

## **Appendix 14.3**

### **Marine Outfall Site Investigation**







**CAUSEWAY**  
— GEOTECH

## Arklow Sewerage Scheme - Marine Outfall Site Investigation

Client: Irish Water

Client's Representative: Byrne Looby ARUP J.V

Report No.: 17-0167

Date: December 2017

Status: Draft for Review

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Document Control Sheet




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## APPENDICES

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## Document Control Sheet

<b>Report No.:</b>		17-0167			
<b>Project Title:</b>		Arklow Sewerage Scheme Marine Outfall – Ground Investigation			
<b>Client:</b>		Irish Water			
<b>Client's Representative:</b>		Byrne Looby ARUP J.V.			
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<b>Prepared by:</b>		<b>Reviewed by:</b>		<b>Approved by:</b>	
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The works were conducted in accordance with:

UK Specification for Ground Investigation 2<sup>nd</sup> 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 on exploratory hole logs	
U	Nominal 100mm diameter undisturbed open tube sample (thick walled sampler)
UT	Nominal 100mm diameter undisturbed open tube sample (thin walled sampler)
P	Nominal 100mm diameter undisturbed piston sample
B	Bulk disturbed sample
LB	Large bulk disturbed sample
D	Small disturbed sample
C	Core sub-sample (displayed in the Field Records column on the logs)
L	Liner sample from dynamic sampled borehole
W	Water sample
ES / EW	Soil sample for environmental testing / Water sample for environmental testing
SPT (s)	Standard penetration test using a split spoon sampler (small disturbed sample obtained)
SPT (c)	Standard penetration test using 60 degree solid cone
x,x/x,x,x,x	Blows per increment during the standard penetration test. The initial two values relate to the seating drive (150mm) and the remaining four to the 75mm increments of the test length. 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 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 29<sup>th</sup> August and 7<sup>th</sup> 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<sub>(s)</sub>) or solid cone attachment (SPT<sub>(c)</sub>). 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<sub>(s)</sub>) or solid cone attachment (SPT<sub>(c)</sub>). 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 as-built 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.



