sample, g	3440
- 1 /	

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	10	
Sand	87	
Fines < 0.063mm	3	

Grading Analysis		
D100	mm	
D60	mm	0.244
D30	mm	0.18
D10	mm	0.123
Uniformity Coefficient		2
Curvature Coefficient		1.1

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Stephen.Watson	09/11/2017 08:13	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH	GEOTECH PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно6	
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	9	
Soil Description	Dark grey gravelly fine to medium SAND.		Depth, m	4.40	
Specimen Reference	6 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus201710093	



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	98		
10	91		
6.3	81		
5	76		
3.35	70		
2	66		
1.18	64		
0.6	62		
0.425	62		
0.3	58		
0.212	38		
0.15	10		
0.063	4		

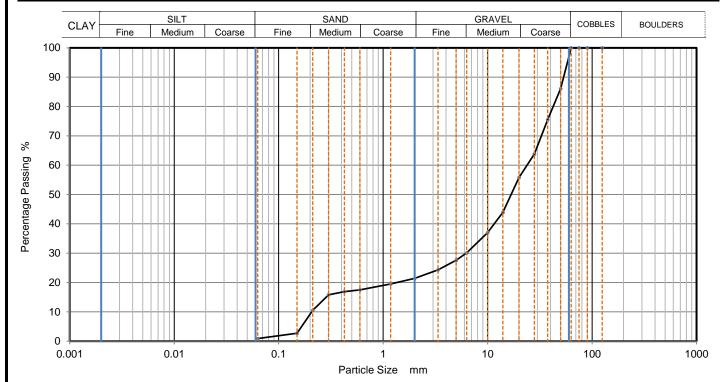
Dry Mass of sample, g	3860
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	34	
Sand	62	
Fines < 0.063mm	4	

Grading Analysis		
D100	mm	
D60	mm	0.356
D30	mm	0.192
D10	mm	0.143
Uniformity Coefficient		2.5
Curvature Coefficient		0.72

Approved		Fig	1
Stephen.Watson	09/11/2017 08:13	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно6		
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	11	
Soil Description	Brownish grey slightly sandy subrounded fine to coarse GRAVEL.		Depth, m	5.00	
Specimen Reference	6 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus201710094	



Siev	/ing	Sedimer	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	86		
37.5	76		
28	64		
20	56		
14	44		
10	37		
6.3	30		
5	28		
3.35	24		
2	21		
1.18	20		
0.6	18		
0.425	17		
0.3	16		
0.212	11		
0.15	3		
0.063	1		

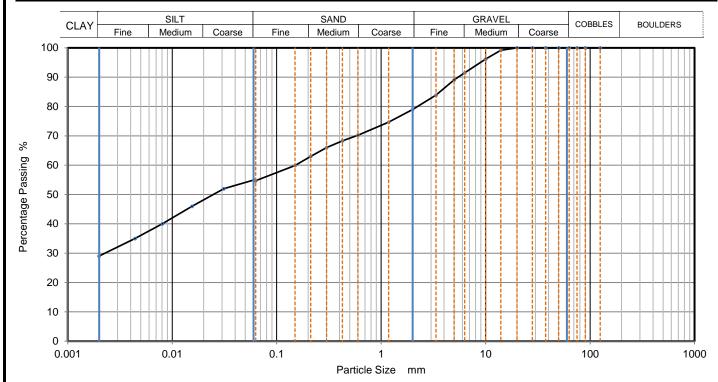
Dry Mass of sample, g	7942
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	79	
Sand	21	
Fines < 0.063mm	1	

Grading Analysis		
D100	mm	
D60	mm	23.9
D30	mm	6.23
D10	mm	0.207
Uniformity Coefficient		120
Curvature Coefficient		7.8

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Stephen.Watson	09/11/2017 08:13	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно6		
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	13	
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		Depth, m	6.20	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus201710095	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0606	55	
90	100	0.0312	52	
75	100	0.0154	46	
63	100	0.0080	40	
50	100	0.0044	35	
37.5	100	0.0020	29	
28	100			
20	100			
14	99			
10	96			
6.3	92			
5	89			
3.35	84			
2	79			
1.18	75			
0.6	70	Particle density	(assumed)	
0.425	68	2.65	Mg/m3	
0.3	66			
0.212	63			
0.15	60			
0.063	55			

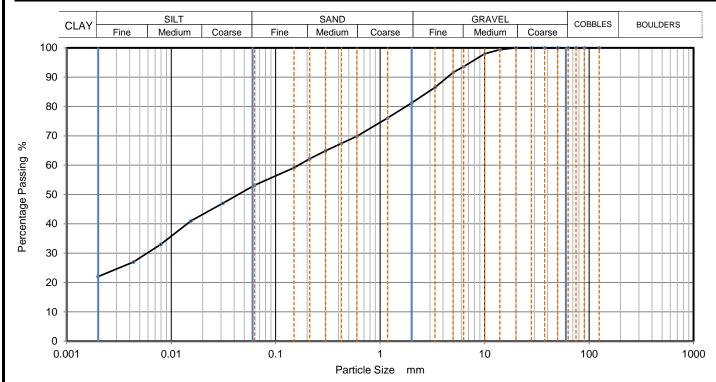
Dry Mass of sample, g	2639

Sample Proportions	% dry mass
Cobbles	0
Gravel	21
Sand	24
Silt	26
Clay	29

Grading Analysis		
D100	mm	
D60	mm	0.152
D30	mm	0.00235
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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Stephen.Watson	09/11/2017 08:13	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно6		
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	20
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		Depth, m	9.00	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus201710096	



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0619	53
90	100	0.0312	47
75	100	0.0154	41
63	100	0.0079	33
50	100	0.0043	27
37.5	100	0.0020	22
28	100		
20	100		
14	99		
10	98		
6.3	94		
5	92		
3.35	87		
2	81		
1.18	76		
0.6	70	Particle density	(assumed)
0.425	67	2.65	Mg/m3
0.3	65		
0.212	62		
0.15	59		
0.063	53		

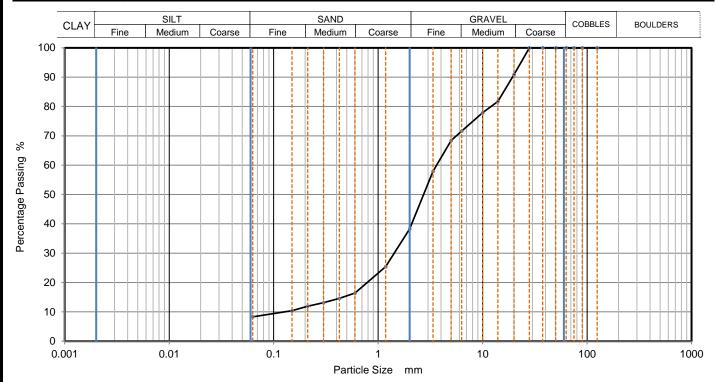
Dry Mass of sample, g	2465
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Sample Proportions	% dry mass
Cobbles	0
Gravel	19
Sand	28
Silt	31
Clay	22

Grading Analysis		
D100	mm	
D60	mm	0.165
D30	mm	0.00603
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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Stephen.Watson	09/11/2017 08:13	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно6	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	15
Soil Description	Brown sandy subangular to subrounded fine to coarse GRAVEL.		Depth, m	12.60	
Specimen Reference	6 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus201710097	



Siev	/ing	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	91		
14	82		
10	78		
6.3	72		
5	68		
3.35	58		
2	38		
1.18	25		
0.6	16		
0.425	15		
0.3	13		
0.212	12		
0.15	10		
0.063	8		

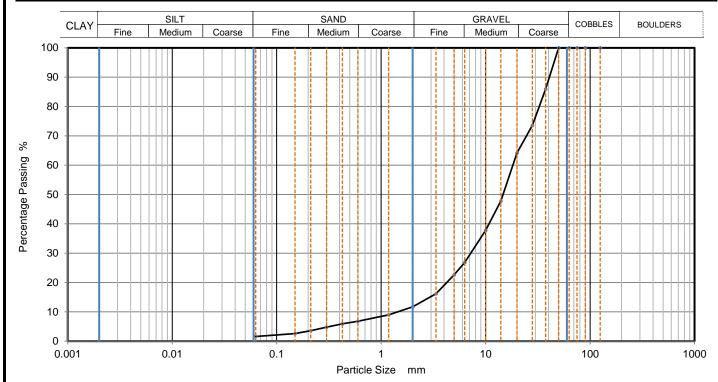
Dry Mass of sample, g	4140
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	62	
Sand	30	
Fines < 0.063mm	8	

Grading Analysis		
D100	mm	
D60	mm	3.64
D30	mm	1.42
D10	mm	0.126
Uniformity Coefficient		29
Curvature Coefficient		4.4

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Stephen.Watson	09/11/2017 08:13	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно6		
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	26
Soil Description	Brown slightly sandy subangular to subrounded fine to coarse GRAVEL.		Depth, m	14.00	
Specimen Reference	6 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus201710098	



Siev	Sieving		ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	86		
28	74		
20	64		
14	48		
10	38		
6.3	27		
5	23		
3.35	16		
2	12		
1.18	9		
0.6	7		
0.425	6		
0.3	5		
0.212	4		
0.15	3		
0.063	2		

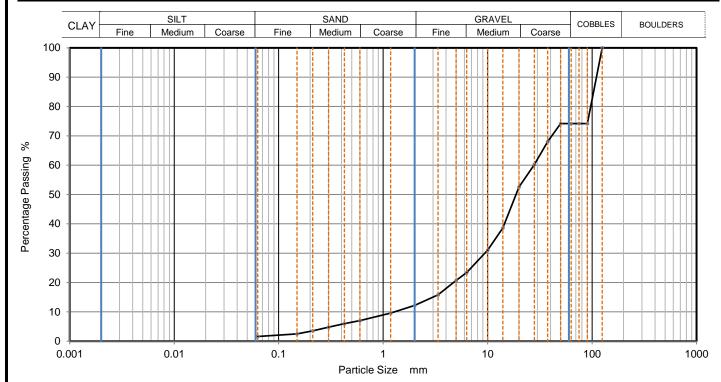
Dry Mass of sample, g	10040

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	88	
Sand	10	
Fines < 0.063mm	2	

Grading Analysis		
D100	mm	
D60	mm	18.3
D30	mm	7.2
D10	mm	1.43
Uniformity Coefficient		13
Curvature Coefficient		2

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Stephen.Watson	09/11/2017 08:13	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167
GEOTECH PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно6		
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	22
Soil Description	Brown slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble content.		Depth, m	16.00	
Specimen Reference	6 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus201710099	



Siev	Sieving		ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	74		
75	74		
63	74		
50	74		
37.5	68		
28	60		
20	53		
14	39		
10	31		
6.3	23		
5	21		
3.35	16		
2	12		
1.18	10		
0.6	7		
0.425	6		
0.3	5		
0.212	4		
0.15	3		
0.063	2		

Dry Mass of sample, g	10735
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Sample Proportions	% dry mass	
Cobbles	26	
Gravel	62	
Sand	11	
Fines < 0.063mm	2	

Grading Analysis		
D100	mm	125
D60	mm	27.8
D30	mm	9.43
D10	mm	1.29
Uniformity Coefficient		22
Curvature Coefficient		2.5

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SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

Client:	Irish Water
Engineer:	Byrne Looby ARUP J.V.
From:	Stephen Watson
	Laboratory Manager
	Causeway Geotech Ltd
Tel:	+44(0)2827666640
E-mail:	stephen.watson@causewaygeotech.com
Date:	04/12/17
Ref:	17-0167 - Schedule 7

Arklow Sewerage Scheme Marine Outfall GI

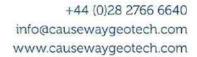
We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the *Contents page(s)*.

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 60 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





Project Name Arklow Sewerage Scheme Marine Outfall GI

Report Reference. 17-0167 - Schedule 7

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report
SOIL	Moisture Content of Soil	BS1377: Part 2: Clause 3.2: 1990	15
SOIL	Liquid and Plastic Limits of soil -1-point cone penetrometer method	BS1377: Part 2: Clauses 4.4, 5.3 & 5.4 1990	6
SOIL	Particle size distribution - wet sieving	BS1377: Part 2: Clause 9.2: 1990	13
SOIL	Particle size distribution -sedimentation hydrometer method	BS1377: Part 2: Clause 9.5: 1990	6
SOIL – Subcontracted to Pro Soils Ltd	Direct Shear Strength using 60mm Small Shear box (up to 4 days)	BS1377: Part 7: Clause 4: 1990	6



Summary of Classification Test Results

Project No.

Project Name

17-0167

Arklow Sewerage Scheme Marine Outfall GI

17-0167 Arklow Sewerage Scheme Marine Outfall GI														
		Sar	mple			Dens		W	Passing	LL	PL	ΡI	Particle	Casagrande
Hole No.	Ref	Тор	Base	Туре	Soil Description	bulk	dry		425µm				density	Classification
		. 0		. , , , ,		Mg/m	13	%	%	%	%	%	Mg/m3	
BH07	1	0.00		В	Dark grey slightly sandy subrounded fine to coarse GRAVEL with shell fragments.			4.7						
ВН07	2	1.00		В	Grey sandy subangular fine to coarse GRAVEL with shell fragments.			13.0						
ВН07	3	2.50		В	Grey slightly sandy gravelly silty CLAY.			24.0						
вно7	5	3.50		В	Grey sandy subrounded fine to coarse GRAVEL with low cobble content.			4.1						
ВН07	7	5.30		В	Brownish grey gravelly fine to coarse SAND.			16.0						
ВН07	8	6.20		В	Greyish brown silty fine to medium SAND.			21.0	100	29 -1pt	NP			
ВН07	9	6.60		В	Greyish brown slightly sandy slightly clayey SILT.			26.0						
ВН07	17	7.00		D	Greyish brown slightly sandy silty CLAY.			23.0	98	30 -1pt	19	11		CL
ВН07	18	8.00		D	Brown slightly sandy gravelly silty CLAY.			23.0	98	36 -1pt	20	16		CI
ВН07	10	9.00		В	Brown slightly sandy silty CLAY.			25.0	97	30 -1pt	19	11		CL
ВН08	1	0.00		В	Dark grey sandy subangular fine to coarse GRAVEL.			11.0						
ВН08	2	1.50		В	Dark grey slightly gravelly fine to medium SAND with shell fragments.			17.0						
ВН08	3	2.30		В	Dark grey slightly gravelly fine to medium SAND.			20.0						
All tests perfo	ormed	in acco	rdance v	vith BS	61377:1990 unless specified	d otherwi	ise							
Key								Date F	Printed		Appr	oved	Ву	Table
Density t		ment unles	e ·	Liquid I		e density nall pyknom	eter	10/0	01/2017	00.00				1
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Summary of Classification Test Results

Project No.

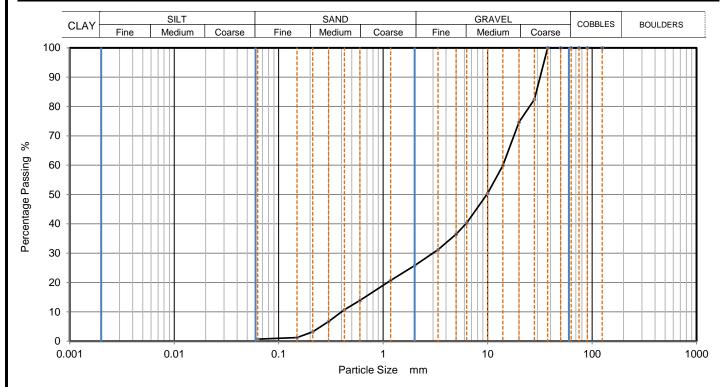
Project Name

17-0167

Arklow Sewerage Scheme Marine Outfall GI

	107				7 11 1	1				e Outiai			1	
	<u> </u>	Sar	mple		_	Dens	ity	w	Passing	LL	PL	PI	Particle	
Hole No.	Ref	Тор	Base	Туре	Soil Description	bulk			425µm				density	Classification
						Mg/m	13	%	%	%	%	%	Mg/m3	
					Brown sandy slightly gravelly									
BH08	5	4.50		В	CLAY.			15.0	45	46 -1pt	22	24		CI
BH08	8	7.00		В	Brown sandy slightly gravelly silty CLAY.			16.0	66	38 -1pt	22	16		CI
	\vdash			<u> </u>										
	П													
			<u> </u>	<u> </u>							l			
All tests perfo	All tests performed in accordance with BS1377:1990 unless specified otherwise													
Key								Date F	Printad		Annr	oved	Rv	Table
Density	test			Liquid I	_imit Particl	e density		Dale F	iiiiteu		Appl	oveu	Бу	
Linear n	neasure	ment unles	s:	4pt con	e unless : sp - sr	nall pyknom	eter	12/0)1/2017	00:00				1
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CAUSEWAY	DARTI	CLE SIZE DIST	DIDITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	Borehole/Pit No.	вно7	
Site Name	Arklow Sewerage Sche	me Marine Outfa	Sample No.	1	
Soil Description	Dark grey slightly sandy si fragments.	ubrounded fine to c	Depth, m	0.00	
Specimen Reference	6	Specimen Depth	m	Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017101848



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	82		
20	75		
14	60		
10	50		
6.3	40		
5	37		
3.35	31		
2	26		
1.18	21		
0.6	14		
0.425	11		
0.3	7		
0.212	3		
0.15	1		
0.063	1		

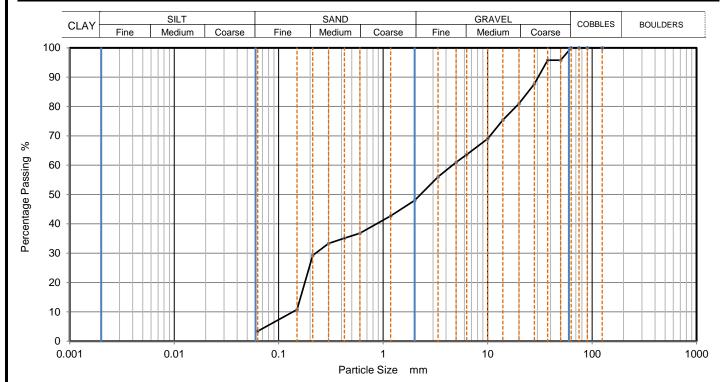
Dry Mass of sample, g	5606

Sample Proportions	% dry mass		
Cobbles	0		
Gravel	74		
Sand	25		
Fines < 0.063mm	1		

Grading Analysis		
D100	mm	
D60	mm	14
D30	mm	2.99
D10	mm	0.399
Uniformity Coefficient	·	35
Curvature Coefficient		1.6

01/12/2017 10:32	Sheet printed Fig 1	Approved
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CAUSEWAY PARTICLE SIZE DISTRIBUTION				Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	Borehole/Pit No.	вно7	
Site Name	Arklow Sewerage Sche	me Marine Outfa	Sample No.	2	
Soil Description	Grey sandy subangular fir	ne to coarse GRAVE	Depth, m	1.00	
Specimen Reference	6	Specimen Depth	m	Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017101849



Siev	/ing	Sedimentation				
Particle Size mm	% Passing	Particle Size mm	% Passing			
125	100					
90	100					
75	100					
63	100					
50	96					
37.5	96					
28	88					
20	81					
14	75					
10	69					
6.3	64					
5	61					
3.35	56					
2	48					
1.18	43					
0.6	37					
0.425	35					
0.3	33					
0.212	29					
0.15	11					
0.063	3					

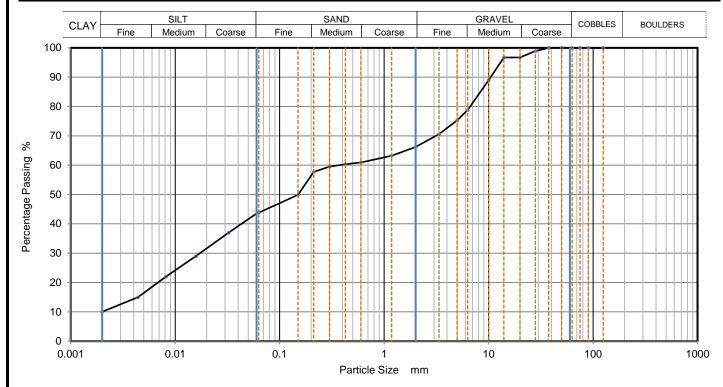
Dry Mass of sample, g	4590
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Sample Proportions	% dry mass		
Cobbles	0		
Gravel	52		
Sand	45		
Fines < 0.063mm	3		

Grading Analysis		
D100	mm	
D60	mm	4.6
D30	mm	0.227
D10	mm	0.137
Uniformity Coefficient		34
Curvature Coefficient		0.082

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Stephen.Watson	01/12/2017 10:32	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно7
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	3
Soil Description	Grey slightly sandy gravelly silty CLAY.		Depth, m	2.50
Specimen Reference	6 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017101850



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0630	44	
90	100	0.0325	37	
75	100	0.0158	29	
63	100	0.0082	22	
50	100	0.0044	15	
37.5	100	0.0020	10	
28	99			
20	97			
14	97			
10	89			
6.3	79			
5	75			
3.35	71			
2	66			
1.18	63			
0.6	61	Particle density	(assumed)	
0.425	60	2.65	Mg/m3	
0.3	60			
0.212	58			
0.15	50			
0.063	44			

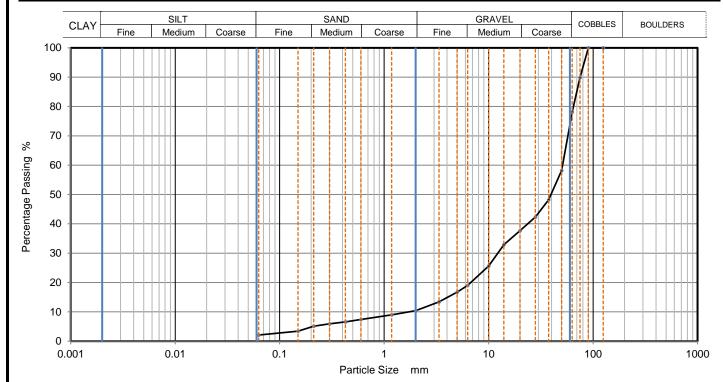
Dry Mass of sample, g	2748
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Sample Proportions	% dry mass
Cobbles	0
Gravel	34
Sand	22
Silt	34
Clay	10

Grading Analysis		
D100	mm	
D60	mm	0.372
D30	mm	0.0176
D10	mm	0.00212
Uniformity Coefficient		180
Curvature Coefficient		0.4

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вно7
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	5
Soil Description	Grey sandy subrounded fine to coarse GRAVEL with low cobble content.		Depth, m	3.50
Specimen Reference	6 Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017101851



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	90		
63	78		
50	58		
37.5	48		
28	42		
20	38		
14	33		
10	26		
6.3	19		
5	17		
3.35	13		
2	10		
1.18	9		
0.6	7		
0.425	7		
0.3	6		
0.212	5		
0.15	3		
0.063	2		

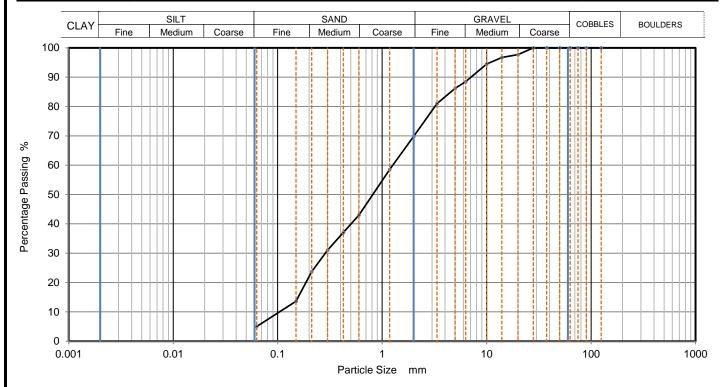
Dry Mass of sample, g	15485
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Sample Proportions	% dry mass		
Cobbles	22		
Gravel	68		
Sand	8		
Fines < 0.063mm	2		

Grading Analysis		
D100	mm	
D60	mm	51
D30	mm	12.3
D10	mm	1.74
Uniformity Coefficient		29
Curvature Coefficient		1.7

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	ВН07	
Site Name	arklow Sewerage Scheme Marine Outfall GI			Sample No.	7
Soil Description	Brownish grey gravelly fine to coarse SAND.		Depth, m	5.30	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017101852



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	98		
14	97		
10	95		
6.3	89		
5	86		
3.35	81		
2	70		
1.18	59		
0.6	43		
0.425	37		
0.3	31		
0.212	24]	
0.15	14		
0.063	5		

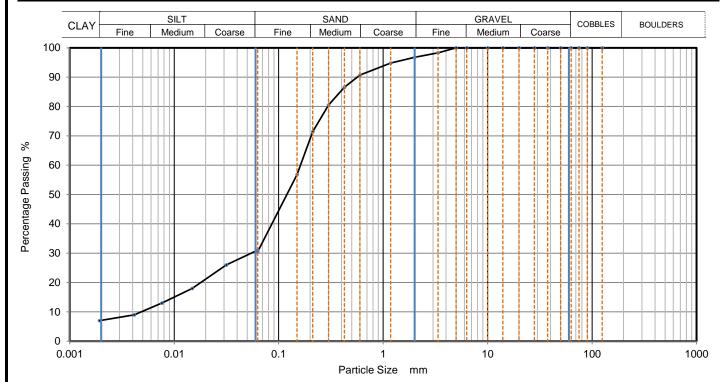
Dry Mass of sample, g	3075
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Sample Proportions	% dry mass		
Cobbles	0		
Gravel	30		
Sand	65		
Fines < 0.063mm	5		

Grading Analysis		
D100	mm	
D60	mm	1.27
D30	mm	0.286
D10	mm	0.104
Uniformity Coefficient		12
Curvature Coefficient		0.62

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION -		Borehole/Pit No.	вно7	
Site Name	arklow Sewerage Scheme Marine Outfall GI			Sample No.	8
Soil Description	Greyish brown silty fine to medium SAND.		Depth, m	6.20	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2017101853



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	31
90	100	0.0316	26
75	100	0.0149	18
63	100	0.0076	13
50	100	0.0041	9
37.5	100	0.0019	7
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	98		
2	97		
1.18	95		
0.6	91	Particle density	(assumed)
0.425	87	2.65	Mg/m3
0.3	81		
0.212	71		
0.15	57		
0.063	31		

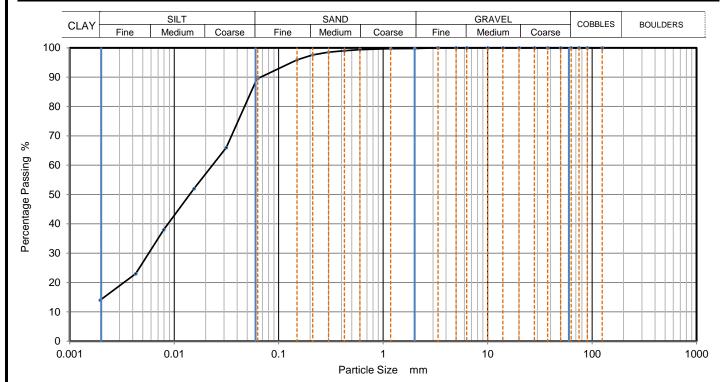
Dry Mass of sample, g	2231
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	3	
Sand	66	
Silt	24	
Clay	7	

Grading Analysis		
D100	mm	
D60	mm	0.162
D30	mm	0.0587
D10	mm	0.00495
Uniformity Coefficient		33
Curvature Coefficient		4.3

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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	вно7	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	9
Soil Description	Greyish brown slightly sandy slightly clayey SILT.		Depth, m	6.60	
Specimen Reference	6 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2017101854



Sie	ving	Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0630	90	
90	100	0.0316	66	
75	100	0.0154	52	
63	100	0.0079	38	
50	100	0.0043	23	
37.5	100	0.0020	14	
28	100			
20	100			
14	100			
10	100			
6.3	100			
5	100			
3.35	100			
2	100			
1.18	100			
0.6	99	Particle density	(assumed)	
0.425	99	2.65	Mg/m3	
0.3	99			
0.212	98			
0.15	96			
0.063	90			

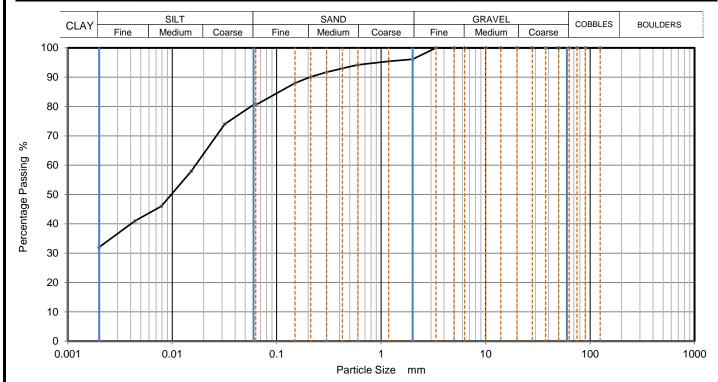
Dry Mass of sample, g 1617	Dry Mass of sample, g	1617
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	0	
Sand	10	
Silt	75	
Clay	15	

Grading Analysis		
D100	mm	
D60	mm	0.023
D30	mm	0.00575
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	вно7	
Site Name	arklow Sewerage Scheme Marine Outfall GI			Sample No.	10
Soil Description	Brown slightly sandy silty CLAY.		Depth, m	9.00	
Specimen Reference	Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2017101857



Siev	ving	Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0625	81	
90	100	0.0319	74	
75	100	0.0152	58	
63	100	0.0078	46	
50	100	0.0044	41	
37.5	100	0.0020	32	
28	100			
20	100			
14	100			
10	100			
6.3	100			
5	100			
3.35	100			
2	96			
1.18	95			
0.6	94	Particle density	(assumed)	
0.425	93	2.65	Mg/m3	
0.3	92			
0.212	90			
0.15	88			
0.063	81			

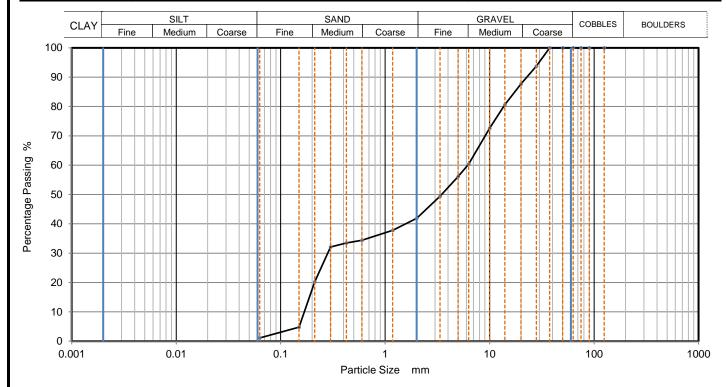
Dry Mass of sample, g	1181
, , , ,	

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	4	
Sand	16	
Silt	48	
Clay	32	

Grading Analysis		
D100	mm	
D60	mm	0.0171
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	внов
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	1
Soil Description	Dark grey sandy subangular fine to coarse GRAVEL.		Depth, m	0.00
Specimen Reference	6 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017101858



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	94		
20	88		
14	81		
10	73		
6.3	60		
5	56		
3.35	49		
2	42		
1.18	38		
0.6	34		
0.425	34		
0.3	32		_
0.212	20		
0.15	5		
0.063	1		

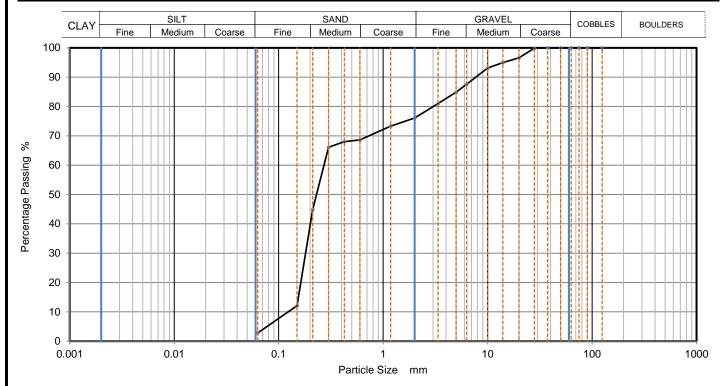
Dry Mass of sample, g	4864
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Sample Proportions	% dry mass		
Cobbles	0		
Gravel	58		
Sand	41		
Fines < 0.063mm	1		

Grading Analysis		
D100	mm	
D60	mm	6.16
D30	mm	0.282
D10	mm	0.169
Uniformity Coefficient		37
Curvature Coefficient		0.077

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Stephen.Watson	01/12/2017 10:32	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вн08
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	2
Soil Description	Dark grey slightly gravelly fine to medium SAND with shell fragments.		Depth, m	1.50
Specimen Reference	6 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017101859



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	97		
14	95		
10	93		
6.3	88		
5	85		
3.35	81		
2	76		
1.18	73		
0.6	69		
0.425	68		
0.3	66		
0.212	45		
0.15	12		
0.063	3		

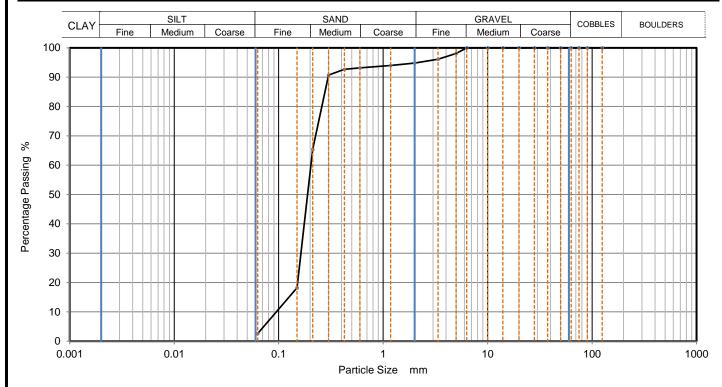
Dry Mass of sample, g	3871
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Sample Proportions	% dry mass		
Cobbles	0		
Gravel	24		
Sand	73		
Fines < 0.063 mm	3		

Grading Analysis		
D100	mm	
D60	mm	0.272
D30	mm	0.181
D10	mm	0.124
Uniformity Coefficient		2.2
Curvature Coefficient		0.98

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	внов	
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	3	
Soil Description	Dark grey slightly gravelly fine to medium SAND.		Depth, m	2.30	
Specimen Reference	6 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017101860



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	98		
3.35	96		
2	95		
1.18	94		
0.6	93		
0.425	93		
0.3	91		
0.212	65		
0.15	18		
0.063	3		

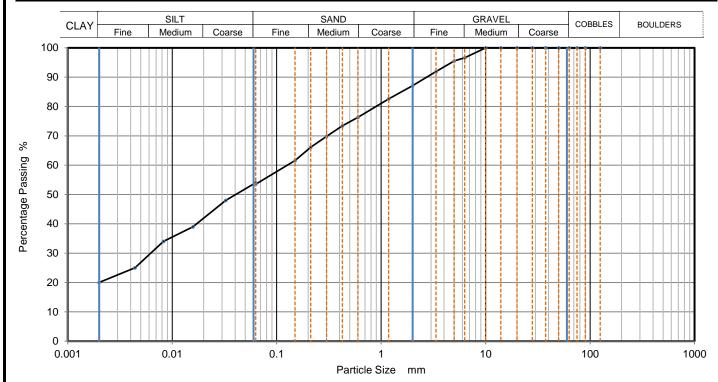
Dry Mass of sample, g	3086

Sample Proportions	% dry mass		
Cobbles	0		
Gravel	5		
Sand	92		
Fines < 0.063mm	3		

Grading Analysis		
D100	mm	
D60	mm	0.204
D30	mm	0.164
D10	mm	0.0949
Uniformity Coefficient		2.1
Curvature Coefficient		1.4

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	внов
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	5
Soil Description	Brown sandy slightly gravelly CLAY.		Depth, m	4.50
Specimen Reference	Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017101861



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0630	54	
90	100	0.0325	48	
75	100	0.0158	39	
63	100	0.0083	34	
50	100	0.0044	25	
37.5	100	0.0020	20	
28	100			
20	100			
14	100			
10	100			
6.3	97			
5	96			
3.35	92			
2	87			
1.18	83			
0.6	76	Particle density	(assumed)	
0.425	73	2.65	Mg/m3	
0.3	70			
0.212	66			
0.15	62			
0.063	54			

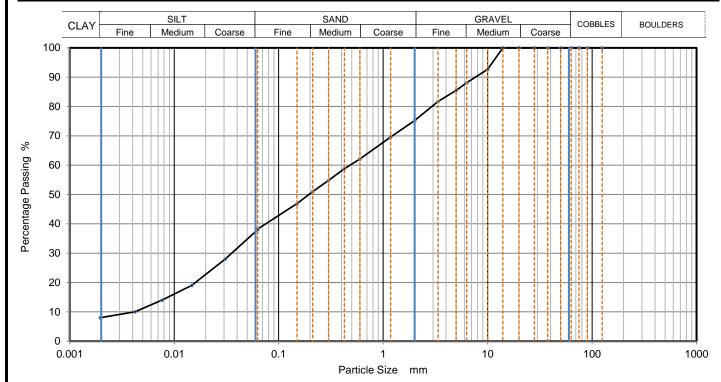
Dry Mass of sample, g	2342

Sample Proportions	% dry mass		
Cobbles	0		
Gravel	13		
Sand	34		
Silt	34		
Clay	20		

Grading Analysis		
D100	mm	
D60	mm	0.126
D30	mm	0.00622
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH	PANII	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	внов
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	8
Soil Description	Brown sandy slightly gravelly silty CLAY.		Depth, m	7.00	
Specimen Reference	8 Specimen m			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2017101862



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	38
90	100	0.0309	28
75	100	0.0147	19
63	100	0.0076	14
50	100	0.0042	10
37.5	100	0.0020	8
28	100		
20	100		
14	100		
10	93		
6.3	88		
5	86		
3.35	82		
2	75		
1.18	70		
0.6	62	Particle density	(assumed)
0.425	59	2.65	Mg/m3
0.3	55		
0.212	51		
0.15	47		
0.063	38		

Dry Mass of sample, g	1859
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Sample Proportions	% dry mass		
Cobbles	0		
Gravel	25		
Sand	37		
Silt	31		
Clay	8		

Grading Analysis		
D100	mm	
D60	mm	0.482
D30	mm	0.0355
D10	mm	0.00398
Uniformity Coefficient		120
Curvature Coefficient		0.66

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LABORATORY REPORT



4043

Contract Number: PSL17/5711

Report Date: 01 December 2017

Client's Reference: 17-0167

Client Name: Causeway Geotech

8 Drumahiskey Road

Ballymoney Co.Antrim BT53 7QL

For the attention of: Neil Haggan

Contract Title: Arklow Sewerage Scheme Marine Outfall GI

Date Received: 23/11/2017
Date Commenced: 23/11/2017
Date Completed: 01/12/2017

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson A Watkins R Berriman (Director) (Director) (Quality Manager)

L Knight S Eyre A Fry

(Senior Technician) (Senior Technician) (Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,

Doncaster DN4 0AR

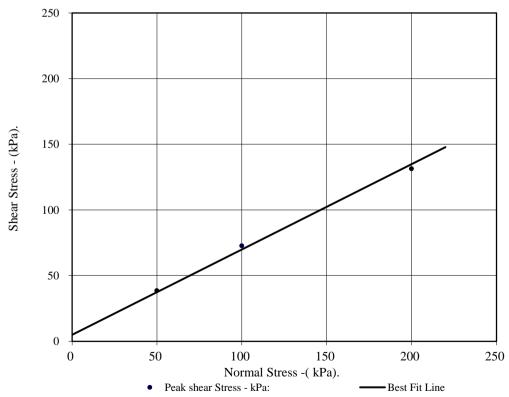
tel: +44 (0)844 815 6641 fax: +44 (0)844 815 6642

e-mail: rgunson@prosoils.co.uk awatkins@prosoils.co.uk

Page 1 of

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:		BH04	Top Depth:		4.2	20
Sample Number:	20 Base Depth		Base Depth: 5.0		00	
Sample Conditions:		Submerged	Sample Typ	e	I	3
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort				
1 1		ed passing 2mm sieve				
Sample Description:	Brown sligh	tly gravelly silty SAND	•			
STAGE				1	2	3
		Initial Conditions				
Height - mm:				19.98	19.98	19.98
Length - mm:				60.01	60.01	60.01
Moisture Content - %:				17	17	17
Bulk Density - Mg/m3:				1.86	1.87	1.88
Dry Density - Mg/m3:				1.60	1.60	1.61
Voids Ratio:				0.661	0.652	0.646
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				19.44	19.35	19.30
		Shearing Stage				
Rate of Strain (mm/min)				0.800	0.800	0.800
Displacement at peak shear s	tress (mm)			5.00	3.00	3.00
Peak shear Stress - kPa:				39	73	131
	Fi	nal Consolidated Condi	tions			
Moisture Content - %:				24	24	23
Bulk Density - Mg/m3:		·		1.91	1.93	1.94
Dry Density - Mg/m3:				1.54	1.56	1.58
		Peak				
Angle of Shearing Resistance	e:(0)				33	
Effective Cohesion - kPa:					5	

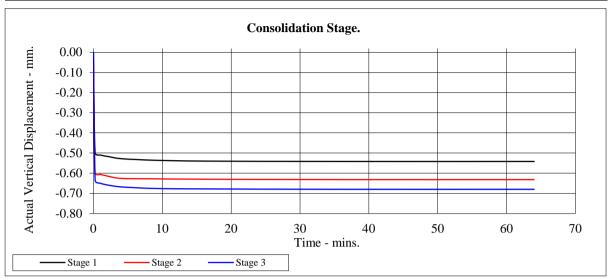


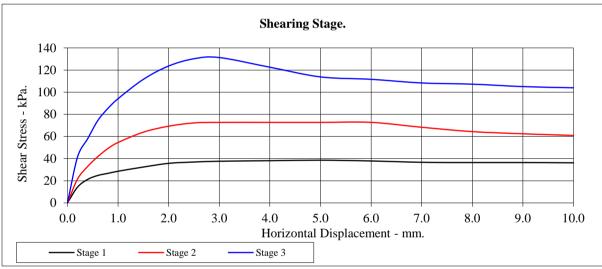


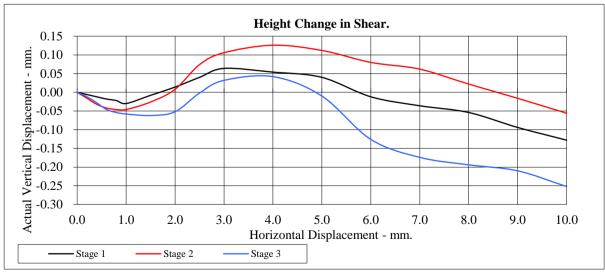
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH04	Top Depth:	4.20
Sample Number:	20	Base Depth:	5.00





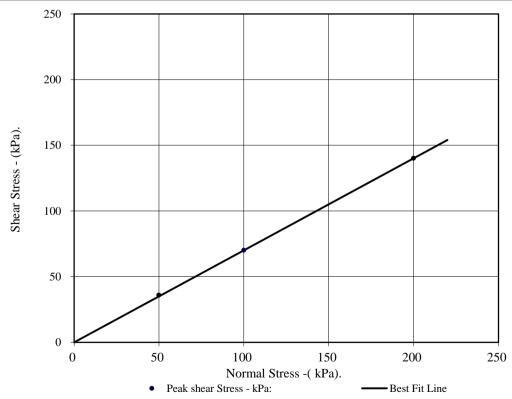




Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH04		Top Depth:		6.10	
Sample Number:	24 Base D		Base Depth	Base Depth:		00
Sample Conditions:		Submerged	Sample Type		В	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded 1	using hand tamped effort				
		ed passing 2mm sieve				
Sample Description:	Brown grav	elly SAND.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				19.98	19.98	19.98
Length - mm:				60.01	60.01	60.01
Moisture Content - %:				5.9	5.9	5.9
Bulk Density - Mg/m3:				1.85	1.85	1.85
Dry Density - Mg/m3:				1.75	1.75	1.75
Voids Ratio:				0.517	0.517	0.517
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				19.23	18.95	18.74
		Shearing Stage				
Rate of Strain (mm/min)				0.800	0.800	0.800
Displacement at peak shear st	tress (mm)			2.50	5.00	5.00
Peak shear Stress - kPa:				36	70	140
	Fi	nal Consolidated Condi	itions			
Moisture Content - %:				18	18	16
Bulk Density - Mg/m3:			1.92	1.95	1.97	
Dry Density - Mg/m3:	·	<u> </u>		1.63	1.65	1.70
		Peak				
Angle of Shearing Resistance	:(0)				35	
Effective Cohesion - kPa: 0					0	

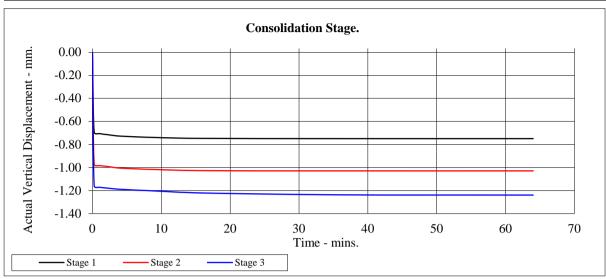


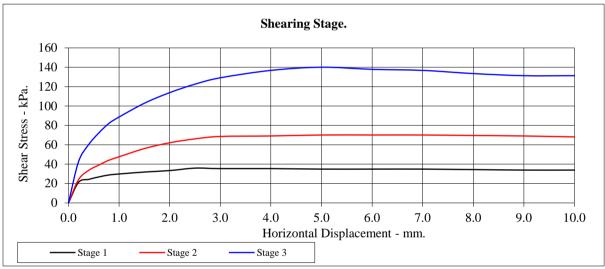


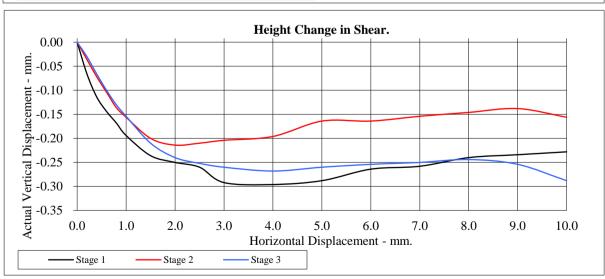
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH04	Top Depth:	6.10
Sample Number:	24	Base Depth:	7.00





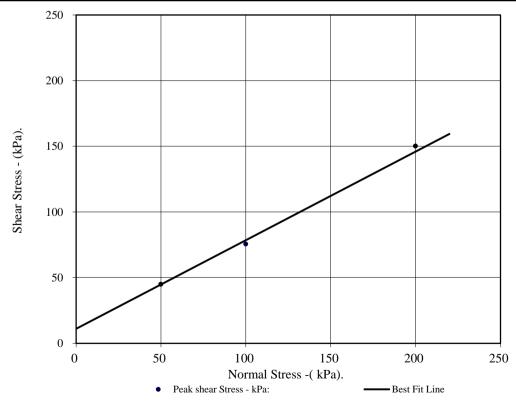




Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:		BH05 T		Top Depth:		2.20	
Sample Number:	9 Base Depth:		:	3.50			
Sample Conditions:		Submerged	Sample Type B			3	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:				
Sample Preparation:	Remoulded	using hand tamped effort.					
Sample Freparation.		ed passing 2mm sieve					
Sample Description:	Brown sligh	tly gravelly silty SAND	•				
STAGE				1	2	3	
		Initial Conditions					
Height - mm:				24.51	24.51	24.51	
Length - mm:				60.00	60.00	60.00	
Moisture Content - %:				17	17	17	
Bulk Density - Mg/m3:				1.90	1.90	1.90	
Dry Density - Mg/m3:				1.62	1.62	1.62	
Voids Ratio:				0.640	0.638	0.637	
Normal Pressure- kPa				50	100	200	
		Consolidation Stage					
Consolidated Height - mm:				24.43	24.35	24.10	
		Shearing Stage					
Rate of Strain - mm/min				0.80	0.80	0.80	
Displacement at peak shear s	tress - mm			1.50	1.50	1.50	
Peak shear Stress - kPa:				45	76	150	
	Fi	nal Consolidated Condi	itions				
Moisture Content - %:				22	22	22	
Bulk Density - Mg/m3:				1.90	1.91	1.93	
Dry Density - Mg/m3:				1.56	1.57	1.59	
		Peak					
Angle of Shearing Resistance	e:(0)				34		
Effective Cohesion - kPa:					11		

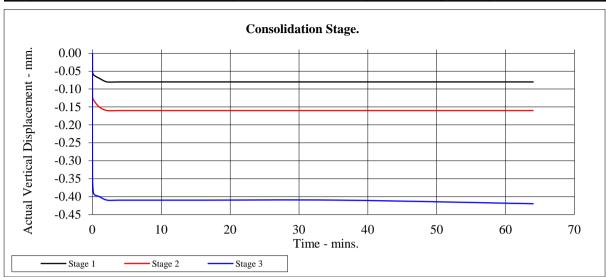


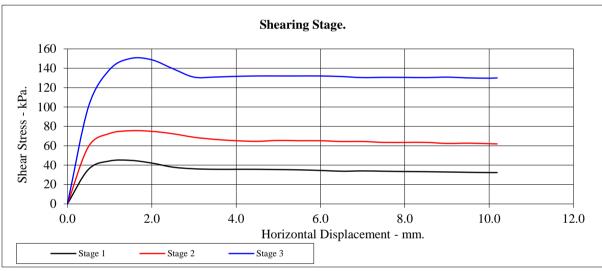


Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH05	Top Depth:	2.20
Sample Number:	9	Base Depth:	3.50







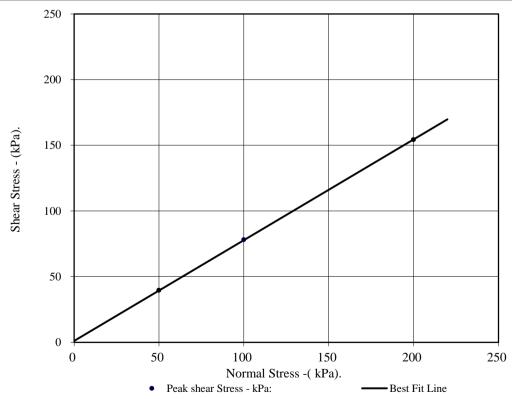


Professional Soils Laboratory

Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:			Top Depth:		7.90	
Sample Number:	12 Base Dep		Base Depth	Base Depth:		00
Sample Conditions:		Submerged	Sample Type		В	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort				
		ed passing 2mm sieve				
Sample Description:	Brown grav	elly SAND.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				19.98	19.98	19.98
Length - mm:				60.01	60.01	60.01
Moisture Content - %:				6.4	6.4	6.4
Bulk Density - Mg/m3:				1.70	1.71	1.71
Dry Density - Mg/m3:				1.60	1.61	1.61
Voids Ratio:				0.655	0.649	0.645
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				19.47	19.32	19.09
		Shearing Stage				
Rate of Strain (mm/min)				0.800	0.800	0.800
Displacement at peak shear st	tress (mm)			4.00	6.00	7.00
Peak shear Stress - kPa:				40	78	154
	Fi	nal Consolidated Condi	itions			
Moisture Content - %:				21	21	21
Bulk Density - Mg/m3:			1.75	1.77	1.79	
Dry Density - Mg/m3:				1.45	1.46	1.49
		Peak				
Angle of Shearing Resistance	::(0)				38	
Effective Cohesion - kPa:						

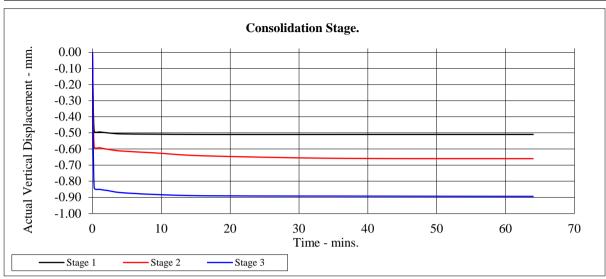


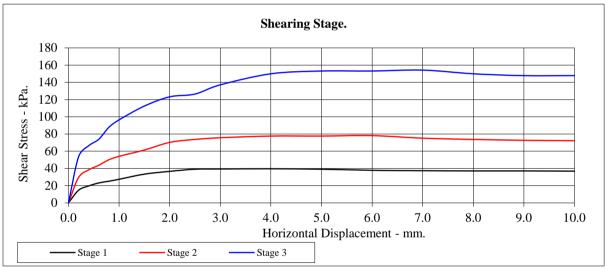


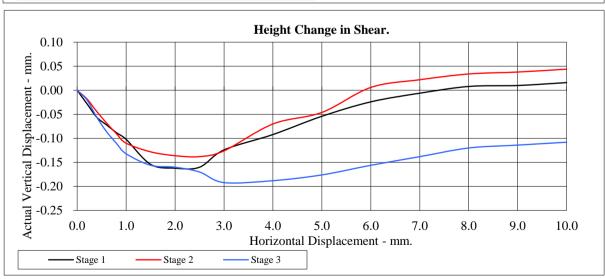
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH05	Top Depth:	7.90
Sample Number:	12	Base Depth:	9.00





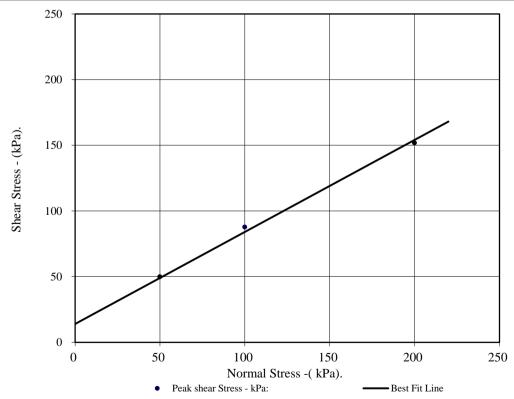




Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH07 Top Dep		Top Deptl	op Depth:		3.00	
Sample Number:	4 Base Depth		Depth: 3.50		50		
Sample Conditions:		Submerged	Sample T	ype	В		
Particle Density - Mg/m3:	2.65	Assumed	Remarks				
Sample Preparation:	Remoulded	using 2.5kg effort.					
		ed passing 2mm sieve					
Sample Description:	Grey very g	ravelly sandy organic	c CLAY.				
STAGE				1	2	3	
		Initial Condition	S				
Height - mm:				24.51	24.51	24.51	
Length - mm:				60.00	60.00	60.00	
Moisture Content - %:				35	35	35	
Bulk Density - Mg/m3:				1.90	1.90	1.90	
Dry Density - Mg/m3:				1.40	1.41	1.41	
Voids Ratio:				0.888	0.885	0.884	
Normal Pressure- kPa				50	100	200	
		Consolidation Sta	ge				
Consolidated Height - mm:			21.46	19.87	19.62		
		Shearing Stage					
Rate of Strain - mm/min				0.04	0.04	0.04	
Displacement at peak shear s	tress - mm			8.41	10.01	6.80	
Peak shear Stress - kPa:				50	88	152	
	Fi	nal Consolidated Cor	nditions				
Moisture Content - %:				37	33	28	
Bulk Density - Mg/m3:				2.16	2.34	2.37	
Dry Density - Mg/m3:		·		1.58	1.76	1.85	
		Peak					
Angle of Shearing Resistance	::(0)				35		
Effective Cohesion - kPa:					14		

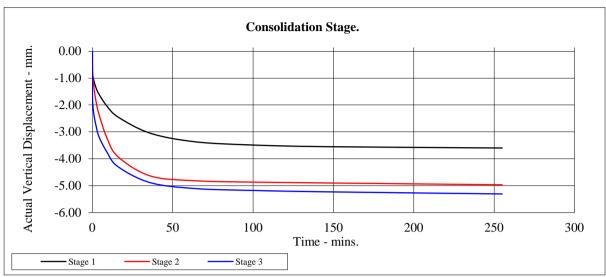


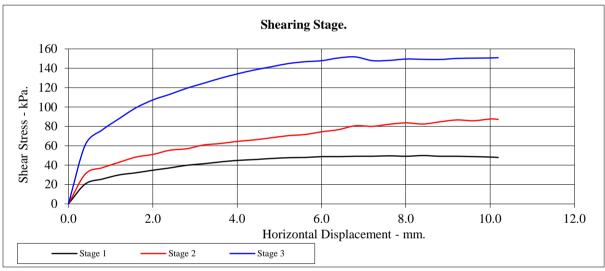


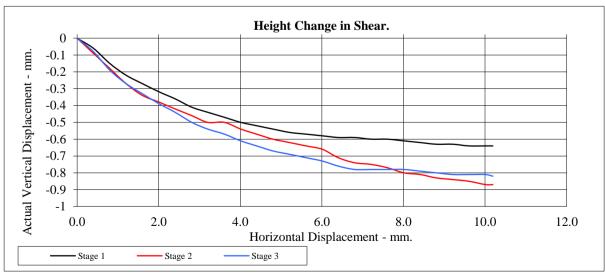
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH07	Top Depth:	3.00
Sample Number:	4	Base Depth:	3.50







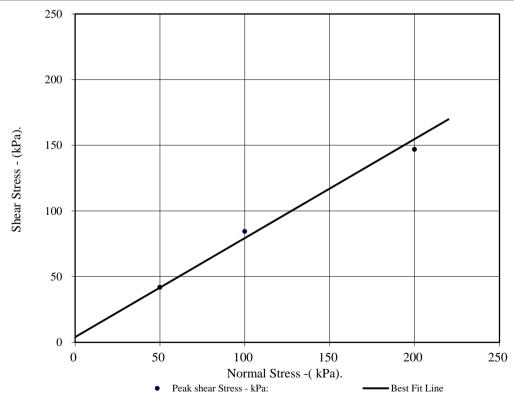


Professional Soils Laboratory

Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:		BH07	Top Depth:		4.0	00	
Sample Number:	6 Base Depth:		:	5.00			
Sample Conditions:		Submerged	Sample Type B			3	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:				
Sample Preparation:	Remoulded	using hand tamped effort					
	Material test	ed passing 2mm sieve					
Sample Description:	Grey sandy	GRAVEL					
STAGE				1	2	3	
		Initial Conditions					
Height - mm:				24.51	24.51	24.51	
Length - mm:				60.00	60.00	60.00	
Moisture Content - %:				17	17	17	
Bulk Density - Mg/m3:				1.79	1.80	1.81	
Dry Density - Mg/m3:				1.54	1.54	1.55	
Voids Ratio:				0.725	0.722	0.712	
Normal Pressure- kPa				50	100	200	
		Consolidation Stage					
Consolidated Height - mm:				24.31	23.96	23.87	
		Shearing Stage					
Rate of Strain - mm/min			0.80	0.80	0.80		
Displacement at peak shear st	tress - mm			4.50	9.50	8.50	
Peak shear Stress - kPa:				42	84	147	
	Fi	nal Consolidated Condi	itions				
Moisture Content - %:				20	19	18	
Bulk Density - Mg/m3:				1.81	1.84	1.85	
Dry Density - Mg/m3:				1.51	1.55	1.58	
	<u> </u>	Peak					
Angle of Shearing Resistance	::(0)		`		37		
Effective Cohesion - kPa:					4		

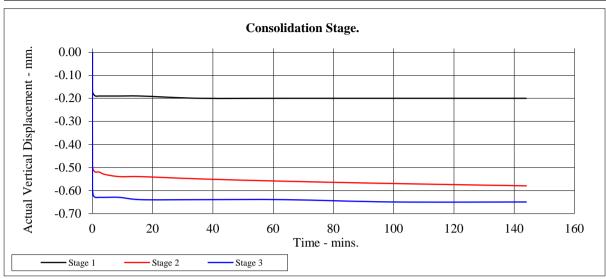


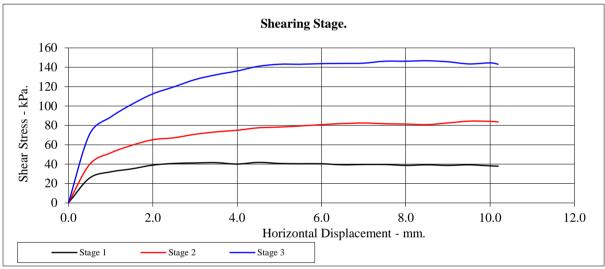


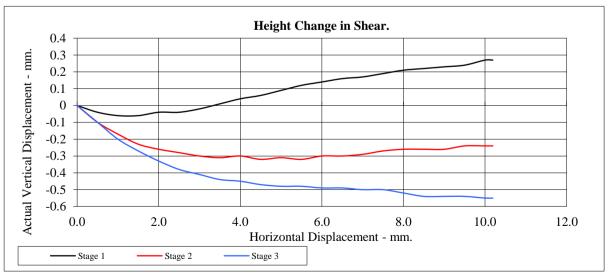
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH07	Top Depth:	4.00
Sample Number:	6	Base Depth:	5.00









PSL
Professional Soils Laboratory

Arklow Sewerage Scheme Marine Outfall GI



SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

Client:	Irish Water
Engineer:	Byrne Looby ARUP J.V.
From:	Stephen Watson
	Laboratory Manager
	Causeway Geotech Ltd
Tel:	+44(0)2827666640
E-mail:	stephen.watson@causewaygeotech.com
Date:	04/12/17
Ref:	17-0167 - Schedule 8

Arklow Sewerage Scheme Marine Outfall GI

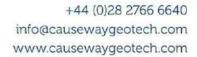
We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the *Contents page(s)*.

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 60 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





Project Name Arklow Sewerage Scheme Marine Outfall GI

Report Reference. 17-0167 - Schedule 8

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report
SOIL	Moisture Content of Soil	BS1377: Part 2: Clause 3.2: 1990	10
SOIL	Liquid and Plastic Limits of soil -1-point cone penetrometer method	BS1377: Part 2: Clauses 4.4, 5.3 & 5.4 1990	4
SOIL	Particle size distribution - wet sieving	BS1377: Part 2: Clause 9.2: 1990	10
SOIL	Particle size distribution -sedimentation hydrometer method	BS1377: Part 2: Clause 9.5: 1990	5
SOIL – Subcontracted to Pro Soils Ltd	Direct Shear Strength using 60mm Small Shear box (up to 4 days)	BS1377: Part 7: Clause 4: 1990	2



Summary of Classification Test Results

Project No.

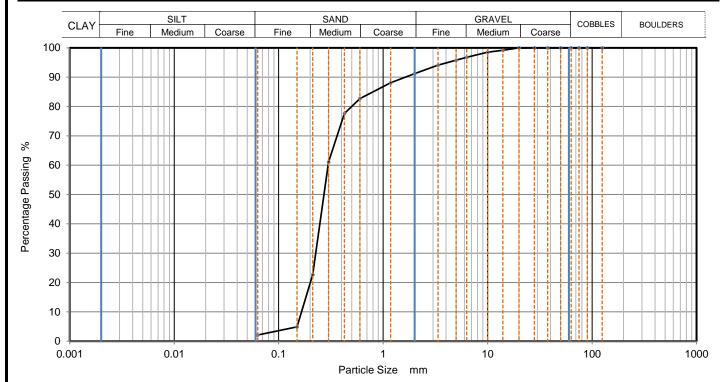
Project Name

17-0167

Arklow Sewerage Scheme Marine Outfall GI

Hole No. Ref Top Base Type Soil Description Density bulk dry hulk dry w hulk dry w hulk dry hulk	agrande sification
BH09 4 3.00 B Grey slightly sandy subangular to subrounded fine to coarse GRAVEL. Soli Description Solit Lary Mg/m3 % % % % % % % Mg/m3 Class Mg/m3 % % % % % % Mg/m3 Class Solit Description Solit Lary Mg/m3 % % % % % % Mg/m3 Class Solit Description Solit Lary Mg/m3 % % % % % % Mg/m3 Class Solit Description Solit Lary Mg/m3 % % % % % % Mg/m3 Class Solit Lary Mg/m3 % % % % % Mg/m3 Class Solit Lary Mg/m3 % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % % % Mg/m3 Solit Lary Mg/m3 % % % % % % % Mg/m3 Solit Lary Mg/m3 Solit Lary Mg/m3 % % % % % % % % Mg/m3 Solit Lary Mg/m3 Mg/m3 % % % % % % % Mg/m3 Solit Lary Mg/m3 Mg/m3 % % % % % % % Mg/m3 Solit Lary Mg/m3 Mg/m3 Solit Lary Mg/m3 Mg/m3 % % % % % % Mg/m3 Solit Lary Mg/m3 Mg/m3 Solit Lary Mg/m3 Mg/m3 Mg/m3 Solit Lary Mg/m3 Mg/m3 Mg/m3 Mg/m3 Solit Lary Mg/m3 Mg/m	sification
BH09 2 1.00 B Grey slightly gravelly fine to medium SAND. Grey slightly sandy subangular to subrounded fine to coarse GRAVEL. 3.5	
BH09 4 3.00 B subrounded fine to coarse GRAVEL. 3.5	
BH09 6 5.00 B Grey sandy gravelly sitty CLAY	
2.100 0 0.00 D 0.00 graverity sincy θελτί. 14.0 01 33-1μί 17 10	CL
BH09 8 7.00 B Light brown sandy gravelly silty CLAY. 15.0 65 37 -1pt 17 20	CI
BH10 2 1.30 B Grey sandy slightly gravelly silty CLAY. 68.0	
BH10 3 2.00 B Dark brown sandy slightly silty subangular fine to coarse GRAVEL.	
BH10 4 3.00 B Grey slightly sandy subangular to subrounded fine to coarse GRAVEL. 5.1	
BH10 5 4.00 B Grey slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble content.	
BH10 7 5.50 B Grey sandy gravelly silty CLAY. 12.0 48 26 -1pt 15 11	CL
BH10 9 7.50 B Light brown sandy gravelly silty CLAY. 12.0 48 33 -1pt 17 16	CL
All tests performed in accordance with BS1377:1990 unless specified otherwise	
No.	
Key Density test Liquid Limit Linear measurement unless: 4pt cone unless: Sp - small pyknometer Date Printed Approved By Table 12/02/2017 00:00	1
wd - water displacement cas - Casagrande method gj - gas jar wi - immersion in water 1pt - single point test Stephen.Watson	1

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PANII	CLE SIZE DIST	RIBUTION	Borehole/Pit No. BH09	
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI		Sample No.	2
Soil Description	Grey slightly gravelly fine to medium SAND.		Depth, m	1.00	
Specimen Reference	4 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	se 9.2		KeyLAB ID	Caus201711090



Siev	/ing	Sedimer	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	99		
10	99		
6.3	97		
5	96		
3.35	94		
2	91		
1.18	88		
0.6	83		
0.425	78		
0.3	61		
0.212	23		
0.15	5		
0.063	2		

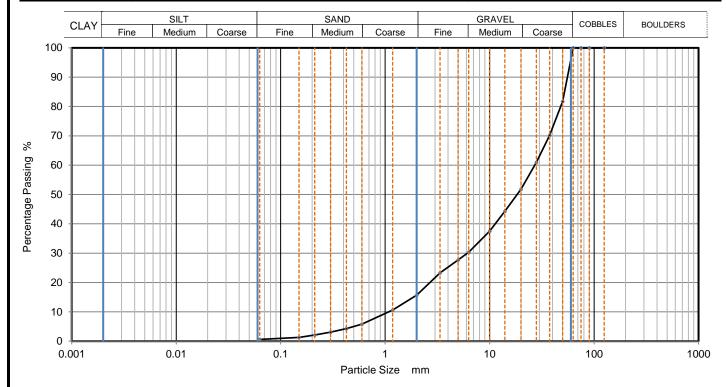
Dry Mass of sample, g	671
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Sample Proportions	% dry mass
Cobbles	0
Gravel	9
Sand	89
Fines < 0.063mm	2

Grading Analysis		
D100	mm	
D60	mm	0.297
D30	mm	0.226
D10	mm	0.166
Uniformity Coefficient		1.8
Curvature Coefficient		1

Approved		Fig	1
Stephen. Watson	02/12/2017 10:01	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No. BH09	
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI		Sample No.	4
Soil Description	Grey slightly sandy subangular to subrounded fine to coarse GRAVEL.		Depth, m	3.00	
Specimen Reference	4 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	se 9.2		KeyLAB ID	Caus201711091



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	82		
37.5	70		
28	61		
20	52		
14	44		
10	38		
6.3	30		
5	28		
3.35	23		
2	16		
1.18	11		
0.6	6		
0.425	4		
0.3	3		
0.212	2		
0.15	1		
0.063	1		

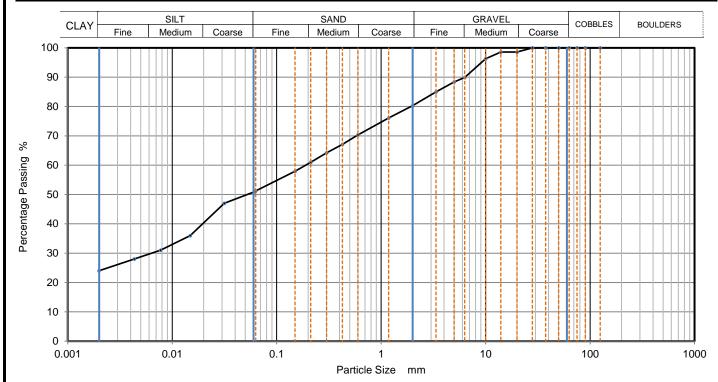
Dry Mass of sample, g	10377

ample Proportions % dry mass		
Cobbles	0	
Gravel	84	
Sand	15	
Fines < 0.063mm	1	

Grading Analysis		
D100	mm	
D60	mm	27
D30	mm	6.15
D10	mm	1.08
Uniformity Coefficient		25
Curvature Coefficient		1.3

Stephen.Watson 02/12/2017 10:01 Sheet	Approved	Sheet printed	Fig	1
	Stephen.Watson	02/12/2017 10:01	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	GEOTECH PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	вн09	
Site Name	Arklow Sewerage Sche	arklow Sewerage Scheme Marine Outfall Gl		Sample No.	6
Soil Description	Grey sandy gravelly silty CLAY.		Depth, m	5.00	
Specimen Reference	5 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus201711092	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0619	51	
90	100	0.0316	47	
75	100	0.0149	36	
63	100	0.0077	31	
50	100	0.0043	28	
37.5	100	0.0020	24	
28	100			
20	99			
14	99			
10	96			
6.3	90			
5	88			
3.35	85			
2	80			
1.18	76			
0.6	70	Particle density	(assumed)	
0.425	67	2.65	Mg/m3	
0.3	64			
0.212	61			
0.15	58			
0.063	51			

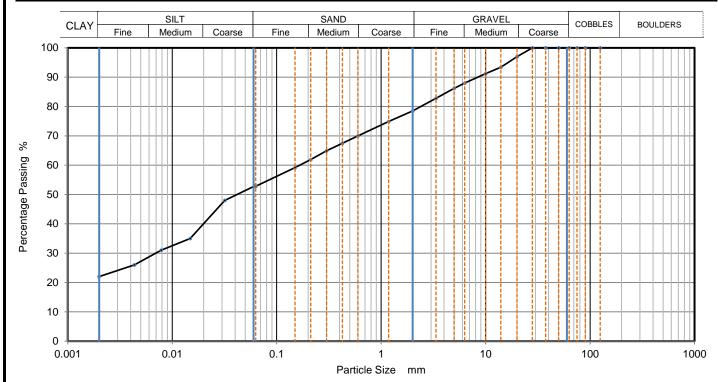
Dry Mass of sample, g	1623
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	20	
Sand	29	
Silt	27	
Clay	24	

Grading Analysis		
D100	mm	
D60	mm	0.191
D30	mm	0.00625
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen. Watson	02/12/2017 10:01	Sheet	

PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167		
		Borehole/Pit No.	вн09		
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	8
Soil Description	Light brown sandy gravelly silty CLAY.		Depth, m	7.00	
Specimen Reference	5 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus201711093	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0625	53	
90	100	0.0319	48	
75	100	0.0149	35	
63	100	0.0078	31	
50	100	0.0043	26	
37.5	100	0.0020	22	
28	100			
20	97			
14	93			
10	91			
6.3	88			
5	86			
3.35	83			
2	79			
1.18	75			
0.6	70	Particle density	(assumed)	
0.425	68	2.65	Mg/m3	
0.3	65			
0.212	62			
0.15	59			
0.063	53			

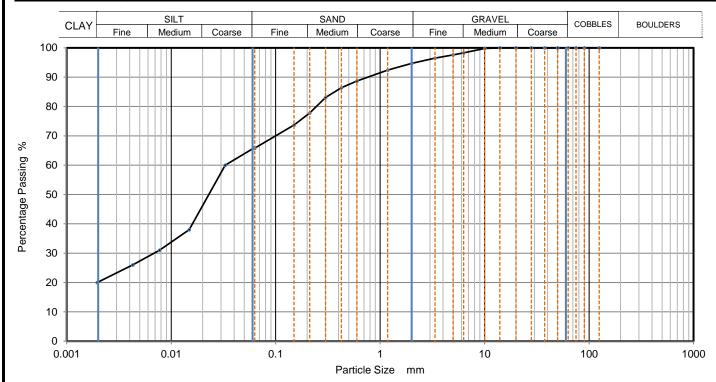
Dry Mass of sample, g	2017
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	22	
Sand	26	
Silt	31	
Clay	22	

Grading Analysis		
D100	mm	
D60	mm	0.166
D30	mm	0.00704
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

02/12/2017 10:01 Sheet	Approved	Sheet printed	Fig	1
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167
GEOTECH			Borehole/Pit No.	BH10
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	2
Soil Description	Grey sandy slightly gravelly silty CLAY.		Depth, m	1.30
Specimen Reference	4 Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus201711094



Siev	Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing		
125	100	0.0630	66		
90	100	0.0328	60		
75	100	0.0149	38		
63	100	0.0077	31		
50	100	0.0043	26		
37.5	100	0.0020	20		
28	100				
20	100				
14	100				
10	100				
6.3	98				
5	98				
3.35	97				
2	95				
1.18	92				
0.6	89	Particle density	(assumed)		
0.425	86	2.65	Mg/m3		
0.3	83				
0.212	78				
0.15	74				
0.063	66				

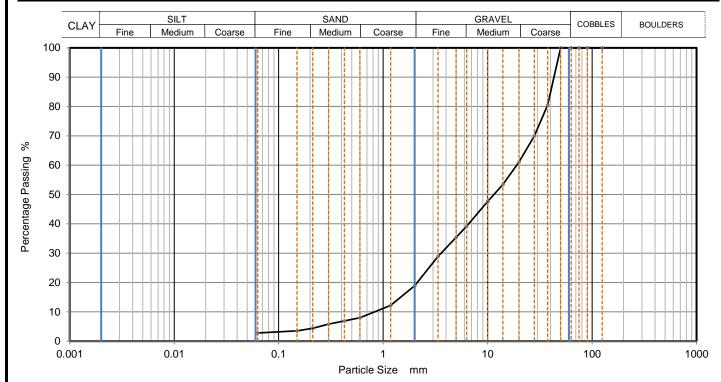
Dry Mass of sample, g	661
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	5	
Sand	29	
Silt	46	
Clay	20	

Grading Analysis		
D100	mm	
D60	mm	0.0325
D30	mm	0.00689
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen. Watson	02/12/2017 10:01	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH10	
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	4
Soil Description	Grey slightly sandy subangular to subrounded fine to coarse GRAVEL.		Depth, m	3.00	
Specimen Reference	4 Specimen m			Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus201711096



Sieving		Sedimer	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	81		
28	70		
20	61		
14	53		
10	48		
6.3	39		
5	35		
3.35	29		
2	19		
1.18	12		
0.6	8		
0.425	7		
0.3	6		
0.212	4		
0.15	4		
0.063	3		

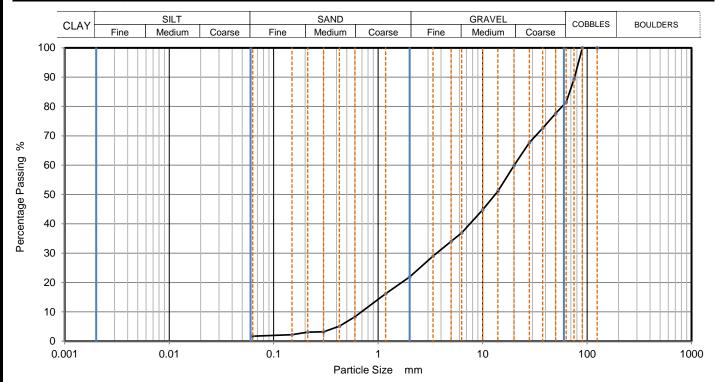
Dry Mass of sample, g	13416
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	81	
Sand	16	
Fines < 0.063mm	3	

Grading Analysis		
D100	mm	
D60	mm	19
D30	mm	3.58
D10	mm	0.826
Uniformity Coefficient	·	23
Curvature Coefficient		0.82

Approved		Fig	1
Stephen.Watson	02/12/2017 10:02	Sheet	

CAUSEWAY	CAUSEWAY PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH	PANII	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH10
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	5	
Soil Description	Grey slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble content.		Depth, m	4.00	
Specimen Reference	4 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus201711097	



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	89		
63	82		
50	78		
37.5	73		
28	68		
20	60		
14	51		
10	45		
6.3	37		
5	34		
3.35	29		
2	22		
1.18	16		
0.6	8		
0.425	5		
0.3	3		_
0.212	3]	
0.15	2]	
0.063	2		

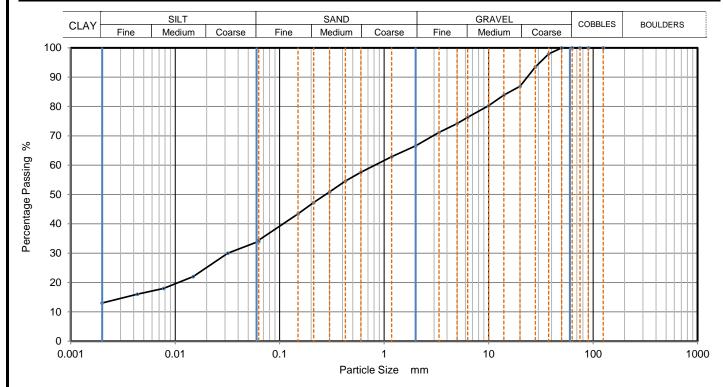
_	
Dry Mass of sample, g	8315

Sample Proportions	% dry mass	
Cobbles	19	
Gravel	60	
Sand	20	
Fines < 0.063mm	2	

Grading Analysis		
D100	mm	
D60	mm	20.1
D30	mm	3.63
D10	mm	0.693
Uniformity Coefficient		29
Curvature Coefficient		0.95

Approved		Fig	1
Stephen.Watson	02/12/2017 10:02	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH	PANII	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH10
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	7	
Soil Description	Grey sandy gravelly silty CLAY.		Depth, m	5.50	
Specimen Reference	5 Specimen m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201711098



Siev	/ing	Sedime	entation
Particle Size mm % Passing		Particle Size mm	% Passing
125	100	0.0630	34
90	100	0.0319	30
75	100	0.0149	22
63	100	0.0077	18
50	100	0.0043	16
37.5	98	0.0020	13
28	94		
20	87		
14	84		
10	80		
6.3	76		
5	74		
3.35	71		
2	67		
1.18	63		
0.6	58	Particle density	(assumed)
0.425	55	2.65	Mg/m3
0.3	51		_
0.212	47		
0.15	43		
0.063	34		

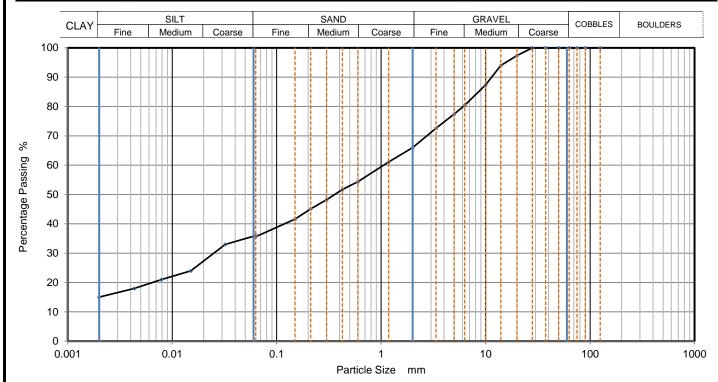
Dry Mass of sample, g	3400
bry wass or sample, g	3100

Sample Proportions	% dry mass
Cobbles	0
Gravel	33
Sand	32
Silt	22
Clay	13

Grading Analysis		
D100	mm	
D60	mm	0.812
D30	mm	0.0306
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen.Watson	02/12/2017 10:02	Sheet	

PARTICLE SIZE DISTRIBUTION			Job Ref	17-0167	
			Borehole/Pit No.	BH10	
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI			9
Soil Description	Light brown sandy gravelly silty CLAY.			Depth, m	7.50
Specimen Reference	Specimen m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201711099



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	36
90	100	0.0322	33
75	100	0.0151	24
63	100	0.0078	21
50	100	0.0043	18
37.5	100	0.0020	15
28	100		
20	97		
14	94		
10	87		
6.3	80		
5	77		
3.35	73		
2	66		
1.18	61		
0.6	54	Particle density	(assumed)
0.425	52	2.65	Mg/m3
0.3	48		
0.212	45		
0.15	42		
0.063	36		

Dry Mass of sample, g	2170

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	34	
Sand	30	
Silt	21	
Clay	15	

Grading Analysis		
D100	mm	
D60	mm	1.06
D30	mm	0.025
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen.Watson	02/12/2017 10:02	Sheet	



LABORATORY REPORT



4043

Contract Number: PSL17/5477

Report Date: 16 November 2017

Client's Reference: 17-0167

Client Name: Causeway Geotech

8 Drumahiskey Road

Ballymoney Co.Antrim BT53 7QL

For the attention of: Stephen Watson

Contract Title: Arklow sewerage scheme marine outfall GI

Date Received: 10/11/2017 Date Commenced: 10/11/2017 Date Completed: 16/11/2017

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson A Watkins R Berriman (Director) (Director) (Quality Manager)

L Knight S Eyre A Fry

(Senior Technician) (Senior Technician) (Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,

Doncaster DN4 0AR

tel: +44 (0)844 815 6641 fax: +44 (0)844 815 6642

e-mail: rgunson@prosoils.co.uk awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH09	3	В	2.00	3.00	Grey gravelly SAND.
BH10	3	В	2.00	3.00	Dark brown sandy slightly silty GRAVEL.
_	_	_	_	_	



Arklow Sewerage Scheme Marine Outfall GI

PARTICLE SIZE DISTRIBUTION TEST

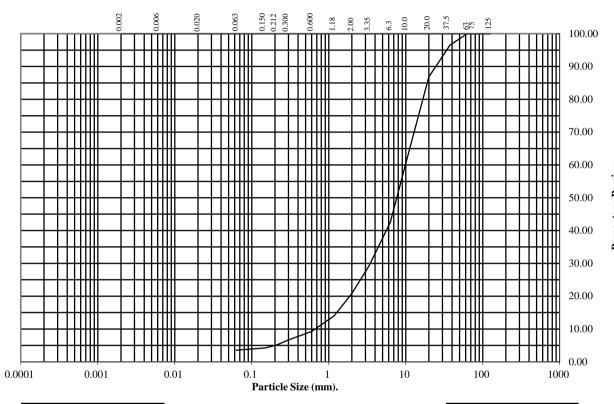
BS1377: Part 2: 1990

Wet Sieve, Clause 9.2

Hole Number: BH10 Top Depth (m): 2.00

Sample Number: 3 Base Depth(m): 3.00

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	97
20	87
10	61
6.3	43
3.35	29
2	21
1.18	14
0.6	9
0.3	7
0.212	5
0.15	4
0.063	4

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 79 17 4

Remarks:

See Summary of Soil Descriptions





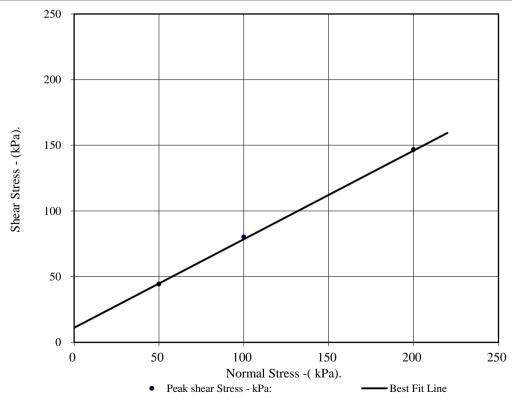
Arklow Sewerage Scheme Marine Outfall GI

Contract No: PSL17/5477 Client Ref: 17-0167

PSL005 Nov 15 Page of

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:		BH09	Top Depth:		2.00	
Sample Number:		3	Base Depth:		3.0	00
Sample Conditions:		Submerged.	Sample Typ	e	F	3
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort	fort.			
		ed passing 2mm sieve				
Sample Description:	See summar	ry of soil descriptions				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				19.98	19.98	19.98
Length - mm:				60.00	60.00	60.00
Moisture Content - %:				6.7	6.7	6.7
Bulk Density - Mg/m3:				1.82	1.83	1.83
Dry Density - Mg/m3:				1.71	1.71	1.71
Voids Ratio:				0.553	0.549	0.549
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				19.51	19.39	19.02
		Shearing Stage				
Rate of Strain - mm/min				0.600	0.600	0.600
Displacement at peak shear s	tress - mm			4.00	8.00	5.00
Peak shear Stress - kPa:				44	80	147
	Fi	nal Consolidated Condi	itions			
Moisture Content - %:				18	18	17
Bulk Density - Mg/m3:					1.88	1.92
Dry Density - Mg/m3:					1.59	1.63
		Peak				
Angle of Shearing Resistance:(0)						
Effective Cohesion - kPa:					11	

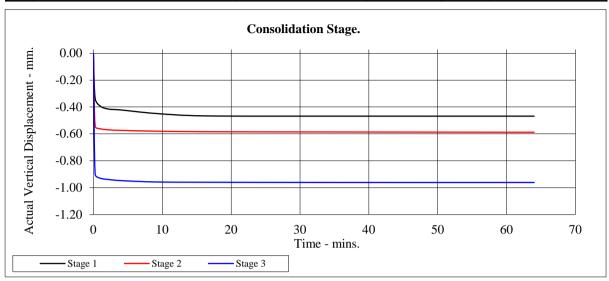


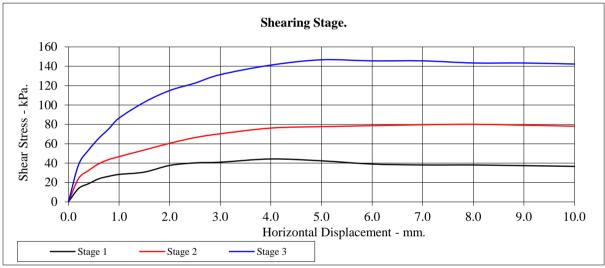


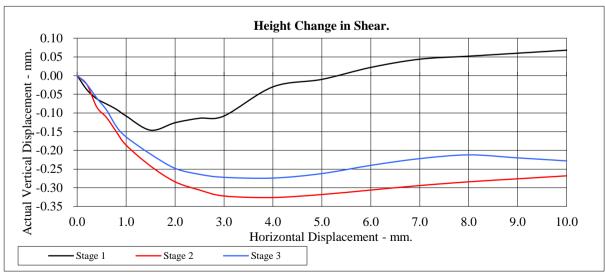
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH09	Top Depth:	2.00
Sample Number:	3	Base Depth:	3.00





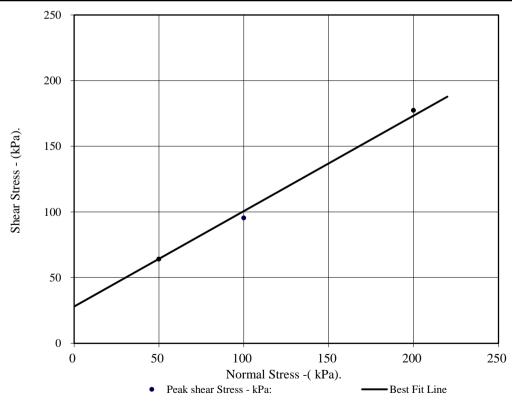




Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH10 Top Depth:				2.0	00
Sample Number:		3	Base Depth: 3.00			00
Sample Conditions:		Submerged.	Sample Type B			
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort.	ort.			
Sample Freparation.	Material test	ed passing 2mm sieve				
Sample Description:	See summar	ry of soil descriptions				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				19.98	19.98	19.98
Length - mm:				60.00	60.00	60.00
Moisture Content - %:				12	12	12
Bulk Density - Mg/m3:				2.10	2.11	2.12
Dry Density - Mg/m3:				1.88	1.89	1.89
Voids Ratio:				0.413	0.405	0.405
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				19.77	19.71	19.34
		Shearing Stage				
Rate of Strain - mm/min				0.600	0.600	0.600
Displacement at peak shear s	stress - mm			5.00	3.00	6.00
Peak shear Stress - kPa:				64	95	177
	Fi	nal Consolidated Condi	tions			
Moisture Content - %:				17	17	16
Bulk Density - Mg/m3:		·		2.13	2.14	2.19
Dry Density - Mg/m3:				1.82	1.84	1.88
		Peak				
Angle of Shearing Resistanc	e:(0)				36	
Effective Cohesion - kPa:					28	

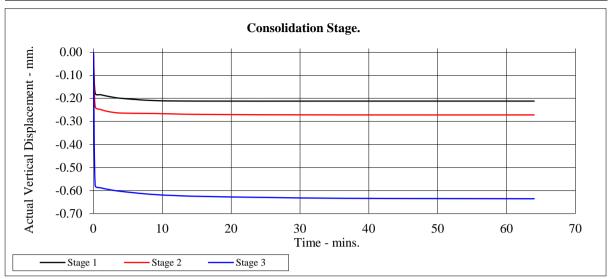


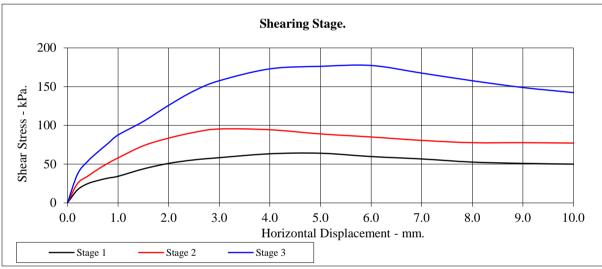


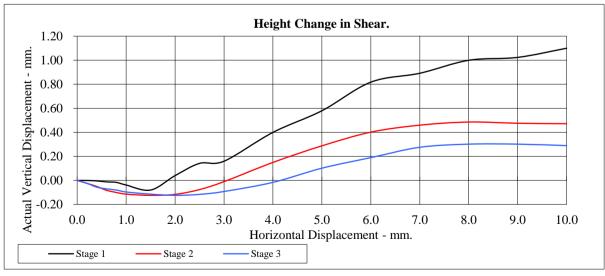
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH10	Top Depth:	2.00
Sample Number:	3	Base Depth:	3.00









Arklow Sewerage Scheme Marine Outfall GI



SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

Client:	Irish Water
Engineer:	Byrne Looby ARUP J.V.
From:	Stephen Watson
	Laboratory Manager
	Causeway Geotech Ltd
Tel:	+44(0)2827666640
E-mail:	stephen.watson@causewaygeotech.com
Date:	14/12/17
Ref:	17-0167 - Schedule 9

Arklow Sewerage Scheme Marine Outfall GI

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

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 60 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





Project Name Arklow Sewerage Scheme Marine Outfall GI

Report Reference. 17-0167 – Schedule 9

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report
SOIL	Moisture Content of Soil	BS1377: Part 2: Clause 3.2: 1990	13
SOIL	Liquid and Plastic Limits of soil -1-point cone penetrometer method	BS1377: Part 2: Clauses 4.4, 5.3 & 5.4 1990	10
SOIL	Particle size distribution - wet sieving	BS1377: Part 2: Clause 9.2: 1990	36
SOIL	Particle size distribution -sedimentation hydrometer method	BS1377: Part 2: Clause 9.5: 1990	18
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS1377: Part 7: Clause 8: 1990	9
SOIL – Subcontracted to Pro Soils Ltd	Direct Shear Strength using 60mm Small Shear box (up to 4 days)	BS1377: Part 7: Clause 4: 1990	12
SOIL – Subcontracted to Chemtest Ltd	pH Value of Soil		14
SOIL - Subcontracted to Chemtest Ltd	Sulphate Content water extract		14



Summary of Classification Test Results

Project No.