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## **APPENDIX A**

### **Site and exploratory hole location plans**





**Project No.:** 17-0167

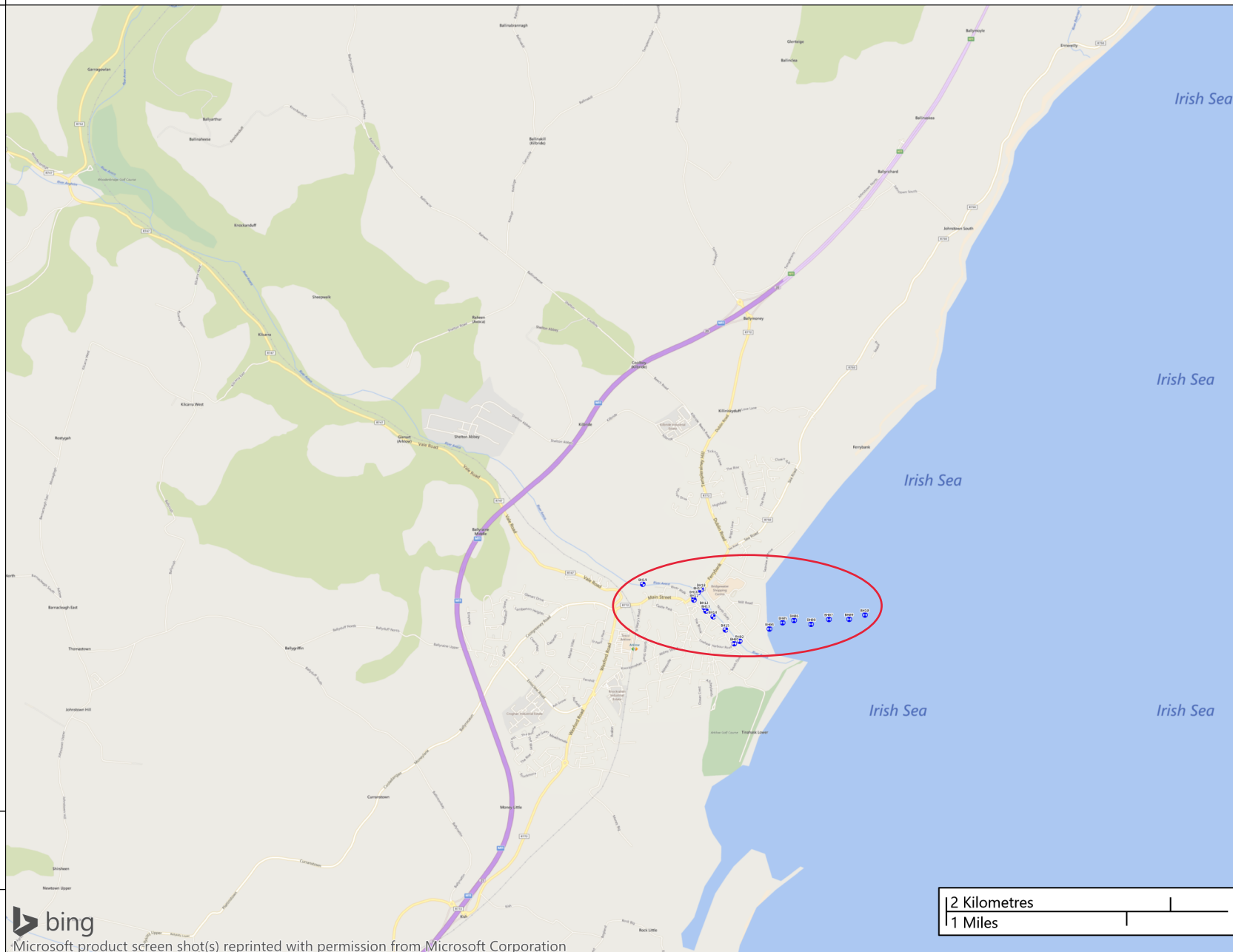
**Client:** Irish Water

**Project Name:** Arklow Sewerage Scheme Marine Outfall GI

**Client's Representative:** Byrne Looby ARUP J.V.

### Legend Key

- Locations By Type - CP
- Locations By Type - CP+RC



### Title:

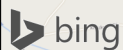
Site Location Plan

### Last Revised:

22/11/2017

### Scale:

1:50000



Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation

2 Kilometres

1 Miles







**Project No.:** 17-0167

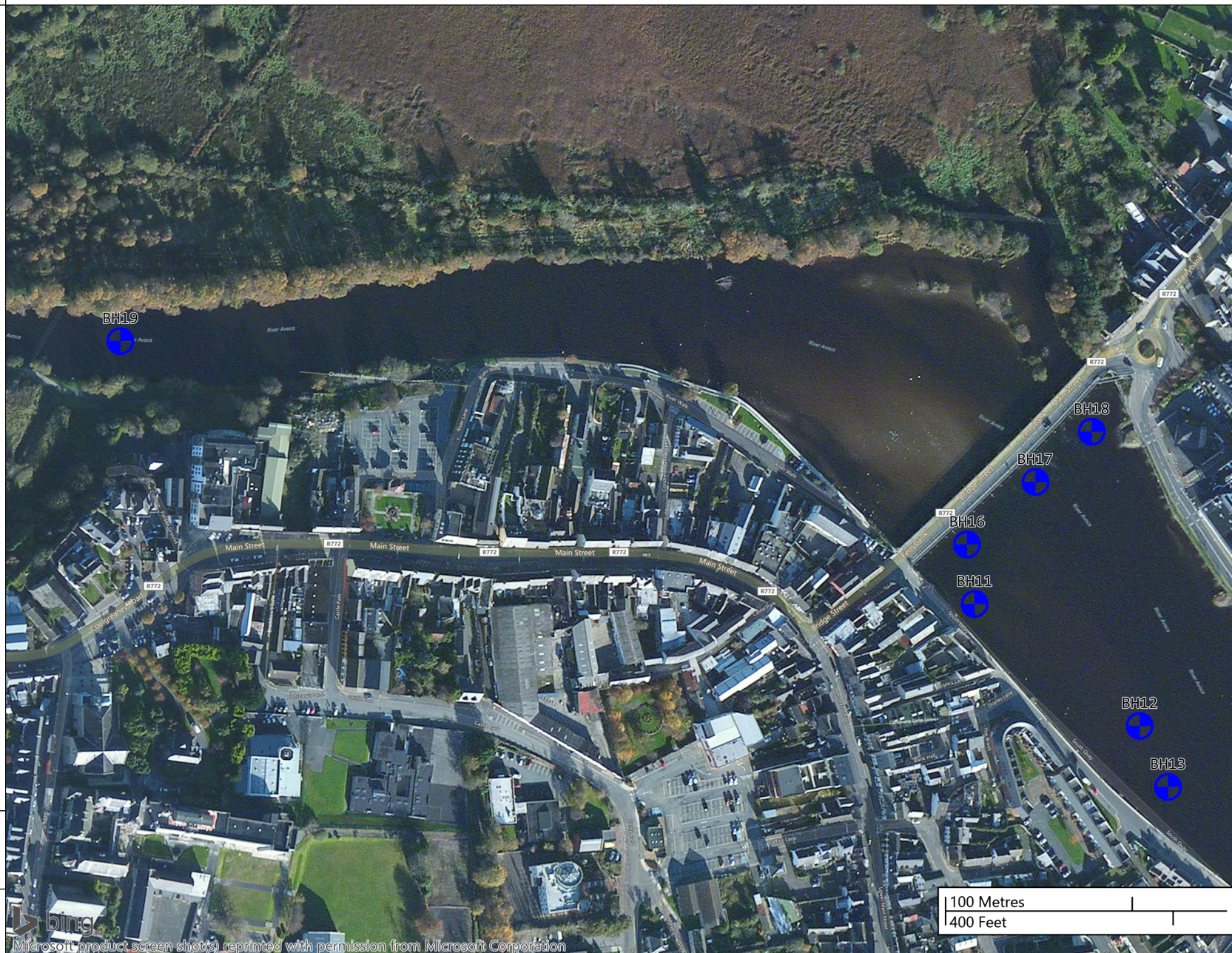
**Client:** Irish Water

**Project Name:** Arklow Sewerage Scheme Marine Outfall GI

**Client's Representative:** Byrne Looby ARUP J.V.

### Legend Key

-  Locations By Type - CP
-  Locations By Type - CP+RC



**Title:**  
Exploratory Hole Location Plan

**Last Revised:**  
22/11/2017

**Scale:**  
1:3000







**Project No.:** 17-0167

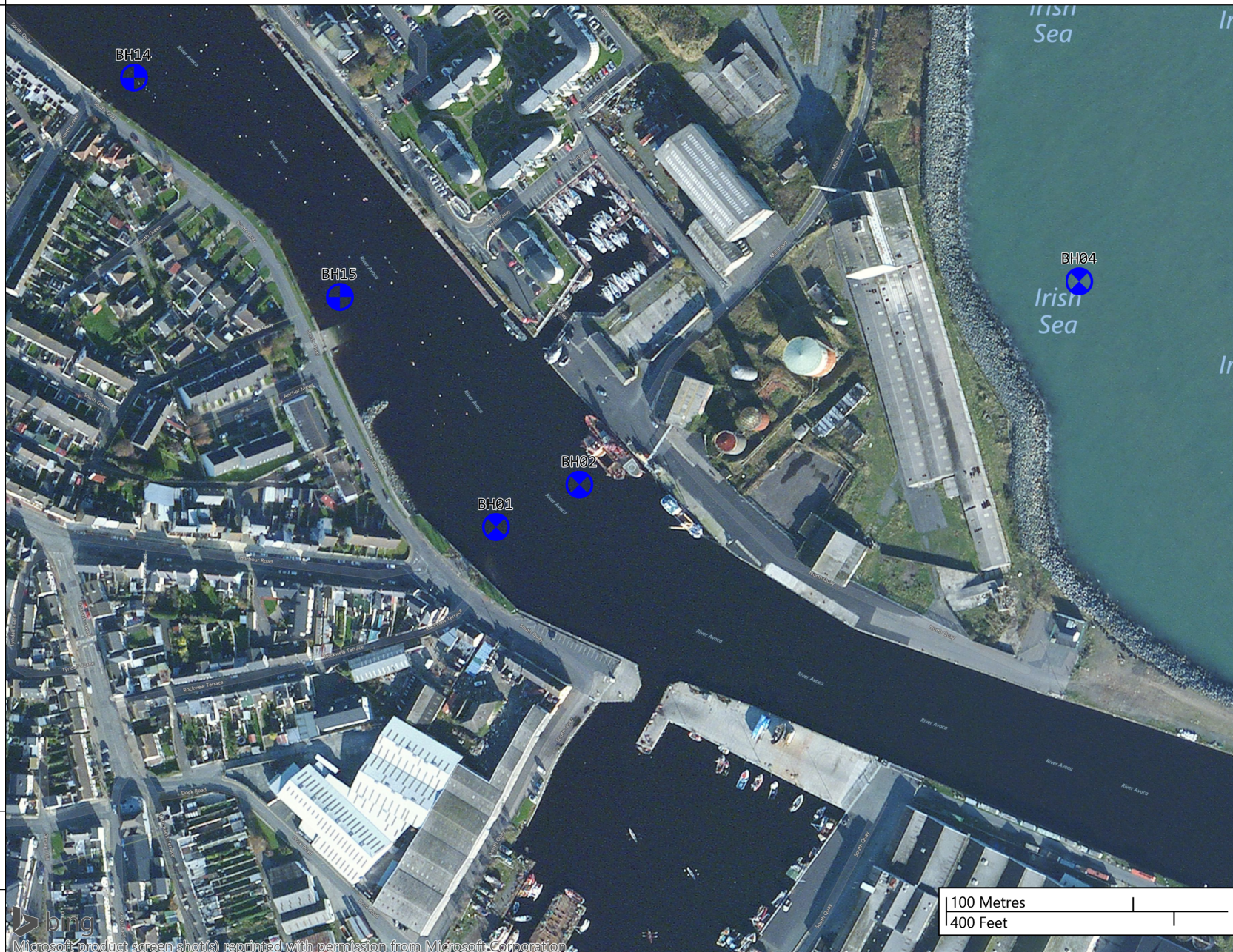
**Client:** Irish Water

**Project Name:** Arklow Sewerage Scheme Marine Outfall GI

**Client's Representative:** Byrne Looby ARUP J.V.

#### Legend Key

-  Locations By Type - CP
-  Locations By Type - CP+RC



**Title:**  
Exploratory Hole Location Plan

**Last Revised:**  
22/11/2017

**Scale:**  
1:3000

Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation







**Project No.:** 17-0167  
**Project Name:** Arklow Sewerage Scheme Marine Outfall GI

**Client:** Irish Water  
**Client's Representative:** Byrne Looby ARUP J.V.

#### Legend Key

-  Locations By Type - CP
-  Locations By Type - CP+RC

*Irish Sea*

*Irish Sea*

*Irish*

BH10

BH07

BH09

BH06

BH05

BH08

*Irish Sea*

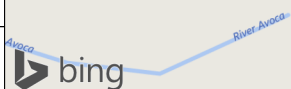
*Irish Sea*

*Irish*

**Title:**  
Exploratory Hole Location Plan

**Last Revised:**  
22/11/2017

**Scale:**  
1:4000



Microsoft product screen shot(s) reprinted with permission from Microsoft Corporation

200 Metres  
600 Feet




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**APPENDIX B**  
**Borehole logs**











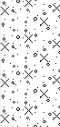
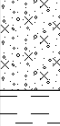


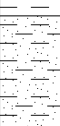
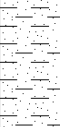
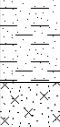
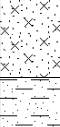
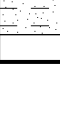





<div><div>CAUSEWAY GEOTECH</div></div>					<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH01						
<div><div>Method</div><div>Plant Used</div><div>Top</div><div>Base</div></div> <div>Cable Percussion Rotary Drilling</div> <div>Dando 3000 Comacchio 405</div> <div>0.00 20.50</div> <div>20.50 25.00</div>					<b>Coordinates:</b> 325103.16 E		<b>Client:</b> Irish Water				Sheet 1 of 3						
					<b>Ground Level:</b> -3.86 mOD		<b>Client's Representative:</b> Byrne Looby ARUP J.V.				<b>Scale:</b> 1:50						
							<b>Dates:</b> 01/09/2017 - 05/09/2017				<b>Driller:</b> CC+TA						
											<b>Logger:</b> SG						
<b>Depth (m)</b>		<b>Sample / Tests</b>		<b>Casing Depth (m)</b>	<b>Water Depth (m)</b>	<b>Field Records</b>		<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Legend</b>	<b>Description</b>		<b>Water</b>	<b>Backfill</b>			
0.00 - 1.00		B1									Black very gravelly silty fine to coarse SAND. Gravel is subrounded fine to medium.						
0.50		ES28							(1.00)						0.5		
1.00		D2						-4.86	1.00						1.0		
1.00 - 2.00		B3									Loose to medium dense black sandy slightly silty subrounded fine to coarse GRAVEL. Sand is fine to coarse.				1.5		
1.00 - 1.45		SPT (S) N=9		1.00	Dry	N=9 (1,2/2,2,2,3)									2.0		
1.50		ES29							(1.80)						2.5		
2.00		D4									Medium dense greyish brown very gravelly slightly silty fine to coarse SAND. Gravel is subrounded fine.				3.0		
2.00 - 2.45		SPT (S) N=12		2.00	Dry	N=12 (2,2/3,3,3,3)									3.5		
2.50		ES30													4.0		
2.80 - 3.50		B5						-6.66	2.80						4.5		
3.00		D6									Firm brown slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine.				5.0		
3.00 - 3.45		SPT (S) N=14		3.00	Dry	N=14 (2,3/4,4,3,3)									5.5		
3.50		ES31							(1.70)		Medium dense brown very sandy slightly silty subrounded fine to medium GRAVEL. Sand is fine to coarse. Locally thin bands of brown silt.				6.0		
3.50 - 4.50		B7													6.5		
4.00		D8													7.0		
4.00 - 4.45		SPT (S) N=18		4.00	Dry	N=18 (3,3/4,4,5,5)									7.5		
4.50		ES32						-8.36	4.50		Firm brown slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine.				8.0		
4.50 - 4.80		B9							(0.30)						8.5		
4.80 - 5.50		B10						-8.66	4.80		Medium dense brown very sandy slightly silty subrounded fine to medium GRAVEL. Sand is fine to coarse. Locally thin bands of brown silt.				9.0		
5.00 - 5.45		SPT (S) N=12		5.00	Dry	N=12 (1,2/2,3,3,4)			(1.10)						9.5		
5.50		ES33													10.0		
5.80 - 7.00		B11															
6.00 - 6.45		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.						
6.50		D12							(1.70)								
7.00		D13															
7.00 - 7.45		SPT (S) N=8		7.00	Dry	N=8 (1,2/2,2,2,2)											
7.60 - 9.00		B14						-11.46	7.60		Firm brownish grey slightly sandy slightly gravelly SILT. Sand is fine to coarse. Gravel is subrounded fine.						
8.00 - 8.45		UT35		8.00	Dry	Ublow=59 100%			(1.10)								
8.50		D15															
8.70 - 10.00		B16						-12.56	8.70		Medium dense brownish grey very silty fine to coarse SAND.						
9.00		D17							(1.40)								
9.00 - 9.45		SPT (S) N=12		9.00	Dry	N=12 (1,1/2,3,3,4)											
10.00 - 10.35		UT36		10.0	Dry	Ublow=61 80%		-13.96	10.10								
10.10 - 10.50		B18		0					(0.40)		Soft grey slightly sandy SILT. Sand is fine to coarse.						
<b>Remarks</b> Deck to Bed = 6.20m										<b>Core Barrel</b> SK6L		<b>Water Strikes</b> Struck at (m) Casing to (m) Time (min) Rose to (m)				<b>Chiselling Details</b> From (m) To (m) Time (hh:mm)	
										<b>Flush Type</b>		<b>Water Added</b> From (m) To (m)		<b>Casing Details</b> To (m) Diam (mm)			
Terminated at scheduled depth																	