Project Name

17-0167

Linear measurement unless :

wd - water displacement

wi - immersion in water

4pt cone unless :

cas - Casagrande method

1pt - single point test

Arklow Sewerage Scheme Marine Outfall GI

17-	17-0167 Arklow Sewerage Scheme Marine Outfall GI													
Hole No.	Ref	Sar Top	mple Base	Туре	Soil Description	Dens bulk	ity dry	W	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	1.01	100	Buoo	. , , ,		Mg/m	n3	%	%	%	%	%	Mg/m3	
BH11	6	5.50		D	Grey slightly sandy silty CLAY.			22.0	99	39 -1pt	17	22		CI
BH11	8	7.50		D	Grey brown sandy subangular fine to coarse GRAVEL.			30.0						
BH11	10	9.50		D	Grey sandy CLAY,			7.5						
BH16	21	1.50		D	Grey sandy slightly gravelly silty CLAY.			52.0	99	63 -1pt	29	34		СН
BH16	24	4.50		D	Grey sandy slightly clayey organic SILT.			167.0	100	190 -1pt	101	89		ME
BH17	9	7.50		D	Grey sandy slightly clayey organic SILT.			146.0	100	184 -1pt	107	77		ME
BH17	11	9.50		D	Grey sandy slightly clayey organic SILT.			123.0	100	148 -1pt	123	25		ME
BH17	14	12.50		D	Grey slightly sandy silty CLAY.			32.0	98	44 -1pt	18	26		CI
BH18	2	2.80		В	Grey slightly sandy subangular to subrounded GRAVEL with low cobble content.			3.5						
BH18	23	5.50		D	Grey sandy silty organic CLAY.			134.0	96	151 -1pt	36	115		CE
BH18	25	7.50		D	Grey sandy slightly organic clayey SILT.			70.0	99	80 -1pt	59	21		MV
BH19	18	3.50		D	Greyish brown sandy organic clayey SILT.			125.0	95	184 -1pt	99	85		ME
BH19	19	4.50		D	Greyish brown sandy organic clayey SILT.			211.0	96	183 -1pt	96	87		ME
All tests performed in accordance with BS1377:1990 unless specified otherwise														
Key								Date F	rinted		Appr	oved	Ву	Table
Density	test			Liquid I	imit Particle	e density								1

sp - small pyknometer

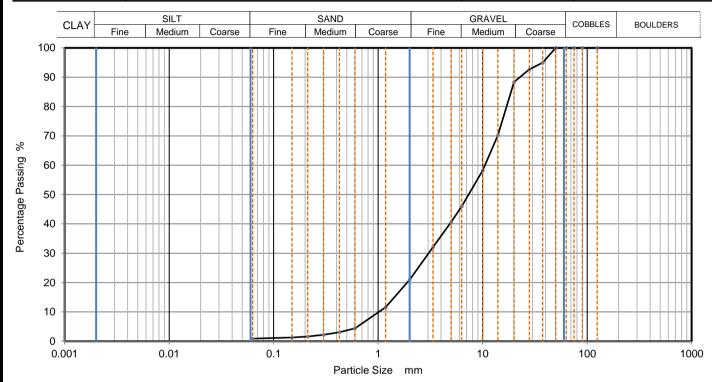
gj - gas jar

14/12/2017

sheet

Stephen.Watson

CAUSEWAY	DARTI	CLE SIZE DIST	Job Ref	17-0167	
GEOTECH	PANII	CLE SIZE DIST	Borehole/Pit No.	BH11	
Site Name	Arklow Sewerage Sche	eme Marine Outfa	ll GI	Sample No.	19
Soil Description	Grey slightly sandy suban	gular to subrounde	Depth, m	0.80	
Specimen Reference	2 Specimen m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clau	se 9.2	KeyLAB ID	Caus201711200	



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	95		
28	93		
20	88		
14	70		
10	58		
6.3	46		
5	41		
3.35	32		
2	21		
1.18	12		
0.6	4		
0.425	3	1	
0.3	2		
0.212	2]	
0.15	1]	
0.063	1		

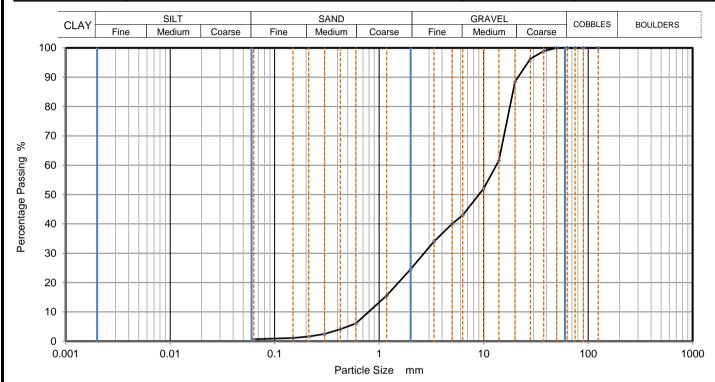
Dry Mass of sample, g	11015

Sample Proportions	% dry mass
Cobbles	0
Gravel	79
Sand	20
Fines < 0.063mm	1

Grading Analysis		
D100	mm	
D60	mm	10.5
D30	mm	3.04
D10	mm	1.02
Uniformity Coefficient		10
Curvature Coefficient		0.86

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH11	
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	21
Soil Description	Grey slightly sandy subangular to subrounded fine to coarse GRAVEL.		Depth, m	2.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus201711201	



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	99		
28	96		
20	89		
14	62		
10	52		
6.3	43		
5	40		
3.35	34		
2	25		
1.18	16		
0.6	6		
0.425	4	1	
0.3	3		
0.212	2]	
0.15	1]	
0.063	1		

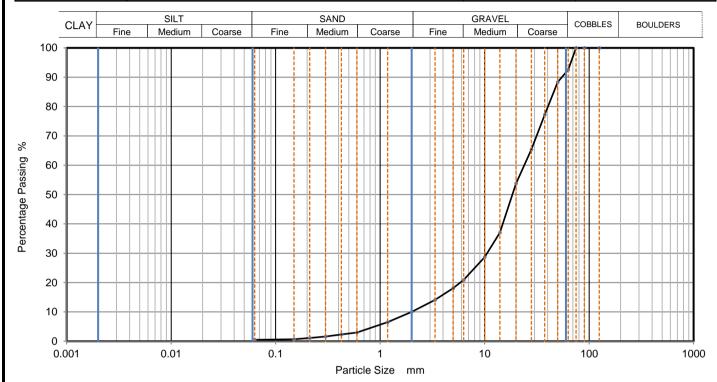
Dry Mass of sample, g	12130
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Sample Proportions	% dry mass	
Cobbles	0 75	
Gravel		
Sand	24	
Fines < 0.063 mm	1	

Grading Analysis		
D100	mm	
D60	mm	13.2
D30	mm	2.69
D10	mm	0.79
Uniformity Coefficient		17
Curvature Coefficient		0.69

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CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH11
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	23
Soil Description	Grey slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble content.		Depth, m	4.80
Specimen Reference	2 Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus201711202



Sieving		Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	93		
50	88		
37.5	77		
28	65		
20	54		
14	37		
10	29		
6.3	21		
5	18		
3.35	14		
2	10		
1.18	7		
0.6	3		
0.425	2	1	
0.3	2		
0.212	1	1	
0.15	1	1	
0.063	1]	

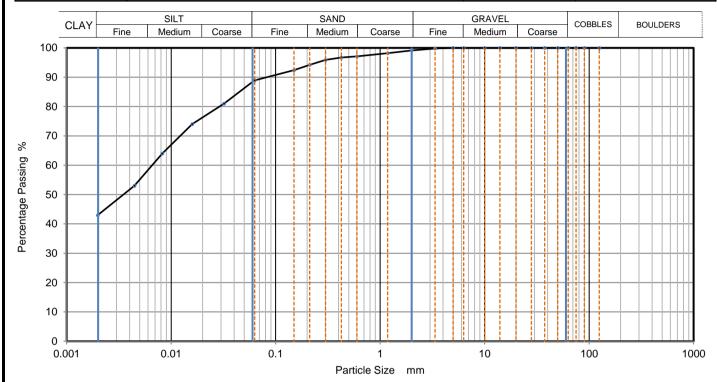
Dry Mass of sample, g	12619
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Sample Proportions	% dry mass
Cobbles	7
Gravel	83
Sand	10
Fines < 0.063mm	0

Grading Analysis		
D100	mm	
D60	mm	24
D30	mm	10.6
D10	mm	2.01
Uniformity Coefficient		12
Curvature Coefficient		2.3

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PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
		Borehole/Pit No.	BH11	
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	24
Soil Description	Grey slightly sandy silty CLAY,		Depth, m	5.80
Specimen Reference	2 Specimen m		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus201711204



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	89
90	100	0.0321	81
75	100	0.0159	74
63	100	0.0082	64
50	100	0.0045	53
37.5	100	0.0020	43
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	98		
0.6	97	Particle density	(assumed)
0.425	97	2.65	Mg/m3
0.3	96		
0.212	94		
0.15	92		
0.063	89		

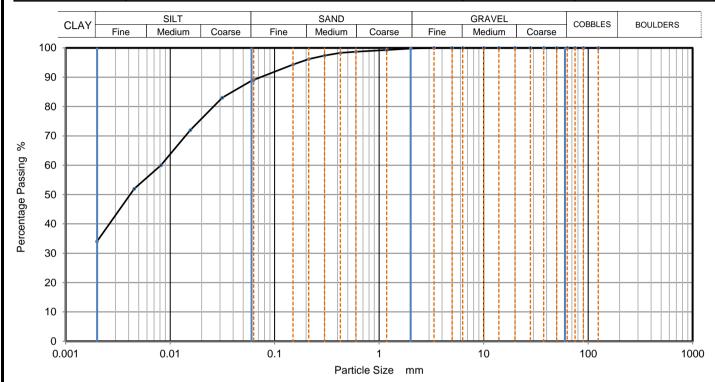
126

Sample Proportions	% dry mass		
Cobbles	0		
Gravel	1		
Sand	10		
Silt	46		
Clay	43		

Grading Analysis		
D100	mm	
D60	mm	0.00666
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167
GEOTECH PARTICLE SIZE DISTRIBUTION		Borehole/Pit No.	BH11	
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	25
Soil Description	Grey slightly sandy silty CLAY,		Depth, m	6.80
Specimen Reference	2 Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus201711206



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0613	89
90	100	0.0316	83
75	100	0.0156	72
63	100	0.0082	60
50	100	0.0045	52
37.5	100	0.0020	34
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	99	Particle density	(assumed)
0.425	98	2.65	Mg/m3
0.3	97		
0.212	96		
0.15	94		
0.063	89		

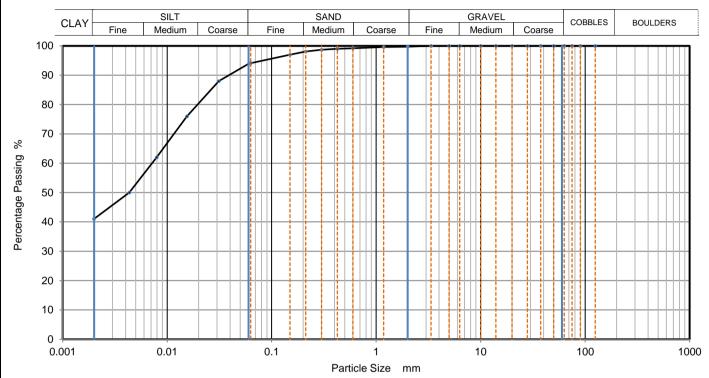
Dry Mass of sample, g	133
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Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	11
Silt	55
Clay	35

Grading Analysis		
D100	mm	
D60	mm	0.00795
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH11	
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI			26
Soil Description	Grey slightly sandy silty CLAY,		Depth, m	7.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus201711208



Sie	ving	Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0606	94
90	100	0.0312	88
75	100	0.0154	76
63	100	0.0079	62
50	100	0.0043	50
37.5	100	0.0020	41
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	99	Particle density	(assumed)
0.425	99	2.65	Mg/m3
0.3	99		
0.212	98		
0.15	97		
0.063	94		

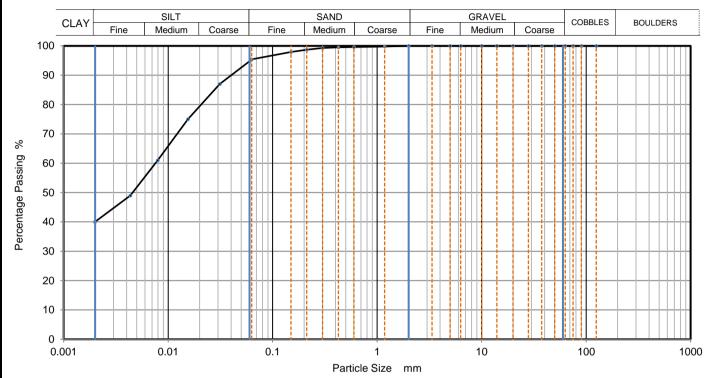
Dry Mass of sample, g	113

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	0	
Sand	6	
Silt	53	
Clay	41	

Grading Analysis		
D100	mm	
D60	mm	0.00726
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH11	
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI			27
Soil Description	Grey sandy CLAY,		Depth, m	8.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5			KeyLAB ID	Caus2017112010



Sieving		Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0613	95
90	100	0.0312	87
75	100	0.0154	75
63	100	0.0079	61
50	100	0.0043	49
37.5	100	0.0020	40
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100	Particle density	(assumed)
0.425	100	2.65	Mg/m3
0.3	99		
0.212	99		
0.15	98		
0.063	95		

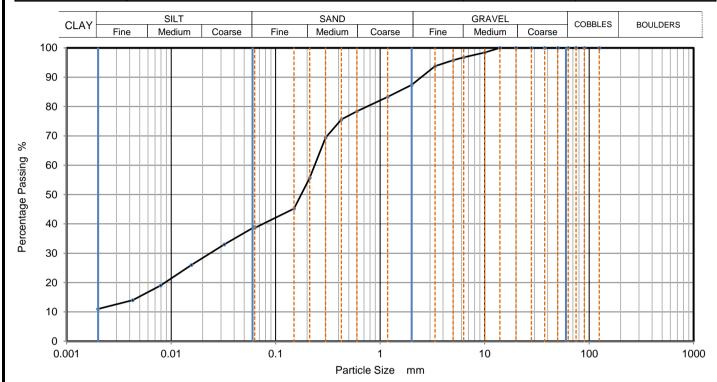
Dry Mass of sample, g	109

Sample Proportions	% dry mass	
Cobbles	0	
Gravel	0	
Sand	5	
Silt	55	
Clay	41	

Grading Analysis		
D100	mm	
D60	mm	0.00766
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Stephen.Watson 14/12/2017 17:56	Approved	Sheet printed	Fig	1
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PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
		Borehole/Pit No.	ВН16	
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	7
Soil Description	Grey sandy slightly gravelly silty CLAY.		Depth, m	0.80
Specimen Reference	2 Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112013



Sieving		Sedim	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	39
90	100	0.0322	33
75	100	0.0156	26
63	100	0.0079	19
50	100	0.0043	14
37.5	100	0.0020	11
28	100		
20	100		
14	100		
10	98		
6.3	97		
5	96		
3.35	94		
2	87		
1.18	83		
0.6	78	Particle density	(assumed)
0.425	76	2.65	Mg/m3
0.3	69		
0.212	56	1	
0.15	45	1	
0.063	39	1	

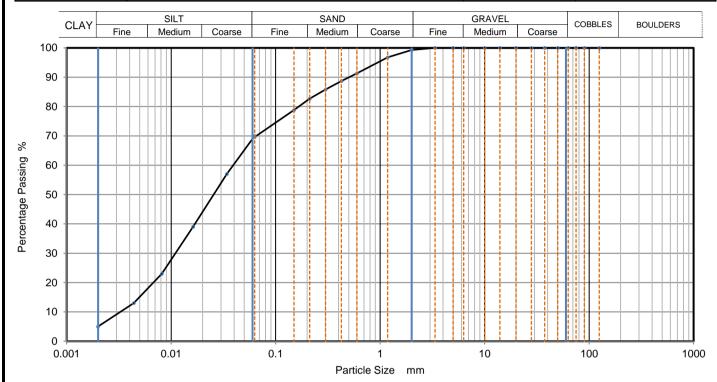
Dry Mass of sample, g	109
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Sample Proportions	% dry mass	
Cobbles	0	
Gravel	13	
Sand	49	
Silt	27	
Clay	11	

Grading Analysis		
D100	mm	
D60	mm	0.237
D30	mm	0.0236
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
		Borehole/Pit No.	BH16	
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	8
Soil Description	Grey sandy slightly clayey SILT.		Depth, m	1.80
Specimen Reference	2 Specimen m Depth		Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112015



-			
Sievi	ing	Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	70
90	100	0.0341	57
75	100	0.0162	39
63	100	0.0081	23
50	100	0.0044	13
37.5	100	0.0020	5
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	99		
1.18	97		
0.6	91	Particle density	(assumed)
0.425	89	2.65	Mg/m3
0.3	86		
0.212	83		
0.15	79	1	
0.063	70	1	

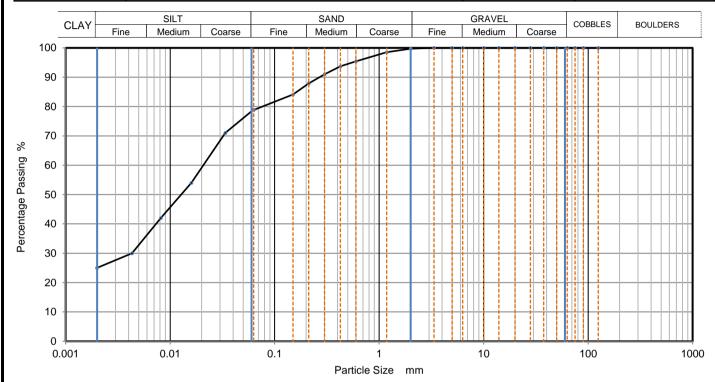
Dry Mass of sample, g	70
Dry Wass or sumple, g	, 0

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	30
Silt	64
Clay	5

Grading Analysis		
D100	mm	
D60	mm	0.0399
D30	mm	0.011
D10	mm	0.00327
Uniformity Coefficient		12
Curvature Coefficient		0.93

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	DARTI	CLE SIZE DIST	DIDITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	ВН16
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI		Sample No.	9
Soil Description	Grey sandy slightly claye	Grey sandy slightly clayey SILT.			2.80
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	SS1377:Part 2:1990, clauses 9.2 and 9.5			Caus2017112017



Sievi	ng	Sedim	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	79
90	100	0.0337	71
75	100	0.0160	54
63	100	0.0081	42
50	100	0.0043	30
37.5	100	0.0020	25
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	95	Particle density	(assumed)
0.425	94	2.65	Mg/m3
0.3	91		
0.212	88	1	
0.15	84	1	
0.063	79		

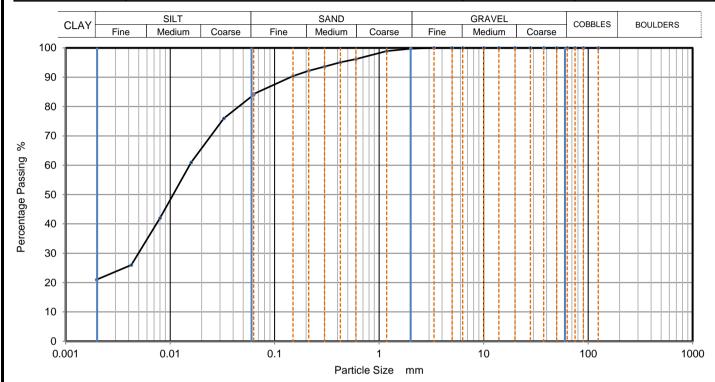
Dry Mass of sample, g	65

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	21
Silt	54
Clay	25

Grading Analysis		
D100	mm	
D60	mm	0.0205
D30	mm	0.00441
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	DARTI	CLE SIZE DIST	DIDI ITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	ВН16
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI		Sample No.	10
Soil Description	Grey sandy slightly clayey SILT.			Depth, m	3.80
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	SS1377:Part 2:1990, clauses 9.2 and 9.5			Caus2017112018



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	84
90	100	0.0327	76
75	100	0.0159	61
63	100	0.0080	42
50	100	0.0042	26
37.5	100	0.0020	21
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	96	Particle density	(assumed)
0.425	95	2.65	Mg/m3
0.3	94		
0.212	92		
0.15	90		
0.063	84		

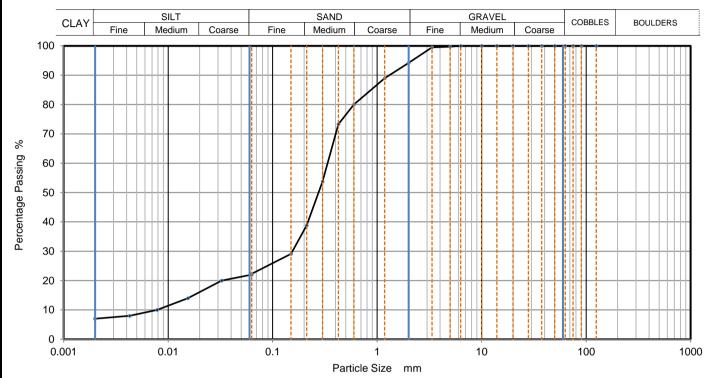
Dry Mass of sample, g	66
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Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	15
Silt	63
Clay	21

Grading Analysis		
D100	mm	
D60	mm	0.0155
D30	mm	0.00491
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Approved		Fig	1
Stephen.Watson	14/12/2017 17:57	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH16	
Site Name	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	11	
Soil Description	Grey slightly gravelly slightly silty fine to coarse SAND.		Depth, m	4.80	
Specimen Reference	2	Specimen Depth	m	Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112021	



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Sievi	ing	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	22
90	100	0.0325	20
75	100	0.0154	14
63	100	0.0078	10
50	100	0.0043	8
37.5	100	0.0020	7
28	100		
20	100		T
14	100	1	
10	100		
6.3	100	1	<u></u>
5	100	1	
3.35	100		
2	94		
1.18	89	1	
0.6	80	Particle density	(assumed)
0.425	73	2.65	Mg/m3
0.3	54	1	
0.212	39	1	
0.15	29	1	
0.063	22	1	

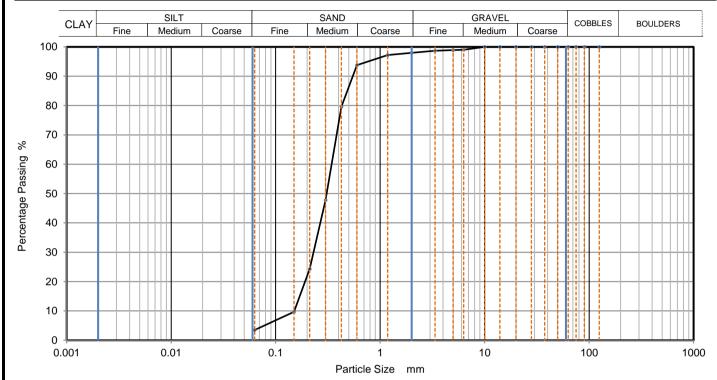
Dry Mass of sample, g	134
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Sample Proportions	% dry mass
Cobbles	0
Gravel	6
Sand	72
Silt	16
Clay	7

Grading Analysis		
D100	mm	
D60	mm	0.335
D30	mm	0.155
D10	mm	0.00699
Uniformity Coefficient		48
Curvature Coefficient		10

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167	
GEOTECH PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	BH16	
Site Name	Arklow Sewerage Sch	rklow Sewerage Scheme Marine Outfall GI		Sample No.	15
Soil Description	Grey fine to medium SAND.		Depth, m	9.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017112024	



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	99		
5	99		
3.35	99		
2	98		
1.18	97		
0.6	94		
0.425	80	1	
0.3	48		
0.212	24]	
0.15	10]	
0.063	4		

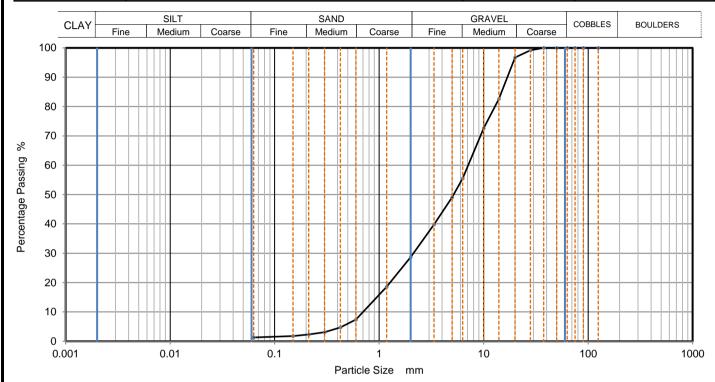
131	
	131

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	95
Fines < 0.063 mm	4

Grading Analysis		
D100	mm	
D60	mm	0.343
D30	mm	0.231
D10	mm	0.151
Uniformity Coefficient		2.3
Curvature Coefficient		1

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
Sneet	Stephen.Watson	14/12/2017 17:57	Sheet	

CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	TARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	BH17
Site Name	Arklow Sewerage Sche	eme Marine Outfa	ll GI	Sample No.	15
Soil Description	Grey slightly sandy subangular to subrounded medium to coarse GRAVEL.		Depth, m	0.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017112025	



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	99		
20	97		
14	83		
10	73		
6.3	56		
5	49		
3.35	40		
2	29		
1.18	19		
0.6	7		
0.425	5	1	
0.3	3		
0.212	2]	
0.15	2]	
0.063	1		

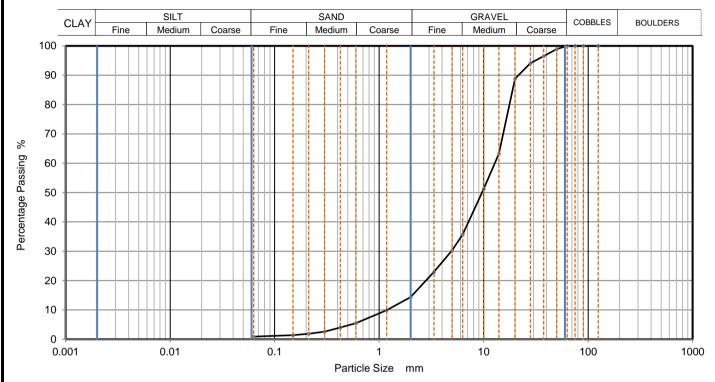
5261

Sample Proportions	% dry mass
Cobbles	0
Gravel	71
Sand	27
Fines < 0.063 mm	1

Grading Analysis		
D100	mm	
D60	mm	7.11
D30	mm	2.12
D10	mm	0.702
Uniformity Coefficient		10
Curvature Coefficient		0.9

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Stephen.Watson	14/12/2017 17:57		

CAUSEWAY	DADTI	CLE SIZE DIST	DIBLITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	RIBUTION	Borehole/Pit No.	BH17
Site Name	Arklow Sewerage Sche	me Marine Outfa	II GI	Sample No.	17
Soil Description	Grey slightly sandy subangular to subrounded medium to coarse GRAVEL.		Depth, m	2.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017112026	



Sie	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	99		
37.5	97		
28	94		
20	89		
14	63		
10	51		
6.3	36		
5	30		
3.35	23		
2	14		
1.18	10		
0.6	6		
0.425	4		
0.3	3		
0.212	2		
0.15	1		
0.063	1		

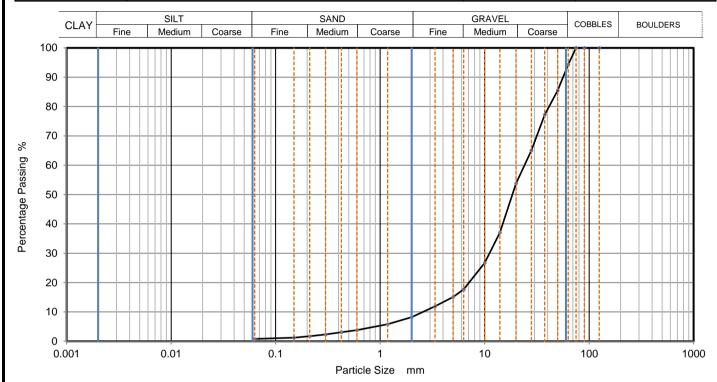
8589

Sample Proportions	% dry mass
Cobbles	0
Gravel	86
Sand	14
Fines < 0.063mm	1

Grading Analysis		
D100	mm	
D60	mm	12.8
D30	mm	4.93
D10	mm	1.2
Uniformity Coefficient		11
Curvature Coefficient		1.6

Stephen.Watson 14/12/2017 17:57 Sheet	Approved	Sheet printed	Fig	1
	Stephen. Watson	14/12/2017 17:57	Sheet	

CAUSEWAY	DADTI	CLE SIZE DIST	DIBLITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	BH17
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	19
Soil Description	Grey slightly sandy subangular to subrounded medium to coarse GRAVEL with low cobble content.		Depth, m	4.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017112027	



Siev	ving	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	94		
50	86		
37.5	77		
28	65		
20	54		
14	37		
10	27		
6.3	18		
5	15		
3.35	12		
2	8		
1.18	6		
0.6	4		
0.425	3	1	
0.3	2		
0.212	2]	
0.15	1]	
0.063	1		

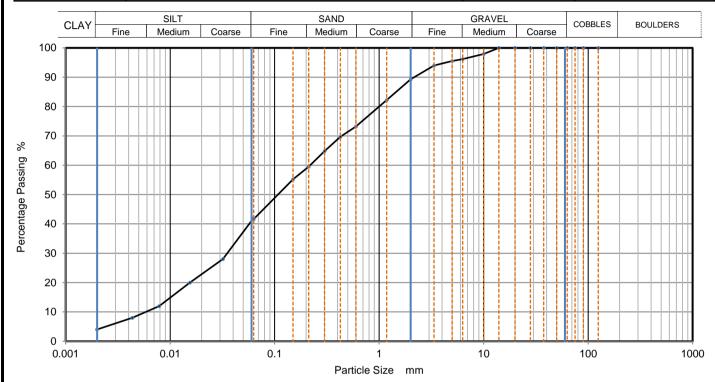
Dry Mass of sample, g	13623
Dry Mass of Sample, g	13023

Sample Proportions	% dry mass
Cobbles	6
Gravel	86
Sand	7
Fines < 0.063 mm	1

Grading Analysis		
D100	mm	
D60	mm	24.1
D30	mm	11.2
D10	mm	2.57
Uniformity Coefficient		9.4
Curvature Coefficient		2

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	BH17
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	20
Soil Description	Grey sandy slightly gravelly clayey SILT.		Depth, m	5.80	
Specimen Reference	2 Specimen m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112028	



Sievi	ng	Sedim	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	42
90	100	0.0319	28
75	100	0.0154	20
63	100	0.0078	12
50	100	0.0043	8
37.5	100	0.0020	4
28	100		
20	100		
14	100		
10	98		
6.3	96		
5	96		
3.35	94		
2	89		
1.18	82		
0.6	73	Particle density	(assumed)
0.425	70	2.65	Mg/m3
0.3	65		
0.212	60	1	
0.15	55	1	
0.063	42	1	

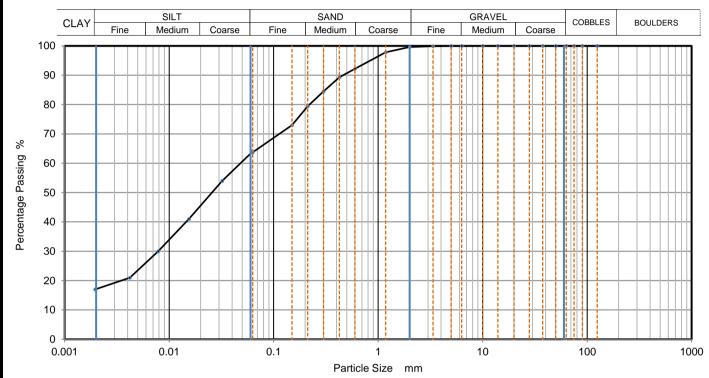
Dry Mass of sample, g	109
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Sample Proportions	% dry mass
Cobbles	0
Gravel	11
Sand	48
Silt	38
Clay	4

Grading Analysis		
D100	mm	
D60	mm	0.219
D30	mm	0.0357
D10	mm	0.00592
Uniformity Coefficient		37
Curvature Coefficient		0.98

Approved		Fig	1
Stephen.Watson	14/12/2017 17:57	Sheet	

CAUSEWAY PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167		
GEOTECH .	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	BH17
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	21
Soil Description	Grey sandy slightly clayey organic SILT.		Depth, m	6.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112030	



Sieving		Sedimentation		
Particle Size mm	% Passing	Particle Size mm	% Passing	
125	100	0.0630	64	
90	100	0.0322	54	
75	100	0.0154	41	
63	100	0.0078	30	
50	100	0.0042	21	
37.5	100	0.0020	17	
28	100			
20	100			
14	100			
10	100			
6.3	100			
5	100			
3.35	100			
2	100			
1.18	98			
0.6	92	Particle density	(assumed)	
0.425	89	2.65	Mg/m3	
0.3	85			
0.212	79			
0.15	73			
0.063	64			

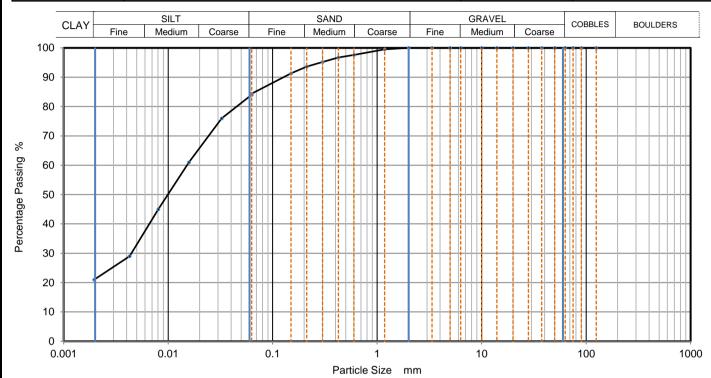
Dry Mass of sample a	60
Dry Mass of sample, g	69

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	36
Silt	47
Clay	17

Grading Analysis		
D100	mm	
D60	mm	0.0483
D30	mm	0.00785
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Stephen.Watson 14/12/2017 17:57 Sheet	Approved	Sheet printed	Fig	1
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CAUSEWAY	DARTI	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167
GEOTECH	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	BH17
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	22
Soil Description	Grey sandy slightly clayey organic SILT.		Depth, m	7.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	3S1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112032



Sievi	ng	Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	84
90	100	0.0325	76
75	100	0.0158	61
63	100	0.0080	45
50	100	0.0043	29
37.5	100	0.0020	21
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100	1	
0.6	98	Particle density	(assumed)
0.425	97	2.65	Mg/m3
0.3	95	1	
0.212	94	7	
0.15	91	7	
0.063	84		

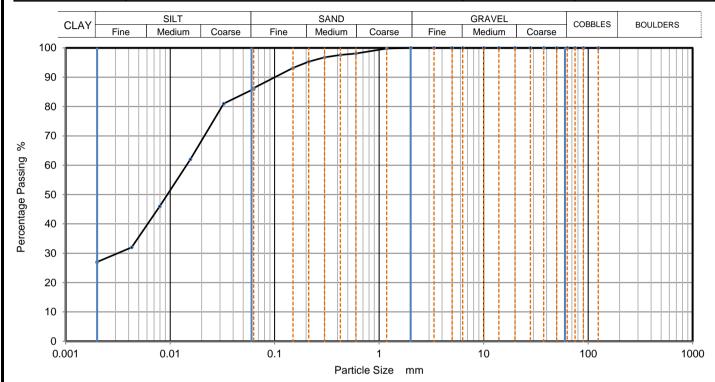
Dry Mass of sample, g	63	
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Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	16
Silt	63
Clay	21

Grading Analysis		
D100	mm	
D60	mm	0.0153
D30	mm	0.00445
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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Stephen.Watson	14/12/2017 17:57	Sheet	

CAUSEWAY	DARTI	PARTICLE SIZE DISTRIBUTION -		Job Ref	17-0167
GEOTECH	PARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	BH17
Site Name	Arklow Sewerage Sche	Arklow Sewerage Scheme Marine Outfall GI		Sample No.	23
Soil Description	Grey sandy slightly clayey organic SILT.		Depth, m	8.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	3S1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112034



Sieving		Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	86
90	100	0.0325	81
75	100	0.0156	62
63	100	0.0079	46
50	100	0.0043	32
37.5	100	0.0020	27
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	98	Particle density	(assumed)
0.425	98	2.65	Mg/m3
0.3	97		
0.212	95		
0.15	93		
0.063	86		

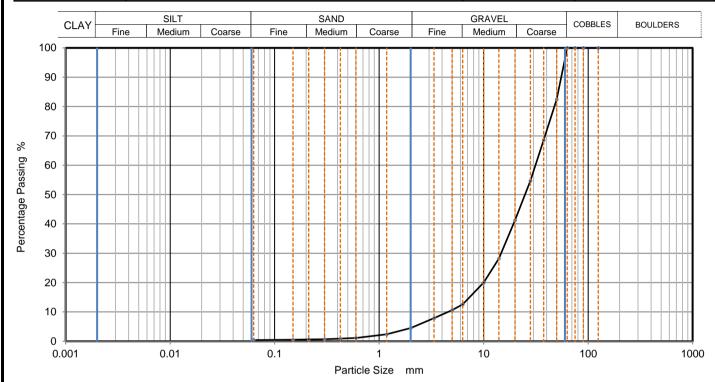
Dry Mass of sample, g	62

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	14
Silt	59
Clay	27

Grading Analysis		
D100	mm	
D60	mm	0.0143
D30	mm	0.00306
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
Sneet	Stephen.Watson	14/12/2017 17:57	Sheet	

CAUSEWAY	DARTI	CLE SIZE DIST	DIBLITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	RIBUTION	Borehole/Pit No.	BH17
Site Name	Arklow Sewerage Sche	eme Marine Outfa	ll GI	Sample No.	24
Soil Description	Grey slightly sandy suban	Grey slightly sandy subangular to subrounded GRAVEL.		Depth, m	9.80
Specimen Reference	2 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017112036



Siev	/ing	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	82		
37.5	69		
28	55		
20	41		
14	28		
10	20		
6.3	13		
5	11		
3.35	8		
2	5		
1.18	2		
0.6	1		
0.425	1	1	
0.3	1		
0.212	1]	
0.15	1]	
0.063	0		

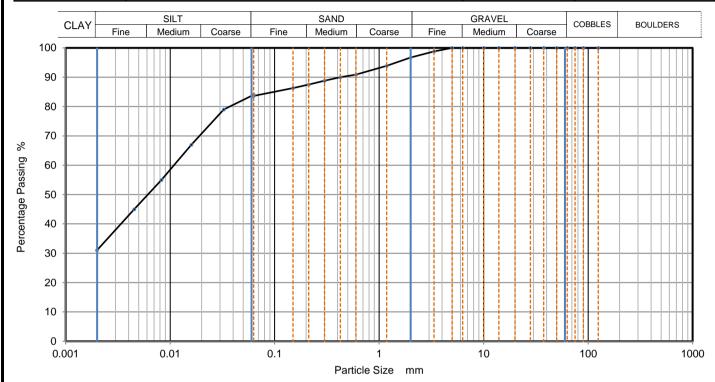
Dry Mass of sample, g	12044

Sample Proportions	% dry mass
Cobbles	0
Gravel	96
Sand	4
Fines < 0.063mm	0

Grading Analysis		
D100	mm	
D60	mm	31.3
D30	mm	14.7
D10	mm	4.58
Uniformity Coefficient		6.8
Curvature Coefficient		1.5

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	DARTI	CLE SIZE DIST	DIDI ITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	BH17
Site Name	Arklow Sewerage Sche	eme Marine Outfa	ll GI	Sample No.	26
Soil Description	Grey slightly sandy claye	Grey slightly sandy clayey SILT,		Depth, m	11.80
Specimen Reference	2 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112037



Sievi	ing	Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	84
90	100	0.0325	79
75	100	0.0160	67
63	100	0.0083	55
50	100	0.0045	45
37.5	100	0.0020	31
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	99		
2	97		
1.18	94		
0.6	91	Particle density	(assumed)
0.425	90	2.65	Mg/m3
0.3	89		
0.212	88	1	
0.15	86	1	
0.063	84	1	

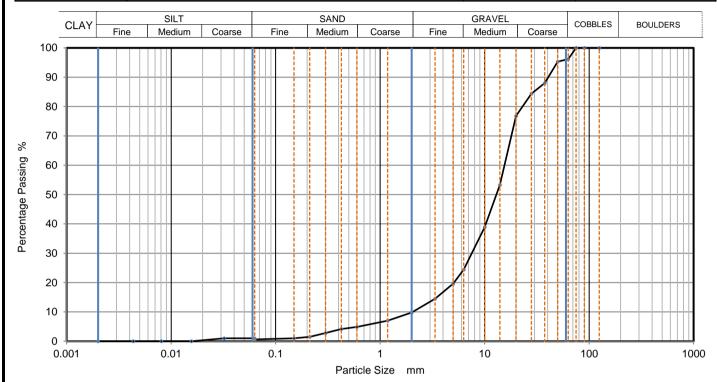
Dry Mass of sample, g	129

Sample Proportions	% dry mass
Cobbles	0
Gravel	3
Sand	13
Silt	52
Clay	31

Grading Analysis		
D100	mm	
D60	mm	0.0109
D30	mm	
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	DARTI	PARTICLE SIZE DISTRIBUTION –			17-0167
GEOTECH	TARTICLE SIZE DISTRIBUTION			Borehole/Pit No.	BH18
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI			2
Soil Description	Grey slightly sandy subangular to subrounded GRAVEL with low cobble content.		Depth, m	2.80	
Specimen Reference	4 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112041	



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	1
90	100	0.0322	1
75	100	0.0156	0
63	96	0.0080	0
50	95	0.0043	0
37.5	88	0.0020	0
28	84		
20	77		
14	53		
10	39		
6.3	24		
5	20		
3.35	15		
2	10		
1.18	7		
0.6	5	Particle density	(assumed)
0.425	4	2.65	Mg/m3
0.3	3		
0.212	2		
0.15	1		
0.063	1		

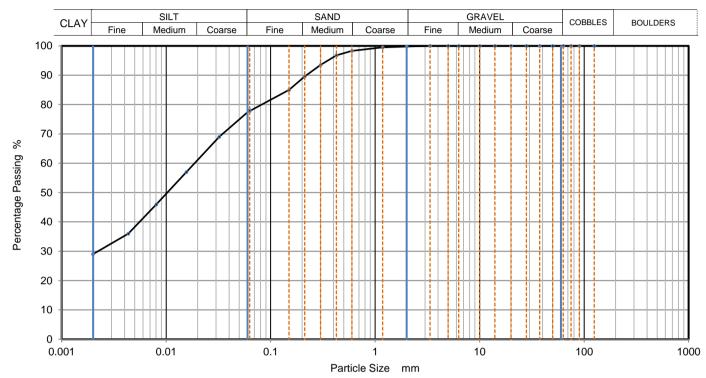
Dry Mass of sample, g	17591
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Sample Proportions	% dry mass
Cobbles	4
Gravel	86
Sand	9
Silt	0
Clay	0

Grading Analysis		
D100	mm	
D60	mm	15.5
D30	mm	7.53
D10	mm	2.04
Uniformity Coefficient		7.6
Curvature Coefficient		1.8

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	PARTICLE SIZE DISTRIBUTION		Job Ref	17-0167	
GEOTECH			Borehole/Pit No.	BH18	
Site Name	Arklow Sewerage Sche	rklow Sewerage Scheme Marine Outfall GI		Sample No.	3
Soil Description	Grey sandy silty CLAY.		Depth, m	4.80	
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112043	



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	78
90	100	0.0322	69
75	100	0.0156	57
63	100	0.0080	46
50	100	0.0043	36
37.5	100	0.0020	29
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	98	Particle density	(assumed)
0.425	97	2.65	Mg/m3
0.3	94		
0.212	90		
0.15	85		
0.063	78		

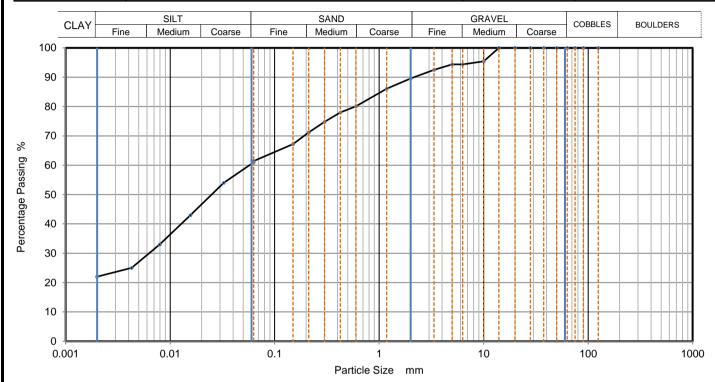
Dry Mass of sample, g	98

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	22
Silt	48
Clay	30

Grading Analysis		
D100	mm	
D60	mm	0.0188
D30	mm	0.00213
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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CAUSEWAY	DART	CLE SIZE DIST	EDIDI ITIONI	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	IKIBUTION	Borehole/Pit No.	BH18
Site Name	Arklow Sewerage Sche	eme Marine Outfa	ll GI	Sample No.	4
Soil Description	Grey sandy slightly grave	Grey sandy slightly gravelly silty CLAY.		Depth, m	6.80
Specimen Reference	2 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112046



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	61
90	100	0.0325	54
75	100	0.0156	43
63	100	0.0079	33
50	100	0.0043	25
37.5	100	0.0020	22
28	100		
20	100		
14	100		
10	95		
6.3	94		
5	94		
3.35	93		
2	90		
1.18	86		
0.6	80	Particle density	(assumed)
0.425	78	2.65	Mg/m3
0.3	75		
0.212	71		
0.15	67		
0.063	61		

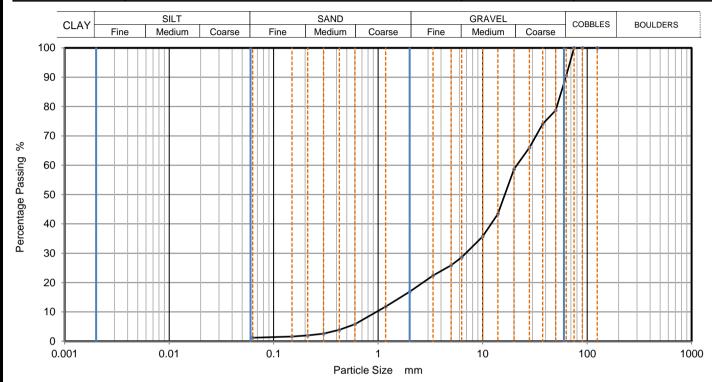
Dry Mass of sample, g	60

Sample Proportions	% dry mass
Cobbles	0
Gravel	10
Sand	28
Silt	39
Clay	22

Grading Analysis		
D100	mm	
D60	mm	0.0559
D30	mm	0.00624
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	DADTI	CLE SIZE DIST	DIDITION	Job Ref	17-0167
GEOTECH	FANII	CLL SIZE DIST	RIBOTION	Borehole/Pit No.	BH18
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	6
Soil Description	Grey slightly sandy suban low cobble content.			Depth, m	8.80
Specimen Reference	2 Specimen m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017112048



Siev	/ing	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	91		
50	79		
37.5	74		
28	66		
20	59		
14	43		
10	36		
6.3	29		
5	26		
3.35	22		
2	17		
1.18	12		
0.6	6		
0.425	4		
0.3	3		
0.212	2		
0.15	2		
0.063	1		

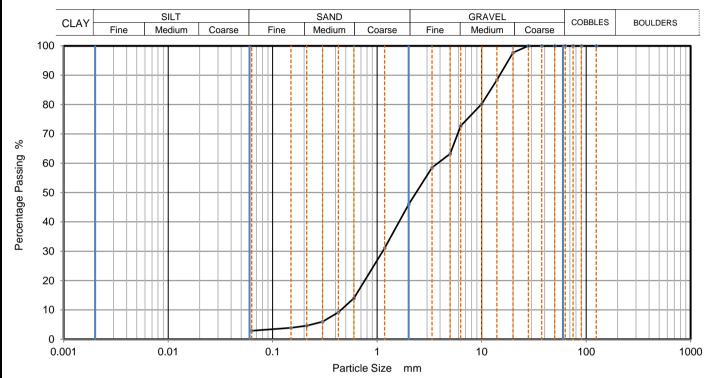
Dry Mass of sample, g	11575

Sample Proportions	% dry mass
Cobbles	10
Gravel	74
Sand	16
Fines < 0.063mm	1

Grading Analysis		
D100	mm	
D60	mm	21.2
D30	mm	6.91
D10	mm	0.962
Uniformity Coefficient		22
Curvature Coefficient		2.3

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
Sneet	Stephen.Watson	14/12/2017 17:57	Sheet	

CAUSEWAY	DADTI	CLE SIZE DIST	DIBLITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	RIBUTION	Borehole/Pit No.	BH18
Site Name	Arklow Sewerage Sche	me Marine Outfa	II GI	Sample No.	8
Soil Description	Grey sandy subangular to subrounded fine to coarse GRAVEL.			Depth, m	10.80
Specimen Reference	2 Specimen m			Sample Type	В
Test Method	3S1377:Part 2:1990, clause 9.2			KeyLAB ID	Caus2017112049



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	100		
20	98		
14	88		
10	80		
6.3	73		
5	63		
3.35	59		
2	46		
1.18	31		
0.6	14		
0.425	9	1	
0.3	6		
0.212	5		
0.15	4		
0.063	3		

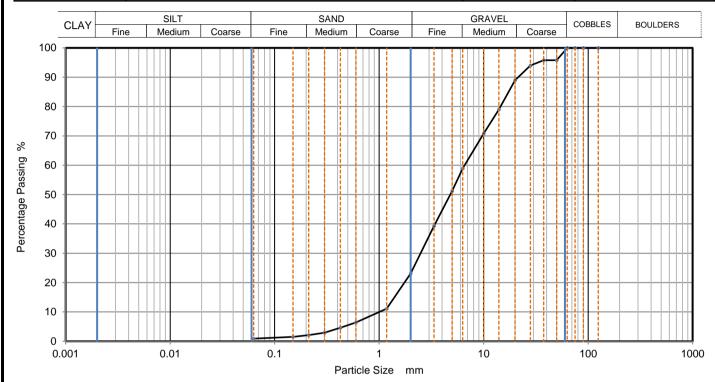
Dry Mass of sample, g	5348
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Sample Proportions	% dry mass
Cobbles	0
Gravel	54
Sand	43
Fines < 0.063 mm	3

Grading Analysis		
D100	mm	
D60	mm	3.8
D30	mm	1.13
D10	mm	0.45
Uniformity Coefficient		8.4
Curvature Coefficient		0.74

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	DARTI	CLE SIZE DIST	DIBLITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	ВН19
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	2
Soil Description	Greyish brown slightly sa GRAVEL.	Greyish brown slightly sandy subangular to subrounded fine to coarse GRAVEL.			1.80
Specimen Reference	2 Specimen m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017112051	



Siev	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	96		
37.5	96		
28	94		
20	89		
14	79		
10	71		
6.3	59		
5	51		
3.35	39		
2	23		
1.18	11		
0.6	6		
0.425	5	1	
0.3	3		
0.212	2		
0.15	2		
0.063	1		

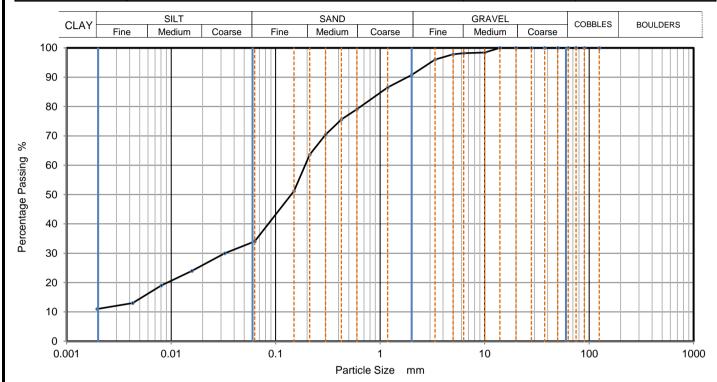
Dry Mass of sample, g	7275
Dry Wass Or sample, g	7273

Sample Proportions	% dry mass
Cobbles	0
Gravel	77
Sand	22
Fines < 0.063mm	1

Grading Analysis		
D100	mm	
D60	mm	6.57
D30	mm	2.49
D10	mm	1.01
Uniformity Coefficient		6.5
Curvature Coefficient		0.93

Stephen.Watson 14/12/2017 17:57 Sheet	Approved	Sheet printed	Fig	1
	Stephen.Watson	14/12/2017 17:57	Sheet	

CAUSEWAY	DARTI	CLE SIZE DIST	DIBLITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	BH19
Site Name	Arklow Sewerage Sche	eme Marine Outfa	ll GI	Sample No.	3
Soil Description	Greyish brown slightly gravelly silty fine to coarse SAND.		Depth, m	2.80	
Specimen Reference	2 Specimen m Depth			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112054	



Sievi	ng	Sedim	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	34
90	100	0.0325	30
75	100	0.0158	24
63	100	0.0080	19
50	100	0.0043	13
37.5	100	0.0020	11
28	100		
20	100		
14	100		
10	98		
6.3	98		
5	98		
3.35	96		
2	91		
1.18	87		
0.6	79	Particle density	(assumed)
0.425	76	2.65	Mg/m3
0.3	70		
0.212	64	7	
0.15	51	7	
0.063	34	7	

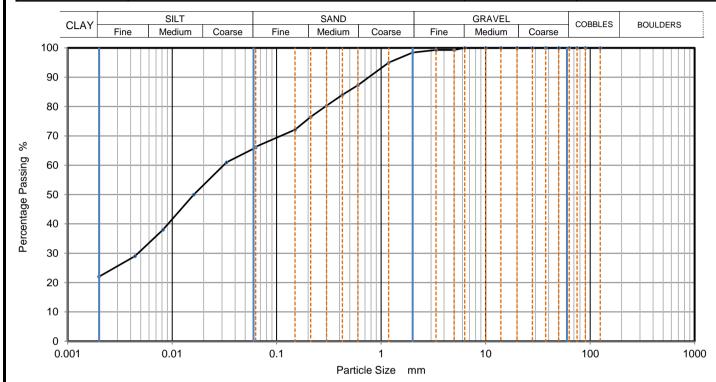
Dry Mass of sample, g	77
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Sample Proportions	% dry mass
Cobbles	0
Gravel	9
Sand	57
Silt	23
Clay	11

Grading Analysis		
D100	mm	
D60	mm	0.192
D30	mm	0.0349
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	DADTI	CLE SIZE DIST	DIBLITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	RIBUTION	Borehole/Pit No.	BH19
Site Name	Arklow Sewerage Sche	eme Marine Outfa	ll GI	Sample No.	4
Soil Description	Greyish brown sandy org	Greyish brown sandy organic clayey SILT.			3.80
Specimen Reference	2 Specimen m			Sample Type	В
Test Method	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112056	



Sie	ving	Sedime	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	66
90	100	0.0332	61
75	100	0.0161	50
63	100	0.0082	38
50	100	0.0044	29
37.5	100	0.0020	22
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	99		
3.35	99		
2	98		
1.18	95		
0.6	87	Particle density	(assumed)
0.425	84	2.65	Mg/m3
0.3	80		
0.212	77		
0.15	72		
0.063	66		

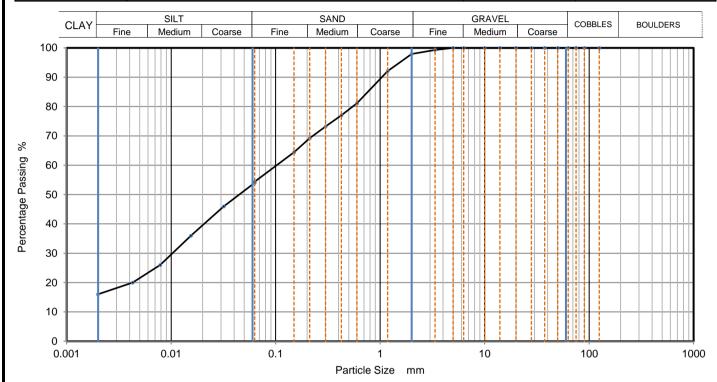
Dry Mass of sample, g	61

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	32
Silt	45
Clay	22

Grading Analysis		
D100	mm	
D60	mm	0.0312
D30	mm	0.00482
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Stephen.Watson 14/12/2017 17:57 Sheet	Approved	Sheet printed	Fig	1
	Stephen.Watson	14/12/2017 17:57	Sheet	

CAUSEWAY	DADTI	CLE SIZE DIST	DIBLITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	ВН19
Site Name	Arklow Sewerage Sche	eme Marine Outfa	ll GI	Sample No.	5
Soil Description	Greyish brown sandy org	Greyish brown sandy organic clayey SILT.		Depth, m	4.80
Specimen Reference	2 Specimen m Depth m		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	BS1377:Part 2:1990, clauses 9.2 and 9.5		KeyLAB ID	Caus2017112059



Sievii	ng	Sedimo	entation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0630	54
90	100	0.0319	46
75	100	0.0154	36
63	100	0.0078	26
50	100	0.0043	20
37.5	100	0.0020	16
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	99		
2	98		
1.18	92		
0.6	81	Particle density	(assumed)
0.425	77	2.65	Mg/m3
0.3	73		
0.212	69	7	
0.15	64	1	
0.063	54	1	

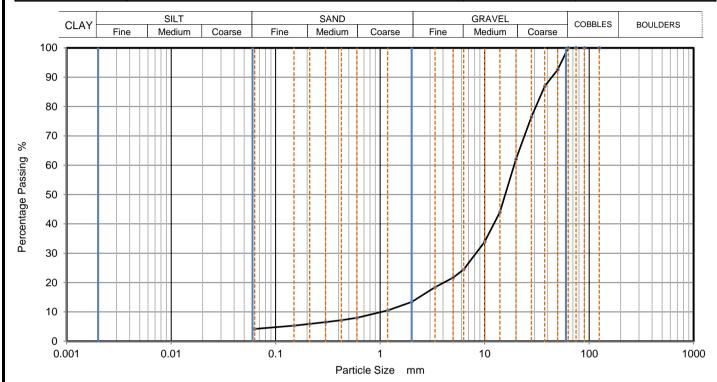
Dry Mass of sample, g	73

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	44
Silt	38
Clay	17

Grading Analysis		
D100	mm	
D60	mm	0.103
D30	mm	0.01
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	DADTI	CLE SIZE DIST	DIDITION	Job Ref	17-0167
GEOTECH	PANII	CLE SIZE DIST	KIBOTION	Borehole/Pit No.	ВН19
Site Name	Arklow Sewerage Sche	me Marine Outfa	ll GI	Sample No.	6
Soil Description	Grey slightly sandy angula	Grey slightly sandy angular to subangular fine to coarse GRAVEL.		Depth, m	5.80
Specimen Reference	2 Specimen m Depth		Sample Type	В	
Test Method	BS1377:Part 2:1990, clau	BS1377:Part 2:1990, clause 9.2		KeyLAB ID	Caus2017112061



Siev	/ing	Sedime	ntation
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	93		
37.5	87		
28	77		
20	62		
14	44		
10	34		
6.3	25		
5	22		
3.35	18		
2	13		
1.18	11		
0.6	8		
0.425	7	1	
0.3	7		
0.212	6]	
0.15	5]	
0.063	4		

Dry Mass of sample, g	6997

Sample Proportions	% dry mass
Cobbles	0
Gravel	87
Sand	9
Fines < 0.063mm	4

Grading Analysis		
D100	mm	
D60	mm	19.2
D30	mm	8.27
D10	mm	1.03
Uniformity Coefficient		19
Curvature Coefficient		3.5

14/12/2017 17:57 Stephen.Watson	Approved	Sheet printed	Fig	1
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CAUSEWAY	Unconsolidate Compression			ent	Job Ref			17-0167	
GEOTECH	of pore press			GIIL	Borehole/Pit No).		BH11	
Site Name	Arklow Sewerage S	Scheme Marine Ou	utfall GI		Sample No.			17	
Soil Description	Grey slightly sandy	silty CLAY,			Depth			6.00	
Specimen Reference	2	Specimen Depth	6.30	m	Sample Type			U	
Specimen Description	Stiff grey slightly sa	andy silty CLAY,	-		KeyLAB ID		Ca	us201711205	
Test Method	BS1377 : Part 7 : 1	990, clause 8, sin	gle specimen		Date of test		(08/12/2017	
	Test Number Length Diameter Bulk Density Moisture Content Dry Density Rate of Strain Cell Pressure At failure	Axial Strain Deviator Stress Undrained She Mode of Failure	ar Strength, cu		1 200.0 100.0 2.19 21.8 1.80 2.0 120 20.0 221 110		mm Mg/m3 % Mg/m3 %/min kPa % kPa kPa	σ1 - σ3)f	
riator Stress v /	Axial Strain	Mode of Fallure	•	ļ					
300									\neg
250									
200				•••	+				
200									
150									
100									_
50									
0 2	4 6 8	10 12	14 16	18 2	20 22 24	4	26	28 30	32
hr Circles	4 0 0	10 12	Axial Strain		20 22 2.	•	20	20 30	52
300								stress correct	ed
250								change and ne effects	
200							Mohr circ	cles and their	
150							by BS13 This is p	rovided for	vered
100							informati	on only.	
50									
0 50	100 150 200	250 300	350 400	450 5	500 550 60	 00			
Remarks	200	Normal Stres	sses kPa			-			
- compress			Approved		Printed				
	ated at 20% strain		Stephen.Watso	- 1	14/12/2017 18:	06		Fig. No.	1

CAUSEWAY	Unconsolidated Undrained Triaxial Compression Test without measurement				Job Ref	17-0167
of pore pressure - single specimen				Borehole/Pit No.	BH11	
Site Name	Arklow Sewerage Scheme Marine Outfall GI				Sample No.	18
Soil Description	Grey slightly sandy silty CLAY,				Depth	8.00
Specimen Reference	2	2 Specimen 8.30 m				U
Specimen Description	Stiff grey slightly	sandy silty CLAY,	KeyLAB ID	Caus201711209		
Test Method	BS1377 : Part 7 :	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	08/12/2017
	Test Number				1 200.0	_
	Length Diameter				100.0	mm mm
	Bulk Density				2.11	Mg/m3

Moisture Content Dry Density

Rate of Strain Cell Pressure At failure

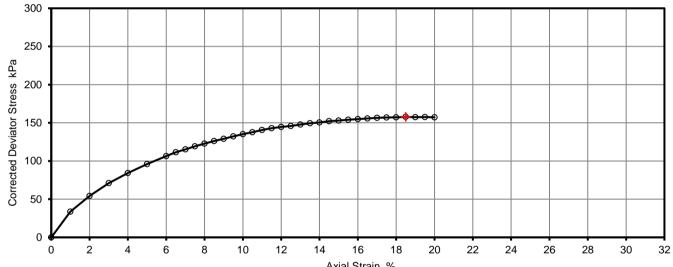
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu

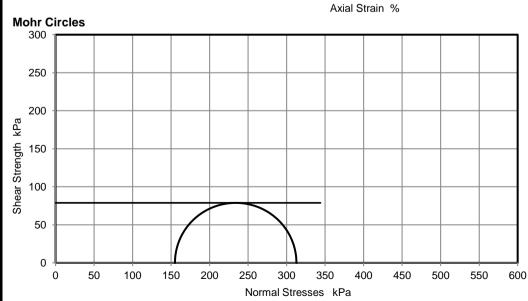
Mode of Failure

1	
200.0	mm
100.0	mm
2.11	Mg/m3
25.5	%
1.68	Mg/m3

2.0	%/min
155	kPa
18.5	%
158	kPa
79	kPa ½(σ1 - σ3)f
Brittle	

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks

Lab Sheet Reference:

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377 Approved

Stephen.Watson

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14/12/2017 18:06

Fig. No. Sheet

Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen				ent	Job Ref	17-0167
				Borehole/Pit No.	BH16	
Site Name	Arklow Sewerage Scheme Marine Outfall GI				Sample No.	18
Soil Description	Grey sandy slightly clayey SILT.				Depth	2.00
Specimen Reference	2	Specimen Depth	2.30	m	Sample Type	UT
Specimen Description	Very soft grey sandy slightly clayey SILT.				KeyLAB ID	Caus2017112016
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen				Date of test	09/12/2017

Test Number Length Diameter Bulk Density Moisture Content Dry Density

Rate of Strain Cell Pressure At failure

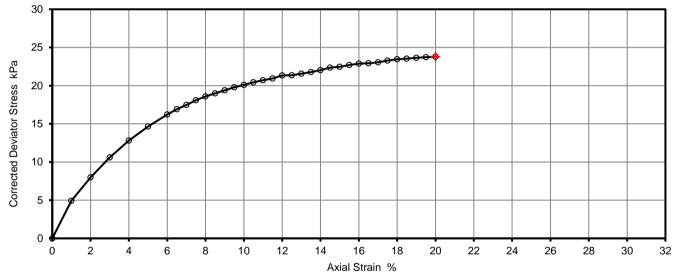
Axial Strain Deviator Stress, (σ1 - σ3)f Undrained Shear Strength, cu

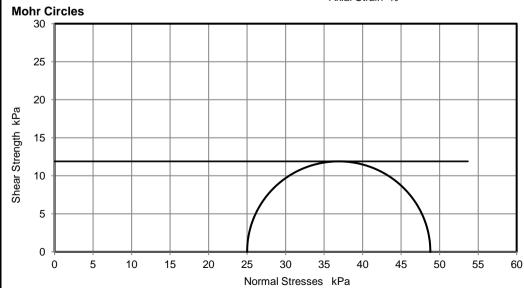
Mode of Failure

200.0 r	nm
100.0 r	nm
1.35	Mg/m3
130.5	%
0.59 N	/lg/m3

2.0	%/min
	kPa
20.0	%
24	kPa
12	kPa ½(σ1 - σ3)f

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks

Lab Sheet Reference:

Testing terminated at 20% strain

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Fig. No. 1 Sheet

3

CAUSEWA	Compression	Inconsolidated Undrained Triaxial Compression Test without measurement If pore pressure - single specimen				17-0167 BH17	
Site Name	 	Scheme Marine Ou	•		Borehole/Pit No. Sample No.	27	
Soil Description	Grey sandy sligh	tly gravelly clayey SI	LT.		Depth	6.00	
Specimen Reference	2	Specimen Depth	6.30	m	Sample Type	UT	
Specimen Description	Very soft to soft of	grey sandy slightly g	L ravelly clayey SILT		KeyLAB ID	Caus20171120)29
Test Method	BS1377 : Part 7 :	1990, clause 8, sin	gle specimen		Date of test	09/12/2017	
	Test Number Length Diameter Bulk Density Moisture Content Dry Density Rate of Strain Cell Pressure At failure	Axial Strain Deviator Stress Undrained Shea Mode of Failure	ar Strength, cu		1 200.0 100.0 1.57 74.2 0.90 2.0 85 20.0 21	mm mm Mg/m3 % Mg/m3 %/min kPa % kPa kPa kPa ½(σ1 - σ3)f	
ator Stress v	Axial Strain						
				000	•		
20		,	,				
10							
5							
0 0 2	4 6 8	3 10 12	14 16	18 2	20 22 24	26 28 30	32
	4 0 0) 10 12	Axial Strain %		20 22 24	20 20 30	32
r Circles						Deviator stress corre for area change and membrane effects	
						Mohr circles and the	

0 20 40 10 30 50 60 70 80 90 100 110 120 Normal Stresses kPa Remarks Approved Printed 14/12/2017 18:06 Stephen.Watson Testing terminated at 20% strain Lab Sheet Reference :

10

Fig. No. 1 Sheet

44	Unconsolidat	ed Undraine	ed Triaxial		Job Ref			17-0167	
CAUSEWAY	Compression of pore press			nent	Borehole/Pit N	0.		BH17	
Site Name	Arklow Sewerage So		-		Sample No.			28	
Soil Description	Grey sandy slightly	clayey organic SI	LT.		Depth			8.00	
Specimen Reference	2	Specimen Depth	8.30	m	Sample Type			UT	
Specimen Description	Soft grey sandy sligl	•	c SILT.		KeyLAB ID		Cau	us20171120)33
Test Method	BS1377 : Part 7 : 19	90, clause 8, sin	gle specimen		Date of test			09/12/2017	
	Test Number Length Diameter Bulk Density Moisture Content Dry Density Rate of Strain Cell Pressure At failure	Axial Strain Deviator Stress Undrained Shea Mode of Failure	ar Strength, cu		1 200.0 100.0 1.31 146.0 0.53 2.0 95 20.0 50 25		mm mg/m3 % Mg/m3 %/min kPa % kPa kPa	σ1 - σ3)f	
Deviator Stress v A	xial Strain								
60									
50				0000					
Deviator Stress KPa 30 40		**************							
ğ. 30 -	A SOURCE STATE OF THE SOUR								
Deviate									
20 20 10									
Š 10									
o /	4 6 9	10 12	11 16	10	20 22 2	14	26	20 20	
0 2	4 6 8	10 12	14 16 Axial Strain		20 22 2	24	26	28 30	32
125 100 100 100 100 100 100 100 100 100 10	50 75 100	125 150	175 200	225 2	250 275 3		for area of membrar Mohr circlinterpreta by BS13	rovided for	eir
Remarks		Normal Stres	sses kPa Approved		Printed				
	ited at 20% strain		Stephen.Watso	on	14/12/2017 18	:06		Fig. N	o. 1
Lab Sheet Reference) :						1	Sheet	5

CAUSEWAY		ated Undrained		ont	Job Ref	17-0167
Compression Test without measurement of pore pressure - single specimen				Borehole/Pit No.	BH18	
Site Name	Arklow Sewerage Scheme Marine Outfall GI				Sample No.	16
Soil Description	Grey sandy organic silty CLAY.				Depth	4.00
Specimen Reference	2	Specimen Depth	4.30	m	Sample Type	UT
Specimen Description	Soft grey sandy organic silty CLAY.				KeyLAB ID	Caus2017112042
Test Method	BS1377 : Part 7 :	1990, clause 8, single	Date of test	11/12/2017		

Test Number Length Diameter **Bulk Density** Moisture Content Dry Density

Rate of Strain Cell Pressure At failure

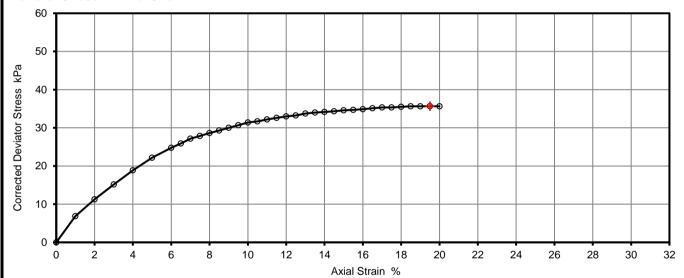
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu

Mode of Failure

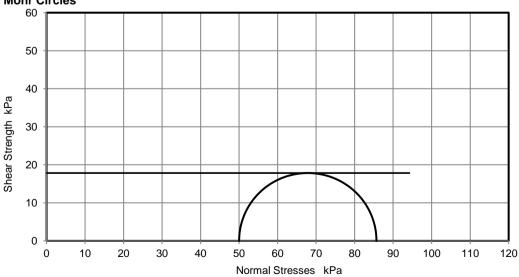
1	
200.0	mm
100.0	mm
1.33	Mg/m3
135.0	%
0.57	Mg/m3

2.0	%/min
50	kPa
19.5	%
36	kPa
18	kPa ½(σ1
Plastic	

Deviator Stress v Axial Strain







Deviator stress corrected for area change and membrane effects

- σ3)f

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377 Approved

Stephen.Watson

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14/12/2017 18:06

Fig. No.

Sheet

Lab Sheet Reference:

CAUSEWAY	Unconsolidate Compression	Test withou	Job Ref Borehole/Pit No.	17-0167 BH18		
	of pore pressi	ire - single				
Site Name	Arklow Sewerage So	heme Marine Ou		Sample No.	17	
Soil Description	Grey sandy silty orga	anic CLAY.		Depth	6.00	
Specimen Reference	2	Specimen Depth	6.30	m	Sample Type	UT
Specimen Description	Very soft grey sandy	silty organic CLA	YY.		KeyLAB ID	Caus2017112045
Test Method	BS1377 : Part 7 : 19	90, clause 8, sinç	gle specimen		Date of test	11/12/2017
	Test Number				1	1
	Length			200.0	mm	
	Diameter			100.0	mm	
	Bulk Density				1.67	Mg/m3
	Moisture Content				58.7	%
	Dry Density				1.05	Mg/m3

Dry Density

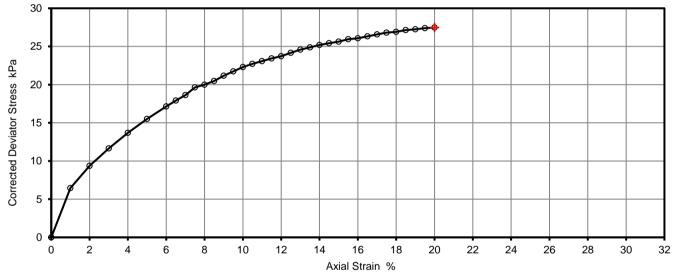
Rate of Strain Cell Pressure At failure

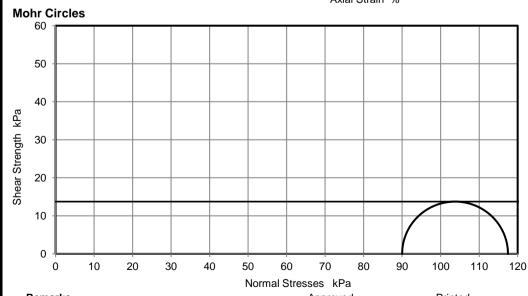
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu Mode of Failure

1	
200.0	mm
100.0	mm
1.67	Mg/m3
58.7	%
1.05	Mg/m3

2.0	%/min
90	kPa
20.0	%
27	kPa
14	kPa ½(σ1 - σ3)f

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks

Lab Sheet Reference:

Testing terminated at 20% strain

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Fig. No.

Sheet

CAUSEWAY		ated Undraine on Test withou	Job Ref	17-0167		
—— GEOTECH	-	ssure - single	Borehole/Pit No.	BH19		
Site Name	Arklow Sewerage	Scheme Marine Ou	Sample No.	13		
Soil Description	Greyish brown sa	andy organic silty CL		Depth	2.00	
Specimen Reference	2	Specimen Depth	2.30	m	Sample Type	UT
Specimen Description	Very soft greyish	brown sandy organi	c silty CLAY.		KeyLAB ID	Caus2017112052
Test Method	BS1377 : Part 7 :	1990, clause 8, sing		Date of test	11/12/2017	

Diameter **Bulk Density** Moisture Content Dry Density

Rate of Strain Cell Pressure At failure

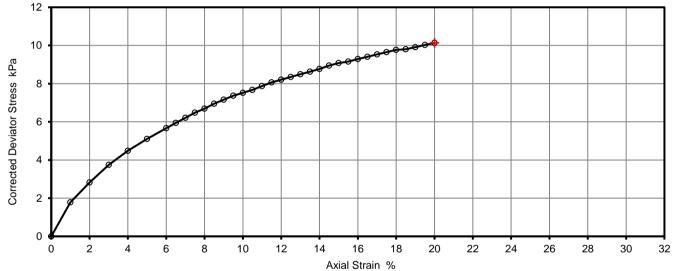
Axial Strain Deviator Stress, (σ 1 - σ 3)f Undrained Shear Strength, cu

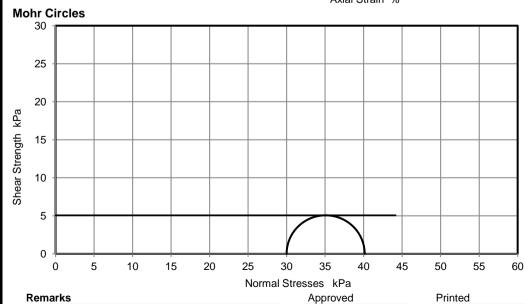
Mode of Failure

1	
200.0	mm
100.0	mm
1.45	Mg/m3
104.2	%
0.71	Mg/m3

2.0	%/min
30	kPa
20.0	%
10	kPa
5	kPa ½(σ1 - σ3)f

Deviator Stress v Axial Strain





Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for information only.

Remarks

Lab Sheet Reference:

Testing terminated at 20% strain

Approved

Stephen.Watson

14/12/2017 18:07

Fig. No. Sheet

8

CAUSEWAY	Unconsolidate Compression			Job Ref	17-0167	
—— GEOTECH	of pore press			Borehole/Pit No.	BH19	
Site Name	Arklow Sewerage So	cheme Marine Ou	tfall GI	Sample No.	14	
Soil Description	Greyish brown sand	y organic clayey \$	SILT.	Depth	4.00	
Specimen Reference	2	Specimen Depth	4.30	Sample Type	UT	
Specimen Description	Very soft greyish bro	own sandy organic	c clayey SILT.	KeyLAB ID	Caus2017112057	
Test Method	BS1377 : Part 7 : 19	90, clause 8, sing	gle specimen		Date of test	11/12/2017

Test Number Length Diameter **Bulk Density** Moisture Content Dry Density

Rate of Strain Cell Pressure At failure

Axial Strain Deviator Stress, (σ 1 - σ 3)f

Undrained Shear Strength, cu

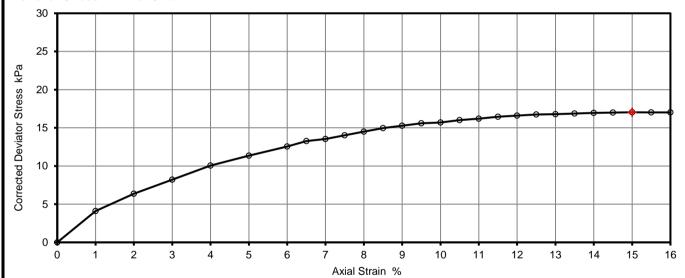
Mode of Failure

1	
200.0	mm
100.0	mm
1.23	Mg/m3
210.5	%
0.40	Ma/m3

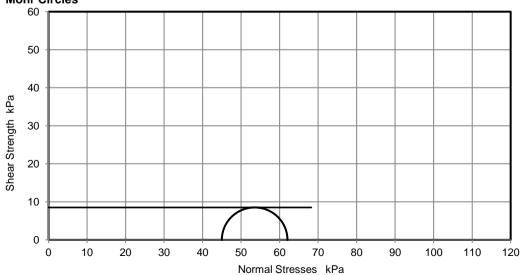
2.0	%/min
45	kPa
15.0	%
17	kPa
9	kPa ½(
Plastic	1

2(σ1 - σ3)f

Deviator Stress v Axial Strain







Deviator stress corrected for area change and membrane effects

Mohr circles and their interpretation is not covered by BS1377. This is provided for

information only.

Remarks

Lab Sheet Reference:

Strengths corrected for area change, and membrane effects based on Fig 11 BS1377 Approved

Stephen.Watson

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14/12/2017 18:07

Fig. No. Sheet





Chemtest Ltd.
Depot Road
Newmarket
CB8 0AL
Tel: 01638 606070

Email: info@chemtest.co.uk

Final Report

Report No.: 17-32875-1

Initial Date of Issue: 12-Dec-2017

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 John Cameron Kevin Dalton Matthew Gilbert Neil Haggan Paul Dunlop Paul McNamara Stephen Curtis Stephen Franey Stephen Watson

Project 17-0167 Arklow Sewerage Scheme

Marina Outfall GI

Quotation No.: Date Received: 08-Dec-2017

Order No.: Date Instructed: 08-Dec-2017

No. of Samples: 14

Turnaround (Wkdays): 3 Results Due: 12-Dec-2017

Date Approved: 12-Dec-2017

Approved By:

Details: Robert Monk, Technical Manager





Project: 17-0167 Arklow Sewerage Scheme Marina Outfall GI

Client: Causeway Geotech Ltd		Chemtest Job No.:			17-32875	17-32875	17-32875	17-32875	17-32875	17-32875	17-32875	17-32875	17-32875
Quotation No.:	(Chemte	st Sam	ple ID.:	552101	552102	552103	552104	552105	552106	552107	552108	552109
Order No.:		Client Location ID.:				5	9	20	23	26	30	1	4
		Client Sample Ref.:			BH11	BH11	BH11	BH16	BH16	BH16	BH16	BH17	BH17
	Sample Type:				SOIL								
	Top Depth (m):			0.50	4.50	8.50	0.50	3.50	6.50	10.50	0.50	3.50	
			Date Sa	ampled:	07-Dec-2017	07-Dec-2017	07-Dec-2017	07-Dec-2017	07-Dec-2017	07-Dec-2017	07-Dec-2017	07-Dec-2017	07-Dec-2017
Determinand	Accred.	SOP	Units	LOD									
Moisture	N	2030	%	0.020	4.2	1.7	22	4.8	59	3.4	19	5.4	4.3
рН	U	2010		N/A	8.6	9.0	8.6	8.5	7.2	8.3	8.3	8.5	7.8
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	< 0.010	< 0.010	0.11	0.13	1.3	0.15	0.020	0.055	0.19





Project: 17-0167 Arklow Sewerage Scheme Marina Outfall GI

Client: Causeway Geotech Ltd	Chemtest Job No.:			17-32875	17-32875	17-32875	17-32875	17-32875	
Quotation No.:	(Chemte	st Sam	ole ID.:	552110	552111	552112	552113	552114
Order No.:		Clie	nt Locat	ion ID.:	10	18	21	15	19
	Client Sample Ref.:				BH17	BH18	BH18	BH19	BH19
		Sample Type:			SOIL	SOIL	SOIL	SOIL	SOIL
		Top Depth (m):			8.50	0.50	3.50	0.50	4.50
	Date Sampled:		07-Dec-2017	07-Dec-2017	07-Dec-2017	07-Dec-2017	07-Dec-2017		
Determinand	Accred.	SOP	Units	LOD					
Moisture	N	2030	%	0.020	60	12	17	2.4	64
рН	U	2010		N/A	6.4	8.5	7.9	8.3	7.1
Sulphate (2:1 Water Soluble) as SO4	U	2120	g/l	0.010	1.7	0.34	0.30	0.019	0.23



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



LABORATORY REPORT



4043

Contract Number: PSL17/5705

Report Date: 08 December 2017

Client's Reference: 17-0167

Client Name: Causeway Geotech

8 Drumahiskey Road

Ballymoney Co.Antrim BT53 7QL

For the attention of: Neil Haggan

Contract Title: Arklow Sewerage Scheme Marine Outfall GI

Date Received: 23/11/2017
Date Commenced: 23/11/2017
Date Completed: 08/12/2017

Notes: Opinions and Interpretations are outside the UKAS Accreditation

A copy of the Laboratory Schedule of accredited tests as issued by UKAS is attached to this report. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced other than in full, without the prior written approval of the laboratory.

Checked and Approved Signatories:

R Gunson A Watkins R Berriman (Director) (Director) (Quality Manager)

L Knight S Eyre A Fry

(Senior Technician) (Senior Technician) (Senior Technician)

5 – 7 Hexthorpe Road, Hexthorpe,

Doncaster DN4 0AR

tel: +44 (0)844 815 6641 fax: +44 (0)844 815 6642

e-mail: rgunson@prosoils.co.uk awatkins@prosoils.co.uk

Page 1 of

SUMMARY OF LABORATORY SOIL DESCRIPTIONS

Hole Number	Sample Number	Sample Type	Top Depth m	Base Depth m	Description of Sample
BH11	20	В	1.80	2.20	Brown very gravelly SAND.
BH11	22	В	3.80	4.20	Brown sandy GRAVEL.
BH11	28	В	9.80	10.20	Brown sandy slightly silty GRAVEL.
BH16	13	В	6.80	7.20	Grey sandy slightly silty GRAVEL.
BH16	14	В	8.80	9.20	Brown slightly gravelly slightly silty SAND.
BH16	16	В	10.80	11.20	Brown very sandy slightly silty GRAVEL.
BH17	16	В	1.80	2.20	Brown gravelly SAND.
BH17	18	В	3.80	4.20	Brown sandy GRAVEL.
BH17	25	В	10.80	11.20	Grey gravelly SAND.
BH18	1	В	0.80	2.20	Dark grey sandy slightly silty GRAVEL.
BH18	7	В	9.80	10.20	Grey gravelly SAND.
BH19	1	В	0.80	1.20	Brown slightly sandy slightly silty GRAVEL.