<div><div>CAUSEWAY GEOTECH</div></div>				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH01						
				<b>Coordinates:</b> 325103.16 E		<b>Client:</b> Irish Water				Sheet 2 of 3						
<b>Method</b>		<b>Plant Used</b>		<b>Top</b>		<b>Base</b>		<b>Client's Representative:</b>				<b>Scale:</b> 1:50				
Cable Percussion Rotary Drilling		Dando 3000 Comacchio 405		0.00 20.50		20.50 25.00		Byrne Looby ARUP J.V.				<b>Driller:</b> CC+TA				
				<b>Ground Level:</b> -3.86 mOD		<b>Dates:</b> 01/09/2017 - 05/09/2017				<b>Logger:</b> SG						
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Casing Depth (m)</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Legend</b>	<b>Description</b>			<b>Water</b>	<b>Backfill</b>				
10.50	D19				-14.36	10.50	× × × ×	Soft grey slightly sandy SILT. Sand is fine to coarse.								
10.50 - 12.00	B20							Medium dense grey very silty fine to coarse SAND with thin bands of greyish brown silt.								
11.00 - 11.45	SPT (S) N=13	11.0 0	Dry	N=13 (1,2/3,3,3,4)		(2.20)										
12.00 - 12.45	SPT (S) N=12	12.0 0	Dry	N=12 (2,3/3,3,3,3)												
12.70 - 13.50	B21				-16.56	12.70		Medium dense to dense greyish brown very sandy silty subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse.								
13.00 - 13.45	SPT (S) N=21	13.0 0	Dry	N=21 (1,2/4,5,5,7)												
14.00	D22															
14.00 - 15.00	B23															
14.00 - 14.45	SPT (S) N=28	14.0 0	Dry	N=28 (3,4/6,6,7,9)		(4.30)										
15.00	D24															
15.00 - 16.00	B25															
15.00 - 15.45	SPT (S) N=31	15.0 0	Dry	N=31 (6,7/9,7,7,8)												
16.00 - 17.00	B26															
16.00 - 16.45	SPT (S) N=31	16.0 0	Dry	N=31 (4,6/7,8,8,8)												
17.00 - 17.45	SPT (S) N=26	17.0 0	Dry	N=26 (2,4/5,5,7,9)	-20.86	17.00		Medium dense to dense brownish grey very sandy very silty subrounded fine to medium GRAVEL. Sand is fine to coarse.								
17.30 - 18.00	B37															
18.00	D38															
18.00 - 19.00	B39															
18.00 - 18.45	SPT (S) N=18	18.0 0	Dry	N=18 (2,3/4,4,5,5)		(3.50)										
19.00	D40															
19.00 - 20.00	B41															
19.00 - 19.45	SPT (S) N=32	19.0 0	Dry	N=32 (3,4/7,8,9,8)												
20.00	D42															
20.00 - 20.45	SPT (S) N=29	20.0 0	Dry	N=29 (2,3/5,7,8,9)												
20.20 - 20.50	B27				-24.36	20.50		Very dense greyish brown gravelly slightly silty fine to coarse SAND. Gravel								
	TCR	SCR	RQD	FI												
<b>Remarks</b> Deck to Bed = 6.20m          Terminated at scheduled depth							<b>Core Barrel</b> SK6L		<b>Water Strikes</b>				<b>Chiselling Details</b>			
									Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)	
							<b>Flush Type</b>		<b>Water Added</b>		<b>Casing Details</b>					
									From (m)	To (m)	To (m)	Diam (mm)				
									15.00		250					

<div><div>CAUSEWAY GEOTECH</div></div>					Project No.: 17-0167		Project Name: Arklow Sewerage Scheme Marine Outfall GI				Borehole No.: BH01							
					Coordinates: 325103.16 E		Client: Irish Water				Sheet 3 of 3							
					173070.75 N		Client's Representative: Byrne Looby ARUP J.V.				Scale: 1:50							
Method Cable Percussion Rotary Drilling		Plant Used Dando 3000 Comacchio 405		Top 0.00 20.50		Base 20.50 25.00		Ground Level: -3.86 mOD		Dates: 01/09/2017 - 05/09/2017				Driller: CC+TA		Logger: SG		
Depth (m)		TCR	SCR	RQD	FI	Field Records		Level (mOD)	Depth (m) (Thickness)	Legend	Description				Water	Backfill		
21.00 - 21.45						N=50 (6,6/7,13,14,16)					is subrounded fine to medium.							
23.00 - 23.40						N=50 (6,7/50 for 250mm)			(4.50)									
25.00 - 25.34						50 (6,9/50 for 185mm)		-28.86	25.00		End of Borehole at 25.00m							
		TCR	SCR	RQD	FI													
Remarks Deck to Bed = 6.20m  Terminated at scheduled depth										Core Barrel SK6L  Flush Type		Water Strikes Struck at (m) Casing to (m) Time (min) Rose to (m)  Water Added To (m) Casing Details To (m) Diam (mm) 24.80 200				Chiselling Details From (m) To (m) Time (hh:mm) 13.60 14.00 01:00		

<div></div> <div>CAUSEWAY GEOTECH</div>				Project No.: 17-0167		Project Name: Arklow Sewerage Scheme Marine Outfall GI				Borehole No.: BH02													
				Coordinates: 325147.66 E		Client: Irish Water				Sheet 1 of 3													
				Method Cable Percussion Rotary Drilling		Plant Used Dando 3000 Comacchio 405		Top 0.00 18.00		Base 18.00 25.00		Scale: 1:50											
				Ground Level: -1.28 mOD		Client's Representative: Byrne Looby ARUP J.V.				Driller: CC+SS													
						Dates: 29/08/2017 - 31/08/2017				Logger: SG													
Depth (m)		Sample / Tests		Casing Depth (m)	Water Depth (m)	Field Records		Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill										
0.00 - 1.00		B1									Black very sandy slightly silty subrounded to rounded fine to coarse GRAVEL. Sand is fine to coarse.												
0.50		ES28							(1.00)				0.5										
1.00		D14						-2.28	1.00		Soft black slightly gravelly very sandy SILT with organic matter. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.		1.0										
1.00 - 2.00		B2																					
1.00 - 1.45		SPT (S)		1.00		N=8 (1,2/2,2,2,2)							1.5										
1.50		N=8 ES29							(1.30)														
2.00		D15											2.0										
2.00 - 2.45		SPT (S)		2.00		N=5 (1,1/1,1,1,2)																	
2.30 - 3.00		N=5 B3						-3.58	2.30		Loose black very sandy slightly silty subrounded to rounded fine to coarse GRAVEL. Sand is fine to coarse.		2.5										
2.50		ES30																					
3.00		D16											3.0										
3.00 - 4.00		B4																					
3.00 - 3.45		SPT (S)		3.00		N=8 (1,2/1,2,2,3)							3.5										
3.50		N=8 ES31							(2.60)														
4.00		D17											4.0										
4.00 - 4.45		SPT (S)		4.00		N=10 (1,1/2,2,3,3)																	
4.50		N=10 ES32											4.5										
4.90 - 6.00		B5						-6.18	4.90		Firm brown CLAY.		5.0										
5.00 - 5.45		UT24				Ublow=76 100%																	
5.50		ES33							(1.10)				5.5										
6.00		D18						-7.28	6.00		Medium dense brown very sandy silty subangular to subrounded fine to medium GRAVEL. Sand is fine to coarse.		6.0										
6.00 - 6.40		B6																					
6.00 - 6.45		SPT (S)		6.00		N=15 (1,2/3,3,4,5)			(0.60)				6.5										
6.40 - 7.00		N=15 B7						-7.88	6.60														
7.00 - 7.45		UT25						-8.18	(0.30)		Firm to stiff brown CLAY.		7.0										
7.00 - 8.00		B8				Ublow=65 100%			6.90		Firm brownish grey slightly sandy CLAY. Sand is fine to medium.												
7.50		D19											7.5										
8.00 - 8.45		SPT (S)		8.00		N=7 (2,1/2,1,2,2)			(2.10)				8.0										
		N=7											8.5										
9.00 - 10.00		B9						-10.28	9.00		Grey silty fine SAND.		9.0										
9.00 - 9.45		UT26				Ublow=30 0%			(0.80)				9.5										
10.00 - 11.00		B10						-11.08	9.80		Firm brownish grey slightly sandy CLAY. Sand is fine to medium.		10.0										
10.00 - 10.45		SPT (S)		10.0		N=8 (1,2/2,2,2,2)																	
		N=8		0																			
Remarks Deck to bed = 5.30m																							
Terminated at scheduled depth										Core Barrel		Water Strikes				Chiselling Details							
												Struck at (m)		Casing to (m)		Time (min)		Rose to (m)		From (m)		To (m)	
																		11.00		12.80		01:00	
										Flush Type		Water Added		Casing Details									
From (m)		To (m)		To (m)		Diam (mm)																	
		2.50		15.00																			



<div><div>CAUSEWAY GEOTECH</div></div>					Project No.: 17-0167		Project Name: Arklow Sewerage Scheme Marine Outfall GI				Borehole No.: BH02																		
<div>MethodPlant UsedTopBaseCable PercussionRotary DrillingDando 3000Comacchio 4050.0018.00173094.73 N25.00</div>					Coordinates: 325147.66 E		Client: Irish Water				Sheet 2 of 3																		
					173094.73 N		Client's Representative: Byrne Looby ARUP J.V.				Scale: 1:50																		
					Ground Level: -1.28 mOD		Dates: 29/08/2017 - 31/08/2017				Driller: CC+SS																		
											Logger: SG																		
Depth (m)		Sample / Tests		Casing Depth (m)	Water Depth (m)	Field Records		Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill																
10.50 10.50 - 10.95		D20 UT27				Ublow=59 100%					Firm brownish grey slightly sandy CLAY. Sand is fine to medium.																		
11.00 11.00 - 11.45		D21 SPT (S) N=15		11.0 0		N=15 (2,2/3,3,3,6)			(1.70)																				
11.50 - 12.50		B11						-12.78	11.50		Medium dense brown very sandy silty subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded.																		
12.00 - 12.45		SPT (S) N=23		12.0 0		N=23 (3,4/6,5,6,6)			(2.25)																				
13.00 - 14.00 13.00 - 13.45		B12 SPT (S) N=24		13.0 0		N=24 (2,4/5,6,6,7)																							
14.00 14.00 - 15.00 14.00 - 14.45		D22 B13 SPT (S) N=39		14.0 0		N=39 (4,6/7,9,10,13)		-15.02	13.75		Dense brown sandy 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.																		
15.00 15.00 - 16.00 15.00 - 15.45		D23 B35 SPT (S) N=34		15.0 0		N=34 (6,9/7,8,8,11)			(3.15)																				
16.00 16.00 - 16.45		D34 SPT (S) N=34				N=34 (4,6/7,9,8,10)																							
16.90 - 17.50 17.00 17.00 - 17.45		B37 D36 SPT (S) N=32		17.0 0		N=32 (4,6/7,7,8,10)		-18.18	16.90		Dense grey sandy silty subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.																		
18.00 - 18.05 18.00 - 18.05		SPT (C)		18.0 0		50 (25 for 25mm/50 for 25mm) for 25mm)		-19.27	18.00 (0.40)		Amphibolite BOULDER.																		
19.00 - 19.45 19.00		40				N=35 (5,6/8,8,9,10)		-19.68	18.40		Grey sandy silty subangular to subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded predominantly of amphibolite.																		
20.00 - 20.45						N=38 (5,7/9,8,10,11)																							
		TCR SCR RQD FI																											
Remarks														Core Barrel		Water Strikes				Chiselling Details									
Deck to bed = 5.30m																Struck at (m)		Casing to (m)		Time (min)		Rose to (m)		From (m)		To (m)		Time (hh:mm)	
																								11.00		12.80		01:00	
Terminated at scheduled depth														Flush Type		Water Added		Casing Details											
																From (m) To (m)		To (m) Diam (mm)											
																		16.50 18.00		250 200									



17-0167

325147.66 E

**Ground Level:**

-1.28 mOD

Arklow Sewerage Scheme Marine Outfall GI

Irish Water

Byrne Looby ARUP J.V.

29/08/2017 - 31/08/2017

**BH02**

Sheet 3 of 3

**Scale:** 1:50

Driller: CC+SS

**Logger:** SG


<div>Remarks</div> <div>Deck to bed = 5.30m</div> <div></div> <div></div> <div></div> <div></div> <div></div> <div>Terminated at scheduled depth</div>	Core Barrel	Water Strikes				Chiselling Details		
		Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
						11.00	12.80	01:00
	Flush Type	Water Added		Casing Details				
		From (m)	To (m)	To (m)	Diam (mm)			



Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.00 - 1.40	B13							Medium dense yellowish brown slightly gravelly fine to coarse SAND with shell fragments. Gravel is subangular to subrounded fine to medium.		
0.50	ES27					(1.40)				0.5
1.00	D14									1.0
1.00 - 1.45	SPT (S) N=21	1.00		N=21 (3,4/5,5,5,6)						
1.40 - 2.50	B15				-3.61	1.40		Medium dense yellowish brown very gravelly slightly silty fine to coarse SAND with occasional shell fragments. Gravel is subrounded fine to medium.		1.5
1.50	ES28									
2.00	D16									2.0
2.00 - 2.45	SPT (S) N=15	2.00		N=15 (2,2/3,4,4,4)						2.5
2.50	ES29					(2.80)				
3.00	D18									3.0
3.00 - 4.00	B17									
3.00 - 3.45	SPT (S) N=12	3.00		N=12 (1,2/2,3,3,4)						3.5
3.50	ES30									4.0
4.00	D19									
4.00 - 4.45	SPT (S) N=17	4.00		N=17 (2,3/3,4,5,5)	-6.41	4.20		Medium dense brownish grey slightly gravelly slightly silty fine to coarse SAND with shell fragments. Gravel is subangular fine to medium.		4.5
4.20 - 5.00	B20									
4.50	ES31					(1.60)				5.0
5.00	D21									5.5
5.00 - 5.45	SPT (S) N=23	5.00		N=23 (1,4/5,5,6,7)						
5.50	ES32									6.0
5.80 - 6.10	B22				-8.01	5.80		Firm brownish grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular fine to coarse.		
6.00	D23					(0.30)				6.5
6.00 - 6.45	SPT (S) N=27	6.00		N=27 (3,4/6,6,7,8)	-8.31	6.10		Medium dense brownish grey very sandy slightly silty subangular fine to coarse GRAVEL. Sand is fine to coarse.		7.0
6.10 - 7.00	B24									7.5
7.00 - 8.00	B25					(2.40)				8.0
7.00 - 7.45	SPT (S) N=23	7.00		N=23 (2,3/5,6,6,6)						
8.00 - 8.45	SPT (S) N=27	8.00		N=27 (4,6/7,8,7,5)						8.5
					-10.71	8.50		Firm brownish grey slightly sandy gravelly SILT. Sand is fine to coarse. Gravel is subangular fine to medium,		9.0
9.00 - 9.50	B26					(0.50)				
9.00 - 9.45	SPT (S) N=15	9.00		N=15 (2,3/3,4,4,4)	-11.21	9.00		Medium dense brownish grey gravelly slightly silty fine to coarse SAND. Gravel is subangular fine.		9.5
						(2.00)				10.0
10.00 - 10.45	SPT (S) N=19	10.00		N=19 (3,3/4,4,5,6)						

<div>Remarks</div> <div>Deck to Bed = 8.70m</div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> 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<div><div>CAUSEWAY GEOTECH</div></div>					<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH04												
					<b>Coordinates:</b> 325414.08 E		<b>Client:</b> Irish Water				Sheet 2 of 3												
					173210.90 N		<b>Client's Representative:</b> Byrne Looby ARUP J.V.				<b>Scale:</b> 1:50												
<b>Method</b> Cable Percussion Rotary Drilling		<b>Plant Used</b> Dando 3000 Comacchio 405		<b>Top</b> 0.00 21.50	<b>Base</b> 21.50 25.00	<b>Ground Level:</b> -2.21 mOD		<b>Dates:</b> 07/09/2017 - 09/09/2017				<b>Driller:</b> CC/AH+SL											
											<b>Logger:</b> SG												
<b>Depth (m)</b>		<b>Sample / Tests</b>	<b>Casing Depth (m)</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Legend</b>	<b>Description</b>			<b>Water</b>	<b>Backfill</b>										
11.00 - 12.00 11.00 - 11.45		B1 SPT (S) N=24	11.0 0		N=24 (3,4/5,6,6,7)	-13.21	11.00   (1.50)		Medium dense brownish grey gravelly slightly silty fine to coarse SAND. Gravel is subangular fine.					10.5 11.0 11.5									
12.00 12.00 - 12.45		D8 SPT (S) N=42	12.0 0		N=42 (4,5/7,9,11,15)				Medium dense to dense grey very gravelly slightly silty fine to coarse SAND. Gravel is subangular to subrounded fine.					12.0 12.5									
12.50 - 13.50		B2				-14.71	12.50		Very stiff brownish grey slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine.					12.5 13.0									
13.00 - 13.45		UT35			Ublow=125 0%									13.0 13.5									
13.50 13.50 - 13.92		D9 SPT (S)	13.5 0		N=50 (5,6/50 for 265mm)									13.5 14.0									
14.00 14.00 - 15.00 14.00 - 14.43		D10 B3 SPT (S)	14.0 0		N=50 (7,8/50 for 280mm)		(4.50)							14.0 14.5 15.0									
15.00 15.00 - 15.35		D11 SPT (S)	15.0 0		50 (6,10/50 for 200mm)									15.0 15.5									
15.50 - 16.50		B4												15.5 16.0									
16.00 - 16.44		SPT (S)	16.0 0		N=50 (5,7/50 for 290mm)									16.0 16.5									
17.00 - 18.00 17.00 - 17.45		B5 SPT (S) N=34	17.0 0		N=34 (3,4/6,8,9,11)	-19.21	17.00		Very stiff brownish grey slightly sandy silty CLAY. Sand is fine to coarse.					17.0 17.5									
18.00 - 18.45		SPT (S) N=42	18.0 0		N=42 (5,8/9,9,11,13)		(2.60)							18.0 18.5									
19.00 19.00 - 19.45		D12 SPT (S) N=29	19.0 0		N=29 (3,4/6,7,8,8)									19.0 19.5									
19.60		B6				-21.81	19.60		Very stiff brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.					19.5 20.0									
20.00 - 20.45		SPT (S) N=32	20.0 0		N=32 (4,6/7,8,8,9)		(1.40)							20.0 20.5									
<b>Remarks</b> Deck to Bed = 8.70m																							
Terminated at scheduled depth																							
								<b>Core Barrel</b>		<b>Water Strikes</b>				<b>Chiselling Details</b>									
								<b>Flush Type</b>		Struck at (m)		Casing to (m)		Time (min)		Rose to (m)		From (m)		To (m)		Time (hh:mm:ss)	
																		21.45		21.50		01:00	
										<b>Water Added</b>		<b>Casing Details</b>											
										From (m)		To (m)		To (m)		Diam (mm)							
														16.50		250							





17-0167

325414.08 E

**Ground Level:**

-2.21 mOD

Arklow Sewerage Scheme Marine Outfall GI

Irish Water

Byrne Looby ARUP J.V.