Arklow Sewerage Scheme Marine Outfall GI

Contract No:	
PSL17/5705	
Client Ref:	
17-0167	

PARTICLE SIZE DISTRIBUTION TEST

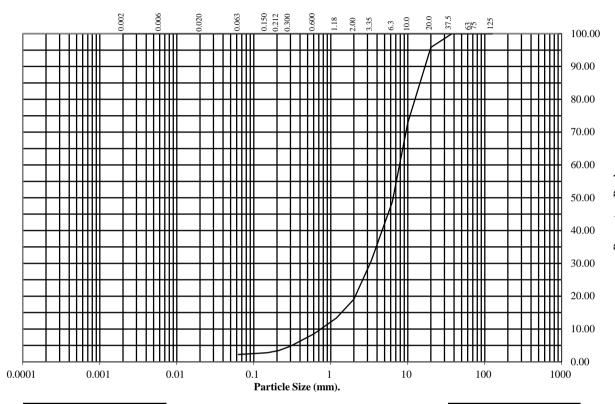
BS1377: Part 2: 1990

Wet Sieve, Clause 9.2

Hole Number: BH11 Top Depth (m): 9.80

Sample Number: 28 Base Depth(m): 10.20

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	100
20	96
10	73
6.3	49
3.35	31
2	19
1.18	13
0.6	8
0.3	5
0.212	3
0.15	3
0.063	2

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 81 17 2

Remarks:

See Summary of Soil Descriptions





Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5705
Client Ref:
17-0167

PSL005 Nov 15 Page of

PARTICLE SIZE DISTRIBUTION TEST

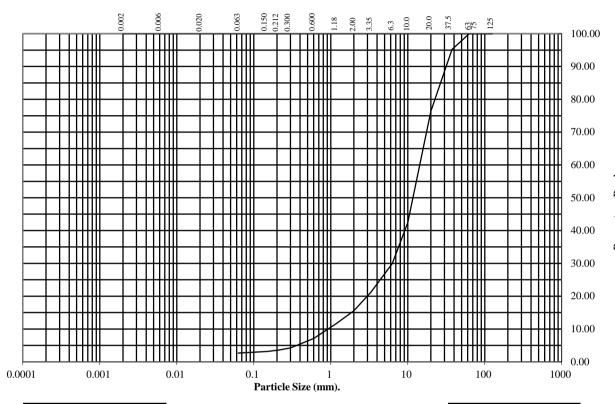
BS1377: Part 2: 1990

Wet Sieve, Clause 9.2

Hole Number: BH16 Top Depth (m): 6.80

Sample Number: 13 Base Depth(m): 7.20

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	95
20	76
10	42
6.3	30
3.35	21
2	16
1.18	12
0.6	7
0.3	4
0.212	4
0.15	3
0.063	3

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 84 13 3

Remarks:

See Summary of Soil Descriptions





Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5705
Client Ref:
17-0167

PSL005 Nov 15 Page of

PARTICLE SIZE DISTRIBUTION TEST

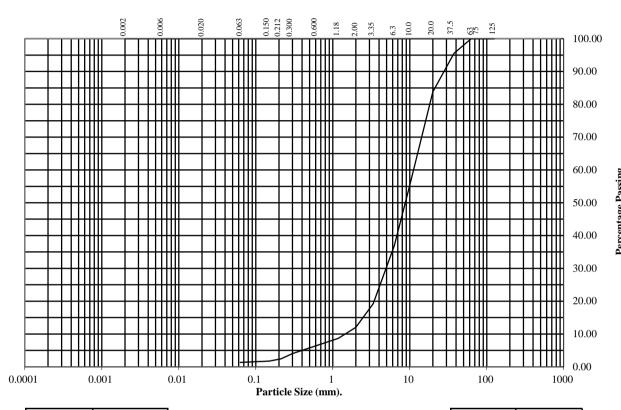
BS1377: Part 2: 1990

Wet Sieve, Clause 9.2

Hole Number: BH18 Top Depth (m): 0.80

Sample Number: 1 Base Depth(m): 2.20

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	96
20	84
10	55
6.3	37
3.35	19
2	12
1.18	9
0.6	6
0.3	4
0.212	2
0.15	2
0.063	1

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 88 11 1

Remarks:

See Summary of Soil Descriptions





Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5705
Client Ref:
17-0167

PSL005 Nov 15 Page of

PARTICLE SIZE DISTRIBUTION TEST

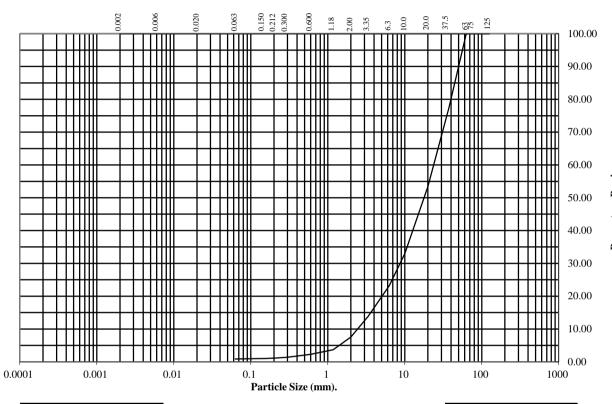
BS1377: Part 2: 1990

Wet Sieve, Clause 9.2

Hole Number: BH19 Top Depth (m): 0.80

Sample Number: 1 Base Depth(m): 1.20

Sample Type: B



BS Test	Percentage
Sieve (mm)	Passing
125	100
75	100
63	100
37.5	77
20	53
10	33
6.3	23
3.35	14
2	8
1.18	4
0.6	2
0.3	1
0.212	1
0.15	1
0.063	1

Soil	Total
Fraction	Percentage
Cobbles Gravel Sand Silt/Clay	0 92 7 1

Remarks:

See Summary of Soil Descriptions





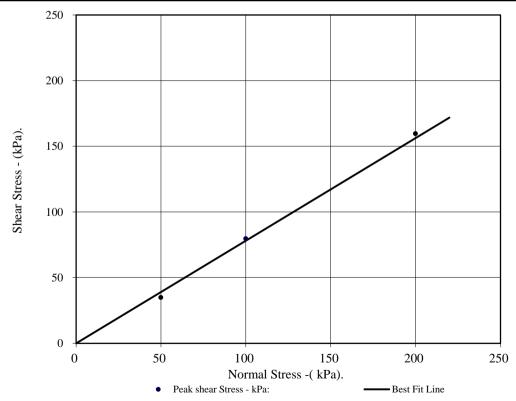
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5705
Client Ref:
17-0167

PSL005 Nov 15 Page of

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:		BH11 Top Depth:		1.80		
Sample Number:		20	Base Depth:		2.20	
Sample Conditions:		Submerged	Sample Type B		3	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort.				
Sample Freparation.	Material test	ed passing 2mm sieve				
Sample Description:	See summar	ry of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				24.51	24.51	24.51
Length - mm:				60.00	60.00	60.00
Moisture Content - %:				7.9	7.9	7.9
Bulk Density - Mg/m3:				1.78	1.78	1.78
Dry Density - Mg/m3:				1.65	1.65	1.65
Voids Ratio:				0.610	0.607	0.605
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				24.36	24.34	24.21
		Shearing Stage				
Rate of Strain - mm/min				0.80	0.80	0.80
Displacement at peak shear s	stress - mm			5.00	6.00	10.00
Peak shear Stress - kPa:				35	80	160
	Fi	nal Consolidated Condi	tions			
Moisture Content - %:				25	24	24
Bulk Density - Mg/m3:		·		1.79	1.79	1.80
Dry Density - Mg/m3:				1.43	1.44	1.46
		Peak				
Angle of Shearing Resistanc	e:(0)				38	
Effective Cohesion - kPa:	<u> </u>				0	

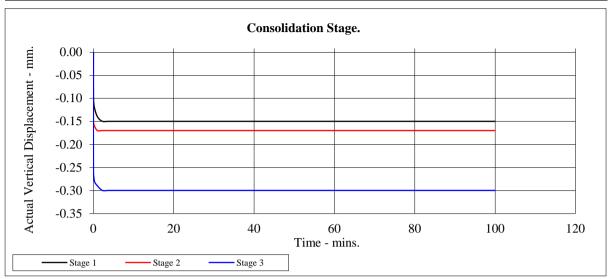


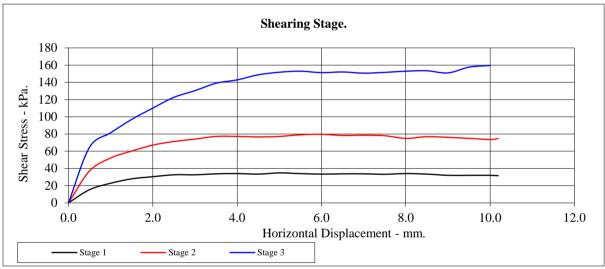


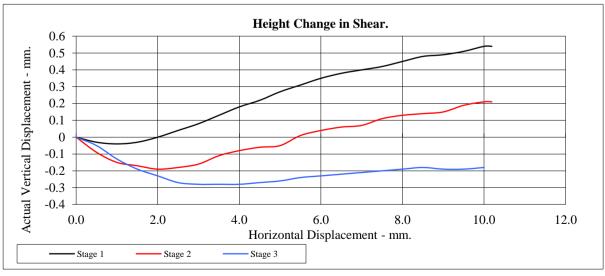
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH11	Top Depth:	1.80
Sample Number:	20	Base Depth:	2.20







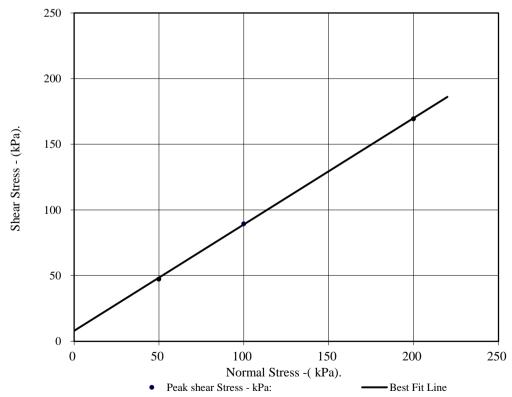


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Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH11		Top Depth:		3.80	
Sample Number:	Base Depth:		h: 4.20		20	
Sample Conditions:		Submerged	Sample Typ	e	F	3
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort				
		ed passing 2mm sieve				
Sample Description:	See summar	ry of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				19.98	19.98	19.98
Length - mm:				60.01	60.01	60.01
Moisture Content - %:				2.7	2.7	2.7
Bulk Density - Mg/m3:				1.72	1.72	1.73
Dry Density - Mg/m3:				1.67	1.68	1.68
Voids Ratio:				0.583	0.578	0.574
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				19.70	19.19	18.93
		Shearing Stage				
Rate of Strain (mm/min)				0.800	0.800	0.800
Displacement at peak shear s	tress (mm)			5.00	6.00	5.00
Peak shear Stress - kPa:				47	89	169
	Fi	nal Consolidated Condi	tions			
Moisture Content - %:				19	19	19
Bulk Density - Mg/m3:				1.74	1.80	1.82
Dry Density - Mg/m3:				1.46	1.50	1.53
	<u> </u>	Peak				
Angle of Shearing Resistance	::(0)				39	
Effective Cohesion - kPa:					8	

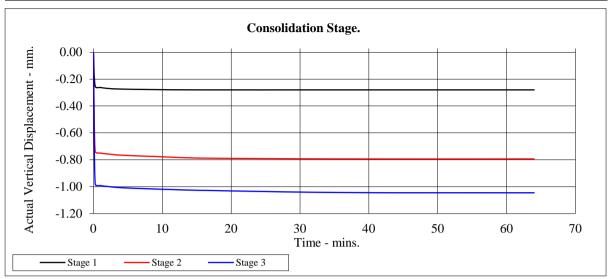


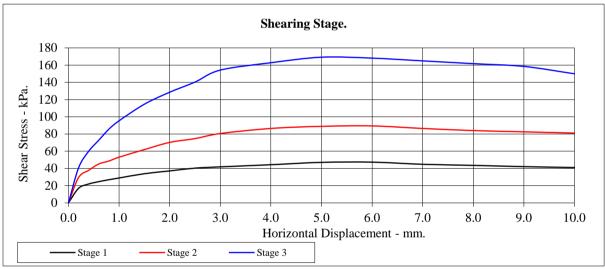


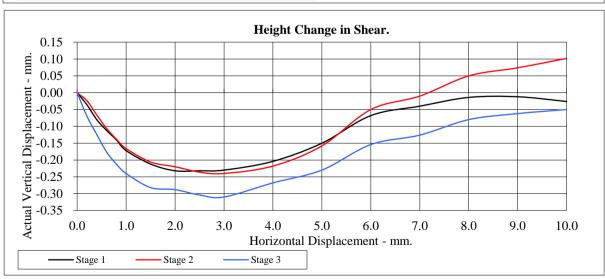
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH11	Top Depth:	3.80
Sample Number:	22	Base Depth:	4.20





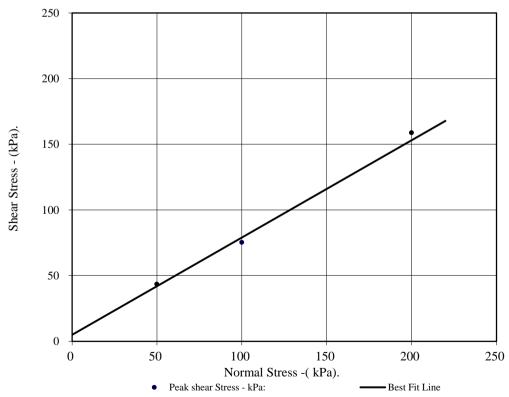




Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH11		Top Depth:		9.80	
Sample Number:	28 Base Depth		Depth: 10.20		20	
Sample Conditions:		Submerged	Sample Typ	e	F	3
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort				
		ed passing 2mm sieve				
Sample Description:	See summar	ry of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				24.51	24.51	24.51
Length - mm:				60.00	60.00	60.00
Moisture Content - %:				4.8	4.8	4.8
Bulk Density - Mg/m3:				1.76	1.76	1.77
Dry Density - Mg/m3:				1.68	1.68	1.69
Voids Ratio:				0.581	0.578	0.568
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				24.38	24.04	23.94
		Shearing Stage				
Rate of Strain - mm/min				0.80	0.80	0.80
Displacement at peak shear st	tress - mm			0.00	0.00	0.00
Peak shear Stress - kPa:				44	75	159
	Fi	nal Consolidated Condi	itions			
Moisture Content - %:				20	20	19
Bulk Density - Mg/m3:				1.77	1.79	1.81
Dry Density - Mg/m3:				1.47	1.49	1.52
		Peak				
Angle of Shearing Resistance	::(0)				37	
Effective Cohesion - kPa:					5	

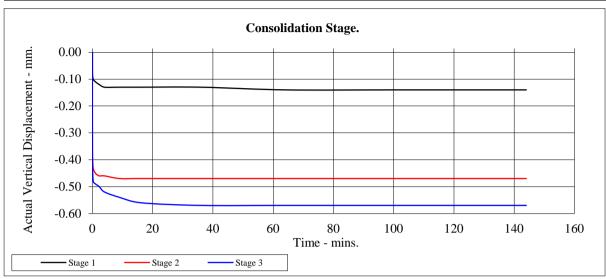


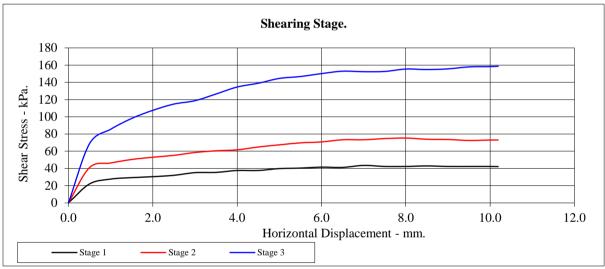


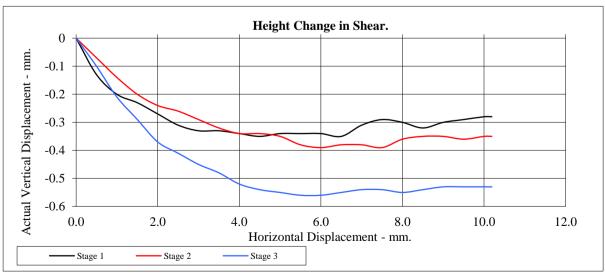
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH11	Top Depth:	9.80
Sample Number:	28	Base Depth:	10.20







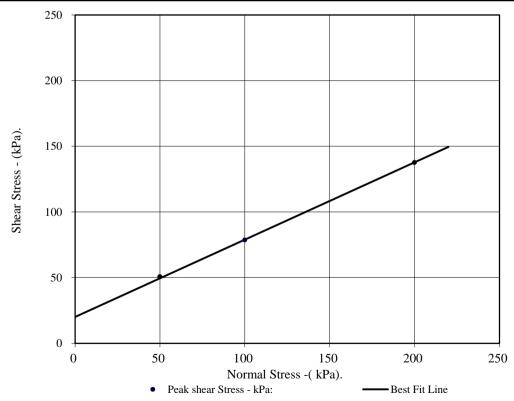


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Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:		BH16 Top I			6.80	
Sample Number:		Base Depth		pth: 7.20		20
Sample Conditions:		Submerged	Sample Typ	be	I	3
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort.				
Sample Freparation.	Material test	ed passing 2mm sieve				
Sample Description:	See summar	ry of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				19.98	19.98	19.98
Length - mm:				60.01	60.01	60.01
Moisture Content - %:				13	13	13
Bulk Density - Mg/m3:				2.01	2.01	2.02
Dry Density - Mg/m3:				1.78	1.78	1.78
Voids Ratio:				0.493	0.488	0.487
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				19.56	19.22	19.02
		Shearing Stage				
Rate of Strain (mm/min)				0.800	0.800	0.800
Displacement at peak shear s	stress (mm)			3.00	8.00	5.00
Peak shear Stress - kPa:				51	79	138
	Fi	nal Consolidated Condi	itions			
Moisture Content - %:				18	19	18
Bulk Density - Mg/m3:				2.05	2.09	2.12
Dry Density - Mg/m3:				1.74	1.76	1.79
		Peak				
Angle of Shearing Resistance	e:(0)				31	
Effective Cohesion - kPa:					20	

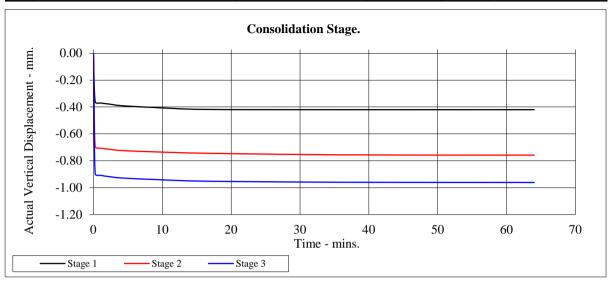


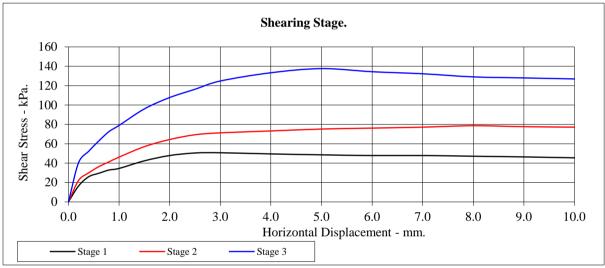


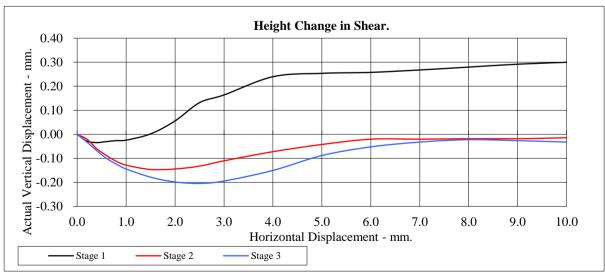
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16	Top Depth:	6.80
Sample Number:	13	Base Depth:	7.20





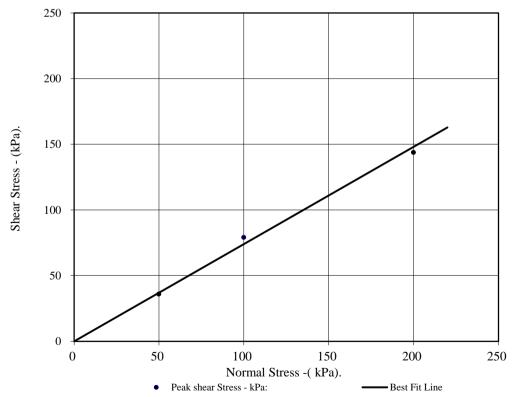




Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16 To		Top Depth:		8.80	
Sample Number:		14 Base De		Base Depth:		20
Sample Conditions:		Submerged	Sample Typ	e	F	3
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort				
		ed passing 2mm sieve				
Sample Description:	See summar	ry of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				24.51	24.51	24.51
Length - mm:				60.00	60.00	60.00
Moisture Content - %:				24	24	24
Bulk Density - Mg/m3:				1.96	1.97	1.98
Dry Density - Mg/m3:				1.58	1.59	1.60
Voids Ratio:				0.673	0.670	0.660
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				24.21	24.08	23.99
		Shearing Stage				
Rate of Strain - mm/min				0.80	0.80	0.80
Displacement at peak shear s	tress - mm			2.00	3.00	3.50
Peak shear Stress - kPa:				36	79	144
	Fi	nal Consolidated Condi	tions			
Moisture Content - %:				22	22	21
Bulk Density - Mg/m3:			,	1.99	2.00	2.02
Dry Density - Mg/m3:				1.62	1.63	1.66
		Peak				
Angle of Shearing Resistance	::(0)				37	
Effective Cohesion - kPa:					0	

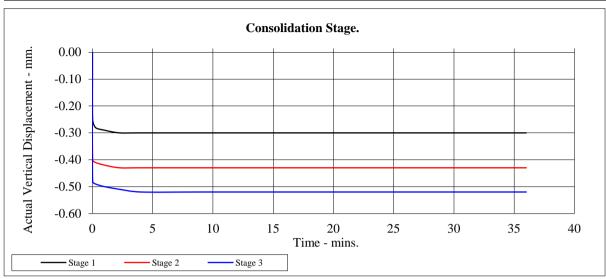


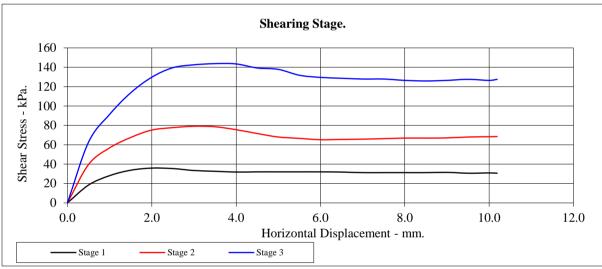


Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16	Top Depth:	8.80
Sample Number:	14	Base Depth:	9.20







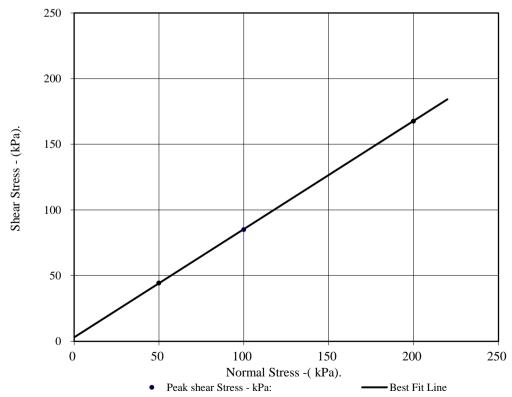


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Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16		Top Depth:		10.80	
Sample Number:		16 B		Base Depth:		20
Sample Conditions:		Submerged	Sample Typ	e	ŀ	3
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort				
		ed passing 2mm sieve				
Sample Description:	See summar	ry of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				19.98	19.98	19.98
Length - mm:				60.01	60.01	60.01
Moisture Content - %:				20	20	20
Bulk Density - Mg/m3:				1.92	1.92	1.93
Dry Density - Mg/m3:				1.61	1.61	1.61
Voids Ratio:				0.649	0.648	0.641
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				19.34	19.13	18.95
		Shearing Stage				
Rate of Strain (mm/min)				0.800	0.800	0.800
Displacement at peak shear st	tress (mm)			3.00	3.00	4.00
Peak shear Stress - kPa:				44	85	167
	Fi	nal Consolidated Condi	tions			
Moisture Content - %:				22	21	19
Bulk Density - Mg/m3:				1.99	2.01	2.04
Dry Density - Mg/m3:				1.63	1.66	1.71
	<u> </u>	Peak				
Angle of Shearing Resistance	::(0)				40	
Effective Cohesion - kPa:					3	

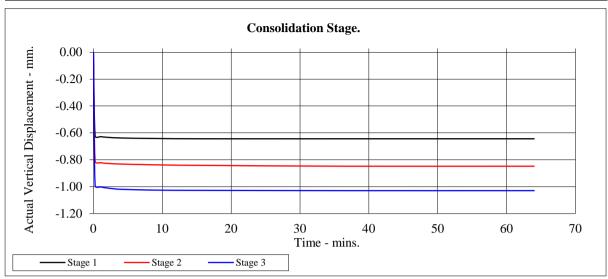


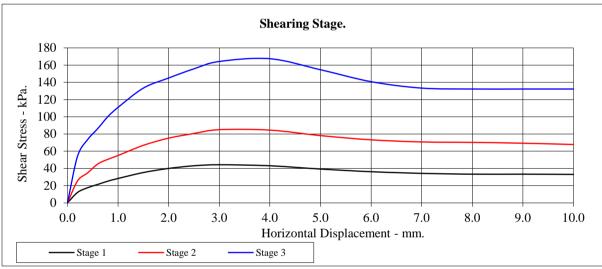


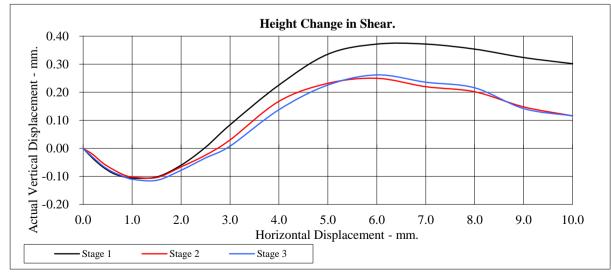
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BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16	Top Depth:	10.80
Sample Number:	16	Base Depth:	11.20





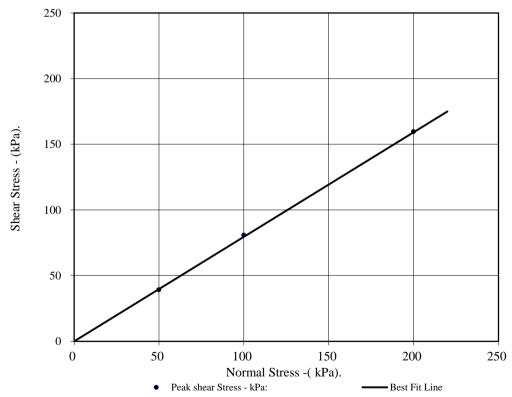




Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17 T		Top Depth:		1.80		
Sample Number:		16 Base Dep		Base Depth:		20	
Sample Conditions:		Submerged	Sample Typ	e	I	В	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:				
Sample Preparation:	Remoulded	using hand tamped effort					
		ed passing 2mm sieve					
Sample Description:	See summar	ry of soil descriptions.					
STAGE				1	2	3	
		Initial Conditions					
Height - mm:				24.51	24.51	24.51	
Length - mm:				60.00	60.00	60.00	
Moisture Content - %:				4.7	4.7	4.7	
Bulk Density - Mg/m3:				1.81	1.81	1.82	
Dry Density - Mg/m3:				1.73	1.73	1.73	
Voids Ratio:				0.529	0.534	0.528	
Normal Pressure- kPa				50	100	200	
		Consolidation Stage					
Consolidated Height - mm:				24.33	24.22	24.12	
		Shearing Stage					
Rate of Strain - mm/min				0.80	0.80	0.80	
Displacement at peak shear s	tress - mm			3.00	4.50	4.50	
Peak shear Stress - kPa:				39	81	160	
	Fi	nal Consolidated Condi	tions				
Moisture Content - %:				19	19	18	
Bulk Density - Mg/m3:				1.83	1.83	1.85	
Dry Density - Mg/m3:				1.53	1.54	1.56	
		Peak					
Angle of Shearing Resistance	e:(0)				39		
Effective Cohesion - kPa:					0		

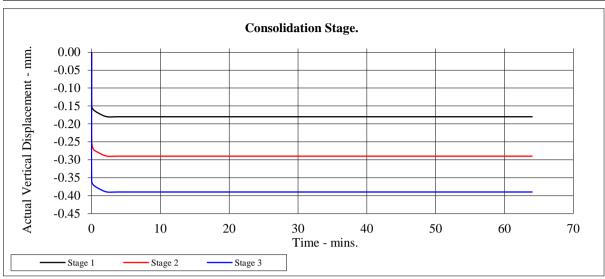


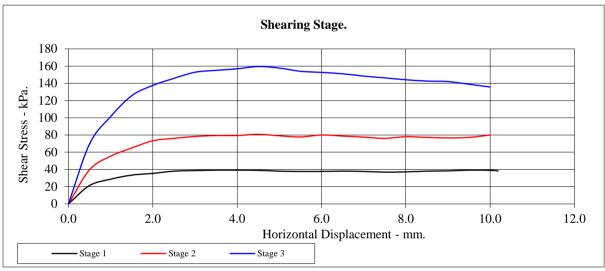


Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17	Top Depth:	1.80
Sample Number:	16	Base Depth:	2.20





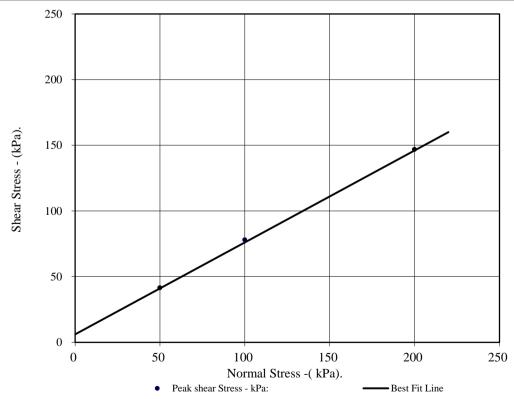




Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17 Top D		Top Depth:		3.80	
Sample Number:		18 Base		Base Depth:		20
Sample Conditions:		Submerged	Sample Typ	e	В	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort				
		ed passing 2mm sieve				
Sample Description:	See summar	y of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				24.51	24.51	24.51
Length - mm:				60.00	60.00	60.00
Moisture Content - %:				4.0	4.0	4.0
Bulk Density - Mg/m3:				1.79	1.79	1.80
Dry Density - Mg/m3:				1.72	1.73	1.73
Voids Ratio:				0.540	0.536	0.530
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				24.29	24.26	24.13
		Shearing Stage				
Rate of Strain - mm/min				0.80	0.80	0.80
Displacement at peak shear st	tress - mm			6.00	10.00	9.00
Peak shear Stress - kPa:				42	78	147
	Fi	nal Consolidated Condi	tions			
Moisture Content - %:				18	17	17
Bulk Density - Mg/m3:				1.81	1.81	1.83
Dry Density - Mg/m3:				1.53	1.54	1.57
		Peak				
Angle of Shearing Resistance	::(0)				35	
Effective Cohesion - kPa:					6	

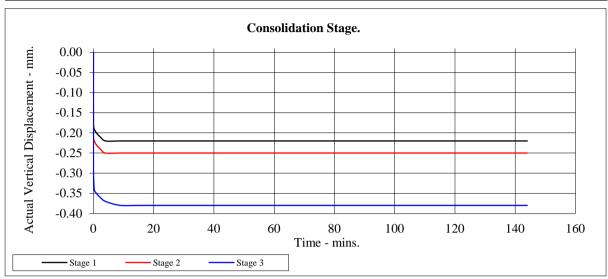


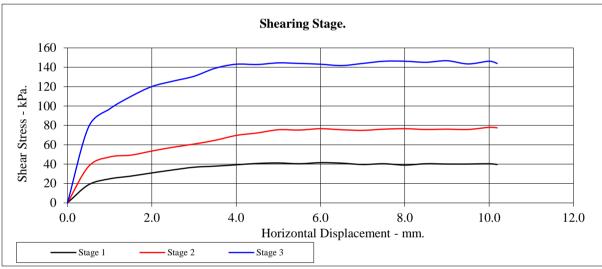


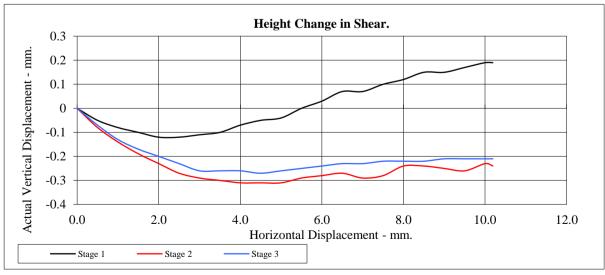
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17	Top Depth:	3.80
Sample Number:	18	Base Depth:	4.20







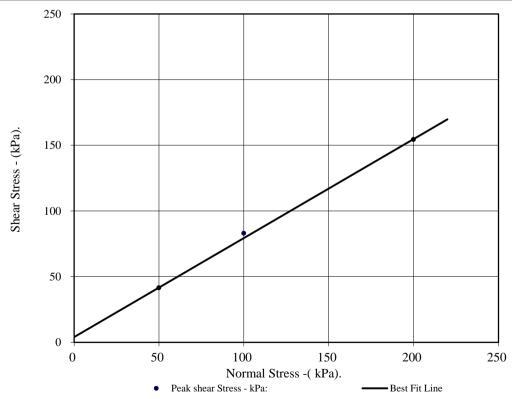


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Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17 Top		Top Depth:		10.80	
Sample Number:		25 Base		Base Depth:		20
Sample Conditions:		Submerged	Sample Typ	oe .	В	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort				
1		ed passing 2mm sieve				
Sample Description:	See summar	y of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				24.51	24.51	24.51
Length - mm:				60.00	60.00	60.00
Moisture Content - %:				5.6	5.6	5.6
Bulk Density - Mg/m3:				1.74	1.75	1.76
Dry Density - Mg/m3:				1.65	1.66	1.67
Voids Ratio:				0.604	0.598	0.586
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				24.31	24.20	24.13
		Shearing Stage				
Rate of Strain - mm/min				0.80	0.80	0.80
Displacement at peak shear st	ress - mm			5.00	4.50	4.50
Peak shear Stress - kPa:				42	83	154
	Fi	nal Consolidated Condi	itions			
Moisture Content - %:				20	19	19
Bulk Density - Mg/m3:			·	1.76	1.77	1.79
Dry Density - Mg/m3:				1.46	1.49	1.51
		Peak				
Angle of Shearing Resistance	:(0)				37	
Effective Cohesion - kPa:					4	

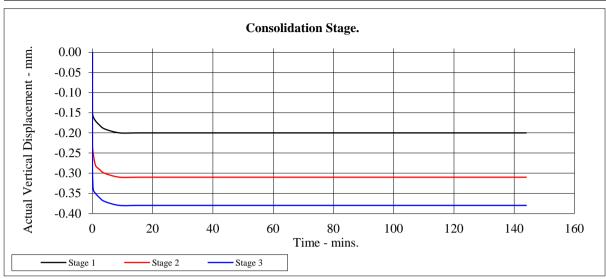


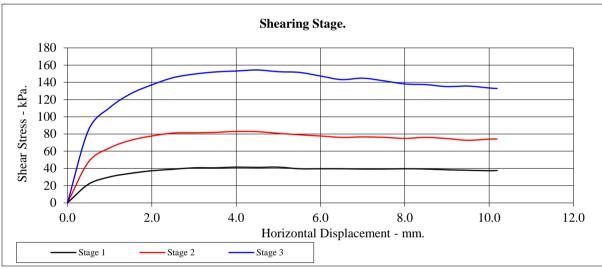


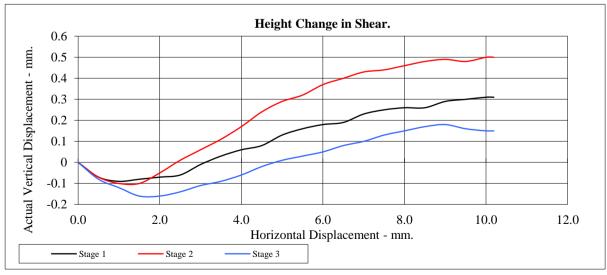
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17	Top Depth:	10.80
Sample Number:	25	Base Depth:	11.20







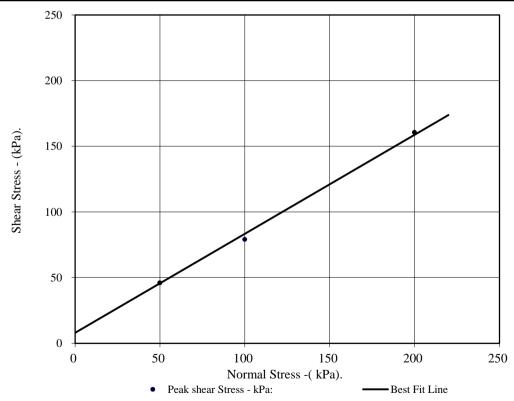


PSL Professional Soils Laboratory

Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:		BH18 T			0.8	80
Sample Number:		1	Base Depth:		2.2	20
Sample Conditions:		Submerged	Sample Type B			3
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort.	.]			
Sample Freparation.	Material test	ed passing 2mm sieve				
Sample Description:	See summar	ry of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				19.98	19.98	19.98
Length - mm:				60.01	60.01	60.01
Moisture Content - %:				3.6	3.6	3.6
Bulk Density - Mg/m3:				1.74	1.74	1.74
Dry Density - Mg/m3:				1.67	1.68	1.68
Voids Ratio:				0.582	0.582	0.581
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				19.67	19.11	18.38
		Shearing Stage				
Rate of Strain (mm/min)				0.800	0.800	0.800
Displacement at peak shear s	stress (mm)			8.00	4.00	5.00
Peak shear Stress - kPa:				46	79	161
	Fi	nal Consolidated Condi	itions			
Moisture Content - %:				19	19	18
Bulk Density - Mg/m3:		·		1.76	1.82	1.89
Dry Density - Mg/m3:				1.48	1.52	1.60
		Peak				
Angle of Shearing Resistance	e:(0)				37	<u> </u>
Effective Cohesion - kPa: 8			8			



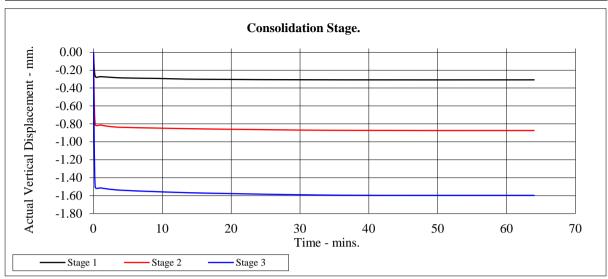


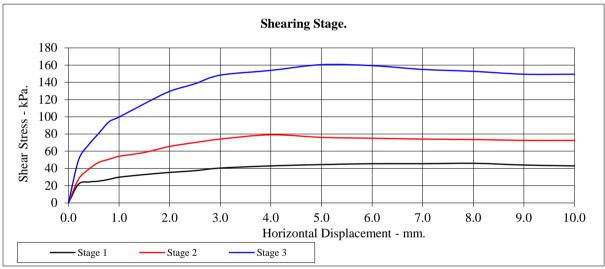
Arklow Sewerage Scheme Marine Outfall GI

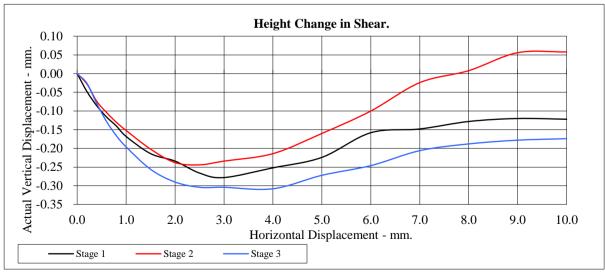
Contract No:
PSL17/5705
Client Ref:
17-0167

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH18	Top Depth:	0.80
Sample Number:	1	Base Depth:	2.20





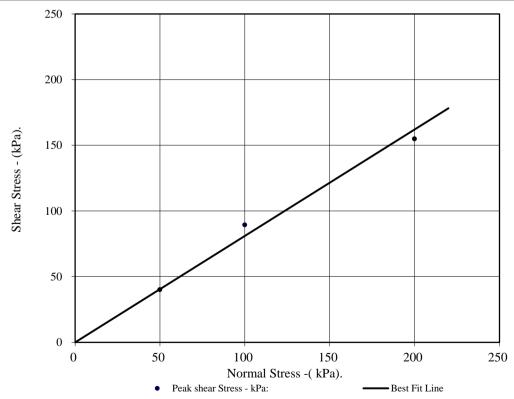




Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH18		Top Depth:	p Depth:		80
Sample Number:		7 Ba		:	10.	20
Sample Conditions:		Submerged Sample Typ		oe .	В	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort				
		ed passing 2mm sieve				
Sample Description:	See summar	y of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				24.51	24.51	24.51
Length - mm:				60.00	60.00	60.00
Moisture Content - %:				5.7	5.7	5.7
Bulk Density - Mg/m3:				1.82	1.82	1.82
Dry Density - Mg/m3:				1.72	1.72	1.72
Voids Ratio:				0.539	0.537	0.536
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				24.27	24.18	24.04
		Shearing Stage				
Rate of Strain - mm/min				0.80	0.80	0.80
Displacement at peak shear st	tress - mm			5.50	3.50	7.00
Peak shear Stress - kPa:				40	89	155
	Fi	nal Consolidated Condi	itions			
Moisture Content - %:				19	17	17
Bulk Density - Mg/m3:				1.84	1.85	1.86
Dry Density - Mg/m3:			`	1.55	1.57	1.59
		Peak				
Angle of Shearing Resistance:(0)						
Effective Cohesion - kPa:					0	

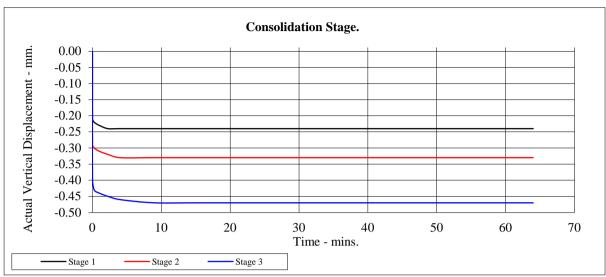


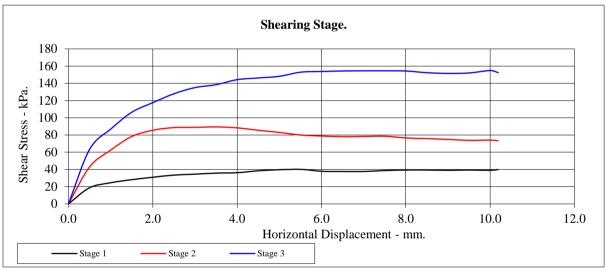


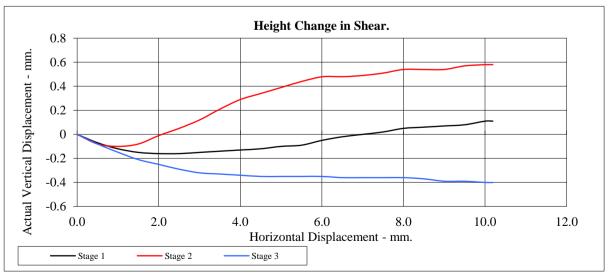
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH18	Top Depth:	9.80
Sample Number:	7	Base Depth:	10.20





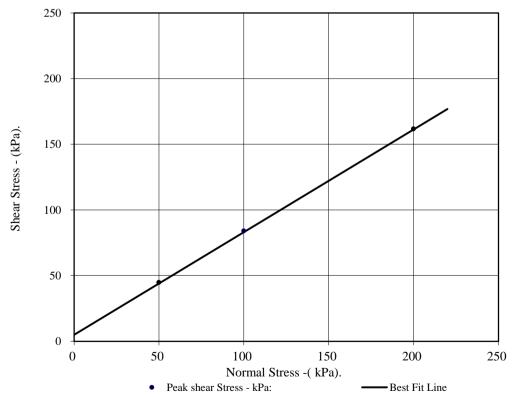




Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH19		Top Depth:		0.80	
Sample Number:		1 E		:	1.20	
Sample Conditions:		Submerged Sample Type			В	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:			
Sample Preparation:	Remoulded	using hand tamped effort				
		ed passing 2mm sieve				
Sample Description:	See summar	ry of soil descriptions.				
STAGE				1	2	3
		Initial Conditions				
Height - mm:				19.98	19.98	19.98
Length - mm:				60.01	60.01	60.01
Moisture Content - %:				3.9	3.9	3.9
Bulk Density - Mg/m3:				1.70	1.70	1.71
Dry Density - Mg/m3:				1.63	1.64	1.65
Voids Ratio:				0.621	0.616	0.611
Normal Pressure- kPa				50	100	200
		Consolidation Stage				
Consolidated Height - mm:				19.64	19.52	19.11
		Shearing Stage				
Rate of Strain (mm/min)				0.800	0.800	0.800
Displacement at peak shear s	tress (mm)			6.00	5.00	7.00
Peak shear Stress - kPa:				45	84	162
	Fi	nal Consolidated Condi	tions			
Moisture Content - %:				21	20	20
Bulk Density - Mg/m3:				1.73	1.74	1.79
Dry Density - Mg/m3:				1.42	1.45	1.49
	<u> </u>	Peak				
Angle of Shearing Resistance:(0) 38						
Effective Cohesion - kPa:					5	

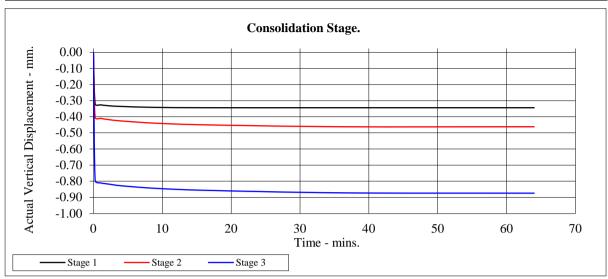


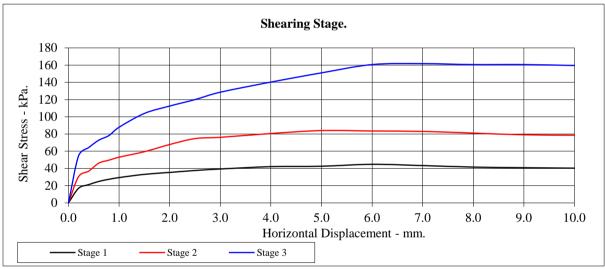


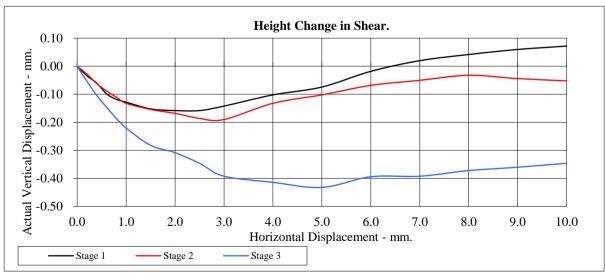
Arklow Sewerage Scheme Marine Outfall GI

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH19	Top Depth:	0.80
Sample Number:	1	Base Depth:	1.20









Arklow Sewerage Scheme Marine Outfall GI



LABORATORY RESTRICTION REPORT

Project Reference	17-0167			То	Neil Haggan
Project Name	Arklow Sewerage Scheme Marine Outfall GI			Position	Project Manager
1 Toject Name	Arklow Sewerage Scheme Manne Oditali Gi			From	Stephen Watson
TR reference	17-0167	1	q		Gropiien rraisen
TTC TOTOTOTIO	17 0107	,	J	Position	Laboratory Manager

The following sample(s) and test(s) are restricted as detailed below. Could you please complete the "Required Action" column and return the completed form to the laboratory.

Hole		Sample		Test		
Number	Number	Depth	Type	Type	Reason for Restriction	Required Action
BH11	10	9.5	D	Atterberg limits	Unsuitable material for test (sandy gravel)	TESTING CANCELLED
BH16	17	4.00- 4.50	UT	Unconsolidated Undrained Triaxial	Sample too granular for test (mostly sand) - collapsed on extrusion	TESTING CANCELLED
BH16	12	5.80- 6.20	В	PSD	No suitable test specimen. Sample damaged/split in transit to laboratory	TESTING CANCELLED
BH18	15	2.00- 2.50	UT	Unconsolidated Undrained Triaxial	Sample too granular for test (mostly sand) - collapsed on extrusion	TESTING CANCELLED
BH18	2	2.8	В	Atterberg limits	Unsuitable material for test (sandy gravel)	TESTING CANCELLED
BH19	17	2.5	D	Atterberg limits, pH & So4	No Sample - lost in transit	TESTING CANCELLED
BH19	20	5.5	D	NMC & Atterberg limits	Unsuitable material for test (Gravel)	TESTING CANCELLED

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

Laboratory Signature Stephen Watson	Project Manager Signature Darren O'Mahony
Date	Date
14 December 2017	14 December 2017



SOIL AND ROCK SAMPLE ANALYSIS LABORATORY TEST REPORT

Client:	Irish Water
Engineer:	Byrne Looby ARUP J.V.
From:	Stephen Watson
	Laboratory Manager
	Causeway Geotech Ltd
Tel:	+44(0)2827666640
E-mail:	stephen.watson@causewaygeotech.com
Date:	07/12/17
Ref:	17-0167 - ROCK 1

Arklow Sewerage Scheme Marine Outfall GI

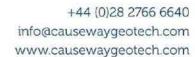
We are pleased to attach the results of laboratory testing carried out for the above project. This memo and its attachments constitute a report of the results of tests as detailed in the *Contents page(s)*.

The attached results complete the testing requested and we would therefore wish to confirm that samples will be retained without charge for a period of 60 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





Project Name Arklow Sewerage Scheme Marine Outfall GI

Report Reference. 17-0167 - ROCK 1

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

Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report
SOIL	Undrained shear strength – triaxial compression without measurement of pore pressure (loads from 0.12 to 24 kN)	BS1377: Part 7: Clause 8: 1990	2
ROCK	Point load index	ISRM Commission on Testing Methods. Suggested Method for Determining Point Load Strength 1985	18

CAUSEWAY	Unconsolidate Compression				Jok	Ref			17-0	167	
—— GEOTECH	of pore pressi				Вог	ehole/Pit N	No.		ВН	08	
Site Name	Arklow Sewerage Sc	heme Marine O	utfall GI		Sai	mple No.					
Soil Description	Brown sandy gravelly				De	oth			15.1	10	
Specimen Reference	1	Specimen Depth		I	m Sai	mple Type		С			
Specimen Description	Stiff brown sandy gra	avelly sity CLAY			Ke	/LAB ID		C	aus2017	7120518	
Test Method	BS1377 : Part 7 : 19	90, clause 8, sin	igle specime	n	Dat	te of test			06/12/	2017	
	Test Number Length Diameter Bulk Density Moisture Content Dry Density					1 200.0 100.0 2.49 10.3 2.26		mm mm Mg/m3 % Mg/m3			
	Rate of Strain Cell Pressure At failure	Axial Strain Deviator Stress Undrained She Mode of Failure	ar Strength,			2.0 335 20.0 469 234		%/min kPa % kPa kPa ½	∕₂(σ1 - c	53)f	
iator Stress v A	Axial Strain										
500											\dashv
400		******	••••								
300											
200											
100											
0 2	4 6 8	10 12		16 18	20	22	24	26	28	30	32
hr Circles			Axial S	Strain %							
500								for area	or stress a change ane effe		ed
100							-		ircles an	nd their s not cov	ered
300							-	by BS1 This is		d for	
								millionii	adon onl	у.	
200							-				
				• 1	1	1	1				
100 -							_				
100 0 100	200 300 400	500 600 Normal Stre		800 900	1000	1100 1	200				
100 0 100 Remarks	200 300 400 ated at 20% strain				Printe			1	F	Fig. No.	

CALISEWAY	Unconsolida				nt	Job Ref			17-0167
CAUSEWAY	of pore press				ent [Borehole	/Pit No.		BH08
Site Name	Arklow Sewerage		-			Sample N	No.	1	
Soil Description	Light brown sandy	gravelly silty Cl	_AY.			Depth			17.00
Specimen Reference	1	Specimen Depth			m	Sample T	- Гуре		С
Specimen Description	Stiff light brown sa	andy gravelly silt	y CLAY.			KeyLAB I	iD	Caus	2017120519
Test Method	BS1377 : Part 7 : '	1990, clause 8,	single speci	men	\Box	Date of te	est	06	6/12/2017
	Test Number Length Diameter Bulk Density Moisture Content					1 200 100 2.4 25	0.0 0.0 41 5.1	mm mm Mg/m3	
	Dry Density				L	1.9	93	Mg/m3	
	Rate of Strain Cell Pressure At failure	Axial Strain Deviator Stra Undrained S Mode of Fail	Shear Streng			2. 36 19 51 25 Plas	65 0.5 17 58	%/min kPa % kPa kPa ½(c	σ1 - σ3)f
iator Stress v <i>i</i>	Avial Strain		u. o				-	_	
600 T	- I I I				T	T			
500	+ + +		*****						
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0 2	4 6 8	10 12		16 1 al Strain %		20 22	24	26 2	8 30 3
nr Circles									
500								Deviator st for area ch membrane	•
100								Mohr circle	es and their
								interpretati	ion is not covered
300	+ + +				-			by BS1377 This is pro	vided for
					_			information	n only.
200					1				
00		<u></u>		\bot					
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0					<u> </u>				
0 100	200 300 400		0 700 tresses kPa		900 1	000 1100	1200		
em <u>arks</u>			Approve			Printed			
Ctuanantha ann	rected for area chang	e. and			7 [07/40/00	17 12:07	٦	Fig. No.
	ects based on Fig 11		Stepn	en.Watson		07/12/20	17 12.07		1 1

GEOTECH							Р	oint			Strength Index Tests mary of Results								
Project No.	17-0167			Project Name Arklow Sewerage Scheme Marine Outfall GI															
Borehole	Sa	ample		Spe	cimen			Type SRM				nsions		Force P	Equivalent diameter, De		Load th Index	Remarks (including	
No.	Depth m	Ref.	Туре	Ref.	Depth m	Rock Type	Type (D, A, I, B)	Direction (L, P or U)	Failure Valid (Y/N)	Lne	W	Dps	Dps'	kN	g Equivale	Is MPa	Is(50) MPa	water content if measured)	
BH02	24.70	1	С	1	24.70	AMPHOLITE	D	U	NO	132.0		101.0	95.0	38.6	98.4	4.0	5.4		
BH05	23.25	1	С	2	23.25	AMPHOLITE	ı	U	YES	36.0	42.0	29.0	24.0	2.3	35.8	1.8	1.5		
BH07	14.65	1	С	3	14.65	BRECCIA	1	U	YES	99.0	78.0	63.0	60.0	0.3	77.2	0.1	0.1		
BH07	14.90	2	С	4	14.90	BRECCIA	ı	U	YES	13.0	79.0	65.0	62.0	0.2	79.0	0.0	0.0		
BH09	10.60	1	С	5	10.60	AMPHIBOLITE	ı	U	NO	33.0	52.0	50.0	48.0	0.4	56.4	0.1	0.1		
BH09	12.80	2	С	6	12.80	AMPHIBOLITE	ı	U	YES	43.0	56.0	38.0	35.0	2.2	50.0	0.9	0.9		
BH09	13.10	3	С	7	13.10	AMPHIBOLITE	Ţ	U	YES	111.0	98.0	78.0	72.0	19.3	94.8	2.1	2.9		
BH09	13.60	4	С	8	13.60	AMPHIBOLITE	Α	U	NO		102.0	65.0	58.0	29.3	86.8	3.9	5.0		
BH10	10.70	1	С	9	10.70	SLATE	А	U	YES		102.0	50.0	47.0	0.5	78.1	0.1	0.1		
BH10	11.90	2	С	10	11.90	SLATE	Α	U	NO		101.0	44.0	38.0	6.5	69.9	1.3	1.5		
BH10	12.35	3	С	11	12.35	SLATE	Α	U	NO		101.0	56.0	51.0	0.9	81.0	0.1	0.2		
BH10	12.60	4	С	12	12.60	SLATE	Α	U	NO		102.0	72.0	68.0	1.1	94.0	0.1	0.2		
BH10	13.00	5	С	13	13.00	SLATE	А	U	YES		102.0	63.0	60.0	1.3	88.3	0.2	0.2		
BH10	13.20	6	С	14	13.20	SLATE	Α	U	NO		101.0	58.0	51.0	5.2	81.0	0.8	1.0		
BH10	13.80	7	С	15	13.80	SLATE	А	U	NO		101.0	66.0	61.0	2.3	88.6	0.3	0.4		
BH10	14.30	8	С	16	14.30	SLATE	А	U	YES		102.0	72.0	66.0	1.9	92.6	0.2	0.3		
BH10	15.60	9	С	17	15.60	SLATE	Α	U	NO		101.0	48.0	41.0	3.6	72.6	0.7	0.8		
BH10	15.80	10	С	18	15.80	SLATE	Α	U	NO		102.0	53.0	48.0	0.9	79.0	0.1	0.2		
Test Type D - Diametral, A Direction L - parallel to pla P - perpendicula U - unknown or r Dimensions Dps - Distance b Dps' - at failure (Lne - Length fror W - Width of sh	nes of weak r to planes of random netween plat see ISRM r m platens to	ens (planote 6)	ness aten se	eparatio	on)		D _{ps}	Diamet	tral P	(*)	D _{ps}	Axia	P	L _r	Blo	ock/irre	gular lu	D _{ps}	
Test performed in Detailed legend in Size factor, F =	for test and	dimensi	ons, ba	-		ods : 2007, unless s shown above.	noted	otherwi	ise			Printed 7/2017	00:00	Appro Stepl		y Vatson	Table sheet	1	



APPENDIX E Environmental laboratory results



ESG Environmental Chemistry - Requested Analysis

Customer Causeway Geotech Ltd

Site Arklow Sewerage Scheme Marine Outfall GI

Report No S179335

Consignment No S69456
Date Logged 05-Oct-2017

Report Due 18-Oct-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report B	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB-7 Congeners (Marine Sediments)	^Dibutyltin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	No	No	No	No	No	No	Yes
CL/1777961	BH01 0.50	21/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1777962	BH01 2.50	21/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1777963	CRM	21/09/17		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1777964	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1777965	Reference Material (% Recovery	<i>(</i>)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)
ID Number	Description	Sediments	Sediments	Sediments	Sediment	Sediments
S1777961	BH01 0.50	14.3	0.85	18.7	81.8	75.1
S1777962	BH01 2.50	9.5	0.12	17.8	32.9	37.9
S1777963	CRM	17.55	1.58	62.55	54.93	80.16
S1777964	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
0	Reference Material					
S1777965	(% Recovery)	98	100	103	96	103

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Manganese	Mercury (MS)	Nickel (MS)	Zinc (MS)	Iron
ID Number	Description	(MS) Sediments	Sediments	Sediments	Sediments	(Sediments)
S1777961	BH01 0.50	319	0.02	17.4	200	22100
S1777962	BH01 2.50	361	<0.015	15.3	79.4	20200
S1777963	CRM	1148	0.724	32.92	323	27700
S1777964	QC Blank	<0.5	<0.015	<0.5	<2	<36
	Reference Material					
S1777965	(% Recovery)	100	96	100	100	102

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005	
	Detection Limit	0.1	0.02	0.12	5	2	
	Units	%	% M/M	%	ug/kg	ug/kg	
		Tot.Moisture @	Total Organic				
		_	Carbon	Carbonate %	^Dibutyltin	^Tributyltin	
ID Number	Description	105C	(Sediment)				
S1777961	BH01 0.50	47.9	2.67	4.32	<5.00	7.1	
S1777962	BH01 2.50	17.5	0.36	3.6	< 5.00	<2.00	
S1777963	CRM		3.16		69	83	
S1777964	QC Blank		<0.02		<5	<2	
	Reference Material						
S1777965	(% Recovery)		105	98	84	92	

Sample ID	Client ID	Moisture (%)
CL/1777961	BH01 0.50	56.2
CL/1777962	BH01 2.50	15.9

		Sample ID :	CL1777964	CL1777965	CL1777961	CL1777962	CL1777963
		Station :	QC Blank	Reference Material (% Recovery)	BH01 0.50	BH01 2.50	CRM
PAH Fraction	# PAH	Mass					
Naphthalene	1	128	<1	97.3	12.5	<1	532.9
C1 Naphthalenes *	2	142	<1	96.7	28.0	1.5	292.9
C2 Naphthalenes *		156	<1	N.D	87.2	3.5	208.5
C3 Naphthalenes *		170	<1	N.D	108.0	4.5	167.5
C4 Naphthalenes *		184	<1	N.D	101.4	4.9	106.1
Sum Naphthalenes *			0	97	337	14	1308
Phenanthrene / Anthracene	2	178	<1	97.4	86.2	5.3	484.7
C1 178 *		192	<1	N.D	99.8	5.0	267.6
C2 178 *		206	<1	N.D	118.1	5.6	239.6
C3 178 *		220	<1	N.D	156.1	3.7	162.1
Sum 178 *			0	97	460.2	19.6	1153.8
Dibenzothiophene *		184	<1	92	8.9	<1	41.4
C1 Dibenzothiophenes *		198	<1	N.D	26.1	1.3	59.8
C2 Dibenzothiophenes *		212	<1	N.D	54.3	2.3	97.7
C3 Dibenzothiophenes *		226	<1	N.D	67.2	2.5	85.8
Sum Dibenzothiophenes *			0	92	156.5	6.0	284.8
Fluoranthene / pyrene	2	202	<1	95	266.9	15.4	1008.9
C1 202 *		216	<1	N.D	86.2	4.5	248.2
C2 202 *		230	<1	N.D	69.9	3.3	205.5
C3 202 *		244	<1	N.D	44.5	1.7	119.4
Sum 202 *			0	95	467.5	24.9	1582.0
Benzoanthracene / Chrysene	2	228	<1	99	143.1	7.7	649.4
C1 228 *		242	<1	N.D	157.6	5.2	265.1
C2 228 *		256	<1	N.D	69.6	2.4	152.0
Sum 228 *			0	99	370.2	15.2	1066.6
Benzofluoranthenes / benzopyrenes	4	252	<1	98	254.0	12.3	1236.5
C1 252 *		266	<1	N.D	79.8	4.1	241.3
C2 252 *		280	<1	N.D	48.0	2.1	208.8
Sum 252 *			0	98	381.8	18.5	1686.6
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	81	117.6	4.5	517.2
C1 276 *		290	<1	N.D	20.6	<1	69.0
C2 276 *		304	<1	N.D	8.7	<1	37.8
Sum 276 *			0	81	146.9	4.5	624.0
Sum of all fractions *			0	94	2320.2	103.2	7705.5
Sum of NPD fraction *			0	95	953.8	40.0	2746.5
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.26	0.70	0.63	0.55

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

* Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1777964	CL1777965	CL1777961	CL1777962	CL1777963
	Station :	QC Blank	Reference Material (% Recovery)	BH01 0.50	BH01 2.50	CRM
PAH	Mass					
Naphthalene	128	<1	97.3	12.5	<1	532.9
Acenaphthylene	152	<1	102.6	4.1	<1	55.1
Acenaphthene	154	<1	104.1	11.3	<1	28.1
Fluorene	166	<1	104.9	17.7	<1	45.3
Phenanthrene	178	<1	99.2	67.9	3.9	344.6
Dibenzothiophene *	184	<1	92.1	8.9	<1	41.4
Anthracene	178	<1	95.5	18.2	1.4	140.0
Fluoranthene	202	<1	96.3	141.7	7.9	568.9
Pyrene	202	<1	94.5	125.2	7.5	439.9
Benzo[a]anthracene	228	<1	96.6	63.0	3.5	250.4
Chrysene	228	<1	101.8	80.1	4.2	399.1
Benzo[b]fluoranthene	252	<1	99.2	83.4	4.0	446.6
Benzo[k]fluoranthene	252	<1	95.2	38.2	1.9	211.8
Benzo[e]pyrene	252	<1	102.6	65.8	3.1	340.6
Benzo[a]pyrene	252	<1	93.4	66.7	3.3	237.6
Indeno[123,cd]pyrene	276	<1	81.7	52.2	2.1	254.0
Dibenzo[a,h]anthracene	278	<1	73.3	11.7	<1	52.9
Benzo[ghi]perylene	276	<1	87.6	53.6	2.4	210.3

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI **Customer and Site Details:** Matrix:

Soil S17_9335 05-Oct-17 Job Number: Date Booked in: 170010 Date Extracted: 13-Oct-17 QC Batch Number: Directory: 131017PCB.TQ1 Date Analysed: 13-Oct-17

Method: Ultrasonic

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1777961	BH01 0.50	0.6	1.1	0.6	0.4	0.6	0.7	0.3
CL1777962	BH01 2.50	0.1	0.2	<0.08	<0.08	<0.08	<0.08	<0.08
CL1777963	CRM	1.8	3.2	3.6	1.8	2.9	2.8	1.9
CL1777964	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1777965	Reference Material (% Recovery)	104	109	101	103	108	95	108

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_9335
QC Batch Number: 170010
Directory: 131017.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:05-Oct-17Date Extracted:13-Oct-17Date Analysed:13-Oct-17UKAS Accredited:No

Sample ID :	CL1777961	CL1777962	CL1777963	CL1777964	CL1777965
					Reference Material (%
Client ID:	BH01 0.50	BH01 2.50	CRM	QC Blank	Recovery)

Compound			Concentration (µg/kg))	
alpha-HCH	<0.10	<0.10	<0.10	<0.10	98
Hexachlorobenzene	0.11	<0.10	4.23	<0.10	93
gamma-HCH	<0.10	<0.10	<0.10	<0.10	100
p,p'-DDE	0.46	0.10	2.76	<0.10	88
Dieldrin	0.48	0.16	0.40	<0.10	97
p,p'-DDD	0.60	<0.10	4.16	<0.10	91
p,p'-DDT	0.30	<0.10	<0.10	<0.10	108

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17 9335

Directory:

D:\TES\DATA\2017\1012HSA GC9\101217 2017-10-12 13-19-49\009F0901.D

Method: Headspace GCFID

Matrix: Soil

Date Booked in: 05-Oct-17

Date extracted: 10-Dec-17

Date Analysed: 12-Oct-17, 15

* Sample data with an asterisk are not UKAS accredited.

Benzene			is wet weig	Aliphatics						
Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO	
<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2	
<0.010	<0.010	<0.010	< 0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2	
<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2	
94	97	100	101	93	115	110	118	114	115	
	<0.010 <0.010	<0.010 <0.010 <0.010 <0.010	<0.010	<0.010	<0.010 <0.010 <0.010 <0.010 <0.010	<0.010 <0.010 <0.010 <0.010 <0.010 <0.02 <0.010	<0.010 <0.010 <0.010 <0.010 <0.010 <0.2 <0.2 <0.010	<0.010 <0.010 <0.010 <0.010 <0.010 <0.2 <0.2 <0.2 <0.010	<0.010 <0.010 <0.010 <0.010 <0.010 <0.2 <0.2 <0.2 <0.2 <0.2 <0.010	

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

 Job Number:
 S17_9335
 Separation:
 Silica gel

 QC Batch Number:
 171092
 Eluents:
 Hexane, DCM

 Directory:
 D:\TES\DATA\Y2017\101617TPH GC3\101617 2017-10-16 11-46-47\055B0701.D

Method: Ultra Sonic

Date Booked ir 05-Oct-17

Matrix:

Date Extracted 13-Oct-17

Date Analysed 16-Oct-17, 13:13:56

Soil

			Concentration, (mg/kg) - as wet weight										
		>C8	- C10	>C10	- C12	>C12	- C16	>C16	- C21	>C21	- C35	>C8	- C40
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
CL1777961	BH01 0.50	<4*	<4*	<4	<4	<4	<4	5.76	7.45	37.5	34.5	45	49.8
CL1777962	BH01 2.50	<5*	<4*	<4	<4	<4	<4	<4	4.57	<8.76	14.4	<20	26.7
CL1777964	QC Blank	<6*	<4*	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
CL1777965	Reference Material (% Recovery)	98*	90*	103	88	99	93	97	101	100	105	99	97
													
													
													
													
													
	L		1		ı		ı	L	ı		L	L	

Report Number: EFS/179335

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
TPHUSSI	CL1777961 TO CL1777965	The Secondary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily (including the Primary Process Control) and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation , where applicable, from the affected analytes (Banding C8-C10 on both the Aliphatic and Aromatic fractions) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1777961 CL1777962 CL1777963	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Dibenzothiothene) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1777961 CL1777962 CL1777963	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.

Sample Descriptions

Client :	Causeway Geotech Ltd	
ite:	Arklow Sewerage Scheme Marine C	Outfall GI
eport Number :	S17_9335	
•		Note: major constituent in upper case
Lab ID Number	Client ID	Description
		Description
CL/1777961	BH01 0.50 BH01 2.50	MARINE SEDIMENT MARINE SEDIMENT QUALITY CONTROL SAMPLE
CL/1777962 CL/1777963	BH01 2.50	MARINE SEDIMENI
CL/17/7963	CRM QC Blank	QUALITY CONTROL SAMPLE
CL/1777964 CL/1777965	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/17/7965	Reference Material (% Recovery)	QUALITY CONTROL SAWIPLE
	+	
	+	

Appendix A Page 1 of 1 12/12/2017

ESG Environmental Chemistry - Requested Analysis

S178703

Customer Site

Causeway Geotech Ltd Arklow Sewerage Scheme Marine Outfall GI Consignment No S68869
Date Logged 14-Sep-2017

Report No S178703

Report Due 02-Oct-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^DibutyItin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
CL/1775344	BH02 1.50	29/08/17	С	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775345	BH02 3.50	29/08/17	С	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775346	CRM	29/08/17		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1775347	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1775348	Reference Material (% Recovery	y)	С	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Copper (MS) Sediment	Lead (MS) Sediments
S1775344	BH02 1.50	16.5	1.05	18.9	120	118.3
S1775345	BH02 3.50	16.1	0.42	17.1	116.7	99.7
S1775346	CRM	16.65	1.475	58.67	57.83	73.36
S1775347	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
S1775348	Reference Material (% Recovery)	105	107	107	95	109

Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
Detection Limit	0.5	0.015	0.5	2	36
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	Manganese	Mercury (MS)	Nickel (MS)	Zinc (MS)	Iron
Description	(MS) Sediments	Sediments	Sediments	Sediments	(Sediments)
BH02 1.50	533	0.12	14.9	302.6	30900
BH02 3.50	538.4	0.07	14.4	170.9	28300
CRM	1117	0.707	31.16	306.6	27700
QC Blank	<0.5	<0.015	<0.5	<2	<36
Reference Material	102	100	106	105	105
	Detection Limit Units Description BH02 1.50 BH02 3.50 CRM QC Blank	Detection Limit 0.5 Units mg/kg Manganese (MS) Sediments Description 533 BH02 1.50 533 BH02 3.50 538.4 CRM 1117 QC Blank <0.5	Detection Limit 0.5 0.015 Units mg/kg mg/kg Manganese (MS) Sediments Mercury (MS) Sediments BH02 1.50 533 0.12 BH02 3.50 538.4 0.07 CRM 1117 0.707 QC Blank <0.5	Detection Limit 0.5 0.015 0.5 Units mg/kg mg/kg mg/kg Manganese (MS) Sediments Mercury (MS) Sediments Nickel (MS) Sediments BH02 1.50 533 0.12 14.9 BH02 3.50 538.4 0.07 14.4 CRM 1117 0.707 31.16 QC Blank <0.5	Detection Limit 0.5 0.015 0.5 2 Units mg/kg mg/kg mg/kg mg/kg Manganese (MS) Sediments Mercury (MS) Sediments Nickel (MS) Sediments Sediments BH02 1.50 533 0.12 14.9 302.6 BH02 3.50 538.4 0.07 14.4 170.9 CRM 1117 0.707 31.16 306.6 QC Blank <0.5

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005
	Detection Limit	0.1	0.02	0.12		
	Units	%	% M/M	%	mg/kg	mg/kg
		Tot.Moisture @	Total Organic Carbon	Carbonate %	^Dibutyltin	^Tributyltin
ID Number	Description	105C	(Sediment)			
S1775344	BH02 1.50	53.4	3.08	3.12	<0.02	<0.05
S1775345	BH02 3.50	30.4	1.07	3.84	<0.02	<0.05
S1775346	CRM		2.8645			
S1775347	QC Blank		<0.02		<0.02	<0.05
S1775348	Reference Material (% Recovery)		91	102	100	107

Sample ID	Client ID	Moisture (%)
CL/1775344	BH02 1.50	59.8
CL/1775345	BH02 3.50	12.7

Polyaromatic Trydrocarbon Concer	iti a tionio (•	UNAS accredit			
		Sample ID :	CL1775347	CL1775348	CL1775344	CL1775345	CL1775346
				Reference			
		Station :	QC Blank	Material (%	BH02 1.50	BH02 3.50	CRM
				Recovery)			
PAH Fraction	# PAH	Mass					
Naphthalene *	1	128	<1	114.7	32.5	6.6	605.0
C1 Naphthalenes *	2	142	<1	114.6	54.4	8.2	345.0
C2 Naphthalenes *		156	<1	N.D	129.4	14.2	227.8
C3 Naphthalenes *		170	<1	N.D	181.7	16.0	166.2
C4 Naphthalenes *		184	<1	N.D	160.6	12.0	124.4
Sum Naphthalenes *			0	115	559	57	1468
Phenanthrene / Anthracene	2	178	<1	103.0	141.1	48.8	520.2
C1 178 *		192	<1	N.D	151.7	23.2	303.2
C2 178 *		206	<1	N.D	236.6	23.9	269.4
C3 178 *		220	<1	N.D	193.9	17.7	179.1
Sum 178 *			0	103	723.3	113.6	1271.9
Dibenzothiophene		184	<1	103	16.6	4.6	43.7
C1 Dibenzothiophenes *		198	<1	N.D	62.5	6.6	86.6
C2 Dibenzothiophenes *		212	<1	N.D	155.4	12.7	117.8
C3 Dibenzothiophenes *		226	<1	N.D	114.6	9.5	73.4
Sum Dibenzothiophenes *			0	103	349.2	33.4	321.5
Fluoranthene / pyrene	2	202	<1	99	333.5	112.5	1047.1
C1 202 *		216	<1	N.D	133.9	35.6	291.8
C2 202 *		230	<1	N.D	119.0	25.3	211.3
C3 202 *		244	<1	N.D	84.8	14.3	136.6
Sum 202 *			0	99	671.2	187.7	1686.8
Benzoanthracene / Chrysene	2	228	<1	98	187.4	67.2	654.5
C1 228 *		242	<1	N.D	432.9	40.5	283.0
C2 228 *		256	<1	N.D	151.8	21.5	150.5
Sum 228 *			0	98	772.1	129.2	1088.0
Benzofluoranthenes / benzopyrenes	4	252	<1	96	275.8	101.9	1177.0
C1 252 *		266	<1	N.D	109.2	33.7	337.4
C2 252 *		280	<1	N.D	80.0	20.6	199.5
Sum 252 *		200	0	96	465.0	156.2	1713.9
	1		U	30	+00.0	100.2	1710.0
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	92	137.4	48.7	558.5
C1 276 *		290	<1	N.D	35.5	13.4	90.7
C2 276 *		304	<1	N.D	45.7	3.7	62.5
Sum 276 *			0	92	218.6	65.8	711.6
Sum of all fractions *	† †		0	101	3758.0	742.8	8261.9
Sum of NPD fraction *			0	107	1631.2	203.9	3061.7
	+ -		#DIV/0!		0.77		0.59
NPD / 4-6 ring PAH ratio *			#1017/0!	0.28	U.//	0.38	0.59

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1775347	CL1775348	CL1775344	CL1775345	CL1775346
	Station :	QC Blank	Reference Material (% Recovery)	BH02 1.50	BH02 3.50	CRM
PAH	Mass					
Naphthalene *	128	<1	114.7	32.5	6.6	605.0
Acenaphthylene	152	<1	117.2	4.0	2.3	51.1
Acenaphthene	154	<1	116.9	17.5	7.1	33.0
Fluorene	166	<1	115.9	31.2	8.7	53.9
Phenanthrene	178	<1	106.6	111.0	34.4	379.2
Dibenzothiophene	184	<1	103.1	16.6	4.6	43.7
Anthracene	178	<1	99.4	30.1	14.3	141.0
Fluoranthene	202	<1	99.6	181.5	61.4	588.4
Pyrene	202	<1	97.6	151.9	51.1	458.7
Benzo[a]anthracene	228	<1	96.4	81.9	32.8	260.7
Chrysene	228	<1	99.1	105.5	34.4	393.8
Benzo[b]fluoranthene	252	<1	94.9	99.3	30.2	423.9
Benzo[k]fluoranthene	252	<1	92.6	33.9	16.0	211.1
Benzo[e]pyrene	252	<1	103.8	72.4	24.7	320.6
Benzo[a]pyrene	252	<1	94.4	70.3	31.1	221.3
Indeno[123,cd]pyrene	276	<1	95.1	64.3	23.3	276.8
Dibenzo[a,h]anthracene	278	<1	80.9	12.5	5.2	63.2
Benzo[ghi]perylene	276	<1	101.1	60.7	20.3	218.4

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$17_8703
 Date Booked in:
 14-Sep-17

 QC Batch Number:
 170006
 Date Extracted:
 21-Sep-17

 Directory:
 290917PCB.TQ1
 Date Analysed:
 28-Sep-17

 Method:
 Ultrasonic

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1775344	BH02 1.50	0.8	0.8	0.5	<0.08	0.5	0.6	0.3
CL1775345	BH02 3.50	0.7	0.8	<0.08	0.6	0.5	0.6	0.3
CL1775346	CRM	2.5	5.0	5.1	4.5	4.4	5.4	2.8
CL1775347	QC Blank	<0.08	<0.08	< 0.08	<0.08	<0.08	<0.08	< 0.08
CL1775348	Reference Material (% Recovery)	105.0	117.6	114.9	153.7	108.2	114.9	114.2

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_8703
QC Batch Number: 170006
Directory: 270917.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:14-Sep-17Date Extracted:27-Sep-17Date Analysed:28-Sep-17

UKAS Accredited: No

Sample ID :	CL1775344	CL1775345	CL1775346	CL1775347	CL1775348
					Reference Material
Client ID:	BH02 1.50	BH02 3.50	CRM	QC Blank	(% Recovery)

Compound		Concentration (μg/kg)								
alpha-HCH	<0.10	<0.10	<0.10	<0.10	168					
Hexachlorobenzene	0.20	<0.10	6.6	<0.10	98					
gamma-HCH	<0.10	<0.10	6.6	<0.10	244					
p,p'-DDE	1.36	1.93	3.6	<0.10	82					
Dieldrin	0.69	0.69	0.6	<0.10	97					
p,p'-DDD	1.26	1.8	5.0	<0.10	108					
p,p'-DDT	1.13	0.7	0.1	<0.10	130					

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_8703

Directory: E:\TES\DATA\2017\0921HSA_GC9\092117 2017-09-21 11-30-37\113B1301.D

 Date Booked in:
 14-Sep-17

 Date extracted:
 21-Sep-17

 21-Sep-17,
 21-Sep-17,

Soil

Matrix:

Method: Headspace GCFID Date Analysed: 15:49:00

* Sample data with an asterisk are not UKAS accredited.

		Co	Concentration, (mg/kg) - as wet weight					Aliphatics					
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO		
CL1775344	BH02 1.50	<0.010	< 0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2		
CL1775345	BH02 3.50	< 0.010	<0.010	<0.010	< 0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2		
CL1775347	QC Blank	< 0.010	<0.010	< 0.010	< 0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2		
CL1775348	Reference Material (% Recovery)	103	105	103	104	101	109	104	108	110	107		
_													

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_8703 Separation: Silica gel 171031 QC Batch Number: Eluents: Hexane, DCM

D:\TES\DATA\2017\092717\092717 2017-09-27 09-53-19\B-025-62-RMS171031ARO.D Directory:

Method:	Ultra Sonic												
					Conce	entration, (mg	/kg) - as wet	weight					
* This sample data is not	UKAS accredited.	>C8	- C10	>C10 - C12 >C12 - C16			>C16	- C21	>C21	- C35	>C8 - C40		
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
CL1775344	BH02 1.50	<4.12	<4*	<4.12*	<4	<4.12	<4	11.1	7.95	51.2	38.8	68.6	53.8
CL1775345	BH02 3.50	<4.08	<4*	<4.08*	<4	<4.08	<4	<4.08	<4	<8.94	<8.76	<20.4	<20
CL1775347	QC Blank	<4.16	<4*	<4.16*	<4	<4.16	<4	<4.16	<4	<9.1	<8.76	<20.8	<20
CL1775348	Reference Material (% Recovery)	98%	126%*	89%*	97%	94%	91%	92%	92%	89%	93%	91%	93%
													
	•	i	1	II.	1	i	i	1	1	i e	1		1

Matrix:

Date Booked ir

Date Extracted 25-Sep-17

Date Analysed 27-Sep-17, 15:15:31

14-Sep-17

Report Number: EFS/178703

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	CL1775344 to CL1775346	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Naphthalene) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1775344 to CL1775346	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.
TPHUSSI	CL1775344 to CL1775348	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Banding C10-C12 on the Aliphatic fraction and C8-C10 on the Apromatic fraction) . These circumstances should be taken into consideration when utilising the data.

Sample Descriptions

Client :	Causeway Geotech Ltd	
Site :	Arklow Sewerage Scheme Marine Ou	utfall GI
Report Number :	S17_8703	
Tiepert Namber :	017_0700	Note: major constituent in upper case
Lab ID Name barr	Ollera ID	Description
Lab ID Number	Client ID	Description
CL/1775344	BH02 1.50	MARINE SEDIMENT MARINE SEDIMENT QUALITY CONTROL SAMPLE
CL/1775345 CL/1775346	BH02 3.50 CRM	MAKINE SEDIMENT
CL/1775346 CL/1775347	QC Blank	QUALITY CONTROL SAMPLE
CL/1775347 CL/1775348	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
GL/1773346	nelerence Material (% necovery)	QUALITY GOIVITIOL SAIVII EL
	+	

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-65410-2

Issue No.: 2

Date of Issue 04/10/2017

Customer Details: ESG Environmental Chemistry, P O Box 100, Bretby Business Park, Burton-on-

Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: \$178703

Quotation Reference: 170504/08

Description: 2 soil samples

Date Received: 22/09/2017

Date Started: 26/09/2017

Date Completed: 03/10/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: This report replaces issue 1 in its entirety

Approved By: Matthew Hickson, Laboratory Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.

Observations and interpretations are outside of the scope of UKAS accreditation.

Results reported herein relate only to the items supplied to the laboratory for testing.

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A member of the RPS Group plc. Terms and conditions apply - copy on request



Results Summary

Report No.: 17-65410-2

Customer Reference: S178703 Customer Order No: 42062 BEC

				Customer	Sample No	S1775344	S1775345
				Custome	r Sample ID	BH02 1.50	BH02 3.50
				RPS	Sample No	340618	340619
				Sa	mple Type	SOIL	SOIL
				Sample	e Depth (m)	1.50m	3.50m
				Sa	mpling Date	29/08/2017	29/08/2017
Determinand	CAS No	Codes	SOP	Units	RL		
ibutyltin (DBT)	1002-53-5	N	in house	mg/kg as cation	0.02	< 0.02	< 0.02
ributyltin (TBT)	56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05
ributyltin (TBT)	56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05



Report No.: 17-65410-2Customer Reference: S178703
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-65410	2 soil samples	Blank: <rl &="" -="" 100%="" 107%<="" aqc:="" dbt="" for="" tbt="" td=""></rl>



Deviating Samples

Report No.: 17-65410-2Customer Reference: S178703
Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).

RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.

Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below.

Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed.

Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No. Customer ID		Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
340618	S1775344		29/08/2017	60ml amber glass jar	No	
340619	S1775345		29/08/2017	60ml amber glass jar	No	



Report Information

Key to Report Codes

U	UKAS Accredited
M	MCERTS Accredited
N	Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units) Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1	Clay - Brown
Type 2	Clay - Grey/Black

Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)
Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally $\!\!\!\!\!\!^*$ be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

ESG Environmental Chemistry - Requested Analysis

Customer Causeway Geotech Ltd Site Arklow Sewerage Scher

Arklow Sewerage Scheme Marine Outfall GI

Report No S179637

Consignment No S69458
Date Logged 12-Oct-2017

Report Due 01-Nov-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^DibutyItin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
CL/1779343	BH04 0.50	23/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1779344	BH04 2.50	23/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1779345	CRM	23/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1779346	QC Blank		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1779348	Reference Material (% Recovery	/)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Copper (MS) Sediment	Lead (MS) Sediments
	BH04 0.50	20.6	0.19	8.5	88.9	37
S1779344	BH04 2.50	8.2	0.11	8.2	17.9	8
S1779345	CRM	17.27	1.482	60.15	59.47	76.55
S1779346	QC Blank	<0.5	<0.04	<0.5	< 0.5	<0.5
S1779348	Reference Material (% Recovery)	102	107	104	92	105

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Manganese	Mercury (MS)	Nickel (MS)	Zinc (MS)	Iron
ID Number	Description	(MS) Sediments	Sediments	Sediments	Sediments	(Sediments)
S1779343	BH04 0.50	513.4	<0.015	8.2	85.1	15400
S1779344	BH04 2.50	188.4	<0.015	7.8	59.2	11700
S1779345	CRM	1103	0.686	31.66	308.8	28000
S1779346	QC Blank	<0.5	<0.015	<0.5	<2	<36
	Reference Material					
S1779348	(% Recovery)	104	106	104	104	96

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005	
	Detection Limit	0.1	0.02	0.12			
	Units	%	% M/M	%	ug/kg	ug/kg	
		Tot.Moisture @	Total Organic				
		105C	Carbon	Carbonate %	^Dibutyltin	^Tributyltin	
ID Number	Description	1050	(Sediment)				
S1779343	BH04 0.50	14.1	0.11	6	<5.00	<2.00	
S1779344	BH04 2.50	13.6	0.06	5.28	< 5.00	<2.00	
S1779345	CRM		3.0489		79%	81%	
S1779346	QC Blank		<0.02		< 5.00	<2.00	
	Reference Material						
S1779348	(% Recovery)		96	102	91	91	

Sample ID	Client ID	Moisture (%)
CL/1779343	BH04 0.50	23.4
CL/1779344	BH04 2.50	9.1

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

		Sample ID :	CL1779346	CL1779348	CL1779343	CL1779344	CL1779345
		•		Reference			
		Station :	QC Blank	Material (%	BH04 0.50	BH04 2.50	CRM
				Recovery)			
PAH Fraction	# PAH	Mass					
Naphthalene	1	128	<1	97.0	<1	<1	513.3
C1 Naphthalenes *	2	142	<1	96.0	<1	<1	318.7
C2 Naphthalenes *		156	<1	N.D	<1	<1	206.1
C3 Naphthalenes *		170	<1	N.D	<1	<1	164.9
C4 Naphthalenes *		184	<1	N.D	<1	<1	102.9
Sum Naphthalenes *			0	96	0	0	1306
Phenanthrene / Anthracene	2	178	<1	97.7	<1	<1	444.0
C1 178 *		192	<1	N.D	<1	<1	268.1
C2 178 *		206	<1	N.D	<1	<1	195.4
C3 178 *		220	<1	N.D	<1	<1	144.4
Sum 178 *			0	98	0.0	0.0	1051.9
Dibenzothiophene *		184	<1	92	<1	<1	38.5
C1 Dibenzothiophenes *		198	<1	N.D	<1	<1	62.1
C2 Dibenzothiophenes *		212	<1	N.D	<1	<1	107.0
C3 Dibenzothiophenes *		226	<1	N.D	<1	<1	67.9
Sum Dibenzothiophenes *			0	92	0.0	0.0	275.4
Fluoranthene / pyrene	2	202	<1	94	<1	<1	903.2
C1 202 *		216	<1	N.D	<1	<1	240.9
C2 202 *		230	<1	N.D	<1	<1	172.5
C3 202 *		244	<1	N.D	<1	<1	106.4
Sum 202 *			0	94	0.0	0.0	1422.9
Benzoanthracene / Chrysene	2	228	<1	93	<1	<1	558.4
C1 228 *		242	<1	N.D	<1	<1	229.0
C2 228 *		256	<1	N.D	<1	<1	125.1
Sum 228 *			0	93	0.0	0.0	912.4
Benzofluoranthenes /	4	252	<1	92	<1	<1	997.0
benzopyrenes		-	·	-			
C1 252 *		266	<1	N.D	<1	<1	202.5
C2 252 *		280	<1	N.D	<1	<1	180.1
Sum 252 *			0	92	0.0	0.0	1379.6
Dibenzoanthracene / Indenopyrene /	_						
Benzoperylene	3	276	<1	87	<1	<1	491.8
		000	_	N.B			70.0
C1 276 *		290	<1	N.D	<1	<1	76.3
C2 276 *		304	<1	N.D	<1	<1	31.9
Sum 276 *	1		0	87	0.0	0.0	600.0
Sum of all fractions *			0	93	0.0	0.0	6948.0
Sum of NPD fraction *			0	95	0.0	0.0	2633.2
NPD / 4-6 ring PAH ratio *		not in the referen	#DIV/0!	0.26	#DIV/0!	#DIV/0!	0.61

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1779346	CL1779348	CL1779343	CL1779344	CL1779345
	Station :	QC Blank	Reference Material (% Recovery)	BH04 0.50	BH04 2.50	CRM
PAH	Mass					
Naphthalene	128	<1	97.0	<1	<1	513.3
Acenaphthylene	152	<1	96.1	<1	<1	52.1
Acenaphthene	154	<1	96.4	<1	<1	34.5
Fluorene	166	<1	98.8	<1	<1	45.8
Phenanthrene	178	<1	100.5	<1	<1	314.0
Dibenzothiophene *	184	<1	92.1	<1	<1	38.5
Anthracene	178	<1	94.8	<1	<1	130.0
Fluoranthene	202	<1	94.6	<1	<1	503.9
Pyrene	202	<1	93.9	<1	<1	399.3
Benzo[a]anthracene	228	<1	91.5	<1	<1	220.1
Chrysene	228	<1	95.3	<1	<1	338.3
Benzo[b]fluoranthene	252	<1	95.4	<1	<1	364.5
Benzo[k]fluoranthene	252	<1	92.4	<1	<1	175.2
Benzo[e]pyrene	252	<1	92.1	<1	<1	267.0
Benzo[a]pyrene	252	<1	88.4	<1	<1	190.3
Indeno[123,cd]pyrene	276	<1	86.8	<1	<1	244.7
Dibenzo[a,h]anthracene	278	<1	84.2	<1	<1	54.9
Benzo[ghi]perylene	276	<1	89.9	<1	<1	192.2

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI **Customer and Site Details:** Matrix:

Soil 12-Oct-17 Job Number: S17_9637 Date Booked in: 170011 Date Extracted: 24-Oct-17 QC Batch Number: Directory: 261017PCB.TQ1 Date Analysed: 27-Oct-17 Method: Ultrasonic

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1779343	BH04 0.50	0.1	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1779344	BH04 2.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1779345	CRM	3.1	4.4	4.5	2.8	3.9	4.9	2.7
CL1779346	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1779348	Reference Material (% Recovery)	123	107	106	108	102	110	111

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_9637
QC Batch Number: 170011
Directory: 261017.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:12-Oct-17Date Extracted:24-Oct-17Date Analysed:27-Oct-17UKAS Accredited:No

Sample ID :	CL1779343	CL1779344	CL1779345	CL1779346	CL1779348
					Reference Material (%
Client ID:	BH04 0.50	BH04 2.50	CRM	QC Blank	Recovery)

Compound		Concentration (μg/kg)								
alpha-HCH	<0.10	<0.10	<0.10	<0.10	91					
Hexachlorobenzene	<0.10	<0.10	6.52	<0.10	94					
gamma-HCH	<0.10	<0.10	<0.10	<0.10	93					
p,p'-DDE	<0.10	<0.10	2.94	<0.10	98					
Dieldrin	<0.10	<0.10	0.40	<0.10	103					
p,p'-DDD	<0.10	<0.10	2.68	<0.10	96					
p,p'-DDT	<0.10	<0.10	<0.10	<0.10						

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17 9637

Directory:

D:\TES\DATA\2017\1025HSA GC9\102517 2017-10-25 12-09-58\125B2501.D

Headspace GCFID Method:

Matrix: Soil 12-Oct-17 Date Booked in: 17-Oct-24 Date extracted: Date Analysed: 25-Oct-17, 19

		Concentration, (mg/kg) - as wet weight					Aliphatics						
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO		
CL1779343	BH04 0.50	<0.010	<0.010	<0.010	<0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2		
CL1779344	BH04 2.50	<0.010	<0.010	<0.010	<0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2		
CL1779346	QC Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2		
CL1779348	Reference Material (% Recovery)	96	95	102	103	97	110	115	120	119	116		
								<u> </u>					

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9. Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

Job Number:S17_9637Separation:Silica gelQC Batch Number:171154Eluents:Hexane, DCM

Directory: D:\TES\DATA\2017\102717\102717 2017-10-27 14-14-24\F-089-82-RMS171154ARO.D

Method: Ultra Sonic

 Date Booked ir
 12-Oct-17

 Date Extracted
 26-Oct-17

 Date Analysed
 28-Oct-17, 09:43:32

Soil

Matrix:

Metriou.	Oiti a Soriic	Concentration, (mg/kg) - as wet weight								-			
		>C8	- C10	>C10	- C12		- C16		- C21	>C21	- C35	>C8	- C40
Sample	ID Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
CL177934		<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
CL177934	4 BH04 2.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
CL177934		<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
CL177934	Reference Material (% Recovery)	92	86	98	90	96	93	96	96	98	101	95	95
													<u> </u>
													<u> </u>

Report Number: EFS/179637

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	CL1779343 CL1779344 CL1779345	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Dibenzothiothene) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1779345	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.

Sample Descriptions

Client :	Causeway Geotech Ltd								
Site:	Arklow Sewerage Scheme Marine Ou	atfall GI							
Report Number :	S17_9637								
•	_	Note: major constituent in upper case							
Lab ID Number	Client ID	Description							
CI /1770040									
CL/1779343 CL/1779344 CL/1779345 CL/1779346 CL/1779348	BH04 0.50	MARINE SEDIMENTS MARINE SEDIMENTS							
CL/17/9344	BH04 2.50	MARINE SEDIMENTS							
CL/17/9345	OC Plank	QUALITY CONTROL SAMPLE							
CL/17/9346	BH04 2.50 CRM QC Blank Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE							
GL/17/9348	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE							

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-66304-1

Issue No.: 1

Date of Issue 01/11/2017

Customer Details: SOCOTEC UK - Environmental Chemistry, P O Box 100, Bretby Business Park,

Burton-on-Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: S179637

Quotation Reference: 170504/06

Description: 2 sediment samples

Date Received: 24/10/2017

Date Started: 25/10/2017

Date Completed: 31/10/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: None

Approved By:

Matthew Hickson, Laboratory Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.

This certificate shall not be reproduced except in full without the prior written approval of the laboratory.

Observations and interpretations are outside of the scope of UKAS accreditation.

Results reported herein relate only to the items supplied to the laboratory for testing.