07/09/2017 - 09/09/2017

**BH04**

Sheet 3 of 3

**Scale:** 1:50

Driller: CC/AH+SJ

**Logger:** SG

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
21.00 - 21.50	B7				-23.21	21.00		Very stiff brown slightly gravelly sandy silty CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.		
21.00 - 21.45	SPT (S) N=49	21.0 0		N=49 (6,9/11,11,13,14)				Dense brown very sandy silty subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded.		
21.50 - 23.50	B33									
22.00 - 22.45	SPT (C) N=44	22.0 0		N=44 (5,7/7,9,13,15)						
23.00 - 23.35	SPT (C)	23.0 0		50 (6,15/50 for 200mm)		(4.00)				
23.50 - 25.00	B34									
24.00 - 24.44	SPT (C)	24.0 0		N=50 (7,6/50 for 295mm)						
25.00 - 25.44	SPT (C)	25.0 0		N=50 (8,8/50 for 285mm)	-27.21	25.00		End of Borehole at 25.00m		

Deck to Bed = 8.70m

Terminated at scheduled depth

**Flush Type**

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

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Water Added		Casing Details	

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

		21.50	200
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From (m)	To (m)	Time (hh:mm)
31.45	31.50	01:00

21.45	21.50	01:00
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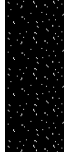
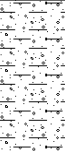
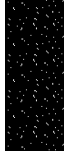
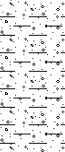
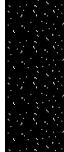
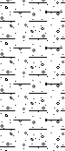

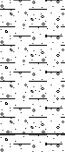
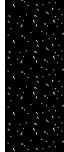
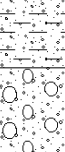
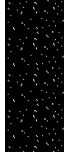
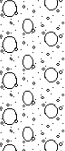
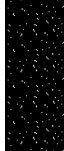
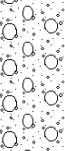
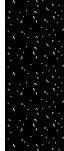


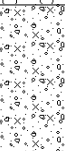
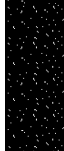


-4.85 mOD

19/09/2017 - 21/09/2017

**Logger:** SG

<div>Remarks</div> <div>Deck to Bed = 9.60m</div> <div></div> <div></div> <div></div> <div>Terminated on instruction of Engineer</div>	<div>Core Barrel</div> <div>SK6L</div>	<div>Water Strikes</div>				<div>Chiselling Details</div>		
		<div>Struck at (m)</div>	<div>Casing to (m)</div>	<div>Time (min)</div>	<div>Rose to (m)</div>	<div>From (m)</div>	<div>To (m)</div>	<div>Time (hh:mm)</div>
					19.10	19.30	01:00	
	<div>Flush Type</div>	<div>Water Added</div>		<div>Casing Details</div>				
		<div>From (m)</div>	<div>To (m)</div>	<div>To (m)</div>	<div>Diam (mm)</div>			
			7.50	250				

 <b>CAUSEWAY</b> GEOTECH				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH05					
				<b>Coordinates:</b> 325533.31 E		<b>Client:</b> Irish Water				Sheet 2 of 3					
<b>Method</b>		<b>Plant Used</b>		<b>Top</b>		<b>Base</b>		<b>Client's Representative:</b>				<b>Scale:</b> 1:50			
Cable Percussion		Dando 3000		0.00		19.30		Byrne Looby ARUP J.V.				<b>Driller:</b> CC/SI+SS/ DR+SJ/CC			
Rotary Percussion		Comacchio 405		19.30		22.50		<b>Dates:</b> 19/09/2017 - 21/09/2017				<b>Logger:</b> SG			
Rotary Coring		Comacchio 405		22.50		24.00									
<b>Ground Level:</b> -4.85 mOD															
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Casing Depth (m)</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Legend</b>	<b>Description</b>			<b>Water</b>	<b>Backfill</b>			
11.00 - 12.00 11.00 - 11.45	B22 SPT (C) N=18	11.0 0		N=18 (2,3/4,4,5,5)	-16.25	11.40		Medium dense brownish grey sandy subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded.							
12.00 - 13.00 12.00 - 12.29	B23 SPT (C)	12.0 0		50 (25 for 140mm/50 for 150mm)				Very stiff brown slightly gravelly sandy CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.							
13.00 - 14.00 13.00 - 13.32	B24 SPT (C)	13.0 0		50 (8,12/50 for 175mm)		(4.00)									
14.00 - 15.00 14.00 - 14.31	B25 SPT (C)	14.0 0		50 (9,13/50 for 160mm)											
15.00 - 15.32	SPT (C)	15.0 0		50 (7,11/50 for 170mm)	-20.25	15.40									
16.00 - 17.00 16.00 - 16.32	B26 SPT (C)	16.0 0		50 (7,10/50 for 175mm)	-20.85	16.00		Very stiff brown sandy gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.							
17.00 17.00 - 18.00 17.00 - 17.32	D28 B27 SPT (C)	17.0 0		50 (5,8/50 for 165mm)		(3.10)		Dense brown very sandy subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subrounded to rounded.							
18.00 18.00 - 18.45	D29 SPT (C) N=47	18.0 0		N=47 (4,9/9,11,12,15)											
19.00 19.00 - 19.30	D30 D31				-23.95	19.10 (0.20)		BOULDERS							
19.00 - 19.16	SPT (C)	19.0 0		50 (25 for 135mm/50 for 25mm)	-24.15	(1.50)		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.							
<b>Remarks</b> Deck to Bed = 9.60m															
Terminated on instruction of Engineer						<b>Core Barrel</b> SK6L		<b>Water Strikes</b>				<b>Chiselling Details</b>			
								Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)	
						<b>Flush Type</b>		<b>Water Added</b>		<b>Casing Details</b>					
								From (m)	To (m)	To (m)	Diam (mm)				
				19.30		200									



17-0167

325533.31 E

**Ground Level:**

-4.85 mOD

Arklow Sewerage Scheme Marine Outfall GI

Irish Water

Byrne Looby ARUP J.V.

19/09/2017 - 21/09/2017

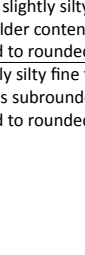

**BH05**

Sheet 3 of 3

**Scale:** 1:50

**Driller:** CC/SJ+SS/  
DR+SJ/CC

**Logger:** SG

Depth (m)	Sample / Tests		Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
20.80 - 20.92	SPT (C)		20.80		50 (50 for 100mm/50 for 20mm)	-25.65	20.80		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.		
							(1.70)				
	24.00	100	51	0			16	-27.35	22.50		
						(1.50)					
						-28.85	24.00		End of Borehole at 24.00m		
	TCR	SCR	RQD	FI							

Remarks
Deck to Bed = 9.60m

Terminated on instruction of Engineer

**Core Barrel**  
SK6L

**Flush Type**

## Water Strikes

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



























### Chiselling Details

Water Services				Sewerage Services		
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
				19.10	19.30	01:00

Water Added

Water Level		Casing Details	
From (m)	To (m)	To (m)	Diam (mm)



<div><div>CAUSEWAY GEOTECH</div></div>				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH06																																																																																																																																																																																																																																																																																																																																																																									
				<b>Coordinates:</b> 325634.18 E		<b>Client:</b> Irish Water				Sheet 1 of 3																																																																																																																																																																																																																																																																																																																																																																									
<b>Method</b>		<b>Plant Used</b>		<b>Top</b>		<b>Base</b>		<b>Client's Representative:</b> Byrne Looby ARUP J.V.				<b>Scale:</b> 1:50																																																																																																																																																																																																																																																																																																																																																																							
Cable Percussion Rotary Drilling		Dando 2000 Comacchio 405		0.00 17.00		17.00 25.20						<b>Driller:</b> CC+SS																																																																																																																																																																																																																																																																																																																																																																							
				<b>Ground Level:</b> -5.62 mOD		<b>Dates:</b> 26/09/2017 - 29/09/2017				<b>Logger:</b> SG																																																																																																																																																																																																																																																																																																																																																																									
<b>Depth (m)</b>		<b>Sample / Tests</b>	<b>Casing Depth (m)</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Legend</b>	<b>Description</b>			<b>Water</b>	<b>Backfill</b>																																																																																																																																																																																																																																																																																																																																																																						
0.00 - 1.00		B1					(0.50)		Black very gravelly slightly silty fine to coarse SAND with shell fragments. Gravel is subrounded fine to medium.																																																																																																																																																																																																																																																																																																																																																																										
0.50		ES29				-6.12	0.50		Medium dense dark grey slightly gravelly slightly silty fine to coarse SAND with occasional shell fragments. Gravel is subrounded fine to medium.					0.5																																																																																																																																																																																																																																																																																																																																																																					
1.00		D2												1.0																																																																																																																																																																																																																																																																																																																																																																					
1.00 - 1.45		SPT (S) N=16	1.00		N=16 (2,3/3,4,4,5)									1.5																																																																																																																																																																																																																																																																																																																																																																					
1.30 - 2.00		B3												2.0																																																																																																																																																																																																																																																																																																																																																																					
1.50		ES30												2.5																																																																																																																																																																																																																																																																																																																																																																					
2.00		D4					(3.90)							3.0																																																																																																																																																																																																																																																																																																																																																																					
2.00 - 3.00		B5												3.5																																																																																																																																																																																																																																																																																																																																																																					
2.00 - 2.45		SPT (S) N=17	2.00		N=17 (1,2/3,3,5,6)									4.0																																																																																																																																																																																																																																																																																																																																																																					
2.50		ES31												4.5																																																																																																																																																																																																																																																																																																																																																																					
3.00		D6												5.0																																																																																																																																																																																																																																																																																																																																																																					
3.00 - 4.00		B7												5.5																																																																																																																																																																																																																																																																																																																																																																					
3.00 - 3.45		SPT (S) N=26	3.00		N=26 (4,5/5,6,7,8)									6.0																																																																																																																																																																																																																																																																																																																																																																					
3.50		ES32												6.5																																																																																																																																																																																																																																																																																																																																																																					
4.00		D8												7.0																																																																																																																																																																																																																																																																																																																																																																					
4.00 - 4.45		SPT (S) N=19	4.00		N=19 (1,2/3,5,5,6)									7.5																																																																																																																																																																																																																																																																																																																																																																					
4.40 - 5.00		B9				-10.02	4.40		Medium dense dark grey very gravelly slightly silty fine to coarse SAND with shell fragments. Gravel is subrounded fine to medium.					8.0																																																																																																																																																																																																																																																																																																																																																																					
4.50		ES33					(0.60)							8.5																																																																																																																																																																																																																																																																																																																																																																					
5.00		D10				-10.62	5.00		Medium dense brownish grey very sandy slightly silty subrounded fine to coarse GRAVEL with occasional shell fragments. Sand is fine to coarse.					9.0																																																																																																																																																																																																																																																																																																																																																																					
5.00 - 6.00		B11					(0.50)							9.5																																																																																																																																																																																																																																																																																																																																																																					
5.00 - 5.45		SPT (S) N=16	5.00		N=16 (2,3/3,4,4,5)				Medium dense brownish grey sandy subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subrounded to rounded.					10.0																																																																																																																																																																																																																																																																																																																																																																					
5.50		ES34				-11.12	5.50																																																																																																																																																																																																																																																																																																																																																																												
6.00		D12					(0.70)																																																																																																																																																																																																																																																																																																																																																																												
6.00 - 6.45		SPT (S) N=27	6.00		N=27 (4,5/6,6,7,8)	-11.82	6.20		Stiff to very stiff brown slightly sandy slightly gravelly silty CLAY with low cobble and boulder content. Sand is fine to coarse. Gravel is subrounded fine to coarse. Cobbles and boulders are subrounded to rounded.																																																																																																																																																																																																																																																																																																																																																																										
6.20 - 7.00		B13																																																																																																																																																																																																																																																																																																																																																																																	
7.00 - 7.45		U27	7.00		Ublow=175 100%																																																																																																																																																																																																																																																																																																																																																																														
7.50		D14																																																																																																																																																																																																																																																																																																																																																																																	
7.50 - 8.00		B35																																																																																																																																																																																																																																																																																																																																																																																	
8.00 - 9.00		B36																																																																																																																																																																																																																																																																																																																																																																																	
8.00 - 8.45		SPT (S) N=43	8.00		N=43 (5,7/9,11,11,12)		(6.40)																																																																																																																																																																																																																																																																																																																																																																												
9.00 - 10.00		B20																																																																																																																																																																																																																																																																																																																																																																																	
9.00 - 9.45		SPT (S) N=46	9.00		N=46 (4,6/8,11,13,14)																																																																																																																																																																																																																																																																																																																																																																														
10.00		D19																																																																																																																																																																																																																																																																																																																																																																																	
10.00 - 10.35		SPT (S)	10.00		50 (8,10/50 for 200mm)																																																																																																																																																																																																																																																																																																																																																																														
<b>Remarks</b> Deck to bed = 12.00m																																																																																																																																																																																																																																																																																																																																																																																			



17-0167

325634.18 E

175252.05 IN

-5.62 mOD

Arklow Sewerage Scheme Marine Outfall GI

Irish Water

Byrne Looby ARUP J.V.

26/09/2017 - 29/09/2017

BH06

Sheet 2 of 3



**Scale:** 1:50


Driller: CC+SS

**Logger:** SG

<div>Remarks</div> <div>Deck to bed = 12.00m</div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> 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<div>CAUSEWAY GEOTECH</div>					Project No.: 17-0167		Project Name: Arklow Sewerage Scheme Marine Outfall GI					Borehole No.: BH06												
MethodPlant UsedTopBase Cable PercussionDando 20000.0017.00 Rotary DrillingComacchio 40517.0025.20					Coordinates: 325634.18 E		Client: Irish Water					Sheet 3 of 3												
					173292.69 N		Client's Representative: Byrne Looby ARUP J.V.					Scale: 1:50												
					Ground Level: -5.62 mOD		Dates: 26/09/2017 - 29/09/2017					Driller: CC+SS												
												Logger: SG												
Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description				Water	Backfill										
24.50 - 24.80 24.50	0				50 (8,13/50 for 155mm)	-30.12	24.50		NO RECOVERY								21.0							
							(6.00)										21.5							
																	22.0							
25.20	100					-30.82	24.50		Orangish brown and grey slightly sandy slightly silty subrounded to rounded fine to coarse GRAVEL of mixed lithologies predominantly amphotite. Sand is fine to coarse.								22.5							
							(0.70)										23.0							
							25.20		End of Borehole at 25.20m								23.5							
																	24.0							
																	24.5							
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																	30.5							
																	31.0							
																	31.0							
	TCR	SCR	RQD	FI																				
Remarks									Core Barrel		Water Strikes				Chiselling Details									
Deck to bed = 12.00m											Struck at (m)		Casing to (m)		Time (min)		Rose to (m)		From (m)		To (m)		Time (hh:mm)	
																			6.60		7.00		02:00	
																		Flush Type		Water Added		Casing Details		
											From (m)		To (m)		To (m)		Diam (mm)							
Terminated at scheduled depth																								


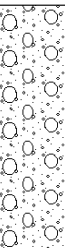





 <b>CAUSEWAY</b> GEOTECH				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI			<b>Borehole No.:</b> BH07	
				<b>Coordinates:</b> 325942.85 E		<b>Client:</b> Irish Water			Sheet 1 of 2	
<b>Method</b>	<b>Plant Used</b>	<b>Top</b>	<b>Base</b>	173310.24 N		<b>Client's Representative:</b> Byrne Looby ARUP J.V.			<b>Scale:</b> 1:50	
Cable Percussion Rotary Coring	Dando 3000 Comacchio 405	0.00 12.50	12.50 18.50	<b>Ground Level:</b> -9.27 mOD		<b>Dates:</b> 09/09/2017 - 10/10/2017			<b>Driller:</b> CC+SJ	
									<b>Logger:</b> SG	
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	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.		
0.50	ES21					(1.00)				0.5
1.00	D11				-10.27	1.00		Loose grey very sandy slightly clayey subrounded fine to coarse GRAVEL with shell fragments. Sand is fine to coarse.		1.0
1.00 - 2.00	B2									
1.00 - 1.45	SPT (S)	1.00		N=6 (2,2/2,1,1,2)						1.5
1.50	ES22					(1.50)				2.0
2.00	D12									
2.00 - 2.45	SPT (S)	2.00		N=9 (1,1/2,2,2,3)						2.5
2.50	ES23				-11.77	2.50		Soft to firm grey slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.		3.0
2.50 - 3.00	B3									
3.00	D13					(1.00)				3.5
3.00 - 3.50	B4									
3.00 - 3.45	SPT (S)	3.00		N=13 (2,2/3,3,3,4)	-12.77	3.50		Medium dense grey slightly silty sandy subrounded fine to coarse GRAVEL with medium cobble content. Sand is fine to coarse. Cobbles are subrounded to rounded.		4.0
3.50	ES24									4.5
3.50 - 4.00	B5					(1.80)				
4.00	D14									5.0
4.00 - 5.00	B6									
4.00 - 4.45	SPT (S)	4.00		N=17 (2,3/4,4,4,5)	-14.57	5.30		Medium dense brownish grey very gravelly silty fine to coarse SAND. Gravel is subrounded fine to coarse.		5.5
4.50	ES25					(0.90)				6.0
5.00	D15									
5.00 - 5.45	SPT (S)	5.00		N=27 (3,4/5,7,7,8)	-15.47	6.20		Dense greyish brown very silty slightly gravelly fine to coarse SAND. Gravel is subrounded fine.		6.5
5.30 - 6.00	B7									
5.50	ES26				-15.87	6.60		Very stiff brown slightly sandy silty CLAY. Sand is fine to coarse.		7.0
6.00	D16									7.5
6.00 - 6.45	SPT (S)	6.00		N=33 (4,5/6,7,9,11)	-17.27	8.00		Very stiff brown slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subrounded fine to coarse.		8.0
6.20 - 6.60	B8					(1.00)				8.5
6.60 - 8.00	B9									
7.00	D17									9.0
7.00 - 7.45	SPT (S)	7.00		N=33 (3,6/6,8,9,10)	-18.27	9.00		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.		9.5
8.00	D18					(2.60)				10.0
8.00 - 8.45	SPT (S)	8.00		N=37 (4,5/7,9,10,11)						
9.00	D19									
9.00 - 10.00	B10									
9.00 - 9.45	SPT (S)	9.00		N=47 (6,7/9,11,13,14)						
10.00	D20									
10.00 - 11.00	B27									
10.00 - 10.38	SPT (S)	10.0		50 (6,10/50 for 225mm)						
<b>Remarks</b> Deck to Bed = 14.20m  Terminated after 6.0m core recovered on instruction of Engineer due to prolonged period of inclement weather approaching							<b>Core Barrel</b> SK6L		<b>Water Strikes</b> Struck at (m) Casing to (m) Time (min) Rose to (m)	
							<b>Flush Type</b>		<b>Chiselling Details</b> From (m) To (m) Time (hh:mm)	
							<b>Water Added</b> From (m) To (m)		<b>Casing Details</b> To (m) Diam (mm)	
									11.60 12.50 02:00	







[illegible]