1663

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A member of the RPS Group plc. Terms and conditions apply - copy on request



Results Summary

Report No.: 17-66304-1

Customer Reference: S179637 Customer Order No: 42062 BEC

				Customer S	Sample No	S1779343	S1779344
				Custome	r Sample ID	BH04 0.50	BH04 2.50
				RPS	Sample No	343731	343732
				Sa	mple Type	SEDIMENT	SEDIMENT
				Sa	mpling Date	23/09/2017	23/09/2017
Determinand	CAS No	Codes	SOP	Units	RL		
butyltin (DBT)	1002-53-5	U	395	ug/kg as cation	5	< 5.00	< 5.00
ibutyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00



Report No.: 17-66304-1Customer Reference: S179637
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-66304		Blank <rl &="" -="" 91%="" 91%<="" aqc="" dbt="" tbt="" td=""></rl>
		CRM DBT - 79% TBT - 81%



Deviating Samples

Report No.: 17-66304-1Customer Reference: S179637
Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).

RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.

Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below.

Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed.

Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
343731	S1779343		23/09/2017	60ml amber glass jar	No	
343732	S1779344		23/09/2017	60ml amber glass jar	No	_



Report Information

Key to Report Codes

U UKAS Accredited
M MCERTS Accredited
N Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units)

Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1 Clay - Brown Type 2 Clay - Grey/Black

Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)
Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

ESG Environmental Chemistry - Requested Analysis

Customer Causeway Geotech Ltd Site Arklow Sewerage Scher

Arklow Sewerage Scheme Marine Outfall GI

Report No S179638

Consignment No S69457 Date Logged 12-Oct-2017

Report Due 01-Nov-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^DibutyItin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
CL/1779349	BH05 0.50	26/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1779350	BH05 3.50	26/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1779351	CRM	26/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1779352	QC Blank		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1779353	Reference Material (% Recovery	/)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)
ID Number	Description	Sediments	Sediments	Sediments	Sediment	Sediments
S1779349	BH05 0.50	10.4	<0.04	12.3	11.4	5.5
S1779350	BH05 3.50	4.5	<0.04	7.1	4.2	3.3
S1779351	CRM	17.27	1.482	60.15	59.47	76.55
S1779352	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
	Reference Material					
S1779353	(% Recovery)	102	107	104	92	105

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Manganese	Mercury (MS)	Nickel (MS)	Zinc (MS)	Iron
ID Number	Description	(MS) Sediments	Sediments	Sediments	Sediments	(Sediments)
S1779349	BH05 0.50	265.4	<0.015	12.2	24.8	13700
S1779350	BH05 3.50	154.6	<0.015	5.9	15.8	7080
S1779351	CRM	1103	0.686	31.66	308.8	28000
S1779352	QC Blank	<0.5	<0.015	<0.5	<2	<36
S1779353	Reference Material (% Recovery)	104	106	104	104	96

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005
	Detection Limit	0.1	0.02	0.12		
	Units	%	% M/M	%	ug/kg	ug/kg
		Tot.Moisture @	Total Organic Carbon	Carbonate %	^Dibutyltin	^Tributyltin
ID Number	Description	105C	(Sediment)	Carbonate 70	Disacyttiii	Tributyitiii
S1779349	BH05 0.50	13.7	0.08	5.76	< 5.00	<2.00
S1779350	BH05 3.50	15.4	0.1	6.96	< 5.00	<2.00
S1779351	CRM		3.0489		79%	81%
S1779352	QC Blank		<0.02		< 5.00	<2.00
S1779353	Reference Material (% Recovery)		96	102	91	91

Sample ID	Sample ID Client ID	
CL/1779349	BH05 0.50	11.8
CL/1779350	BH05 3.50	25.1

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAH Fraction			Sample ID :	CL1779352	CL1779353	CL1779349	CL1779350	CL1779351
PAH Fraction								
PAH Fraction			Station :	QC Blank		BH05 0.50	BH05 3.50	CRM
PAH Fraction					,			
C. 1 Naphthalenes * 2 142	PAH Fraction	# PAH	Mass		,,,			
C2 Naphthalenes *	Naphthalene	1	128	<1	97.0	<1	<1	513.3
C3 Naphthalenes * C4 Naphthalenes * Sum Naphthalene	C1 Naphthalenes *	2	142	<1	96.0	<1	<1	318.7
C4 Naphthalenes * Sum Naphthalen	C2 Naphthalenes *			<1	N.D	<1	1.0	206.1
Sum Naphthalenes 0 96 0 1 1306	C3 Naphthalenes *		170	<1	N.D	<1	<1	164.9
Phenanthrene Anthracene 2 178 <1 97.7 <1 <1 444.0	C4 Naphthalenes *		184	<1	N.D	<1	<1	102.9
C1 178 *	Sum Naphthalenes *			0	96	0	1	1306
C2 178 *	Phenanthrene / Anthracene	2	178	<1	97.7	<1	<1	444.0
C3 178 *	C1 178 *		192	<1	N.D	<1	<1	268.1
Sum 178* 0 98 0.0 0.0 1051.9 Dibenzothiophene* 184 <1	C2 178 *		206	<1	N.D	<1	<1	195.4
Dibenzothiophene * 184	C3 178 *		220	<1	N.D	<1	<1	144.4
C1 Dibenzothiophenes *	Sum 178 *			0	98	0.0	0.0	1051.9
C2 Dibenzothiophenes * 212 <1	Dibenzothiophene *		184	<1	92	<1	<1	38.5
C3 Dibenzothiophenes * Sum Dibenzothiophenes * 226 <1			198	<1	N.D	<1	<1	62.1
Sum Dibenzothiophenes* 0 92 0.0 0.0 275.4 Fluoranthene / pyrene 2 202 <1	C2 Dibenzothiophenes *		212	<1	N.D	<1	<1	107.0
Fluoranthene / pyrene 2 202 <1 94 <1 <1 93.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1 903.2 <1	C3 Dibenzothiophenes *		226	<1	N.D	<1	<1	67.9
C1 202 *	Sum Dibenzothiophenes *			0		0.0	0.0	
C2 202 * 230 <1		2		<1		<1	<1	
C3 202 * 244 <1							<1	
Sum 202 * 0 94 0.0 0.0 1422.9 Benzoanthracene / Chrysene 2 228 <1						<1	<1	
Benzoanthracene / Chrysene 2 228 <1 93 <1 <1 558.4	C3 202 *		244	<1	N.D	<1	<1	
C1 228 *								
C2 228 * 256 <1	Benzoanthracene / Chrysene	2		<1		<1	<1	
Sum 228 * 0 93 0.0 0.0 912.4 Benzofluoranthenes / benzopyrenes 4 252 <1				<1		<1	<1	
Benzofluoranthenes / benzopyrenes 4 252 <1	C2 228 *		256	<1			<1	
benzopyrenes C1 252 * C2 252 * C2 252 * C2 252 * C3 0 92 0.0 1379.6 Dibenzopanthracene / Indenopyrene / Benzoperylene C1 276 * C2 276 * C3 290	Sum 228 *			0	93	0.0	0.0	912.4
C2 252 * Sum 25		4	252	<1	92	<1	<1	997.0
Sum 252 * 0 92 0.0 0.0 1379.6 Dibenzoanthracene / Indenopyrene / Benzoperylene 3 276 <1	C1 252 *		266	<1	N.D	<1	<1	202.5
Dibenzoanthracene / Indenopyrene / Benzoperylene 3 276 <1	C2 252 *		280	<1	N.D	<1	<1	180.1
Benzoperylene 3 276 <1	Sum 252 *			0	92	0.0	0.0	1379.6
C1 276 * 290 <1	Dibenzoanthracene / Indenopyrene /	2	276	.1	97	.1	.1	/Q1 Q
C2 276 * 304 <1	Benzoperylene		210	` '	07	`'	` '	+31.0
Sum 276 * 0 87 0.0 0.0 600.0 Sum of all fractions * 0 93 0.0 1.0 6948.0 Sum of NPD fraction * 0 95 0.0 1.0 2633.2	C1 276 *		290	<1	N.D	<1	<1	76.3
Sum of all fractions * 0 93 0.0 1.0 6948.0 Sum of NPD fraction * 0 95 0.0 1.0 2633.2	C2 276 *		304	<1	N.D	<1	<1	31.9
Sum of NPD fraction * 0 95 0.0 1.0 2633.2	Sum 276 *			0		0.0	0.0	600.0
	Sum of all fractions *			0	93	0.0	1.0	6948.0
	Sum of NPD fraction *			0	95	0.0	1.0	2633.2
	NPD / 4-6 ring PAH ratio *			#DIV/0!	0.26	#DIV/0!	#DIV/0!	0.61

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1779352	CL1779353	CL1779349	CL1779350	CL1779351
	Station :	QC Blank	Reference Material (% Recovery)	BH05 0.50	BH05 3.50	CRM
PAH	Mass					
Naphthalene	128	<1	97.0	<1	<1	513.3
Acenaphthylene	152	<1	96.1	<1	<1	52.1
Acenaphthene	154	<1	96.4	<1	<1	34.5
Fluorene	166	<1	98.8	<1	<1	45.8
Phenanthrene	178	<1	100.5	<1	<1	314.0
Dibenzothiophene *	184	<1	92.1	<1	<1	38.5
Anthracene	178	<1	94.8	<1	<1	130.0
Fluoranthene	202	<1	94.6	<1	<1	503.9
Pyrene	202	<1	93.9	<1	<1	399.3
Benzo[a]anthracene	228	<1	91.5	<1	<1	220.1
Chrysene	228	<1	95.3	<1	<1	338.3
Benzo[b]fluoranthene	252	<1	95.4	<1	<1	364.5
Benzo[k]fluoranthene	252	<1	92.4	<1	<1	175.2
Benzo[e]pyrene	252	<1	92.1	<1	<1	267.0
Benzo[a]pyrene	252	<1	88.4	<1	<1	190.3
Indeno[123,cd]pyrene	276	<1	86.8	<1	<1	244.7
Dibenzo[a,h]anthracene	278	<1	84.2	<1	<1	54.9
Benzo[ghi]perylene	276	<1	89.9	<1	<1	192.2

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI **Customer and Site Details:** Matrix:

Soil S17_9638 12-Oct-17 Job Number: Date Booked in: 170011 Date Extracted: 24-Oct-17 QC Batch Number: Directory: 261017PCB.TQ1 Date Analysed: 27-Oct-17

Method: Ultrasonic Compounds marked * are not UKAS or MCerts accredited

		Concentration, (μg/kg)							
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*	
CL1779349	BH05 0.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	
CL1779350	BH05 3.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	
CL1779351	CRM	3.1	4.4	4.5	2.8	3.9	4.9	2.7	
CL1779352	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	
CL1779353	Reference Material (% Recovery)	123	107	106	108	102	110	111	

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_9638
QC Batch Number: 170011
Directory: 261017.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:12-Oct-17Date Extracted:24-Oct-17Date Analysed:27-Oct-17UKAS Accredited:No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1779349	CL1779350	CL1779351	CL1779352	CL1779353
					Reference Material (%
Client ID:	BH05 0.50	BH05 3.50	CRM	QC Blank	Recovery)

Compound		Concentration (μg/kg)											
alpha-HCH	<0.10	<0.10	<0.10	<0.10	91								
Hexachlorobenzene	<0.10	<0.10	6.52	<0.10	94								
gamma-HCH	<0.10	<0.10	<0.10	<0.10	93								
p,p'-DDE	<0.10	<0.10	2.94	<0.10	98								
Dieldrin	<0.10	<0.10	0.40	<0.10	103								
p,p'-DDD	<0.10	<0.10	2.68	<0.10	96								
p,p'-DDT	<0.10	<0.10	<0.10	<0.10									

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17 9638

Directory: D:\TES\DATA\2017\1025HSA GC9\102517 2017-10-25 12-09-58\034F3401.D

Method: Headspace GCFID

Matrix:SoilDate Booked in:12-Oct-17Date extracted:17-Oct-24Date Analysed:25-Oct-17, 22

		C	oncentratio	on, (mg/kg) - a	as wet weig	Aliphatics					
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
CL1779349	BH05 0.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1779350	BH05 3.50	< 0.010	<0.010	< 0.010	0.012	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1779352	QC Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1779353	Reference Material (% Recovery)	103	101	100	101	98	105	108	108	104	106

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9. Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

Job Number:S17_9638Separation:Silica gelQC Batch Number:171154Eluents:Hexane, DCM

Directory: D:\TES\DATA\2017\102717\102717 2017-10-27 14-14-24\F-089-82-RMS171154ARO.D

Method: Ultra Sonic

Soil

12-Oct-17

Matrix:

Date Booked ir

			onionitation, (mg/mg/ us not noight										
		>C8	- C10	>C10	- C12	>C12	- C16	>C16	- C21	>C21	- C35	>C8	- C40
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
CL1779349	BH05 0.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
CL1779350	BH05 3.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
CL1779352	QC Blank	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
CL1779353	Reference Material (% Recovery)	92	86	98	90	96	93	96	96	98	101	95	95
													i l

Report Number: EFS/179638

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	CL1779349 CL1779350 CL1779351	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Dibenzothiothene) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1779351	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.

Sample Descriptions

Client :	Causeway Geotech Ltd	
Site :	Arklow Sewerage Scheme Marine	Outfall GI
Report Number :	S17_9638	
neport Number .	317_9030	Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1779349 CL/1779350	BH05 0.50 BH05 3.50	MARINE SEDIMENTS MARINE SEDIMENTS
CL/1779350 CL/1779351	CRM	OLIALITY CONTROL SAMPLE
CL/1779351 CL/1779352	CRM QC Blank	QUALITY CONTROL SAMPLE
CL/1779353	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
<u> </u>		

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-66305-1

Issue No.: 1

Date of Issue 01/11/2017

Customer Details: SOCOTEC UK - Environmental Chemistry, P O Box 100, Bretby Business Park,

Burton-on-Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: S179638

Quotation Reference: 170504/06

Description: 2 sediment samples

Date Received: 24/10/2017

Date Started: 25/10/2017

Date Completed: 31/10/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: None

Approved By:

Matthew Hickson, Laboratory Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.

This certificate shall not be reproduced except in full without the prior written approval of the laboratory.

Observations and interpretations are outside of the scope of UKAS accreditation.

Results reported herein relate only to the items supplied to the laboratory for testing.



1663

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Results Summary

Report No.: 17-66305-1

Customer Reference: S179638 Customer Order No: 42062 BEC

				Customer S	Sample No	S1779349	S1779350
				Custome	r Sample ID	BH05 0.50	BH05 3.50
				RPS	Sample No	343733	343734
				Sa	mple Type	SEDIMENT	SEDIMENT
				Sa	mpling Date	26/09/2017	26/09/2017
Determinand	CAS No	Codes	SOP	Units	RL		
butyltin (DBT)	1002-53-5	U	395	ug/kg as cation	5	< 5.00	< 5.00
ibutyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00



Report No.: 17-66305-1Customer Reference: S179638
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-66305	·	Blank <rl &="" -="" 91%="" aqc="" crm<="" dbt="" tbt="" td=""></rl>
		DBT - 79% TBT - 81%



Deviating Samples

Report No.: 17-66305-1Customer Reference: S179638
Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).

RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.

Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below.

Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed.

Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
343733	S1779349		26/09/2017	60ml amber glass jar	No	
343734	S1779350		26/09/2017	60ml amber glass jar	No	



Report Information

Key to Report Codes

U UKAS Accredited
M MCERTS Accredited
N Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units)

Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1 Clay - Brown Type 2 Clay - Grey/Black

Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)
Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

Socotec Environmental Chemistry - Requested Analysis

Customer **Causeway Geotech Ltd** Site

Arklow Sewerage Scheme Marine Outfall GI Report No

S179800

Consignment No S_NonCon Date Logged 17-Oct-2017

Report Due 03-Nov-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^Dibutyltin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
CL/1780171	BH06 0.50	29/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1780172	BH06 1.50	29/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1780173	BH06 2.50	29/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1780174	CRM	29/09/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1780175	QC Blank		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1780176	Reference Material (% Recovery	/)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)
ID Number	Description	Sediments	Sediments	Sediments	Sediment	Sediments
S1780171	BH06 0.50	8.5	0.07	9.7	8.6	5.7
S1780172	BH06 1.50	4.7	0.04	6.5	4	2.8
S1780173	BH06 2.50	4.5	<0.04	6.2	4	2.7
S1780174	CRM	17.98	1.576	61.02	57.25	78.09
S1780175	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
_	Reference Material					
S1780176	(% Recovery)	98	100	103	96	103

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
S1780171	BH06 0.50	227.1	<0.015	8.3	22.5	9740
S1780172	BH06 1.50	127.8	<0.015	5	12.2	6380
S1780173	BH06 2.50	118.9	<0.015	4.7	12.2	6150
S1780174	CRM	1150	0.753	32.89	323	27800
S1780175	QC Blank	<0.5	<0.015	<0.5	<2	<36
S1780176	Reference Material (% Recovery)	100	96	100	100	102

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005
	Detection Limit	0.1	0.02	0.12		
	Units	%	% M/M	%	ug/kg	ug/kg
		Tot Moisture @	Total Organic			
		Tot.Moisture @	Carbon	Carbonate %	^Dibutyltin	^Tributyltin
ID Number	Description	105C	(Sediment)			
S1780171	BH06 0.50	15.9	0.08	5.28	<5	<2
S1780172	BH06 1.50	15.5	0.04	4.56	<5	<2
S1780173	BH06 2.50	16.5	0.04	4.32	<5	<2
S1780174	CRM		3.249		70	101
S1780175	QC Blank		<0.02		<5	<2
	Reference Material					
S1780176	(% Recovery)		103	97.6	93	109

Sample ID	Client ID	Moisture (%)
CL/1780171	BH06 0.50	12.7
CL/1780172	BH06 1.50	27.6
CL/1780173	BH06 2.50	18.7

		Sample ID :	CL1780175	CL1780176	CL1780171	CL1780172	CL1780173	CL1780174
		-		Reference				
		Station :	QC Blank	Material (%	BH06 0.50	BH06 1.50	BH06 2.50	CRM
544.5				Recovery)				
PAH Fraction	# PAH	Mass		27.0				
Naphthalene	1	128	<1	97.0	<1	<1	<1	513.3
C1 Naphthalenes *	2	142	<1	96.0	1.8	<1	<1	318.7
C2 Naphthalenes *		156	<1	N.D	2.3	<1	<1	206.1
C3 Naphthalenes *		170	<1	N.D	1.5	<1	<1	164.9
C4 Naphthalenes *		184	<1	N.D	<1	<1	<1	102.9
Sum Naphthalenes *			0	96	6	0	0	1306
Phenanthrene / Anthracene	2	178	<1	97.7	1.4	<1	<1	444.0
C1 178 *		192	<1	N.D	2.2	<1	<1	268.1
C2 178 *		206	<1	N.D	2.1	<1	<1	195.4
C3 178 *		220	<1	N.D	1.3	<1	<1	144.4
Sum 178 *			0	98	7.1	0.0	0.0	1051.9
Dibenzothiophene *		184	<1	92	<1	<1	<1	38.5
C1 Dibenzothiophenes *		198	<1	N.D	<1	<1	<1	62.1
C2 Dibenzothiophenes *		212	<1	N.D	<1	<1	<1	107.0
C3 Dibenzothiophenes *		226	<1	N.D	<1	<1	<1	67.9
Sum Dibenzothiophenes *			0	92	0.0	0.0	0.0	275.4
Fluoranthene / pyrene	2	202	<1	94	2.8	<1	<1	903.2
C1 202 *		216	<1	N.D	1.6	<1	<1	240.9
C2 202 *		230	<1	N.D	1.5	<1	<1	172.5
C3 202 *		244	<1	N.D	1.1	<1	<1	106.4
Sum 202 *			0	94	6.9	0.0	0.0	1422.9
Benzoanthracene / Chrysene	2	228	<1	93	1.5	<1	<1	558.4
C1 228 *		242	<1	N.D	1.6	<1	<1	229.0
C2 228 *		256	<1	N.D	1.3	<1	<1	125.1
Sum 228 *			0	93	4.4	0.0	0.0	912.4
Benzofluoranthenes / benzopyrenes	4	252	<1	92	3.0	<1	<1	997.0
C1 252 *		266	<1	N.D	1.8	<1	<1	202.5
C2 252 *		280	<1	N.D	1.6	<1	<1	180.1
Sum 252 *			0	92	6.4	0.0	0.0	1379.6
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	87	2.7	<1	<1	491.8
C1 276 *		290	<1	N.D	<1	<1	<1	76.3
C2 276 *		304	<1	N.D	<1	<1	<1	31.9
Sum 276 *		557	0	87	2.7	0.0	0.0	600.0
Sum of all fractions *	1		0	93	33.2	0.0	0.0	6948.0
Sum of NPD fraction *			0	95	12.8	0.0	0.0	2633.2
	1		#DIV/0!	0.26		#DIV/0!	#DIV/0!	
NPD / 4-6 ring PAH ratio *			#UIV/U!	0.26	0.63	#UIV/U!	#DIV/U!	0.61

N.D = Not Determined as these compounds are not in the reference material spike.
 As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1780175	CL1780176	CL1780171	CL1780172	CL1780173	CL1780174
	Station :	QC Blank	Reference Material (% Recovery)	BH06 0.50	BH06 1.50	BH06 2.50	CRM
PAH	Mass						
Naphthalene	128	<1	97.0	<1	<1	<1	513.3
Acenaphthylene	152	<1	96.1	<1	<1	<1	52.1
Acenaphthene	154	<1	96.4	<1	<1	<1	34.5
Fluorene	166	<1	98.8	<1	<1	<1	45.8
Phenanthrene	178	<1	100.5	1.4	<1	<1	314.0
Dibenzothiophene *	184	<1	92.1	<1	<1	<1	38.5
Anthracene	178	<1	94.8	<1	<1	<1	130.0
Fluoranthene	202	<1	94.6	1.5	<1	<1	503.9
Pyrene	202	<1	93.9	1.2	<1	<1	399.3
Benzo[a]anthracene	228	<1	91.5	<1	<1	<1	220.1
Chrysene	228	<1	95.3	1.5	<1	<1	338.3
Benzo[b]fluoranthene	252	<1	95.4	1.7	<1	<1	364.5
Benzo[k]fluoranthene	252	<1	92.4	<1	<1	<1	175.2
Benzo[e]pyrene	252	<1	92.1	1.3	<1	<1	267.0
Benzo[a]pyrene	252	<1	88.4	<1	<1	<1	190.3
Indeno[123,cd]pyrene	276	<1	86.8	1.4	<1	<1	244.7
Dibenzo[a,h]anthracene	278	<1	84.2	<1	<1	<1	54.9
Benzo[ghi]perylene	276	<1	89.9	1.4	<1	<1	192.2

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI **Customer and Site Details:** Matrix:

Soil S17_9800 17-Oct-17 Job Number: Date Booked in: 170011 Date Extracted: 24-Oct-17 QC Batch Number: Directory: 261017PCB.TQ1 Date Analysed: 27-Oct-17 Ultrasonic

Method: Compounds marked * are not UKAS or MCerts accredited

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1780171	BH06 0.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780172	BH06 1.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780173	BH06 2.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780174	CRM	3.1	4.4	4.5	2.8	3.9	4.9	2.7
CL1780175	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780176	Reference Material (% Recovery)	123	107	106	108	102	110	111

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_9800 QC Batch Number: 170011 Directory: 261017.TQ1 Method: Ultrasonic Matrix:SedimentDate Booked in:17-Oct-17Date Extracted:24-Oct-17Date Analysed:27-Oct-17

UKAS Accredited: No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1780171	CL1780172	CL1780173	CL1780174	CL1780175	CL1780176
						Reference Material
Client ID:	BH06 0.50	BH06 1.50	BH06 2.50	CRM	QC Blank	(% Recovery)

Compound			Concentrat	tion (μg/kg)		
alpha-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	91
Hexachlorobenzene	<0.10	<0.10	<0.10	6.52	<0.10	94
gamma-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	93
p,p'-DDE	<0.10	<0.10	<0.10	2.94	<0.10	98
Dieldrin	<0.10	<0.10	<0.10	0.40	<0.10	103
p,p'-DDD	<0.10	<0.10	<0.10	2.68	<0.10	96
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	<0.10	

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17 9800

Directory:

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Headspace GCFID Method:

Matrix: Soil 17-Oct-17 Date Booked in: 17-Oct-24 Date extracted: Date Analysed: 25-Oct-17, 01

		C	oncentration	on, (mg/kg) - a	as wet weigl	ht			Aliphatics		
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
CL1780171	BH06 0.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1780172	BH06 1.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1780173	BH06 2.50	<0.010	<0.010	<0.010	<0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1780175	QC Blank	<0.010	<0.010	<0.010	< 0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1780176	Reference Material (% Recovery)	103	101	100	101	98	105	108	108	104	106
					100 11						

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9. Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_9800 Separation: Silica gel Date Booked ir 17-Oct-17 171154 Eluents: Hexane, DCM QC Batch Number: Date Extracted 26-Oct-17

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Ultra Sonic												
				Conce	entration, (mg	/kg) - as wet	weight					
S accredited.	>C8	- C10	>C10	- C12	>C12 - C16		>C16 - C21		>C21 - C35		>C8	- C40
Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
BH06 0.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
BH06 1.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
BH06 2.50	<4	<4	<4	<4	<4	<4	4.77	<4	<8.76	<8.76	<20	<20
QC Blank	<4		<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
Reference Material (% Recovery)	92	86	98	90	96	93	96	96	98	101	95	95
												
												
												
												
												
												
												
												
												
	S accredited. Client ID BH06 0.50 BH06 1.50 BH06 2.50 QC Blank Reference Material (%	S accredited. >C8	S accredited. >C8 - C10	S accredited. >C8 - C10 >C10	S accredited. SC8 - C10 SC10 - C12	Concentration, (mg S accredited. >C8 - C10 >C10 - C12 >C12	Concentration, (mg/kg) - as wet	Concentration, (mg/kg) - as wet weight	Concentration, (mg/kg) - as wet weight		Concentration, (mg/kg) - as wet weight S accredited. SC8 - C10 SC10 - C12 SC12 - C16 SC16 - C21 SC21 - C35	Concentration, (mg/kg) - as wet weight Secretited. S

Matrix:

Soil

Report Number: EFS/179800

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	CL1780172	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Dibenzothiothene) . These circumstances should be taken into consideration when utilising the data.
PAHSED		Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.

Sample Descriptions

Client :	Causeway Geotech Ltd	
Site:	Arklow Sewerage Scheme Marine O	utfall GI
Report Number :	S17_9800	
icport italiiber :	017_0000	Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1780171	BH06 0.50	MARINE SEDIMENTS
CL/1780172	BH06 1.50	MARINE SEDIMENTS
CL/1780172 CL/1780173	BH06 2.50	MARINE SEDIMENTS MARINE SEDIMENTS
CL/1780174	CRM	QUALITY CONTROL SAMPLE
CL/1780175	QC Blank	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1780174 CL/1780175 CL/1780176	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE

Appendix A Page 1 of 1 12/12/2017

Socotec Environmental Chemistry - Requested Analysis

S179865

Customer Causeway Geotech Ltd Site Arklow Sewerage Scher

Arklow Sewerage Scheme Marine Outfall GI

Report No S179865

Consignment No S_NonCon Date Logged 19-Oct-2017

Report Due 07-Nov-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^Dibutyltin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	Yes
CL/1780497	BH07 0.50	11/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1780498	BH07 1.50	11/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1780499	BH07 2.50	11/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1780500	CRM	11/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1780501	QC Blank		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1780502	Reference Material (% Recovery	/)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS)	Cadmium (MS)		Copper (MS)	Lead (MS)
ID Number	Description	Sediments	Sediments	Sediments	Sediment	Sediments
S1780497	BH07 0.50	5.2	0.07	20.7	10	5.2
S1780498	BH07 1.50	15.9	0.17	12	20.9	24.4
S1780499	BH07 2.50	9	0.11	20	12	11.3
S1780500	CRM	17.98	1.576	61.02	57.25	78.09
S1780501	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
	Reference Material					
S1780502	(% Recovery)	98	100	103	96	103

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL 36 mg/kg	
	Detection Limit	0.5	0.015	0.5	2		
	Units	mg/kg	mg/kg	mg/kg	mg/kg		
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	
	BH07 0.50	142.8	<0.015	14.9	18.3	8970	
S1780498	BH07 1.50	374.5	<0.015	11.3	73	13900	
S1780499	BH07 2.50	452.3	<0.015	21	49.9	20200	
S1780500	CRM	1150	0.753	32.89	323	27800	
S1780501	QC Blank	<0.5	<0.015	<0.5	<2	<36	
S1780502	Reference Material (% Recovery)	100	96	100	100	102	

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005	
	Detection Limit	0.1	0.02	0.12			
	Units	%	% M/M	%	ug/kg	ug/kg	
		Tot Moisture @	Total Organic				
		Tot.Moisture @	Carbon	Carbonate %	^Dibutyltin	^Tributyltin	
ID Number	Description	105C	(Sediment)				
S1780497	BH07 0.50	1.3	0.07	8.16	<5.00	<2.00	
S1780498	BH07 1.50	10.9	0.13	9.6	< 5.00	<2.00	
S1780499	BH07 2.50	21	0.33	6.96	<5.00	<2.00	
S1780500	CRM		3.179		70	101	
S1780501	QC Blank		<0.02		<5	<2	
	Reference Material						
S1780502	(% Recovery)		101	102	93	109	

Sample ID	Client ID	Moisture (%)
CL/1780497	BH07 0.50	12.5
CL/1780498	BH07 1.50	13.8
CL/1780499	BH07 2.50	27.2

UKAS accredited?: Yes

		Sample ID :	CL1780501	CL1780502	CL1780497	CL1780498	CL1780499	CL1780500
		Station :	QC Blank	Reference Material (% Recovery)	BH07 0.50	BH07 1.50	BH07 2.50	CRM
PAH Fraction	# PAH	Mass						
Naphthalene	1	128	<1	96.6	1.2	<1	<1	477.5
C1 Naphthalenes *	2	142	<1	95.7	1.6	1.4	4.5	268.2
C2 Naphthalenes *		156	<1	N.D	1.5	2.1	7.2	187.5
C3 Naphthalenes *		170	<1	N.D	1.0	1.4	6.4	152.0
C4 Naphthalenes *		184	<1	N.D	<1	<1	4.6	94.5
Sum Naphthalenes *			0	96	5	5	23	1180
Phenanthrene / Anthracene	2	178	<1	94.0	4.7	2.5	6.3	403.4
C1 178 *		192	<1	N.D	2.2	1.9	7.4	227.8
C2 178 *		206	<1	N.D	1.5	1.5	5.7	186.7
C3 178 *		220	<1	N.D	<1	<1	3.9	146.9
Sum 178 *			0.0	94	8.4	6.0	23.2	964.8
Dibenzothiophene *		184	<1	91	<1	<1	1.1	36.5
C1 Dibenzothiophenes *		198	<1	N.D	<1	<1	1.6	61.8
C2 Dibenzothiophenes *		212	<1	N.D	<1	<1	1.7	93.9
C3 Dibenzothiophenes *		226	<1	N.D	<1	<1	1.0	85.6
Sum Dibenzothiophenes *			0.0	91	0.0	0.0	5.4	277.8
Fluoranthene / pyrene	2	202	<1	92	8.7	4.7	5.5	879.4
C1 202 *		216	<1	N.D	2.7	1.7	5.7	263.4
C2 202 *		230	<1	N.D	1.4	1.1	4.7	228.8
C3 202 *		244	<1	N.D	<1	<1	3.6	109.3
Sum 202 *			0.0	92	12.8	7.5	19.5	1480.9
Benzoanthracene / Chrysene	2	228	<1	93	3.9	2.5	4.7	572.4
C1 228 *		242	<1	N.D	1.9	1.2	4.3	224.7
C2 228 *		256	<1	N.D	1.1	1.1	3.5	128.6
Sum 228 *			0.0	93	6.8	4.9	12.5	925.6
Benzofluoranthenes / benzopyrenes	4	252	<1	91	6.4	3.5	6.8	1048.7
C1 252 *		266	<1	N.D	2.6	2.1	4.4	219.9
C2 252 *		280	<1	N.D	1.1	<1	4.2	210.3
Sum 252 *			0.0	91	10.1	5.6	15.4	1478.8
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	101	3.0	2.1	3.5	532.2
C1 276 *		290	<1	N.D	<1	<1	1.0	108.8
C2 276 *		304	<1	N.D N.D	<1 <1	<1	1.5	30.8
Sum 276 *		30 4	0.0	101	3.0	2.1	6.1	671.9
Sum of all fractions *	 		0.0	94	46.5	31.0	104.8	6979.4
Sum of NPD fraction *	 		0.0	94	13.8	10.9	51.3	2422.2
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.25	0.42	0.54	0.96	0.53

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

* Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

EPA 16 PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1780501	CL1780502	CL1780497	CL1780498	CL1780499	CL1780500
	Station :	QC Blank	Reference Material (% Recovery)	BH07 0.50	BH07 1.50	BH07 2.50	CRM
PAH	Mass						
Naphthalene	128	<1	96.6	1.2	<1	<1	477.5
Acenaphthylene	152	<1	98.5	<1	<1	<1	46.5
Acenaphthene	154	<1	99.3	<1	<1	<1	33.4
Fluorene	166	<1	101.0	<1	<1	1.2	40.2
Phenanthrene	178	<1	95.5	3.6	2.5	5.3	292.6
Dibenzothiophene *	184	<1	90.8	<1	<1	1.1	36.5
Anthracene	178	<1	92.5	1.2	<1	1.0	110.8
Fluoranthene	202	<1	93.2	4.1	2.3	2.5	493.9
Pyrene	202	<1	90.7	4.6	2.4	3.0	385.5
Benzo[a]anthracene	228	<1	91.9	1.7	1.1	1.4	221.4
Chrysene	228	<1	94.7	2.1	1.5	3.3	351.0
Benzo[b]fluoranthene	252	<1	86.9	1.9	1.3	2.7	363.1
Benzo[k]fluoranthene	252	<1	89.0	1.3	<1	<1	201.8
Benzo[e]pyrene	252	<1	93.0	1.7	1.1	2.9	280.4
Benzo[a]pyrene	252	<1	93.8	1.5	1.0	1.2	203.3
Indeno[123,cd]pyrene	276	<1	100.0	1.5	1.0	1.0	262.3
Dibenzo[a,h]anthracene	278	<1	103.0	<1	<1	<1	57.4
Benzo[ghi]perylene	276	<1	101.2	1.5	1.1	2.5	212.6

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Soil

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix:

 Job Number:
 \$17_9865
 Date Booked in:
 19-Oct-17

 QC Batch Number:
 170011
 Date Extracted:
 24-Oct-17

 Directory:
 261017PCB.TQ1
 Date Analysed:
 27-Oct-17

 Method:
 Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1780497	BH07 0.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780498	BH07 1.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780499	BH07 2.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780500	CRM	3.1	4.4	4.5	2.8	3.9	4.9	2.7
CL1780501	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780502	Reference Material (% Recovery)	123	107	106	108	102	110	111

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_9865 QC Batch Number: 170011 Directory: 261017.TQ1 Method: Ultrasonic Matrix:SedimentDate Booked in:19-Oct-17Date Extracted:24-Oct-17Date Analysed:27-Oct-17

UKAS Accredited: No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1780497	CL1780498	CL1780499	CL1780500	CL1780501	CL1780502
						Reference Material
Client ID:	BH07 0.50	BH07 1.50	BH07 2.50	CRM	QC Blank	(% Recovery)

Compound			Concentrat	tion (μg/kg)		
alpha-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	91
Hexachlorobenzene	<0.10	<0.10	<0.10	6.52	<0.10	94
gamma-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	93
p,p'-DDE	<0.10	<0.10	<0.10	2.94	<0.10	98
Dieldrin	<0.10	<0.10	<0.10	0.40	<0.10	103
p,p'-DDD	0.19	<0.10	<0.10	2.68	<0.10	96
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	<0.10	

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17 9865

Directory:

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Headspace GCFID Method:

Matrix: Soil 19-Oct-17 Date Booked in: 17-Oct-25 Date extracted: Date Analysed: 26-Oct-17, 07

		C	oncentrati	on, (mg/kg) - a	s wet weig	ht		Aliphatics								
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO					
CL1780497	BH07 0.50	< 0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2					
CL1780498	BH07 1.50	< 0.010	< 0.010	< 0.010	<0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2					
CL1780499	BH07 2.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2					
CL1780501	QC Blank	<0.010	<0.010	< 0.010	< 0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2					
CL1780502	Reference Material (% Recovery)	94	90	102	102	97	90	84	81	93	88					

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9. Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_9865 Separation: Silica gel 171154 Eluents: Hexane, DCM QC Batch Number:

D:\TES\DATA\2017\102717\102717 2017-10-27 14-14-24\F-089-82-RMS171154ARO.D Directory:

Method: Ultra Sonic

Soil Date Booked ir 19-Oct-17

Matrix:

Date Extracted 26-Oct-17 Date Analysed 28-Oct-17, 09:43:32

		Concentration, (mg/kg) - as wet weight												
		>C8	- C10	>C10	- C12	>C12	- C16	>C16	- C21	>C21	- C35	>C8	- C40	
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	
CL1780497	BH07 0.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20	
CL1780498	BH07 1.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20	
CL1780499	BH07 2.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20	
CL1780501	QC Blank	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20	
CL1780502	Reference Material (% Recovery)	92	86	98	90	96	93	96	96	98	101	95	95	
														
													 	
													 	
													<u> </u>	
	•		•		•			•	•		•	•		

Report Number: EFS/179865

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	CL1780498 CL1780499	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Dibenzothiothene) . These circumstances should be taken into consideration when utilising the data.
PAHSED		Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.
_		

Sample Descriptions

Client :	Causeway Geotech Ltd	
Site :	Arklow Sewerage Scheme Marine O	utfall Gl
Report Number :	S17_9865	
noport number :		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1780497	BH07 0.50	
CI /1780/08	BH07 0.50	MARINE SEDIMENTS MARINE SEDIMENTS
CL/1780499	BH07 1.50 BH07 2.50	MARINE SEDIMENTS
CL/1780500	CRM	QUALITY CONTROL SAMPLE
CL/1780501	QC Blank	QUALITY CONTROL SAMPLE
CL/1780499 CL/1780500 CL/1780501 CL/1780502	QC Blank Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
	1	1

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-66337-1

Issue No.: 1

Date of Issue 03/11/2017

Customer Details: SOCOTEC UK - Environmental Chemistry, P O Box 100, Bretby Business Park,

Burton-on-Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: S179865

Quotation Reference: 170504/06

Description: 3 sediment samples

Date Received: 25/10/2017

Date Started: 01/11/2017

Date Completed: 03/11/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: None

Approved By:

Marco Lattughi, Operational Director

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.

This certificate shall not be reproduced except in full without the prior written approval of the laboratory.

Observations and interpretations are outside of the scope of UKAS accreditation.

Results reported herein relate only to the items supplied to the laboratory for testing.



1663

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Results Summary

Report No.: 17-66337-1

Customer Reference: S179865 Customer Order No: 42062 BEC

				Customer S	Sample No	S1780497	S1780498	S1780499			
				Custome	r Sample ID	BH07 0.50	BH07 1.50	BH07 2.50			
	RPS Sample No 343837 343838 3438										
				Sa	mple Type	SEDIMENT	SEDIMENT	SEDIMENT			
				Sai	mpling Date	11/10/2017	11/10/2017	11/10/2017			
Determinand	CAS No	Codes	SOP	Units	RL						
ibutyltin (DBT)	1002-53-5	U	395	ug/kg as cation	5	< 5.00	< 5.00	< 5.00			
ibutyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00	< 2.00			



Report No.: 17-66337-1Customer Reference: S179865
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-66337	3 sediment samples	Method Blank
		TBT = < 2ug/Kg
		DBT= < 5ug/Kg
		CRM recovery
		TBT = 101%
		DBT = 70%
		AOC recovery
		AQC recovery
		TBT = 109%
		DBT = 93%



Deviating Samples

Report No.: 17-66337-1Customer Reference: S179865
Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).

RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.

Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below. Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed.

Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
343837	S1780497		11/10/2017	60ml amber glass jar	No	
343838	S1780498		11/10/2017	60ml amber glass jar	No	
343839	S1780499		11/10/2017	60ml amber glass jar	No	



Report Information

Key to Report Codes

U UKAS Accredited
M MCERTS Accredited
N Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units)

Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1 Clay - Brown
Type 2 Clay - Grey/Black
Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)

Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

Socotec Environmental Chemistry - Requested Analysis

Customer Site

Report No

Causeway Geotech Ltd Arklow Sewerage Scheme Marine Outfall GI

S179862

Consignment No S_NonCon
Date Logged 19-Oct-2017

Report Due 07-Nov-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^Dibutyltin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	No	No	Yes
CL/1780485	BH08 0.50	10/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1780486	BH08 1.50	10/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1780487	BH08 2.50	10/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1780488	CRM	10/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1780489	QC Blank		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1780490	Reference Material (% Recovery	/)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS)	Cadmium (MS)		Copper (MS)	Lead (MS)
ID Number	Description	Sediments	Sediments	Sediments	Sediment	Sediments
S1780485	BH08 0.50	10.5	0.09	9.1	14	16.7
S1780486	BH08 1.50	6.3	0.06	9	9.5	6.1
S1780487	BH08 2.50	3.8	<0.04	6.4	7.5	3.4
S1780488	CRM	17.98	1.576	61.02	57.25	78.09
S1780489	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
0	Reference Material					
S1780490	(% Recovery)	98	100	103	96	103

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
S1780485	BH08 0.50	247.3	<0.015	8.2	33.3	20400
S1780486	BH08 1.50	171.5	<0.015	7.3	22.4	8950
S1780487	BH08 2.50	126.9	<0.015	4.9	14.2	6100
S1780488	CRM	1150	0.753	32.89	323	27800
S1780489	QC Blank	<0.5	<0.015	<0.5	<2	<36
S1780490	Reference Material (% Recovery)	100	96	100	100	102

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005
	Detection Limit	0.1	0.02	0.12		
	Units	%	% M/M	%	ug/kg	ug/kg
		Tot Maisture @	Total Organic			
		Tot.Moisture @	Carbon	Carbonate %	^Dibutyltin	^Tributyltin
ID Number	Description	105C	(Sediment)			
S1780485	BH08 0.50	9	0.07	5.28	<5	<2
S1780486	BH08 1.50	14	0.08	6.48	<5	<2
S1780487	BH08 2.50	16.8	0.06	4.32	<5	<2
S1780488	CRM		3.179		70	101
S1780489	QC Blank		<0.02		<5	<2
	Reference Material					
S1780490	(% Recovery)		101	102	93	109

Sample ID	Client ID	Moisture (%)
CL/1780485	BH08 0.50	13.7
CL/1780486	BH08 1.50	26.7
CL/1780487	BH08 2.50	17.1

UKAS accredited?: Yes

		Sample ID :	CL1780489	CL1780490	CL1780485	CL1780486	CL1780487	CL1780488
		Station :	QC Blank	Reference Material (% Recovery)	BH08 0.50	BH08 1.50	BH08 2.50	CRM
PAH Fraction	# PAH	Mass						
Naphthalene	1	128	<1	96.6	<1	<1	<1	477.5
C1 Naphthalenes *	2	142	<1	95.7	1.2	<1	<1	268.2
C2 Naphthalenes *		156	<1	N.D	1.5	1.2	1.1	187.5
C3 Naphthalenes *		170	<1	N.D	<1	<1	<1	152.0
C4 Naphthalenes *		184	<1	N.D	<1	<1	<1	94.5
Sum Naphthalenes *			0	96	3	1	1	1180
Phenanthrene / Anthracene	2	178	<1	94.0	1.1	<1	<1	403.4
C1 178 *		192	<1	N.D	1.4	1.0	<1	227.8
C2 178 *		206	<1	N.D	1.2	<1	<1	186.7
C3 178 *		220	<1	N.D	<1	<1	<1	146.9
Sum 178 *			0.0	94	3.7	1.0	0.0	964.8
Dibenzothiophene *		184	<1	91	<1	<1	<1	36.5
C1 Dibenzothiophenes *		198	<1	N.D	<1	<1	<1	61.8
C2 Dibenzothiophenes *		212	<1	N.D	<1	<1	<1	93.9
C3 Dibenzothiophenes *		226	<1	N.D	<1	<1	<1	85.6
Sum Dibenzothiophenes *			0.0	91	0.0	0.0	0.0	277.8
Fluoranthene / pyrene	2	202	<1	92	1.1	<1	<1	879.4
C1 202 *		216	<1	N.D	<1	<1	<1	263.4
C2 202 *		230	<1	N.D	<1	<1	<1	228.8
C3 202 *		244	<1	N.D	<1	<1	<1	109.3
Sum 202 *			0.0	92	1.1	0.0	0.0	1480.9
Benzoanthracene / Chrysene	2	228	<1	93	<1	<1	<1	572.4
C1 228 *		242	<1	N.D	<1	<1	<1	224.7
C2 228 *		256	<1	N.D	<1	<1	<1	128.6
Sum 228 *			0.0	93	0.0	0.0	0.0	925.6
Benzofluoranthenes / benzopyrenes	4	252	<1	91	<1	<1	<1	1048.7
C1 252 *		266	<1	N.D	1.5	<1	<1	219.9
C2 252 *		280	<1	N.D	<1	<1	<1	210.3
Sum 252 *			0.0	91	1.5	0.0	0.0	1478.8
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	101	<1	<1	<1	532.2
C1 276 *		290	<1	N.D	<1	<1	<1	108.8
C2 276 *		304	<1	N.D N.D	<1	<1	<1	30.8
Sum 276 *		JU4	0.0	101	0.0	0.0	0.0	671.9
Sum of all fractions *			0.0	94	8.9	2.2	1.1	6979.4
Sum of NPD fraction *	 		0.0	94	6.3	2.2	1.1	2422.2
	 		#DIV/0!	0.25	2.47	#DIV/0!	#DIV/0!	0.53
NPD / 4-6 ring PAH ratio *			#DIV/U!	0.∠5	2.41	#DIV/U!	#DIV/U!	U.ეკ

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

* Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1780489	CL1780490	CL1780485	CL1780486	CL1780487	CL1780488
	Station :	QC Blank	Reference Material (% Recovery)	BH08 0.50	BH08 1.50	BH08 2.50	CRM
PAH	Mass						
Naphthalene	128	<1	96.6	<1	<1	<1	477.5
Acenaphthylene	152	<1	98.5	<1	<1	<1	46.5
Acenaphthene	154	<1	99.3	<1	<1	<1	33.4
Fluorene	166	<1	101.0	<1	<1	<1	40.2
Phenanthrene	178	<1	95.5	1.1	<1	<1	292.6
Dibenzothiophene *	184	<1	90.8	<1	<1	<1	36.5
Anthracene	178	<1	92.5	<1	<1	<1	110.8
Fluoranthene	202	<1	93.2	<1	<1	<1	493.9
Pyrene	202	<1	90.7	1.1	<1	<1	385.5
Benzo[a]anthracene	228	<1	91.9	<1	<1	<1	221.4
Chrysene	228	<1	94.7	<1	<1	<1	351.0
Benzo[b]fluoranthene	252	<1	86.9	<1	<1	<1	363.1
Benzo[k]fluoranthene	252	<1	89.0	<1	<1	<1	201.8
Benzo[e]pyrene	252	<1	93.0	<1	<1	<1	280.4
Benzo[a]pyrene	252	<1	93.8	<1	<1	<1	203.3
Indeno[123,cd]pyrene	276	<1	100.0	<1	<1	<1	262.3
Dibenzo[a,h]anthracene	278	<1	103.0	<1	<1	<1	57.4
Benzo[ghi]perylene	276	<1	101.2	<1	<1	<1	212.6

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall Gl Matrix:

 Job Number:
 S17_9862
 Date Booked in:
 19-Oct-17

 QC Batch Number:
 170011
 Date Extracted:
 24-Oct-17

 Directory:
 261017PCB.TQ1
 Date Analysed:
 27-Oct-17

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

Soil

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1780485	BH08 0.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780486	BH08 1.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780487	BH08 2.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780488	CRM	3.1	4.4	4.5	2.8	3.9	4.9	2.7
CL1780489	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1780490	Reference Material (% Recovery)	123	107	106	108	102	110	111

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_9862 QC Batch Number: 170011 Directory: 261017.TQ1 Method: Ultrasonic Matrix:SedimentDate Booked in:19-Oct-17Date Extracted:24-Oct-17Date Analysed:27-Oct-17

UKAS Accredited: No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1780485	CL1780486	CL1780487	CL1780488	CL1780489	CL1780490
						Reference Material
Client ID:	BH08 0.50	BH08 1.50	BH08 2.50	CRM	QC Blank	(% Recovery)

Compound		Concentration (µg/kg)											
alpha-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	91							
Hexachlorobenzene	<0.10	<0.10	<0.10	6.52	<0.10	94							
gamma-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	93							
p,p'-DDE	<0.10	<0.10	<0.10	2.94	<0.10	98							
Dieldrin	<0.10	<0.10	<0.10	0.40	<0.10	103							
p,p'-DDD	<0.10	<0.10	<0.10	2.68	<0.10	96							
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	<0.10								

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17 9862

Directory:

D:\TES\DATA\2017\1024HSA GC9\102417 2017-10-24 12-17-32\149B4901.D

Headspace GCFID Method:

Matrix: Soil 19-Oct-17 Date Booked in: 17-Oct-24 Date extracted: Date Analysed: 25-Oct-17, 02

		C	oncentratio	on, (mg/kg) - a	s wet weig	ht			Aliphatics		
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
CL1780485	BH08 0.50	< 0.010	<0.010	<0.010	<0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1780486	BH08 1.50	< 0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1780487	BH08 2.50	< 0.010	<0.010	<0.010	<0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1780489	QC Blank	<0.010	<0.010	<0.010	< 0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1780490	Reference Material (% Recovery)	103	101	100	101	98	105	108	108	104	106

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9. Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_9862 Separation: Silica gel 171154 Eluents: Hexane, DCM QC Batch Number:

D:\TES\DATA\2017\102717\102717 2017-10-27 14-14-24\F-089-82-RMS171154ARO.D Directory:

Method: Ultra Sonic Date Booked ir 19-Oct-17 Date Extracted 26-Oct-17

Matrix:

Date Analysed 28-Oct-17, 09:43:32

Soil

			Concentration, (mg/kg) - as wet weight											
			>C8 ·	C8 - C10 >C10 - C12			>C12	- C16	>C16	- C21	>C21	- C35	>C8	- C40
Sa	mple ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
CL	L1780485	BH08 0.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
CL	L1780486	BH08 1.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
CL	L1780487	BH08 2.50	<4	<4	<4	<4	<4	<4	<4	5.85	<8.76	<8.76	<20	<20
CL	L1780489	QC Blank	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
CL	L1780490	Reference Material (% Recovery)	92		98	90	96	93	96	96	98	101	95	95

Report Number: EFS/179862

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	CL1780486	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Dibenzothiothene) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1780488	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.

Sample Descriptions

Client :	Causeway Geotech Ltd	
Site :	Arklow Sewerage Scheme Marine Out	ifall GI
Report Number :	S17_9862	
neport rumber :		Note: major constituent in upper case
Lab ID Name barr	Client ID	
Lab ID Number		Description
CL/1780485	BH08 0.50	MARINE SEDIMENTS
CL/1780486 CL/1780487	BH08 1.50	MARINE SEDIMENTS MARINE SEDIMENTS
CL/1780487	BH08 2.50	MARINE SEDIMENTS
CL/1780488	CRM	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1780488 CL/1780489 CL/1780490	QC Blank Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1780490	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE
		<u> </u>

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-66334-1

Issue No.: 1

Date of Issue 03/11/2017

Customer Details: SOCOTEC UK - Environmental Chemistry, P O Box 100, Bretby Business Park,

Burton-on-Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: S179862

Quotation Reference: 170504/06

Description: 3 sediment samples

Date Received: 25/10/2017

Date Started: 01/11/2017

Date Completed: 03/11/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: None

Approved By:

Marco Lattughi, Operational Director

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.

This certificate shall not be reproduced except in full without the prior written approval of the laboratory.

Observations and interpretations are outside of the scope of UKAS accreditation.

Results reported herein relate only to the items supplied to the laboratory for testing.



166

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Results Summary

Report No.: 17-66334-1

Customer Reference: S179862 Customer Order No: 42062 BEC

				Customer S	Sample No	S1780485	S1780486	S1780487
				Custome	r Sample ID	BH08 0.50	BH08 1.50	BH08 2.50
				RPS	Sample No	343819	343820	343821
				Sa	mple Type	SEDIMENT	SEDIMENT	SEDIMENT
				Sai	mpling Date	10/10/2017	10/10/2017	10/10/2017
Determinand	CAS No	Codes	SOP	Units	RL			
butyltin (DBT)	1002-53-5	J	395	ug/kg as cation	5	< 5.00	< 5.00	< 5.00
ibutyltin (TBT)	56573-85-4	J	395	ug/kg as cation	2	< 2.00	< 2.00	< 2.00



Report No.: 17-66334-1Customer Reference: S179862
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-66334	3 sediment samples	Method Blank
		TBT = < 2ug/Kg
		DBT= < 5ug/Kg
		CRM recovery
		TBT = 101%
		DBT = 70%
		AOC vees very
		AQC recovery
		TBT = 109%
		DBT = 93%



Deviating Samples

Report No.: 17-66334-1Customer Reference: S179862
Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).

RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.

Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below. Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed. Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
343819	S1780485		10/10/2017	60ml amber glass jar	No	
343820	S1780486		10/10/2017	60ml amber glass jar	No	
343821	S1780487		10/10/2017	60ml amber glass jar	No	



Report Information

Key to Report Codes

U UKAS Accredited
M MCERTS Accredited
N Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units)

Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1 Clay - Brown
Type 2 Clay - Grey/Black
Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)

Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

Socotec Environmental Chemistry - Requested Analysis

Customer **Causeway Geotech Ltd**

Site **Arklow Sewerage Scheme Marine Outfall GI Report No**

S180512

Consignment No S_NonCon Date Logged 09-Nov-2017

Report Due 29-Nov-2017

		MethodID	ANC	CustSer	GROHSA	ICPMSS		rt Due							ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	™ Report C	GRO (AA) by HSA GC-FID	s Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	⊩ Iron (Sediments)	PAH by M	Organochlorine Pesticides (Marine	PCB- 7 Congeners (Marine Sediments)	^DibutyItin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	S Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
CL/1783099	BH09 0.50	27/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1783100	BH09 1.50	27/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1783101	BH09 2.50	27/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1783102	CRM	27/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1783103	QC Blank		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1783104	Reference Material (% Recovery	<i>'</i>)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R				R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)
ID Number	Description	Sediments	Sediments	Sediments	Sediment	Sediments
S1783099	BH09 0.50	7.2	0.07	8	17.5	12.8
S1783100	BH09 1.50	7.9	0.05	8	16.4	11.6
S1783101	BH09 2.50	16.2	0.08	13.9	22.2	15
S1783102	CRM	18.96	1.653	63.24	52.84	77.69
S1783103	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
	Reference Material					
S1783104	(% Recovery)	93	96	99	104	103

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.015	0.5	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Mercury (MS) Sediments	Manganese (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
	BH09 0.50	0.05	177.3	6.5	37.5	10700
S1783100	BH09 1.50	0.03	162.8	6.2	34.4	10100
S1783101	BH09 2.50	0.03	278.5	12.9	49.7	18800
S1783102	CRM	0.696	1197	34.45	323.6	27900
S1783103	QC Blank	< 0.015	<0.5	<0.5	<2	<36
S1783104	Reference Material (% Recovery)	104	96	96	100	104

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005
	Detection Limit	0.1	0.02	0.12		
	Units	%	% M/M	%	ug/kg	ug/kg
		Tet Meisture	Total Organic			
		Tot.Moisture @	Carbon	Carbonate %	^Dibutyltin	^Tributyltin
ID Number	Description	105C	(Sediment)			
S1783099	BH09 0.50	13.4	0.06	4.56	<5.00	<2.00
S1783100	BH09 1.50	16.7	0.06	1.68	<5.00	<2.00
S1783101	BH09 2.50	16.8	0.16	6.72	<5.00	<2.00
S1783102	CRM		3.1765		78%	103%
S1783103	QC Blank		<0.02		<5	<2
	Reference Material					
S1783104	(% Recovery)		101	98.5		

Sample ID	Client ID	Moisture (%)
CL/1783099	BH09 0.50	16
CL/1783100	BH09 1.50	13.5
CL/1783101	BH09 2.50	12.2

		Sample ID :	CL1783103	CL1783104	CL1783102	CL1783099	CL1783100	CL1783101
		-		Reference				
		Station :	QC Blank	Material (% Recovery)	CRM 1941b	BH09 0.50	BH09 1.50	BH09 2.50
PAH Fraction	# PAH	Mass						
Naphthalene *	1	128	<1	118.9	575.0	1.4	<1	<1
C1 Naphthalenes *	2	142	<1	124.1	319.4	1.7	3.7	1.1
C2 Naphthalenes *		156	<1	N.D	208.4	8.5	17.7	9.1
C3 Naphthalenes *		170	<1	N.D	154.4	1.8	3.7	8.7
C4 Naphthalenes *		184	<1	N.D	109.9	1.4	<1	<1
Sum Naphthalenes *			0	122	1367	15	25	19
Phenanthrene / Anthracene	2	178	<1	108.2	526.6	10.6	3.5	<1
C1 178 *		192	<1	N.D	317.3	8.1	3.2	<1
C2 178 *		206	<1	N.D	253.2	7.4	2.7	<1
C3 178 *		220	<1	N.D	161.2	4.3	1.4	<1
Sum 178 *			0	108	1258.4	30.3	10.8	0.0
Dibenzothiophene		184	<1	109	45.1	<1	<1	<1
C1 Dibenzothiophenes *		198	<1	N.D	69.2	1.2	<1	<1
C2 Dibenzothiophenes *		212	<1	N.D	108.8	1.8	<1	<1
C3 Dibenzothiophenes *		226	<1	N.D	60.2	1.7	<1	<1
Sum Dibenzothiophenes *			0	109	283.3	4.8	0.0	0.0
Fluoranthene / pyrene	2	202	<1	107	1081.7	58.0	11.8	<1
C1 202 *		216	<1	N.D	247.5	18.8	3.7	<1
C2 202 *		230	<1	N.D	213.4	11.8	2.2	<1
C3 202 *		244	<1	N.D	107.4	4.9	1.0	<1
Sum 202 *			0	107	1650.1	93.5	18.7	0.0
Benzoanthracene / Chrysene	2	228	<1	107	666.6	41.6	6.7	<1
C1 228 *		242	<1	N.D	253.7	16.7	3.1	<1
C2 228 *		256	<1	N.D	142.6	7.2	1.5	<1
Sum 228 *			0	107	1062.9	65.5	11.4	0.0
Benzofluoranthenes / benzopyrenes	4	252	<1	102	1255.9	80.1	11.7	<1
C1 252 *		266	<1	N.D	261.1	13.8	<1	<1
C2 252 *		280	<1	N.D	97.7	7.9	<1	<1
Sum 252 *			0	102	1614.6	101.8	11.7	0.0
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	102	566.1	36.1	5.2	<1
C1 276 *		290	<1	N.D	79.2	4.6	<1	<1
C2 276 *		304	<1	N.D	35.7	2.3	<1	<1
Sum 276 *		304	0	102	681.0	43.0	5.2	0.0
Sum of all fractions *			0	108	7917.4	353.7	83.0	18.9
Sum of NPD fraction *			0	113	2908.8		36.0	18.9
			•			49.9		
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.27	0.58	0.16	0.76	#DIV/0!

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1783103	CL1783104	CL1783102	CL1783099	CL1783100	CL1783101
	Station :	QC Blank	Reference Material (% Recovery)	CRM 1941b	BH09 0.50	BH09 1.50	BH09 2.50
PAH	Mass						
Naphthalene *	128	<1	118.9	575.0	1.4	<1	<1
Acenaphthylene	152	<1	125.7	50.7	1.9	<1	<1
Acenaphthene	154	<1	125.5	32.9	<1	<1	<1
Fluorene *	166	<1	126.7	48.4	<1	<1	<1
Phenanthrene	178	<1	111.8	383.8	7.9	3.5	<1
Dibenzothiophene	184	<1	109.4	45.1	<1	<1	<1
Anthracene	178	<1	104.7	142.9	2.7	<1	<1
Fluoranthene	202	<1	106.5	603.7	28.7	6.0	<1
Pyrene	202	<1	107.7	478.0	29.3	5.9	<1
Benzo[a]anthracene	228	<1	104.4	269.1	18.7	2.9	<1
Chrysene	228	<1	110.3	397.5	22.9	3.8	<1
Benzo[b]fluoranthene	252	<1	93.4	453.0	24.5	3.8	<1
Benzo[k]fluoranthene	252	<1	106.8	227.6	12.6	2.0	<1
Benzo[e]pyrene	252	<1	105.6	333.8	18.6	2.9	<1
Benzo[a]pyrene	252	<1	101.2	241.5	24.3	3.0	<1
Perylene *	252	<1	104.0	254.0	6.3	<1	7.4
Indeno[123,cd]pyrene	276	<1	101.8	276.6	17.1	2.7	<1
Dibenzo[a,h]anthracene	278	<1	100.4	55.0	3.8	<1	<1
Benzo[ghi]perylene	276	<1	103.8	234.5	15.2	2.5	<1

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Soil

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix:

 Job Number:
 \$18_0512
 Date Booked in:
 09-Nov-17

 QC Batch Number:
 170015
 Date Extracted:
 24-Nov-17

 Directory:
 241117PCB.TQ1
 Date Analysed:
 28-Nov-17

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1783099	BH09 0.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1783100	BH09 1.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1783101	BH09 2.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1783102	CRM	3.25	4.26	5.13	3.02	4.25	3.88	2.65
CL1783103	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1783104	Reference Material (% Recovery)	87	100	105	105	101	102	118



Polychlorinated Biphenyls

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18_0512
QC Batch Number: 170015
Directory: 241117.TQ1
Method: Ultrasonic

Matrix: Sediment
Date Booked in: 09-Nov-17
Date Extracted: 24-Nov-17
Date Analysed: 28-Nov-17

UKAS Accredited: No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1783099	CL1783100	CL1783101	CL1783102	CL1783103	CL1783104
						Reference Material
Client ID:	BH09 0.50	BH09 1.50	BH09 2.50	CRM	QC Blank	(% Recovery)

Compound	Concentration (μg/kg)								
alpha-HCH	<0.10 <0.10		<0.10	<0.10	<0.10	89			
Hexachlorobenzene	<0.10	<0.10	<0.10	7.93	<0.10	97			
gamma-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	93			
p,p'-DDE	<0.10	<0.10	<0.10	2.37	<0.10	90			
Dieldrin	<0.10	<0.10	<0.10	0.25	<0.10	92			
p,p'-DDD	<0.10	<0.10	<0.10	3.44	<0.10	97			
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	<0.10	90			

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18_0512

Directory: D:\TES\DATA\2017\1115HSA_GC9\111517 2017-11-15 12-58-23\015F1501.D

Method: Headspace GCFID

Matrix: Soil

Date Booked in: 09-Nov-

Date Booked in: 09-Nov-17
Date extracted: 17-Nov-15

Date Analysed: 15-Nov-17, 17:1

* Sample data with an asterisk are not UKAS accredited.

		Concentration, (mg/kg) - as wet weight				Aliphatics					
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
* CL1783099	BH09 0.50	< 0.010	<0.010	<0.010	< 0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1783100	BH09 1.50	<0.010	<0.010	<0.010	< 0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1783101	BH09 2.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1783103	QC Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1783104	Reference Material (% Recovery)	93	93	96	92	91	87	99	110	123	103

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

 Job Number:
 S18_0512
 Separation:
 Silica gel

 QC Batch Number:
 171230
 Eluents:
 Hexane, DCM

 Directory:
 D:\TES\DATA\Y2017\111717TPH_GC3\111717 2017-11-17 16-31-32\060B1501.D

Method: Ultra Sonic

				Concentration, (mg/kg) - as wet weight										
* Th	nis sample data is not UK	AS accredited.	>C8 - C10		>C10 - C12		>C12 - C16		>C16 - C21		>C21 - C35		>C8 - C40	
	Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
*	CL1783099	BH09 0.50	<4.04	<4	<4.04	<4	17.1	<4	<4.04	<4	<8.85	12.1	30.3	21.8
*	CL1783100	BH09 1.50	<4	<4	<4	<4	26.9	<4	<4	<4	17.7	13.7	51.5	22.4
*	CL1783101	BH09 2.50	<4	<4	<4	<4	13.2	<4	<4	<4	<8.76	11.8	<20	<20
*	CL1783103	QC Blank	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
*	CL1783104	Reference Material (% Recovery)	82	94	90	106	93	110	91	113	103	120	97	113

Matrix:

Soil

Date Analysed: 17-Nov-17, 19:39:58

Date Booked in 09-Nov-17

Date Extracted: 16-Nov-17

Report Number: EFS/180512

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	CL1783099 to CL1783102	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Naphthalene, Fluorene) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1783099 to CL1783104	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.
PAHSED	to	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc.

Sample Descriptions

		Sample Descriptions
lient :	Causeway Geotech Ltd	
ite:	Arklow Sewerage Scheme Marine	Outfall GI
eport Number :	S18_0512	
oport italiiber i		Note: major constituent in upper case
Lab ID Number		Description
Lab ID Number	Client ID	Description
CL/1783099	BH09 0.50	MARINE SEDIMENTS MARINE SEDIMENTS MARINE SEDIMENTS
CL/1783100 CL/1783101	BH09 1.50 BH09 2.50	MARINE SEDIMENTS MARINE SEDIMENTS
CL/1783101 CL/1783102	CRM	OLIALITY CONTROL SAMPLE
CL/1783103	QC Blank	QUALITY CONTROL SAMPLE
CL/1783104	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
	-	
	-	

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-67031-1

Issue No.: 1

Date of Issue 23/11/2017

Customer Details: SOCOTEC UK - Environmental Chemistry, P O Box 100, Bretby Business Park,

Burton-on-Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: S180512

Quotation Reference: 170504/06

Description: 3 sediment samples

Date Received: 14/11/2017

Date Started: 21/11/2017

Date Completed: 22/11/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: None

Approved By:

Matthew Hickson, Laboratory Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.

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166

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Results Summary

Report No.: 17-67031-1Customer Reference: S180512

Customer Order No: 42062 BEC

				Customer :	Sample No	S1783099	S1783100	S1783101
				Custome	r Sample ID	BH09 0.50	BH09 1.50	BH09 2.50
				RPS	Sample No	346349	346350	346351
				Sa	mple Type	SEDIMENT	SEDIMENT	SEDIMENT
				Sample	e Depth (m)	0.50m	1.50m	2.50m
				Sa	mpling Date	27/10/2017	27/10/2017	27/10/2017
Determinand	CAS No	Codes	SOP	Units	RL			
butyltin (DBT)	1002-53-5	U	395	ug/kg as cation	5	< 5.00	< 5.00	< 5.00
butyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00	< 2.00



Report No.: 17-67031-1Customer Reference: S180512
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-67031		BLANK: DBT <rl <rl<="" tbt="" td=""></rl>
		CRM: DBT - 78% TBT - 103%



Deviating Samples

Report No.: 17-67031-1Customer Reference: S180512
Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).

RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.

Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below. Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed. Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
346349	S1783099		27/10/2017	120ml amber glass jar	No	
346350	S1783100		27/10/2017	120ml amber glass jar	No	
346351	S1783101		27/10/2017	120ml amber glass jar	No	



Report Information

Key to Report Codes

U UKAS Accredited
M MCERTS Accredited
N Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units)

Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1 Clay - Brown Type 2 Clay - Grey/Black

Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)
Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

Socotec Environmental Chemistry - Requested Analysis

Customer **Causeway Geotech Ltd**

Site **Arklow Sewerage Scheme Marine Outfall GI Report No**

S180514

Consignment No S_NonCon Date Logged 09-Nov-2017

Report Due 29-Nov-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS	·								ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^Dibutyltin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
CL/1783110	BH10 0.50	26/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1783111	BH10 1.50	26/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1783112	BH10 2.50	26/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1783113	CRM	26/10/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1783114	QC Blank		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1783115	Reference Material (% Recovery	/)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R				R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Copper (MS) Sediment	Lead (MS) Sediments
ID Number	Description	Sediments	Seamlents	Seamlents	Seamlent	Sediments
S1783110	BH10 0.50	14.9	0.25	13.2	25.9	31.3
S1783111	BH10 1.50	14.6	0.92	29.7	27.2	23.2
S1783112	BH10 2.50	14.4	0.32	19.3	22.6	10.8
S1783113	CRM	18.96	1.653	63.24	52.84	77.69
S1783114	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
S1783115	Reference Material (% Recovery)	93	96	99	104	103

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.015	0.5	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Mercury (MS) Sediments	Nickel (MS) Sediments	Manganese (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
	BH10 0.50	0.06	11.4	457.1	89.8	22800
S1783111	BH10 1.50	0.06	38.8	389.3	149.6	35900
S1783112	BH10 2.50	0.04	30.5	748.6	92.9	32100
S1783113	CRM	0.696	34.45	1197	323.6	27900
S1783114	QC Blank	<0.015	<0.5	<0.5	<2	<36
S1783115	Reference Material (% Recovery)	104	96	96	100	104

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005
	Detection Limit	0.1	0.02	0.12		
	Units	%	% M/M	%	ug/kg	ug/kg
		Tot Moisture @	Total Organic			
		Tot.Moisture @	Carbon	Carbonate %	^Dibutyltin	^Tributyltin
ID Number	Description	105C	(Sediment)			
S1783110	BH10 0.50	5.9	0.08	5.52	<5.00	<2.00
S1783111	BH10 1.50	43.7	6	0.72	<5.00	<2.00
S1783112	BH10 2.50	7.7	0.18	1.2	<5.00	<2.00
S1783113	CRM		3.18		78%	103%
S1783114	QC Blank		<0.02		<5	<2
	Reference Material					
S1783115	(% Recovery)		101	99		

Sample ID	Client ID	Moisture (%)
CL/1783110	BH10 0.50	40.2
CL/1783111	BH10 1.50	18.8
CL/1783112	BH10 2.50	15.8

		Sample ID :	CL1783114	CL1783115	CL178313	CL1783110	CL1783111	CL1783112
		•		Reference				
		Station :	QC Blank	Material (% Recovery)	CRM 1941b	BH10 0.50	BH10 1.50	BH10 2.50
PAH Fraction	# PAH	Mass						
Naphthalene *	1	128	<1	118.9	575.0	2.4	2.4	<1
C1 Naphthalenes *	2	142	<1	124.1	319.4	3.8	12.5	<1
C2 Naphthalenes *		156	<1	N.D	208.4	5.8	20.7	3.0
C3 Naphthalenes *		170	<1	N.D	154.4	6.4	17.0	3.9
C4 Naphthalenes *		184	<1	N.D	109.9	3.4	11.4	1.9
Sum Naphthalenes *			0	122	1367	22	64	9
Phenanthrene / Anthracene	2	178	<1	108.2	526.6	51.0	14.4	2.0
C1 178 *		192	<1	N.D	317.3	10.4	23.1	2.1
C2 178 *		206	<1	N.D	253.2	5.3	16.4	1.6
C3 178 *		220	<1	N.D	161.2	3.1	11.1	<1
Sum 178 *			0	108	1258.4	69.7	64.9	5.7
Dibenzothiophene		184	<1	109	45.1	4.5	2.8	<1
C1 Dibenzothiophenes *		198	<1	N.D	69.2	2.2	4.5	<1
C2 Dibenzothiophenes *		212	<1	N.D	108.8	2.2	4.5	<1
C3 Dibenzothiophenes *		226	<1	N.D	60.2	1.7	2.6	<1
Sum Dibenzothiophenes *			0	109	283.3	10.7	14.4	0.0
Fluoranthene / pyrene	2	202	<1	107	1081.7	57.9	9.4	<1
C1 202 *		216	<1	N.D	247.5	7.0	13.5	<1
C2 202 *		230	<1	N.D	213.4	5.1	23.7	1.2
C3 202 *		244	<1	N.D	107.4	2.1	11.6	1.2
Sum 202 *			0	107	1650.1	72.1	58.2	2.5
Benzoanthracene / Chrysene	2	228	<1	107	666.6	10.1	10.3	<1
C1 228 *		242	<1	N.D	253.7	4.6	12.4	<1
C2 228 *		256	<1	N.D	142.6	2.5	9.7	<1
Sum 228 *			0	107	1062.9	17.2	32.5	0.0
Benzofluoranthenes / benzopyrenes	4	252	<1	102	1255.9	17.7	16.2	<1
C1 252 *		266	<1	N.D	261.1	5.0	27.6	<1
C2 252 *		280	<1	N.D	97.7	3.1	13.2	<1
Sum 252 *			0	102	1614.6	25.8	57.0	0.0
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	102	566.1	8.4	8.0	<1
C1 276 *		290	<1	N.D	79.2	1.7	4.8	<1
C2 276 *		304	<1	N.D	35.7	<1.7 <1	3.1	<1
Sum 276 *		557	0	102	681.0	10.2	15.8	0.0
Sum of all fractions *			0	108	7917.4	227.5	306.8	16.9
Sum of NPD fraction *			0	113	2908.8	102.2	143.4	14.4
			#DIV/0!	0.27	0.58	0.82	0.88	5.84
NPD / 4-6 ring PAH ratio *			#DIV/U!	0.27	ს.ეგ	0.82	ს.გგ	ე.გ4

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1783114	CL1783115	CL178313	CL1783110	CL1783111	CL1783112
	Station :	QC Blank	Reference Material (% Recovery)	CRM 1941b	BH10 0.50	BH10 1.50	BH10 2.50
PAH	Mass						
Naphthalene *	128	<1	118.9	575.0	2.4	2.4	<1
Acenaphthylene	152	<1	125.7	50.7	<1	<1	<1
Acenaphthene	154	<1	125.5	32.9	1.4	1.1	<1
Fluorene *	166	<1	126.7	48.4	4.6	3.4	<1
Phenanthrene	178	<1	111.8	383.8	27.1	13.3	2.0
Dibenzothiophene	184	<1	109.4	45.1	4.5	2.8	<1
Anthracene	178	<1	104.7	142.9	23.9	1.2	<1
Fluoranthene	202	<1	106.5	603.7	31.0	4.1	<1
Pyrene	202	<1	107.7	478.0	26.9	5.3	<1
Benzo[a]anthracene	228	<1	104.4	269.1	4.4	2.3	<1
Chrysene	228	<1	110.3	397.5	5.7	8.0	<1
Benzo[b]fluoranthene	252	<1	93.4	453.0	5.9	6.0	<1
Benzo[k]fluoranthene	252	<1	106.8	227.6	2.9	1.1	<1
Benzo[e]pyrene	252	<1	105.6	333.8	4.7	7.3	<1
Benzo[a]pyrene	252	<1	101.2	241.5	4.1	1.8	<1
Perylene *	252	<1	104.0	254.0	3.6	871.9	79.3
Indeno[123,cd]pyrene	276	<1	101.8	276.6	4.4	1.8	<1
Dibenzo[a,h]anthracene	278	<1	100.4	55.0	<1	<1	<1
Benzo[ghi]perylene	276	<1	103.8	234.5	4.0	6.2	<1

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$18_0514
 Date Booked in:
 09-Nov-17

 QC Batch Number:
 170015
 Date Extracted:
 24-Nov-17

 Directory:
 241117PCB.TQ1
 Date Analysed:
 28-Nov-17

 Method:
 Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

		Concentration, (μg/kg)						
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1783110	BH10 0.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1783111	BH10 1.50	0.10	0.09	<0.08	<0.08	<0.08	<0.08	<0.08
CL1783112	BH10 2.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1783113	CRM	3.25	4.26	5.13	3.02	4.25	3.88	2.65
CL1783114	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1783115	Reference Material (% Recovery)	87	100	105	105	101	102	118

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18_0514
QC Batch Number: 170015
Directory: 241117.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:09-Nov-17Date Extracted:24-Nov-17

Date Analysed: 28-Nov-17
UKAS Accredited: No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1783110	CL1783111	CL1783112	CL1783113	CL1783114	CL1783115
						Reference Material
Client ID:	BH10 0.50	BH10 1.50	BH10 2.50	CRM	QC Blank	(% Recovery)

Compound			Concentrat	tion (μg/kg)		
alpha-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	89
Hexachlorobenzene	<0.10	<0.10	<0.10	7.93	<0.10	97
gamma-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	93
p,p'-DDE	<0.10	<0.10	<0.10	2.37	<0.10	90
Dieldrin	<0.10	<0.10	<0.10	0.25	<0.10	92
p,p'-DDD	<0.10	<0.10	<0.10	3.44	<0.10	97
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	<0.10	90

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI Job Number: S18_0514

D:\TE\$\DATA\2017\1115HSA_GC9\111517 2017-11-15 12-58-23\018F1801.D Headspace GCFID

Directory: Method:

Matrix: Date Booked in:

09-Nov-17 Date extracted: 17-Nov-15 Date Analysed:

15-Nov-17, 18:09:33

* Sample data with an asterisk are not UKAS accredited.

		Co	oncentratio	on, (mg/kg) - a	s wet weig	ht			Aliphatics		
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
* CL1783110	BH10 0.50	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
· CL1783111	BH10 1.50	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
· CL1783112	BH10 2.50	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
· CL1783114	QC Blank	< 0.010	< 0.010	< 0.010	< 0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
- CL1783115	Reference Material (% Recovery)	93	93	96	92	91	87	99	110	123	103
				alutas batusan C7							

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

S18_0514 Separation: Silica gel 181251 . Eluents: Hexane, DCM

D:\TES\DATA\2017\112317\112317 2017-11-23 12-23-21\B-078-63-RMS171251ARO.D Directory:

Job Number:

QC Batch Number:

Method	:	Ultra Sonic												
						Conce	ntration, (mg	/kg) - as wet	weight					
* Thi	s sample data is not U	KAS accredited.	>C8	- C10	>C10	- C12	>C12	- C16	>C16	- C21	>C21 - C35		>C8 - C40	
	Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
*	CL1783110	BH10 0.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	11.3	<20	<20
*	CL1783111	BH10 1.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	16.1	<20	24.9
*	CL1783112	BH10 2.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	13.8	<20	21.4
*	CL1783114	QC Blank	<4	<4	<4	<4	<4	<4	<4	<4	14.1	9.2	<20	<20
*	CL1783115	Reference Material (% Recovery)	104	84	122	106	119	115	112	119	102	0.98	113	110

Matrix:

Date Booked ir

Date Extracted 22-Nov-17

Date Analysed: 24-Nov-17, 03:26:57

09-Nov-17

Report Number: EFS/180514

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	CL1783110 to CL1783115	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Naphthalene, Fluorene) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1783111 to CL1783113	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.

Sample Descriptions

Client :	Causeway Geotech Ltd	
Site :		Outfall CI
	Arklow Sewerage Scheme Marine	Outraii Gi
Report Number :	S18_0514	
		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1783110	BH10 0.50	MARINE SEDIMENTS
CL/1703110	BH10 0.50 BH10 1.50	MADINE SEDIMENTS
CL/1783111 CL/1783112	BH10 1.50 BH10 2.50	MARINE SEDIMENTS MARINE SEDIMENTS
CL/1783112	CRM	OLIALITY CONTROL SAMPLE
CL/1783114	QC Blank	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1783113 CL/1783114 CL/1783115	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE
	(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-67032-1

Issue No.: 1

Date of Issue 23/11/2017

Customer Details: SOCOTEC UK - Environmental Chemistry, P O Box 100, Bretby Business Park,

Burton-on-Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: S180514

Quotation Reference: 170504/06

Description: 3 sediment samples

Date Received: 14/11/2017

Date Started: 21/11/2017

Date Completed: 22/11/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: None

Approved By:

Matthew Hickson, Laboratory Manager

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1663

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Results Summary

Report No.: 17-67032-1Customer Reference: S180514

Customer Order No: 42062 BEC

				Customer	Sample No	S1783110	S1783111	S1783112			
		BH10 0.50	BH10 1.50	BH10 2.50							
RPS Sample No 346352 346353											
Sample Type SEDIMENT SEDIMENT											
				Sample	e Depth (m)	0.50m	1.50m	2.50m			
				Sa	mpling Date	26/10/2017	26/10/2017	26/10/2017			
Determinand	CAS No	Codes	SOP	Units	RL						
dibutyltin (DBT)	1002-53-5	5	< 5.00	< 5.00	< 5.00						
ributyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00	< 2.00			



Report No.: 17-67032-1Customer Reference: S180514
Customer Order No: 42062 BEC

Comments

Description	Job Comments
3 sediment samples	BLANK:
	DBT <rl< td=""></rl<>
	TBT <rl< td=""></rl<>
	CRM:
	DBT - 78%
	TBT - 103%
	3 sediment samples



Deviating Samples

Report No.: 17-67032-1Customer Reference: S180514
Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).

RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.

Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below. Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed. Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
346352	S1783110		26/10/2017	120ml amber glass jar	No	
346353	S1783111		26/10/2017	120ml amber glass jar	No	
346354	S1783112		26/10/2017	120ml amber glass jar	No	



Report Information

Key to Report Codes

U UKAS Accredited
M MCERTS Accredited
N Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units)

Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1 Clay - Brown Type 2 Clay - Grey/Black

Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)
Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

Customer Causeway Geotech Ltd Site Arklow Sewerage Scher

Arklow Sewerage Scheme Marine Outfall GI

Report No S180837

Consignment No S70496 Date Logged 21-Nov-2017

Report Due 11-Dec-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	OGSNSED		PAHSED	PCBMS3Q		TMSS	TPHUSSI	65WTSM
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	Dibutyl Tin (Sediments)	Tributyl Tin (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKAS Accredited No			Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes	
CL/1784492	BH11 1.50	02/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784493	BH11 3.50	02/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784494	CRM			R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			R
CL/1784495	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1784496	Reference Material (% Recovery)			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)
ID Number	Description	Sediments	Sediments	Sediments	Sediment	Sediments
S1784492	BH11 1.50	19.1	0.18	24.8	80.7	53.2
S1784493	BH11 3.50	16.7	0.11	19	59.9	44.9
S1784494	CRM	17.77	1.611	62.77	56.42	81.22
S1784495	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
S1784496	Reference Material (% Recovery)	99	98	100	97	99

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Manganese	Mercury (MS)	Nickel (MS)	Zinc (MS)	Iron
ID Number	Description	(MS) Sediments	Sediments	Sediments	Sediments	(Sediments)
S1784492	BH11 1.50	706.7	0.07	19.7	171.7	38100
S1784493	BH11 3.50	685.1	0.03	16	131.3	33500
S1784494	CRM	1200	0.761	33.1	327.2	28200
S1784495	QC Blank	<0.5	<0.015	<0.5	<2	<36
	Reference Material					
S1784496	(% Recovery)	96	95	99	99	99

	Method Codes	TMSS	WSLM59	ANC	OGSNSED	OGSNSED
	Detection Limit	0.1	0.02	0.12	1	1
	Units	%	% M/M	%	ug Sn/kg	ug Sn/kg
		Tot.Moisture @	Total Organic		Dibutyl Tin	Tributyl Tin
		Carbon Carbonate %		(Sediments)	(Sediments)	
ID Number	Description	1030	(Sediment)		(Seamlents)	(Sedifferits)
S1784492	BH11 1.50	5.9	0.43	1.92	<1	<1
S1784493	BH11 3.50	5	0.18	1.2	<1	<1
S1784494	CRM		3.1073		120	94
S1784495	QC Blank		< 0.02		<1	<1
	Reference Material					
S1784496	(% Recovery)		98	98	93	91

Sample ID	Client ID	Moisture (%)
CL/1784492	BH11 1.50	6.6
CL/1784493	BH11 3.50	8.0

		Sample ID :	CL1784495	CL1784496	CL1784494	CL1784492	CL1784493
		-		Reference			
		Station :	QC Blank	Material (% Recovery)	1941b	BH11 1.50	BH11 3.50
PAH Fraction	# PAH	Mass		.,			
Naphthalene	1	128	<1	104.4	582.4	2.3	1.4
C1 Naphthalenes *	2	142	<1	100.1	325.7	2.5	3.2
C2 Naphthalenes *		156	<1	N.D	219.2	3.8	10.1
C3 Naphthalenes *		170	<1	N.D	179.5	5.6	11.9
C4 Naphthalenes *		184	<1	N.D	120.0	3.9	6.0
Sum Naphthalenes *			0	102	1427	18	33
Phenanthrene / Anthracene	2	178	<1	105.2	519.2	74.1	25.5
C1 178 *		192	<1	N.D	309.5	33.6	15.9
C2 178 *		206	<1	N.D	243.8	21.3	15.0
C3 178 *		220	<1	N.D	171.0	11.5	14.5
Sum 178 *			0	105	1243.5	140.5	70.9
Dibenzothiophene		184	<1	105	46.9	3.5	1.4
C1 Dibenzothiophenes *		198	<1	N.D	72.1	3.8	3.2
C2 Dibenzothiophenes *		212	<1	N.D	104.8	4.0	7.3
C3 Dibenzothiophenes *		226	<1	N.D	67.3	2.8	10.9
Sum Dibenzothiophenes *			0	105	291.0	14.1	22.8
Fluoranthene / pyrene	2	202	<1	105	1061.6	223.7	79.7
C1 202 *		216	<1	N.D	291.9	45.8	19.9
C2 202 *		230	<1	N.D	248.4	26.3	13.6
C3 202 *		244	<1	N.D	111.6	9.1	6.7
Sum 202 *			0	105	1713.4	304.9	119.9
Benzoanthracene / Chrysene	2	228	<1	104	679.3	113.5	40.3
C1 228 *		242	<1	N.D	272.2	33.2	15.8
C2 228 *		256	<1	N.D	146.6	20.1	10.6
Sum 228 *			0	104	1098.1	166.8	66.8
Benzofluoranthenes /	4	252	<1	99	1224.0	154.0	52.7
benzopyrenes C1 252 *		266	<1	N.D	319.9	37.3	15.9
C2 252 *		280	<1 <1	N.D N.D	231.3	18.9	7.7
Sum 252 *		200	0	99	1775.2	210.3	7.7 76.3
Suiii 232			U	99	1775.2	210.3	70.3
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	97	603.7	71.9	21.9
C1 276 *		290	<1	N.D	89.3	14.7	5.4
C2 276 *		304	<1	N.D	37.8	4.3	1.7
Sum 276 *			0	97	730.8	91.0	29.1
Sum of all fractions *			0	103	8278.6	945.6	418.4
Sum of NPD fraction *			0	104	2961.2	172.7	126.3
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.26	0.56	0.22	0.43

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1784495	CL1784496	CL1784494	CL1784492	CL1784493
	Station :	QC Blank	Reference Material (% Recovery)	1941b	BH11 1.50	BH11 3.50
PAH	Mass					
Naphthalene	128	<1	104	582.4	2.3	1.4
Acenaphthylene	152	<1	103	59.8	5.6	1.0
Acenaphthene	154	<1	105	32.9	1.8	1.2
Fluorene	166	<1	105	50.4	5.3	2.0
Phenanthrene	178	<1	108	372.7	55.5	18.1
Dibenzothiophene	184	<1	105	46.9	3.5	1.4
Anthracene	178	<1	103	146.5	18.6	7.5
Fluoranthene	202	<1	105	596.8	119.0	42.2
Pyrene	202	<1	106	464.8	104.6	37.5
Benzo[a]anthracene	228	<1	102	269.7	54.9	18.9
Chrysene	228	<1	106	409.7	58.7	21.4
Benzo[b]fluoranthene	252	<1	98	449.7	38.9	15.2
Benzo[k]fluoranthene	252	<1	95	213.0	23.9	8.4
Benzo[e]pyrene	252	<1	103	326.8	35.7	12.4
Benzo[a]pyrene	252	<1	99	234.4	55.6	16.7
Perylene *	252	<1	103	257.0	16.3	5.4
Indeno[123,cd]pyrene	276	<1	95	295.9	34.4	10.3
Dibenzo[a,h]anthracene	278	<1	97	57.4	5.0	1.8
Benzo[ghi]perylene	276	<1	100	250.4	32.6	9.9

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$18_0837
 Date Booked in:
 21-Nov-17

 QC Batch Number:
 170016
 Date Extracted:
 01-Dec-17

 Directory:
 041217PCB.TQ1
 Date Analysed:
 05-Dec-17

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1784492	BH11 1.50	<0.08	0.10	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784493	BH11 3.50	0.14	0.15	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784494	CRM	2.96	4.08	4.48	2.94	3.73	3.47	2.38
CL1784495	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784496	Reference Material (% Recovery)	113	111	111	113	108	107	113

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18_0837
QC Batch Number: 170016
Directory: 041217.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:21-Nov-17Date Extracted:01-Dec-17Date Analysed:05-Dec-17UKAS Accredited:No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1784492	CL1784493	CL1784494	CL1784495	CL1784496
					Reference Material (%
Client ID:	BH11 1.50	BH11 3.50	CRM	QC Blank	Recovery)

Compound		Concentration (μg/kg)										
alpha-HCH	<0.10	<0.10	<0.10	<0.10	88							
Hexachlorobenzene	<0.10	<0.10	7.92	<0.10	98							
gamma-HCH	<0.10	<0.10	<0.10	<0.10	93							
p,p'-DDE	<0.10	<0.10	2.80	<0.10	84							
Dieldrin	<0.10	<0.10	0.29	<0.10	91							
p,p'-DDD	<0.10	<0.10	3.39	<0.10	86							
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	96							

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18_0837

Directory: D:\TES\DATA\Y2017\1204HSA_GC12\171204 2017-12-04 17-22-19\043F4301.D

Method: Headspace GCFID

Matrix: Soil

Date Booked in: 21-Nov-17
Date extracted: 04-Dec-17

Date Analysed: 05-Dec-17, 07:06:37

* Sample data with an asterisk are not UKAS accredited.

		Co		on, (mg/kg) - a					Aliphatics		
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene			C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
* CL1784492	BH11 1.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784493	BH11 3.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784495	QC BLANK	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784496	Reference Material (% recovery)	102	101	98	99	96	120	117	110	88	114

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall Gl Matrix: Soil

 Job Number:
 S18_0837
 Separation:
 Silica gel
 Date Booked ir
 21-Nov-17

 QC Batch Number:
 171296
 Eluents:
 Hexane, DCM
 Date Extracted
 04-Dec-17

 Directory:
 C:\CHEM32\1\DATA\120517TPH_GC15\120517 2017-12-05 18-17-42\066B2001.D
 Date Analysed: 05-Dec-17, 22:20:07

Method: Ultra Sonic

					Conce	entration, (mg	/kg) - as wet v	weight					
* This sample data is not UI	KAS accredited.	>C8 - C10		- C12	>C12 - C16		>C16 - C21		>C21	- C35	>C8	- C40	
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
* CL1784492	BH11 1.50	<4.04	<4	<4.04	<4	<4.04	<4	<4.04	6.7	<8.85	10.8	<20.2	<20
* CL1784493	BH11 3.50	<4	<4	<4	<4	12.9	<4	<4	<4	<8.76	<8.76	<20	<20
* CL1784495	QC Blank	<4.08	<4	<4.08	<4	<4.08	<4	<4.08	<4	<8.94	<8.76	<20.4	<20
* CL1784496	Reference Material (% Recovery)	103	97	108	111	102	109	100	102	101	102	101	105
	+												
	+												

Sample Descriptions

		Sample Descriptions
Client :	Causeway Geotech Ltd	
Site :	Arklow Sewerage Scheme Marin	e Outfall GI
Report Number :	S18_0837	
neport Number .		Note: major constituent in upper case
Lab ID Number	Client ID	
		Description
CL/1784492	BH11 1.50	MARINE SEDIMENTS
CL/1784493 CL/1784494	BH11 3.50 CRM	MAKINE SEDIMEN I S
CL/1784494	OC Blank	QUALITY CONTROL SAMPLE
CL/1784495 CL/1784496	QC Blank Reference Material (% Recovery)	MARINE SEDIMENTS QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE

Appendix A Page 1 of 1 12/12/2017

ESG Environmental Chemistry - Requested Analysis

S178705

Customer Causeway Geotech Ltd Site Arklow Sewerage Scher

Arklow Sewerage Scheme Marine Outfall GI

Report No S178705

Consignment No S68870 Date Logged 14-Sep-2017

Report Due 02-Oct-2017

							перо	i c D a c	02-0	CC 201													
		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^DibutyItin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
CL/1775353	BH12 1.50	24/08/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775354	BH12 3.50	24/08/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775355	BH12 5.50	24/08/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775356	CRM	24/08/17		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1775357	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1775358	Reference Material (% Recovery	/)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID N	D	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Copper (MS) Sediment	Lead (MS) Sediments
	Description BH12 1.50	12.8	0.14	17.4	20.9	10.2
	BH12 3.50	11.2	0.14	28.8	20.8	18.5
S1775355	BH12 5.50	10.8	0.32	30.3	25.6	17.3
S1775356	CRM	16.65	1.475	58.67	57.83	73.36
S1775357	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
S1775358	Reference Material (% Recovery)	105	107	107	95	109

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL		
	Detection Limit	0.5	0.015	0.5	2	36		
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg		
		Manganese (MS) Sediments	Mercury (MS)	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)		
ID Number	Description	(ivis) seaments	Sediments	Seuments	Seaments	(Seaments)		
S1775353	BH12 1.50	503.8	0.02	14.9	50.7	32600		
S1775354	BH12 3.50	554.8	0.05	30.3	57.3	31500		
S1775355	BH12 5.50	550.8	0.07	31.3	55.8	30900		
S1775356	CRM	1117	0.707	31.16	306.6	27700		
S1775357	QC Blank	<0.5	<0.015	<0.5	<2	<36		
0.1775050	Reference Material	100	100	100	105	105		
S1775358	(% Recovery)	103	102	106	105	105		

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005
	Detection Limit	0.1	0.02	0.12		
	Units	%	% M/M	%	mg/kg	mg/kg
		Tot Moieture @	Total Organic			
		Tot.Moisture @	Carbon	Carbonate %	^Dibutyltin	^Tributyltin
ID Number	Description	105C	(Sediment)			
S1775353	BH12 1.50	7	0.1	4.32	<0.02	<0.05
S1775354	BH12 3.50	21.8	0.43	6.72	<0.02	<0.05
S1775355	BH12 5.50	20.8	0.46	10.32	<0.02	<0.05
S1775356	CRM		2.8645			
S1775357	QC Blank		<0.02		<0.02	<0.05
	Reference Material					
S1775358	(% Recovery)		91	102	100	107

Sample ID	Client ID	Moisture (%)
CL/1775353	BH12 1.50	16.5
CL/1775354	BH12 3.50	21.9
CL/1775355	BH12 5.50	20

		Sample ID :	CL1775357	CL1775358	CL1775353	CL1775354	CL1775355	CL1775356
		•		Reference				
		Station :	QC Blank	Material (%	BH12 1.50	BH12 3.50	BH12 5.50	CRM
				Recovery)				
PAH Fraction	# PAH	Mass						
Naphthalene *	1	128	<1	114.7	<1	5.2	5.7	605.0
C1 Naphthalenes *	2	142	<1	114.6	<1	22.5	22.3	345.0
C2 Naphthalenes *		156	<1	N.D	1.2	28.7	27.5	227.8
C3 Naphthalenes *		170	<1	N.D	<1	29.5	30.7	166.2
C4 Naphthalenes *		184	<1	N.D	<1	22.9	21.9	124.4
Sum Naphthalenes *			0	115	1	109	108	1468
Phenanthrene / Anthracene	2	178	<1	103.0	<1	22.2	22.1	520.2
C1 178 *		192	<1	N.D	<1	35.0	32.9	303.2
C2 178 *		206	<1	N.D	<1	32.8	31.9	269.4
C3 178 *		220	<1	N.D	<1	24.0	23.0	179.1
Sum 178 *			0	103	0.0	114.0	109.9	1271.9
Dibenzothiophene		184	<1	103	<1	4.3	4.1	43.7
C1 Dibenzothiophenes *		198	<1	N.D	<1	7.9	7.1	86.6
C2 Dibenzothiophenes *		212	<1	N.D	<1	8.2	7.0	117.8
C3 Dibenzothiophenes *		226	<1	N.D	<1	4.8	6.2	73.4
Sum Dibenzothiophenes *			0	103	0.0	25.2	24.3	321.5
Fluoranthene / pyrene	2	202	<1	99	<1	17.2	15.9	1047.1
C1 202 *		216	<1	N.D	<1	26.4	24.7	291.8
C2 202 *		230	<1	N.D	<1	29.2	27.9	211.3
C3 202 *		244	<1	N.D	<1	19.0	19.6	136.6
Sum 202 *			0	99	0.0	91.8	88.0	1686.8
Benzoanthracene / Chrysene	2	228	<1	98	<1	17.6	16.3	654.5
C1 228 *		242	<1	N.D	<1	19.7	19.9	283.0
C2 228 *		256	<1	N.D	<1	18.4	18.2	150.5
Sum 228 *			0	98	0.0	55.8	54.4	1088.0
Benzofluoranthenes / benzopyrenes	4	252	<1	96	<1	29.4	29.0	1177.0
C1 252 *		266	<1	N.D	<1	32.7	33.1	337.4
C2 252 *		280	<1	N.D	<1	27.2	27.5	199.5
Sum 252 *			0	96	0.0	89.4	89.6	1713.9
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	92	<1	18.3	17.3	558.5
C1 276 *		290	<1	N.D	<1	18.5	10.5	90.7
C2 276 *		304	<1	N.D	<1	8.3	8.1	62.5
Sum 276 *		00 1	0	92	0.0	45.0	35.9	711.6
Sum of all fractions *			0	101	1.2	530.2	510.1	8261.9
Sum of NPD fraction *	1		0	107	1.2	248.1	242.2	3061.7
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.28	#DIV/0!	0.88	0.90	0.59

N.D = Not Determined as these compounds are not in the reference material spike.
 As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1775357	CL1775358	CL1775353	CL1775354	CL1775355	CL1775356
	Station :	QC Blank	Reference Material (% Recovery)	BH12 1.50	BH12 3.50	BH12 5.50	CRM
PAH	Mass						
Naphthalene *	128	<1	114.7	<1	5.2	5.7	605.0
Acenaphthylene	152	<1	117.2	<1	<1	<1	51.1
Acenaphthene	154	<1	116.9	<1	1.9	1.7	33.0
Fluorene	166	<1	115.9	<1	5.3	5.1	53.9
Phenanthrene	178	<1	106.6	<1	22.2	21.0	379.2
Dibenzothiophene	184	<1	103.1	<1	4.3	4.1	43.7
Anthracene	178	<1	99.4	<1	<1	1.1	141.0
Fluoranthene	202	<1	99.6	<1	7.0	6.3	588.4
Pyrene	202	<1	97.6	<1	10.2	9.5	458.7
Benzo[a]anthracene	228	<1	96.4	<1	3.2	3.2	260.7
Chrysene	228	<1	99.1	<1	14.4	13.0	393.8
Benzo[b]fluoranthene	252	<1	94.9	<1	10.6	10.7	423.9
Benzo[k]fluoranthene	252	<1	92.6	<1	1.3	1.2	211.1
Benzo[e]pyrene	252	<1	103.8	<1	13.8	13.5	320.6
Benzo[a]pyrene	252	<1	94.4	<1	3.7	3.6	221.3
Indeno[123,cd]pyrene	276	<1	95.1	<1	3.4	3.1	276.8
Dibenzo[a,h]anthracene	278	<1	80.9	<1	1.6	1.5	63.2
Benzo[ghi]perylene	276	<1	101.1	<1	13.3	12.7	218.4

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$17_8705
 Date Booked in:
 14-Sep-17

 QC Batch Number:
 170006
 Date Extracted:
 21-Sep-17

 Directory:
 290917PCB.TQ1
 Date Analysed:
 28-Sep-17

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

	Concentration, (μg/kg)							
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1775353	BH12 1.50	<0.08	0.1	<0.08	0.1	0.1	<0.08	<0.08
CL1775354	BH12 3.50	0.2	0.2	<0.08	0.3	0.1	<0.08	<0.08
CL1775355	BH12 5.50	0.2	0.2	<0.08	0.2	0.1	0.1	<0.08
CL1775356	CRM	2.5	5.0	5.1	4.5	4.4	5.4	2.8
CL1775357	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1775358	Reference Material (% Recovery)		117.6	114.9	153.7	108.2	114.9	114.2

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_8705
QC Batch Number: 170006
Directory: 270917.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:14-Sep-17Date Extracted:27-Sep-17Date Analysed:28-Sep-17

UKAS Accredited: No

Compounds marked * are not UKAS or MCerts accredited

-				-		
Sample ID :	CL1775353	CL1775354	CL1775355	CL1775356	CL1775357	CL1775358
						Reference Material (%
Client ID:	BH12 1.50	BH12 3.50	BH12 5.50	CRM	QC Blank	Recovery)

Compound		Concentration (μg/kg)							
alpha-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	168			
Hexachlorobenzene	<0.10	<0.10	<0.10	6.6	<0.10	98			
gamma-HCH	<0.10	<0.10	<0.10	6.6	<0.10	244			
p,p'-DDE	<0.10	<0.10	0.17	3.6	<0.10	82			
Dieldrin	<0.10	<0.10	<0.10	0.6	<0.10	97			
p,p'-DDD	<0.10	<0.10	<0.10	5.0	<0.10	108			
p,p'-DDT	<0.10	<0.10	<0.10	0.1	<0.10	130			

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17 8705

Directory: E:\TES\DATA\2017\0921HSA GC9\092117 2017-09-21 11-30-37\118B1801.D

Method: Headspace GCFID

Matrix: Soil Date Booked in: 14-So

Date Booked in: 14-Sep-17
Date extracted: 21-Sep-17
Date Analysed: 21-Sep-17, 1

* Sample data with an asterisk are not UKAS accredited.

		Concentration, (mg/kg) - as wet weight				Aliphatics					
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
CL1775353	BH12 1.50	<0.010	<0.010	<0.010	< 0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1775354	BH12 3.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1775355	BH12 5.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1775357	QC Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1775358	Reference Material (% Recovery)	103	105	103	104	101	109	104	108	110	107

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

Client ID

BH12 1.50

BH12 3.50

BH12 5.50 QC Blank

Reference Material (%

Recovery)

Job Number:s17_8705Separation:Silica gelQC Batch Number:171031Eluents:Hexane, DCM

Directory: D:\TES\DATA\2017\092717\092717 2017-09-27 09-53-19\B-025-62-RMS171031ARO.D

Method: Ultra Sonic

Sample ID

CL1775353

CL1775354 CL1775355

CL1775357

CL1775358

* This sample data is not UKAS accredited.

\092717 2017	-09-27 09-53-19	\B-025-62-RMS	171031ARO.D			Date Analysed 27-Sep-17, 15:15:31						
			Conce	entration, (mg	/kg) - as wet	weight						
>C8	- C10	>C10	- C12	>C12	- C16	>C16	- C21	>C21	- C35	>C8	- C40	
Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	
<4.12	<4*	<4.12*	<4	<4.12	<4	<4.12	<4	<9	<8.76	<20.6	<20	
<4	<4*	<4*	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20	
<4.08	<4*	<4.08*	<4	<4.08	<4	<4.08	<4	<8.94	<8.76	<20.4	<20	
<4.16	<4*	<4.16*	<4	<4.16	<4	<4.16	<4	<9.1	<8.76	<20.8	<20	
98	126*	89*	97	94	91	92	92	89	93	91	93	

Matrix:

Date Booked ir

Date Extracted

14-Sep-17

25-Sep-17

Report Number: EFS/178705

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
TPHUSSI	TO CL1775355, CL1775357 TO CL1775358	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Banding C10-C12 on the Aliphatic fraction and C8-C10 on the Aromatic fraction) . These circumstances should be taken into consideration when utilising the data.
PAHSED	GL1775358	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Naphthalene) . These circumstances should be taken into consideration when utilising the data.
PAHSED		Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.

Sample Descriptions

Client :	Causeway Geotech Ltd	
Site :	Arklow Sewerage Scheme Marine	Outfall GI
Report Number :	\$17_8705	
neport Number .		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1775353	BH12 1.50	MARINE SEDIMENT
CL/1775354 CL/1775355	BH12 3.50	MARINE SEDIMENT MARINE SEDIMENT
CL/1775355	BH12 5.50	MARINE SEDIMENT
CL/1775356	CRM	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1775356 CL/1775357 CL/1775358	QC Blank	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
GL/17/5358	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE
<u> </u>		

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-65411-2

Issue No.: 2

Date of Issue 04/10/2017

Customer Details: ESG Environmental Chemistry, P O Box 100, Bretby Business Park, Burton-on-

Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: \$178705

Quotation Reference: 170504/08

Description: 3 soil samples

Date Received: 22/09/2017

Date Started: 26/09/2017

Date Completed: 03/10/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: This report replaces issue 1 in its entirety

Approved By: Matthew Hickson, Laboratory Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.

Observations and interpretations are outside of the scope of UKAS accreditation.

Results reported herein relate only to the items supplied to the laboratory for testing.

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A member of the RPS Group plc. Terms and conditions apply - copy on request



Results Summary

Determinand

dibutyltin (DBT)

tributyltin (TBT)

Report No.: 17-65411-2Customer Reference: S178705

Customer Order No: 42062 BEC

			Customer S	Sample No	S1775353	S1775354	S1775355
			r Sample ID	BH12 1.50	BH12 3.50	BH12 5.50	
			Sample No	340620	340621	340622	
			mple Type	SOIL	SOIL	SOIL	
			e Depth (m)	1.50m	3.50m	5.50m	
			Sai	mpling Date	24/08/2017	24/08/2017	24/08/2017
CAS No	Codes	SOP	Units RL				
1002-53-5	N	in house	mg/kg as cation	0.02	< 0.02	< 0.02	< 0.02
56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05	< 0.05



Report No.: 17-65411-2Customer Reference: S178705
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-65411	3 soil samples	Blank: <rl &="" -="" 100%="" 107%<="" aqc:="" dbt="" for="" tbt="" td=""></rl>



Deviating Samples

Report No.: 17-65411-2Customer Reference: S178705
Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).

RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.

Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below. Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed. Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
340620	S1775353		24/08/2017	60ml amber glass jar	No	
340621	S1775354		24/08/2017	60ml amber glass jar	No	
340622	S1775355		24/08/2017	60ml amber glass jar	No	



Report Information

Key to Report Codes

U	UKAS Accredited
M	MCERTS Accredited
N	Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units) Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1	Clay - Brown
Type 2	Clay - Grey/Black

Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)
Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally $\!\!\!\!\!\!^*$ be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

ESG Environmental Chemistry - Requested Analysis

S178717

Customer Ca Site Ar

Report No

Causeway Geotech Ltd Arklow Sewerage Scheme Marine Outfall GI

S178717

Consignment No S68871
Date Logged 14-Sep-2017

Report Due 02-Oct-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB-7 Congeners (Marine Sediments)	^DibutyItin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes		No	No	No	Yes	Yes	Yes
CL/1775425	BH13 2.50	23/08/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775426	BH13 5.50	23/08/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775427	CRM	23/08/17		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1775428	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1775429	Reference Material (% Recovery	<i>(</i>)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)
ID Number	Description	Sediments	Sediments	Sediments	Sediment	Sediments
S1775425	BH13 2.50	9.2	0.12	18.2	11.3	10.9
S1775426	BH13 5.50	10.1	0.28	30.9	21.2	16.2
S1775427	CRM	16.65	1.475	58.67	57.83	73.36
S1775428	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
S1775429	Reference Material (% Recovery)	105	107	107	95	109

r	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
ι	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Manganese	Mercury (MS)	Nickel (MS)	Zinc (MS)	Iron
ID Number [Description	(MS) Sediments	Sediments	Sediments	Sediments	(Sediments)
S1775425 E	3H13 2.50	370.5	0.05	15.5	35.6	20600
S1775426 E	3H13 5.50	590	0.06	32	56.3	28500
S1775427 (CRM	1117	0.707	31.16	306.6	27700
S1775428 (QC Blank	<0.5	<0.015	<0.5	<2	<36
	Reference Material					
S1775429 ((% Recovery)	103	102	106	105	105

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005	
	Detection Limit	0.1	0.02	0.12			
	Units	%	% M/M	%	mg/kg	mg/kg	
		Tot.Moisture @	Total Organic Carbon	Carbonate %	^Dibutyltin	^Tributyltin	
ID Number	Description	105C	(Sediment)	Gar Donate 75		1117	
S1775425	BH13 2.50	5.5	0.12	1.68	<0.02	<0.05	
S1775426	BH13 5.50	20.8	0.49	5.76	<0.02	< 0.05	
S1775427	CRM		3.2083				
S1775428	QC Blank		<0.02		<0.02	<0.05	
S1775429	Reference Material (% Recovery)		101	102	100	107	

Sample ID	•	
CL/1775425	BH13 2.50	12.3
CL/1775426	BH13 5.50	19.9

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

		Sample ID :	CL1775428	CL1775429	CL1775425	CL1775426	CL1775427
		Station :	QC Blank	Reference Material (% Recovery)	BH13 2.50	BH13 5.50	CRM
PAH Fraction	# PAH	Mass					
Naphthalene *	1	128	<1	114.7	<1	5.2	605.0
C1 Naphthalenes *	2	142	<1	114.6	5.8	21.0	345.0
C2 Naphthalenes *		156	<1	N.D	9.3	25.8	227.8
C3 Naphthalenes *		170	<1	N.D	11.0	27.4	166.2
C4 Naphthalenes *		184	<1	N.D	7.4	22.3	124.4
Sum Naphthalenes *			0	115	34	102	1468
Phenanthrene / Anthracene	2	178	<1	103.0	6.0	20.6	520.2
C1 178 *		192	<1	N.D	8.8	29.6	303.2
C2 178 *		206	<1	N.D	8.3	28.5	269.4
C3 178 *		220	<1	N.D	5.5	21.3	179.1
Sum 178 *			0	103	28.6	100.1	1271.9
Dibenzothiophene		184	<1	103	<1	4.0	43.7
C1 Dibenzothiophenes *		198	<1	N.D	1.3	6.6	86.6
C2 Dibenzothiophenes *		212	<1	N.D	1.2	7.2	117.8
C3 Dibenzothiophenes *		226	<1	N.D	<1	5.6	73.4
Sum Dibenzothiophenes *			0	103	2.6	23.4	321.5
Fluoranthene / pyrene	2	202	<1	99	3.2	14.5	1047.1
C1 202 *		216	<1	N.D	5.7	22.1	291.8
C2 202 *		230	<1	N.D	6.6	24.2	211.3
C3 202 *		244	<1	N.D	5.3	17.2	136.6
Sum 202 *			0	99	20.8	78.0	1686.8
Benzoanthracene / Chrysene	2	228	<1	98	3.2	15.0	654.5
C1 228 *		242	<1	N.D	4.9	16.4	283.0
C2 228 *		256	<1	N.D	3.9	15.6	150.5
Sum 228 *			0	98	12.0	46.9	1088.0
Benzofluoranthenes / benzopyrenes	4	252	<1	96	2.9	25.6	1177.0
C1 252 *		266	<1	N.D	4.6	29.1	337.4
C2 252 *		280	<1	N.D	5.0	23.5	199.5
Sum 252 *			0	96	12.6	78.2	1713.9
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	92	1.3	16.2	558.5
C1 276 *		290	<1	N.D	<1	9.6	90.7
C2 276 *		304	<1	N.D N.D	<1	9.0 9.1	62.5
Sum 276 *		304	0	92	1.3	35.0	711.6
Sum of all fractions *			0	101	111.4	463.2	8261.9
Sum of NPD fraction *			0	107	64.6	225.1	3061.7
NPD / 4-6 ring PAH ratio *	 		#DIV/0!	0.28	1.38	0.95	0.59
NPD / 4-6 ring PAH ratio			#DIV/U!	∪.∠δ	1.38	0.95	0.59

N.D = Not Determined as these compounds are not in the reference material spike.As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1775428	CL1775429	CL1775425	CL1775426	CL1775427
	Station :	QC Blank	Reference Material (% Recovery)	BH13 2.50	BH13 5.50	CRM
PAH	Mass					
Naphthalene *	128	<1	114.7	<1	5.2	605.0
Acenaphthylene	152	<1	117.2	<1	<1	51.1
Acenaphthene	154	<1	116.9	<1	1.5	33.0
Fluorene	166	<1	115.9	<1	4.9	53.9
Phenanthrene	178	<1	106.6	6.0	19.4	379.2
Dibenzothiophene	184	<1	103.1	<1	4.0	43.7
Anthracene	178	<1	99.4	<1	1.2	141.0
Fluoranthene	202	<1	99.6	1.3	5.8	588.4
Pyrene	202	<1	97.6	1.9	8.7	458.7
Benzo[a]anthracene	228	<1	96.4	1.1	2.7	260.7
Chrysene	228	<1	99.1	2.1	12.2	393.8
Benzo[b]fluoranthene	252	<1	94.9	1.2	9.0	423.9
Benzo[k]fluoranthene	252	<1	92.6	<1	1.7	211.1
Benzo[e]pyrene	252	<1	103.8	1.8	11.6	320.6
Benzo[a]pyrene	252	<1	94.4	<1	3.2	221.3
Indeno[123,cd]pyrene	276	<1	95.1	<1	2.9	276.8
Dibenzo[a,h]anthracene	278	<1	80.9	<1	1.7	63.2
Benzo[ghi]perylene	276	<1	101.1	1.3	11.6	218.4

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$17_8717
 Date Booked in:
 14-Sep-17

 QC Batch Number:
 170007
 Date Extracted:
 21-Sep-17

 Directory:
 290917PCB.TQ1
 Date Analysed:
 28-Sep-17

 Method:
 Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1775425	BH13 2.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1775426	BH13 5.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1775427	CRM	2.2	4.0	4.2	3.4	3.3	4.2	2.0
CL1775428	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1775429	Reference Material (% Recovery)	99.4	115.7	115.0	104.4	117.8	116.0	117.1

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_8717
QC Batch Number: 170007
Directory: 270917.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:14-Sep-17Date Extracted:27-Sep-17Date Analysed:28-Sep-17UKAS Accredited:No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1775425	CL1775426	CL1775427	CL1775428	CL1775429
					Reference Material (%
Client ID:	BH13 2.50	BH13 5.50	CRM	QC Blank	Recovery)

Compound			Concentration (µg/kg))	
alpha-HCH	<0.10	<0.10	<0.10	<0.10	108
Hexachlorobenzene	<0.10	<0.10	5.57	<0.10	100
gamma-HCH	<0.10	<0.10	<0.10	<0.10	120
p,p'-DDE	<0.10	<0.10	2.22	<0.10	114
Dieldrin	<0.10	<0.10	0.36	<0.10	127
p,p'-DDD	<0.10	<0.10	2.99	<0.10	109
p,p'-DDT	<0.10	<0.10	0.38	<0.10	106

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17 8717

Directory: E:\TES\DATA\2017\0921HSA GC9\092117 2017-09-21 11-30-37\137B3701.D

Method: Headspace GCFID

Matrix: Soil

Date Booked in: 14-Sep-17
Date extracted: 21-Sep-17

Date Analysed: 21-Sep-17, 2

* Sample data with an asterisk are not UKAS accredited.

		С	oncentration	on, (mg/kg) - a	s wet weig	Aliphatics									
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO				
CL1775425	BH13 2.50	<0.010	<0.010	<0.010	< 0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2				
CL1775426	BH13 5.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2				
CL1775428	QC Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2				
CL1775429	Reference Material (% Recovery)	99	99	98	98	97	114	110	107	98	108				

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI **Customer and Site Details:**

Job Number: s17_8717 Separation: Silica gel 171031 Eluents: QC Batch Number: Hexane, DCM D:\TES\DATA\2017\092717\092717 2017-09-27 09-53-19\B-025-62-RMS171031ARO.D Directory:

Method: Ultra Sonic Date Booked ir 14-Sep-17

Matrix:

Date Extracted 25-Sep-17 Date Analysed 27-Sep-17, 15:15:31

Soil

					Conce	entration, (mg	/kg) - as wet	weight					
* This sample data is not U	KAS accredited.	>C8	- C10	>C10	- C12		- C16	>C16	- C21	>C21	- C35	>C8	- C40
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
CL1775425	BH13 2.50	<4.12	<4*	<4.12*	<4	<4.12	<4	<4.12	<4	<9	9.2	<20.6	20.3
CL1775426	BH13 5.50	<4.12	<4*	<4.12*	<4	<4.12	<4	<4.12	<4	15.4	8.88	<20.6	<20
CL1775428	QC Blank	<4.16	<4*	<4.16*	<4	<4.16	<4	<4.16	<4	<9.1	<8.76	<20.8	<20
CL1775429	Reference Material (% Recovery)	98	126*	89*	97	94	91	92	92	89	93	91	93
													ļ

Report Number: EFS/178717

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	I t∩	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Naphthalene) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1775425 to CL1775427	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.
TPHUSSI	TO CL1775426, CL1775428 TO CL1775429	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Banding C8-C10 on the Aromatic fraction and C10-C12 on the Aliphatic fraction). These circumstances should be taken into consideration when utilising the data.

Sample Descriptions

Client : Site : Report Number :	Causeway Geotech Ltd Arklow Sewerage Scheme Marine Outf S17_8717	iall Gl
port Humber .	IS1/ 8/1/	
		Note: major constituent in upper case
Lab ID Number	Client ID	Description Description
CL/1775425 CL/1775426	BH13 2.50 BH13 5.50	MARINE SEDIMENTS MARINE SEDIMENTS
CL/1775427	CRM	QUALITY CONTROL SAMPLE
CL/1775428	QC Blank	QUALITY CONTROL SAMPLE
CL/1775427 CL/1775428 CL/1775429	CRM QC Blank Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
		1
	-	
	1	
		-

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-65414-2

Issue No.: 2

Date of Issue 04/10/2017

Customer Details: ESG Environmental Chemistry, P O Box 100, Bretby Business Park, Burton-on-

Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: S178717

Quotation Reference: 170504/08

Description: 2 soil samples

Date Received: 22/09/2017

Date Started: 26/09/2017

Date Completed: 03/10/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: This report replaces issue 1 in its entirety

Approved By: Matthew Hickson, Laboratory Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.

Observations and interpretations are outside of the scope of UKAS accreditation.

Results reported herein relate only to the items supplied to the laboratory for testing.

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A member of the RPS Group plc. Terms and conditions apply - copy on request



Results Summary

Report No.: 17-65414-2

Customer Reference: S178717 Customer Order No: 42062 BEC

				Customer	Sample No	S1775425	S1775426
				Custome	r Sample ID	BH13 2.50	BH13 5.50
		Sample No	340628	340629			
	mple Type	SOIL	SOIL				
			e Depth (m)	2.50m	5.50m		
				Sa	mpling Date	23/08/2017	23/08/2017
Determinand	CAS No	Codes	SOP	Units	RL		
ibutyltin (DBT)	1002-53-5	N	in house	mg/kg as cation	0.02	< 0.02	< 0.02
ributyltin (TBT)	56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05



Report No.: 17-65414-2Customer Reference: S178717
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-65414	2 soil samples	Blank:
		<pre><rl &="" dbt="" for="" pre="" tbt<=""></rl></pre>
		AQC:
		DBT - 100%
		TBT - 107%



Deviating Samples

Report No.: 17-65414-2 Customer Reference: S178717 Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63). RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating. Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below. Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed.

Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
340628	S1775425		23/08/2017	60ml amber glass jar	No	
340629	S1775426		23/08/2017	60ml amber glass jar	No	



Report Information

Key to Report Codes

U	UKAS Accredited
M	MCERTS Accredited
N	Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units) Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1	Clay - Brown
Type 2	Clay - Grey/Black

Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)
Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally $\!\!\!\!\!\!^*$ be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

ESG Environmental Chemistry - Requested Analysis

Customer C

Report No

Causeway Geotech Ltd

Arklow Sewerage Scheme Marine Outfall GI

S178712

Consignment No S68872 Date Logged 14-Sep-2017

Report Due 02-Oct-2017

		MethodID	ANC	CustSer	GROHSA	ICPMSS			02-0						ICPSOIL	PAHSED	PCBMS30		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	₁∟ Iron (Sediments)	PAH by MS Dti	organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^Dibutyltin	^TributyItin	S Tot.Moisture @ 105C	SI TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
CL/1775392	BH14 0.75	22/08/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775393	BH14 1.75	22/08/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775394	BH14 4.00	22/08/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775395	CRM	22/08/17		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1775396	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1775397	Reference Material (% Recovery	')	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS)	Cadmium (MS)	1	Copper (MS)	Lead (MS)
ID Number	Description	Sediments	Sediments	Sediments	Sediment	Sediments
S1775392	BH14 0.75	12.6	1.67	17.7	181	197.5
S1775393	BH14 1.75	12	0.61	16.9	110.4	194.7
S1775394	BH14 4.00	11.5	0.28	27.6	20.4	16.6
S1775395	CRM	16.65	1.475	58.67	57.83	73.36
S1775396	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
S1775397	Reference Material (% Recovery)	105	107	107	95	109

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
	BH14 0.75	417	0.43	18.9	451.4	28900
S1775393	BH14 1.75	455.4	0.17	14.9	287.1	33500
S1775394	BH14 4.00	519.4	0.07	30.3	56.9	27600
S1775395	CRM	1117	0.707	31.16	306.6	27700
S1775396	QC Blank	<0.5	<0.015	<0.5	<2	<36
S1775397	Reference Material (% Recovery)	103	102	106	105	105

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005
	Detection Limit	0.1	0.02	0.12		
	Units	%	% M/M	%	mg/kg	mg/kg
		Tot Moisture @	Total Organic			
		Tot.Moisture @	Carbon	Carbonate %	^Dibutyltin	^Tributyltin
ID Number	Description	105C	(Sediment)			
S1775392	BH14 0.75	64.6	8.3	6.48	<0.02	<0.05
S1775393	BH14 1.75	23	4.7	2.64	<0.02	<0.05
S1775394	BH14 4.00	18.3	0.51	7.2	<0.02	<0.05
S1775395	CRM		3.0609			
S1775396	QC Blank		<0.02		<0.02	< 0.05
	Reference Material					
S1775397	(% Recovery)		97	102	100	107

Sample ID	Client ID	Moisture (%)
CL/1775392	BH14 0.75	58
CL/1775393	BH14 1.75	12.5
CL/1775394	BH14 4.00	19.9

UKAS accredited?: Yes

		Sample ID :	CL1775396	CL1775397	CL1775392	CL1775393	CL1775394	CL1775395
		Station :	QC Blank	e Material (% F		BH14 1.75	BH14 4.00	CRM
PAH Fraction	# PAH	Mass	-,					
Naphthalene *	1	128	<1	114.7	861.4	57.5	3.0	605.0
C1 Naphthalenes *	2	142	<1	114.6	1725.0	98.5	13.3	345.0
C2 Naphthalenes *		156	<1	N.D	2599.0	106.3	15.4	227.8
C3 Naphthalenes *		170	<1	N.D	2781.0	116.8	15.8	166.2
C4 Naphthalenes *		184	<1	N.D	1454.8	67.6	12.1	124.4
Sum Naphthalenes *			0	115	9421	447	60	1468
Phenanthrene / Anthracene	2	178	<1	103.0	24882.2	735.2	11.8	520.2
C1 178 *		192	<1	N.D	9795.9	392.7	16.4	303.2
C2 178 *		206	<1	N.D	6355.5	272.4	15.8	269.4
C3 178 *		220	<1	N.D	4098.5	158.1	10.7	179.1
Sum 178 *			0	103	45132.1	1558.4	54.8	1271.9
Dibenzothiophene		184	<1	103	1575.8	44.2	2.3	43.7
C1 Dibenzothiophenes *		198	<1	N.D	1499.3	44.8	3.9	86.6
C2 Dibenzothiophenes *		212	<1	N.D	1277.8	44.4	3.9	117.8
C3 Dibenzothiophenes *		226	<1	N.D	712.2	1.9	3.2	73.4
Sum Dibenzothiophenes *			0	103	5065.1	135.4	13.2	321.5
Fluoranthene / pyrene	2	202	<1	99	56503.7	2084.7	12.7	1047.1
C1 202 *		216	<1	N.D	12824.8	533.0	13.5	291.8
C2 202 *		230	<1	N.D	7265.8	229.3	14.0	211.3
C3 202 *		244	<1	N.D	3403.2	101.6	10.6	136.6
Sum 202 *			0	99	79997.5	2948.5	50.8	1686.8
Benzoanthracene / Chrysene	2	228	<1	98	26088.3	1019.4	10.5	654.5
C1 228 *		242	<1	N.D	7866.9	305.0	9.7	283.0
C2 228 *		256	<1	N.D	5611.9	220.3	9.1	150.5
Sum 228 *			0	98	39567.1	1544.7	29.3	1088.0
Benzofluoranthenes /	4	252	<1	96	33593.0	1362.6	15.1	1177.0
benzopyrenes	4		<1	90	33393.0			1177.0
C1 252 *		266	<1	N.D	8901.1	352.7	15.1	337.4
C2 252 *		280	<1	N.D	4821.7	166.7	12.7	199.5
Sum 252 *			0	96	47315.8	1882.0	42.9	1713.9
Dibenzoanthracene / Indenopyrene /								
Benzoperylene	3	276	<1	92	15104.2	495.3	8.2	558.5
, ,								
C1 276 *		290	<1	N.D	3902.9	133.4	5.5	90.7
C2 276 *		304	<1	N.D	910.4	54.1	4.2	62.5
Sum 276 *			0	92	19917.5	682.7	17.9	711.6
Sum of all fractions *			0	101	246416.4	9198.4	268.4	8261.9
Sum of NPD fraction *			0	107	59618.5	2140.5	127.5	3061.7
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.28	0.32	0.30	0.91	0.59

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

* Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

EPA 16 PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1775396	CL1775397	CL1775392	CL1775393	CL1775394	CL1775395
	Station :	QC Blank	Reference Material (% Recovery)	BH14 0.75	BH14 1.75	BH14 4.00	CRM
PAH	Mass						
Naphthalene *	128	<1	114.7	861.4	57.5	3.0	605.0
Acenaphthylene	152	<1	117.2	1865.4	52.9	<1	51.1
Acenaphthene	154	<1	116.9	752.7	43.4	<1	33.0
Fluorene	166	<1	115.9	2336.7	86.6	3.0	53.9
Phenanthrene	178	<1	106.6	20067.7	547.0	11.8	379.2
Dibenzothiophene	184	<1	103.1	1575.8	44.2	2.3	43.7
Anthracene	178	<1	99.4	4814.5	188.2	<1	141.0
Fluoranthene	202	<1	99.6	31874.8	1149.1	6.0	588.4
Pyrene	202	<1	97.6	24628.8	935.6	6.6	458.7
Benzo[a]anthracene	228	<1	96.4	12216.7	503.4	2.9	260.7
Chrysene	228	<1	99.1	13871.7	516.0	7.6	393.8
Benzo[b]fluoranthene	252	<1	94.9	10007.4	329.1	4.8	423.9
Benzo[k]fluoranthene	252	<1	92.6	4891.3	360.1	1.1	211.1
Benzo[e]pyrene	252	<1	103.8	7712.6	284.3	6.7	320.6
Benzo[a]pyrene	252	<1	94.4	10981.6	389.1	2.6	221.3
Indeno[123,cd]pyrene	276	<1	95.1	7237.7	227.1	2.1	276.8
Dibenzo[a,h]anthracene	278	<1	80.9	1771.6	54.6	<1	63.2
Benzo[ghi]perylene	276	<1	101.1	6095.0	213.5	6.1	218.4

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$17_8712
 Date Booked in:
 14-Sep-17

 QC Batch Number:
 170007
 Date Extracted:
 21-Sep-17

 Directory:
 290917PCB.TQ1
 Date Analysed:
 28-Sep-17

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

		Concentration, (μg/kg)						
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1775392	BH14 0.75	1.1	0.9	0.6	0.5	0.9	1.0	1.1
CL1775393	BH14 1.75	0.2	0.1	0.1	0.1	0.1	0.1	0.1
CL1775394	BH14 4.00	0.1	0.1	<0.08	<0.08	0.1	<0.08	<0.08
CL1775395	CRM	2.2	4.0	4.2	3.4	3.3	4.2	2.0
CL1775396	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1775397	Reference Material (% Recovery)	99.4	115.7	115.0	104.4	117.8	116.0	117.1

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_8712
QC Batch Number: 170007
Directory: 270917.TQ1
Method: Ultrasonic

Matrix:

Date Booked in:
Date Extracted:
Date Analysed:
UKAS Accredited:

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1775392	CL1775393	CL1775394	CL1775395	CL1775396
Client ID :	BH14 0.75	BH14 1.75	BH14 4.00	CRM	QC Blank

Compound	Concentration (μg/kg)										
alpha-HCH	<0.10	<0.10	<0.10	<0.10	<0.10						
Hexachlorobenzene	0.14	<0.10	<0.10	5.57	<0.10						
gamma-HCH	<0.10	<0.10	<0.10	<0.10	<0.10						
p,p'-DDE	1.90	0.31	0.16	2.22	<0.10						
Dieldrin	0.57	0.14	<0.10	0.36	<0.10						
p,p'-DDD	0.67	0.16	<0.10	2.99	<0.10						
p,p'-DDT	0.39	<0.10	<0.10	0.38	<0.10						

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17 8712

Directory: E:\TES\DATA\2017\0921HSA GC9\092117 2017-09-21 11-30-37\133B3301.D

Method: Headspace GCFID

Matrix: Soil

Date Booked in: 14-Sep-17
Date extracted: 21-Sep-17

Date Analysed: 21-Sep-17, 2

* Sample data with an asterisk are not UKAS accredited.

		С	oncentration	on, (mg/kg) - a	s wet weig	ht			Aliphatics		
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
CL1775392	BH14 0.75	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1775393	BH14 1.75	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1775394	BH14 4.00	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1775396	QC Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
CL1775397	Reference Material (% Recovery)	99	99	98	98	97	114	110	107	98	108

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: s17_8712 Separation: Silica gel 171031 QC Batch Number: Eluents: Hexane, DCM D:\TES\DATA\2017\092717\092717 2017-09-27 09-53-19\B-025-62-RMS171031ARO.D Directory:

Method: Ultra Sonic Date Booked ir 14-Sep-17

Matrix:

Date Extracted 25-Sep-01 Date Analysed 27-Sep-17, 15:15:31

Soil

					Conce	ntration, (mg	/kg) - as wet	weight					
* This sample data is not UI	(AS accredited.	>C8	- C10	>C10	- C12	>C12	- C16	>C16	- C21	>C21	- C35	>C8 ·	- C40
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
CL1775392	BH14 0.75	<4.16	<4*	<4.16*	<4	5.17	14.2	10.7	73.2	40.6	247	57.8	355
CL1775393	BH14 1.75	<4.12	<4*	<4.12*	<4	<4.12	<4	<4.12	8.94	14.5	24.8	<20.6	38.7
CL1775394	BH14 4.00	<4.2	<4*	<4.2*	<4	<4.2	<4	<4.2	<4	<9.2	11	<21	20.2
CL1775396	QC Blank	<4.16	<4*	<4.16*	<4	<4.16	<4	<4.16	<4	<9.1	<8.76	<20.8	<20
CL1775397	Reference Material (% Recovery)	98	126*	89*	97	94	91	92	92	89	93	91	93
	l		1										

Report Number: EFS/178712

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	I t∩	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Naphthalene) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1775392 to CL1775395	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.
TPHUSSI		The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Banding C10-C12 on the Aliphatic fraction and C8-C10 on the Aromatic fraction) . These circumstances should be taken into consideration when utilising the data.

Sample Descriptions

Client :	Causeway Geotech Ltd	
ite:	Arklow Sewerage Scheme Marine C	Outfall GI
leport Number :	S17_8712	
		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1775392	BH14 0.75	MARINE SEDIMENT MARINE SEDIMENT MARINE SEDIMENT
CL/1775393 CL/1775394	BH14 1.75	MARINE SEDIMENT
CL/1775394	BH14 4.00	MARINE SEDIMENT
CL/1775395	CRM QC Blank	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1775396 CL/1775397	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	
		1

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-65413-2

Issue No.: 2

Date of Issue 04/10/2017

Customer Details: ESG Environmental Chemistry, P O Box 100, Bretby Business Park, Burton-on-

Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: S178712

Quotation Reference: 170504/08

Description: 3 soil samples

Date Received: 22/09/2017

Date Started: 26/09/2017

Date Completed: 03/10/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: This report replaces issue 1 in its entirety

Approved By: Matthew Hickson, Laboratory Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.

Observations and interpretations are outside of the scope of UKAS accreditation.

Results reported herein relate only to the items supplied to the laboratory for testing.

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A member of the RPS Group plc. Terms and conditions apply - copy on request



Results Summary

Determinand

dibutyltin (DBT)

tributyltin (TBT)

Report No.: 17-65413-2Customer Reference: S178712
Customer Order No: 42062 BEC

			Customore	Commis No	C477F202	C177F303	C177F204
			customer	Sample No	S1775392	S1775393	S1775394
			Custome	r Sample ID	BH14 0.75	BH14 1.75	BH14 4.00
			RPS	Sample No	340625	340626	340627
			Sa	mple Type	SOIL	SOIL	SOIL
			Sample	e Depth (m)	0.75m	1.75m	4.00m
			Sai	mpling Date	22/08/2017	22/08/2017	22/08/2017
CAS No	Codes	SOP	Units	RL			
1002-53-5	N	in house	mg/kg as cation	0.02	< 0.02	< 0.02	< 0.02
56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05	< 0.05



Report No.: 17-65413-2Customer Reference: S178712
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-65413	3 soil samples	Blank: <rl &="" aqc:<="" dbt="" for="" tbt="" td=""></rl>
		DBT - 100% TBT - 107%



Deviating Samples

Report No.: 17-65413-2Customer Reference: S178712
Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63). RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.

Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below. Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed. Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
340625	S1775392		22/08/2017	60ml amber glass jar	No	
340626	S1775393		22/08/2017	60ml amber glass jar	No	
340627	S1775394		22/08/2017	60ml amber glass jar	No	



Report Information

Key to Report Codes

U UKAS Accredited
M MCERTS Accredited
N Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units) Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1	Clay - Brown
Type 2	Clay - Grey/Black

Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)
Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally* be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

ESG Environmental Chemistry - Requested Analysis

Customer Causeway Geotech Ltd Site Arklow Sewerage Scher

Arklow Sewerage Scheme Marine Outfall GI

Report No S178708

Consignment No S68873 Date Logged 14-Sep-2017

Report Due 02-Oct-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q		Sub005		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB-7 Congeners (Marine Sediments)	^DibutyItin	^TributyItin	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	S Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	Yes	Yes
CL/1775381	BH15 0.50	25/08/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775382	BH15 2.50	25/08/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1775383	CRM	25/08/17		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1775384	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1775385	Reference Material (% Recovery	<i>(</i>)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Copper (MS) Sediment	Lead (MS) Sediments
S1775381	BH15 0.50	11.6	0.47	14.2	44.8	53.4
S1775382	BH15 2.50	8.9	0.13	8.1	17.8	20.8
S1775383	CRM	16.65	1.475	58.67	57.83	73.36
S1775384	QC Blank	<0.5	<0.04	<0.5	< 0.5	<0.5
S1775385	Reference Material (% Recovery)	105	107	107	95	109

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Manganese	Mercury (MS)	Nickel (MS)	Zinc (MS)	Iron
ID Number	Description	(MS) Sediments	Sediments	Sediments	Sediments	(Sediments)
S1775381	BH15 0.50	592.8	0.06	15.2	147.9	26100
S1775382	BH15 2.50	227.9	0.06	7.2	53	12500
S1775383	CRM	1117	0.707	31.16	306.6	27700
S1775384	QC Blank	<0.5	<0.015	<0.5	<2	<36
	Reference Material					
S1775385	(% Recovery)	103	102	106	105	105

	Method Codes	TMSS	WSLM59	ANC	Sub005	Sub005
	Detection Limit	0.1	0.02	0.12		
	Units	%	% M/M	%	mg/kg	mg/kg
		Tot.Moisture @	Total Organic	0.1	AD'IL I II'	AT 11. 1 11.
		105C	Carbon	Carbonate %	^Dibutyltin	^Tributyltin
ID Number	Description		(Sediment)			
S1775381	BH15 0.50	10.7	0.31	7.44	<0.02	<0.05
S1775382	BH15 2.50	15.9	0.08	2.88	<0.02	<0.05
S1775383	CRM		2.8645			
S1775384	QC Blank		< 0.02		<0.02	< 0.05
	Reference Material					
S1775385	(% Recovery)		91	102	100	107

Sample ID	Client ID	Moisture (%)
CL/1775381	BH15 0.50	20.7
CL/1775382	BH15 2.50	19.1

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

		Sample ID :	CL1775384	CL1775385	CL1775381	CL1775382	CL1775383
		Station :	QC Blank	e Material (% F		BH15 2.50	CRM
PAH Fraction	# PAH	Mass					
Naphthalene *	1	128	<1	114.7	19.2	1.7	605.0
C1 Naphthalenes *	2	142	<1	114.6	10.3	2.1	345.0
C2 Naphthalenes *		156	<1	N.D	13.8	3.0	227.8
C3 Naphthalenes *		170	<1	N.D	11.2	3.1	166.2
C4 Naphthalenes *		184	<1	N.D	9.3	2.3	124.4
Sum Naphthalenes *			0	115	64	12	1468
Phenanthrene / Anthracene	2	178	<1	103.0	34.0	30.6	520.2
C1 178 *		192	<1	N.D	27.3	13.9	303.2
C2 178 *		206	<1	N.D	31.8	11.0	269.4
C3 178 *		220	<1	N.D	24.2	4.8	179.1
Sum 178 *			0	103	117.3	60.4	1271.9
Dibenzothiophene		184	<1	103	5.6	1.9	43.7
C1 Dibenzothiophenes *		198	<1	N.D	7.7	1.7	86.6
C2 Dibenzothiophenes *		212	<1	N.D	17.1	1.6	117.8
C3 Dibenzothiophenes *		226	<1	N.D	19.1	<1	73.4
Sum Dibenzothiophenes *			0	103	49.5	5.2	321.5
Fluoranthene / pyrene	2	202	<1	99	190.1	73.7	1047.1
C1 202 *		216	<1	N.D	65.3	16.7	291.8
C2 202 *		230	<1	N.D	34.6	10.4	211.3
C3 202 *		244	<1	N.D	20.9	4.7	136.6
Sum 202 *			0	99	311.0	105.4	1686.8
Benzoanthracene / Chrysene	2	228	<1	98	91.3	32.8	654.5
C1 228 *		242	<1	N.D	51.8	11.0	283.0
C2 228 *		256	<1	N.D	28.2	7.6	150.5
Sum 228 *			0	98	171.2	51.4	1088.0
Benzofluoranthenes / benzopyrenes	4	252	<1	96	114.9	47.3	1177.0
C1 252 *		266	<1	N.D	46.9	14.0	337.4
C2 252 *		280	<1	N.D	29.8	8.6	199.5
Sum 252 *			0	96	191.6	69.9	1713.9
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	92	42.9	19.9	558.5
C1 276 *		290	.1	N.D	19.4	5.6	90.7
C2 276 *		304	<1 <1	N.D N.D	5.8	1.2	90.7 62.5
Sum 276 *		304	< 1 0	1N.D 92	5.8 68.1	26.7	62.5 711.6
Sum of all fractions *	 		0	101	972.4	331.4	8261.9
Sum of All fractions * Sum of NPD fraction *			0	107			
			#DIV/0!		230.7	77.9	3061.7
NPD / 4-6 ring PAH ratio *	لـــبــــا			0.28	0.31	0.31	0.59

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

* Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1775384	CL1775385	CL1775381	CL1775382	CL1775383
	Station :	QC Blank	Reference Material (% Recovery)	BH15 0.50	BH15 2.50	CRM
PAH	Mass					
Naphthalene *	128	<1	114.7	19.2	1.7	605.0
Acenaphthylene	152	<1	117.2	7.3	2.1	51.1
Acenaphthene	154	<1	116.9	5.8	<1	33.0
Fluorene	166	<1	115.9	10.5	2.7	53.9
Phenanthrene	178	<1	106.6	20.1	24.0	379.2
Dibenzothiophene	184	<1	103.1	5.6	1.9	43.7
Anthracene	178	<1	99.4	13.8	6.6	141.0
Fluoranthene	202	<1	99.6	81.8	39.1	588.4
Pyrene	202	<1	97.6	108.3	34.6	458.7
Benzo[a]anthracene	228	<1	96.4	45.0	15.8	260.7
Chrysene	228	<1	99.1	46.3	16.9	393.8
Benzo[b]fluoranthene	252	<1	94.9	30.7	13.4	423.9
Benzo[k]fluoranthene	252	<1	92.6	19.2	8.1	211.1
Benzo[e]pyrene	252	<1	103.8	29.0	10.8	320.6
Benzo[a]pyrene	252	<1	94.4	36.0	15.0	221.3
Indeno[123,cd]pyrene	276	<1	95.1	19.0	9.2	276.8
Dibenzo[a,h]anthracene	278	<1	80.9	4.7	1.8	63.2
Benzo[ghi]perylene	276	<1	101.1	19.2	8.9	218.4

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$17_8708
 Date Booked in:
 14-Sep-17

 QC Batch Number:
 170007
 Date Extracted:
 21-Sep-17

 Directory:
 290917PCB.TQ1
 Date Analysed:
 28-Sep-17

 Method:
 Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

		Concentration, (μg/kg)						
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1775381	BH15 0.50	<0.08	<0.08	0.2	0.2	0.1	0.1	<0.08
CL1775382	BH15 2.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1775383	CRM	2.2	4.0	4.2	3.4	3.3	4.2	2.0
CL1775384	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1775385	Reference Material (% Recovery)	99.4	115.7	115.0	104.4	117.8	116.0	117.1

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$17_8708
QC Batch Number: 170007
Directory: 270917.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:14-Sep-17Date Extracted:27-Sep-17Date Analysed:28-Sep-17UKAS Accredited:No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1775381	CL1775382	CL1775383	CL1775384	CL1775385
					Reference Material (%
Client ID:	BH15 0.50	BH15 2.50	CRM	QC Blank	Recovery)

Compound		Concentration (μg/kg)									
alpha-HCH	<0.10	<0.10	<0.10	<0.10	108						
Hexachlorobenzene	<0.10	<0.10	5.57	<0.10	100						
gamma-HCH	<0.10	<0.10	<0.10	<0.10	120						
p,p'-DDE	<0.10	<0.10	2.22	<0.10	114						
Dieldrin	<0.10	<0.10	0.36	<0.10	127						
p,p'-DDD	<0.10	<0.10	2.99	<0.10	109						
p,p'-DDT	<0.10	<0.10	0.38	<0.10	106						

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17 8708

Directory: E:\TES\DATA\2017\0921HSA GC9\092117 2017-09-21 11-30-37\123B2301.D

Method: Headspace GCFID

Matrix: Soil

Date Booked in: 14-Sep-17
Date extracted: 21-Sep-17

Date Analysed: 21-Sep-17, 1

* Sample data with an asterisk are not UKAS accredited.

		C	Concentration, (mg/kg) - as wet weight					Aliphatics				
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO	
CL1775381	BH15 0.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2	
CL1775382	BH15 2.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2	
CL1775384	QC Blank	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2	
CL1775385	Reference Material (% Recovery)	103	105	103	104	101	109	104	108	110	107	

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

Job Number:\$17_8708Separation:Silica gelQC Batch Number:171031Eluents:Hexane, DCM

Directory: D:\TES\DATA\2017\092717\092717 2017-09-27 09-53-19\B-025-62-RMS171031ARO.D

Method: Ultra Sonic

Matrix: Soil

Date Booked ir 14-Sep-17
Date Extracted 25-Sep-17
Date Analysed 27-Sep-17, 15:15:31

		Concentration, (mg/kg) - as wet weight											
* This sample data is not U	KAS accredited.	>C8	>C8 - C10		>C12	- C16	>C16	- C21	>C21	- C35	>C8 ·	- C40	
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
CL1775381	BH15 0.50	<4.08	<4*	<4.08*	<4	<4.08	<4	<4.08	<4	9.4	<8.76	<20.4	<20
CL1775382	BH15 2.50	<4.12	<4*	<4.12*	<4	<4.12	4.21	<4.12	<4	<9	9.3	<20.6	<20
CL1775384	QC Blank	<4.16	<4*	<4.16*	<4	<4.16	<4	<4.16	<4	<9.1	<8.76	<20.8	<20
CL1775385	Reference Material (% Recovery)	98	126*	89*	97	94	91	92	92	89	93	91	93

Report Number: EFS/178708

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
PAHSED	I t∩	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Naphthalene) . These circumstances should be taken into consideration when utilising the data.
PAHSED	CL1775381 to CL1775383	Chrysene is known to coelute with Triphenylene and these peaks can not be resolved. It is believed Triphenylene is present in these samples therefore it is suggested that the Chrysene results should be taken as a Chrysene (inc. Triphenylene). This should be taken into consideration when utilising the data.
TPHUSSI		The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation, where applicable, from the affected analytes (Banding C10-C12 on the Aliphatic fraction and C8-C10 on the Aromatic fraction) . These circumstances should be taken into consideration when utilising the data.

Sample Descriptions

Client :	Causeway Geotech Ltd	
Site :	Arklow Sewerage Scheme Marine Ou	utfall GI
Report Number :	S17_8708	
		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1775381	BH15 0.50	MARINE SEDIMENT
CL/1775382 CL/1775383	BH15 2.50	MARINE SEDIMENT MARINE SEDIMENT QUALITY CONTROL SAMPLE
CL/1775383	CRM	QUALITY CONTROL SAMPLE
CL/1775384 CL/1775385	QC Blank Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
GL/17/5385	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE

Appendix A Page 1 of 1 12/12/2017



Certificate of Analysis

Report No.: 17-65412-2

Issue No.: 2

Date of Issue 04/10/2017

Customer Details: ESG Environmental Chemistry, P O Box 100, Bretby Business Park, Burton-on-

Trent, Staffordshire, DE15 0XD

Customer Contact: Catherine Goodwin

Customer Order No.: 42062 BEC

Customer Reference: \$178708

Quotation Reference: 170504/08

Description: 2 soil samples

Date Received: 22/09/2017

Date Started: 26/09/2017

Date Completed: 03/10/2017

Test Methods: Details available on request (refer to SOP code against relevant result/s)

Notes: This report replaces issue 1 in its entirety

Approved By: Matthew Hickson, Laboratory Manager

This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service.

Observations and interpretations are outside of the scope of UKAS accreditation.

Results reported herein relate only to the items supplied to the laboratory for testing.

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Results Summary

Report No.: 17-65412-2

Customer Reference: S178708 Customer Order No: 42062 BEC

				Customer S	Sample No	S1775381	S1775382
				Custome	r Sample ID	BH15 0.50	BH15 2.50
		Sample Depth (r Sampling Da					340624
	Sample Type						SOIL
				Sample	e Depth (m)	0.50m	2.50m
				Sai	mpling Date	25/08/2017	25/08/2017
Determinand	CAS No	Codes	SOP	Units	RL		
butyltin (DBT)	1002-53-5	N	in house	mg/kg as cation	0.02	< 0.02	< 0.02
ibutyltin (TBT)	56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05



Report No.: 17-65412-2Customer Reference: S178708
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-65412	2 soil samples	Blank: <rl &="" -="" 100%="" 107%<="" aqc:="" dbt="" for="" tbt="" td=""></rl>



Deviating Samples

Report No.: 17-65412-2Customer Reference: S178708
Customer Order No: 42062 BEC

Our policy on Deviating Samples and reference list of Holding Times applied can be supplied on request. These have been implemented in accordance with UKAS Policy on Deviating Samples (TPS63).

RPS is not responsible for the integrity of samples as received, unless RPS personnel performed the sampling, and it is possible that samples submitted may be declared to be deviating.

Where applicable the analysis method remains UKAS accredited, however results reported for a deviating sample may be invalid. The reason for a sample being declared to be deviating is indicated below.

Where no sampling date was supplied, samples have been declared to be deviating. However, if a date of sampling can be supplied, the results may be reissued with the deviating sample status removed. Where the sample container used was unsuitable, the appropriate Holding Time was exceeded, or the sample is flagged as deviating for some other reason, re-sampling/re-submisson may be required.

RPS No.	Customer No.	Customer ID	Date Sampled	Containers Received	Deviating Sample	Reason for Sample Deviation
340623	S1775381		25/08/2017	60ml amber glass jar	No	
340624	S1775382		25/08/2017	60ml amber glass jar	No	



Report Information

Key to Report Codes

U	UKAS Accredited
M	MCERTS Accredited
N	Not accredited

S Subcontracted to approved laboratory

US Subcontracted to approved laboratory UKAS Accredited for the test

MS Subcontracted to approved laboratory MCERTS/UKAS Accredited for the test

SI Subcontracted to internal RPS Group laboratory

USI Subcontracted to internal RPS Group laboratory UKAS Accredited for the test

MSI Subcontracted to internal RPS Group laboratory MCERTS/UKAS Accredited for the test

I/S (in results)
U/S (in results)
S/C (in results)
ND (in results)
Insufficient Sample
Unsuitable Sample
See Comments
Not Detected

DW (in units) Results are expressed on a dry weight basis

Where the dry solids value of a sample is low (<50%), reporting limits are automatically raised for all determinants analysed on an asreceived basis.

Soil Typing

Type 1	Clay - Brown
Type 2	Clay - Grey/Black

Type 3 Sand

Type 4 Top Soil (Standard)
Type 5 Top Soil (High Peat)
Type 6 Made Ground (>50% Clay)
Type 7 Made Ground (>50% Sand)
Type 8 Made Ground (>50% Top Soil)

Type X Other

Sample Retention and Disposal

Samples will generally $\!\!\!\!\!\!^*$ be retained for the following times prior to disposal:

Perishables, e.g. foodstuffs 1 month (if frozen) from the issue date of this report

Waters 2 weeks from the issue date of this report
Other Liquids 1 month from the issue date of this report
Solids (including Soils) 1 month from the issue date of this report

^{*}Sample retention may be subject to agreement with the customer for particular projects

Customer Causeway Geotech Ltd Site Arklow Sewerage Scher

Arklow Sewerage Scheme Marine Outfall GI

Report No S180841

Consignment No S70512
Date Logged 21-Nov-2017

Report Due 11-Dec-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	OGSNSED		PAHSED	PCBMS3Q		TMSS	TPHUSSI	65WTSM
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	Dibutyl Tin (Sediments)	Tributyl Tin (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	S Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes
CL/1784512	BH16 0.50	05/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784513	BH16 2.50	05/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784514	BH16 4.50	05/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784515	CRM	05/11/17		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			R
CL/1784516	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1784517	Reference Material (% Recovery	<i>'</i>)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
Detection Limit	0.5	0.04	0.5	0.5	0.5
Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
	Arsenic (MS)	Cadmium (MS)			Lead (MS)
Description	Seaiments	Seaiments	Seaiments	Seaiment	Sediments
BH16 0.50	26.4	0.19	16.4	52.2	45
BH16 2.50	8.8	0.85	19.2	17.9	19.3
BH16 4.50	13.1	0.98	30.9	29.1	25.7
CRM	17.77	1.611	62.77	56.42	81.22
QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
Reference Material	00	00	100	07	99
	Detection Limit Units Description BH16 0.50 BH16 2.50 BH16 4.50 CRM QC Blank	Detection Limit 0.5 Units mg/kg Arsenic (MS) Sediments BH16 0.50 26.4 BH16 2.50 8.8 BH16 4.50 13.1 CRM 17.77 QC Blank <0.5	Detection Limit 0.5 0.04 Units mg/kg mg/kg Arsenic (MS) Cadmium (MS) Sediments Sediments BH16 0.50 26.4 0.19 BH16 2.50 8.8 0.85 BH16 4.50 13.1 0.98 CRM 17.77 1.611 QC Blank <0.5	Detection Limit 0.5 0.04 0.5 Units mg/kg mg/kg mg/kg Arsenic (MS) Cadmium (MS) Chromium (MS) Sediments Sediments BH16 0.50 26.4 0.19 16.4 BH16 2.50 8.8 0.85 19.2 BH16 4.50 13.1 0.98 30.9 CRM 17.77 1.611 62.77 QC Blank <0.5	Detection Limit 0.5 0.04 0.5 0.5 Units mg/kg mg/kg mg/kg mg/kg Arsenic (MS) Cadmium (MS) Chromium (MS) Copper (MS) Sediments Sediments Sediment BH16 0.50 26.4 0.19 16.4 52.2 BH16 2.50 8.8 0.85 19.2 17.9 BH16 4.50 13.1 0.98 30.9 29.1 CRM 17.77 1.611 62.77 56.42 QC Blank <0.5

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
	BH16 0.50	639.3	0.05	13.6	113.9	26400
S1784513	BH16 2.50	417.5	0.02	20.8	104.7	23300
S1784514	BH16 4.50	828.4	0.04	35.1	146.2	34700
S1784515	CRM	1200	0.761	33.1	327.2	28200
S1784516	QC Blank	<0.5	<0.015	<0.5	<2	<36
S1784517	Reference Material (% Recovery)	96	95	99	99	99

	Method Codes	TMSS	WSLM59	ANC	OGSNSED	OGSNSED
	Detection Limit	0.1	0.02	0.12	1	1
	Units	%	% M/M	%	ug Sn/kg	ug Sn/kg
		Tet Meisture	Total Organic		Dibutul Tip	Taibutud Tip
		Tot.Moisture @	Carbon	Carbonate %	Dibutyl Tin	Tributyl Tin
ID Number	Description	105C	(Sediment)		(Sediments)	(Sediments)
S1784512	BH16 0.50	2.2	0.15	2.64	<1	<1
S1784513	BH16 2.50	59.8	9.2	3.12	<1	<1
S1784514	BH16 4.50	60	8.8	2.88	<1	<1
S1784515	CRM		3.1073		12	94
S1784516	QC Blank		<0.02		<1	<1
	Reference Material					
S1784517	(% Recovery)		98	98	93	91

Sample ID	Client ID	Moisture (%)
CL/1784512	BH16 0.50	16.2
CL/1784513	BH16 2.50	60.9
CL/1784514	BH16 4.50	60.7

		Sample ID :	CL1784516	CL1784517	CL1784515	CL1784512	CL1784513	CL1784514
		Station :	QC Blank	Reference Material (% Recovery)	1941b	BH16 0.50	BH16 2.50	BH16 4.50
PAH Fraction	# PAH	Mass						
Naphthalene	1	128	<1	104	582	<1	4	3
C1 Naphthalenes *	2	142	<1	100	326	<1	11	13
C2 Naphthalenes *		156	<1	N.D	219	<1	84	123
C3 Naphthalenes *		170	<1	N.D	179	<1	22	36
C4 Naphthalenes *		184	<1	N.D	120	<1	21	34
Sum Naphthalenes *			0	102	1427	0	142	209
Phenanthrene / Anthracene	2	178	<1	105	519	<1	12	16
C1 178 *		192	<1	N.D	310	<1	21	26
C2 178 *		206	<1	N.D	244	<1	17	27
C3 178 *		220	<1	N.D	171	<1	9	14
Sum 178 *			0	105	1243	0	59	83
Dibenzothiophene		184	<1	105	47	<1	4	5
C1 Dibenzothiophenes *		198	<1	N.D	72	<1	5	7
C2 Dibenzothiophenes *		212	<1	N.D	105	<1	5	7
C3 Dibenzothiophenes *		226	<1	N.D	67	<1	3	5
Sum Dibenzothiophenes *			0	105	291	0	17	24
Fluoranthene / pyrene	2	202	<1	105	1062	<1	11	13
C1 202 *		216	<1	N.D	292	<1	22	25
C2 202 *		230	<1	N.D	248	<1	35	85
C3 202 *		244	<1	N.D	112	<1	15	20
Sum 202 *			0	105	1713	0	84	143
Benzoanthracene / Chrysene	2	228	<1	104	679	<1	11	14
C1 228 *		242	<1	N.D	272	<1	16	15
C2 228 *		256	<1	N.D	147	<1	21	23
Sum 228 *			0	104	1098	0	48	52
Benzofluoranthenes / benzopyrenes	4	252	<1	99	1224	<1	16	21
C1 252 *		266	<1	N.D	320	<1	99	43
C2 252 *		280	<1	N.D	231	<1	14	19
Sum 252 *			0	99	1775	0	129	84
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	97	604	<1	9	14
C1 276 *		290	<1	N.D	89	<1	11	7
C2 276 *		304	<1	N.D N.D	38	<1	3	4
Sum 276 *		JU 4	0	97	731	0	23	25
Sum of all fractions *	 		0	103	8278.6	0.0	502.3	621.2
	 							
Sum of NPD fraction *	 		0	104	2961.2	0.0	217.7	316.7
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.26	0.56	#DIV/0!	0.77	1.04

N.D = Not Determined as these compounds are not in the reference material spike.
 As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1784516	CL1784517	CL1784515	CL1784512	CL1784513	CL1784514
	Station :	QC Blank	Reference Material (% Recovery)	1941b	BH16 0.50	BH16 2.50	BH16 4.50
PAH	Mass						
Naphthalene	128	<1	104.4	582.4	<1	3.7	3.3
Acenaphthylene	152	<1	103.2	59.8	<1	1.0	1.2
Acenaphthene	154	<1	105.0	32.9	<1	4.1	3.1
Fluorene	166	<1	104.7	50.4	<1	4.2	5.7
Phenanthrene	178	<1	107.9	372.7	<1	10.6	14.2
Dibenzothiophene	184	<1	105.5	46.9	<1	4.1	5.0
Anthracene	178	<1	102.5	146.5	<1	1.5	2.0
Fluoranthene	202	<1	104.7	596.8	<1	4.5	5.4
Pyrene	202	<1	105.9	464.8	<1	6.4	7.9
Benzo[a]anthracene	228	<1	101.7	269.7	<1	3.2	3.7
Chrysene	228	<1	106.4	409.7	<1	7.4	10.4
Benzo[b]fluoranthene	252	<1	97.6	449.7	<1	6.7	8.4
Benzo[k]fluoranthene	252	<1	94.8	213.0	<1	1.3	1.7
Benzo[e]pyrene	252	<1	103.4	326.8	<1	6.6	9.1
Benzo[a]pyrene	252	<1	99.4	234.4	<1	1.6	2.2
Perylene *	252	<1	102.8	257.0	1.5	2331	1219
Indeno[123,cd]pyrene	276	<1	94.7	295.9	<1	2.4	3.0
Dibenzo[a,h]anthracene	278	<1	97.3	57.4	<1	<1	1.4
Benzo[ghi]perylene	276	<1	99.9	250.4	<1	7.1	10.0

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$18_0841
 21-Nov-17

 QC Batch Number:
 170016
 Date Extracted:
 01-Dec-17

 Directory:
 041217PCB.TQ1
 Date Analysed:
 05-Dec-17

 Method:
 Ultrasonic
 05-Dec-17

Compounds marked * are not UKAS or MCerts accredited

		Concentration, (μg/kg)									
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*			
CL1784512	BH16 0.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08			
CL1784513	BH16 2.50	0.28	0.28	<0.08	<0.08	<0.08	<0.08	<0.08			
CL1784514	BH16 4.50	0.18	0.18	<0.08	<0.08	<0.08	<0.08	<0.08			
CL1784515	CRM	2.96	4.08	4.48	2.94	3.73	3.47	2.38			
CL1784516	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08			
CL1784517	Reference Material (% Recovery)	113	111	111	113	108	107	113			

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18_0841
QC Batch Number: 170016
Directory: 041217.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:21-Nov-17Date Extracted:01-Dec-17

Date Analysed: 05-Dec-17
UKAS Accredited: No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1784512	CL1784513	CL1784514	CL1784515	CL1784516	CL1784517
						Reference Material
Client ID:	BH16 0.50	BH16 2.50	BH16 4.50	CRM	QC Blank	(% Recovery)

Compound		Concentration (μg/kg)										
alpha-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	88						
Hexachlorobenzene	<0.10	<0.10	<0.10	7.92	<0.10	98						
gamma-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	93						
p,p'-DDE	<0.10	<0.10	<0.10	2.80	<0.10	84						
Dieldrin	<0.10	<0.10	<0.10	0.29	<0.10	91						
p,p'-DDD	<0.10	<0.10	<0.10	3.39	<0.10	86						
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	<0.10	96						

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18 0841

Directory: D:\TES\DATA\Y2017\1204HSA_GC12\\171204 2017-12-04 17-22-19\049F4901.D

Method: Headspace GCFID

Matrix: Soil

Date Booked in: 21-Nov-

Date Booked in: 21-Nov-17
Date extracted: 04-Dec-17

Date Analysed: 05-Dec-17, 09:01:14

* Sample data with an asterisk are not UKAS accredited.

		Concentration, (mg/kg) - as wet weight Aliphatics								1	
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
* CL1784512	BH16 0.50	< 0.010	<0.010	<0.010	<0.010	<0.010*	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784513	BH16 2.50	<0.010	<0.010	<0.010	<0.010	<0.010*	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784514	BH16 4.50	<0.010	<0.010	<0.010	<0.010	<0.010*	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784516	QC BLANK	<0.010	<0.010	<0.010	<0.010	<0.010*	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784517	Reference Material (% recovery)	102	101	98	99	96*	120	117	110	88	114

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

Separation: Silica gel

Matrix: Soil Date Booked in

Job Number: QC Batch Number: S18 0841 171301 Eluents: Hexane, DCM

21-Nov-17 05-Dec-17 Date Extracted

Directory:

C:\CHEM32\1\DATA\120617TPH GC15\120617 2017-12-06 12-58-48\OnlineEdited--024B.D

Date Analysed: 06-Dec-17, 17:50:19

Method: Ultra Sonic

					Conce	entration, (mg	/kg) - as wet	weight					
* This sample data is not UKAS accredited.		>C8 - C10 >C10 - C12		>C12 - C16		>C16 - C21		>C21 - C35		>C8 - C40			
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
* CL1784512	BH16 0.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
* CL1784513	BH16 2.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
* CL1784514	BH16 4.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	8.91	<20	<20
* CL1784516	QC Blank	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
* CL1784517	Reference Material (% Recovery)	99	99	99	102	97	91	96	96	99	97	97	94

Sample Descriptions

	0									
ent :	Causeway Geotech Ltd									
e:	Arklow Sewerage Scheme Marine Outfall GI									
port Number :	S18_0841									
		Note: major constituent in upper case								
Lab ID Number	Client ID	Description								
CL/1784512	BH16 0.50	MARINE SEDIMENTS								
CL/1784513	BH16 2.50	MARINE SEDIMENTS								
CL/1784513 CL/1784514	BH16 4.50	MARINE SEDIMENTS MARINE SEDIMENTS								
CL/1784515	CRM	QUALITY CONTROL SAMPLE								
CL/1784516	QC Blank	QUALITY CONTROL SAMPLE								
CL/1784517	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE								
	<u> </u>									

Appendix A Page 1 of 1 12/12/2017

Customer Causeway Geotech Ltd

Site Arklow Sewerage Scheme Marine Outfall GI

Report No S180843

Consignment No S70498
Date Logged 21-Nov-2017

Report Due 11-Dec-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	OGSNSED		PAHSED	PCBMS3Q		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	Dibutyl Tin (Sediments)	Tributyl Tin (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes
CL/1784522	BH17 1.50	03/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784523	BH17 3.50	03/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784524	CRM	03/11/17		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			R
CL/1784525	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1784526	Reference Material (% Recovery	/)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS)	Cadmium (MS)	Chromium (MS)	Copper (MS)	Lead (MS)
ID Number	Description	Sediments	Sediments	Sediments	Sediment	Sediments
S1784522	BH17 1.50	8.8	0.38	16.7	19	9.1
S1784523	BH17 3.50	10.4	0.07	13.9	26.1	10.9
S1784524	CRM	17.77	1.611	62.77	56.42	81.22
S1784525	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
S1784526	Reference Material (% Recovery)	99	98	100	97	99

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Manganese	Mercury (MS)	Nickel (MS)	Zinc (MS)	Iron
ID Number	Description	(MS) Sediments	Sediments	Sediments	Sediments	(Sediments)
S1784522	BH17 1.50	631	<0.015	12.9	80.2	26500
S1784523	BH17 3.50	663	<0.015	12.4	111	26300
S1784524	CRM	1200	0.761	33.1	327.2	28200
S1784525	QC Blank	<0.5	<0.015	<0.5	<2	<36
S1784526	Reference Material (% Recovery)	96	95	99	99	99

	Method Codes	TMSS	WSLM59	ANC	OGSNSED	OGSNSED
	Detection Limit	0.1	0.02	0.12	1	1
	Units	%	% M/M	%	ug Sn/kg	ug Sn/kg
		Tot.Moisture @	Total Organic		Dibutul Tip	Tributul Tin
		_	Carbon	Carbonate %	Dibutyl Tin	Tributyl Tin (Sediments)
ID Number	Description	105C	(Sediment)		(Sediments)	(Seaiments)
S1784522	BH17 1.50	7	0.12	1.2	<1	<1
S1784523	BH17 3.50	5.6	0.14	0.72	<1	<1
S1784524	CRM		3.1073		120	94
S1784525	QC Blank		<0.02		<1	<1
	Reference Material					
S1784526	(% Recovery)		98	98	93	91

Sample ID	Client ID	Moisture (%)
CL/1784522	BH17 1.50	3.6
CL/1784523	BH17 3.50	16.2

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAH Fraction			Sample ID :	CL1784525	CL1784526	CL1784524	CL1784522	CL1784523
PAH Fraction								
Recovery Recovery			Station :	QC Blank		1941b	BH17 1.50	BH17 3.50
Naphthalene					,			
C1 Naphthalenes * 2 142	PAH Fraction	# PAH	Mass					
C2 Naphthalenes *	Naphthalene	1	128	<1	104	582	<1	1.3
C3 Naphthalenes * C4 Naphthalenes * C5 Naphthalenes * C5 Naphthalenes * C6 Naphthalenes * C6 Naphthalenes * C6 Naphthalenes * C6 Naphthalenes * C7 Naphthalenes * C8 Naphthalenes * C8 Naphthalenes * C8 Naphthalenes * C9 Naphthale	C1 Naphthalenes *	2	142	<1			<1	1.1
C4 Naphthalenes *	C2 Naphthalenes *			<1	N.D	219	<1	<1
Sum Naphthalenes	C3 Naphthalenes *		170	<1	N.D	179	<1	<1
Phenanthrene Anthracene 2	C4 Naphthalenes *		184	<1	N.D	120	<1	<1
C1 178 *	Sum Naphthalenes *			0	102	1427	0	2
C2 178 * 206	Phenanthrene / Anthracene	2	178	<1	105	519	<1	3.3
C3 178 * 220	C1 178 *		192	<1	N.D	310	<1	1.5
Sum 178 * 0 105 1243 0.0 5.9 Dibenzothiophene 184 <1	C2 178 *		206	<1	N.D	244	<1	1.1
Dibenzothiophene	C3 178 *		220	<1	N.D	171	<1	<1
C1 Dibenzothiophenes * 198	Sum 178 *			0	105	1243	0.0	5.9
C2 Dibenzothiophenes * C3 Dibenzothiophenes * C3 Dibenzothiophenes * C4 Dibenzothiophenes * C5 Dibenzothiophenes * C5 Dibenzothiophenes * C5 Dibenzothiophenes * C6 Dibenzothiophenes * C6 Dibenzothiophenes * C7 Dibenzothiophenes * C8 Dibenzothiophenes * C8 Dibenzothiophenes * C8 Dibenzothiophenes * C9 Dibenzothiophenes * C1 Dibenzothiophenes *	Dibenzothiophene		184	<1	105	47	<1	<1
C3 Dibenzothiophenes * 226 <1			198	<1	N.D	72	<1	<1
Sum Dibenzothiophenes* 0 105 291 0.0 0.0 Fluoranthene / pyrene 2 202 <1	C2 Dibenzothiophenes *		212	<1	N.D	105	<1	<1
Fluoranthene / pyrene 2 202 <1 105 1062 <1 6.2 C1 202* C1 216 <1 N.D 292 <1 1.7 C2 202* C2 202* C1 N.D 248 <1 <1 C1 C2 202* C1 N.D 248 <1 <1 C1 C2 202* C1 N.D 248 <1 <1 C1 C2 202* C1 N.D 112 <1 <1 <1 C1 C2 202* C1 N.D 112 <1 <1 <1 C1 C2 202* C1 N.D 112 <1 <1 <1 C1 C2 202* C1 N.D 112 <1 <1 <1 <1 C2 C2 C2* C1 N.D 272 <1 1.1 C2 C2 C28* C1 N.D 272 <1 1.1 C228* C228* C1 N.D 272 <1 1.1 C228* C228* C1 N.D 147 2.1 4.2 Sum 228* C1 N.D 147 2.1 4.2 Sum 228* C1 N.D 147 2.1 4.2 Sum 228* C1 N.D 144 1098 2.1 8.0 Senzofluoranthenes / benzopyrenes C1 252* C1 S22* C1 S22* C1 S22* C228* C266 <1 N.D 320 <1 1.3 C2 252* C228* C280 <1 N.D 231 <1 <1 Sum 252* C252* C280 <1 N.D 231 <1 <1 Sum 252* C252* C280 <1 N.D 231 <1 <1 Sum 252* C252* C266 <1 N.D 231 <1 <1 Sum 252* C252* C266 <1 N.D 231 <1 <1 Sum 252* C252* C266 <1 N.D 231 <1 <1 <1 Sum 252* C252* C266 <1 N.D 231 <1 <1 <1 Sum 252* C252* C276*	C3 Dibenzothiophenes *		226	<1	N.D	67	<1	<1
C1 202 *	Sum Dibenzothiophenes *			0	105	291	0.0	0.0
C2 202 * 230 <1		2		<1			<1	
C3 202 * 244 <1	C1 202 *		216	<1		292	<1	1.7
Sum 202 * 0 105 1713 0.0 8.0 Benzoanthracene / Chrysene 2 228 <1							<1	
Benzoanthracene / Chrysene 2 228 <1 104 679 <1 2.7	C3 202 *		244	<1	N.D	112	<1	
C1 228 *	Sum 202 *						0.0	
C2 228 * 256 <1	Benzoanthracene / Chrysene	2	228	<1		679	<1	2.7
Sum 228 * 0 104 1098 2.1 8.0 Benzofluoranthenes / benzopyrenes 4 252 <1				<1			· ·	
Benzofluoranthenes / benzopyrenes 4 252 <1	C2 228 *		256	<1				
benzopyrenes C1 252 *	Sum 228 *			0	104	1098	2.1	8.0
C1 252 * 266 <1		4	252	<1	99	1224	<1	<1
C2 252 * Sum 252 * Sum 252 * 280 <1 N.D 231	C1 252 *		266	<1	N.D	320	<1	1.3
Dibenzoanthracene / Indenopyrene / Benzoperylene 3 276 <1	C2 252 *			<1	N.D	231	<1	<1
Benzoperylene 3 276 <1	Sum 252 *			0	99	1775	0.0	1.3
C1 276 * 290 <1	Dibenzoanthracene / Indenopyrene /	2	276	-1	97	604	<i>-</i> 1	<i>-</i> 1
C2 276 * 304 <1	Benzoperylene		210		31	004	<u> </u>	< 1
Sum 276 * 0 97 731 0.0 0.0 Sum of all fractions * 0 103 8279 2.1 25.5 Sum of NPD fraction * 0 104 2961 0.0 8.3	C1 276 *		290	<1	N.D	89	<1	<1
Sum of all fractions * 0 103 8279 2.1 25.5 Sum of NPD fraction * 0 104 2961 0.0 8.3	C2 276 *		304	<1	N.D		<1	<1
Sum of NPD fraction * 0 104 2961 0.0 8.3	Sum 276 *			0		731	0.0	
Sum of NPD fraction * 0 104 2961 0.0 8.3	Sum of all fractions *			0	103	8279	2.1	25.5
	Sum of NPD fraction *			0	104	2961	0.0	8.3
	NPD / 4-6 ring PAH ratio *			#DIV/0!	0.26		0.00	

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1784525	CL1784526	CL1784524	CL1784522	CL1784523
	Station :	QC Blank	Reference Material (% Recovery)	1941b	BH17 1.50	BH17 3.50
PAH	Mass					
Naphthalene	128	<1	104.4	582.4	<1	1.3
Acenaphthylene	152	<1	103.2	59.8	<1	<1
Acenaphthene	154	<1	105.0	32.9	<1	<1
Fluorene	166	<1	104.7	50.4	<1	<1
Phenanthrene	178	<1	107.9	372.7	<1	3.3
Dibenzothiophene	184	<1	105.5	46.9	<1	<1
Anthracene	178	<1	102.5	146.5	<1	<1
Fluoranthene	202	<1	104.7	596.8	<1	3.3
Pyrene	202	<1	105.9	464.8	<1	3.0
Benzo[a]anthracene	228	<1	101.7	269.7	<1	1.3
Chrysene	228	<1	106.4	409.7	<1	1.4
Benzo[b]fluoranthene	252	<1	97.6	449.7	<1	<1
Benzo[k]fluoranthene	252	<1	94.8	213.0	<1	<1
Benzo[e]pyrene	252	<1	103.4	326.8	<1	<1
Benzo[a]pyrene	252	<1	99.4	234.4	<1	<1
Perylene *	252	<1	102.8	257.0	2.4	1.0
Indeno[123,cd]pyrene	276	<1	94.7	295.9	<1	<1
Dibenzo[a,h]anthracene	278	<1	97.3	57.4	<1	<1
Benzo[ghi]perylene	276	<1	99.9	250.4	<1	<1

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$18_0843
 Date Booked in:
 21-Nov-17

 QC Batch Number:
 170016
 Date Extracted:
 01-Dec-17

 Directory:
 041217PCB.TQ1
 Date Analysed:
 05-Dec-17

 Method:
 Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1784522	BH17 1.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784523	BH17 3.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784524	CRM	2.96	4.08	4.48	2.94	3.73	3.47	2.38
CL1784525	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784526	Reference Material (% Recovery)	113	111	111	113	108	107	113

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18_0843
QC Batch Number: 170016
Directory: 041217.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:21-Nov-17Date Extracted:01-Dec-17Date Analysed:05-Dec-17UKAS Accredited:No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1784522	CL1784523	CL1784524	CL1784525	CL1784526
					Reference Material (%
Client ID:	BH17 1.50	BH17 3.50	CRM	QC Blank	Recovery)

Compound			Concentration (µg/kg))	
alpha-HCH	<0.10	<0.10	<0.10	<0.10	88
Hexachlorobenzene	<0.10	<0.10	7.92	<0.10	98
gamma-HCH	<0.10	<0.10	<0.10	<0.10	93
p,p'-DDE	<0.10	<0.10	2.80	<0.10	84
Dieldrin	<0.10	<0.10	0.29	<0.10	91
p,p'-DDD	<0.10	<0.10	3.39	<0.10	86
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	96

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S18 0843

D:\TES\DATA\2017\1206HSA_GC9\120617 2017-12-06 14-49-22\035F3501.D Directory:

Method: Headspace GCFID Matrix: Soil Date Booked in:

21-Nov-17

Date extracted:

06-Dec-17

Date Analysed: 07-Dec-17, 00:49:54

* Sample data with an asterisk are not UKAS accredited.

		Co		on, (mg/kg) - a					Aliphatics	1	
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene			C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
* CL1784522	BH17 1.50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784523	BH17 3.50	<0.010	<0.010	<0.010	<0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784525	QC Blank	<0.010	<0.010	<0.010	<0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784526	Reference Material (% Recovery)	98	96	105	107	102	116	94	124	118*	113
_											

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall Gl Matrix: Soil

 Job Number:
 S18_0843
 Separation:
 Silica gel
 Date Booked ir
 21-Nov-17

 QC Batch Number:
 171297
 Eluents:
 Hexane, DCM
 Date Extracted
 04-Dec-17

 Directory:
 D:\TES\DATA\Y2017\120117TPH_GC3\120117C 2017-12-04 16-20-01\047B5701.D
 Date Analysed:05-Dec-17, 04:05:51

Method: Ultra Sonic

					Conce	entration, (mg	/kg) - as wet v	weight					
* This sample data is	not UKAS accredited.	>C8	- C10	>C10	- C12	>C12	- C16	>C16	- C21	>C21	- C35	>C8	- C40
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
* CL1784522	BH17 1.50	<4.08	<4	<4.08	<4	<4.08	<4	5.49	<4	<8.94	<8.76	<20.4	<20
* CL1784523	BH17 3.50	<4.08	<4	<4.08	<4	<4.08	<4	12.5	<4	11.3	9.6	26.4	<20
* CL1784525	QC Blank	<4.12	<4	<4.12	<4	<4.12	<4	<4.12	<4	<9	<8.76	<20.6	<20
* CL1784526	Reference Material (% Recovery)	92	90	85	109	82	85	86	82	95	93	87	87
													
													
													

Sample Descriptions

Client :	Causeway Geotech Ltd	
Site :	Arklow Sewerage Scheme Marine	Outfall GI
Report Number :	S18_0843	
		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1784522	BH17 1.50 BH17 3.50	MARINE SEDIMENTS
CL/1784523 CL/1784524	CRM	MARINE SEDIMENTS QUALITY CONTROL SAMPLE
CL/1784525	QC Blank	QUALITY CONTROL SAMPLE
CL/1784525 CL/1784526	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
		I .

Appendix A Page 1 of 1 12/12/2017

Customer Causeway Geotech Ltd

Site Arklow Sewerage Scheme Marine Outfall GI

Report No S180834

Consignment No S70514 Date Logged 21-Nov-2017

Report Due 11-Dec-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS	•								ICPSOIL	OGSNSED		PAHSED	PCBMS3Q		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	Dibutyl Tin (Sediments)	Tributyl Tin (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes
CL/1784477	BH18 0.50	06/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784478	BH18 2.50	06/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784479	BH18 4.50	06/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784480	CRM	06/11/17		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			R
CL/1784481	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1784482	Reference Material (% Recovery	/)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
		Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Copper (MS) Sediment	Lead (MS) Sediments
	Description	ocuments.	ocumento.		ocuc	000
S1784477	BH18 0.50	19.1	0.14	15.2	36.1	26.8
S1784478	BH18 2.50	7.2	0.11	16.4	14.6	7.6
S1784479	BH18 4.50	6.8	0.18	16.9	19	9.7
S1784480	CRM	18.28	1.56	61.38	59.16	82.15
S1784481	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
	Reference Material					
S1784482	(% Recovery)	96	101	102	93	98

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
	BH18 0.50	584	0.49	13.4	143	26300
S1784478	BH18 2.50	615	0.03	15.4	55.3	26100
S1784479	BH18 4.50	587	0.03	15.5	60.4	25800
S1784480	CRM	1174	0.802	32.24	334.7	27100
S1784481	QC Blank	<0.5	<0.015	<0.5	<2	<36
S1784482	Reference Material (% Recovery)	98	90	102	96	99

	Method Codes	TMSS	WSLM59	ANC	OGSNSED	OGSNSED
	Detection Limit	0.1	0.02	0.12	1	1
	Units	%	% M/M	%	ug Sn/kg	ug Sn/kg
		Tet Meisture	Total Organic		Dibutul Tip	Tributal Tip
		Tot.Moisture @	Carbon	Carbonate %	Dibutyl Tin	Tributyl Tin
ID Number	Description	105C	(Sediment)		(Sediments)	(Sediments)
S1784477	BH18 0.50	11.1	0.11	4.8	<1	<1
S1784478	BH18 2.50	4.7	0.1	2.16	<1	<1
S1784479	BH18 4.50	6.8	0.1	0.96	<1	<1
S1784480	CRM		3.1073		120	94
S1784481	QC Blank		<0.02		<1	<1
	Reference Material					
S1784482	(% Recovery)		98	98	93	91

Sample ID	Client ID	Moisture (%)
CL/1784477	BH18 0.50	13.8
CL/1784478	BH18 2.50	13.6
CL/1784479	BH18 4.50	11.4

		Sample ID :	CL1784481	CL1784482	CL1784480	CL1784477	CL1784478	CL1784479
				Reference				
		Station :	QC Blank	Material (% Recovery)	1941b	BH18 0.50	BH18 2.50	BH18 4.50
PAH Fraction	# PAH	Mass						
Naphthalene	1	128	<1	104	582	1.7	<1	<1
C1 Naphthalenes *	2	142	<1	100	326	1.3	<1	<1
C2 Naphthalenes *		156	<1	N.D	219	1.3	2.1	<1
C3 Naphthalenes *		170	<1	N.D	179	1.0	4.2	1.0
C4 Naphthalenes *		184	<1	N.D	120	<1	2.3	<1
Sum Naphthalenes *			0	102	1427	5	9	1
Phenanthrene / Anthracene	2	178	<1	105	519	20.7	21.6	5.0
C1 178 *		192	<1	N.D	310	8.3	9.3	2.7
C2 178 *		206	<1	N.D	244	3.5	4.9	1.6
C3 178 *		220	<1	N.D	171	1.0	2.5	1.1
Sum 178 *			0	105	1243	33.5	38.3	10.3
Dibenzothiophene		184	<1	105	47	<1	1.1	<1
C1 Dibenzothiophenes *		198	<1	N.D	72	<1	1.2	<1
C2 Dibenzothiophenes *		212	<1	N.D	105	<1	<1	<1
C3 Dibenzothiophenes *		226	<1	N.D	67	<1	<1	<1
Sum Dibenzothiophenes *			0	105	291	0.0	2.3	0.0
Fluoranthene / pyrene	2	202	<1	105	1062	19.8	27.0	6.4
C1 202 *		216	<1	N.D	292	4.5	9.1	1.7
C2 202 *		230	<1	N.D	248	1.8	3.6	<1
C3 202 *		244	<1	N.D	112	<1	1.3	<1
Sum 202 *			0	105	1713	26.1	41.0	8.1
Benzoanthracene / Chrysene	2	228	<1	104	679	8.4	13.6	2.8
C1 228 *		242	<1	N.D	272	2.5	4.0	1.2
C2 228 *		256	<1	N.D	147	1.1	1.8	<1
Sum 228 *			0	104	1098	11.9	19.5	4.0
Benzofluoranthenes / benzopyrenes	4	252	<1	99	1224	8.7	13.4	<1
C1 252 *		266	<1	N.D	320	2.7	5.4	1.3
C2 252 *		280	<1	N.D	231	<1	2.1	<1
Sum 252 *			0	99	1775	11.3	20.9	1.3
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	97	604	2.4	3.4	<1
C1 276 *		290	<1	N.D	89	1.2	<1	<1
C2 276 *		304	<1	N.D N.D	38	<1 <1	<1	<1
Sum 276 *		304	0	97	731	3.6	3.4	0.0
Sum of all fractions *			0	103	8279	91.8	134.0	24.8
Sum of NPD fraction *			0	104	2961	38.9	49.1	11.4
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.26	0.56	0.73	0.58	0.85

N.D = Not Determined as these compounds are not in the reference material spike.
 As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1784481	CL1784482	CL1784480	CL1784477	CL1784478	CL1784479
	Station :	QC Blank	Reference Material (% Recovery)	1941b	BH18 0.50	BH18 2.50	BH18 4.50
PAH	Mass						
Naphthalene	128	<1	104.4	582.4	1.7	<1	<1
Acenaphthylene	152	<1	103.2	59.8	<1	<1	<1
Acenaphthene	154	<1	105.0	32.9	1.3	<1	<1
Fluorene	166	<1	104.7	50.4	1.5	1.6	<1
Phenanthrene	178	<1	107.9	372.7	16.9	13.9	3.9
Dibenzothiophene	184	<1	105.5	46.9	<1	1.1	<1
Anthracene	178	<1	102.5	146.5	3.8	7.7	1.0
Fluoranthene	202	<1	104.7	596.8	9.7	16.0	3.3
Pyrene	202	<1	105.9	464.8	10.1	11.1	3.1
Benzo[a]anthracene	228	<1	101.7	269.7	4.1	6.9	1.4
Chrysene	228	<1	106.4	409.7	4.3	6.7	1.4
Benzo[b]fluoranthene	252	<1	97.6	449.7	2.1	3.6	<1
Benzo[k]fluoranthene	252	<1	94.8	213.0	1.7	2.4	<1
Benzo[e]pyrene	252	<1	103.4	326.8	2.0	2.9	<1
Benzo[a]pyrene	252	<1	99.4	234.4	2.8	4.5	<1
Perylene *	252	<1	102.8	257.0	1.7	4.3	3.8
Indeno[123,cd]pyrene	276	<1	94.7	295.9	1.2	1.9	<1
Dibenzo[a,h]anthracene	278	<1	97.3	57.4	<1	<1	<1
Benzo[ghi]perylene	276	<1	99.9	250.4	1.2	1.6	<1

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$18_0834
 Date Booked in:
 21-Nov-17

 QC Batch Number:
 170016
 Date Extracted:
 01-Dec-17

 Directory:
 041217PCB.TQ1
 Date Analysed:
 05-Dec-17

 Method:
 Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

				Con	centration,	(μg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1784477	BH18 0.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784478	BH18 2.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784479	BH18 4.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784480	CRM	2.96	4.08	4.48	2.94	3.73	3.47	2.38
CL1784481	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784482	Reference Material (% Recovery)	113	111	111	113	108	107	113

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18_0834
QC Batch Number: 170016
Directory: 041217.TQ1
Method: Ultrasonic

Matrix:SedimentDate Booked in:21-Nov-17Date Extracted:01-Dec-17

Date Analysed: 05-Dec-17
UKAS Accredited: No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1784477	CL1784478	CL1784479	CL1784480	CL1784481	CL1784482
						Reference Material
Client ID:	BH18 0.50	BH18 2.50	BH18 4.50	CRM	QC Blank	(% Recovery)

Compound			Concentrat	tion (μg/kg)		
alpha-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	88
Hexachlorobenzene	<0.10	<0.10	<0.10	7.92	<0.10	98
gamma-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	93
p,p'-DDE	<0.10	<0.10	<0.10	2.80	<0.10	84
Dieldrin	<0.10	<0.10	<0.10	0.29	<0.10	91
p,p'-DDD	<0.10	<0.10	<0.10	3.39	<0.10	86
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	<0.10	96

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S18 0834

Directory: D:\TES\DATA\Y2017\1204HSA GC12\171204 2017-12-04 17-22-19\041F4101.D

Method: Headspace GCFID

Matrix: Soil

Date Booked in: 21-Nov-17
Date extracted: 04-Dec-17

Date Analysed: 05-Dec-17, 06:28:32

* Sample data with an asterisk are not UKAS accredited.