<div></div> <div>CAUSEWAY GEOTECH</div>				Project No.:		Project Name:		Borehole No.:													
				17-0167		Arklow Sewerage Scheme Marine Outfall GI		BH08													
MethodPlant UsedTopBaseCable PercussionDando 30000.0014.50Rotary CoringComacchio 40514.5026.50				Coordinates:		Client:		Sheet 1 of 3													
				325789.41 E		Irish Water															
				173262.57 N		Client's Representative:		Scale: 1:50													
						Byrne Looby ARUP J.V.		Driller: CC+SS													
				Ground Level:		Dates:		Logger: SG													
				-7.07 mOD		08/10/2017 - 09/10/2017															
Depth (m)		Sample / Tests		Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill									
0.00 - 1.00		B1								Medium dense dark grey sandy slightly silty subrounded fine to coarse GRAVEL with shell fragments. Sand is fine to coarse.											
0.50		ES25						(1.50)				0.5									
1.00		D16		1.00		N=14 (2,3/3,3,4,4)		-8.57	1.50			1.0									
1.00 - 1.45		SPT (S) N=14																			
1.50		ES26		2.00		N=17 (1,3/3,4,5,5)		-9.37	(0.80)			1.5									
1.50 - 2.00		B2																			
2.00		D17		3.00		N=21 (2,4/4,5,6,6)						2.0									
2.00 - 2.45		SPT (S) N=17																			
2.30 - 3.00		B3		4.00		N=28 (3,3/6,7,7,8)		-11.07	4.00			2.5									
2.50		ES27																			
3.00		D18		5.00		Ublow=80 0%						3.0									
3.00 - 3.45		SPT (S) N=21																			
3.30 - 4.00		B4		5.50		N=45 (5,7/9,10,12,14)		-11.57	4.50			3.5									
3.50		ES28																			
4.00		D19		6.50		N=43 (4,5/8,11,11,13)		-14.07	7.00			4.0									
4.00 - 4.45		SPT (S) N=28																			
4.50		ES29		8.00		N=40 (7,7/8,9,11,12)						4.5									
4.50 - 5.00		B5																			
5.00 - 5.10		U31		10.0		N=34 (4,5/7,7,9,11)						5.0									
5.00 - 6.00		B6																			
5.50		D20		10.0								5.5									
5.50 - 5.95		ES30																			
6.00 - 7.00		SPT (S) N=45		10.0								6.0									
		B7																			
6.50		D21		10.0								6.5									
6.50 - 6.95		SPT (S) N=43																			
7.00 - 8.00		B8		10.0								7.0									
8.00		D22		10.0								7.5									
8.00 - 9.00		B9																			
8.00 - 8.45		SPT (C) N=40		10.0								8.0									
9.00 - 10.00		B10		10.0								8.5									
10.00		D23		10.0								9.0									
10.00 - 11.00		B11																			
10.00 - 10.45		SPT (C) N=34		10.0								9.5									
Remarks												Core Barrel	Water Strikes				Chiselling Details				
Deck to Bed = 11.20m													SK6L	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)	
																		14.40	14.50	01:00	
														Flush Type	Water Added		Casing Details				
															From (m)	To (m)	To (m)	Diam (mm)			
Terminated after 3.0m core recovered														10.00	250						

[illegible]

<div><div><b>CAUSEWAY</b> GEOTECH</div></div>					<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH08								
<b>Method</b> Cable Percussion Rotary Coring					<b>Plant Used</b> Dando 3000 Comacchio 405		<b>Top</b> 0.00 14.50		<b>Base</b> 14.50 26.50		<b>Coordinates:</b> 325789.41 E		<b>Client:</b> Irish Water		Sheet 3 of 3				
											<b>Client's Representative:</b> Byrne Looby ARUP J.V.		<b>Scale:</b> 1:50						
											<b>Driller:</b> CC+SS								
											<b>Logger:</b> SG								
<b>Depth (m)</b>		<b>TCR</b>	<b>SCR</b>	<b>RQD</b>	<b>FI</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Legend</b>	<b>Description</b>	<b>Water</b>	<b>Backfill</b>							
22.00		20				50 (25 for 110mm/50 for 55mm)				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)			21.0						
							-29.47	22.40	(0.70)		Dark yellowish brown slightly clayey firm to coarse SAND.			21.5					
		73					-30.17	23.10	(0.40)		Dark yellowish brown and dark bluish grey subangular fine to coarse GRAVEL with low cobble content.			22.0					
23.50 - 23.66 23.50							-30.57	23.50	(0.90)		Weak highly fractured dark orangish brown SLATE. Partially weathered with weathering penetrating in from fracture surfaces. Discontinuities: 1. 0 to 40 degree joints very closely spaced, 2/10/20, planar, smooth, closed with heavy orangish brown staining. 2. 50 to 80 degree joints, very closely spaced 2/10/20, planar, smooth, closed with heavy orangish brown staining 3. Subvertical joint planar, smooth, closed with heavy orangish brown staining.			22.5					
25.00		100	0	0	NI		-31.47	24.40	(2.50)		Weak highly fractured dark bluish grey SLATE. Largely unweathered. Discontinuities: 1. 0 to 20 joints very closely spaced 5/30/50, planar, smooth closed. 2. Subvertical joints, planar occasionally undulating smooth closed.			23.0					
26.50		100	0	0	20		-33.57	26.50		End of Borehole at 26.50m			23.5						
													24.0						
													24.5						
													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						
<b>Remarks</b> Deck to Bed = 11.20m												<b>Core Barrel</b> SK6L		<b>Water Strikes</b> Struck at (m) Casing to (m) Time (min) Rose to (m)				<b>Chiselling Details</b> From (m) To (m) Time (hh:mm)	
Terminated after 3.0m core recovered												<b>Flush Type</b>		<b>Water Added</b> From (m) To (m)		<b>Casing Details</b> To (m) Diam (mm)			

<div></div> <div>CAUSEWAY GEOTECH</div>				Project No.: 17-0167		Project Name: Arklow Sewerage Scheme Marine Outfall GI				Borehole No.: BH09								
				Coordinates: 326127.26 E		Client: Irish Water				Sheet 1 of 2								
Method Cable Percussion Rotary Coring		Plant Used Dando 3000 Comacchio 405		Top 0.00 8.90		Base 8.90 14.30		Client's Representative: Byrne Looby ARUP J.V.				Scale: 1:50						
						Ground Level: -10.80 mOD		Dates: 27/10/2017 - 28/10/2017				Driller: AH+SS						
												Logger: SG+LN						
Depth (m)		Sample / Tests		Casing Depth (m)	Water Depth (m)	Field Records		Level (mOD)	Depth (m) (Thickness)	Legend	Description		Water	Backfill				
0.00 - 1.00		B1				N=19 (3,5/5,5,4,5)	-13.60	(2.80)		Medium dense grey slightly gravelly slightly silty fine to coarse SAND with occasional layers of grey subangular to subrounded grey fine to medium GRAVEL. Gravel is subangular to subrounded fine to medium.								
0.50		ES18																
1.00		D11		1.00														
1.00 - 2.00		B2																
1.00 - 1.45		SPT (S)																
1.50		N=19 ES19																
2.00		D12		2.00														
2.00 - 3.00		B3																
2.00 - 2.45		SPT (S)																
2.50		N=18 ES20																
3.00		D13		3.00														
3.00 - 4.00		B4																
3.00 - 3.45		SPT (S)																
3.50		N=20 ES21																
4.00		D14		4.00														
4.00 - 5.00		B5																
4.00 - 4.45		SPT (S)																
4.50		N=24 ES22																
5.00		D15		5.00														
5.00 - 6.00		B6																
5.00 - 5.45		SPT (S)																
5.50		N=26 ES23																
6.00 - 7.00		B7		6.00														
6.00 - 6.45		SPT (S)																
6.50		N=34 D16																
7.00 - 8.00		B8																
7.00 - 7.32		SPT (C)		7.00														
7.50		D17																
8.00		U24																
8.00 - 8.80		B9																
8.50 - 8.75		SPT (C)		8.50														
8.80 - 8.90		B10																
		100																
9.90																		
					20													
		TCR		SCR	RQD	FI												
Remarks Deck to Bed = 14.80m       Terminated 6.0m into bedrock										Core Barrel		Water Strikes				Chiselling Details		
												Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
										Flush Type		Water Added		Casing Details				
												From (m)	To (m)	To (m)	Diam (mm)			
														8.90	200			

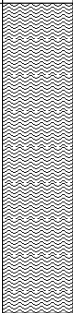
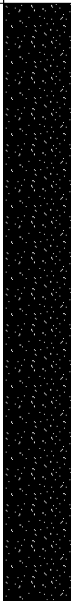
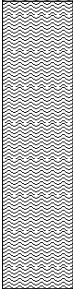



-10.80 mOD

27/10/2017 - 28/10/2017

**Logger:** SG+LN

<b>Base</b>
8.90
14.30

Depth (m)	TCR	SCR	RQD	FI	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill					
11.20	100	49	11	14			(2.50)		surfaces. 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 and patchy orange staining.			10.5				
				20								11.0				
				5								11.5				
12.40	58	5	0	20+								-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: 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 and patchy orange staining.	12.0
																100
13.20				10									(1.90)		12.70m: 20 degree joint open approximately 20mm with black sand and gravel infill.	13.0
							91	77	23							13.5
14.30				15	-25.10	14.30		End of Borehole at 14.30m	14.0							
											14.5					
												15.0				
												15.5				
												16.0				
												16.5				
												17.0				
												17.5				
												18.0				
												18.5				
												19.0				
												19.5				
												20.0				
												20.5				
	TCR	SCR	RQD	FI												


Terminated 6.0m into bedrock

**Flush Type**

Water Added		Casing Details	
From (m)	To (m)	To (m)	Dinner (m)

Water Added		Casing Details	
From (in)	To (in)	To (in)	Dinner (feet)