		С	oncentration	on, (mg/kg) - a	s wet weigl	ht			Aliphatics		
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
* CL1784477	BH18 0.50	< 0.010	<0.010	<0.010	< 0.010	<0.010*	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784478	BH18 2.50	<0.010	<0.010	<0.010	<0.010	<0.010*	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784479	BH18 4.50	<0.010	<0.010	<0.010	<0.010	<0.010*	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784481	QC Blank	<0.010	<0.010	<0.010	<0.010	<0.010*	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784482	Reference Material (% Recovery)	102	101	98	99	96*	120	117	110	88	114

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

 Job Number:
 S18_0834
 Separation:
 Silica gel

 QC Batch Number:
 171296
 Eluents:
 Hexane, DCM

 Directory:
 C:\CHEM32\1\DATA\120517TPH_GC15\120517 2017-12-05 18-17-42\066B2001.D

Method: Ultra Sonic

Matrix: So	oil
Date Booked ir	21-Nov-17
Date Extracted	04-Dec-17
Date Analysed:05	5-Dec-17, 22:20

						Concentration, (mg/kg) - as wet weight								
* Th	is sample data is not U	KAS accredited.	>C8	- C10	>C10	- C12	>C12	- C16	>C16	- C21	>C21	- C35	>C8	- C40
	Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
*	CL1784477	BH18 0.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
*	CL1784478	BH18 2.50	<4.04	<4	<4.04	<4	<4.04	<4	<4.04	<4	<8.85	<8.76	<20.2	<20
*	CL1784479	BH18 4.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
*	CL1784481	QC Blank	<4.08	<4	<4.08	<4	<4.08	<4	<4.08	<4	<8.94	<8.76	<20.4	<20
*	CL1784482	Reference Material (% Recovery)	103	97	108	111	102	109	100	102	101	102	101	105

Sample Descriptions

Client : Site : Report Number : Lab ID Number CL/1784477 CL/1784478 CL/1784479 CL/1784480 CL/1784481 CL/1784482	Causeway Geotech Ltd Arklow Sewerage Scheme Marine (S18_0834 Client ID BH18 0.50 BH18 2.50 BH18 4.50 CRM QC Blank Reference Material (% Recovery)	Note: major constituent in upper case Description MARINE SEDIMENTS MARINE SEDIMENTS MARINE SEDIMENTS QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
Report Number : Lab ID Number CL/1784477 CL/1784478 CL/1784479	Client ID BH18 0.50 BH18 2.50 BH18 4.50 CRM QC Blank	Note: major constituent in upper case Description MARINE SEDIMENTS MARINE SEDIMENTS MARINE SEDIMENTS MARINE SEDIMENTS QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
Lab ID Number CL/1784477 CL/1784478 CL/1784479	Client ID BH18 0.50 BH18 2.50 BH18 4.50 CRM QC Blank	Description MARINE SEDIMENTS MARINE SEDIMENTS MARINE SEDIMENTS QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1784477 CL/1784478 CL/1784479	Client ID BH18 0.50 BH18 2.50 BH18 4.50 CRM QC Blank	Description MARINE SEDIMENTS MARINE SEDIMENTS MARINE SEDIMENTS QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1784477 CL/1784478 CL/1784479	BH18 0.50 BH18 2.50 BH18 4.50 CRM QC Blank	MARINE SEDIMENTS MARINE SEDIMENTS MARINE SEDIMENTS QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1784478 CL/1784479	BH18 2.50 BH18 4.50 CRM QC Blank	MARINE SEDIMENTS MARINE SEDIMENTS QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1784478 CL/1784479 CL/1784480 CL/1784481 CL/1784482	BH18 4.50 CRM QC Blank	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/17844/9 CL/1784480 CL/1784481 CL/1784482	CRM QC Blank	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1784481 CL/1784482	QC Blank	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1784482	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE

Appendix A Page 1 of 1 12/12/2017

Customer Causeway Geotech Ltd Site Arklow Sewerage Scher

Arklow Sewerage Scheme Marine Outfall GI

Report No S180839

Consignment No S70515
Date Logged 21-Nov-2017

Report Due 11-Dec-2017

		MethodID	ANC	CustServ	GROHSA	ICPMSS	•								ICPSOIL	OGSNSED		PAHSED	PCBMS3Q		TMSS	TPHUSSI	WSLM59
ID Number	Description	Sampled	Carbonate %	Report C	GRO (AA) by HSA GC-FID	Copper (MS) Sediment	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Lead (MS) Sediments	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)	Dibutyl Tin (Sediments)	Tributyl Tin (Sediments)	PAH by MS Dti	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	Tot.Moisture @ 105C	TPH by GCFID (AR/Si)	Total Organic Carbon (Sediment)
	UKA	AS Accredited	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	No	No	Yes	Yes	Yes
CL/1784501	BH19 0.50	07/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784502	BH19 2.50	07/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784503	BH19 4.50	07/11/17	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R
CL/1784504	CRM	07/11/17		R		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			R
CL/1784505	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R
CL/1784506	Reference Material (% Recovery	/)	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	Detection Limit	0.5	0.04	0.5	0.5	0.5
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	Arsenic (MS) Sediments	Cadmium (MS) Sediments	Chromium (MS) Sediments	Copper (MS) Sediment	Lead (MS) Sediments
	Description BH19 0.50	18.2	0.11	17.3	43.1	37.6
	BH19 2.50	16.4	0.11	19	34.2	39.8
S1784503	BH19 4.50	16.2	1.14	30.5	32.1	33.7
S1784504	CRM	17.77	1.611	62.77	56.42	81.22
S1784505	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
S1784506	Reference Material (% Recovery)	99	98	100	97	99

	Method Codes	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	Detection Limit	0.5	0.015	0.5	2	36
	Units	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Nivershave	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
S1784501	Description BH19 0.50	829.9	0.02	16.3	102.2	38900
	BH19 2.50	945.3	0.02	17.3	117.7	38700
S1784503	BH19 4.50	801.5	0.04	33.6	151	39300
S1784504	CRM	1200	0.761	33.1	327.2	28200
S1784505	QC Blank	<0.5	<0.015	<0.5	<2	<36
S1784506	Reference Material (% Recovery)	96	95	99	99	99

	Method Codes	TMSS	WSLM59	ANC	OGSNSED	OGSNSED
	Detection Limit	0.1	0.02	0.12	1	1
	Units	%	% M/M	%	ug Sn/kg	ug Sn/kg
		Tot.Moisture @	Total Organic		Dibutul Tip	Tributal Tip
			Carbon	Carbonate %	Dibutyl Tin	Tributyl Tin
ID Number	Description	105C	(Sediment)		(Sediments)	(Sediments)
S1784501	BH19 0.50	3.4	0.14	2.16	<1	<1
S1784502	BH19 2.50	3.7	0.15	4.32	<1	<1
S1784503	BH19 4.50	63.8	8.9	3.36	<1	<1
S1784504	CRM		3.36		120	94
S1784505	QC Blank		<0.05		<1	<1
	Reference Material					
S1784506	(% Recovery)		101	98	93	91

Sample ID	Client ID	Moisture (%)
CL/1784501	BH19 0.50	8.4
CL/1784502	BH19 2.50	5.8
CL/1784503	BH19 4.50	60.5

UKAS accredited?: Yes

		Sample ID :	CL1784505	CL1784506	CL1784504	CL1784501	CL1784502	CL1784503
		-		Reference				
		Station :	QC Blank	Material (% Recovery)	1941b	BH19 0.50	BH19 2.50	BH19 4.50
PAH Fraction	# PAH	Mass						
Naphthalene	1	128	<1	104	582	<1	<1	2.5
C1 Naphthalenes *	2	142	<1	100	326	<1	<1	9.0
C2 Naphthalenes *		156	<1	N.D	219	<1	<1	59.2
C3 Naphthalenes *		170	<1	N.D	179	<1	<1	18.9
C4 Naphthalenes *		184	<1	N.D	120	<1	<1	13.4
Sum Naphthalenes *			0	102	1427	0	0	103
Phenanthrene / Anthracene	2	178	<1	105	519	<1	<1	11.2
C1 178 *		192	<1	N.D	310	<1	1.5	18.1
C2 178 *		206	<1	N.D	244	<1	1.6	16.6
C3 178 *		220	<1	N.D	171	<1	<1	11.0
Sum 178 *			0	105	1243	0.0	3.1	56.8
Dibenzothiophene		184	<1	105	47	<1	<1	4.2
C1 Dibenzothiophenes *		198	<1	N.D	72	<1	<1	6.1
C2 Dibenzothiophenes *		212	<1	N.D	105	<1	<1	4.6
C3 Dibenzothiophenes *		226	<1	N.D	67	<1	<1	2.0
Sum Dibenzothiophenes *			0	105	291	0.0	0.0	16.9
Fluoranthene / pyrene	2	202	<1	105	1062	<1	12.1	11.6
C1 202 *		216	<1	N.D	292	<1	4.2	13.5
C2 202 *		230	<1	N.D	248	<1	2.2	39.6
C3 202 *		244	<1	N.D	112	<1	<1	13.2
Sum 202 *			0	105	1713	0.0	18.5	77.9
Benzoanthracene / Chrysene	2	228	<1	104	679	<1	8.2	10.2
C1 228 *		242	<1	N.D	272	<1	3.0	14.0
C2 228 *		256	<1	N.D	147	<1	1.6	19.2
Sum 228 *			0	104	1098	0.0	12.8	43.4
Benzofluoranthenes /	4	050	4	00		_		
benzopyrenes	4	252	<1	99	1224	<1	11.6	14.8
C1 252 *		266	<1	N.D	320	<1	4.0	44.1
C2 252 *		280	<1	N.D	231	<1	1.4	13.2
Sum 252 *			0	99	1775	0.0	17.0	72.1
Dibenzoanthracene / Indenopyrene /								
Benzoperylene	3	276	<1	97	604	<1	3.9	8.6
C1 276 *		290	.4	N.D	89	.4	1.1	3.7
C1 276 * C2 276 *		290 304	<1	N.D N.D	38	<1		3.7 2.5
C2 276 * Sum 276 *		304	<1 0	N.D 97	38 731	<1 0.0	<1 5.0	2.5 14.8
Sum of all fractions *			0	103	8278.6	0.0	56.5	384.9
Sum of NPD fraction *			0	104	2961.2	0.0	3.1	176.7
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.26	0.56	#DIV/0!	0.06	0.85

N.D = Not Determined as these compounds are not in the reference material spike.

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

^{*} Denotes not UKAS accredited

Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)

UKAS accredited?: Yes

PAHs

Compounds marked with a * are reported not UKAS.

	Sample ID :	CL1784505	CL1784506	CL1784504	CL1784501	CL1784502	CL1784503
	Station :	QC Blank	Reference Material (% Recovery)	1941b	BH19 0.50	BH19 2.50	BH19 4.50
PAH	Mass						
Naphthalene	128	<1	104.4	582.4	<1	<1	2.5
Acenaphthylene	152	<1	103.2	59.8	<1	<1	<1
Acenaphthene	154	<1	105.0	32.9	<1	<1	4.2
Fluorene	166	<1	104.7	50.4	<1	<1	3.7
Phenanthrene	178	<1	107.9	372.7	<1	<1	9.8
Dibenzothiophene	184	<1	105.5	46.9	<1	<1	4.2
Anthracene	178	<1	102.5	146.5	<1	<1	1.4
Fluoranthene	202	<1	104.7	596.8	<1	6.7	4.3
Pyrene	202	<1	105.9	464.8	<1	5.4	7.3
Benzo[a]anthracene	228	<1	101.7	269.7	<1	3.9	2.4
Chrysene	228	<1	106.4	409.7	<1	4.3	7.8
Benzo[b]fluoranthene	252	<1	97.6	449.7	<1	3.5	5.8
Benzo[k]fluoranthene	252	<1	94.8	213.0	<1	1.9	1.2
Benzo[e]pyrene	252	<1	103.4	326.8	<1	2.7	5.8
Benzo[a]pyrene	252	<1	99.4	234.4	<1	3.5	2.0
Perylene *	252	<1	102.8	257.0	<1	9.4	941.8
Indeno[123,cd]pyrene	276	<1	94.7	295.9	<1	2.1	1.9
Dibenzo[a,h]anthracene	278	<1	97.3	57.4	<1	<1	<1
Benzo[ghi]perylene	276	<1	99.9	250.4	<1	1.8	6.6

As the method uses surrogate standards to correct for losses, the RM results are reported as percentage trueness, not recovery.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 \$18_0839
 Date Booked in:
 21-Nov-17

 QC Batch Number:
 170016
 Date Extracted:
 01-Dec-17

 Directory:
 041217PCB.TQ1
 Date Analysed:
 05-Dec-17

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

				Con	centration,	(µg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1784501	BH19 0.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784502	BH19 2.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784503	BH19 4.50	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784504	CRM	2.96	4.08	4.48	2.94	3.73	3.47	2.38
CL1784505	QC Blank	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
CL1784506	Reference Material (% Recovery)	113	111	111	113	108	107	113

Organochlorine Pesticides

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18_0839

QC Batch Number: 170016

Directory: 041217.TQ1

Method: Ultrasonic

Matrix: Sediment
Date Booked in: 21-Nov-17
Date Extracted: 01-Dec-17

Date Analysed: 05-Dec-17
UKAS Accredited: No

Compounds marked * are not UKAS or MCerts accredited

Sample ID :	CL1784501	CL1784502	CL1784503	CL1784504	CL1784505	CL1784506
						Reference Material
Client ID:	BH19 0.50	BH19 2.50	BH19 4.50	CRM	QC Blank	(% Recovery)

Compound	Concentration (μg/kg)									
alpha-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	88				
Hexachlorobenzene	<0.10	<0.10	<0.10	7.92	<0.10	98				
gamma-HCH	<0.10	<0.10	<0.10	<0.10	<0.10	93				
p,p'-DDE	<0.10	<0.10	<0.10	2.80	<0.10	84				
Dieldrin	<0.10	<0.10	<0.10	0.29	<0.10	91				
p,p'-DDD	<0.10	<0.10	<0.10	3.39	<0.10	86				
p,p'-DDT	<0.10	<0.10	<0.10	<0.10	<0.10	96				

Gasoline Range Organics (BTEX and Aliphatic Carbon Ranges)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: \$18 0839

Directory: D:\TES\DATA\Y2017\1204HSA_GC12\\171204 2017-12-04 17-22-19\046F4601.D

Method: Headspace GCFID

Matrix: Soil
Date Booked in: 21-Nov-17

Date extracted: 04-Dec-17

Date Analysed: 05-Dec-17, 08:04:00

* Sample data with an asterisk are not UKAS accredited.

		Concentration, (mg/kg) - as wet weight				Aliphatics					
Sample ID	Client ID	Benzene	Toluene	Ethyl benzene	m/p-Xylene	o-Xylene	C5 - C6	>C6 - C7	>C7 - C8	>C8 - C10	Total GRO
* CL1784501	BH19 0.50	< 0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784502	BH19 2.50	< 0.010	<0.010	<0.010	<0.010	<0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784503	BH19 4.50	< 0.010	<0.010	<0.010	<0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784505	QC BLANK	< 0.010	<0.010	<0.010	< 0.010	< 0.010	<0.2	<0.2	<0.2	<0.2	<0.2
* CL1784506	Reference Material (% recovery)	102	101	98	99	96	120	117	110	88	114

Note: Benzene elutes between C6 and C7, toluene elutes between C7 and C8, ethyl benzene and the xylenes elute between C8 and C9.

Each BTEX compound is deducted from the appropriate band to give the aliphatic fractions, however aromatic compounds may still be contributing to these fractions

ALIPHATIC / AROMATIC FRACTION BY GC/FID

Customer and Site Details: Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI Matrix: Soil

 Job Number:
 S18_0839
 Separation:
 Silica gel
 Date Booked ir
 21-Nov-17

 QC Batch Number:
 171296
 Eluents:
 Hexane, DCM
 Date Extracted
 04-Dec-17

 Directory:
 C:\CHEM32\1\DATA\120517TPH_GC15\120517 2017-12-05 18-17-42\066B2001.D
 Date Analysed: 05-Dec-17, 22:20:07

Method: Ultra Sonic

		Concentration, (mg/kg) - as wet weight											
* This sample data is not I	JKAS accredited.	>C8	- C10	>C10	- C12	>C12	- C16	>C16	- C21	>C21 - C35		>C8	- C40
Sample ID	Client ID	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics	Aliphatics	Aromatics
* CL1784501	BH19 0.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
* CL1784502	BH19 2.50	<4	<4	<4	<4	<4	<4	<4	<4	<8.76	<8.76	<20	<20
* CL1784503	BH19 4.50	<4.04	<4	<4.04	<4	<4.04	<4	<4.04	5.49	<8.85	<8.76	<20.2	<20
* CL1784505	QC Blank	<4.08	<4	<4.08	<4	<4.08	<4	<4.08	<4	<8.94	<8.76	<20.4	<20
* CL1784506	Reference Material (% Recovery)	103	97	108	111	102	109	100	102	101	102	101	105

Sample Descriptions

Client :	Causeway Geotech Ltd	
Site :	Arklow Sewerage Scheme Marin	e Outfall GI
Report Number :	S18_0839	
		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1784501	BH19 0.50	
CL/1784502	BH19 2.50	MARINE SEDIMENTS MARINE SEDIMENTS
CL/1784503	BH19 4.50	MARINE SEDIMENTS QUALITY CONTROL SAMPLE
CL/1784504	CRM QC Blank	QUALITY CONTROL SAMPLE
CL/1784505 CL/1784506	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
OL/1704000	ricicience waterial (70 riccovery)	QONENT CONTINUE ON WILL EL

Appendix A Page 1 of 1 12/12/2017

Our Ref: EFS/179334 (Ver. 1)

Your Ref: 17-0167 October 23, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

The samples will be kept until the agreed date when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

THEOLOGINE

J Colbourne

Project Co-ordinator 01283 554547

TEST REPORT



Report No. EFS/179334 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 4 samples described in this report were registered for analysis by SOCOTEC UK Limited on 05-Oct-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 23-Oct-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)

Table of PAH (MS-SIM) (80) Results (Pages 3 to 6)

Table of PCB Congener Results (Page 7)

Table of WAC Analysis Results (Pages 8 to 9)

Analytical and Deviating Sample Overview (Page 10)

Table of Additional Report Notes (Page 11)

Table of Method Descriptions (Page 12)

Table of Report Notes (Page 13)

Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim

Tim Barnes Operations Director Energy & Waste Services

Tests marked 'A' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 23-Oct-2017

		Units :	μg/kg	pH Units	%	mg/kg	mg/kg	% M/M	Mol/kg	%	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	mg/kg
	Metho Method Reporti	od Codes :	PCBECD 5	PHSOIL	TMSS 0.1	TPHFIDUS 10	TPHFIDUS 10	WSLM59 0.02	ANC 0.04	LOI(%MM) 0.2	BTEXHSA 10	BTEXHSA 10	BTEXHSA 10	BTEXHSA 20	BTEXHSA 30	BTEXHSA 20	BTEXHSA 10	PAHMSUS
		ccredited :	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	LO.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1777957	BH01 1.50	21-Sep-17	Req	7.9	10.9	64	65	0.47	1.20	5.1	<10	<10*	<10	<20	<30	<20	<10	Req
1777958	BH01 3.50	21-Sep-17	Req	8.4	15.6	22	22	0.10	0.80	0.8	<25	<25	<25	<50	<75	<50	<25	Req
1777959	QC Blank		Req §			<10 §	<10 §	<0.02 §			<10 §	<10* §	<10 §	<20 §	<30 §	<20 §	<10 §	Req §
1777960	Reference Material (% Recovery)		Req §	100 §		106 §	106 §	100 §	101	4.0	106 §	111* §	106 §	103 §	106 §	108 §	104 §	Req §
	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400		Client No.		Neil Hag	way Geot		ne Ma	rine (Dutfall	l GI	Date Prir Report N	nted lumber	ple Ana	23	-Oct-2017 FS/179334		

Page 2 of 13 Where individual results are flagged see report notes for status.

EFS/179334 Ver. 1

Fax +44 (0) 1283 554422

Polycyclic Aromatic Hydrocarbons GC/MS (SIM)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: BH01 1.50 Job Number: S17_9334 LIMS ID Number: CL1777957 Date Booked in: 05-Oct-17 **QC Batch Number:** 171103 **Date Extracted:** 15-Oct-17 **Quantitation File:** Initial Calibration Date Analysed: 16-Oct-17 Matrix: **Directory:** 101617.MS17\ Soil Dilution: **Ext Method:** 1.0 Ultrasonic

UKAS accredited?: Yes

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	6.36	0.15	91
Pyrene	129-00-0	6.62	0.12	90
Benzo[a]anthracene	56-55-3	8.25	0.24	90
Chrysene	218-01-9	8.29	0.24	95
Benzo[b]fluoranthene	205-99-2	9.74	0.30	91
Benzo[k]fluoranthene	207-08-9	9.77	0.13	91
Benzo[a]pyrene	50-32-8	10.15	0.23	96
Indeno[1,2,3-cd]pyrene	193-39-5	11.51	0.13	89
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	11.79	0.12	93
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 2.22	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	98
Acenaphthene-d10	94
Phenanthrene-d10	96
Chrysene-d12	104
Perylene-d12	105

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	111
Terphenyl-d14	86

Concentrations are reported on a wet weight basis.

The Total PAH result is the sum of non-rounded individual PAH results and therefore may differ to the sum of the rounded individual PAH results printed above. By convention, where any one or more result is a "less than", the total is expressed as a "less than" and includes the "less than" concentration within the total.

Polycyclic Aromatic Hydrocarbons GC/MS (SIM)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: BH01 3.50 Job Number: s17_9334 LIMS ID Number: CL1777958 Date Booked in: 05-Oct-17 **QC Batch Number:** 171103 15-Oct-17 Date Extracted: **Quantitation File:** Initial Calibration Date Analysed: 16-Oct-17 Matrix: **Directory:** 101617.MS17\ Soil Dilution: Ext Method: 1.0 Ultrasonic

UKAS accredited?: Yes

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	1	< 0.08	ı
Acenaphthene	83-32-9	-	< 0.08	1
Fluorene	86-73-7	1	< 0.08	ı
Phenanthrene	85-01-8	-	< 0.08	1
Anthracene	120-12-7	1	< 0.08	ı
Fluoranthene	206-44-0	-	< 0.08	1
Pyrene	129-00-0	1	< 0.08	ı
Benzo[a]anthracene	56-55-3	-	< 0.08	1
Chrysene	218-01-9	1	< 0.08	ı
Benzo[b]fluoranthene	205-99-2	9.74	0.12	91
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	1
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	ı
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	* D	< 1.32	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	107
Acenaphthene-d10	102
Phenanthrene-d10	105
Chrysene-d12	120
Perylene-d12	121

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	104
Terphenyl-d14	86

Concentrations are reported on a wet weight basis.

The Total PAH result is the sum of non-rounded individual PAH results and therefore may differ to the sum of the rounded individual PAH results printed above. By convention, where any one or more result is a "less than", the total is expressed as a "less than" and includes the "less than" concentration within the total.

Polycyclic Aromatic Hydrocarbons GC/MS (SIM)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: QC Blank Job Number: S17_9334 LIMS ID Number: CL1777959 Date Booked in: 05-Oct-17 **QC Batch Number:** 171103 15-Oct-17 **Date Extracted: Quantitation File: Initial Calibration** Date Analysed: 17-Oct-17 Matrix: **Directory:** 101617.MS17\ Soil Dilution: **Ext Method:** 1.0 Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	ı
Acenaphthylene	208-96-8	-	< 0.08	ı
Acenaphthene	83-32-9	-	< 0.08	1
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	ı
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	1
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	1
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	1
Benzo[k]fluoranthene	207-08-9	-	< 0.08	1
Benzo[a]pyrene	50-32-8	-	< 0.08	ı
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

[&]quot;M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	99
Acenaphthene-d10	92
Phenanthrene-d10	96
Chrysene-d12	120
Perylene-d12	120

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	113
Terphenyl-d14	97

Concentrations are reported on a wet weight basis.

The Total PAH result is the sum of non-rounded individual PAH results and therefore may differ to the sum of the rounded individual PAH results printed above. By convention, where any one or more result is a "less than", the total is expressed as a "less than" and includes the "less than" concentration within the total.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: Sample Details: s17_9334 LIMS ID Number: CL1777960 Date Booked in: 05-Oct-17 **QC Batch Number:** 171103 **Date Extracted:** 15-Oct-17 **Quantitation File:** Initial Calibration Date Analysed: 16-Oct-17 Matrix: **Directory:** 101617.MS17\ Soil Dilution: **Ext Method:** 1.0 Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	2.88	106	100
Acenaphthylene	208-96-8	3.91	103	99
Acenaphthene	83-32-9	4.02	104	97
Fluorene	86-73-7	4.36	101	96
Phenanthrene	85-01-8	5.12	99	99
Anthracene	120-12-7	5.17	99	99
Fluoranthene	206-44-0	6.36	103	91
Pyrene	129-00-0	6.62	103	90
Benzo[a]anthracene	56-55-3	8.25	107	99
Chrysene	218-01-9	8.29	110	100
Benzo[b]fluoranthene	205-99-2	9.74	102	96
Benzo[k]fluoranthene	207-08-9	9.78	101	97
Benzo[a]pyrene	50-32-8	10.15	110	96
Indeno[1,2,3-cd]pyrene	193-39-5	11.51	109	92
Dibenzo[a,h]anthracene	53-70-3	11.55	102	97
Benzo[g,h,i]perylene	191-24-2	11.79	96	96
Coronene	191-07-1	13.50	108	66
Total (USEPA16) PAHs	-	-	104	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	98
Acenaphthene-d10	96
Phenanthrene-d10	93
Chrysene-d12	99
Perylene-d12	111

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	104
Terphenyl-d14	82

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

 Job Number:
 \$17_9334

 QC Batch Number:
 171103

Directory: 100917PCB.GC70

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

Soil

05-Oct-17

15-Oct-17

17-Oct-17

		Concentration, (µg/kg)						
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180
CL1777957	BH01 1.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1777958	BH01 3.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1777959	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1777960	Reference Material (% Recovery)	101.0	112.5	90.2	122.8	112.1	110.4	100.5

Page 7 of 13 EFS/179334 Ver. 1

Client	Causaway Caataah	Courseway Cootook Ltd		Leaching Data		
Ciletit	Causeway Geolecii	Causeway Geotech Ltd			Weight of sample (kg)	0.099
Contact	Noil Hoggon	Neil Heagen			Moisture content @ 105°C (% of Wet Weight)	
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg)	0.090	
Site	Arklow Sowerage Sc	Arklow Sewerage Scheme Marine Outfall GI			Volume of water required to carry out 10:1 stage (litres)	0.891
Site	Alkiow Sewerage Sc				Fraction of sample above 4 mm %	92.000
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH01 1.50		s17_9334	CL/1777957	23-Oct-17		
			1	l		

note:	rne >4mm rra	ction is crushed	using a disc mili

		on is crushed using a disc mili	Landfill Wast	e Acceptance Criteria Limit Values		
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
U	WSLM59	Total Organic Carbon (% M/M)	0.44	3	5	6
N	LOI450	Loss on Ignition (%)	4.8			10
U	BTEXHSA	Sum of BTEX (mg/kg)	< 0.06	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
U	TPHFIDUS	Mineral Oil (mg/kg)	72	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<2.6	100		
Ū	PHSOIL	pH (pH units)	7.9		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.12		To be evaluated	To be evaluated

ccreditatio	hod Coc	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Lim BSEN 12457/2 @ L/S 10 litre k		
Acci	Method		mg/l except [∞]	mg/kg (dry weight)		mg/kg (dry weight)	
U	WSLM3	pH (pH units) ⁰⁰	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	606	Calculated data flot OKAS Accredited			
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25
U	ICPWATVAR	Barium	0.07	0.7	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	0.003	0.03	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.005	0.05	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.001	0.01	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.026	0.26	4	50	200
U	KONENS	Chloride	138	1380	800	15000	25000
U		Fluoride	0.4	4	10	150	500
Ū	ICPWATVAR	Sulphate as SO4	26	260	1000	20000	50000
Ν	WSLM27	Total Dissolved Solids	473	4730	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
Ν	WSLM13	Dissolved Organic Carbon	5.5	55	500	800	1000

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009. Template Ver. 1 Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Client	Causeway Geotech Ltd		Leaching Data			
Ciletit			Weight of sample (kg)	0.106		
Contact	Neil Hearen			Moisture content @ 105°C (% of Wet Weight)	15.6	
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg)	0.090	
Site	Arklaw Cawaraga Cahama Marina Outfall Cl			Volume of water required to carry out 10:1 stage (litres)		
Site	Arklow Sewerage Scheme Marine Outfall GI				Fraction of sample above 4 mm %	0.000
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH01 3.50		s17 9334	17 9334 CL/1777958			
	D1101 0.00	317_0004	02/1/1/000	23-Oct-17		

MOLE.	THE >4HIHH HACH	on is crusiled	using a disc iiiii	

	ne >4mm macu		Landfill Wast	e Acceptance Crit	eria Limit Values	
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
U	WSLM59	Total Organic Carbon (% M/M)	0.1	3	5	6
N	LOI450	Loss on Ignition (%)	0.8			10
U	BTEXHSA	Sum of BTEX (mg/kg)	<0.179	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
U	TPHFIDUS	Mineral Oil (mg/kg)	26	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.7	100		
Ū	PHSOIL	pH (pH units)	8.4		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.8		To be evaluated	To be evaluated

Accreditatio	hod Coc	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit BSEN 12457/2 @ L/S 10 litre kg		
Accı	Method		mg/l except ⁰⁰	mg/kg (dry weight)		mg/kg (dry weight)	
U	WSLM3	pH (pH units) 00	7.3	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	880	Calculated data not UKAS Accredited			
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25
U	ICPWATVAR	Barium	0.06	0.6	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	0.004	0.04	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.003	0.03	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.03	0.3	4	50	200
U	KONENS	Chloride	224	2240	800	15000	25000
U	ISEF	Fluoride	0.2	2	10	150	500
U	ICPWATVAR	Sulphate as SO4	35	350	1000	20000	50000
Ν	WSLM27	Total Dissolved Solids	686	6860	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1	_	
Ν	WSLM13	Dissolved Organic Carbon	4.1	41	500	800	1000

Template Ver. 1 Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009. Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

ESG Environmental Chemistry S179334

Analytical and Deviating Sample Overview

Customer Causeway Geotech Ltd
Site Arklow Sewerage Scheme Marine Outfall GI
Report No S179334

Consignment No S69456

Date Logged 05-Oct-2017

In-House Report Due 18-Oct-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

	-														
		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report B	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL/1777957	BH01 1.50	21/09/17		Е	Е				Е		Е	✓	Е	Е	
CL/1777958	BH01 3.50	21/09/17		Ē	Ē				E		E		E	E	
CL/1777959	QC Blank	21/09/17		_					_		_		_		
CL/1777960	Reference Material (% Recover	у)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- B The sample was received without the correct preservation for this analysis
- Headspace present in the sample container
- D The sampling date was not supplied so holding time may be compromised applicable to all analysis
- Sample processing did not commence within the appropriate holding time
- F Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number : EFS/179334

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
BTEXHSA	CL1777958	The matrix of this sample has been found to interfere with the result for this test. The sample has therefore been diluted, but in doing so, the detection limit for this test has been elevated.
BTEXHSA	CL1777957 CL1777959 CL1777960	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation from the affected analytes (Toluene). These circumstances should be taken into consideration when utilising the data"

Report Number: EFS/179334

Method Descriptions

Matrix	MethodID	Analysis	Method Description				
		Basis	·				
Soil	ANC	Oven Dried @ < 35°C	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7				
Soil	BTEXHSA	As Received	Determination of Benzene, Toluene, Ethyl benzene and Xylenes (BTEX) by Headspace GCFID				
Soil	LOI(%MM)	Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry				
Soil	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection				
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection				
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.				
Soil	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)				
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.				
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection				
Water	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS				
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES				
Water	ISEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)				
Water	KONENS	As Received	Direct analysis using discrete colorimetric analysis				
Water	SFAPI	As Received	Segmented flow analysis with colorimetric detection				
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection				
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.				
Water	WSLM27	As Received	Gravimetric Determination				
Water	WSLM3		Determination of the pH of water samples by pH probe				

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.

 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- \$\$ Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Reg Analysis requested, see attached sheets for results

P Raised detection limit due to nature of the sample

- * All accreditation has been removed by the laboratory for this result
- **‡** MCERTS accreditation has been removed for this result

§ accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 13 of 13 EFS/179334 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: S17_9334

Note: major constituent in upper case

Lab 15 M ·		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1777957	BH01 1.50	Grey/Black Stone SILT
CL/1777958	BH01 3.50 QC Blank	Grey SAND
CL/1777959	QC Blank	QUALITY CONTROL SAMPLE
CL/1777958 CL/1777959 CL/1777960	Reference Material (% Recovery)	Grey/Black Stone SILT Grey SAND QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
	+	
	+	
	+	

Appendix A Page 1 of 1 23/10/2017EFS/179334 Ver. 1

Our Ref: EFS/178702 (Ver. 1)

Your Ref: 17-0167 September 29, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom



Environmental Chemistry

ESC

Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

BT53 7QL

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

The samples will be kept until the agreed date when they will be discarded. Please call 01283 554458 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with Environmental Scientifics Group Ltd (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for ESG

J Chislett
Project Co-ordinator
01283 554458

TEST REPORT



Report No. EFS/178702 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 5 samples described in this report were registered for analysis by ESG on 14-Sep-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 29-Sep-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 7)
Table of PCB Congener Results (Page 8)
Table of WAC Analysis Results (Pages 9 to 11)
Analytical and Deviating Sample Overview (Page 12)
Table of Additional Report Notes (Page 13)
Table of Method Descriptions (Page 14)
Table of Report Notes (Page 15)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of ESG:

Tim Barnes

Operations Director Energy & Waste Services Date of Issue: 29-Sep-2017

Tests marked 'A' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

ESG accepts no responsibility for any sampling not carried out by our personnel.

		Units :	μg/kg	pH Units	%	mg/kg	mg/kg	% M/M	Mol/kg	%	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	mg/kg
		od Codes :	PCBECD	PHSOIL	TMSS	TPHFIDUS	TPHFIDUS	WSLM59	ANC	LOI(%MM)	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA		BTEXHSA	BTEXHSA	PAHMSUS
	Method Reporti	ng Limits :	5		0.1	10	10	0.02	0.04	0.2	10	10	10	20	30	20	10	
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1775339	BH02 0.50	29-Aug-17	Req	8.2	12.4	40	51	0.22	0.40	1.0	<10	<10	<10	<20	<30	<20	<10	Req
1775340	BH02 2.50	29-Aug-17	Req	8.1	20.2	95	106	0.94	0.48	2.9	<10	<10	<10	<20	<30	<20	<10	Req
1775341	BH02 5.50	29-Aug-17	Req	8.6	24.0	<10	20	0.50	2.96	3.1	<10	<10	<10	<20	<30	<20	<10	Req
1775342	QC Blank		Req §			<10 §	<10 §	<0.02 §			<10 §	<10 §	<10 §	<20 §	<30 §	<20 §	<10 §	Req §
1775343	Reference Material (% Recovery)		Req §	102.4 §		92 §	92 §	91 §	102	98.3	103 §	105 §	103 §	101 §	103 §	104 §	101 §	Req §
	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400		Client N Contact		Neil Hagg	way Geot		ne Ma	rine (Outfal	I GI	Date Prii Report N	nted lumber	ple Ana	29-	Sep-2017 FS/178702		
	Fax +44 (0) 1283 554422																	

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

S17_8702 **Sample Details:** BH02 0.50 **Job Number:** LIMS ID Number: CL1775339 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	3.26	0.36	99
Acenaphthylene	208-96-8	1	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	1	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.56	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	95
Acenaphthene-d10	93
Phenanthrene-d10	86
Chrysene-d12	79
Perylene-d12	74

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	96
Terphenyl-d14	72

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: s17_8702 **Sample Details:** BH02 2.50 LIMS ID Number: CL1775340 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	1	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	7.00	0.37	76
Pyrene	129-00-0	7.29	0.33	75
Benzo[a]anthracene	56-55-3	8.98	0.44	95
Chrysene	218-01-9	9.03	0.41	98
Benzo[b]fluoranthene	205-99-2	10.51	0.47	80
Benzo[k]fluoranthene	207-08-9	10.54	0.24	80
Benzo[a]pyrene	50-32-8	10.93	0.37	96
Indeno[1,2,3-cd]pyrene	193-39-5	12.31	0.22	67
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	12.60	0.20	80
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 3.61	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	93
Acenaphthene-d10	90
Phenanthrene-d10	84
Chrysene-d12	78
Perylene-d12	73

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	100
Terphenyl-d14	75

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

S17_8702 **Sample Details:** BH02 5.50 **Job Number:** LIMS ID Number: CL1775341 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	ı	< 0.08	-
Acenaphthene	83-32-9	ı	< 0.08	-
Fluorene	86-73-7	ı	< 0.08	-
Phenanthrene	85-01-8	ı	< 0.08	-
Anthracene	120-12-7	ı	< 0.08	-
Fluoranthene	206-44-0	ı	< 0.08	-
Pyrene	129-00-0	ı	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	1	< 0.08	-
Benzo[b]fluoranthene	205-99-2	ı	< 0.08	-
Benzo[k]fluoranthene	207-08-9	ı	< 0.08	-
Benzo[a]pyrene	50-32-8	ı	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	ı	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	94
Acenaphthene-d10	90
Phenanthrene-d10	83
Chrysene-d12	75
Perylene-d12	64

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	103
Terphenyl-d14	78

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

QC Blank S17_8702 **Sample Details: Job Number:** LIMS ID Number: CL1775342 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	rget Compounds CAS # R.T. Concent		Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	1	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	1	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	86
Acenaphthene-d10	82
Phenanthrene-d10	74
Chrysene-d12	57
Perylene-d12	43

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	108
Terphenyl-d14	76

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: S17_8702 **Sample Details:** LIMS ID Number: CL1775343 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File:** Initial Calibration **Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.26	101	100
Acenaphthylene	208-96-8	4.30	99	99
Acenaphthene	83-32-9	4.42	107	97
Fluorene	86-73-7	4.81	103	98
Phenanthrene	85-01-8	5.65	106	99
Anthracene	120-12-7	5.70	103	100
Fluoranthene	206-44-0	7.00	111	91
Pyrene	129-00-0	7.29	109	90
Benzo[a]anthracene	56-55-3	8.97	108	99
Chrysene	218-01-9	9.02	112	99
Benzo[b]fluoranthene	205-99-2	10.50	101	96
Benzo[k]fluoranthene	207-08-9	10.54	103	97
Benzo[a]pyrene	50-32-8	10.93	109	97
Indeno[1,2,3-cd]pyrene	193-39-5	12.30	109	91
Dibenzo[a,h]anthracene	53-70-3	12.34	107	97
Benzo[g,h,i]perylene	191-24-2	12.60	103	95
Coronene	191-07-1	14.74	112	67
Total (USEPA16) PAHs	-	-	106	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	90
Acenaphthene-d10	92
Phenanthrene-d10	87
Chrysene-d12	96
Perylene-d12	100

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	104
Terphenyl-d14	85

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

 Job Number:
 \$17_8702

 QC Batch Number:
 171030

Directory: 092517PCB.GC70

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

				Con	centration,	(µg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1775339	BH02 0.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1775340	BH02 2.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1775341	BH02 5.50	<5.0	< 5.0	<5.0	<5.0	<5.0	<5.0	< 5.0
CL1775342	QC Blank	<5.0	< 5.0	<5.0	<5.0	<5.0	<5.0	< 5.0
CL1775343	Reference Material (% Recovery)	87.6	93.2	80.4	91.5	87.9	92.5	83.4
							<u> </u>	

Soil

14-Sep-17

22-Sep-17

25-Sep-17

Client	Causaway Caataah Ltd	Causeway Geotech Ltd			Leaching Data				
Client	Causeway Geolech Lid				Weight of sample (kg)	0.102			
Contact	Contact INGI Haddan			Moisture content @ 105°C (% of Wet Weight)	12.4				
Contact				Equivalent Weight based on drying at 105°C (kg)	0.090				
Site	Arklow Sewerage Scheme Marine Outfall GI		Volume of water required to carry out 10:1 stage (litres)	0.888					
Site	Arkiow Sewerage Schen	ie ivianne Ou	liali Gi	Fraction of sample above 4 mm %	45.500				
Sam	nple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000			
BH02 0.50		s17_8702	CL/1775339	29-Sep-17					
Note: The >4mm fra	Note: The >4mm fraction is crushed using a disc mill								

	4			Landfill Waste Acceptance Criteria Limit Values			
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill	
N	WSLM59	Total Organic Carbon (% M/M)	0.22	3	5	6	
N	LOI450	Loss on Ignition (%)	1			10	
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.06	6			
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1			
Ν	TPHFIDUS	Mineral Oil (mg/kg)	46	500			
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.87	100			

8.2

0.4

>6

To be evaluated

To be evaluated

itation	Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values BSEN 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)			
Accreditation	Method	-	mg/l except ⁰⁰	mg/kg (dry weight)			ht)	
U	WSLM3	pH (pH units) ⁰⁰	7.3	Calculated data not UKAS Accredited				
U	WSLM2	Conductivity (µs/cm) 00	1060	Calculated data not UKAS Accredited				
U	ICPMSW	Arsenic	0.003	0.03	0.5	2	25	
U	ICPWATVAR	Barium	0.05	0.5	20	100	300	
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5	
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70	
U	ICPMSW	Copper	0.003	0.03	2	50	100	
U		Mercury	<0.0001	<0.001	0.01	0.2	2	
U	ICPMSW	Molybdenum	0.012	0.12	0.5	10	30	
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40	
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50	
U	ICPMSW	Antimony	0.003	0.03	0.06	0.7	5	
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7	
U	ICPMSW	Zinc	0.032	0.32	4	50	200	
U	KONENS	Chloride	258	2580	800	15000	25000	
U	ISEF	Fluoride	0.6	6	10	150	500	
U	ICPWATVAR	Sulphate as SO4	41	410	1000	20000	50000	
N	WSLM27	Total Dissolved Solids	827	8270	4000	60000	100000	
U	SFAPI	Phenol Index	<0.05	<0.5	1			
N	WSLM13	Dissolved Organic Carbon	2.9	29	500	800	1000	

emplate Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Ν

PHSOIL

ANC

pH (pH units)

Acid Neutralisation Capacity (mol/kg) @pH 7

Client	Causaway Caataah I td				Leaching Data					
Client	Causeway Geotech Ltd	Weight of sample (kg)								
Contact	Noil Haggan	Moisture content @ 105°C (% of Wet Weight)	20.2							
Contact	Neil Haggan		Equivalent Weight based on drying at 105°C (kg)							
Site	Arklow Sewerage Schem	o Marina Ou	ffall CI		Volume of water required to carry out 10:1 stage (litres)	0.876				
Site	Arkiow Sewerage Scrien	ie ivianne Ou	liali Gi		Fraction of sample above 4 mm %	19.300				
Samp	ole Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000				
	BH02 2.50	s17 8702	CL/1775340 29-Sep-17							
	DNU2 2.50	517_0702	CL/17/5340	29-3ep-17						

	4	-	_					
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill		
Ν	WSLM59	Total Organic Carbon (% M/M)	0.99	3	5	6		
Ν	LOI450	Loss on Ignition (%)	3			10		
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6				
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1				
Ν	TPHFIDUS	Mineral Oil (mg/kg)	119	500				
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<4.62	100				
Ν	PHSOIL	pH (pH units)	8.1		>6			
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.5		To be evaluated	To be evaluated		

itation	Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1				
Accreditation	Method		mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry		weight)		
U	WSLM3	pH (pH units) ⁰⁰	7.3	Calculated data not UKAS Accredited					
U	WSLM2	Conductivity (µs/cm) 00	1620	Calculated data flot OKAS Accredited					
U	ICPMSW	Arsenic	0.003	0.03	0.5	2	25		
U	ICPWATVAR	Barium	0.07	0.7	20	100	300		
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5		
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70		
U	ICPMSW	Copper	0.003	0.03	2	50	100		
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2		
U	ICPMSW	Molybdenum	0.015	0.15	0.5	10	30		
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40		
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50		
U	ICPMSW	Antimony	0.004	0.04	0.06	0.7	5		
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7		
U	ICPMSW	Zinc	0.038	0.38	4	50	200		
U	KONENS	Chloride	414	4140	800	15000	25000		
U	ISEF	Fluoride	0.8	8	10	150	500		
U	ICPWATVAR	Sulphate as SO4	36	360	1000 20000 5		50000		
Ν	WSLM27	Total Dissolved Solids	1260	12600	4000	60000	100000		
U	SFAPI	Phenol Index	<0.05	<0.5	1				
Ν	WSLM13	Dissolved Organic Carbon	4.4	44	500	800	1000		

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Client	Causeway Geotech Ltd				Leaching Data						
Client	Causeway Geolech Lid				Weight of sample (kg)	0.117					
Contact	Noil Haggan	Moisture content @ 105°C (% of Wet Weight)	24.0								
Contact	Neil Haggan	Equivalent Weight based on drying at 105°C (kg) (
Site	Arklow Sewerage Schem	o Marina Ou	#all CI		Volume of water required to carry out 10:1 stage (litres)	0.873					
Site	Arkiow Sewerage Schem	ie Marine Ou	liali Gi	Fraction of sample above 4 mm %	6.000						
Samp	le Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000					
E	BH02 5.50	s17_8702	2 CL/1775341 29-Sep-17								
Note: The >4mm fract	Note: The >4mm fraction is crushed using a disc mill										

				Landfill Was	teria Limit Values	
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.56	3	5	6
Ν	LOI450	Loss on Ignition (%)	3.5			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.042	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	<13	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.79	100		

8.6

3.3

>6

To be evaluated

To be evaluated

itation	Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1				
Accreditation	Method	-	mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry weight)				
U	WSLM3	pH (pH units) ⁰⁰	7.4	Calculated data not UKAS Accredited					
U	WSLM2	Conductivity (µs/cm) 00	430	Calculated data not UKAS Accredited					
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25		
U	ICPWATVAR	Barium	0.08	0.8	20	100	300		
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5		
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70		
U	ICPMSW	Copper	0.004	0.04	2	50	100		
U		Mercury	<0.0001	<0.001	0.01	0.2	2		
U	ICPMSW	Molybdenum	0.003	0.03	0.5	10	30		
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40		
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50		
U	ICPMSW	Antimony	0.001	0.01	0.06	0.7	5		
U	ICPMSW	Selenium	0.001	0.01	0.1	0.5	7		
U	ICPMSW	Zinc	0.014	0.14	4	50	200		
U	KONENS	Chloride	83	830	800	15000	25000		
U	ISEF	Fluoride	0.4	4	10	150	500		
U	ICPWATVAR	Sulphate as SO4	17	170	1000	20000	50000		
N	WSLM27	Total Dissolved Solids	336	3360	4000	60000	100000		
U	SFAPI	Phenol Index	<0.05	<0.5	<0.5				
N	WSLM13	Dissolved Organic Carbon	2	20	500	800	1000		

e Ver. 1 Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Ν

PHSOIL

ANC

pH (pH units)

Acid Neutralisation Capacity (mol/kg) @pH 7

Report No

S178702

ESG Environmental Chemistry Analytical and Deviating Sample Overview

Customer Causeway Geotech Ltd
Site Arklow Sewerage Scheme Marine C

Arklow Sewerage Scheme Marine Outfall GI S178702

Consignment No S68869
Date Logged 14-Sep-2017

In-House Report Due 02-Oct-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

											101	· / ·		itiact	
		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
	T=														
CL/1775339	BH02 0.50	29/08/17		Е	Е				Е		Е		Е	Е	
CL/1775340	BH02 2.50	29/08/17		Е	Е				Е		Е		Е	Е	
CL/1775341	BH02 5.50	29/08/17		Е	Е				Е		Е		Е	Е	
CL/1775342	QC Blank														
CL/1775343	Reference Material (% Recovery	y)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- C Headspace present in the sample container
- D The sampling date was not supplied so holding time may be compromised applicable to all analysis
- E Sample processing did not commence within the appropriate holding time
- F Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number : EFS/178702

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report

Report Number: EFS/178702

Method Descriptions

Soil E	ANC BTEXHSA LOI(%MM)	Oven Dried @ < 35°C As Received	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7 Determination of Benzene, Toluene, Ethyl benzene and Xylenes
		As Received	Determination of Renzene Tolliene, Ethyl henzene and Yylenes
Soil	LOI(%MM)		(BTEX) by Headspace GCFID
		Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil F	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil F	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil F	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil 1	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil 1	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water I	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water I	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water I	SEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water k	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water S	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water V	WSLM27	As Received	Gravimetric Determination
Water V	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 15 of 15 EFS/178702 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: S17_8702

Note: major constituent in upper case

		Note. Major constituent in upper case
Lab ID Number	Client ID	Description
CL/1775339	BH02 0.50	MARINE SEDIMENT
CL/1775339	BHU2 U.5U	MAKINE SEDIMENT
CL/1775340	BH02 2.50	MARINE SEDIMENT
CL/1775341	BH02 5.50	MARINE SEDIMENT
CL/1775342	QC Blank	QUALITY CONTROL SAMPLE
CL/1775343	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
	, , , , , , , , , , , , , , , , , , , ,	***

Appendix A Page 1 of 1 04/10/2017EFS/178702 Ver. 1

Our Ref: EFS/179799 (Ver. 1)

Your Ref: 17-0167 November 1, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom **BT53 7QL**



Environmental Chemistry SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

The samples will be kept until the agreed date when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

THEOLOGINE

J Colbourne

Project Co-ordinator 01283 554547

TEST REPORT



Report No. EFS/179799 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 5 samples described in this report were registered for analysis by SOCOTEC UK Limited on 17-Oct-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 01-Nov-2017

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)

Table of PAH (MS-SIM) (80) Results (Pages 3 to 7)

Table of PCB Congener Results (Page 8)

Table of WAC Analysis Results (Pages 9 to 11)

Analytical and Deviating Sample Overview (Page 12)

Table of Additional Report Notes (Page 13)

Table of Method Descriptions (Page 14)

Table of Report Notes (Page 15)

Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim

Tim Barnes Ope

Operations Director Energy & Waste Services

Tests marked '^' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 01-Nov-2017

	Meth Method Report	Units :	μg/kg PCBECD 5	pH Units PHSOIL	% TMSS 0.1	mg/kg TPHFIDUS 10	mg/kg TPHFIDUS 10	% M/M WSLM59 0.02	Mol/kg ANC 0.04	% LOI(%MM) 0.2	μg/kg BTEXHSA 10	µg/kg BTEXHSA 10	μg/kg BTEXHSA 10	μg/kg BTEXHSA 20	µg/kg BTEXHSA 30	μg/kg BTEXHSA 20	μg/kg BTEXHSA 10	mg/kg PAHMSUS
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	PH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	LO.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1780166	BH06 0.50	29-Sep-17	Req	8.8	14.3	<10	<10	0.09	2.24	0.9	<10	<10	<10	<20*	<30	<20	<10	Req
1780167	BH06 1.50	29-Sep-17	Req	8.7	15.7	<10	<10	0.05	1.60	0.7	<10	<10	<10	<20	<30	<20	<10	Req
1780168	BH06 2.50	29-Sep-17	Req	8.6	16.1	<10	<10	0.03	1.52	0.7	<10	<10	<10	<20	<30	<20	<10	Req
1780169	QC Blank		Req			<10	<10	<0.02			<10	<10	<10	<20	<30	<20	<10	Req
1780170	Reference Material (% Recovery)		Req	101.5		99	99	103	97.6	98.7	103	101	100	100	100	101	98	Req
	SOCOTEC (Client N		Cause Neil Hag	way Geot	ech Ltd			1				ple Ana				
	Bretby Business Park, Ashby Road											Date Prin				Nov-2017		
	Burton-on-Trent, Staffordshire, DE15 0YZ		Δrl	klow S	Sewe	rage S	Schem	ne Ma	rine (Jutfall	GI	Report Number EFS/179799]		
	Tel +44 (0) 1283 554400			XIOW (age c	JUI 1611	ic ivia		Julian	. .	Table Number 1						

Page 2 of 15 Where individual results are flagged see report notes for status.

EFS/179799 Ver. 1

Fax +44 (0) 1283 554422

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

S17_9799 Sample Details: BH06 0.50 Job Number: LIMS ID Number: CL1780166 Date Booked in: 17-Oct-17 171155 **QC Batch Number:** Date Extracted: 26-Oct-17 **Quantitation File: Initial Calibration** Date Analysed: 27-Oct-17 Matrix: **Directory:** 102617.MS17\ Soil Dilution: **Ext Method:** 1.0 Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	ı
Acenaphthylene	208-96-8	-	< 0.08	ı
Acenaphthene	83-32-9	-	< 0.08	1
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	ı
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	1
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	1
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	1
Benzo[k]fluoranthene	207-08-9	-	< 0.08	1
Benzo[a]pyrene	50-32-8	-	< 0.08	ı
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

[&]quot;M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	110
Acenaphthene-d10	115
Phenanthrene-d10	119
Chrysene-d12	134
Perylene-d12	139

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	88
Terphenyl-d14	75

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: BH06 1.50 Job Number: s17_9799 LIMS ID Number: CL1780167 Date Booked in: 17-Oct-17 171155 **QC Batch Number:** Date Extracted: 26-Oct-17 **Quantitation File:** Initial Calibration Date Analysed: 27-Oct-17 Matrix: **Directory:** 102617.MS17\ Soil Dilution: Ext Method: 1.0 Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	105
Acenaphthene-d10	107
Phenanthrene-d10	107
Chrysene-d12	109
Perylene-d12	106

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	95
Terphenyl-d14	82

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: BH06 2.50 Job Number: S17_9799 LIMS ID Number: CL1780168 Date Booked in: 17-Oct-17 171155 **QC Batch Number:** 26-Oct-17 **Date Extracted: Quantitation File: Initial Calibration** Date Analysed: 27-Oct-17 Matrix: **Directory:** 102617.MS17\ Soil Dilution: **Ext Method:** 1.0 Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	109
Acenaphthene-d10	111
Phenanthrene-d10	115
Chrysene-d12	129
Perylene-d12	129

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	94
Terphenyl-d14	81

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: QC Blank Job Number: s17_9799 LIMS ID Number: CL1780169 Date Booked in: 17-Oct-17 171155 **QC Batch Number:** 26-Oct-17 **Date Extracted: Quantitation File: Initial Calibration** Date Analysed: 27-Oct-17 Matrix: **Directory:** 102617.MS17\ Soil Dilution: **Ext Method:** 1.0 Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	ı
Acenaphthylene	208-96-8	-	< 0.08	ı
Acenaphthene	83-32-9	-	< 0.08	1
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	ı
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	1
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	1
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	1
Benzo[k]fluoranthene	207-08-9	-	< 0.08	1
Benzo[a]pyrene	50-32-8	-	< 0.08	ı
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

[&]quot;M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	98
Acenaphthene-d10	107
Phenanthrene-d10	109
Chrysene-d12	123
Perylene-d12	130

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	101
Terphenyl-d14	86

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: Sample Details: S17_9799 LIMS ID Number: CL1780170 Date Booked in: 17-Oct-17 171155 **QC Batch Number: Date Extracted:** 26-Oct-17 **Quantitation File:** Initial Calibration Date Analysed: 27-Oct-17 **Directory:** 102617.MS17\ Matrix: Soil Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.33	106	99
Acenaphthylene	208-96-8	4.38	109	99
Acenaphthene	83-32-9	4.50	105	93
Fluorene	86-73-7	4.89	105	91
Phenanthrene	85-01-8	5.75	101	100
Anthracene	120-12-7	5.80	104	100
Fluoranthene	206-44-0	7.11	107	97
Pyrene	129-00-0	7.40	106	97
Benzo[a]anthracene	56-55-3	9.09	109	99
Chrysene	218-01-9	9.14	104	99
Benzo[b]fluoranthene	205-99-2	10.62	90	99
Benzo[k]fluoranthene	207-08-9	10.65	95	99
Benzo[a]pyrene	50-32-8	11.05	104	99
Indeno[1,2,3-cd]pyrene	193-39-5	12.42	116	92
Dibenzo[a,h]anthracene	53-70-3	12.46	105	95
Benzo[g,h,i]perylene	191-24-2	12.73	95	95
Coronene	191-07-1	14.95	105	51
Total (USEPA16) PAHs	-	-	104	-

^{*} Denotes compound is not UKAS accredited

[&]quot;M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	94
Acenaphthene-d10	104
Phenanthrene-d10	104
Chrysene-d12	135
Perylene-d12	166

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	100
Terphenyl-d14	88

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix:

 Job Number:
 \$17_9799

 QC Batch Number:
 171158

Directory: 102617PCB.GC22

Method: Ultrasonic

* This sample data is not UKAS or Mcerts accredited.

Soil

17-Oct-17

26-Oct-17

27-Oct-17

Date Booked in:

Date Extracted:

Date Analysed:

		Concentration, (µg/kg)						
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180
CL1780166	BH06 0.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1780167	BH06 1.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1780168	BH06 2.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	< 5.0
CL1780169	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	< 5.0
CL1780170	Reference Material (% Recovery)	85.0	95.9	80.1	93.6	88.4	88.1	79.4

Page 8 of 15 EFS/179799 Ver. 1

Client	ent Causeway Geotech Ltd			Leaching Data			
Ciletit				Weight of sample (kg)			
Contact	Noil Hoggen			Moisture content @ 105°C (% of Wet Weight)	14.3		
Contact Neil Haggan				Equivalent Weight based on drying at 105°C (kg)	0.090		
Site	Arklow Sewerage Scheme Marine Outfall GI			Volume of water required to carry out 10:1 stage (litres)			
Site	Arkiow Sewerage Schen	ie ivianne Ou	liali Gi	Fraction of sample above 4 mm %	0.000		
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000	
BH06 0.50		s17 9799	CL/1780166	01-Nov-17			
	DI 100 0.30	517_9799	CL/1700100	01-1100-17			

Note: The >4mm fraction is crushed using a disc mill

_	ø.			Landfill Waste Acceptance Criteria Limit Values		
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)		Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.09	3	5	6
N	LOI450	Loss on Ignition (%)	0.9			10
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	<12	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.59	100		
N	PHSOIL	pH (pH units)	8.8		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.22		To be evaluated	To be evaluated

ccı	eth	L oachato Analysis	Leachate Analysis 10:1 Single Stage Leachate mg/l except 00		Calculated cumulative amount	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1		
Ψ	Š	Leachate Analysis	mg/l except ⁰⁰	mg/kg (dry weight)	B3EN 12431/2 @ L/3 10 little kg-		iitre kg-i	
U	WSLM3	pH (pH units) 00	8.6	Calculated data not UKAS Accredited				
U	WSLM2	Conductivity (µs/cm) 00	1220	Calculated data not onas accredited				
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25	
U	ICPWATVAR	Barium	0.07	0.7	20	100	300	
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5	
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70	
U	ICPMSW	Copper	<0.001	<0.01	2	50	100	
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2	
U	ICPMSW	Molybdenum	0.002	0.02	0.5	10	30	
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40	
U	ICPMSW	Lead	0.018	0.18	0.5	10	50	
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5	
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7	
U	ICPMSW	Zinc	0.01	0.1	4	50	200	
U	KONENS	Chloride	345	3450	800	15000	25000	
U	ISEF	Fluoride	0.2	2	10	150	500	
U	ICPWATVAR	Sulphate as SO4	55	550	1000	20000	50000	
N	WSLM27	Total Dissolved Solids	948	9480	4000	60000	100000	
U	SFAPI	Phenol Index	<0.05	<0.5	1			
N	WSLM13	Dissolved Organic Carbon	3.1	31	500	800	1000	

Template Ver. 1

ndfill Waste Acceptance Criteria limit values correct as of 11th March 2009

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Client	Causaway Caataah Ltd				Leaching Data				
Cilent	Causeway Geotech Ltd				Weight of sample (kg)	0.105			
Contact	Noil Hoggon				Moisture content @ 105°C (% of Wet Weight)	15.7			
Comaci	Neil Haggan			Equivalent Weight based on drying at 105°C (kg)	0.090				
Site	Arklaw Cawaraga Cabam	a Marina Ou	tfall CI		Volume of water required to carry out 10:1 stage (litres)	0.885			
Site	Arklow Sewerage Schem	ie Marine Ou	liali Gi		Fraction of sample above 4 mm %	0.000			
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000			
	BH06 1.50	s17 9799 CL/1780167 01-		01-Nov-17					
	DI 100 1.30	511_9199	CL/1/00107	01-INOV-17					

Note: The >4mm fraction is crushed using a disc mill

_				Landfill Waste	e Acceptance Crite	eria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.05	3	5	6
N	LOI450	Loss on Ignition (%)	0.7			10
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	<12	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.61	100		
N	PHSOIL	pH (pH units)	8.7		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.59		To be evaluated	To be evaluated

သ	it.	Lacabata Analysis	10:1 Single Stage Leachate	Calculated cumulative amount	Eandfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1				
ĕ	Met	Leachate Analysis	mg/l except ⁰⁰	mg/kg (dry weight)	BSEN	1245//2 @ L/5 10	пте кд-1		
U	WSLM3	pH (pH units) 00	7.6	Calculated data not UKAS Accredited					
U	WSLM2	Conductivity (µs/cm) 00	1080	Calculated data not UKAS Accredited					
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25		
U	ICPWATVAR	Barium	0.07	0.7	20	100	300		
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5		
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70		
U	ICPMSW	Copper	0.001	0.01	2	50	100		
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2		
U	ICPMSW	Molybdenum	0.008	0.08	0.5	10	30		
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40		
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50		
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5		
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7		
U	ICPMSW	Zinc	0.006	0.06	4	50	200		
U	KONENS	Chloride	298	2980	800	15000	25000		
U	ISEF	Fluoride	0.2	2	10	150	500		
U	ICPWATVAR	Sulphate as SO4	44	440	1000	20000	50000		
Ν	WSLM27	Total Dissolved Solids	843	8430	4000	60000	100000		
U	SFAPI	Phenol Index	<0.05	<0.5	1				
Ν	WSLM13	Dissolved Organic Carbon	3.4	34	500	800	1000		

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causeway Geotech Ltd			Leaching Data					
Ciletti	Causeway Geolech Liu			Weight of sample (kg)	0.105				
Contact	Neil Haggan			Moisture content @ 105°C (% of Wet Weight)	16.1				
Contact	Neirriaggari			Equivalent Weight based on drying at 105°C (kg)					
Site	Arklow Sewerage Schem	o Marina Ou	tfall CI		Volume of water required to carry out 10:1 stage (litres)	0.885			
Site	Arkiow Sewerage Schen	ie ivianne Ou	liali Gi		Fraction of sample above 4 mm %	0.000			
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000			
	BH06 2.50	s17 9799 CL/1780168 01-No		01-Nov-17					
	DI 100 2.30	511_9199	CL/1/00100	01-1100-17					

Note: The >4mm fraction is crushed using a disc mill

u	o)			Landfill Wast	e Acceptance Crite	eria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.03	3	5	6
Ν	LOI450	Loss on Ignition (%)	0.7			10
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	<12	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.62	100		
Ν	PHSOIL	pH (pH units)	8.6		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.52		To be evaluated	To be evaluated

Ö	Meth	Lacabata Analysia	10:1 Single Stage Leachate	Calculated cumulative amount	Landfill Waste Acceptance Criteria Limit Valu BSEN 12457/2 @ L/S 10 litre kg-1					
Acc	ž	Leachate Analysis	mg/l except ⁰⁰	mg/kg (dry weight)	BSEN	1245//2 @ L/5 10	litre kg-1			
U	WSLM3	pH (pH units) 00	7.4	Calculated data not UKAS Accredited						
U	WSLM2	Conductivity (µs/cm) 00	1170	Calculated data flot OKAS Accredited						
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25			
U	ICPWATVAR	Barium	0.07	0.7	20	100	300			
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5			
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70			
U	ICPMSW	Copper	0.002	0.02	2	50	100			
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2			
U	ICPMSW	Molybdenum	0.002	0.02	0.5	10	30			
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40			
U	ICPMSW	Lead	0.003	0.03	0.5	10	50			
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5			
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7			
U	ICPMSW	Zinc	0.008	0.08	4	50	200			
U	KONENS	Chloride	330	3300	800	15000	25000			
U	ISEF	Fluoride	0.2	2	10	150	500			
U	ICPWATVAR	Sulphate as SO4	51	510	1000	20000	50000			
Ν	WSLM27	Total Dissolved Solids	911	9110	4000	60000	100000			
U	SFAPI	Phenol Index	<0.05	<0.5	1					
Ν	WSLM13	Dissolved Organic Carbon	3	30	500	800	1000			
Templa	ate Ver. 1				te Acceptance Criter	ia limit values correct	as of 11th March 2009.			

Report No

Socotec Environmental Chemistry Analytical and Deviating Sample Overview

Causeway Geotech Ltd Customer Site **Arklow Sewerage Scheme Marine Outfall GI**

S179799

Consignment No S69781 Date Logged 17-Oct-2017

In-House Report Due 03-Nov-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working

		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL /1790166	BH06 0.50	29/09/17		E	E				Е		Е		Е	Е	Е
CL/1780166 CL/1780167	BH06 1.50	29/09/17		듣	듣				듵		E		E	E	E
CL/1780167 CL/1780168	BH06 2.50	29/09/17		늗	늗				늗		E		Ė	Ė	E
CL/1780169	QC Blank	23/03/17		<u> </u>					<u> </u>		_		_	_	_
CL/1780109 CL/1780170	Reference Material (% Recovery	y)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- The sample was received in an inappropriate container for this analysis
 - The sample was received without the correct preservation for this analysis
- Headspace present in the sample container
- The sampling date was not supplied so holding time may be compromised applicable to all analysis
- Sample processing did not commence within the appropriate holding time
- Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number : EFS/179799

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
BTEXHSA	CL1780166	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation from the affected analytes (MTBE) . These circumstances should be taken into consideration when utilising the data"

Report Number: EFS/179799

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ANC	Oven Dried	Quantitative digestion with Hydrochloric Acid back titration with 1M
		@ < 35°C	Sodium Hydroxide to pH 7
Soil	BTEXHSA	As Received	Determination of Benzene, Toluene, Ethyl benzene and Xylenes (BTEX) by Headspace GCFID
Soil	LOI(%MM)	Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water	ISEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water	SFAPI		Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water	WSLM27	As Received	Gravimetric Determination
Water	WSLM3		Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.

 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite

TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- \$\$ Unable to analyse due to the nature of the sample
- \P Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

P Raised detection limit due to nature of the sample

- * All accreditation has been removed by the laboratory for this result
- **‡** MCERTS accreditation has been removed for this result

§ accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 15 of 15 EFS/179799 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: S17_9799

Note: major constituent in upper case

Lab ID Number CL1/780-167 B100 0.00 MARINE SEDMENTS CL1/780-167 B100 1.50 MARINE SEDMENTS CL1/780-179 Reference Material (% Recovery) Reference Mater			Note. Illajor constituent ili upper case
CL/1780167 BH06 1.50 MARINE SEDIMENTS CL/1780168 BH06 2.50 MARINE SEDIMENTS	Lab ID Number	Client ID	
CL/1780167 BH06 1.50 MARINE SEDIMENTS CL/1780168 BH06 2.50 MARINE SEDIMENTS	CI /1780166	BH06.0.50	MARINE SEDIMENTS
CL/1780168 BH06 2.50 MARINE SEDIMENTS	CL/1700100	DI 100 0.00	MADINE SEDIMENTS
CU1760170 Reference Meterial (% Recovery) GUALITY CONTROL SAMPLE GU1760170 Reference Meterial (% Recovery) GUALITY CONTROL SAMPLE	OL/1700107	DH00 1.30	MADINE OF DIMENTO
CU1780170 Reference Material (W. Recovery) OUALITY CONTROL SAMPLE OUALITY CONTROL SAMPLE	CL/1780168	BH06 2.50	MARINE SEDIMENTS
CL1780170 Reference Material (% Recovery OUALITY CONTROL SAMPLE	CL/1780169	QC Blank	QUALITY CONTROL SAMPLE
	CL/1780170	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE
		+	
		+	
		+	
		-	
		+	
		+	
		-	
		<u> </u>	

Appendix A Page 1 of 1 01/11/2017EFS/179799 Ver. 1

Our Ref: EFS/179864 (Ver. 1)

Your Ref: 17-0167 November 2, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry

SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

The samples will be kept until the agreed date when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

JACOLDOVINE

J Colbourne
Project Co-ordinator
01283 554547

TEST REPORT



Report No. EFS/179864 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 5 samples described in this report were registered for analysis by SOCOTEC UK Limited on 19-Oct-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 02-Nov-2017

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 7)
Table of PCB Congener Results (Page 8)
Table of WAC Analysis Results (Pages 9 to 11)
Analytical and Deviating Sample Overview (Page 12)
Table of Additional Report Notes (Page 13)
Table of Method Descriptions (Page 14)
Table of Report Notes (Page 15)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim (

Tim Barnes Operations Director
Energy & Waste Services

Tests marked '^' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 02-Nov-2017

		Units :	μg/kg	pH Units	%	mg/kg	mg/kg	% M/M	Mol/kg	%	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	mg/kg
		od Codes :	PCBECD	PHSOIL	TMSS	TPHFIDUS	TPHFIDUS		ANC		BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	PAHMSUS
	Method Reporti	ng Limits :	5		0.1	10	10	0.02	0.04	0.2	10	10	10	20	30	20	10	
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1780492	BH07 0.50	11-Oct-17	Req	9.2	1.7	<10	<10	0.08	1.68	0.7	<10	<10	<10	<20*	<30	<20	<10	Req
1780493	BH07 1.50	11-Oct-17	Req	8.8	11.9	12	12	0.14	3.92	1.2	<10	<10	<10	<20*	<30	<20	<10	Req
1780494	BH07 2.50	11-Oct-17	Req	8.2	19.0	13	14	0.37	2.16	3.0	<10	<10	<10	<20*	<30	<20	<10	Req
1780495	QC Blank		Req			<10	<10	<0.02			<10	<10	<10	<20*	<30	<20	<10	Req
1780496	Reference Material (% Recovery)		Req	98		106	106	108	100	97	94	90	102	103	100	102	97	Req
	SOCOTEC (3)		Client N		Cause Neil Hag	eway Geot	ech Ltd						Sam	ple Ana	alysis			
	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		Ark	dow S	Sewe	rage S	Schen	ne Ma	rine (Outfal	I GI	Date Pri Report N Table No	lumber			-Nov-2017 EFS/179864 1		

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

s17_9864 **Sample Details:** BH07 0.50 **Job Number:** LIMS ID Number: CL1780492 Date Booked in: 19-Oct-17 **QC Batch Number:** 171157 **Date Extracted:** 26-Oct-17 **Quantitation File:** Initial Calibration Date Analysed: 26-Oct-17 **Directory:** a\102617GC5\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	ı	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	100
Acenaphthene-d10	99
Phenanthrene-d10	99
Chrysene-d12	97
Perylene-d12	95

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	89
Terphenyl-d14	74

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_9864 **Sample Details:** BH07 1.50 LIMS ID Number: CL1780493 Date Booked in: 19-Oct-17 **QC Batch Number:** 171157 **Date Extracted:** 26-Oct-17 **Quantitation File:** Initial Calibration Date Analysed: 26-Oct-17 **Directory:** a\102617GC5\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	1	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	100
Acenaphthene-d10	99
Phenanthrene-d10	99
Chrysene-d12	103
Perylene-d12	104

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	98
Terphenyl-d14	84

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: s17_9864 **Sample Details:** BH07 2.50 LIMS ID Number: CL1780494 Date Booked in: 19-Oct-17 **QC Batch Number:** 171157 **Date Extracted:** 26-Oct-17 **Quantitation File:** Initial Calibration Date Analysed: 26-Oct-17 Directory: a\102617GC5\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	97
Acenaphthene-d10	95
Phenanthrene-d10	95
Chrysene-d12	91
Perylene-d12	85

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	104
Terphenyl-d14	87

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

QC Blank Job Number: S17_9864 **Sample Details:** LIMS ID Number: CL1780495 Date Booked in: 19-Oct-17 **QC Batch Number:** 171157 **Date Extracted:** 26-Oct-17 **Quantitation File: Initial Calibration** Date Analysed: 27-Oct-17 **Directory:** a\102617GC5\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	ı	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	ı
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	ı
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	100
Acenaphthene-d10	102
Phenanthrene-d10	100
Chrysene-d12	98
Perylene-d12	109

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	96
Terphenyl-d14	81

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: s17_9864 **Sample Details:** LIMS ID Number: CL1780496 Date Booked in: 19-Oct-17 **QC Batch Number:** 171157 **Date Extracted:** 26-Oct-17 **Quantitation File:** Initial Calibration Date Analysed: 26-Oct-17 **Directory:** a\102617GC5\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.42	104	100
Acenaphthylene	208-96-8	4.49	106	100
Acenaphthene	83-32-9	4.61	104	97
Fluorene	86-73-7	5.01	103	97
Phenanthrene	85-01-8	5.90	101	99
Anthracene	120-12-7	5.95	102	99
Fluoranthene	206-44-0	7.29	100	98
Pyrene	129-00-0	7.58	99	97
Benzo[a]anthracene	56-55-3	9.29	103	99
Chrysene	218-01-9	9.34	103	99
Benzo[b]fluoranthene	205-99-2	10.83	88	100
Benzo[k]fluoranthene	207-08-9	10.87	94	99
Benzo[a]pyrene	50-32-8	11.27	98	99
Indeno[1,2,3-cd]pyrene	193-39-5	12.66	103	96
Dibenzo[a,h]anthracene	53-70-3	12.70	108	98
Benzo[g,h,i]perylene	191-24-2	12.99	89	73
Coronene	191-07-1	15.38	107	90
Total (USEPA16) PAHs	-	-	101	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	101
Acenaphthene-d10	102
Phenanthrene-d10	100
Chrysene-d12	107
Perylene-d12	119

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	100
Terphenyl-d14	83

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_9864
QC Batch Number: 171157

Directory: 102617PCB.GC22

Method: Ultrasonic

* This sample data is not UKAS or Mcerts accredited.

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

				Con	centration,	(µg/kg)		
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180
CL1780492	BH07 0.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1780493	BH07 1.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1780494	BH07 2.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1780495	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1780496	Reference Material (% Recovery)	88.5	99.7	80.1	101.2	101.0	95.3	84.0

Soil

19-Oct-17

26-Oct-17

27-Oct-17

Client	Causeway Geotech Ltd	_		_	Leaching Data			
Cilent	Causeway Geolech Llu				Weight of sample (kg)	0.092		
Contact	Noil Hoggon				Moisture content @ 105°C (% of Wet Weight)	1.7		
Contact	Neil Haggan				Equivalent Weight based on drying at 105°C (kg)			
Site	Arklow Cowered Cohem	o Marina Ou	tfall CI		Volume of water required to carry out 10:1 stage (litres)			
Site	Arklow Sewerage Schem	ie Marine Ou	iliali Gi		Fraction of sample above 4 mm %	100.000		
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000		
BH07 0.50		s17 9864	CL/1780492	02-Nov-17				
BHU7 0.50 S17_986			CL/1700492	02-INOV-17	_			

Note: The >4mm fraction is crushed using a disc mill

	4			Landfill Was	te Acceptance Cri	teria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.08	3	5	6
N	LOI450	Loss on Ignition (%)	0.7			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.06	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	<10	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.38	100		
Ν	PHSOIL	pH (pH units)	9.2		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.69		To be evaluated	To be evaluated

tation	Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1			
Accreditation	Method	,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	mg/l except [∞]	mg/kg (dry weight)		mg/kg (dry weight)		
U	WSLM3	pH (pH units) ⁰⁰	7.6	Calculated data not UKAS Accredited				
U	WSLM2	Conductivity (µs/cm) 00	379	Calculated data not offas Accredited				
U	ICPMSW	Arsenic	<0.001	<0.01	0.5	2	25	
U	ICPWATVAR	Barium	0.09	0.9	20	100	300	
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5	
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70	
U	ICPMSW	Copper	0.002	0.02	2	50	100	
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2	
U	ICPMSW	Molybdenum	0.006	0.06	0.5	10	30	
U	ICPMSW	Nickel	0.001	0.01	0.4	10	40	
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50	
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5	
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7	
U	ICPMSW	Zinc	0.019	0.19	4	50	200	
U	KONENS	Chloride	74	740	800	15000	25000	
U	ISEF	Fluoride	0.2	2	10	150	500	
U	ICPWATVAR	Sulphate as SO4	18	180	1000	20000	50000	
Ν	WSLM27	Total Dissolved Solids	295	2950	4000	60000	100000	
U	SFAPI	Phenol Index	<0.05	<0.5	1			
N	WSLM13	Dissolved Organic Carbon	1.1	11	500	800	1000	

500 800 1000

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causeway Geotech Ltd				Leaching Data		
Cilent	Causeway Geolech Llu				Weight of sample (kg)		
Contact	Noil Hoggon				Moisture content @ 105°C (% of Wet Weight)	11.9	
Contact Neil Haggan				Equivalent Weight based on drying at 105°C (kg) 0.0			
Site	Articlass Cassara da Cabada	a Marina Ou	#all CI		Volume of water required to carry out 10:1 stage (litres)		
Site	Arklow Sewerage Schem	ie Marine Ou	liali Gi		Fraction of sample above 4 mm %	71.500	
Samp	ole Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000	
	BH07 1.50	s17 9864	CL/1780493	02-Nov-17			
'	BH07 1.50 \$17_9864 CL/1780493 02-Nov-						

Note: The >4mm fraction is crushed using a disc mill

				Landfill Was	te Acceptance Cri	teria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.14	3	5	6
Ν	LOI450	Loss on Ignition (%)	1.2			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	14	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.54	100		
Ν	PHSOIL	pH (pH units)	8.8		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	3.97		To be evaluated	To be evaluated

ation	ode			Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1		
Accreditation	Method Code	Leachate Analysis	mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry weight)		ht)
U	WSLM3	pH (pH units) ⁰⁰	7.7	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	885	Calculated data not OKAS Accredited			
U	ICPMSW	Arsenic	0.003	0.03	0.5	2	25
U	ICPWATVAR	Barium	0.08	0.8	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04 1		5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	0.001	0.01	2	50	100
U		Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.007	0.07	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.003	0.03	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.018	0.18	4	50	200
U	KONENS	Chloride	211	2110	800	15000	25000
U	ISEF	Fluoride	0.3	3	10	150	500
U	ICPWATVAR	Sulphate as SO4	52	520	1000	20000	50000
N	WSLM27	Total Dissolved Solids	690	6900	4000	60000	100000
U	SFAPI	Phenol Index	< 0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	1.3	13	500	800	1000

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Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causeway Geotech Ltd				Leaching Data		
Cilent	Causeway Geolech Llu				Weight of sample (kg)	0.106	
Contact	Noil Hoggon				Moisture content @ 105°C (% of Wet Weight)		
Contact Neil Haggan				Equivalent Weight based on drying at 105°C (kg)	0.090		
Site	Articlass Cassara da Cabada	a Marina Ou	#all CI		Volume of water required to carry out 10:1 stage (litres)		
Site	Arklow Sewerage Schem	ie Marine Ou	liali Gi		Fraction of sample above 4 mm %	71.900	
Samp	ole Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000	
	BH07 2.50	s17 9864	CL/1780494	02-Nov-17			
BH07 2.50 \$17_9864			CL/1700494	02-INOV-17			

Note: The >4mm fraction is crushed using a disc mill

				Landfill Was	te Acceptance Cri	teria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)		Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.37	3	5	6
Ν	LOI450	Loss on Ignition (%)	3			10
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	16	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.68	100		
Ν	PHSOIL	pH (pH units)	8.2		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.19		To be evaluated	To be evaluated

ation	Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1		e Acceptance Crite N 12457/2 @ L/S 1	ria Limit Values for 0 litre kg-1
Accreditation	Method Code		mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry weight)		ıht)
J	WSLM3	pH (pH units) 00	7.8	Calculated data not UKAS Accredited			
J	WSLM2	Conductivity (µs/cm) 00	1360	Calculated data not office Accredited			
U	ICPMSW	Arsenic	0.009	0.09	0.5	2	25
U	ICPWATVAR	Barium	0.09	0.9	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	0.002	0.02	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.014	0.14	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.007	0.07	0.06	0.7	5
U	ICPMSW	Selenium	0.001	0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.029	0.29	4	50	200
U	KONENS	Chloride	332	3320	800	15000	25000
U	ISEF	Fluoride	0.3	3	10	150	500
U	ICPWATVAR	Sulphate as SO4	78	780	1000	20000	50000
N	WSLM27	Total Dissolved Solids	1060	10600	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	2.7	27	500	800	1000

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Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Sample Analysis

Causeway Geotech Ltd

Customer

Report No

Site

Socotec Environmental Chemistry

Consignment No S69782

Analytical and Deviating Sample Overview

Arklow Sewerage Scheme Marine Outfall GI Date Logged 19-Oct-2017

S179864 In-House Report Due 07-Nov-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

S179864

															ica a
		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
	BH07 0.50	11/10/17		Е	Е						Е				
CL/1780493	BH07 1.50	11/10/17		Е	Е						Е				
CL/1780494	BH07 2.50	11/10/17		Е	Е						Е				
CL/1780495	QC Blank														
CL/1780496	Reference Material (% Recovery	y)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- Headspace present in the sample container
- The sampling date was not supplied so holding time may be compromised applicable to all analysis
- Sample processing did not commence within the appropriate holding time Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Report Number: EFS/179864

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
BTEXHSA	CL1780492 TO CL1780496	The Secondary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily (including the Primary Process Control) and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation from the affected analytes (MTBE). These circumstances should be taken into consideration when utilising the data"
TPHFIDUS	CL1780492 TO CL1780496	The Secondary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily (including the Primary Process Control) and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation , where applicable, from the affected analytes (Banding C8-C10) . These circumstances should be taken into consideration when utilising the data.

Report Number: EFS/179864

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ANC	Oven Dried	Quantitative digestion with Hydrochloric Acid back titration with 1M
		@ < 35°C	Sodium Hydroxide to pH 7
Soil	BTEXHSA	As Received	Determination of Benzene, Toluene, Ethyl benzene and Xylenes (BTEX) by Headspace GCFID
Soil	LOI(%MM)	Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water	ISEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water	WSLM27	As Received	Gravimetric Determination
Water	WSLM3		Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 15 of 15 EFS/179864 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: S17_9864

Note: major constituent in upper case

Lab ID Number Client ID Description CL/1780492 BH07 0.50 MARINE SEDIMENTS CL/1780493 BH07 1.50 MARINE SEDIMENTS CL/1780494 BH07 2.50 MARINE SEDIMENTS CL/1780495 QC Blank QUALITY CONTROL SAMPLE CL/1780496 Reference Material (% Recovery) QUALITY CONTROL SAMPLE	
CL/1780493 BH07 1.50 MARINE SEDIMENTS CL/1780494 BH07 2.50 MARINE SEDIMENTS CL/1780495 QC Blank QUALITY CONTROL SAMPLE	
CL/1780493 BH07 1.50 MARINE SEDIMENTS CL/1780494 BH07 2.50 MARINE SEDIMENTS CL/1780495 QC Blank QUALITY CONTROL SAMPLE	
CL/1780494 BH07 2.50 MARINE SEDIMENTS CL/1780495 QC Blank QUALITY CONTROL SAMPLE	
CL/1780495 QC Blank QUALITY CONTROL SAMPLE	
CL/1780495 QC Blank QUALITY CONTROL SAMPLE CL/1780496 Reference Material (% Recovery) QUALITY CONTROL SAMPLE	
CL/1780496 Reference Material (% Recovery) QUALITY CONTROL SAMPLE	
'	

Our Ref: EFS/179861 (Ver. 1)

Your Ref: 17-0167 November 2, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry

SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

The samples will be kept until the agreed date when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

J Colbourne
Project Co-ordinator
01283 554547

TEST REPORT



Report No. EFS/179861 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 5 samples described in this report were registered for analysis by SOCOTEC UK Limited on 19-Oct-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 02-Nov-2017

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 7)
Table of PCB Congener Results (Page 8)
Table of WAC Analysis Results (Pages 9 to 11)
Analytical and Deviating Sample Overview (Page 12)
Table of Additional Report Notes (Page 13)
Table of Method Descriptions (Page 14)
Table of Report Notes (Page 15)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim (

Tim Barnes Operations Director
Energy & Waste Services

Tests marked '^' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 02-Nov-2017

		Units : od Codes :	μg/kg PCBECD	pH Units PHSOIL	% TMSS		mg/kg TPHFIDUS		Mol/kg ANC		μg/kg BTEXHSA		μg/kg BTEXHSA		μg/kg BTEXHSA			mg/kg PAHMSUS
	Method Reporti	ng Limits :	5		0.1	10	10	0.02	0.04	0.2	10	10	10	20	30	20	10	
LABID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1780480	BH08 0.50	10-Oct-17	Req	8.6	13.3	16	16	0.17	1.92	1.1	<10	<10	<10	<20	<30	<20	<10	Req
1780481	BH08 1.50	10-Oct-17	Req	8.5	11.5	<10	<10	0.09	1.84	0.9	<10	<10	<10	<20*	<30	<20	<10	Req
1780482	BH08 2.50	10-Oct-17	Req	8.5	16.7	11	12	0.06	1.60	0.8	<10	<10	<10	<20	<30	<20	<10	Req
1780483 1780484	QC Blank Reference Material (% Recovery)		Req Req	98		<10 106	<10 106	<0.02 108	102	102	<10 103	<10 101	<10 100	<20 100	<30 100	<20 101	<10 98	Req Req
	SOCOTEC (Client N			way Geot	ech Ltd					Sample Analysis						
	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		Ark		Neil Hagg	age S	Schem	ne Ma	rine (Outfal	I GI	Date Prin Report N	lumber			Nov-2017 FS/179861		

Where individual results are flagged see report notes for status.

Page 2 of 15

EFS/179861 Ver. 1

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: s17_9861 **Sample Details:** BH08 0.50 LIMS ID Number: CL1780480 Date Booked in: 19-Oct-17 **QC Batch Number:** 171157 **Date Extracted:** 26-Oct-17 **Quantitation File: Initial Calibration** Date Analysed: 26-Oct-17 **Directory:** a\102617GC5\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	ı	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	ı
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	ı
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	104
Acenaphthene-d10	104
Phenanthrene-d10	103
Chrysene-d12	109
Perylene-d12	118

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	91
Terphenyl-d14	78

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

S17_9861 **Sample Details:** BH08 1.50 **Job Number:** LIMS ID Number: CL1780481 Date Booked in: 19-Oct-17 **QC Batch Number:** 171157 **Date Extracted:** 26-Oct-17 **Quantitation File:** Initial Calibration Date Analysed: 26-Oct-17 **Directory:** a\102617GC5\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	ı	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	104
Acenaphthene-d10	103
Phenanthrene-d10	104
Chrysene-d12	105
Perylene-d12	108

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	100
Terphenyl-d14	84

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

s17_9861 **Sample Details:** BH08 2.50 **Job Number:** LIMS ID Number: CL1780482 Date Booked in: 19-Oct-17 **QC Batch Number:** 171157 **Date Extracted:** 26-Oct-17 **Quantitation File:** Initial Calibration Date Analysed: 26-Oct-17 **Directory:** a\102617GC5\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	ı	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	ı
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	ı
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	104
Acenaphthene-d10	104
Phenanthrene-d10	104
Chrysene-d12	102
Perylene-d12	98

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	95
Terphenyl-d14	80

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

QC Blank Job Number: S17_9861 **Sample Details:** LIMS ID Number: CL1780483 Date Booked in: 19-Oct-17 **QC Batch Number:** 171157 **Date Extracted:** 26-Oct-17 **Quantitation File: Initial Calibration** Date Analysed: 27-Oct-17 **Directory:** a\102617GC5\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	ı
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	ı
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	100
Acenaphthene-d10	102
Phenanthrene-d10	100
Chrysene-d12	98
Perylene-d12	109

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	96
Terphenyl-d14	81

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: S17_9861 **Sample Details:** LIMS ID Number: CL1780484 Date Booked in: 19-Oct-17 **QC Batch Number:** 171157 **Date Extracted:** 26-Oct-17 **Quantitation File:** Initial Calibration **Date Analysed:** 26-Oct-17 **Directory:** a\102617GC5\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.42	104	100
Acenaphthylene	208-96-8	4.49	106	100
Acenaphthene	83-32-9	4.61	104	97
Fluorene	86-73-7	5.01	103	97
Phenanthrene	85-01-8	5.90	101	99
Anthracene	120-12-7	5.95	102	99
Fluoranthene	206-44-0	7.29	100	98
Pyrene	129-00-0	7.58	99	97
Benzo[a]anthracene	56-55-3	9.29	103	99
Chrysene	218-01-9	9.34	103	99
Benzo[b]fluoranthene	205-99-2	10.83	88	100
Benzo[k]fluoranthene	207-08-9	10.87	94	99
Benzo[a]pyrene	50-32-8	11.27	98	99
Indeno[1,2,3-cd]pyrene	193-39-5	12.66	103	96
Dibenzo[a,h]anthracene	53-70-3	12.70	108	98
Benzo[g,h,i]perylene	191-24-2	12.99	89	73
Coronene	191-07-1	15.38	107	90
Total (USEPA16) PAHs	-	-	101	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	101
Acenaphthene-d10	102
Phenanthrene-d10	100
Chrysene-d12	107
Perylene-d12	119

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	100
Terphenyl-d14	83

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall Gl

Job Number: S17_9861 QC Batch Number: 171157

Directory: 102617PCB.GC22

Method: Ultrasonic

* This sample data is not UKAS or Mcerts accredited.

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

		Concentration, (µg/kg)						
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180
CL1780480	BH08 0.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1780481	BH08 1.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	< 5.0
CL1780482	BH08 2.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1780483	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1780484	Reference Material (% Recovery)	88.5	99.7	80.1	101.2	101.0	95.3	84.0

Soil

19-Oct-17

26-Oct-17

27-Oct-17

Client	Caucaway Caataah Ltd		Leaching Data				
Client Causeway Geotech Ltd			Weight of sample (kg)	0.100			
IContact INDI Haddan			Moisture content @ 105°C (% of Wet Weight)	13.3			
				Equivalent Weight based on drying at 105°C (kg)			
Site	Arklow Cowered Cohem	a Marina Ou	tfall CI		Volume of water required to carry out 10:1 stage (litres)		
Site	Arklow Sewerage Schem	ie Marine Ou	liali Gi		Fraction of sample above 4 mm %	43.500	
Sample Description Report No Sample No Issue Date			Issue Date	Fraction of non-crushable material %	0.000		
BH08 0.50		s17_9861 CL/1780480 02-Nov-17		02-Nov-17			

Note: The >4mm fraction is crushed using a disc mill

				Landfill Was	te Acceptance Cr	iteria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.17	3	5	6
Ν	LOI450	Loss on Ignition (%)	1.1			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.06	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	18	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.57	100		
Ν	PHSOIL	pH (pH units)	8.6		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.97		To be evaluated	To be evaluated

Accreditation	d Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values BSEN 12457/2 @ L/S 10 litre kg-1			
Accred	Method		mg/l except ⁰⁰	mg/kg (dry weight)			ght)	
U	WSLM3	pH (pH units) ⁰⁰	7.9	Calculated data not UKAS Accredited				
U	WSLM2	Conductivity (µs/cm) 00	889	Calculated data not OKAS Accredited				
U	ICPMSW	Arsenic	0.005	0.05	0.5	2	25	
U	ICPWATVAR	Barium	0.08	0.8	20	100	300	
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	0.04 1		
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70	
U	ICPMSW	Copper	0.001	0.01	2	50	100	
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.01 0.2		
U	ICPMSW	Molybdenum	0.005	0.05	0.5	10	30	
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40	
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50	
U	ICPMSW	Antimony	0.002	0.02	0.06	0.7	5	
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7	
U	ICPMSW	Zinc	0.021	0.21	4	50	200	
U	KONENS	Chloride	212	2120	800	15000	25000	
U	ISEF	Fluoride	0.3	3	10	150	500	
U	ICPWATVAR	Sulphate as SO4	58	580	1000	20000	50000	
N	WSLM27	Total Dissolved Solids	693	6930	4000	60000	100000	
U	SFAPI	Phenol Index	<0.05	<0.5	1			
Ν	WSLM13	Dissolved Organic Carbon	1.8	18	500	800	1000	

nplate Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causaway Caataah Ltd			Leaching Data			
Cilent	Causeway Geotech Ltd				Weight of sample (kg)	0.102	
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	11.5	
Contact					Equivalent Weight based on drying at 105°C (kg)		
Site	Arklow Sewerage Scheme Marine Outfall GI				Volume of water required to carry out 10:1 stage (litres)		
Site					Fraction of sample above 4 mm %		
Sample Description Report No Sample No Issue Date					te Fraction of non-crushable material %		
E	3H08 1.50	s17_9861 CL/1780481 02-Nov-17		02-Nov-17			

Note: The >4mm fraction is crushed using a disc mill

				Landfill Waste Acceptance Criteria Limit Values		
Accreditation	eth		Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.09	3	5	6
Ν	LOI450	Loss on Ignition (%)	0.9			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.06	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	<11	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.54	100		
Ν	PHSOIL	pH (pH units)	8.5		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.88		To be evaluated	To be evaluated

Accreditation	d Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Val BSEN 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)		
Accre	Method	, , ,	mg/l except [∞]	mg/kg (dry weight)			ght)
J	WSLM3	pH (pH units) 00	7.8	Calculated data not UKAS Accredited			
J	WSLM2	Conductivity (µs/cm) 00	1020	Calculated data not onas accredited			
כ	ICPMSW	Arsenic	0.003	0.03	0.5	2	25
U	ICPWATVAR	Barium	0.07	0.7	20	100	300
J	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
כ	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
\Box	ICPMSW	Copper	<0.001	<0.01	2	50	100
U		Mercury	<0.0001	<0.001	0.01 0.2		2
U	ICPMSW	Molybdenum	0.004	0.04	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.001	0.01	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.023	0.23	4	50	200
U	KONENS	Chloride	250	2500	800	15000	25000
U	ISEF	Fluoride	0.2	2	10	150	500
U	ICPWATVAR	Sulphate as SO4	48	480	1000 20000 5000		50000
N	WSLM27	Total Dissolved Solids	795	7950	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
Ν	WSLM13	Dissolved Organic Carbon	1	10	500	800	1000

nplate Ver. 1

andfill Waste Acceptance Criteria limit values correct as of 11th March 2009

Client	Causaway Castash I td			Leaching Data			
Cilent	Causeway Geotech Ltd				Weight of sample (kg)	0.107	
Contact Noil Llogger				Moisture content @ 105°C (% of Wet Weight)			
Contact	Neil Haggan				Equivalent Weight based on drying at 105°C (kg)		
Site	Arklow Sewerage Scheme Marine Outfall GI				Volume of water required to carry out 10:1 stage (litres)		
Site					Fraction of sample above 4 mm %		
Sample Description Report No Sample No Issue Date					e Fraction of non-crushable material %		
E	3H08 2.50	s17_9861 CL/1780482 02-Nov-17		02-Nov-17			

Note: The >4mm fraction is crushed using a disc mill

				Landfill Waste Acceptance Criteria Limit Values		
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.06	3	5	6
Ν	LOI450	Loss on Ignition (%)	0.8			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	13	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.63	100		
Ν	PHSOIL	pH (pH units)	8.5		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.61		To be evaluated	To be evaluated

Accreditation	d Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Val BSEN 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)		
Accre	Method	,	mg/l except ⁰⁰	mg/kg (dry weight)			ght)
J	WSLM3	pH (pH units) ⁰⁰	7.4	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	1400	Calculated data not offao Accredited			
J	ICPMSW	Arsenic	0.003	0.03	0.5	2	25
J	ICPWATVAR	Barium	0.07	0.7	20	100	300
כ	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
J	ICPMSW	Copper	<0.001	<0.01	2	50	100
J		Mercury	<0.0001	<0.001	0.01	0.01 0.2	
U	ICPMSW	Molybdenum	0.003	0.03	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	0.002	0.02	0.5	10	50
U	ICPMSW	Antimony	0.001	0.01	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.026	0.26	4	50	200
U	KONENS	Chloride	365	3650	800	15000	25000
U	ISEF	Fluoride	0.2	2	10	150	500
U	ICPWATVAR	Sulphate as SO4	59	590	1000		
Ν	WSLM27	Total Dissolved Solids	1090	10900	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	1.1	11	500	800	1000

nplate Ver. 1

andfill Waste Acceptance Criteria limit values correct as of 11th March 2009

Report No

S179861

Socotec Environmental Chemistry Analytical and Deviating Sample Overview

Customer Causeway Geotech Ltd
Site Arklow Sewerage Scheme Marine Outfall GI

Consignment No S69780
Date Logged 19-Oct-2017

S179861

In-House Report Due 07-Nov-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

															cu and
		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL/1780480	BH08 0.50	10/10/17		Е	Е						Е				
CL/1780481	BH08 1.50	10/10/17		Е	Е						Е				
CL/1780482	BH08 2.50	10/10/17		Е	Е						Е				
CL/1780483	QC Blank														
CL/1780484	Reference Material (% Recovery	y)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- C Headspace present in the sample container
- The sampling date was not supplied so holding time may be compromised applicable to all analysis
- E Sample processing did not commence within the appropriate holding time
- F Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number : EFS/179861

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
BTEXHSA	CL1780481	The Primary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation from the affected analytes (MTBE) . These circumstances should be taken into consideration when utilising the data"
TPHFIDUS	CL1780480 TO CL1780484	The Secondary process control data associated with this Test has not wholly met the requirements of the Laboratory Quality Management System QMS with one or more target analytes falling outside acceptable limits. However the remaining data gives the Laboratory confidence that the test has performed satisfactorily (including the Primary Process Control) and that the validity of the data may not have been significantly affected. However in line with our QMS policy we have removed accreditation , where applicable, from the affected analytes (Banding C8-C10) . These circumstances should be taken into consideration when utilising the data.

Report Number: EFS/179861

Method Descriptions

Matrix	MethodID	Analysis	Method Description
		Basis	·
Soil	ANC	Oven Dried @ < 35°C	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7
Soil	BTEXHSA	As Received	Determination of Benzene, Toluene, Ethyl benzene and Xylenes (BTEX) by Headspace GCFID
Soil	LOI(%MM)	Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water	ISEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water	WSLM27	As Received	Gravimetric Determination
Water	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 15 of 15 EFS/179861 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: S17_9861

Note: major constituent in upper case

Lab ID Number Client ID Description CLY70A017 CH 100 GM MARRIE SCHMENTS CLY70A018 SH0 1-50 MARRIE SCHMENTS CLY786494 Reference Material (% Recovery) CLY780494 Reference Material (% Recovery) CLY780494 Reference Material (% Recovery)			Twote: major constituent in upper case
CL/1780481 BH08 1.50 MARINE SEDIMENTS CL/1780482 BH08 2.50 MARINE SEDIMENTS CL/1780483 QC Blank QUALITY CONTROL SAMPLE	Lab ID Number	Client ID	Description
CL/1780481 BH08 1.50 MARINE SEDIMENTS CL/1780482 BH08 2.50 MARINE SEDIMENTS CL/1780483 QC Blank QUALITY CONTROL SAMPLE	CI /1780480	RH08 0 50	MARINE SEDIMENTS
CL/1780482 BH08 2.50 MARINE SEDIMENTS CL/1780483 QC Blank QUALITY CONTROL SAMPLE	CL/1700400	DI 100 0.50	MADINE SEDIMENTS
CL/1780483 QC Blank QUALITY CONTROL SAMPLE	CL/1780481	BH08 1.50	MARINE SEDIMENTS
CU1780-894 Reference Memoral (% Recovery) QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE	CL/1780482	BH08 2.50	MARINE SEDIMENTS
CL/1780484 Reference Material (% Recovery) QUALITY CONTROL SAMPLE	CL/1780483	QC Blank	QUALITY CONTROL SAMPLE
	CL/1780484	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE
		<u> </u>	

Appendix A Page 1 of 1

Our Ref: EFS/180511 (Ver. 1)

Your Ref: 17-0167 November 29, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

The samples will be kept until the agreed date when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

JACOUDOVINE

J Colbourne

Project Co-ordinator 01283 554547

TEST REPORT



Report No. EFS/180511 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 5 samples described in this report were registered for analysis by SOCOTEC UK Limited on 09-Nov-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 29-Nov-2017

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 7)
Table of PCB Congener Results (Page 8)
Table of WAC Analysis Results (Pages 9 to 11)
Analytical and Deviating Sample Overview (Page 12)
Table of Method Descriptions (Page 13)
Table of Report Notes (Page 14)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim

Tim Barnes Operations Director Energy & Waste Services

Tests marked 'A' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 29-Nov-2017

	Meth	Units : od Codes :		pH Units PHSOIL	% TMSS	mg/kg TPHFIDUS	mg/kg TPHFIDUS	% M/M WSLM59	Mol/kg ANC	% LOI(%MM)	μg/kg BTEXHSA	μg/kg BTEXHSA	μg/kg BTEXHSA	μg/kg BTEXHSA	μg/kg BTEXHSA	μg/kg BTEXHSA	μg/kg BTEXHSA	mg/kg PAHMSUS
	Method Reporti			TTIOOIL	0.1	10	10	0.02	0.04	0.2	10	10	10	20	30	20	10	1 Al IIVIOOO
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	ylenes MTBE					o Xylene	PAH (17) by GCMS
1783094	BH09 0.50	27-Oct-17	Req	8.4	14.1	42	42	0.06	1.68	1.1	<10	<10	<10	<20	<30	<20	<10	Req
1783095	BH09 1.50	27-Oct-17	Req	8.5	16.5	84	84	0.06	1.04	0.9	<10	<10	<10	<20	<30	<20	<10	Req
1783096	BH09 2.50	27-Oct-17	Req	8.5	18.2	27	27	0.16	2.48	1.3	<10	<10	<10	<20	<30	<20	<10	Req
1783097	QC Blank		Req			<10	<10	<0.02			<10	<10	<10	<20	<30	<20	<10	Req
1783098	Reference Material (% Recovery)		Req	101.2		89	89	108	101	101.7	93	93	96	103	94	97	91	Req
	SOCOTEC 3		Client N Contact		Causeway Geotech Ltd Neil Haggan Sample Analysis													
1	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422				•	rage S	Schem	ne Ma	rine (Dutfal	I GI	Date Printed 27-Nov-2017 Report Number EFS/180511 Table Number 1				-		

Where individual results are flagged see report notes for status.

Page 2 of 14

EFS/180511 Ver. 1

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: Job Number: BH09 0.50 S18_0511 **LIMS ID Number:** CL1783094 Date Booked in: 09-Nov-17 **QC Batch Number:** 171249 **Date Extracted:** 22-Nov-17 **Quantitation File:** Initial Calibration 22-Nov-17 **Date Analysed:**

Directory: 112217.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	* Danata	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	102
Acenaphthene-d10	105
Phenanthrene-d10	102
Chrysene-d12	93
Perylene-d12	94

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	92
Terphenyl-d14	73

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: Job Number: BH09 1.50 s18_0511 **LIMS ID Number:** CL1783095 Date Booked in: 09-Nov-17 **QC Batch Number:** 171249 **Date Extracted:** 22-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 22-Nov-17

Directory: 112217.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	1
Phenanthrene	85-01-8	-	< 0.08	1
Anthracene	120-12-7	-	< 0.08	1
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	1
Chrysene	218-01-9	-	< 0.08	1
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	1
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	- + D (-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	102
Acenaphthene-d10	107
Phenanthrene-d10	108
Chrysene-d12	128
Perylene-d12	153

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	91
Terphenyl-d14	80

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: Job Number: BH09 2.50 S18_0511 **LIMS ID Number:** CL1783096 Date Booked in: 09-Nov-17 **QC Batch Number:** 171249 **Date Extracted:** 22-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 22-Nov-17

Directory: 112217.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	1
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	- * D (.	< 1.28	- Pr. 1

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	102
Acenaphthene-d10	105
Phenanthrene-d10	103
Chrysene-d12	99
Perylene-d12	98

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	92
Terphenyl-d14	74

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: QC Blank Job Number: s18_0511 **LIMS ID Number:** CL1783097 Date Booked in: 09-Nov-17 **QC Batch Number:** 171249 **Date Extracted:** 22-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 22-Nov-17

Directory: 112217.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	* Danata	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	93
Acenaphthene-d10	94
Phenanthrene-d10	95
Chrysene-d12	89
Perylene-d12	85

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	105
Terphenyl-d14	82

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details:Reference Material (% Rec Job Number:\$18_0511LIMS ID Number:CL1783098Date Booked in:09-Nov-17QC Batch Number:171249Date Extracted:22-Nov-17Quantitation File:Initial CalibrationDate Analysed:22-Nov-17

Directory: 112217.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.31	87	100
Acenaphthylene	208-96-8	4.36	95	99
Acenaphthene	83-32-9	4.48	93	92
Fluorene	86-73-7	4.87	91	91
Phenanthrene	85-01-8	5.72	88	100
Anthracene	120-12-7	5.78	95	99
Fluoranthene	206-44-0	7.08	87	90
Pyrene	129-00-0	7.37	87	89
Benzo[a]anthracene	56-55-3	9.06	100	99
Chrysene	218-01-9	9.11	93	98
Benzo[b]fluoranthene	205-99-2	10.59	81	97
Benzo[k]fluoranthene	207-08-9	10.63	82	97
Benzo[a]pyrene	50-32-8	11.02	93	96
Indeno[1,2,3-cd]pyrene	193-39-5	12.39	90	92
Dibenzo[a,h]anthracene	53-70-3	12.43	88	97
Benzo[g,h,i]perylene	191-24-2	12.70	72	95
Coronene	191-07-1	14.89	68	68
Total (USEPA16) PAHs	-	-	87	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	95
Acenaphthene-d10	98
Phenanthrene-d10	97
Chrysene-d12	120
Perylene-d12	152

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	87
Terphenyl-d14	72

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix:

 Job Number:
 S18_0511
 Date Booked in:
 09-Nov-17

 QC Batch Number:
 171249
 Date Extracted:
 22-Nov-17

 Directory:
 112117PCB.GC22
 Date Analysed:
 22-Nov-17

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

		Concentration, (µg/kg)						
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180
CL1783094	BH09 0.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1783095	BH09 1.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1783096	BH09 2.50	< 5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1783097	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1783098	Reference Material (% Recovery)	78.3	86.4	91.2	88.9	89.3	84.6	75.7
				1				

Soil

Client	Causaway Caataah	soway Caataah Ltd			Leaching Data		
Cilent	Causeway Geotech Ltd			Weight of sample (kg)	0.103		
Contact Noil Hoggen		Moisture content @ 105°C (% of Wet Weight)	14.1				
Contact	Contact Neil Haggan			Equivalent Weight based on drying at 105°C (kg)	0.090		
Site	te Arklow Sewerage Scheme Marine Outfall GI		Volume of water required to carry out 10:1 stage (litres)				
Site	Arkiow Sewerage Sc		liali Gi		Fraction of sample above 4 mm %	7.300	
Sam	Sample Description Report No Sample No Issue Date		Fraction of non-crushable material %	0.000			
BH09 0.50		s18_0511	CL/1783094	27-Nov-17			

Note: The >4mm fraction is crushed using a disc mill

				Landfill Wa	aste Acceptance Ci	riteria Limit Values
Accreditation	Solid Waste Analysis (Dry Basis)		Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.06	3	5	6
N	LOI450	Loss on Ignition (%)	1.1			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	49	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.58	100		
Ν	PHSOIL	pH (pH units)	8.4		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.7		To be evaluated	To be evaluated

ion	ode		10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BS 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)		a Limit Values for BSEN
Accreditation	Method Code	Leachate Analysis	mg/l except ⁰⁰	mg/kg (dry weight)			
U	WSLM3	pH (pH units) ⁰⁰	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	1270	Calculated data flot ONAS Accredited			
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	0.001	0.01	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.002	0.02	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5
U	ICPMSW	Selenium	0.001	0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.004	0.04	4	50	200
U	KONENS	Chloride	331	3310	800	15000	25000
U	ISEF	Fluoride	0.2	2	10	150	500
U	ICPWATVAR	Sulphate as SO4	44	440	1000	20000	50000
N	WSLM27	Total Dissolved Solids	989	9890	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	2.3	23	500	800	1000

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causaway Caataah	l +d		Leaching Data				
Cilent	Causeway Geotech	Liu		Weight of sample (kg)	0.108			
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	16.5		
Contact	пен паудан				Equivalent Weight based on drying at 105°C (kg)	0.090		
Site	Arklow Sewerage So	shama Marina Out	Hall Cl		Volume of water required to carry out 10:1 stage (litres)	0.882		
Site	Arklow Sewerage Sc	neme Manne Ou	liali Gi		Fraction of sample above 4 mm %	11.600		
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000		
	BH09 1.50	s18_0511	CL/1783095	27-Nov-17				

Note: The >4mm fraction is crushed using a disc mill

				Landfill Waste Acceptance Criteria Limit Values					
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill			
Ν	WSLM59	Total Organic Carbon (% M/M)	0.06	3	5	6			
N	LOI450	Loss on Ignition (%)	0.9			10			
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.07	6					
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1					
Ν	TPHFIDUS	Mineral Oil (mg/kg)	101	500					
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.63	100					
Ν	PHSOIL	pH (pH units)	8.5		>6				
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.04		To be evaluated	To be evaluated			

ion	Code		10:1 Single Stage Leachate		Landfill Waste Acceptance Criteria Limit Values for BSEN				
Accreditation	Method Co	Leachate Analysis	mg/l except ⁰⁰	mg/kg (dry weight)	12457/2 @ L/S 10 litre l mg/kg (dry weight)				
U	WSLM3	pH (pH units) ⁰⁰	7.6	Calculated data not UKAS Accredited					
U	WSLM2	Conductivity (µs/cm) 00	1590	Calculated data flot ONAS Accredited					
U	ICPMSW	Arsenic	0.003	0.03	0.5	2	25		
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300		
U	ICPMSW	Cadmium	0.0003	0.003	0.04	1	5		
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70		
U	ICPMSW	Copper	0.002	0.02	2	50	100		
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2		
U	ICPMSW	Molybdenum	0.003	0.03	0.5	10	30		
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40		
U	ICPMSW	Lead	0.002	0.02	0.5	10	50		
U	ICPMSW	Antimony	0.002	0.02	0.06	0.7	5		
U	ICPMSW	Selenium	0.001	0.01	0.1	0.5	7		
U	ICPMSW	Zinc	0.008	0.08	4	50	200		
U	KONENS	Chloride	437	4370	800	15000	25000		
U	ISEF	Fluoride	0.2	2	10	150	500		
U	ICPWATVAR	Sulphate as SO4	44	440	1000	20000	50000		
N	WSLM27	Total Dissolved Solids	1240	12400	4000	60000	100000		
U	SFAPI	Phenol Index	<0.05	<0.5	1				
N	WSLM13	Dissolved Organic Carbon	9.3	93					

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causaway Caataah I			Leaching Data				
Cilent	Causeway Geotech I	Lla		Weight of sample (kg)	0.102			
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	18.2		
Contact	neli Haggari				Equivalent Weight based on drying at 105°C (kg)	0.090		
Site	Arklow Sewerage Sc	homo Marino Out	Hall CI		Volume of water required to carry out 10:1 stage (litres)	0.888		
Site	Arkiow Sewerage Sc		liali Gi		Fraction of sample above 4 mm %	52.200		
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000		
	BH09 2.50	s18_0511	CL/1783096	27-Nov-17				

Note: The >4mm fraction is crushed using a disc mill

				Landfill Waste Acceptance Criteria Limit Values					
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill			
Ν	WSLM59	Total Organic Carbon (% M/M)	0.17	3	5	6			
N	LOI450	Loss on Ignition (%)	1.4			10			
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6					
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1					
Ν	TPHFIDUS	Mineral Oil (mg/kg)	33	500					
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.66	100					
Ν	PHSOIL	pH (pH units)	8.5		>6				
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.68		To be evaluated	To be evaluated			

ion	opc .		10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN				
Accreditation	Method Code	Leachate Analysis	mg/l except ⁰⁰	mg/kg (dry weight)		12457/2 @ L/S 10 I mg/kg (dry we			
U	WSLM3	pH (pH units) ⁰⁰	8	Calculated data not UKAS Accredited					
U	WSLM2	Conductivity (µs/cm) 00	1150	Calculated data flot ONAS Accredited					
U	ICPMSW	Arsenic	0.005	0.05	0.5	2	25		
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300		
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5		
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70		
U	ICPMSW	Copper	<0.001	<0.01	2	50	100		
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2		
U	ICPMSW	Molybdenum	0.009	0.09	0.5	10	30		
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40		
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50		
U	ICPMSW	Antimony	0.003	0.03	0.06	0.7	5		
U	ICPMSW	Selenium	0.001	0.01	0.1	0.5	7		
U	ICPMSW	Zinc	0.002	0.02	4	50	200		
U	KONENS	Chloride	293	2930	800	15000	25000		
U	ISEF	Fluoride	0.2	2	10	150	500		
U	ICPWATVAR	Sulphate as SO4	44	440	1000	20000	50000		
N	WSLM27	Total Dissolved Solids	898	8980	4000	60000	100000		
U	SFAPI	Phenol Index	<0.05	<0.5	1				
Ν	WSLM13	Dissolved Organic Carbon	3.7	37	500	800	1000		

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

S180511

Socotec Environmental Chemistry Analytical and Deviating Sample Overview

Customer Causeway Geotech Ltd
Site Arklow Sewerage Scheme Marine Outfall GI
Report No S180511

Consignment No S70198
Date Logged 09-Nov-2017

In-House Report Due 29-Nov-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working

		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL/1783094	BH09 0.50	27/10/17		Е	E				Е		Е		Е	Е	Е
CL/1783095	BH09 1.50	27/10/17		E	E				E		E		E	E	E
CL/1783096	BH09 2.50	27/10/17		E	E				E		E		E	E	E
CL/1783097	QC Blank														
CL/1783098	Reference Material (% Recovery	y)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- C Headspace present in the sample container
- D The sampling date was not supplied so holding time may be compromised applicable to all analysis
- E Sample processing did not commence within the appropriate holding time
- F Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number: EFS/180511

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ANC	Oven Dried @ < 35°C	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7
Soil	BTEXHSA	As Received	Determination of Benzene, Toluene, Ethyl benzene and Xylenes (BTEX) by Headspace GCFID
Soil	LOI(%MM)	Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water	ISEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water	WSLM27	As Received	Gravimetric Determination
Water	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.

 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- P Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- **‡** MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 14 of 14 EFS/180511 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: \$18_0511

Note: major constituent in upper case

Lab ID Number	Client ID	Note: major constituent in upper case Description
		<u> </u>
CL/1783094	BH09 0.50	Grey Stone MARINE SEDIMENTS
CL/1783095	BH09 1.50	Grey Gravel MARINE SEDIMENTS
CL/1783096	BH09 2.50	Grey Stone MARINE SEDIMENTS
CL/1783097	QC Blank	Grey Stone MARINE SEDIMENTS Grey Gravel MARINE SEDIMENTS Grey Stone MARINE SEDIMENTS QUALITY CONTROL SAMPLE
CL/1783098	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE
	(,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,,	

Appendix A Page 1 of 1 29/11/2017EFS/180511 Ver. 1

Our Ref: EFS/180513 (Ver. 1)

Your Ref: 17-0167 November 29, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

The samples will be kept until the agreed date when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

JACOUDOVINE

J Colbourne

Project Co-ordinator 01283 554547

TEST REPORT



Report No. EFS/180513 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 5 samples described in this report were registered for analysis by SOCOTEC UK Limited on 09-Nov-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 29-Nov-2017

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 7)
Table of PCB Congener Results (Page 8)
Table of WAC Analysis Results (Pages 9 to 11)
Analytical and Deviating Sample Overview (Page 12)
Table of Method Descriptions (Page 13)
Table of Report Notes (Page 14)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim (

Tim Barnes Operations Director Energy & Waste Services

Tests marked 'A' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 29-Nov-2017

		Units :	μg/kg	pH Units	%	mg/kg	mg/kg	% M/M	Mol/kg	%	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	mg/kg
	Method Reporti	od Codes:	PCBECD	PHSOIL	TMSS 0.1	TPHFIDUS 10	TPHFIDUS 10	WSLM59 0.02	ANC 0.04	LOI(%MM) 0.2	BTEXHSA 10	BTEXHSA 10	BTEXHSA 10	BTEXHSA 20	BTEXHSA 30	BTEXHSA 20	BTEXHSA 10	PAHMSUS
	wethod Reporti	ily Lillius .	5		0.1	10	10	0.02	0.04	0.2	10	10	10	20	30	20	10	
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1783105	BH10 0.50	26-Oct-17	Req	8.8	7.2	25	26	0.08	1.28	1.2	<10	<10	<10	<20	<30	<20	<10	Req
1783106	BH10 1.50	26-Oct-17	Req	8.1	40.5	49	50	6.0	0.64	13.6	<10	<10	<10	<20	<30	<20	<10	Req
1783107	BH10 2.50	26-Oct-17	Req	7.8	9.2	19	20	0.18	0.08	1.4	<10	<10	<10	<20	<30	<20	<10	Req
1783108	QC Blank		Req			<10	<10	<0.02			<10	<10	<10	<20	<30	<20	<10	Req
1783109	Reference Material (% Recovery)		Req	101.2		89	89	108	101	103.8	93	93	96	103	94	97	91	Req
	SOCOTEC (3)		Client N	ame	Causev	way Geot	ech Ltd						Sam	ple Ana	alysis			
	SOCOTEC		Contact		Neil Hago	-												
	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		Ark	clow S	Sewer	age S	Schem	ne Ma	rine (Outfal	I GI	Report N Table Nu	lumber			-Nov-2017 FS/180513 1		

Where individual results are flagged see report notes for status.

Page 2 of 14

EFS/180513 Ver. 1

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: Job Number: BH10 0.50 s18_0513 **LIMS ID Number:** CL1783105 Date Booked in: 09-Nov-17 **QC Batch Number:** 171249 **Date Extracted:** 22-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 22-Nov-17

Directory: 112217.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	* D (< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	102
Acenaphthene-d10	103
Phenanthrene-d10	103
Chrysene-d12	94
Perylene-d12	82

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	92
Terphenyl-d14	73

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: Job Number: BH10 1.50 S18_0513 **LIMS ID Number:** CL1783106 Date Booked in: 09-Nov-17 **QC Batch Number:** 171249 **Date Extracted:** 22-Nov-17 **Quantitation File:** Initial Calibration 22-Nov-17 **Date Analysed:**

Directory: 112217.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	1	< 0.08	-
Acenaphthylene	208-96-8	1	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	1	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	1	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	101
Acenaphthene-d10	102
Phenanthrene-d10	100
Chrysene-d12	95
Perylene-d12	88

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	85
Terphenyl-d14	66

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: Job Number: BH10 2.50 s18_0513 **LIMS ID Number:** CL1783107 Date Booked in: 09-Nov-17 **QC Batch Number:** 171249 **Date Extracted:** 22-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 23-Nov-17

Directory: 112217.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	1	< 0.08	-
Acenaphthylene	208-96-8	1	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	1	< 0.08	-
Chrysene	218-01-9	1	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	1	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	99
Acenaphthene-d10	100
Phenanthrene-d10	99
Chrysene-d12	90
Perylene-d12	81

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	95
Terphenyl-d14	74

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: QC Blank Job Number: S18_0513 **LIMS ID Number:** CL1783108 Date Booked in: 09-Nov-17 **QC Batch Number:** 171249 **Date Extracted:** 22-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 22-Nov-17

Directory: 112217.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	* D (< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	93
Acenaphthene-d10	94
Phenanthrene-d10	95
Chrysene-d12	89
Perylene-d12	85

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	105
Terphenyl-d14	82

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details:Reference Material (% Rec Job Number:\$18_0513LIMS ID Number:CL1783109Date Booked in:09-Nov-17QC Batch Number:171249Date Extracted:22-Nov-17Quantitation File:Initial CalibrationDate Analysed:22-Nov-17

Directory: 112217.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.31	87	100
Acenaphthylene	208-96-8	4.36	95	99
Acenaphthene	83-32-9	4.48	93	92
Fluorene	86-73-7	4.87	91	91
Phenanthrene	85-01-8	5.72	88	100
Anthracene	120-12-7	5.78	95	99
Fluoranthene	206-44-0	7.08	87	90
Pyrene	129-00-0	7.37	87	89
Benzo[a]anthracene	56-55-3	9.06	100	99
Chrysene	218-01-9	9.11	93	98
Benzo[b]fluoranthene	205-99-2	10.59	81	97
Benzo[k]fluoranthene	207-08-9	10.63	82	97
Benzo[a]pyrene	50-32-8	11.02	93	96
Indeno[1,2,3-cd]pyrene	193-39-5	12.39	90	92
Dibenzo[a,h]anthracene	53-70-3	12.43	88	97
Benzo[g,h,i]perylene	191-24-2	12.70	72	95
Coronene	191-07-1	14.89	68	68
Total (USEPA16) PAHs	-	-	87	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	95
Acenaphthene-d10	98
Phenanthrene-d10	97
Chrysene-d12	120
Perylene-d12	152

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	87
Terphenyl-d14	72

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix:

 Job Number:
 S18_0513
 Date Booked in:
 09-Nov-17

 QC Batch Number:
 171249
 Date Extracted:
 22-Nov-17

 Directory:
 112117PCB.GC22
 Date Analysed:
 22-Nov-17

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

		Concentration, (μg/kg)									
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180			
CL1783105	BH10 0.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0			
CL1783106	BH10 1.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0			
CL1783107	BH10 2.50	<5.0	<5.0	<5.0	< 5.0	<5.0	<5.0	<5.0			
CL1783108	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0			
CL1783109	Reference Material (% Recovery)	78.3	86.4	91.2	88.9	89.3	84.6	75.7			

Soil

Client	Causaway Caataah I ta				Leaching Data						
Ciletti	Causeway Geotech Ltd	1		Weight of sample (kg) 0							
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)						
Contact	iveii i iaggaii		Equivalent Weight based on drying at 105°C (kg) 0.090								
Site	ite Arklow Sewerage Scheme Marine Outfall GI				Volume of water required to carry out 10:1 stage (litres) 0.8						
Site	Arkiow Sewerage Scrie		liali Gi	Fraction of sample above 4 mm %	85.200						
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000					
BH10 0.50		s18_0513	CL/1783105	27-Nov-17							

Note: The >4mm fraction is crushed using a disc mill

				Landfill W	/aste Acceptance (Criteria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.08	3	5	6
N	LOI450	Loss on Ignition (%)	1.2			10
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	27	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.47	100		
N	PHSOIL	pH (pH units)	8.8		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.24		To be evaluated	To be evaluated

tation	Code		10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSE 12457/2 @ L/S 10 litre kg-1				
Accreditation	Method	Leachate Analysis	mg/l except ⁰⁰	mg/kg (dry weight)		mg/kg (dry w			
U	WSLM3	pH (pH units) ⁰⁰	7.9	Calculated data not UKAS Accredited					
U	WSLM2	Conductivity (µs/cm) 00	645	Calculated data flot OKAS Accredited					
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25		
U	ICPWATVAR	Barium	0.06	0.6	20	100	300		
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5		
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70		
U	ICPMSW	Copper	<0.001	<0.01	2	50	100		
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2		
U	ICPMSW	Molybdenum	0.003	0.03	0.5	10	30		
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40		
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50		
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5		
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7		
U	ICPMSW	Zinc	0.003	0.03	4	50	200		
U	KONENS	Chloride	148	1480	800	15000	25000		
U	ISEF	Fluoride	0.3	3	10	150	500		
U	ICPWATVAR	Sulphate as SO4	40	400	1000	20000	50000		
N	WSLM27	Total Dissolved Solids	503	5030	4000	60000	100000		
U	SFAPI	Phenol Index	<0.05	<0.5	1				
N	WSLM13	Dissolved Organic Carbon	2	20	500	800	1000		

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Client Causeway Geotech Ltd				Leaching Data					
Cilent	Causeway Geolech Lic			Weight of sample (kg)						
Contact	Noil Haggan				Moisture content @ 105°C (% of Wet Weight)					
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg) 0.090						
Site	ite Arklow Sewerage Scheme Marine Outfall GI				Volume of water required to carry out 10:1 stage (litres) 0.8					
Site	Arkiow Sewerage Scrie		liali Gi	Fraction of sample above 4 mm %	17.000					
Samı	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000				
BH10 1.50		s18_0513	CL/1783106	27-Nov-17						

Note: The >4mm fraction is crushed using a disc mill

				Landfill W	/aste Acceptance (Criteria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	5.4	3	5	6
N	LOI450	Loss on Ignition (%)	12.2			10
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.11	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	<0.028	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	82	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<2.29	100		
N	PHSOIL	pH (pH units)	8.1		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.58		To be evaluated	To be evaluated

tation	Code		10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1					
Accreditation	Method	Leachate Analysis	mg/l except ^{oo}	mg/kg (dry weight)	g (dry weight) mg/kg (dry weight)					
U	WSLM3	pH (pH units) 00	7.6	Calculated data not UKAS Accredited						
U	WSLM2	Conductivity (µs/cm) 00	4340	Calculated data flot OKAS Accredited						
U	ICPMSW	Arsenic	0.006	0.06	0.5	2	25			
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300			
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5			
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70			
U	ICPMSW	Copper	<0.001	<0.01	2 50		100			
U	ICPMSW	Mercury	<0.0001	<0.001	0.01 0.2		2			
U	ICPMSW	Molybdenum	0.061	0.61	0.5	10	30			
U	ICPMSW	Nickel	0.001	0.01	0.4	10	40			
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50			
U	ICPMSW	Antimony	0.004	0.04	0.06	0.7	5			
U	ICPMSW	Selenium	0.005	0.05	0.1	0.5	7			
U	ICPMSW	Zinc	0.002	0.02	4	50	200			
U	KONENS	Chloride	1250	12500	800	15000	25000			
U	ISEF	Fluoride	0.5	5	10	150	500			
U	ICPWATVAR	Sulphate as SO4	254	2540	1000	20000	50000			
N	WSLM27	Total Dissolved Solids	3380	33800	4000	60000	100000			
U	SFAPI	Phenol Index	<0.05	<0.5	1					
N	WSLM13	Dissolved Organic Carbon	11	110	500	800	1000			

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causaway Caataah	l +d			Leaching Data						
Cilent	Causeway Geotech	Liu			Weight of sample (kg)	0.107					
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight) 9						
Contact	пен паууан			Equivalent Weight based on drying at 105°C (kg) 0.090							
Site	Arklow Sewerage Scheme Marine Outfall GI				Volume of water required to carry out 10:1 stage (litres) 0.						
Site	Arkiow Sewerage St		iali Gi	Fraction of sample above 4 mm %	0.000						
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000					
BH10 2.50		s18_0513	CL/1783107	27-Nov-17							

Note: The >4mm fraction is crushed using a disc mill

	4			Landfill W	aste Acceptance (Criteria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.18	3	5	6
N	LOI450	Loss on Ignition (%)	1.4			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	21	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.50	100		
Ν	PHSOIL	pH (pH units)	7.8		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.08		To be evaluated	To be evaluated

tation	Code		10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1					
Accreditation	Method	Leachate Analysis	mg/l except ^{oo}	mg/kg (dry weight)		mg/kg (dry we				
U	WSLM3	pH (pH units) 00	7.7	Calculated data not UKAS Accredited						
U	WSLM2	Conductivity (µs/cm) 00	909	Calculated data flot OKAS Accredited						
U	ICPMSW	Arsenic	0.012	0.12	0.5	2	25			
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300			
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5			
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70			
U	ICPMSW	Copper	<0.001	<0.01	2	50	100			
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2			
U	ICPMSW	Molybdenum	0.02	0.2	0.5	10	30			
U	ICPMSW	Nickel	0.002	0.02	0.4	10	40			
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50			
U	ICPMSW	Antimony	0.013	0.13	0.06	0.7	5			
U	ICPMSW	Selenium	0.002	0.02	0.1	0.5	7			
U	ICPMSW	Zinc	<0.002	<0.02	4	50	200			
U	KONENS	Chloride	229	2290	800	15000	25000			
U	ISEF	Fluoride	0.3	3	10	150	500			
U	ICPWATVAR	Sulphate as SO4	41	410	1000	20000	50000			
N	WSLM27	Total Dissolved Solids	709	7090	4000	60000	100000			
U	SFAPI	Phenol Index	<0.05	<0.5	1					
N	WSLM13	Dissolved Organic Carbon	1.4	14	500	800	1000			

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

S180513

Socotec Environmental Chemistry Analytical and Deviating Sample Overview

Customer Causeway Geotech Ltd
Site Arklow Sewerage Scheme Marine Outfall GI
Report No S180513

Consignment No S70198
Date Logged 09-Nov-2017

In-House Report Due 29-Nov-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working

		MethodID	ANC	втехнѕа		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL/1783105	BH10 0.50	26/10/17		Е	E				Е		Е		Е	Е	Е
CL/1783106	BH10 1.50	26/10/17		E	E				E		E		E	E	E
CL/1783107	BH10 2.50	26/10/17		E	E				E		E		E	E	E
CL/1783108	QC Blank														
CL/1783109	Reference Material (% Recovery	<u>/</u>)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- C Headspace present in the sample container
- D The sampling date was not supplied so holding time may be compromised applicable to all analysis
- E Sample processing did not commence within the appropriate holding time
- F Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number: EFS/180513

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ANC	Oven Dried	Quantitative digestion with Hydrochloric Acid back titration with 1M
		@ < 35°C	Sodium Hydroxide to pH 7
Soil	BTEXHSA	As Received	Determination of Benzene, Toluene, Ethyl benzene and Xylenes (BTEX) by Headspace GCFID
Soil	LOI(%MM)	Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water	ISEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water	WSLM27	As Received	Gravimetric Determination
Water	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.

 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- P Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- **‡** MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 14 of 14 EFS/180513 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number : \$18_0513

Note: major constituent in upper case

		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1783105	BH10 0.50	MARINE SEDIMENTS
CL/1783106	BH10 1.50	MARINE SEDIMENTS
CL/1783107	BH10 2.50	MARINE SEDIMENTS
CL/1783108	QC Blank	QUALITY CONTROL SAMPLE
CL/1783109	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE
02/1/00/100	received waterial (70 recovery)	QOALIT I CONTINCE OAMI EL

Appendix A Page 1 of 1 29/11/2017EFS/180513 Ver. 1

Our Ref: EFS/180835 (Ver. 1)

Your Ref: 17-0167 December 6, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry

SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

Where appropriate the samples will be kept until 02/01/18 when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

J Colbourne
Project Co-ordinator
01283 554547

TEST REPORT



Report No. EFS/180835 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 5 samples described in this report were registered for analysis by SOCOTEC UK Limited on 21-Nov-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 06-Dec-2017

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 7)
Table of PCB Congener Results (Page 8)
Table of WAC Analysis Results (Pages 9 to 11)
Analytical and Deviating Sample Overview (Page 12)
Table of Method Descriptions (Page 13)
Table of Report Notes (Page 14)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim (

Tim Barnes

Operations Director Energy & Waste Services

Tests marked '^' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 06-Dec-2017

		Units :	μg/kg	pH Units	%	mg/kg	mg/kg	% M/M	Mol/kg	%	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	mg/kg
	Method Reporti	od Codes :	PCBECD 5	PHSOIL	TMSS 0.1	TPHFIDUS 10	TPHFIDUS 10	WSLM59 0.02	ANC 0.04	0.2	BTEXHSA 10	BTEXHSA 10	BTEXHSA 10	BTEXHSA 20	30	BTEXHSA 20	BTEXHSA 10	PAHMSUS
	memed Report		Ů		0.1	10	10	0.02	0.01	0.2	10	10	10	20		20	10	
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	МТВЕ	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1784483	BH11 0.50	02-Nov-17	Req	7.9	3.1	21	21	0.17	0.96	0.7	<10	<10	<10	<20	<30	<20	<10	Req
1784484	BH11 2.50	02-Nov-17	Req	8	6.8	234	235	0.33	1.04	1.2	<10	<10	<10	<20	<30	<20	<10	Req
1784485	BH11 4.50	02-Nov-17	Req	8	4.8	11	12	0.08	0.48	0.6	<10	<10	<10	<20	<30	<20	<10	Req
1784486	QC Blank		Req			<10	<10	<0.02			<10	<10	<10	<20	<30	<20	<10	Req
1784487	Reference Material (% Recovery)		Req	99		103	103	100	99	104	102	101	98	106	195	99	96	Req
	SOCOTEC Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ		Client N Contact		Causeway Geotech Ltd Neil Haggan Date Printed Report Number													
	Tel +44 (0) 1283 554422 Arklow Sewerage Scheme Marine Outfall GI Fax +44 (0) 1283 554422 Report Number Table Number 1																	

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: **Sample Details:** BH11 0.50 S18_0835 LIMS ID Number: CL1784483 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration Date Analysed: 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	96
Acenaphthene-d10	97
Phenanthrene-d10	96
Chrysene-d12	95
Perylene-d12	83

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	95
Terphenyl-d14	78

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: **Sample Details:** BH11 2.50 S18_0835 LIMS ID Number: CL1784484 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File: Initial Calibration** Date Analysed: 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	93
Acenaphthene-d10	95
Phenanthrene-d10	91
Chrysene-d12	82
Perylene-d12	62

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	97
Terphenyl-d14	78

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: **Sample Details:** BH11 4.50 S18_0835 LIMS ID Number: CL1784485 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File: Initial Calibration Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	1	< 0.08	-
Chrysene	218-01-9	1	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	92
Acenaphthene-d10	92
Phenanthrene-d10	90
Chrysene-d12	82
Perylene-d12	63

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	102
Terphenyl-d14	81

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

QC Blank Job Number: **Sample Details:** S18_0835 LIMS ID Number: CL1784486 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File: Initial Calibration** Date Analysed: 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	ı	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	96
Acenaphthene-d10	97
Phenanthrene-d10	95
Chrysene-d12	81
Perylene-d12	62

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	103
Terphenyl-d14	80

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: **Sample Details:** S18_0835 LIMS ID Number: CL1784487 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration Date Analysed: 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil Dilution: **Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.31	103	100
Acenaphthylene	208-96-8	4.36	103	99
Acenaphthene	83-32-9	4.48	104	92
Fluorene	86-73-7	4.87	101	92
Phenanthrene	85-01-8	5.72	97	100
Anthracene	120-12-7	5.77	100	99
Fluoranthene	206-44-0	7.08	98	90
Pyrene	129-00-0	7.37	98	88
Benzo[a]anthracene	56-55-3	9.06	102	99
Chrysene	218-01-9	9.11	98	99
Benzo[b]fluoranthene	205-99-2	10.59	96	96
Benzo[k]fluoranthene	207-08-9	10.62	96	96
Benzo[a]pyrene	50-32-8	11.02	98	96
Indeno[1,2,3-cd]pyrene	193-39-5	12.39	80	90
Dibenzo[a,h]anthracene	53-70-3	12.43	71	94
Benzo[g,h,i]perylene	191-24-2	12.69	82	93
Coronene	191-07-1	14.89	63	73
Total (USEPA16) PAHs	-	-	99	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	-
Acenaphthene-d10	-
Phenanthrene-d10	-
Chrysene-d12	-
Perylene-d12	-

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	-
Terphenyl-d14	-

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall Gl

 Job Number:
 \$18_0835

 QC Batch Number:
 171265

Directory: 112317PCB.GC70

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

				Con	centration,	(µg/kg)		
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180
CL1784483	BH11 0.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784484	BH11 2.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784485	BH11 4.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784486	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784487	Reference Material (% Recovery)	87	90	81	98	96	95	80

Soil

21-Nov-17

23-Nov-17

23-Nov-17

Client Causeway Geotech Ltd		Leaching Data				
Cilent	Causeway Geotech Ltd			Weight of sample (kg)	0.095	
Contact Neil Haggan			Moisture content @ 105°C (% of Wet Weight)	3.1		
Comaci	Neil Haggan				Equivalent Weight based on drying at 105°C (kg)	
Site	Arklow Coweres Cohem	o Marina Ou	tfall CI	Volume of water required to carry out 10:1 stage (litres)		
Site	Arklow Sewerage Schem	le Marine Ou	liali Gi	Fraction of sample above 4 mm %	21.900	
Sample Description Report No Sample			Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH11 0.50		s18_0835	CL/1784483	06-Dec-17		

Note: The >4mm fraction is crushed using a disc mill

				Landfill Was	ste Acceptance Cri	teria Limit Values
Accreditation	Method Code	Metho		Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.17	3	5	6
Ν	LOI450	Loss on Ignition (%)	0.7			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	22	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.40	100		
Ν	PHSOIL	pH (pH units)	7.9		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.96		To be evaluated	To be evaluated

itation	I Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1		e Acceptance Crite N 12457/2 @ L/S 1	eria Limit Values for 0 litre kg-1
Accreditation	Method		mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry weight)		ght)
U	WSLM3	pH (pH units) 00	7.8	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	136	Calculated data flot OKAS Accredited			
U	ICPMSW	Arsenic	0.006	0.06	0.5	2	25
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	0.008	0.08	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.003	0.03	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	0.009	0.09	0.5	10	50
U	ICPMSW	Antimony	0.001	0.01	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.015	0.15	4	50	200
U	KONENS	Chloride	15	150	800	15000	25000
U	ISEF	Fluoride	0.4	4	10	150	500
U	ICPWATVAR	Sulphate as SO4	11	110	1000 20000 50000		50000
Ν	WSLM27	Total Dissolved Solids	106	1060	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
Ν	WSLM13	Dissolved Organic Carbon	2.4	24	500	800	1000

Template Ver.

andfill Waste Acceptance Criteria limit values correct as of 11th March 200

Client	Causaway Caataah	t d		Leaching Data		
Ciletit	Causeway Geotech	Liu		Weight of sample (kg)	0.092	
Contact Neil Haggan			Moisture content @ 105°C (% of Wet Weight)	6.8		
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg)		
Site	Arklow Coweres Co	homo Marina Ou	utfall CI	Volume of water required to carry out 10:1 stage (litres)		
Site	Arklow Sewerage Sc	neme Manne Ou	iliali Gi	Fraction of sample above 4 mm %	93.500	
Sa	ample Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH11 2.50		s18 0835	CL/1784484	06-Dec-17		
BH112.30 \$10_			CL/1704404	00-Dec-17		

Note: The >4mm fraction is crushed using a disc mill

	4			Landfill Was	ste Acceptance Cri	teria Limit Values
Accreditation	Method Code	Metho		Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.33	3	5	6
Ν	LOI450	Loss on Ignition (%)	1.2			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.06	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	251	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.46	100		
Ν	PHSOIL	pH (pH units)	8		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.05		To be evaluated	To be evaluated

itation	I Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1		eria Limit Values for 0 litre kg-1	
Accreditation	Method Code	•	mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry weight)		ght)
כ	WSLM3	pH (pH units) 00	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	142	Calculated data flot ONAS Accredited			
U	ICPMSW	Arsenic	0.006	0.06	0.5	2	25
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	0.001	0.01	0.5	10	70
U	ICPMSW	Copper	0.01	0.1	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.001	0.01	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	0.008	0.08	0.5	10	50
U	ICPMSW	Antimony	0.001	0.01	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.014	0.14	4	50	200
U	KONENS	Chloride	21	210	800	15000	25000
U	ISEF	Fluoride	0.3	3	10	150	500
U	ICPWATVAR	Sulphate as SO4	10	100	1000	20000	50000
Ν	WSLM27	Total Dissolved Solids	111	1110	4000	60000	100000
U	SFAPI	Phenol Index	< 0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	2	20	500	800	1000

Template Ver.

andfill Waste Acceptance Criteria limit values correct as of 11th March 200

Client	Causaway Caataah Ltd				Leaching Data			
Cilent	Causeway Geotech Ltd			Weight of sample (kg)	0.100			
Contact	Noil Hoggon			Moisture content @ 105°C (% of Wet Weight)				
Contact	Neil Haggan		Equivalent Weight based on drying at 105°C (kg)	0.090				
Site	Arklow Coweres Cohem	o Marina Ou	tfall CI		Volume of water required to carry out 10:1 stage (litres) (
Site	Arklow Sewerage Schem	le Marine Ou	liali Gi		Fraction of sample above 4 mm %	90.800		
Samp	le Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000		
BH11 4.50		s18 0835	CL/1784485 06-Dec-17					
·	DELL 4.50	\$10_0033	CL/1/04403	00-Dec-17		4.8 0.090 0.890 90.800		

Note: The >4mm fraction is crushed using a disc mill

				Landfill Was	ste Acceptance Cri	teria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.08	3	5	6
Ν	LOI450	Loss on Ignition (%)	0.6			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.06	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	12	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.43	100		
Ν	PHSOIL	pH (pH units)	8		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.48		To be evaluated	To be evaluated

itation	l Code	Leachate Analysis	10:1 Single Stage Leachate	Leachate Calculated cumulative amount leached @ 10:1		Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1				
Accreditation	Method Code	·	mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry weight)					
כ	WSLM3	pH (pH units) 00	7.5	Calculated data not UKAS Accredited						
U	WSLM2	Conductivity (µs/cm) 00	<100	Calculated data flot ONAS Accredited						
U	ICPMSW	Arsenic	0.014	0.14	0.5	2	25			
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300			
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5			
U	ICPMSW	Chromium	0.001	0.01	0.5	10	70			
U	ICPMSW	Copper	0.005	0.05		50	100			
U	ICPMSW	Mercury	0.0011	0.011	0.01	0.2	2			
U	ICPMSW	Molybdenum	0.002	0.02	0.5	10	30			
U	ICPMSW	Nickel	0.001	0.01	0.4	10	40			
U	ICPMSW	Lead	0.005	0.05	0.5	10	50			
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5			
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7			
U	ICPMSW	Zinc	0.01	0.1	4	50	200			
U	KONENS	Chloride	12	120	800	15000	25000			
U	ISEF	Fluoride	0.2	2	10	150	500			
U	ICPWATVAR	Sulphate as SO4	9	90	1000	20000	50000			
Ν	WSLM27	Total Dissolved Solids	64.6	646	4000	60000	100000			
U	SFAPI	Phenol Index	< 0.05	<0.5	1					
Ν	WSLM13	Dissolved Organic Carbon	1.3	13	500	800	1000			

Template Ver.

andfill Waste Acceptance Criteria limit values correct as of 11th March 200

Report No

S180835

Socotec Environmental Chemistry Analytical and Deviating Sample Overview

Customer Causeway Geotech Ltd
Site Arklow Sewerage Scheme Marine Outfall GI

Consignment No S70496
Date Logged 21-Nov-2017

S180835

In-House Report Due 11-Dec-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

									c the			u, u	u 00.		
		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)	CEN Leac(P)C	Report C	LO.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL/1784483	BH11 0.50	02/11/17		Е	Е				Е		Е		Е	Е	Е
CL/1784484	BH11 2.50	02/11/17		E	Ē				E		E		E	E	E
CL/1784485	BH11 4.50	02/11/17		E	Ē				E		E		E	E	E
CL/1784486	QC Blank	02/11/17		_	_				_		_		_	_	-
CL/1784487	Reference Material (% Recovery	/)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- C Headspace present in the sample container
- The sampling date was not supplied so holding time may be compromised applicable to all analysis
- Sample processing did not commence within the appropriate holding time
- F Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number: EFS/180835

Method Descriptions

Soil E	ANC BTEXHSA LOI(%MM)	Oven Dried @ < 35°C As Received	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7 Determination of Benzene, Toluene, Ethyl benzene and Xylenes
		As Received	Determination of Renzene Tolliene, Ethyl henzene and Yylenes
Soil	LOI(%MM)		(BTEX) by Headspace GCFID
		Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil F	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil F	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil F	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil 1	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil 1	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water I	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water I	CPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water I	SEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water k	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water S	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water V	WSLM27	As Received	Gravimetric Determination
Water V	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite

TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 14 of 14 EFS/180835 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: S18_0835

Note: major constituent in upper case

L-LIBNE 1		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1784483	BH11 0.50	MARINE SEDIMENTS
CL/1784484	RH11 2 50	MARINE SEDIMENTS
CL/1784484 CL/1784485	BH11 2.50 BH11 4.50	MARINE SEDIMENTS
CL/1784485	BH11 4.50	WARTINE SEDIMENTS
CL/1784486	QC Blank	QUALITY CONTROL SAMPLE
CL/1784487	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE
	+	
	<u> </u>	

Appendix A Page 1 of 1 12/12/2017EFS/180835 Ver. 1

Our Ref: EFS/178704 (Ver. 1)

Your Ref: 17-0167 September 29, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry

ESC

Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

The samples will be kept until the agreed date when they will be discarded. Please call 01283 554458 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with Environmental Scientifics Group Ltd (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for ESG

J Chislett
Project Co-ordinator
01283 554458

TEST REPORT



Report No. EFS/178704 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 4 samples described in this report were registered for analysis by ESG on 14-Sep-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 29-Sep-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 6)
Table of PCB Congener Results (Page 7)
Table of WAC Analysis Results (Pages 8 to 9)
Analytical and Deviating Sample Overview (Page 10)
Table of Additional Report Notes (Page 11)
Table of Method Descriptions (Page 12)
Table of Report Notes (Page 13)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of ESG:

Tim Barnes

Operations Director Energy & Waste Services

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Tests marked 'A' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

ESG accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 29-Sep-2017

		Units :	μg/kg	pH Units	%	mg/kg	mg/kg	% M/M	Mol/kg	%	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	mg/kg
		od Codes :	PCBECD	PHSOIL	TMSS	TPHFIDUS	TPHFIDUS	WSLM59	ANC	LOI(%MM)	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	PAHMSUS
	Method Reporti	ng Limits :	5		0.1	10	10	0.02	0.04	0.2	10	10	10	20	30	20	10	
LABID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1775349	BH12 0.50	24-Aug-17	Req	8.4	9.3	<10	18	0.27	0.56	0.9	<10	<10	<10	<20	<30	<20	<10	Req
1775350	BH12 4.50	24-Aug-17	Req	8.4	19.8	<10	19	0.49	2.56	3.2	<10	<10	<10	<20	<30	<20	<10	Req
1775351	QC Blank		Req §			<10 §	<10 §	<0.02 §			<10 §	<10 §	<10 §	<20 §	<30 §	<20 §	<10 §	Req §
1775352	Reference Material (% Recovery)		Req §	102.9 §		92 §	92 §	91 §	102	98.3	103 §	105 §	103 §	101 §	103 §	104 §	101 §	Req §
	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ		Client N Contact		Neil Hagg			- B4-		246-1	1.01	Date Prin	nted	ple Ana	29-	Sep-2017 FS/178704		
	Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		Ark	iow S	bewer	age S	cnem	ie ivia	rine (Dutfal	ı GI	Table Nu				1	-	

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

S17_8704 **Sample Details:** BH12 0.50 **Job Number:** LIMS ID Number: CL1775349 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	3.26	0.12	96
Acenaphthylene	208-96-8	ı	< 0.08	-
Acenaphthene	83-32-9	ı	< 0.08	-
Fluorene	86-73-7	ı	< 0.08	-
Phenanthrene	85-01-8	ı	< 0.08	-
Anthracene	120-12-7	ı	< 0.08	-
Fluoranthene	206-44-0	ı	< 0.08	-
Pyrene	129-00-0	ı	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	ı	< 0.08	-
Benzo[b]fluoranthene	205-99-2	ı	< 0.08	-
Benzo[k]fluoranthene	207-08-9	ı	< 0.08	-
Benzo[a]pyrene	50-32-8	ı	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	ı	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	ı	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.32	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	95
Acenaphthene-d10	92
Phenanthrene-d10	86
Chrysene-d12	76
Perylene-d12	64

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	103
Terphenyl-d14	77

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: s17_8704 **Sample Details:** BH12 4.50 LIMS ID Number: CL1775350 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	ı	< 0.08	-
Acenaphthene	83-32-9	ı	< 0.08	-
Fluorene	86-73-7	ı	< 0.08	-
Phenanthrene	85-01-8	ı	< 0.08	-
Anthracene	120-12-7	ı	< 0.08	-
Fluoranthene	206-44-0	ı	< 0.08	-
Pyrene	129-00-0	ı	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	ı	< 0.08	-
Benzo[b]fluoranthene	205-99-2	ı	< 0.08	-
Benzo[k]fluoranthene	207-08-9	ı	< 0.08	-
Benzo[a]pyrene	50-32-8	ı	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	ı	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	ı	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	92
Acenaphthene-d10	88
Phenanthrene-d10	82
Chrysene-d12	73
Perylene-d12	61

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	104
Terphenyl-d14	78

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

QC Blank s17_8704 **Sample Details: Job Number:** LIMS ID Number: CL1775351 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	1	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	1	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	86
Acenaphthene-d10	82
Phenanthrene-d10	74
Chrysene-d12	57
Perylene-d12	43

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	108
Terphenyl-d14	76

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: S17_8704 **Sample Details:** LIMS ID Number: CL1775352 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File:** Initial Calibration **Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.26	101	100
Acenaphthylene	208-96-8	4.30	99	99
Acenaphthene	83-32-9	4.42	107	97
Fluorene	86-73-7	4.81	103	98
Phenanthrene	85-01-8	5.65	106	99
Anthracene	120-12-7	5.70	103	100
Fluoranthene	206-44-0	7.00	111	91
Pyrene	129-00-0	7.29	109	90
Benzo[a]anthracene	56-55-3	8.97	108	99
Chrysene	218-01-9	9.02	112	99
Benzo[b]fluoranthene	205-99-2	10.50	101	96
Benzo[k]fluoranthene	207-08-9	10.54	103	97
Benzo[a]pyrene	50-32-8	10.93	109	97
Indeno[1,2,3-cd]pyrene	193-39-5	12.30	109	91
Dibenzo[a,h]anthracene	53-70-3	12.34	107	97
Benzo[g,h,i]perylene	191-24-2	12.60	103	95
Coronene	191-07-1	14.74	112	67
Total (USEPA16) PAHs	-	-	106	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	90
Acenaphthene-d10	92
Phenanthrene-d10	87
Chrysene-d12	96
Perylene-d12	100

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	104
Terphenyl-d14	85

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall Gl

 Job Number:
 \$17_8704

 QC Batch Number:
 171030

Directory: 092517PCB.GC70

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

		Concentration, (µg/kg)						
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1775349	BH12 0.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1775350	BH12 4.50	< 5.0	<5.0	<5.0	<5.0	<5.0	<5.0	< 5.0
CL1775351	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	< 5.0
CL1775352	Reference Material (% Recovery)	87.6	93.2	80.4	91.5	87.9	92.5	83.4

Soil

14-Sep-17

22-Sep-17

25-Sep-17

Client	Caucaway	Causeway Geotech Ltd			Leaching Data	
Client	Causeway G				Weight of sample (kg)	0.103
Contact	Noil Hoggon	oil Haggan			Moisture content @ 105°C (% of Wet Weight)	9.3
Contact	ntact Neil Haggan			Equivalent Weight based on drying at 105°C (kg)		
Site	Arklow Cowo	Arkiow Sewerage Scheme Marine Cilitali (4)		1.01	Volume of water required to carry out 10:1 stage (litres)	0.887
Site	AIRIOW Sewel			ii Gi	Fraction of sample above 4 mm %	50.100
Sample Descript	ion	Report No	port No Sample No Issue Date		Fraction of non-crushable material %	0.000
BH12 0.50		s17_8704	CL/1775349	29-Sep-17		

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_	_				fill Waste Acceptar	nce Criteria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.27	3	5	6
N	LOI450	Loss on Ignition (%)	0.9			10
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.06	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	<11	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.5	100		
N	PHSOIL	pH (pH units)	8.4		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.55		To be evaluated	To be evaluated

Accreditation	ditation od Leachate Analysis		10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Ac	10 litre	_
Accre	Method		mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry weight)		y weight)
U	WSLM3	pH (pH units) ^{oq}	6.9	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µ	984	Calculated data flot OKAS Accredited			
U	ICPMSW	Arsenic	0.003	0.03	0.5	2	25
U	ICPWATVAR	Barium	0.05	0.5	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	0.004	0.04	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.014	0.14	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	0.001	0.01	0.5	10	50
U	ICPMSW	Antimony	0.004	0.04	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.039	0.39	4	50	200
U	KONENS	Chloride	218	2180	800	15000	25000
U	ISEF	Fluoride	0.7	7	10	150	500
U	ICPWATVAR	Sulphate as SQ	65	650	1000	20000	50000
N	WSLM27	Total Dissolved	768	7680	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Orga	3.2	32	500	800	1000

Template Ver. 1

Client	Caucaway	useway Geotech Ltd			Leaching Data			
Client	Causeway G				Weight of sample (kg)	0.114		
Contact	Noil Hoggen				Moisture content @ 105°C (% of Wet Weight)	19.8		
Contact	Neil Haggan				Equivalent Weight based on drying at 105°C (kg)	0.090		
Site	A wistons Consor		Marina Outfal	1.01	Volume of water required to carry out 10:1 stage (litres)	0.876		
Site	Arklow Sewe	rage Scrienie	Marine Outrai	ii Gi	Fraction of sample above 4 mm %	0.000		
Sample Description Rep		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000		
BH12 4.50		s17 8704	CL/1775350	29-Sep-17	_			
DITIZ 4.50		317_0704	OL/11/0000	20 06p-17				

note:	ı ne	>4mm	rraction	15	crusnea	using	j a	aisc n	niii

_				Land	Ifill Waste Acceptar	nce Criteria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.51	3	5	6
N	LOI450	Loss on Ignition (%)	3.3			10
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	<12	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.70	100		
N	PHSOIL	pH (pH units)	8.4		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.67		To be evaluated	To be evaluated

Accreditation	d Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)					
Accre	Method		mg/l except ⁰⁰	mg/kg (dry weight)						
U	WSLM3	pH (pH units) ^{oq}	7.4	Calculated data not UKAS Accredited						
U	WSLM2	Conductivity (µ	984	Calculated data flot OKAS Accredited						
U	ICPMSW	Arsenic	0.006	0.06	0.5	2	25			
U	ICPWATVAR	Barium	0.06	0.6	20	100	300			
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5			
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70			
U	ICPMSW	Copper	0.002	0.02	2	50	100			
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2			
U	ICPMSW	Molybdenum	0.002	0.02	0.5	10	30			
U	ICPMSW	Nickel	0.002	0.02	0.4	10	40			
U	ICPMSW	Lead	0.001	0.01	0.5	10	50			
U	ICPMSW	Antimony	0.004	0.04	0.06	0.7	5			
U	ICPMSW	Selenium	0.002	0.02	0.1	0.5	7			
U	ICPMSW	Zinc	0.011	0.11	4	50	200			
U	KONENS	Chloride	228	2280	800	15000	25000			
U	ISEF	Fluoride	0.4	4	10	150	500			
U	ICPWATVAR	Sulphate as SQ	45	450	1000	20000	50000			
N	WSLM27	Total Dissolved	768	7680	4000	60000	100000			
U	SFAPI	Phenol Index	<0.05	<0.5	1					
N	WSLM13	Dissolved Orga	2.5	25	500	800	1000			

Template Ver. 1

Sample Analysis

ESG Environmental Chemistry Analytical and Deviating Sample Overview

S178704

Customer Causeway Geotech Ltd
Site Arklow Sewerage Scheme Marine Outfall GI
Report No S178704

Consignment No S_NonCon
Date Logged 14-Sep-2017
In-House Report Due 02-Oct-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
01 /47750 40	ID.140 0 50	0.1/0.0/17		_	_				_		_		_	_	
CL/1775349	BH12 0.50	24/08/17		Е	Е				Е		Е		Е	Е	
CL/1775350	BH12 4.50	24/08/17		Е	Е				Е		Е		Е	Е	
CL/1775351	QC Blank														
CL/1775352	Reference Material (% Recovery	y)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- B The sample was received without the correct preservation for this analysis
 - Headspace present in the sample container
- D The sampling date was not supplied so holding time may be compromised applicable to all analysis
 - Sample processing did not commence within the appropriate holding time Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Report Number : EFS/178704

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report

Report Number: EFS/178704

Method Descriptions

Soil E	ANC BTEXHSA LOI(%MM)	Oven Dried @ < 35°C As Received	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7 Determination of Benzene, Toluene, Ethyl benzene and Xylenes
		As Received	Determination of Renzene Tolliene, Ethyl henzene and Yylenes
Soil	LOI(%MM)		(BTEX) by Headspace GCFID
		Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil F	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil F	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil F	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil 1	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil 1	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water I	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water I	CPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water I	SEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water k	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water S	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water V	WSLM27	As Received	Gravimetric Determination
Water V	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 13 of 13 EFS/178704 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: S17_8704

Note: major constituent in upper case

Lai D Number Client D Description (CH777536) BH12 450 MARINE SEDMENT (CH777535) BH12 450 MARINE SEDMENT (CH777535) CB Description (CH77545) CB Description (CH775455) CB Description (CH775455) CB			Note: major constituent in upper case
CL/1775349 BH12 0.50 MARINE SEDIMENT CL/1775350 BH12 4.50 MARINE SEDIMENT	Lab ID Number	Client ID	Description
CL/1775350 BH12 4.50 MARINE SEDIMENT			
LU17/1350 GC Binn GULTY CONTROL SAMPLE CL1777352 Reference interest (is Recovery) GULTY CONTROL SAMPLE GULTY CONTROL SAMPLE	CL/17/5349	BH12 0.50	MARINE SEDIMENT
CL1773552 Gelleric Material (% Recovery QUALITY CONTROL SAMPLE CL1773552 Reference Material (% Recovery QUALITY CONTROL SAMPLE)	CL/1775350	BH12 4.50	MARINE SEDIMENT
CU1773362 Reference Material (W. Recovery) QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE	CL/1775351	QC Blank	QUALITY CONTROL SAMPLE
	CL/1775352	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE
		I	

Appendix A Page 1 of 1 04/10/2017EFS/178704 Ver. 1

Our Ref: EFS/178716 (Ver. 1)

Your Ref: 17-0167 September 29, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom



Environmental Chemistry

ESC

Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

BT53 7QL

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied.

The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

Where appropriate the samples will be kept until 26/10/17 when they will be discarded. Please call 01283 554458 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with Environmental Scientifics Group Ltd (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for ESG

J Chislett
Project Co-ordinator
01283 554458

TEST REPORT



Report No. EFS/178716 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 4 samples described in this report were registered for analysis by ESG on 14-Sep-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 29-Sep-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 6)
Table of PCB Congener Results (Page 7)
Table of WAC Analysis Results (Pages 8 to 9)
Analytical and Deviating Sample Overview (Page 10)
Table of Additional Report Notes (Page 11)
Table of Method Descriptions (Page 12)
Table of Report Notes (Page 13)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of ESG:

Tim Barnes

Operations Director Energy & Waste Services

Sarvicas

Tests marked 'A' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

ESG accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 29-Sep-2017

		Units :	μg/kg	pH Units	%	mg/kg	mg/kg	% M/M	Mol/kg	%	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	mg/kg
	Meth Method Reporti	od Codes :	PCBECD 5	PHSOIL	TMSS 0.1	TPHFIDUS 10	TPHFIDUS 10	0.02	ANC 0.04	LOI(%MM) 0.2	BTEXHSA 10	BTEXHSA 10	BTEXHSA 10	BTEXHSA 20	BTEXHSA 30	BTEXHSA 20	BTEXHSA 10	PAHMSUS
	method Reporti	ng Linits .	J		0.1	10	10	0.02	0.04	0.2	10	10	10	20	30	20	10	
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	МТВЕ	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1775421	BH13 0.50	23-Aug-17	Req	8.7	6.5	<10	18	0.13	<0.04	0.9	<10	<10	<10	<20	<30	<20	<10	Req
1775422	BH13 4.50	23-Aug-17	Req	8.8	20.4	<10	18	0.49	2.56	3.7	<10	<10	<10	<20	<30	<20	<10	Req
1775423	QC Blank		Req §			<10 §	<10 §	<0.02 §			<10 §	<10 §	<10 §	<20 §	<30 §	<20 §	<10 §	Req §
1775424	Reference Material (% Recovery)		Req §	103 §		92 §	92 §	101 §	101.8	101.1	99 §	99 §	98 §	100 §	98 §	98 §	97 §	Req §
	ESG &		Client N Contact		Causev Neil Hagg	vay Geot	ech Ltd					Date Prii	'	ple Ana		Sep-2017		
	Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		Ark	dow S	Sewer	age S	Schem	ne Ma	rine (Dutfal	Report Number EFS/178716 Table Number 1							

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: s17_8716 **Sample Details:** BH13 0.50 LIMS ID Number: CL1775421 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File:** Initial Calibration Date Analysed: 26-Sep-17 Directory: 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	1	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	1	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	- + D	< 1.28	- 1

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	95
Acenaphthene-d10	91
Phenanthrene-d10	83
Chrysene-d12	75
Perylene-d12	69

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	102
Terphenyl-d14	74

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_8716 **Sample Details:** BH13 4.50 LIMS ID Number: CL1775422 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	3.26	2.04	100
Acenaphthylene	208-96-8	ı	< 0.08	-
Acenaphthene	83-32-9	ı	< 0.08	-
Fluorene	86-73-7	ı	< 0.08	-
Phenanthrene	85-01-8	ı	< 0.08	-
Anthracene	120-12-7	ı	< 0.08	-
Fluoranthene	206-44-0	ı	< 0.08	-
Pyrene	129-00-0	ı	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	ı	< 0.08	-
Benzo[b]fluoranthene	205-99-2	ı	< 0.08	-
Benzo[k]fluoranthene	207-08-9	ı	< 0.08	-
Benzo[a]pyrene	50-32-8	ı	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	ı	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 3.24	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	113
Acenaphthene-d10	114
Phenanthrene-d10	113
Chrysene-d12	135
Perylene-d12	149

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	95
Terphenyl-d14	79

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

QC Blank s17_8716 **Sample Details: Job Number:** LIMS ID Number: CL1775423 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	1	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	1	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	86
Acenaphthene-d10	82
Phenanthrene-d10	74
Chrysene-d12	57
Perylene-d12	43

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	108
Terphenyl-d14	76

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: S17_8716 **Sample Details:** LIMS ID Number: CL1775424 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File:** Initial Calibration **Date Analysed:** 26-Sep-17 Directory: 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Recovery	% Fit	
		(min)	%		
Naphthalene	91-20-3	3.26	101	100	
Acenaphthylene	208-96-8	4.30	99	99	
Acenaphthene	83-32-9	4.42	107	97	
Fluorene	86-73-7	4.81	103	98	
Phenanthrene	85-01-8	5.65	106	99	
Anthracene	120-12-7	5.70	103	100	
Fluoranthene	206-44-0	7.00	111	91	
Pyrene	129-00-0	7.29	109	90	
Benzo[a]anthracene	56-55-3	8.97	108	99	
Chrysene	218-01-9	9.02	112	99	
Benzo[b]fluoranthene	205-99-2	10.50	101	96	
Benzo[k]fluoranthene	207-08-9	10.54	103	97	
Benzo[a]pyrene	50-32-8	10.93	109	97	
Indeno[1,2,3-cd]pyrene	193-39-5	12.30	109	91	
Dibenzo[a,h]anthracene	53-70-3	12.34	107	97	
Benzo[g,h,i]perylene	191-24-2	12.60	103	95	
Coronene	191-07-1	14.74	112	67	
Total (USEPA16) PAHs	-	-	106	-	

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	90
Acenaphthene-d10	92
Phenanthrene-d10	87
Chrysene-d12	96
Perylene-d12	100

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	104
Terphenyl-d14	85

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

 Job Number:
 \$17_8716

 QC Batch Number:
 171030

Directory: 092517PCB.GC70

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

				Con	centration,	(µg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1775421	BH13 0.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1775422	BH13 4.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1775423	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1775424	Reference Material (% Recovery)	87.6	93.2	80.4	91.5	87.9	92.5	83.4
		<u> </u>						

Soil

14-Sep-17

22-Sep-17

25-Sep-17

WASTE ACCEPTANCE CRITERIA TESTING BSEN 12457/2

Client	Courseway Costock Ltd		Leaching Data				
Cilent	Client Causeway Geotech Ltd				Weight of sample (kg)	0.100	
Contact Neil Haggan				Moisture content @ 105°C (% of Wet Weight)			
					Equivalent Weight based on drying at 105°C (kg) 0.0		
Site	Arklow Sewerage Scheme Marine Outfall GI				Volume of water required to carry out 10:1 stage (litres)		
Site	Arkiow Sewerage Schem	ie Marine Ou	liali Gi		Fraction of sample above 4 mm %	6.100	
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000	
BH13 0.50		s17 8716	CL/1775421	29-Sep-17			
		S17_0/10 CL/1//5421		29-3ep-17			

Note: The >4mm fraction is crushed using a disc mill

	4			Landfill Wast	te Acceptance Crit	eria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.13	3	5	6
N	LOI450	Loss on Ignition (%)	0.9			10
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.06	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	<11	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.45	100		
Ν	PHSOIL	pH (pH units)	8.7		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	< 0.04		To be evaluated	To be evaluated

tation	Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1			
Accreditation	Method Code		mg/l except [∞]	mg/kg (dry weight)	mg/kg (dry weight)		ht)	
U	WSLM3	pH (pH units) 00	7	Calculated data not UKAS Accredited				
U	WSLM2	Conductivity (µs/cm) 00	616	Calculated data not OKAS Accredited				
U	ICPMSW	Arsenic	0.001	0.01	0.5	2	25	
U	ICPWATVAR	Barium	0.05	0.5	20	100	300	
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5	
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70	
U	ICPMSW	Copper	0.001	0.01 2 50		50	100	
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2	
U	ICPMSW	Molybdenum	0.003	0.03	0.5	10	30	
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40	
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50	
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5	
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7	
U	ICPMSW	Zinc	0.01	0.1	4	50	200	
U	KONENS	Chloride	136	1360	800	15000	25000	
U	ISEF	Fluoride	0.4	4	10	150	500	
U	ICPWATVAR	Sulphate as SO4	28	280	1000	20000	50000	
Ν	WSLM27	Total Dissolved Solids	480	4800	4000	60000	100000	
U	SFAPI	Phenol Index	<0.05	<0.5	1			
N	WSLM13	Dissolved Organic Carbon	1.1	11	500 800 100		1000	

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

WASTE ACCEPTANCE CRITERIA TESTING BSEN 12457/2

Client	Causaway Castash Ltd			Leaching Data			
Cilent	Causeway Geotech Ltd		Weight of sample (kg) 0				
Contact	Noil Hoggon		Moisture content @ 105°C (% of Wet Weight)				
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg) 0.			
Site	Arklow Coweres Cohem	a Marina Ou	Volume of water required to carry out 10:1 stage (litres)				
Site	Arklow Sewerage Schem	ie Marine Ou	liali Gi	Fraction of sample above 4 mm %			
Samp	le Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000	
	3H13 4.50	s17 8716	CL/1775422	29-Sep-17			
<u> </u>	DH 13 4.30	517_0710		29-3ep-17			

Note: The >4mm fraction is crushed using a disc mill

	4			Landfill Wast	te Acceptance Crit	eria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.52	3	5	6
N	LOI450	Loss on Ignition (%)	3.9			10
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	<13	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<4.17	100		
Ν	PHSOIL	pH (pH units)	8.8		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.72		To be evaluated	To be evaluated

tation	Code	Leachate Analysis	10:1 Single Stage Leachate	chate Calculated cumulative amount leached @ 10:1		Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1				
Accreditation	Method	2000/idio / iliayolo	mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry weight)		ht)			
U	WSLM3	pH (pH units) 00	7.6	Calculated data not UKAS Accredited						
U	WSLM2	Conductivity (µs/cm) 00	1190	Calculated data not onas accredited						
U	ICPMSW	Arsenic	0.007	0.07	0.5	2	25			
U	ICPWATVAR	Barium	0.07	0.7	20	100	300			
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5			
U		Chromium	0.001	0.01	0.5	10	70			
U	ICPMSW	Copper	0.006	0.06	2	50	100			
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2			
U	ICPMSW	Molybdenum	0.002	0.02	0.5	10	30			
U	ICPMSW	Nickel	0.003	0.03	0.4	10	40			
U	ICPMSW	Lead	0.003	0.03	0.5	10	50			
U	ICPMSW	Antimony	0.004	0.04	0.06	0.7	5			
U	ICPMSW	Selenium	0.002	0.02	0.1	0.5	7			
U	ICPMSW	Zinc	0.063	0.63	4	50	200			
U	KONENS	Chloride	271	2710	800	15000	25000			
U	ISEF	Fluoride	0.4	4	10	150	500			
U	ICPWATVAR	Sulphate as SO4	56	560	1000	20000	50000			
Ν	WSLM27	Total Dissolved Solids	927	9270	4000	60000	100000			
U	SFAPI	Phenol Index	<0.05	<0.5	1					
Ν	WSLM13	Dissolved Organic Carbon	3.1	31	500 800 100		1000			

nplate Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

ESG Environmental Chemistry

Analytical and Deviating Sample Overview

Customer **Causeway Geotech Ltd**

Site **Arklow Sewerage Scheme Marine Outfall GI** Report No

S178716

Consignment No S68871 Date Logged 14-Sep-2017

In-House Report Due 02-Oct-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

												· / ·			cu un
		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL/1775421	BH13 0.50	23/08/17		Е	Е				Е		Е		Е	Е	
CL/1775422	BH13 4.50	23/08/17		Ē	Ē				Ē		Ē		Ē	Ē	
CL/1775423	QC Blank														
CL/1775424	Reference Material (% Recovery	/)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- Headspace present in the sample container
- The sampling date was not supplied so holding time may be compromised applicable to all analysis
- Sample processing did not commence within the appropriate holding time
- Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number : EFS/178716

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report
_		

Report Number: EFS/178716

Method Descriptions

Soil E	ANC BTEXHSA LOI(%MM)	Oven Dried @ < 35°C As Received	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7 Determination of Benzene, Toluene, Ethyl benzene and Xylenes
		As Received	Determination of Renzene Tolliene, Ethyl henzene and Yylenes
Soil	LOI(%MM)		(BTEX) by Headspace GCFID
		Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil F	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil F	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil F	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil 1	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil 1	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water I	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water I	CPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water I	SEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water k	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water S	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water V	WSLM27	As Received	Gravimetric Determination
Water V	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 13 of 13 EFS/178716 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: S17_8716

Note: major constituent in upper case

		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1775421	BH13 0.50	MARINE SEDIMENT MARINE SEDIMENT
CL/1775422	BH13 4.50	MARINE SEDIMENT
CL/1775423	QC Blank	QUALITY CONTROL SAMPLE
CL/1775423 CL/1775424	QC Blank Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE

Appendix A Page 1 of 1 04/10/2017EFS/178716 Ver. 1

Our Ref: EFS/178710 (Ver. 1)

Your Ref: 17-0167 September 29, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry

ESC

Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

The samples will be kept until the agreed date when they will be discarded. Please call 01283 554458 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with Environmental Scientifics Group Ltd (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for ESG

J Chislett
Project Co-ordinator
01283 554458

TEST REPORT



Report No. EFS/178710 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 4 samples described in this report were registered for analysis by ESG on 14-Sep-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 29-Sep-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 6)
Table of PCB Congener Results (Page 7)
Table of WAC Analysis Results (Pages 8 to 9)
Analytical and Deviating Sample Overview (Page 10)
Table of Additional Report Notes (Page 11)
Table of Method Descriptions (Page 12)
Table of Report Notes (Page 13)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of ESG:

Tim Barnes

Operations Director Energy & Waste Services Date of Issue: 29-Sep-2017

Tests marked 'A' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

ESG accepts no responsibility for any sampling not carried out by our personnel.

		Units :	μg/kg	pH Units	%	mg/kg	mg/kg	% M/M	Mol/kg	%	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	mg/kg
	Method Codes : Method Reporting Limits :		PCBECD 5	PHSOIL	TMSS 0.1	TPHFIDUS 10	TPHFIDUS 10	WSLM59 0.02	ANC 0.04	0.2	BTEXHSA 10	BTEXHSA 10	BTEXHSA 10	BTEXHSA 20	BTEXHSA 30	BTEXHSA 20	BTEXHSA 10	PAHMSUS
	Method Reporti	iig Liiiits .	,		0.1	10	10	0.02	0.04	0.2	10	10	10	20	30	20	10	
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1775387	BH14 0.25	22-Aug-17	Req	8.6	17.7	66	79	0.27	0.72	1.2	<10	<10	<10	<20	<30	<20	<10	Req
1775388	BH14 2.75	22-Aug-17	Req	9	18.1	<10	20	0.42	3.04	2.6	<10	<10	<10	<20	<30	<20	<10	Req
1775389	QC Blank		Req §		N/A §	<10 §	<10 §	<0.02 §			<10 §	<10 §	<10 §	<20 §	<30 §	<20 §	<10 §	Req §
1775390	Reference Material (% Recovery)		Req §	103 §	N/A §	92 §	92 §	91 §	102	98.3	103 §	105 §	103 §	101 §	103 §	104 §	101 §	Req §
													S					
	ESG 🕏		Client N			vay Geot	ecn Ltd					Sample Analysis						
	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ		Contact		Neil Hagg	age S	chem	ne Ma	rine (Outfal	l GI	Date Printed 29-Sep-2017 Report Number EFS/178710						
	Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		-									Table Number 1						

Where individual results are flagged see report notes for status.

Page 2 of 13

EFS/178710 Ver. 1

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

s17_8710 **Sample Details:** BH14 0.25 **Job Number:** LIMS ID Number: CL1775387 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 Directory: 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	ı	< 0.08	-
Fluorene	86-73-7	ı	< 0.08	-
Phenanthrene	85-01-8	ı	< 0.08	-
Anthracene	120-12-7	ı	< 0.08	-
Fluoranthene	206-44-0	ı	< 0.08	-
Pyrene	129-00-0	ı	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	ı	< 0.08	-
Benzo[b]fluoranthene	205-99-2	ı	< 0.08	-
Benzo[k]fluoranthene	207-08-9	ı	< 0.08	-
Benzo[a]pyrene	50-32-8	ı	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	ı	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	ı	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	93
Acenaphthene-d10	89
Phenanthrene-d10	83
Chrysene-d12	79
Perylene-d12	82

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	103
Terphenyl-d14	74

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_8710 **Sample Details:** BH14 2.75 LIMS ID Number: CL1775388 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	3.26	0.09	95
Acenaphthylene	208-96-8	ı	< 0.08	-
Acenaphthene	83-32-9	ı	< 0.08	-
Fluorene	86-73-7	ı	< 0.08	-
Phenanthrene	85-01-8	ı	< 0.08	-
Anthracene	120-12-7	ı	< 0.08	-
Fluoranthene	206-44-0	ı	< 0.08	-
Pyrene	129-00-0	ı	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	ı	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.29	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	100
Acenaphthene-d10	97
Phenanthrene-d10	90
Chrysene-d12	86
Perylene-d12	82

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	98
Terphenyl-d14	72

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

QC Blank s17_8710 **Sample Details: Job Number:** LIMS ID Number: CL1775389 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 Directory: 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	86
Acenaphthene-d10	82
Phenanthrene-d10	74
Chrysene-d12	57
Perylene-d12	43

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	108
Terphenyl-d14	76

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: S17_8710 **Sample Details:** Date Booked in: LIMS ID Number: CL1775390 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File:** Initial Calibration **Date Analysed:** 26-Sep-17 Directory: 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.26	101	100
Acenaphthylene	208-96-8	4.30	99	99
Acenaphthene	83-32-9	4.42	107	97
Fluorene	86-73-7	4.81	103	98
Phenanthrene	85-01-8	5.65	106	99
Anthracene	120-12-7	5.70	103	100
Fluoranthene	206-44-0	7.00	111	91
Pyrene	129-00-0	7.29	109	90
Benzo[a]anthracene	56-55-3	8.97	108	99
Chrysene	218-01-9	9.02	112	99
Benzo[b]fluoranthene	205-99-2	10.50	101	96
Benzo[k]fluoranthene	207-08-9	10.54	103	97
Benzo[a]pyrene	50-32-8	10.93	109	97
Indeno[1,2,3-cd]pyrene	193-39-5	12.30	109	91
Dibenzo[a,h]anthracene	53-70-3	12.34	107	97
Benzo[g,h,i]perylene	191-24-2	12.60	103	95
Coronene	191-07-1	14.74	112	67
Total (USEPA16) PAHs	-	-	106	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	90
Acenaphthene-d10	92
Phenanthrene-d10	87
Chrysene-d12	96
Perylene-d12	100

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	104
Terphenyl-d14	85

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

 Job Number:
 \$17_8710

 QC Batch Number:
 171030

Directory: 092517PCB.GC70

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

				Con	centration,	(µg/kg)		
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1775387	BH14 0.25	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1775388	BH14 2.75	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1775389	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1775390	Reference Material (% Recovery)	87.6	93.2	80.4	91.5	87.9	92.5	83.4

Soil

14-Sep-17

22-Sep-17

25-Sep-17

WASTE ACCEPTANCE CRITERIA TESTING BSEN 12457/2

Client	Causeway Geotech Ltd		Leaching Data			
Cilent			Weight of sample (kg)	0.103		
Contact	rt INNA Hannan		Moisture content @ 105°C (% of Wet Weight)	17.7		
Contact			Equivalent Weight based on drying at 105°C (kg) 0.090			
Site	Arklow Sewerage Scheme Marine Outfall GI		Volume of water required to carry out 10:1 stage (litres)			
Site	Arkiow Sewerage Sci	neme Manne Ou	liali Gi		Fraction of sample above 4 mm %	0.000
Sam	Sample Description Report No Sample No Issue Date		Fraction of non-crushable material %	0.000		
BH14 0.25		s17_8710	CL/1775387	29-Sep-17		

Note: The >4mm fraction is crushed using a disc mill

					Vaste Acceptance	Criteria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.28	3	5	6
N	LOI450	Loss on Ignition (%)	1.2			10
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	80	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.65	100		
Ν	PHSOIL	pH (pH units)	8.6		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.74		To be evaluated	To be evaluated

Accreditation	Method Code	Leachate Analysis	10:1 Single Stage Leachate mg/l except ⁰⁰	Calculated cumulative amount leached @ 10:1 mg/kg (dry weight)	Landfill Waste Acceptance Criteria Limit Values for BSE 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)		
U	WSLM3	pH (pH units) 00	7.2	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	1010	Calculated data not office Accredited			
U	ICPMSW	Arsenic	0.003	0.03	0.5	2	25
U	ICPWATVAR	Barium	0.05	0.5	20	100	300
U	ICPMSW	Cadmium	0.0001	0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	0.005	0.05	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.012	0.12	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	0.007	0.07	0.5	10	50
U	ICPMSW	Antimony	0.003	0.03	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.037	0.37	4	50	200
U	KONENS	Chloride	244	2440	800	15000	25000
U	ISEF	Fluoride	0.5	5	10	150	500
U	ICPWATVAR	Sulphate as SO4	42	420	1000	20000	50000
N	WSLM27	Total Dissolved Solids	791	7910	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
Ν	WSLM13	Dissolved Organic Carbon	2.9	29	500	800	1000

Template Ver.

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

WASTE ACCEPTANCE CRITERIA TESTING BSEN 12457/2

Client	Causaway Caataah Ltd	Leaching Data						
Cilent	Causeway Geotech Ltd			Weight of sample (kg) 0				
Contact Neil Haggan					Moisture content @ 105°C (% of Wet Weight) 18			
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg) 0.0				
Site	Arklow Sowerage Schem	o Marina Out	foll CI		Volume of water required to carry out 10:1 stage (litres)			
Site	Arklow Sewerage Schem	le Marine Out	iaii Gi	Fraction of sample above 4 mm %	0.000			
Sample Description Report No Sample No Issue Date					Fraction of non-crushable material %			
· ·	BH14 2.75	s17_8710	CL/1775388	29-Sep-17				

Note: The >4mm fraction is crushed using a disc mill

				Landfill V	Vaste Acceptance	Criteria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.43	3	5	6
N	LOI450	Loss on Ignition (%)	2.7			10
N	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	<12	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.67	100		
Ν	PHSOIL	pH (pH units)	9		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	3.14		To be evaluated	To be evaluated

Accreditation	Method Code	Leachate Analysis	10:1 Single Stage Leachate mg/l except 00	Calculated cumulative amount leached @ 10:1 mg/kg (dry weight)	Landfill Waste Acceptance Criteria Limit Values for BSEI 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)		
U		pH (pH units) 00	8.1 1180	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	0.018	0.18	0.5	0	25
U	ICPMSW	Arsenic	0.018	0.18	0.5 20	100	300
<u> </u>	ICPWATVAR	* *	<0.001	•••		100	
U	ICPMSW	Cadmium		<0.001	0.04		5 70
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	-
U		Copper	0.003	0.03	2	50	100
U		Mercury	<0.0001	<0.001	0.01	0.2	2
U		Molybdenum	0.002	0.02	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.006	0.06	0.06	0.7	5
U	ICPMSW	Selenium	0.002	0.02	0.1	0.5	7
U	ICPMSW	Zinc	<0.002	<0.02	4	50	200
U	KONENS	Chloride	257	2570	800	15000	25000
U	ISEF	Fluoride	0.4	4	10	150	500
U	ICPWATVAR	Sulphate as SO4	62	620	1000	20000	50000
Ν	WSLM27	Total Dissolved Solids	923	9230	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	5.5	55	500	800	1000

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Sample Analysis

Customer

Report No

Site

ESG Environmental Chemistry Analytical and Deviating Sample Overview

Causeway Geotech Ltd Arklow Sewerage Scheme Marine Outfall GI

Date Logged 14-Sep-2017

Consignment No S68872

S178710 In-House Report Due 02-Oct-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

S178710

		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL /4775207	BH14 0.25	22/09/17		Е	Е				Е		Е		Е	Е	
CL/1775387 CL/1775388	BH14 2.75	22/08/17 22/08/17		E	E				E		E		E	E	
CL/1775389	QC Blank	22/00/17		_					_		_				
CL/1775390	Reference Material (% Recovery	y)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- Headspace present in the sample container
- The sampling date was not supplied so holding time may be compromised applicable to all analysis
- Sample processing did not commence within the appropriate holding time Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Report Number : EFS/178710

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report

Report Number: EFS/178710

Method Descriptions

Soil E	ANC BTEXHSA LOI(%MM)	Oven Dried @ < 35°C As Received	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7 Determination of Benzene, Toluene, Ethyl benzene and Xylenes
		As Received	Determination of Renzene Tolliene, Ethyl henzene and Yylenes
Soil	LOI(%MM)		(BTEX) by Headspace GCFID
		Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil F	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil F	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil F	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil 1	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil 1	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water I	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water I	CPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water I	SEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water k	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water S	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water V	WSLM27	As Received	Gravimetric Determination
Water V	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 13 of 13 EFS/178710 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: S17_8710

Note: major constituent in upper case

Lab ID Number Client ID Description CL/1775387 BH14 0.25 MARINE SEDIMENT CL/1775388 BH14 2.75 MARINE SEDIMENT CL/1775389 QC Blank QUALITY CONTROL SAMPLE CL/1775390 Reference Material (% Recovery) QUALITY CONTROL SAMPLE	
CL/1775387 BH14 0.25 MARINE SEDIMENT CL/1775388 BH14 2.75 MARINE SEDIMENT	
CL/1775388 BH14 2.75 MARINE SEDIMENT	
CL/1775388 BH14 2.75 MARKINE SEDIMENT CL/1775389 QC Blank QUALITY CONTROL SAMPLE CL/1775390 Reference Material (% Recovery) QUALITY CONTROL SAMPLE	
CL/1775389 QC Blank QUALITY CONTROL SAMPLE CL/1775390 Reference Material (% Recovery) QUALITY CONTROL SAMPLE	
CL/1775390 Reference Material (% Recovery) QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE	

Appendix A Page 1 of 1 04/10/2017EFS/178710 Ver. 1

Our Ref: EFS/178706 (Ver. 1)

Your Ref: 17-0167 September 29, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom



Environmental Chemistry

FS(

Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

BT53 7QL

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied.

The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

The samples will be kept until the agreed date when they will be discarded. Please call 01283 554458 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with Environmental Scientifics Group Ltd (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for ESG

J Chislett
Project Co-ordinator
01283 554458

TEST REPORT



Report No. EFS/178706 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 5 samples described in this report were registered for analysis by ESG on 14-Sep-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 29-Sep-2017

Tests where the accreditation is set to N or No, and any individual data items marked with a * are not UKAS accredited. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation.

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 7)
Table of PCB Congener Results (Page 8)
Table of WAC Analysis Results (Pages 9 to 11)
Analytical and Deviating Sample Overview (Page 12)
Table of Additional Report Notes (Page 13)
Table of Method Descriptions (Page 14)
Table of Report Notes (Page 15)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of ESG:

Tim Barnes

Operations Director Energy & Waste Services

Services

Tests marked 'A' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

ESG accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 29-Sep-2017

		Units :	μg/kg	pH Units	%	mg/kg	mg/kg	% M/M	Mol/kg	%	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	mg/kg
		od Codes :	PCBECD	PHSOIL	TMSS	TPHFIDUS	TPHFIDUS	WSLM59	ANC	LOI(%MM)	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	BTEXHSA	PAHMSUS
	Method Reporti	ing Limits :	5		0.1	10	10	0.02	0.04	0.2	10	10	10	20	30	20	10	
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1775359	BH15 1.50	25-Aug-17	Req	8.4	12.2	<10	16	0.14	1.52	0.8	<10	<10	<10	<20	<30	<20	<10	Req
1775360	BH15 3.50	25-Aug-17	Req	8.7	18.0	<10	16	0.09	1.12	0.8	<10	<10	<10	<20	<30	<20	<10	Req
1775361	BH15 5.50	25-Aug-17	Req	8.6	47.3	13	27	0.53	3.12	3.2	<10	<10	<10	<20	<30	<20	<10	Req
1775362	QC Blank		Req §			<10 §	<10 §	<0.02 §			<10 §	<10 §	<10 §	<20 §	<30 §	<20 §	<10 §	Req §
1775363	Reference Material (% Recovery)		Req §	103 §		92 §	92 §	101 §	102	101.1	103 §	105 §	103 §	101 §	103 §	104 §	101 §	Req §
	ESG 🕏		Client N			way Geot	ech Ltd						Sample Analysis					
	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422				Neil Hagg	rage S	Schem	ne Ma	rine (Outfal	I GI	Date Pri Report N Table Nu	lumber			Sep-2017 FS/178706 1		

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_8706 **Sample Details:** BH15 1.50 LIMS ID Number: CL1775359 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	3.26	0.14	99
Acenaphthylene	208-96-8	ı	< 0.08	-
Acenaphthene	83-32-9	ı	< 0.08	-
Fluorene	86-73-7	ı	< 0.08	-
Phenanthrene	85-01-8	ı	< 0.08	-
Anthracene	120-12-7	ı	< 0.08	-
Fluoranthene	206-44-0	ı	< 0.08	-
Pyrene	129-00-0	ı	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	ı	< 0.08	-
Benzo[b]fluoranthene	205-99-2	ı	< 0.08	-
Benzo[k]fluoranthene	207-08-9	ı	< 0.08	-
Benzo[a]pyrene	50-32-8	ı	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	ı	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.34	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	98
Acenaphthene-d10	97
Phenanthrene-d10	92
Chrysene-d12	89
Perylene-d12	90

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	102
Terphenyl-d14	77

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

s17_8706 **Sample Details:** BH15 3.50 **Job Number:** LIMS ID Number: CL1775360 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	3.26	0.50	98
Acenaphthylene	208-96-8	ı	< 0.08	•
Acenaphthene	83-32-9	ı	< 0.08	•
Fluorene	86-73-7	ı	< 0.08	-
Phenanthrene	85-01-8	ı	< 0.08	-
Anthracene	120-12-7	ı	< 0.08	-
Fluoranthene	206-44-0	ı	< 0.08	-
Pyrene	129-00-0	ı	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	-
Chrysene	218-01-9	ı	< 0.08	•
Benzo[b]fluoranthene	205-99-2	ı	< 0.08	•
Benzo[k]fluoranthene	207-08-9	ı	< 0.08	•
Benzo[a]pyrene	50-32-8	ı	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	ı	< 0.08	•
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.70	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	99
Acenaphthene-d10	97
Phenanthrene-d10	91
Chrysene-d12	89
Perylene-d12	88

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	103
Terphenyl-d14	76

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S17_8706 **Sample Details:** BH15 5.50 LIMS ID Number: CL1775361 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File:** Initial Calibration Date Analysed: 26-Sep-17 Directory: 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3 *	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1 *	-	< 0.08	-
Total (USEPA16) PAHs	-		< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	94
Acenaphthene-d10	91
Phenanthrene-d10	83
Chrysene-d12	76
Perylene-d12	74

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	105
Terphenyl-d14	76

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

QC Blank s17_8706 **Sample Details: Job Number:** LIMS ID Number: CL1775362 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File: Initial Calibration Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	86
Acenaphthene-d10	82
Phenanthrene-d10	74
Chrysene-d12	57
Perylene-d12	43

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	108
Terphenyl-d14	76

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: S17_8706 **Sample Details:** LIMS ID Number: CL1775363 Date Booked in: 14-Sep-17 **QC Batch Number:** 171030 **Date Extracted:** 22-Sep-17 **Quantitation File:** Initial Calibration **Date Analysed:** 26-Sep-17 **Directory:** 092517.MS17\ Matrix: Soil **Dilution:** 1.0 **Ext Method:** Ultrasonic

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.26	101	100
Acenaphthylene	208-96-8	4.30	99	99
Acenaphthene	83-32-9	4.42	107	97
Fluorene	86-73-7	4.81	103	98
Phenanthrene	85-01-8	5.65	106	99
Anthracene	120-12-7	5.70	103	100
Fluoranthene	206-44-0	7.00	111	91
Pyrene	129-00-0	7.29	109	90
Benzo[a]anthracene	56-55-3	8.97	108	99
Chrysene	218-01-9	9.02	112	99
Benzo[b]fluoranthene	205-99-2	10.50	101	96
Benzo[k]fluoranthene	207-08-9	10.54	103	97
Benzo[a]pyrene	50-32-8	10.93	109	97
Indeno[1,2,3-cd]pyrene	193-39-5	12.30	109	91
Dibenzo[a,h]anthracene	53-70-3	12.34	107	97
Benzo[g,h,i]perylene	191-24-2	12.60	103	95
Coronene	191-07-1	14.74	112	67
Total (USEPA16) PAHs	-	-	106	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	90
Acenaphthene-d10	92
Phenanthrene-d10	87
Chrysene-d12	96
Perylene-d12	100

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	104
Terphenyl-d14	85

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

 Job Number:
 \$17_8706

 QC Batch Number:
 171030

Directory: 092517PCB.GC70

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

		Concentration, (µg/kg)						
Sample ID	Customer ID	PCB28*	PCB52*	PCB101*	PCB118*	PCB153*	PCB138*	PCB180*
CL1775359	BH15 1.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1775360	BH15 3.50	<5.0	< 5.0	<5.0	<5.0	<5.0	<5.0	< 5.0
CL1775361	BH15 5.50	<5.0	< 5.0	<5.0	<5.0	<5.0	<5.0	< 5.0
CL1775362	QC Blank	<5.0	< 5.0	<5.0	<5.0	<5.0	<5.0	< 5.0
CL1775363	Reference Material (% Recovery)	87.6	93.2	80.4	91.5	87.9	92.5	83.4
-								

Soil

14-Sep-17

22-Sep-17

25-Sep-17

WASTE ACCEPTANCE CRITERIA TESTING BSEN 12457/2

Client	Coupoway Costock Ltd			Leaching Data			
Ciletit	Causeway Geotech Ltd				Weight of sample (kg)		
Contact	Meil Haggan				Moisture content @ 105°C (% of Wet Weight)		
Contact					Equivalent Weight based on drying at 105°C (kg) 0.		
Site	Arklow Sowerage Schor	Arklay Cayoraga Cahama Marina Outfall Cl			Volume of water required to carry out 10:1 stage (litres)		
Site	Arklow Sewerage Scheme Marine Outfall GI				Fraction of sample above 4 mm %		
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000	
BH15 1.50		s17 8706	CL/1775359	29-Sep-17			
БП13 1.30		317_0700	CL/17/3339	29-3ep-17			

Note: The >4mm fraction is crushed using a disc mill

5 0				Landfill Wast	e Acceptance Crit	eria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.14	3	5	6
Ν	LOI450	Loss on Ignition (%)	0.8			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	<11	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.62	100		
Ν	PHSOIL	pH (pH units)	8.4		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.49		To be evaluated	To be evaluated

Accreditation	d Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1			
Accrec	Method		mg/l except ⁰⁰ mg/kg (dry weight)		mg/kg (dry weight)			
U		pH (pH units) ⁰⁰	7.3	Calculated data not UKAS Accredited				
U	WSLM2	Conductivity (µs/cm) 00	964	Calculated data not orkas accredited				
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25	
U	ICPWATVAR	Barium	0.05	0.5	20	100	300	
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5	
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70	
U	ICPMSW	Copper	<0.001	<0.01	2	50	100	
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2	
U	ICPMSW	Molybdenum	0.004	0.04	0.5	10	30	
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40	
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50	
U	ICPMSW	Antimony	0.003	0.03	0.06	0.7	5	
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7	
U	ICPMSW	Zinc	0.013	0.13	4	50	200	
U	KONENS	Chloride	225	2250	800	15000	25000	
U	ISEF	Fluoride	0.3	3	10	150	500	
U	ICPWATVAR	Sulphate as SO4	50	500	1000	20000	50000	
Ν	WSLM27	Total Dissolved Solids	752	7520	4000	60000	100000	
U	SFAPI	Phenol Index	<0.05	<0.5	1			
Ν	WSLM13	Dissolved Organic Carbon	1.1	11	500	800	1000	

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Client	Causaway Caataah Ltd				Leaching Data				
Cilent	Causeway Geotech Ltd			Weight of sample (kg)					
Contact	Noil Hoggon			Moisture content @ 105°C (% of Wet Weight)	18.0				
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg)					
Site	Arklow Sewerage Schem	o Marina Ou	fall CI		Volume of water required to carry out 10:1 stage (litres)				
Site	Arkiow Sewerage Schen	ie Marine Ou	liali Gi		Fraction of sample above 4 mm %	0.000			
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000			
	BH15 3.50	s17 8706 CL/1775360 29-Sep		29-Sep-17					
	B113 3.50	\$17_0700	CL/1773300	29-3ep-17					

Note: The >4mm fraction is crushed using a disc mill

				Landfill Wast	e Acceptance Crit	eria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.09	3	5	6
Ν	LOI450	Loss on Ignition (%)	0.8			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.07	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	<12	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<2.17	100		
Ν	PHSOIL	pH (pH units)	8.7		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.16		To be evaluated	To be evaluated

Accreditation	Method Code	Leachate Analysis	10:1 Single Stage Leachate mg/l except ⁰⁰	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)				
U	WSLM3	pH (pH units) 00	7.2	Calculated data not UKAS Accredited					
U	WSLM2	Conductivity (µs/cm) 00	1360	Calculated data not envio 7 tooledited					
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25		
U	ICPWATVAR	Barium	0.04	0.4	20	100	300		
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5		
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70		
U	ICPMSW	Copper	0.001	0.01	2	50	100		
U		Mercury	<0.0001	<0.001	0.01	0.2	2		
U	ICPMSW	Molybdenum	<0.001	<0.01	0.5	10	30		
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40		
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50		
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5		
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7		
U	ICPMSW	Zinc	0.013	0.13	4	50	200		
U	KONENS	Chloride	351	3510	800	15000	25000		
U	ISEF	Fluoride	0.1	1	10	150	500		
U	ICPWATVAR	Sulphate as SO4	52	520	1000	20000	50000		
N	WSLM27	Total Dissolved Solids	1060	10600 4000		60000	100000		
U	SFAPI	Phenol Index	<0.05	<0.5	1				
N	WSLM13	Dissolved Organic Carbon	1.5	15	500	800	1000		

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causaway Castash I td				Leaching Data				
Cilent	Causeway Geotech Ltd		Weight of sample (kg)						
Contact	Noil Hoggon			Moisture content @ 105°C (% of Wet Weight)	47.3				
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg)					
Site	Arklow Sewerage Schem	o Marina Ou	fall CI		Volume of water required to carry out 10:1 stage (litres)				
Site	Arkiow Sewerage Scrien	ie Marine Ou	liali Gi		Fraction of sample above 4 mm %	0.000			
Samp	le Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000			
	3H15 5.50	s17 8706 CL/1775361 29-Sep-17		29-Sep-17					
-	31113 3.30	517_0700	CL/17/3301	29-3ep-17					

Note: The >4mm fraction is crushed using a disc mill

				Landfill Wast	e Acceptance Crit	eria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	0.85	3	5	6
Ν	LOI450	Loss on Ignition (%)	5.1			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.12	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.056	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	25	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<2.58	100		
Ν	PHSOIL	pH (pH units)	8.6		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	5.01		To be evaluated	To be evaluated

litation	a Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1			
Accreditation	Method		mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry weight)		nt)	
U		pH (pH units) ⁰⁰	7.5	Calculated data not UKAS Accredited				
U	WSLM2	Conductivity (µs/cm) 00	1490	Calculated data not OKAS Accredited				
U	ICPMSW	Arsenic	0.01	0.1	0.5	2	25	
U	ICPWATVAR	Barium	0.06	0.6	20	100	300	
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5	
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70	
U	ICPMSW	Copper	0.004	0.04	2	50	100	
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2	
U	ICPMSW	Molybdenum	0.002	0.02	0.5	10	30	
U	ICPMSW	Nickel	0.002	0.02	0.4	10	40	
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50	
U	ICPMSW	Antimony	0.005	0.05	0.06	0.7	5	
U	ICPMSW	Selenium	0.003	0.03	0.1	0.5	7	
U	ICPMSW	Zinc	0.009	0.09	4	50	200	
U	KONENS	Chloride	358	3580	800	15000	25000	
U	ISEF	Fluoride	0.5	5	10	150	500	
U	ICPWATVAR	Sulphate as SO4	73	730	730 1000 20000		50000	
Ν	WSLM27	Total Dissolved Solids	1160	11600	4000	60000	100000	
U	SFAPI	Phenol Index	<0.05	<0.5	1			
N	WSLM13	Dissolved Organic Carbon	2.4	24	500	800	1000	

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

S178706

ESG Environmental Chemistry

Analytical and Deviating Sample Overview

Customer Causeway Geotech Ltd

Site Arklow Sewerage Scheme Marine Outfall GI

Report No \$178706

Consignment No S68873

Date Logged 14-Sep-2017

In-House Report Due 02-Oct-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL/1775359	BH15 1.50	25/08/17		Е	Е				Е		Е		Е	Е	
CL/1775360	BH15 3.50	25/08/17		Е	Е				ш		ш		Е	Е	
CL/1775361	BH15 5.50	25/08/17		Е	Е				Е		Е		Е	Е	
CL/1775362	QC Blank														
CL/1775363	Reference Material (% Recovery	/)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- C Headspace present in the sample container
- The sampling date was not supplied so holding time may be compromised applicable to all analysis
- Sample processing did not commence within the appropriate holding time
- F Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number : EFS/178706

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report

Report Number: EFS/178706

Method Descriptions

Soil E	ANC BTEXHSA LOI(%MM)	Oven Dried @ < 35°C As Received	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7 Determination of Benzene, Toluene, Ethyl benzene and Xylenes
		As Received	Determination of Renzene Tolliene, Ethyl henzene and Yylenes
Soil	LOI(%MM)		(BTEX) by Headspace GCFID
		Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil F	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil F	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil F	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil 1	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil 1	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water I	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water I	CPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water I	SEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water k	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water S	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water V	WSLM27	As Received	Gravimetric Determination
Water V	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis

I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 15 of 15 EFS/178706 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: S17_8706

Note: major constituent in upper case

		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1775359	BH15 1.50	MARINE SEDIMENT
CL/1773339	BH15 3.50	MARINE SEDIMENT
CL/1775360	BH15 3.50	MADINE OF DIMENT
CL/1775361 CL/1775362	BH15 5.50	MARINE SEDIMENT
CL/1775362	QC Blank	QUALITY CONTROL SAMPLE
CL/1775363	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE

Appendix A Page 1 of 1 04/10/2017EFS/178706 Ver. 1

Our Ref: EFS/180840 (Ver. 1)

Your Ref: 17-0167 December 6, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry

SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

Where appropriate the samples will be kept until 02/01/18 when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

JACOLDOVINE

J Colbourne
Project Co-ordinator
01283 554547

TEST REPORT



Report No. EFS/180840 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 5 samples described in this report were registered for analysis by SOCOTEC UK Limited on 21-Nov-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 06-Dec-2017

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 7)
Table of PCB Congener Results (Page 8)
Table of WAC Analysis Results (Pages 9 to 11)
Analytical and Deviating Sample Overview (Page 12)
Table of Method Descriptions (Page 13)
Table of Report Notes (Page 14)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim (

Tim Barnes

Operations Director Energy & Waste Services

Tests marked '^' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 06-Dec-2017

	Method Reporti	Units : od Codes : na Limits :	μg/kg PCBECD 5	pH Units PHSOIL	% TMSS 0.1	mg/kg TPHFIDUS 10	mg/kg TPHFIDUS 10	% M/M WSLM59 0.02	Mol/kg ANC 0.04	% LOI(%MM) 0.2	μg/kg BTEXHSA 10	μg/kg BTEXHSA 10	μg/kg BTEXHSA 10	μg/kg BTEXHSA 20	μg/kg BTEXHSA 30	μg/kg BTEXHSA 20	μg/kg BTEXHSA 10	mg/kg PAHMSUS
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot. Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	мтве	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1784507	BH16 1.50	05-Nov-17	Req	8.6	36.5	25	26	1.75	2.72	5.5	<10	<10	<10	<20	<30	<20	<10	Req
1784508	BH16 3.50	05-Nov-17	Req	7.7	60.9	46	46	7.8	0.88	15.9	<10	<10	<10	<20	<30	<20	<10	Req
1784509	BH16 5.50	05-Nov-17	Req	7.5	62.2	74	74	10.2	1.68	19.6	<10	<10	<10	<20	<30	<20	<10	Req
1784510	QC Blank		Req			<10	<10	<0.02			<10	<10	<10	<20	<30	<20	<10	Req
1784511	Reference Material (% Recovery)		Req	102		103	103	100	99	104	102	101	98	106	195	99	96	Req
	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		Client N Contact		Neil Hag	way Geot		ne Ma	rine (Outfal	I GI	Date Pri Report N	nted lumber	ple Ana	06-	-Dec-2017 FS/180840 1		

Where individual results are flagged see report notes for status.

Page 2 of 14

EFS/180840 Ver. 1

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: **Sample Details:** BH16 1.50 s18_0840 LIMS ID Number: CL1784507 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File: Initial Calibration Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	ı	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	95
Acenaphthene-d10	96
Phenanthrene-d10	94
Chrysene-d12	86
Perylene-d12	70

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	102
Terphenyl-d14	82

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: BH16 3.50 **Job Number:** S18_0840 LIMS ID Number: CL1784508 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File: Initial Calibration Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	ı	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	ı
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	95
Acenaphthene-d10	97
Phenanthrene-d10	95
Chrysene-d12	92
Perylene-d12	73

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	101
Terphenyl-d14	82

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: BH16 5.50 **Job Number:** s18_0840 LIMS ID Number: CL1784509 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	ı	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	ı
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	ı
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	93
Acenaphthene-d10	94
Phenanthrene-d10	93
Chrysene-d12	87
Perylene-d12	70

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	104
Terphenyl-d14	82

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: QC Blank **Job Number:** S18_0840 LIMS ID Number: CL1784510 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File: Initial Calibration Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	ı	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	96
Acenaphthene-d10	97
Phenanthrene-d10	95
Chrysene-d12	81
Perylene-d12	62

Surrogates	% Rec	
Nitrobenzene-d5	NA	
2-Fluorobiphenyl	103	
Terphenyl-d14	80	

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: **Sample Details:** S18_0840 CL1784511 LIMS ID Number: Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.31	103	100
Acenaphthylene	208-96-8	4.36	103	99
Acenaphthene	83-32-9	4.48	104	92
Fluorene	86-73-7	4.87	101	92
Phenanthrene	85-01-8	5.72	97	100
Anthracene	120-12-7	5.77	100	99
Fluoranthene	206-44-0	7.08	98	90
Pyrene	129-00-0	7.37	98	88
Benzo[a]anthracene	56-55-3	9.06	102	99
Chrysene	218-01-9	9.11	98	99
Benzo[b]fluoranthene	205-99-2	10.59	96	96
Benzo[k]fluoranthene	207-08-9	10.62	96	96
Benzo[a]pyrene	50-32-8	11.02	98	96
Indeno[1,2,3-cd]pyrene	193-39-5	12.39	80	90
Dibenzo[a,h]anthracene	53-70-3	12.43	71	94
Benzo[g,h,i]perylene	191-24-2	12.69	82	93
Coronene	191-07-1	14.89	63	73
Total (USEPA16) PAHs	-	-	99.24	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	-
Acenaphthene-d10	-
Phenanthrene-d10	-
Chrysene-d12	-
Perylene-d12	-

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	-
Terphenyl-d14	-

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: S18_0840 QC Batch Number: 171265

112317PCB.GC70 **Directory:**

Method: Ultrasonic

Matrix: Date Booked in: 21-Nov-17

Date Extracted: 23-Nov-17

Date Analysed: 23-Nov-17

Soil

Compounds marked * are not UKAS or MCerts accredited

		Concentration, (µg/kg)						
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180
CL1784507	BH16 1.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784508	BH16 3.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784509	BH16 5.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784510	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784511	Reference Material (% Recovery)	87	90	81	98	96	95	80

Client	Causaway Caataah Ltd				Leaching Data	
Cilent	Causeway Geotech Ltd				Weight of sample (kg)	0.148
Contact	Noil Hoggon				Moisture content @ 105°C (% of Wet Weight)	36.5
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg)		
Site	Arklow Sewerage Schem	a Marina Ou	ffall CI		Volume of water required to carry out 10:1 stage (litres)	0.842
Site	Arkiow Sewerage Scrien	ie ivianne Ou	liali Gi	Fraction of sample above 4 mm %	6.300	
Samp	le Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH16 1.50		010 0040	CL /4794507	06-Dec-17		
	טפ.ו סוחכ	s18_0840 CL/1784507		06-Dec-17		

Note: The >4mm fraction is crushed using a disc mill

_				Landfill Was	te Acceptance Crit	eria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
Ν	WSLM59	Total Organic Carbon (% M/M)	1.84	3	5	6
Ν	LOI450	Loss on Ignition (%)	5.8			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.11	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
Ν	TPHFIDUS	Mineral Oil (mg/kg)	39	500		
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<2.14	100		
Ν	PHSOIL	pH (pH units)	8.6		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.86		To be evaluated	To be evaluated

Accreditation	od Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1		
Accre	Method		mg/l except ⁰⁰	mg/kg (dry weight)		mg/kg (dry weig	ht)
U		pH (pH units) 00	7.7	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	3580				
U	ICPMSW	Arsenic	0.008	0.08	0.5	2	25
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	<0.001	<0.01	2	2 50	
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.025	0.25	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.002	0.02	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.003	0.03	4	50	200
U	KONENS	Chloride	963	9630	800	15000	25000
U	ISEF	Fluoride	0.5	5	10	150	500
U	ICPWATVAR	Sulphate as SO4	191	1910	1000	1000 20000 50000	
Ν	WSLM27	Total Dissolved Solids	2790	27900	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	12	120	500	800	1000

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causeway Geotech Ltd				Leaching Data		
Cilent	Causeway Geolech Lid			Weight of sample (kg)	0.231		
Contact	Noil Haggan			Moisture content @ 105°C (% of Wet Weight)	60.9		
Comaci	Neil Haggan			Equivalent Weight based on drying at 105°C (kg)	0.090		
Site	Arklow Sewerage Schem	o Marina Ou	tfall CI	Volume of water required to carry out 10:1 stage (litres)			
Site	Arkiow Sewerage Schen	le Maririe Ou	liali Gi	Fraction of sample above 4 mm %	0.000		
Samp	le Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000	
BH16 3.50		-40,0040	01 /470 4500	06-Dec-17			
· · · · · · · · · · · · · · · · · · ·	3.30	s18_0840 CL/1	CL/1784508	00-Dec-17			

Note: The >4mm fraction is crushed using a disc mill

_				Landfill Was	te Acceptance Crit	teria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)		Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	8.5	3	5	6
N	LOI450	Loss on Ignition (%)	17.2			10
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.17	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	118	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<3.48	100		
N	PHSOIL	pH (pH units)	7.7		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.95		To be evaluated	To be evaluated

Accreditation	od Code	Leachate Analysis	10:1 Single Stage Leachate Calcul		Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1		
Accre	Method		mg/l except ⁰⁰	mg/kg (dry weight)	mg/kg (dry weight)		ht)
U		pH (pH units) ⁰⁰	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	3630				
U	ICPMSW	Arsenic	0.016	0.16	0.5	2	25
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	<0.001	<0.01	2	2 50	
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.254	2.54	0.5	10	30
U	ICPMSW	Nickel	0.001	0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.003	0.03	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.007	0.07	4	50	200
U	KONENS	Chloride	930	9300	800	15000	25000
U	ISEF	Fluoride	0.4	4	10	150	500
U	ICPWATVAR	Sulphate as SO4	227	2270	1000	1000 20000 50000	
Ν	WSLM27	Total Dissolved Solids	2830	28300	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1	_	
N	WSLM13	Dissolved Organic Carbon	22	220	500	800	1000

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causaway Caataah Ltd				Leaching Data	
Cilent	Causeway Geotech Ltd				Weight of sample (kg)	0.243
Contact	Noil Hoggon				Moisture content @ 105°C (% of Wet Weight)	62.2
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg)		
Site	Arklow Sewerage Schem	a Marina Ou	ffall CI		Volume of water required to carry out 10:1 stage (litres)	
Site	Arkiow Sewerage Scrien	ie ivianne Ou	liali Gi	Fraction of sample above 4 mm %	0.000	
Samp	le Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH16 5.50		-40 0040 01	CL/1784509	00 D 47		
	UC.C 01 TIC	s18_0840	CL/1784509	06-Dec-17		

Note: The >4mm fraction is crushed using a disc mill

				Landfill Was	te Acceptance Crit	teria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)		Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	10.2	3	5	6
N	LOI450	Loss on Ignition (%)	19.6			10
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.17	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	196	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<3.60	100		
N	PHSOIL	pH (pH units)	7.5		>6	
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.68		To be evaluated	To be evaluated

Accreditation	od Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1		Acceptance Crite I 12457/2 @ L/S 10	ria Limit Values for) litre kg-1
Accre	Method		mg/l except ^{oo}	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) 00	7.7	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	3760	Calculated data flot ONAS Accredited			
U	ICPMSW	Arsenic	0.015	0.15	0.5	2	25
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	<0.001	<0.01	2	2 50	
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.228	2.28	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.003	0.03	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.004	0.04	4	50	200
U	KONENS	Chloride	936	9360	800	15000	25000
U	ISEF	Fluoride	0.4	4	10	150	500
U	ICPWATVAR	Sulphate as SO4	268	2680	1000 20000 50000		50000
Ν	WSLM27	Total Dissolved Solids	2930	29300	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
Ν	WSLM13	Dissolved Organic Carbon	19	190	500	800	1000

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Report No

Socotec Environmental Chemistry Analytical and Deviating Sample Overview

S180840

Customer Causeway Geotech Ltd Site Arklow Sewerage Sche

Arklow Sewerage Scheme Marine Outfall GI

S180840

Consignment No S70512
Date Logged 21-Nov-2017

In-House Report Due 11-Dec-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

											13 101				
		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		65WTSM
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report C	LO.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL/1784507	BH16 1.50	05/11/17		Е	Е						Е				Е
CL/1784508	BH16 3.50	05/11/17		Ē	Ē						Ē				Ē
CL/1784509	BH16 5.50	05/11/17		E	Ē						E				Ē
CL/1784510	QC Blank	2 2, 1 1, 1 1													
CL/1784511	Reference Material (% Recovery	/)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- C Headspace present in the sample container
- D The sampling date was not supplied so holding time may be compromised applicable to all analysis
- Sample processing did not commence within the appropriate holding time
- F Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number: EFS/180840

Method Descriptions

Matrix MethodID Analysis		Analysis	Method Description			
		Basis	•			
Soil	ANC	Oven Dried @ < 35°C	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7			
Soil	BTEXHSA	As Received	Determination of Benzene, Toluene, Ethyl benzene and Xylenes (BTEX) by Headspace GCFID			
Soil	LOI(%MM)	Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry			
Soil	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection			
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection			
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.			
Soil	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)			
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.			
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection			
Water	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS			
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES			
Water	ISEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)			
Water	KONENS	As Received	Direct analysis using discrete colorimetric analysis			
Water	SFAPI	As Received	Segmented flow analysis with colorimetric detection			
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection			
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.			
Water	WSLM27	As Received	Gravimetric Determination			
Water	WSLM3	As Received	Determination of the pH of water samples by pH probe			

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 14 of 14 EFS/180840 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: \$18_0840

Note: major constituent in upper case

Lab ID Number	Client ID	Description
CL/1784507	BH16 1.50	MARINE SEDIMENTS
CL/1784508	BH16 3.50	MARINE SEDIMENTS
CL/1784509	BH16 5.50	MARINE SEDIMENTS
CL/1784510	QC Blank	OLIALITY CONTROL SAMPLE
CL/1784510 CL/1784511	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1/64511	Reference Material (% Recovery)	QUALITY CONTROL SAWIFLE

Appendix A Page 1 of 1 12/12/2017EFS/180840 Ver. 1

Our Ref: EFS/180842 (Ver. 1)

Your Ref: 17-0167 December 6, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

Where appropriate the samples will be kept until 02/01/18 when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

JACOUDOVINE

J Colbourne

Project Co-ordinator 01283 554547

TEST REPORT



Report No. EFS/180842 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall Gl

The 4 samples described in this report were registered for analysis by SOCOTEC UK Limited on 21-Nov-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 06-Dec-2017

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 6)
Table of PCB Congener Results (Page 7)
Table of WAC Analysis Results (Pages 8 to 9)
Analytical and Deviating Sample Overview (Page 10)
Table of Method Descriptions (Page 11)
Table of Report Notes (Page 12)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim (

Tim Barnes Operations Director Energy & Waste Services

Tests marked 'A' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected. SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 06-Dec-2017

	Meth	Units : od Codes :		pH Units PHSOIL	% TMSS	mg/kg TPHFIDUS	mg/kg TPHFIDUS	% M/M WSLM59	Mol/kg ANC	% LOI(%MM)	μg/kg BTEXHSA	μg/kg BTEXHSA	μg/kg BTEXHSA	μg/kg BTEXHSA	μg/kg BTEXHSA	μg/kg BTEXHSA	μg/kg BTEXHSA	mg/kg PAHMSUS
	Method Reporti			TTIOOIL	0.1	10	10	0.02	0.04	0.2	10	10	10	20	30	20	10	17111111000
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1784518	BH17 2.50	03-Nov-17	Req	8	8.4	11	12	0.26	0.80	1.1	<10	<10	<10	<20	<30	<20	<10*	Req
1784519	BH17 4.50	03-Nov-17	Req	8.6	8.2	14	14	0.13	0.96	0.8	<10	<10	<10	<20	<30	<20	<10*	Req
1784520	QC Blank		Req			<10	<10	<0.02			<10	<10	<10	<20	<30	<20	<10*	Req
1784521	Reference Material (% Recovery)		Req	101.6		103%	103%	100	99.3	103.6	102	101	98	106	195	99	96*	Req
E	SOCOTEC Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		Client N Contact		Neil Hag	eway Geot		ne Ma	rine (Dutfal	I GI	Date Pring Report No.	nted lumber	ple Ana	06-	-Dec-2017 FS/180842		

Where individual results are flagged see report notes for status.

Page 2 of 12

EFS/180842 Ver. 1

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: Job Number: BH17 2.50 S18_0842 **LIMS ID Number:** CL1784518 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 25-Nov-17

Directory: 112417.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	1	< 0.08	-
Acenaphthylene	208-96-8	1	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	1	< 0.08	-
Chrysene	218-01-9	1	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	1	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	92
Acenaphthene-d10	93
Phenanthrene-d10	90
Chrysene-d12	79
Perylene-d12	60

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	94
Terphenyl-d14	75

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: Job Number: BH17 4.50 s18_0842 **LIMS ID Number:** CL1784519 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration 25-Nov-17 **Date Analysed:**

Directory: 112417.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	* Danata	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	87
Acenaphthene-d10	87
Phenanthrene-d10	84
Chrysene-d12	76
Perylene-d12	58

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	101
Terphenyl-d14	80

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: QC Blank Job Number: S18_0842 **LIMS ID Number:** CL1784520 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 25-Nov-17

Directory: 112417.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	1
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	- * D (.	< 1.28	- Pr. 1

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	96
Acenaphthene-d10	97
Phenanthrene-d10	95
Chrysene-d12	81
Perylene-d12	62

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	103
Terphenyl-d14	80

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details:Reference Material (% Rec Job Number:\$18_0842LIMS ID Number:CL1784521Date Booked in:21-Nov-17QC Batch Number:171265Date Extracted:24-Nov-17Quantitation File:Initial CalibrationDate Analysed:25-Nov-17

Directory: 112417.MS17\ Matrix: Soil

Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.31	103	100
Acenaphthylene	208-96-8	4.36	103	99
Acenaphthene	83-32-9	4.48	104	92
Fluorene	86-73-7	4.87	101	92
Phenanthrene	85-01-8	5.72	97	100
Anthracene	120-12-7	5.77	100	99
Fluoranthene	206-44-0	7.08	98	90
Pyrene	129-00-0	7.37	98	88
Benzo[a]anthracene	56-55-3	9.06	102	99
Chrysene	218-01-9	9.11	98	99
Benzo[b]fluoranthene	205-99-2	10.59	96	96
Benzo[k]fluoranthene	207-08-9	10.62	96	96
Benzo[a]pyrene	50-32-8	11.02	98	96
Indeno[1,2,3-cd]pyrene	193-39-5	12.39	80	90
Dibenzo[a,h]anthracene	53-70-3	12.43	71	94
Benzo[g,h,i]perylene	191-24-2	12.69	82	93
Coronene	191-07-1	14.89	63	73
Total (USEPA16) PAHs	-	-	99	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	-
Acenaphthene-d10	-
Phenanthrene-d10	-
Chrysene-d12	-
Perylene-d12	-

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	-
Terphenyl-d14	-

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI Matrix:

Job Number:S18_0842Date Booked in:21-Nov-17QC Batch Number:171265Date Extracted:23-Nov-17Directory:112317PCB.GC70Date Analysed:23-Nov-17

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

				Cor	centration,	(µg/kg)		
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180
CL1784518	BH17 2.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784519	BH17 4.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784520	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784521	Reference Material (% Recovery)	86.6	90.5	80.9	98.0	95.9	95.3	79.5
·								

Soil

Cliont	Causaway Caataah I ta	I			Leaching Data					
Client	Causeway Geotech Ltd	l			Weight of sample (kg)	0.095				
Contact	Noil Hoggon				Moisture content @ 105°C (% of Wet Weight)					
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg) 0.0						
Site	Arklow Soworage Sobe	ma Marina Ou	utfall CI		Volume of water required to carry out 10:1 stage (litres)					
Site	Arklow Sewerage Sche	ine manne Ou	iliali Gi	Fraction of sample above 4 mm %	11.200					
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000				
BH17 2.50		s18_0842	_0842 CL/1784518 06-Dec-17							

Note: The >4mm fraction is crushed using a disc mill

	4			Landfill Waste Acceptance Criteria Limit Values					
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill			
Ν	WSLM59	Total Organic Carbon (% M/M)	0.26	3	5	6			
N	LOI450	Loss on Ignition (%)	1.1			10			
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6					
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	<0.035	1					
Ν	TPHFIDUS	Mineral Oil (mg/kg)	12	500					
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.48	100					
Ν	PHSOIL	pH (pH units)	8		>6				
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.81		To be evaluated	To be evaluated			

itation	Code	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BS 12457/2 @ L/S 10 litre kg-1					
Accreditation	Method		mg/l except ^{oo}	mg/kg (dry weight)	mg/kg (dry weight)					
U	WSLM3	pH (pH units) ⁰⁰	7.5	Calculated data not UKAS Accredited						
U	WSLM2	Conductivity (µs/cm) 00	314	Calculated data not ONAS Accredited						
U	ICPMSW	Arsenic	<0.001	<0.01	0.5	2	25			
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300			
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5			
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70			
U	ICPMSW	Copper	<0.001	<0.01	2	50	100			
U	ICPMSW	Mercury	0.0003	0.003	0.01	0.2	2			
U	ICPMSW	Molybdenum	0.003	0.03	0.5	10	30			
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40			
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50			
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5			
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7			
U	ICPMSW	Zinc	<0.002	<0.02	4	50	200			
U	KONENS	Chloride	69	690	800	15000	25000			
U	ISEF	Fluoride	0.4	4	10	150	500			
U	ICPWATVAR	Sulphate as SO4	31	310	1000	20000	50000			
N	WSLM27	Total Dissolved Solids	245	2450	4000	60000	100000			
U	SFAPI	Phenol Index	<0.05	<0.5	1					
N	WSLM13	Dissolved Organic Carbon	0.81	8.1	500	800	1000			

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causaway Castash I td				Leaching Data					
Cilent	Causeway Geotech Ltd				Weight of sample (kg)					
Contact	Noil Hoggon				Moisture content @ 105°C (% of Wet Weight)					
Comaci	Neil Haggan			Equivalent Weight based on drying at 105°C (kg) 0.090						
Site	Arklow Soworogo Sobor	oo Marina Ou	tfall Cl		Volume of water required to carry out 10:1 stage (litres)					
Site	Arklow Sewerage Schen	ie Marine Ou	liali Gi	Fraction of sample above 4 mm % 37						
Sam	ple Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000				
BH17 4.50		s18_0842	CL/1784519	06-Dec-17						

Note: The >4mm fraction is crushed using a disc mill

	4)			Landfill Waste Acceptance Criteria Limit Values					
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill			
Ν	WSLM59	Total Organic Carbon (% M/M)	0.13	3	5	6			
Ν	LOI450	Loss on Ignition (%)	0.8			10			
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6					
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	<0.035	1					
Ν	TPHFIDUS	Mineral Oil (mg/kg)	15	500					
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.48	100					
Ν	PHSOIL	pH (pH units)	8.6		>6				
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.97		To be evaluated	To be evaluated			

itation	Code	10:1 Single Stage Leachate Calculated cumulating leached @ 1 Leachate Analysis		Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1					
Accreditation	Method Code		mg/l except ^{oo}	mg/kg (dry weight)	mg/kg (dry weight)					
U	WSLM3	pH (pH units) 00	7.6	Calculated data not UKAS Accredited						
U	WSLM2	Conductivity (µs/cm) 00	436	Calculated data not ONAS Accredited						
U	ICPMSW	Arsenic	0.001	0.01	0.5	2	25			
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300			
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5			
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70			
U	ICPMSW	Copper	<0.001	<0.01	2 50		100			
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2			
U	ICPMSW	Molybdenum	0.012	0.12	0.5	10	30			
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40			
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50			
U	ICPMSW	Antimony	0.001	0.01	0.06	0.7	5			
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7			
U	ICPMSW	Zinc	0.002	0.02	4	50	200			
U	KONENS	Chloride	94	940	800	15000	25000			
U	ISEF	Fluoride	0.4	4	10	150	500			
U	ICPWATVAR	Sulphate as SO4	90	900	1000	20000	50000			
N	WSLM27	Total Dissolved Solids	340	3400	4000	60000	100000			
U	SFAPI	Phenol Index	<0.05	<0.5	1					
Ν	WSLM13	Dissolved Organic Carbon	1.7	17	500	800	1000			

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Sample Analysis

Socotec Environmental Chemistry Analytical and Deviating Sample Overview

S180842

Customer Causeway Geotech Ltd
Site Arklow Sewerage Scheme Marine Outfall GI
Report No S180842

Consignment No S70498 Date Logged 21-Nov-2017

In-House Report Due 11-Dec-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

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		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL /170/E10	DU17 2 50	02/11/17		Е	E				Е		Е		Е	Е	Е
CL/1784518	BH17 2.50	03/11/17			_										
CL/1784519	BH17 4.50	03/11/17		Е	E				Е		Е		Е	Е	Е
CL/1784520	QC Blank														
CL/1784521	Reference Material (% Recovery	/)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
 - The sample was received without the correct preservation for this analysis
- C Headspace present in the sample container
- D The sampling date was not supplied so holding time may be compromised applicable to all analysis
- E Sample processing did not commence within the appropriate holding time
 - Sample processing did not commence within the appropriate handling time

Requested Analysis Key

- Analysis Required
- Analysis dependant upon trigger result Note: due date may be affected if triggered
- No analysis scheduled
- Analysis Subcontracted Note: due date may vary

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Report Number: EFS/180842

Method Descriptions

Matrix	MethodID	Analysis Basis	Method Description
Soil	ANC	Oven Dried	Quantitative digestion with Hydrochloric Acid back titration with 1M
		@ < 35°C	Sodium Hydroxide to pH 7
Soil	BTEXHSA	As Received	Determination of Benzene, Toluene, Ethyl benzene and Xylenes (BTEX) by Headspace GCFID
Soil	LOI(%MM)	Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water	ISEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water	WSLM27	As Received	Gravimetric Determination
Water	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.

 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- $\P \ \text{Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols}.$

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- P Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- **‡** MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 12 of 12 EFS/180842 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: \$18_0842

Note: major constituent in upper case

Las ID Number Client ID Description (1774-518) FIRT 25.0 MANNE SEDMENTS (1774-519) BHT7-4.50 MANNE SEDMENTS (1774-519) CUT7-84-51 CUT7-84-52 CUT7-84-52 CUT7-84-52 PREFERENT FIGURIAL IN THE PROPERTY CONTROL SAMPLE (1774-612) PROPERTY CONTROL SAMPLE (1774-612) PROPERTY CONTROL SAMPLE (1774-612) PROPERTY CONTROL SAMPLE (1774-612) PROPERTY CONTROL SAMPLE (1774-612) PROPERTY CONTROL SAMPLE (1774-612) PROPERTY CONTROL SAMPLE (1774-612) PROPERTY CONTROL SAMPLE (1774-612) PROPERTY CONTROL SAMPLE (1774-612) PROPERTY CONTROL			Note: major constituent in upper case
CL/1784518 BH17 2.50 MARINE SEDIMENTS CL/1784519 BH17 4.50 MARINE SEDIMENTS CL/1784520 QC Blank QUALITY CONTROL SAMPLE	Lab ID Number	Client ID	Description
CL/1784519 BH17 4.50 MARINE SEDIMENTS CL/1784520 QC Blank QUALITY CONTROL SAMPLE		RH17 2 50	
CL/1784520 QC Blank QUALITY CONTROL SAMPLE	CI /1784510	RH17 4 50	MARINE SEDIMENTS
CL/1764521 Reference Material (% Recovery) CL/1764521 Recovery) CL/1764521 Recovery CL/1704519	OC Blank	OLIALITY CONTROL SAMPLE	
		Potorono Motorial (9/ Popovory)	OLIALITY CONTROL SAMPLE
	GL/1764521	Reference Material (% Recovery)	QUALITI CONTROL SAWIFLE
		I	

Appendix A Page 1 of 1 06/12/2017EFS/180842 Ver. 1

Our Ref: EFS/180830 (Ver. 1)

Your Ref: 17-0167 December 5, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry

SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

Where appropriate the samples will be kept until 02/01/18 when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

J Colbourne
Project Co-ordinator
01283 554547

TEST REPORT



Report No. EFS/180830 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 5 samples described in this report were registered for analysis by SOCOTEC UK Limited on 21-Nov-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 05-Dec-2017

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 7)
Table of PCB Congener Results (Pages 8 to 9)
Table of WAC Analysis Results (Pages 10 to 12)
Analytical and Deviating Sample Overview (Page 13)
Table of Additional Report Notes (Page 14)
Table of Method Descriptions (Page 15)
Table of Report Notes (Page 16)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim (

Tim Barnes

Operations Director Energy & Waste Services

Tests marked '^' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 05-Dec-2017

		Units :	μg/kg	pH Units	%	mg/kg	mg/kg	% M/M	Mol/kg	%	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	μg/kg	mg/kg
	Metho Method Reportii	od Codes :	PCBECD 5	PHSOIL	TMSS 0.1	TPHFIDUS 10	TPHFIDUS 10	0.02	ANC 0.04	0.2	BTEXHSA 10	BTEXHSA 10	BTEXHSA 10	BTEXHSA 20	30	BTEXHSA 20	BTEXHSA 10	PAHMSUS
	moniou reporti		Ů		0.1	10	10	0.02	0.01	0.2	10	10	10	20		20	10	
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	МТВЕ	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1784463	BH18 1.50	06-Nov-17	Req	8.5	33.4	20	20	0.11	0.88	0.8	<10	<10	<10	<20	<30	<20	<10	Req
1784464	BH18 3.50	06-Nov-17	Req	8.7	10.9	16	17	0.13	1.36	0.7	<10	<10	<10	<20	<30	<20	<10	Req
1784465	BH18 5.50	06-Nov-17	Req	8	5.5	30	30	2.40	2.32	7.4	<10	<10	<10	<20	<30	<20	<10	Req
1784466	QC Blank		Req			<10	<10	<0.02			<10	<10	<10	<20	<30	<20	<10	Req
1784467	Reference Material (% Recovery)		Req	99		103	103	107	99	104	<10	<10	<10	<20	<30	<20	<10	Req
E	SOCOTEC Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ		Client N Contact		Causeway Geotech Ltd Sample Analysis Peil Haggan Date Printed Report Number FFS/1808													
Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554420 Arklow Sewerage Scheme Marine Outfall GI Fax +44 (0) 1283 554422 Report Number Table Number 1																		

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: **Sample Details:** BH18 1.50 S18_0830 LIMS ID Number: CL1784463 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File: Initial Calibration Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	1	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	97
Acenaphthene-d10	100
Phenanthrene-d10	99
Chrysene-d12	90
Perylene-d12	75

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	98
Terphenyl-d14	78

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: **Sample Details:** BH18 3.50 S18_0830 LIMS ID Number: CL1784464 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	ı
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	ı
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	96
Acenaphthene-d10	97
Phenanthrene-d10	95
Chrysene-d12	86
Perylene-d12	70

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	101
Terphenyl-d14	80

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: BH18 5.50 **Job Number:** S18_0830 LIMS ID Number: CL1784465 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	94
Acenaphthene-d10	94
Phenanthrene-d10	93
Chrysene-d12	90
Perylene-d12	80

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	102
Terphenyl-d14	82

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

QC Blank Job Number: **Sample Details:** S18_0830 LIMS ID Number: CL1784466 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File: Initial Calibration Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	96
Acenaphthene-d10	97
Phenanthrene-d10	95
Chrysene-d12	81
Perylene-d12	62

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	103
Terphenyl-d14	80

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: **Sample Details:** s18_0830 LIMS ID Number: CL1784467 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil Dilution: 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.31	103	100
Acenaphthylene	208-96-8	4.36	103	99
Acenaphthene	83-32-9	4.48	104	92
Fluorene	86-73-7	4.87	101	92
Phenanthrene	85-01-8	5.72	97	100
Anthracene	120-12-7	5.77	100	99
Fluoranthene	206-44-0	7.08	98	90
Pyrene	129-00-0	7.37	98	88
Benzo[a]anthracene	56-55-3	9.06	102	99
Chrysene	218-01-9	9.11	98	99
Benzo[b]fluoranthene	205-99-2	10.59	96	96
Benzo[k]fluoranthene	207-08-9	10.62	96	96
Benzo[a]pyrene	50-32-8	11.02	98	96
Indeno[1,2,3-cd]pyrene	193-39-5	12.39	80	90
Dibenzo[a,h]anthracene	53-70-3	12.43	71	94
Benzo[g,h,i]perylene	191-24-2	12.69	82	93
Coronene	191-07-1	14.89	63	73
Total (USEPA16) PAHs	-	-	99	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	-
Acenaphthene-d10	-
Phenanthrene-d10	-
Chrysene-d12	-
Perylene-d12	-

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	-
Terphenyl-d14	-

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

 Job Number:
 \$18_0830

 QC Batch Number:
 171265

Directory: 112317PCB.GC70

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

				Cor	ncentration,	(µg/kg)		
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180
CL1784464	BH18 3.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784465	BH18 5.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784466	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784467	Reference Material (% Recovery)	87	90	81	98	96	95	80

Soil

21-Nov-17

23-Nov-17

23-Nov-17

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall Gl

 Job Number:
 \$18_0830

 QC Batch Number:
 171265

Directory: 112717PCB.GC22

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

Matrix:

Date Booked in:

Date Extracted:

Date Analysed:

Soil

21-Nov-17

24-Nov-17

28-Nov-17

				Con	centration,	(µg/kg)		
Sample ID	Customer ID	PCB28	PCB52	PCB101*	PCB118	PCB153	PCB138	PCB180
CL1784463	BH18 1.50	48.8	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0

Client	Causaway Caataah Ltd				Leaching Data		
Cilent	Causeway Geotech Ltd			Weight of sample (kg)	0.095		
IContact INeil Haddan				Moisture content @ 105°C (% of Wet Weight)			
				Equivalent Weight based on drying at 105°C (kg) 0.			
Site	Arklow Sowerage Schem	a Marina Out	fall CI		Volume of water required to carry out 10:1 stage (litres)		
Site	Arklow Sewerage Schem	e Manne Out	iaii Gi		Fraction of sample above 4 mm %	93.500	
Samp	ole Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000	
BH18 1.50		s18 0830	CL/1784463	05-Dec-17			
DE 1.00		\$18_0830 CL/1/84463 05-Dec-1/		05-Dec-17			

Note: The >4mm fraction is crushed using a disc mill

_	4			Landfill W	aste Acceptance C	Criteria Limit Values
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.11	3	5	6
N	LOI450	Loss on Ignition (%)	0.8			10
Ν	BTEXHSA	Sum of BTEX (mg/kg)	< 0.06	6		
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.0796	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	21	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.44	100		
Ν	PHSOIL	pH (pH units)	8.5		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.9		To be evaluated	To be evaluated

٦	<u>o</u>		10:1 Single Stage Leachate	Josephod @ 10:1			
Accreditation	Method Code	Leachate Analysis	mg/l except ⁰⁰	mg/kg (dry weight)	Landfill Waste Acceptance Criteria Limit Values for B: 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)		litre kg-1
U	WSLM3	pH (pH units) 00	7.7	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	342	Calculated data flot ONAS Accredited			
U	ICPMSW	Arsenic	<0.001	<0.01	0.5	2	25
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	<0.001	<0.01	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.003	0.03	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.001	0.01	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	<0.002	<0.02	4	50	200
U	KONENS	Chloride	67	670	800	15000	25000
U	ISEF	Fluoride	0.2	2	10	150	500
Ū	ICPWATVAR	Sulphate as SO4	76	760	1000	20000	50000
Ν	WSLM27	Total Dissolved Solids	267	2670	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
Ν	WSLM13	Dissolved Organic Carbon	1.5	15	500	800	1000

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client Causeway Geotech Ltd				Leaching Data			
				Weight of sample (kg)	0.100		
Contact	Noil Hoggen				Moisture content @ 105°C (% of Wet Weight)	10.9	
Contact Neil Haggan				Equivalent Weight based on drying at 105°C (kg)			
Site	Arklow Sewerage Schem	a Marina Out	fall CI		Volume of water required to carry out 10:1 stage (litres)		
Site	Arkiow Sewerage Schem	e Marine Out	iali Gi		Fraction of sample above 4 mm %	30.200	
Sample Description Report No Sample No Issue Date		Issue Date	Fraction of non-crushable material %	0.000			
BH18 3.50		s18 0830	CL/1784464	05-Dec-17			

Note: The >4mm fraction is crushed using a disc mill

	-	•		Landfill Waste Acceptance Criteria Limit Values			
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill	
Ν	WSLM59	Total Organic Carbon (% M/M)	0.13	3	5	6	
Ν	LOI450	Loss on Ignition (%)	0.7			10	
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6			
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1			
N	TPHFIDUS	Mineral Oil (mg/kg)	18	500			
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.53	100			
N	PHSOIL	pH (pH units)	8.7		>6		
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.37		To be evaluated	To be evaluated	

u	<u>o</u>		10:1 Single Stage Leachate	Josephod @ 10:1	Landfill Waste Acceptance Criteria Limit Values fo 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)		
Accreditation	Method Code	Leachate Analysis	mg/l except ^{oo}	mg/kg (dry weight)			litre kg-1
U	WSLM3	pH (pH units) 00	7.4	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	569	Calculated data not onas accredited			
U	ICPMSW	Arsenic	<0.001	<0.01	0.5	2	25
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	<0.001	<0.01	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.005	0.05	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	<0.002	<0.02	4	50	200
U	KONENS	Chloride	128	1280	800	15000	25000
U	ISEF	Fluoride	0.2	2	10	150	500
Ū	ICPWATVAR	Sulphate as SO4	135	1350	1000	20000	50000
Ν	WSLM27	Total Dissolved Solids	443	4430	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
Ν	WSLM13	Dissolved Organic Carbon	1.2	12	500	800	1000

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Client	Causeway Geotech Ltd			Leaching Data			
Cilent	Causeway Geolech Llu			Weight of sample (kg)			
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	33.4	
Contact	пен паууан			Equivalent Weight based on drying at 105°C (kg) 0.0			
Site	Arklow Sowerage Scham	a Marina Out	fall CI		Volume of water required to carry out 10:1 stage (litres)	0.856	
Site	Arklow Sewerage Schem	e Marine Out	iali Gi	Fraction of sample above 4 mm %			
Samp	le Description	Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000	
	3H18 5.50	s18 0830	CL/1784465	05-Dec-17			
	50 10 5.50	\$10_0000	CL/1704403	05-Dec-17			

Note: The >4mm fraction is crushed using a disc mill

_				Landfill Waste Acceptance Criteria Limit Values					
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill			
N	WSLM59	Total Organic Carbon (% M/M)	2.44	3	5	6			
N	LOI450	Loss on Ignition (%)	7.5			10			
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.11	6					
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1					
N	TPHFIDUS	Mineral Oil (mg/kg)	45	500					
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<2.04	100					
Ν	PHSOIL	pH (pH units)	8		>6				
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.36		To be evaluated	To be evaluated			

u	<u>o</u>		10:1 Single Stage Leachate	Jeached @ 10:1	Landfill Waste Acceptance Criteria Limit Values fo 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)		
Accreditation	Method Code	Leachate Analysis	mg/l except ^{oo}	mg/kg (dry weight)			litre kg-1
U	WSLM3	pH (pH units) 00	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	2710	Calculated data not onas accredited			
U	ICPMSW	Arsenic	0.002	0.02	0.5	2	25
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	<0.001	<0.01	2	50	100
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.055	0.55	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.002	0.02	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.003	0.03	4	50	200
U	KONENS	Chloride	660	6600	800	15000	25000
U	ISEF	Fluoride	0.3	3	10	150	500
U	ICPWATVAR	Sulphate as SO4	199	1990	1000	20000	50000
N	WSLM27	Total Dissolved Solids	2120	21200	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	8.3	83	500	800	1000

Template Ver. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Sample Analysis

Socotec Environmental Chemistry Analytical and Deviating Sample Overview

S180830

Customer **Causeway Geotech Ltd** Site Arklow Sewerage Scheme Marine Outfall GI Report No S180830

Consignment No S70514 Date Logged 21-Nov-2017 In-House Report Due 11-Dec-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working days.

	1		1					1					1		
		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL/1784463	BH18 1.50	06/11/17		Е	Е						Е				
CL/1784464	BH18 3.50	06/11/17		Е	Е						Е				
CL/1784465	BH18 5.50	06/11/17		ш	Е						Е				
CL/1784466	QC Blank														
CL/1784467	Reference Material (% Recovery	y)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- The sample was received in an inappropriate container for this analysis
- The sample was received without the correct preservation for this analysis
- B C Headspace present in the sample container
- D The sampling date was not supplied so holding time may be compromised - applicable to all analysis
- Sample processing did not commence within the appropriate holding time
- Sample processing did not commence within the appropriate handling time

Requested Analysis Key

- Analysis Required
- Analysis dependant upon trigger result Note: due date may be affected if triggered
- No analysis scheduled
- Analysis Subcontracted Note: due date may vary

The integrity of data for samples/analysis that have been categorised as Deviating may be compromised. Data may not be representative of the sample at the time of sampling.

Report Number: EFS/180830

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report

Report Number: EFS/180830

Method Descriptions

Soil E	ANC BTEXHSA LOI(%MM)	Oven Dried @ < 35°C As Received	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7 Determination of Benzene, Toluene, Ethyl benzene and Xylenes
		As Received	Determination of Renzene Tolliene, Ethyl henzene and Yylenes
Soil	LOI(%MM)		(BTEX) by Headspace GCFID
		Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry
Soil F	PAHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection
Soil F	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection
Soil F	PHSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.
Soil 1	TMSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)
Soil 1	TPHFIDUS	As Received	Determination of hexane/acetone extractable Hydrocarbons in soil with GCFID detection.
Soil	WSLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection
Water I	ICPMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS
Water I	CPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES
Water I	SEF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)
Water k	KONENS	As Received	Direct analysis using discrete colorimetric analysis
Water S	SFAPI	As Received	Segmented flow analysis with colorimetric detection
Water	WSLM13	As Received	Instrumental analysis using acid/persulphate digestion and non- dispersive IR detection
Water	WSLM2	As Received	Determination of the Electrical Conductivity (µS/cm) by electrical conductivity probe.
Water V	WSLM27	As Received	Gravimetric Determination
Water V	WSLM3	As Received	Determination of the pH of water samples by pH probe

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 16 of 16 EFS/180830 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: \$18_0830

Note: major constituent in upper case

		Note. major constituent in upper case
Lab ID Number	Client ID	Description
		MARINE SEDIMENTS
CL/1784463	BH18 1.50	MARINE SEDIMENTS
CL/1784464	BH18 3.50	MARINE SEDIMENTS
CL/1784465	BH18 5.50	MARINE SEDIMENTS
CL/1784466	QC Blank	OHALITY CONTROL SAMPLE
CL/1764466	QC Blank	QUALITY CONTROL SAMPLE QUALITY CONTROL SAMPLE
CL/1784467	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE

Appendix A Page 1 of 1 12/12/2017EFS/180830 Ver. 1

Our Ref: EFS/180838 (Ver. 1)

Your Ref: 17-0167 November 30, 2017

> Neil Haggan Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL



Environmental Chemistry

SOCOTEC UK Limited Bretby Business Park Ashby Road Burton-on-Trent Staffordshire DE15 0YZ

Telephone: 01283 554400 Facsimile: 01283 554422

For the attention of Neil Haggan

Dear Neil Haggan

Sample Analysis - Arklow Sewerage Scheme Marine Outfall GI

Samples from the above site have been analysed in accordance with the schedule supplied. The sample details and the results of analyses for these samples are given in the appended report.

An invoice for this work will follow under a separate cover.

Where appropriate the samples will be kept until 02/01/18 when they will be discarded. Please call 01283 554547 for an extension of this date.

Please be aware that our policy for the retention of paper based laboratory records and analysis reports is 6 years.

The work was carried out in accordance with SOCOTEC UK Limited (Multi-Sector Services) Standard Terms and Conditions of Contract.

If I can be of any further assistance please do not hesitate to contact me.

Yours sincerely

for SOCOTEC UK Limited

J Colbourne
Project Co-ordinator
01283 554547

TEST REPORT



Report No. EFS/180838 (Ver. 1)

Causeway Geotech Ltd 8 Drumahiskey Road Ballymoney United Kingdom BT53 7QL

Site: Arklow Sewerage Scheme Marine Outfall GI

The 4 samples described in this report were registered for analysis by SOCOTEC UK Limited on 21-Nov-2017. This report supersedes any versions previously issued by the laboratory.

The analysis was completed by: 30-Nov-2017

The following tables are contained in this report:

Table 1 Main Analysis Results (Page 2)
Table of PAH (MS-SIM) (80) Results (Pages 3 to 6)
Table of PCB Congener Results (Page 7)
Table of WAC Analysis Results (Pages 8 to 9)
Analytical and Deviating Sample Overview (Page 10)
Table of Additional Report Notes (Page 11)
Table of Method Descriptions (Page 12)
Table of Report Notes (Page 13)
Table of Sample Descriptions (Appendix A Page 1 of 1)

On behalf of SOCOTEC UK Lim (

Tim Barnes Operations

Operations Director Energy & Waste Services

Tests marked '^' have been subcontracted to another laboratory.

Where samples have been flagged as deviant on the Analytical and Deviating Sample Overview, for any reason, the data may not be representative of the sample at the point of sampling and the validity of the data may be affected.

SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.

Date of Issue: 30-Nov-2017

	Meth Method Reporti	Units : od Codes : ng Limits :	μg/kg PCBECD 5	pH Units PHSOIL	% TMSS 0.1	mg/kg TPHFIDUS 10	mg/kg TPHFIDUS 10	% M/M WSLM59 0.02	Mol/kg ANC 0.04	% LOI(%MM) 0.2	μg/kg BTEXHSA 10	μg/kg BTEXHSA 10	μg/kg BTEXHSA 10	μg/kg BTEXHSA 20	μg/kg BTEXHSA 30	μg/kg BTEXHSA 20	μg/kg BTEXHSA 10	mg/kg PAHMSUS
LAB ID Number CL/	Client Sample Description	Sample Date	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon	Acid Neut. Capacity	L.O.I. % @ 450C	Benzene	Toluene	Ethyl Benzene	MTBE	Xylenes	m/p Xylenes	o Xylene	PAH (17) by GCMS
1784497	BH19 1.50	07-Nov-17	Req	7.6	4.4	15	15	0.12	0.80	0.8	<10	<10	<10	<20	<30	<20	<10	Req
1784498	BH19 3.50	07-Nov-17	Req	7.5	58.8	42	43	8.6	0.96	17.9	<10	<10	<10	<20	<30	<20	<10	Req
1784499	QC Blank		Req			<10	<10	<0.02			<10	<10	<10	<20	<30	<20	<10	Req
1784500	Reference Material (% Recovery)		Req	102		103	103	100	99.3	103.6	96	95	102	105	103	104	101	Req
	Bretby Business Park, Ashby Road Burton-on-Trent, Staffordshire, DE15 0YZ Tel +44 (0) 1283 554400 Fax +44 (0) 1283 554422		Client N Contact	<u>:</u>	Neil Hag			ne Ma	rine (Outfal	l Gl	Date Prin Report N Table Nu	nted lumber	ple Ana	29-	-Nov-2017 FS/180838 1		

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: **Sample Details:** BH19 1.50 s18_0838 LIMS ID Number: CL1784497 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	93
Acenaphthene-d10	93
Phenanthrene-d10	92
Chrysene-d12	78
Perylene-d12	57

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	100
Terphenyl-d14	79

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Job Number: **Sample Details:** BH19 3.50 S18_0838 LIMS ID Number: CL1784498 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 25-Nov-17 Directory: 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	rget Compounds CAS #		Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	-	< 0.08	-
Fluorene	86-73-7	-	< 0.08	-
Phenanthrene	85-01-8	-	< 0.08	-
Anthracene	120-12-7	-	< 0.08	-
Fluoranthene	206-44-0	-	< 0.08	-
Pyrene	129-00-0	-	< 0.08	-
Benzo[a]anthracene	56-55-3	-	< 0.08	-
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	-	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	-	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	-	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	-	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	94
Acenaphthene-d10	95
Phenanthrene-d10	93
Chrysene-d12	88
Perylene-d12	69

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	102
Terphenyl-d14	82

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Sample Details: QC Blank Job Number: s18_0838 LIMS ID Number: CL1784499 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File: Initial Calibration Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Concentration	% Fit
		(min)	mg/kg	
Naphthalene	91-20-3	-	< 0.08	-
Acenaphthylene	208-96-8	-	< 0.08	-
Acenaphthene	83-32-9	1	< 0.08	-
Fluorene	86-73-7	1	< 0.08	-
Phenanthrene	85-01-8	1	< 0.08	-
Anthracene	120-12-7	1	< 0.08	-
Fluoranthene	206-44-0	1	< 0.08	-
Pyrene	129-00-0	1	< 0.08	-
Benzo[a]anthracene	56-55-3	ı	< 0.08	ī
Chrysene	218-01-9	-	< 0.08	-
Benzo[b]fluoranthene	205-99-2	1	< 0.08	-
Benzo[k]fluoranthene	207-08-9	-	< 0.08	-
Benzo[a]pyrene	50-32-8	1	< 0.08	-
Indeno[1,2,3-cd]pyrene	193-39-5	1	< 0.08	-
Dibenzo[a,h]anthracene	53-70-3	1	< 0.08	-
Benzo[g,h,i]perylene	191-24-2	-	< 0.08	-
Coronene	191-07-1	-	< 0.08	-
Total (USEPA16) PAHs	-	-	< 1.28	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	96
Acenaphthene-d10	97
Phenanthrene-d10	95
Chrysene-d12	81
Perylene-d12	62

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	103
Terphenyl-d14	80

Concentrations are reported on a wet weight basis.

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

Reference Material (% Rec Job Number: **Sample Details:** s18_0838 LIMS ID Number: CL1784500 Date Booked in: 21-Nov-17 **QC Batch Number:** 171265 **Date Extracted:** 24-Nov-17 **Quantitation File:** Initial Calibration **Date Analysed:** 25-Nov-17 **Directory:** 112417.MS17\ Matrix: Soil **Dilution: Ext Method:** Ultrasonic 1.0

UKAS accredited?: No

Target Compounds	CAS#	R.T.	Recovery	% Fit
		(min)	%	
Naphthalene	91-20-3	3.31	103	100
Acenaphthylene	208-96-8	4.36	103	99
Acenaphthene	83-32-9	4.48	104	92
Fluorene	86-73-7	4.87	101	92
Phenanthrene	85-01-8	5.72	97	100
Anthracene	120-12-7	5.77	100	99
Fluoranthene	206-44-0	7.08	98	90
Pyrene	129-00-0	7.37	98	88
Benzo[a]anthracene	56-55-3	9.06	102	99
Chrysene	218-01-9	9.11	98	99
Benzo[b]fluoranthene	205-99-2	10.59	96	96
Benzo[k]fluoranthene	207-08-9	10.62	96	96
Benzo[a]pyrene	50-32-8	11.02	98	96
Indeno[1,2,3-cd]pyrene	193-39-5	12.39	80	90
Dibenzo[a,h]anthracene	53-70-3	12.43	71	94
Benzo[g,h,i]perylene	191-24-2	12.69	82	93
Coronene	191-07-1	14.89	63	73
Total (USEPA16) PAHs	-	-	99	-

^{*} Denotes compound is not UKAS accredited

"M" denotes that % fit has been manually interpreted

Internal Standards	% Area
1,4-Dichlorobenzene-d4	NA
Naphthalene-d8	-
Acenaphthene-d10	-
Phenanthrene-d10	-
Chrysene-d12	-
Perylene-d12	-

Surrogates	% Rec
Nitrobenzene-d5	NA
2-Fluorobiphenyl	-
Terphenyl-d14	-

Concentrations are reported on a wet weight basis.

Polychlorinated Biphenyls (congeners)

Customer and Site Details: Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall Gl Matrix:

 Job Number:
 \$18_0838

 QC Batch Number:
 171265

Directory: 112317PCB.GC70

Method: Ultrasonic

Compounds marked * are not UKAS or MCerts accredited

				Cor	centration,	(µg/kg)		
Sample ID	Customer ID	PCB28	PCB52	PCB101	PCB118	PCB153	PCB138	PCB180
CL1784497	BH19 1.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784498	BH19 3.50	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784499	QC Blank	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0
CL1784500	Reference Material (% Recovery)	86.6	90.5	80.9	98.0	95.9	95.3	79.5

Soil

21-Nov-17

23-Nov-17

23-Nov-17

Date Booked in:

Date Extracted:

Date Analysed:

Client	client Causeway Geotech Ltd			Leaching Data		
Cilent	Causeway Geolech Lid			Weight of sample (kg)		
Contact	Noil Hoggon			Moisture content @ 105°C (% of Wet Weight)		
Contact	Neil Haggan			Equivalent Weight based on drying at 105°C (kg) 0.0		
Site	Arklow Sewerage Schem	o Marina Ou	#all CI	Volume of water required to carry out 10:1 stage (litres) 0		
Site	Arkiow Sewerage Schen	ie ivianne Ou	liali Gi	Fraction of sample above 4 mm %	11.200	
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
DU10.1.50		s18 0838	CL/1784497	30-Nov-17		
BH19 1.50		\$10_0000 CL/1/8449/ 30-110		30-NOV-17		

Note: The >4mm fraction is crushed using a disc mill

				Landfill Waste Acceptance Criteria Limit Values			
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill	
Ν	WSLM59	Total Organic Carbon (% M/M)	0.12	3	5	6	
Ν	LOI450	Loss on Ignition (%)	0.8			10	
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6			
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1			
Ν	TPHFIDUS	Mineral Oil (mg/kg)	16	500			
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.42	100			
N	PHSOIL	pH (pH units)	7.6		>6		
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.81		To be evaluated	To be evaluated	

ي	Φ		10:1 Single Stage Leachate	10:1 Single Stage Leachate Calculated cumulative amount leached @ 10:1		Landfill Waste Acceptance Criteria Limit Values for				
Accreditation	Method Code	Leachate Analysis	mg/l except ⁰⁰ mg/kg (dry weight)		BSEN 12457/2 @ L/S 10 litre kg-1 mg/kg (dry weight)					
U		pH (pH units) 00	7.1	Calculated data not UKAS Accredited						
U	WSLM2	Conductivity (µs/cm) 00	124	Calculated data not offao Accredited						
U	ICPMSW	Arsenic	0.005	0.05	0.5	2	25			
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300			
U	ICPMSW	Cadmium	0.0001	0.001	0.04	1	5			
U	ICPMSW	Chromium	0.002	0.02	0.5	10	70			
U	ICPMSW	Copper	0.007	0.07	2	50	100			
U	ICPMSW	Mercury	<0.0001	<0.001	0.01	0.2	2			
U	ICPMSW	Molybdenum	0.002	0.02	0.5	10	30			
U	ICPMSW	Nickel	0.001	0.01	0.4	10	40			
U	ICPMSW	Lead	0.018	0.18	0.5	10	50			
U	ICPMSW	Antimony	<0.001	<0.01	0.06	0.7	5			
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7			
U	ICPMSW	Zinc	0.038	0.38	4	50	200			
U	KONENS	Chloride	24	240	800	15000	25000			
U	ISEF	Fluoride	0.3	3	10	150	500			
U	ICPWATVAR	Sulphate as SO4	11	110	1000	20000	50000			
Ν	WSLM27	Total Dissolved Solids	96.9	969	4000	60000	100000			
U	SFAPI	Phenol Index	<0.05	<0.5	1					
Ν	WSLM13	Dissolved Organic Carbon	1.8	18	500	800	1000			

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Template Ver. 1

Client	Causaway Caataah Ltd				Leaching Data Weight of sample (kg) 0.2				
Cilent	Causeway Geotech Ltd								
Contact	Noil Haggan				Moisture content @ 105°C (% of Wet Weight)				
Contact	Neil Haggan				Equivalent Weight based on drying at 105°C (kg) 0.				
Site	Arklow Sewerage Schem	o Marina Ou	tfall CI		Volume of water required to carry out 10:1 stage (litres)				
Site	Arkiow Sewerage Schem	le Marine Ou	liali Gi		Fraction of sample above 4 mm %	5.600			
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000			
BH19 3.50		s18 0838	CL/1784498 30-Nov-17						
-	DH 19 3.30	\$10_000	CL/1704490	30-Nov-17					

Note: The >4mm fraction is crushed using a disc mill

				Landfill Was	Vaste Acceptance Criteria Limit Values			
Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Inert Waste Landfill	Stable Non- reactive Hazardous Waste in Non- Hazardous Landfill	Hazardous Waste Landfill		
N	WSLM59	Total Organic Carbon (% M/M)	9.1	3	5	6		
Ν	LOI450	Loss on Ignition (%)	18.9			10		
Ν	BTEXHSA	Sum of BTEX (mg/kg)	<0.13	6				
Ν	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	< 0.035	1				
Ν	TPHFIDUS	Mineral Oil (mg/kg)	102	500				
Ν	PAHMSUS	PAH Sum of 17 (mg/kg)	<3.30	100				
N	PHSOIL	pH (pH units)	7.5		>6			
Ν	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.02		To be evaluated	To be evaluated		

_ c	Φ		10:1 Single Stage Leachate	Calculated cumulative amount leached @ 10:1	Landfill Waste	Acceptance Crite	ria Limit Values for
Accreditation	Method Code	Leachate Analysis	mg/l except [∞]	mg/kg (dry weight)	BSEN 12457/2 @ L/S 10 litre g/kg (dry weight) mg/kg (dry weight)		
U	WSLM3	pH (pH units) 00	7.5	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) 00	3580	Calculated data flot 617.16 / toricalica			
U	ICPMSW	Arsenic	0.009	0.09	0.5	2	25
U	ICPWATVAR	Barium	<0.01	<0.1	20	100	300
U	ICPMSW	Cadmium	<0.0001	<0.001	0.04	1	5
U	ICPMSW	Chromium	<0.001	<0.01	0.5	10	70
U	ICPMSW	Copper	<0.001	<0.01	2	50	100
U		Mercury	<0.0001	<0.001	0.01	0.2	2
U	ICPMSW	Molybdenum	0.086	0.86	0.5	10	30
U	ICPMSW	Nickel	<0.001	<0.01	0.4	10	40
U	ICPMSW	Lead	<0.001	<0.01	0.5	10	50
U	ICPMSW	Antimony	0.001	0.01	0.06	0.7	5
U	ICPMSW	Selenium	<0.001	<0.01	0.1	0.5	7
U	ICPMSW	Zinc	0.004	0.04	4	50	200
U	KONENS	Chloride	929	9290	800	15000	25000
U	ISEF	Fluoride	0.6	6	10	150	500
U	ICPWATVAR	Sulphate as SO4	148	1480	1000	20000	50000
Ν	WSLM27	Total Dissolved Solids	2790	27900	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	15	150	500	800	1000

Template Ver. 1 Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

S180838

Socotec Environmental Chemistry Analytical and Deviating Sample Overview

Customer Causeway Geotech Ltd
Site Arklow Sewerage Scheme Marine Outfall GI
Report No S180838

Consignment No S70515

Date Logged 21-Nov-2017

In-House Report Due 11-Dec-2017

Please note the results for any subcontracted analysis (identified with a '^') is likely to take up to an additional five working

		MethodID	ANC	BTEXHSA		CEN Leachate	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLM59
ID Number	Description	Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (μg/kg)	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GCFID (AR)	Total Organic Carbon
CL/1784497	BH19 1.50	07/11/17		Е	Е						Е				
CL/1784497 CL/1784498	BH19 3.50	07/11/17		E	E						E				
CL/1784499	QC Blank	07/11/17		_							_				
CL/1784500	Reference Material (% Recovery	/)													

Note: We will endeavour to prioritise samples to complete analysis within holding time; however any delay could result in samples becoming deviant whilst being processed in the laboratory.

If sampling dates are missing or matrices unclassified then results will not be ISO 17025 accredited. Please contact us as soon as possible to provide missing information in order to reinstate accreditation.

Deviating Sample Key

- A The sample was received in an inappropriate container for this analysis
- B The sample was received without the correct preservation for this analysis
- C Headspace present in the sample container
- The sampling date was not supplied so holding time may be compromised applicable to all analysis
- Sample processing did not commence within the appropriate holding time
- Sample processing did not commence within the appropriate handling time

Requested Analysis Key

Analysis Required

Analysis dependant upon trigger result - Note: due date may be affected if triggered

No analysis scheduled

Analysis Subcontracted - Note: due date may vary

Report Number: EFS/180838

Additional Report Notes

Method Code	Sample ID	The following information should be taken into consideration when using the data contained within this report

Report Number: EFS/180838

Method Descriptions

Soil BT	NC FEXHSA DI(%MM)	Oven Dried @ < 35°C As Received	Quantitative digestion with Hydrochloric Acid back titration with 1M Sodium Hydroxide to pH 7 Determination of Benzene, Toluene, Ethyl benzene and Xylenes			
		As Received	Determination of Benzene, Toluene, Ethyl benzene and Xylenes			
Soil LC	OI(%MM)	Outra Dais I	(BTEX) by Headspace GCFID			
		Oven Dried @ < 35°C	Determination of loss on ignition for soil samples at specified temperature by gravimetry			
Soil PA	AHMSUS	As Received	Determination of Polycyclic Aromatic Hydrocarbons (PAH) by hexane/acetone extraction followed by GCMS detection			
Soil PC	CBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GCECD detection			
Soil Ph	HSOIL	As Received	Determination of pH of 2.5:1 deionised water to soil extracts using pH probe.			
Soil TN	MSS	As Received	Determination of the Total Moisture content at 105°C by loss on oven drying gravimetric analysis (% based upon wet weight)			
Soil TF	PHFIDUS	As Received				
Soil W	SLM59	Oven Dried @ < 35°C	Determination of Organic Carbon in soil using sulphurous Acid digestion followed by high temperature combustion and IR detection			
Water IC	PMSW	As Received	Direct quantitative determination of Metals in water samples using ICPMS			
Water IC	PWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using ICPOES			
Water IS	EF	As Received	Determination of Fluoride in water samples by Ion Selective Electrode (ISE)			
Water K0	ONENS	As Received	Direct analysis using discrete colorimetric analysis			
Water SF	API	As Received	Segmented flow analysis with colorimetric detection			
Water W	SLM13	As Received				
Water W	SLM2	As Received				
Water W	SLM27	As Received				
Water W	SLM3	As Received	Determination of the pH of water samples by pH probe			

Report Notes

Generic Notes

Soil/Solid Analysis

Unless stated otherwise,

- Results expressed as mg/kg have been calculated on the basis indicated in the Method Description table.
 All results on MCERTS reports are reported on a 105°C dry weight basis with the exception of pH and conductivity.
- Sulphate analysis not conducted in accordance with BS1377
- Water Soluble Sulphate is on a 2:1 water:soil extract

Waters Analysis

Unless stated otherwise results are expressed as mg/l

Nil: Where "Nil" has been entered against Total Alkalinity or Total Acidity this indicates that a measurement was not required due to the inherent pH of the sample.

Oil analysis specific

Unless stated otherwise,

- Results are expressed as mg/kg
- SG is expressed as g/cm³@ 15°C

Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

Asbestos Analysis

CH Denotes Chrysotile
CR Denotes Crocidolite
AM Denotes Amosite
TR Denotes Tremolite
AC Denotes Actinolite
AN Denotes Anthophylite

NAIIS No Asbestos Identified in Sample **NADIS** No Asbestos Detected In Sample

Symbol Reference

- ^ Sub-contracted analysis.
- **\$\$** Unable to analyse due to the nature of the sample
- ¶ Samples submitted for this analyte were not preserved on site in accordance with laboratory protocols.

This may have resulted in deterioration of the sample(s) during transit to the laboratory.

Consequently the reported data may not represent the concentration of the target analyte present in the sample at the time of sampling

- ¥ Results for guidance only due to possible interference
- & Blank corrected result
- I.S Insufficient sample to complete requested analysis
- I.S(g) Insufficient sample to re-analyse, results for guidance only

Intf Unable to analyse due to interferences

N.D Not determined N.Det Not detected

N.F No Flow

NS Information Not Supplied

Req Analysis requested, see attached sheets for results

- **Þ** Raised detection limit due to nature of the sample
- * All accreditation has been removed by the laboratory for this result
- # MCERTS accreditation has been removed for this result
- § accreditation has been removed for this result as it is a non-accredited matrix

Note: The Laboratory may only claim that data is accredited when all of the requirements of our Quality System have been met. Where these requirements have not been met the laboratory may elect to include the data in its final report and remove the accreditation from individual data items if it believes that the validity of the data has not been affected. If further details are required of the circumstances which have led to the removal of accreditation then please do not hesitate to contact the laboratory.

Page 13 of 13 EFS/180838 Ver. 1

Sample Descriptions

Client : Causeway Geotech Ltd

Site: Arklow Sewerage Scheme Marine Outfall GI

Report Number: \$18_0838

Note: major constituent in upper case

		Note: major constituent in upper case
Lab ID Number	Client ID	Description
CL/1784497	BH19 1.50	MARINE SEDIMENTS
CL/1704437	BH19 3.50	MARINE SEDIMENTS MARINE SEDIMENTS
CL/1704490	QC Blank	QUALITY CONTROL SAMPLE
CL/1784498 CL/1784499 CL/1784500	QC Blank	QUALITY CONTROL SAMPLE
CL/1784500	Reference Material (% Recovery)	QUALITY CONTROL SAMPLE

Appendix A Page 1 of 1 12/12/2017EFS/180838 Ver. 1



APPENDIX F
SPT hammer energy measurement results



SPT Calibration Report www.equipegroup.com Hammer Energy Measurement Report SPT HAMMER Type of Hammer Key **CAUSEWAY GEOTECH** Client 1 Anvil 2 Part of instrumented rod 3 Drive Rod 4 Strain Gauge EOU1763 Test No 7.50 Test Depth (m) 5 Accelerometer 18 February 2017 Date of Test 6 Ground 18 February 2018 Valid until F Force d, Diameter of rod EQU1763 Hammer ID ød, Mass of the hammer m = 63.5 kgh = 0.76mFalling height $m \times g \times h = 473$ E theor = Characteristics of the instrumented rod $d_r = 0.052 \, \text{m}$ Diameter Length of the instrumented rod 0.558 m $A = 11.61 \text{ cm}^2$ $E_o = 206843 \text{ MPa}$ Modulus Fig. 8.1 and B.2 BS EN ISO 22476-3: 2005 + A1: 2011 **Particle Velocity** Force Force F (IdN) Time I (µs) Time ((ps) **Energy Ratio per Blow** Acceleration 100 000 95 000 ◆Blow 1 B5 000 • Slow 2 80.000 e Blow 3 75 000 ◆ Blow 4 70-000 • Blow S Blow 6 • Blow 8 55 000 Blow 9 50 000 • Blow 10 45 000 Maximum Force (Fmax) Time t (µs) Observations: E_{ineas} 0.277 kN-m E meas -58.61% **Energy Ratio** $E_{\rm theor}$ E theor = 0.473 kN-m AF **Equipe SPT Analyzer Operators:** Date 02/03/2017 Checked by: Prepared by: Corners



SPT Hammer Energy Test Report

in accordance with BSEN ISO 22476-3:2005

Southern Testing Laboratories

Keeble House Stuart Way East Grinstead West Sussex RH19 4QA SPT Hammer Ref: DR1

Test Date:

01/06/2017

Report Date:

01/06/2017

File Name:

DR1.spt

Test Operator:

NPB

Instrumented Rod Data

Diameter d_r (mm): 54

Wall Thickness t_r (mm): 6.0

Assumed Modulus E_a (GPa): 200

Accelerometer No.1: 6458

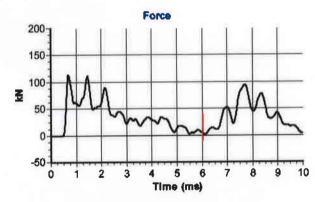
Accelerometer No.2: 9607

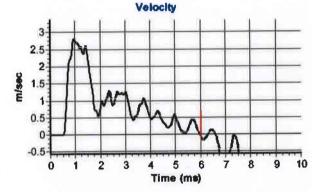
SPT Hammer Information

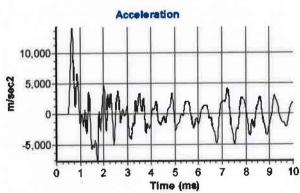
Hammer Mass m (kg): 63.5 Falling Height h (mm): 760 SPT String Length L (m): 14.5

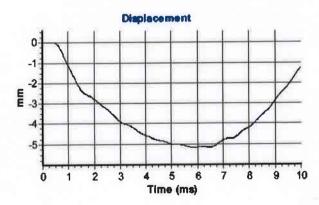
Comments / Location

CHARLWOODS









Calculations

Area of Rod A (mm2): 905 Theoretical Energy E_{theor} (J): 473 Measured Energy E_{meas} (J): 287

Energy Ratio E_r (%):

61

Signed: Neil Burrows

Title:

Field Operations Manager

The recommended calibration interval is 12 months