<div><div>CAUSEWAY GEOTECH</div></div>				Project No.: 17-0167		Project Name: Arklow Sewerage Scheme Marine Outfall GI				Borehole No.: BH10											
				Coordinates: 326265.74 E		Client: Irish Water				Sheet 1 of 2											
Method		Plant Used		Top		Base		Client's Representative: Byrne Looby ARUP J.V.				Scale: 1:50									
Cable percussion		Dando 3000		0.00		10.00		Ground Level: -11.37 mOD				Driller: AH+SS									
Rotary Coring		Comacchio 405		10.00		16.00		Dates: 26/10/2017 - 27/10/2017				Logger: SG+LN									
Depth (m)		Sample / Tests		Casing Depth (m)		Water Depth (m)		Field Records		Level (mOD)		Depth (m) (Thickness)		Legend		Description		Water		Backfill	
0.00 - 1.00		B1														Grey sandy slightly silty subangular to subrounded fine to medium GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded.					
0.50		ES17										(1.10)									
1.00		D12										1.10									
1.00 - 1.45		SPT (S) N=7		1.00				N=7 (2,2/2,1,2,2)		-12.47						Soft grey slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium. Cobbles are subangular to subrounded.					
1.30 - 1.80		B2										(0.80)									
1.50		ES18																			
2.00		D13										1.90									
2.00 - 3.00		B3														Medium dense grey sandy slightly silty subangular to subrounded fine to coarse GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subangular to subrounded.					
2.00 - 2.45		SPT (S) N=11		2.00				N=11 (2,3/3,2,3,3)		-13.27											
2.50		ES19										(2.10)									
3.00		D14										4.00									
3.00 - 4.00		B4																			
3.00 - 3.45		SPT (S) N=14		3.00				N=14 (2,2/3,3,4,4)		-15.37						Medium dense grey very sandy slightly silty subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded.					
3.50		ES20										(1.40)									
4.00		D15										5.40									
4.00 - 5.00		B5																			
4.00 - 4.45		SPT (S) N=20		4.00				N=20 (3,3/5,4,5,6)		-16.77						Stiff grey slightly sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse.					
4.50		ES21										(1.10)									
5.00		D16										6.50									
5.00 - 5.40		B6																			
5.00 - 5.45		SPT (S) N=20		5.00				N=20 (3,5/5,4,6,5)		-17.87						Very stiff light brown slightly sandy slightly gravelly silty CLAY with low cobble content. Sand is fine to coarse. Gravel is subrounded to rounded fine to coarse. Cobbles are subrounded to rounded.					
5.50		ES22										(3.00)									
5.50 - 6.00		B7																			
6.00 - 6.45		SPT (S) N=27		6.00				N=27 (3,4/4,6,7,10)		-20.87											
6.50 - 7.20		B8										9.50									
7.00 - 7.31		SPT (C)		7.00				50 (22,21/50 for 160mm)		-21.37		(0.50)				Grey BEDROCK (Slate - drillers description)					
7.50 - 7.95		U23										10.00									
7.50 - 8.00		B9																			
8.00 - 8.31		SPT (C)		8.00				50 (21,21/50 for 160mm)													
8.50 - 9.20		B10																			
9.00 - 9.32		SPT (C)		9.00				50 (21,20/50 for 165mm)													
9.50 - 10.00		B11																			



17-0167

326265.74 E

**Ground Level:**

(mOD)	(Thickness)
0.000	0.000
0.001	0.001
0.002	0.002
0.003	0.003
0.004	0.004
0.005	0.005
0.006	0.006
0.007	0.007
0.008	0.008
0.009	0.009
0.010	0.010
0.011	0.011
0.012	0.012
0.013	0.013
0.014	0.014
0.015	0.015
0.016	0.016
0.017	0.017
0.018	0.018
0.019	0.019
0.020	0.020
0.021	0.021
0.022	0.022
0.023	0.023
0.024	0.024
0.025	0.025
0.026	0.026
0.027	0.027
0.028	0.028
0.029	0.029
0.030	0.030
0.031	0.031
0.032	0.032
0.033	0.033
0.034	0.034
0.035	0.035
0.036	0.036
0.037	0.037
0.038	0.038
0.039	0.039
0.040	0.040
0.041	0.041
0.042	0.042
0.043	0.043
0.044	0.044
0.045	0.045
0.046	0.046
0.047	0.047
0.048	0.048
0.049	0.049
0.050	0.050
0.051	0.051
0.052	0.052
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0.066	0.066
0.067	0.067
0.068	0.068
0.069	0.069
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0.071	0.071
0.072	0.072
0.073	0.073
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0.076	0.076
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0.080	0.080
0.081	0.081
0.082	0.082
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0.084	0.084
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0.112	0.112
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0.116	0.116
0.117	0.117
0.118	0.118
0.119	0.119
0.120	0.120
0.121	0.121
0.122	0.122
0.123	0.123
0.124	0.124
0.125	0.125
0.126	0.126
0.127	0.127
0.128	0.128
0.129	0.129
0.130	0.130
0.131	0.131
0.132	0.132
0.133	0.133
0.134	0.134
0.135	0.135
0.136	0.136
0.137	0.137
0.138	0.138
0.139	0.139

Arklow Sewerage Scheme Marine Outfall GI

Irish Water

Byrne Looby ARUP J.V.

26/10/2017 - 27/10/2017

**BH10**

Sheet 2 of 2

**Scale:** 1:50


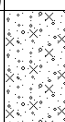


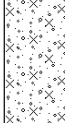
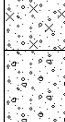
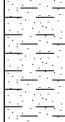

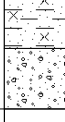

**Driller:** AH+SS

**Logger:** SG+LN


<b>Remarks</b> Deck to Bed = 15.20m      Terminated after 6.0m core recovered on instruction of Engineer	<b>Core Barrel</b>	<b>Water Strikes</b>				<b>Chiselling Details</b>		
		Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
						9.85	10.00	01:00
	<b>Flush Type</b>	<b>Water Added</b>		<b>Casing Details</b>				
		From (m)	To (m)	To (m)	Diam (mm)			
				16.00	150			





<div><div>CAUSEWAY GEOTECH</div></div>				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH11											
				<b>Coordinates:</b> 324730.75 E 173452.99 N		<b>Client:</b> Irish Water				Sheet 1 of 2											
<b>Method</b> Cable Percussion		<b>Plant Used</b> Dando 3000		<b>Top</b> 0.00		<b>Base</b> 10.70		<b>Client's Representative:</b> Byrne Looby ARUP J.V.													
				<b>Ground Level:</b> -0.33 mOD		<b>Dates:</b> 02/11/2017				<b>Scale:</b> 1:50											
								<b>Driller:</b> AH													
								<b>Logger:</b> LN													
<b>Depth (m)</b>		<b>Sample / Tests</b>		<b>Casing Depth (m)</b>		<b>Water Depth (m)</b>		<b>Field Records</b>		<b>Level (mOD)</b>		<b>Depth (m) (Thickness)</b>		<b>Legend</b>		<b>Description</b>		<b>Water</b>		<b>Backfill</b>	
0.50		D1 ES11 B19						N=14 (3,3/3,4,3,4)								Medium dense grey very sandy slightly silty subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.					
0.80 - 1.20		SPT (S) N=14						N=19 (3,4/5,5,4,5)				(4.00)								1.0 -	
1.50		D2 ES12 B20						N=20 (4,5/5,5,4,6)												1.5 -	
1.80 - 2.20		SPT (C) N=19						N=30 (5,6/7,8,7,8)								Medium dense grey sandy subangular to subrounded fine to coarse GRAVEL with low cobble content. Sand is medium to coarse. Cobbles are subangular to subrounded of mixed lithologies.				2.0 -	
2.00 - 2.45		D3 ES13 B21						N=23 (4,6/6,5,6,6)												2.5 -	
2.50		SPT (C) N=20						Ublow=40 98%								Stiff grey slightly sandy slightly gravelly CLAY . Sand is fine to coarse. Gravel is subangular to subrounded fine.				3.0 -	
2.80 - 3.20		D4 ES14 B22						N=27 (5,6/6,7,6,8)												3.5 -	
3.00 - 3.45		SPT (C) N=20						Ublow=38 97%								Stiff grey slightly sandy slightly silty CLAY . Sand is fine to coarse.				4.0 -	
3.50		D5 ES15 B23						N=27 (5,7/6,6,7,8)												4.5 -	
3.80 - 4.20		SPT (C) N=23						Ublow=40 98%												5.0 -	
4.00 - 4.45		D6 ES16 B24						N=27 (5,7/6,6,7,8)												5.5 -	
4.50		SPT (C) N=23						Ublow=40 98%												6.0 -	
4.80 - 5.20		D7 ES17 B25						N=27 (5,7/6,6,7,8)												6.5 -	
5.00 - 5.45		SPT (C) N=23						Ublow=40 98%												7.0 -	
5.50		D8 ES18 B26						Ublow=40 98%												7.5 -	
5.80 - 6.20		SPT (C) N=23						Ublow=40 98%												8.0 -	
6.00 - 6.50		D9 ES19 B27						Ublow=40 98%												8.5 -	
6.50		SPT (C) N=23						Ublow=40 98%												9.0 -	
6.80 - 7.20		D10 ES20 B28						Ublow=40 98%												9.5 -	
7.00 - 7.45		SPT (C) N=23						Ublow=40 98%												10.0 -	
7.50		SPT (C) N=23						Ublow=40 98%												10.5 -	
7.80 - 8.20		SPT (C) N=23						Ublow=40 98%												11.0 -	
8.00 - 8.50		SPT (C) N=23						Ublow=40 98%												11.5 -	
8.50		SPT (C) N=23						Ublow=40 98%												12.0 -	
8.80 - 9.20		SPT (C) N=23						Ublow=40 98%												12.5 -	
9.00 - 9.45		SPT (C) N=23						Ublow=40 98%												13.0 -	
9.50		SPT (C) N=23						Ublow=40 98%												13.5 -	
9.80 - 10.20		SPT (C) N=23						Ublow=40 98%												14.0 -	
<b>Remarks</b> Drilled from floating platform												<b>Water Strikes</b> Struck at (m) 9.60 Casing to (m) 9.60 Time (min) 20 Rose to (m) 0.80				<b>Chiselling Details</b> From (m) 0.80 To (m) 0.90 Time (hh:mm) 00:30					
												<b>Water Added</b> From (m) To (m)				<b>Casing Details</b> To (m) Diam (mm)					
Terminated at refusal on large boulder																					



 <b>CAUSEWAY</b> GEOTECH				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI		<b>Borehole No.:</b> BH12	
				<b>Coordinates:</b> 324821.38 E 173389.74 N		<b>Client:</b> Irish Water		Sheet 1 of 2	
<b>Method</b> Cable Percussion	<b>Plant Used</b> Dando 3000	<b>Top</b> 0.00	<b>Base</b> 10.50	<b>Ground Level:</b> -0.88 mOD		<b>Client's Representative:</b> Byrne Looby ARUP J.V.		<b>Scale:</b> 1:50	
						<b>Dates:</b> 24/08/2017		<b>Driller:</b> CC	
								<b>Logger:</b> SG	

Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill
0.00 - 1.00	B1							Medium dense brown very sandy slightly silty subangular to subrounded fine to medium GRAVEL. Sand is fine to coarse.		
0.50	ES21					(1.30)				
1.00	D10									
1.00 - 1.45	SPT (S) N=15	1.00		N=15 (2,3/3,4,4,4)	-2.18	1.30		Medium dense brown sandy slightly silty subangular to subrounded fine to medium GRAVEL. Sand is fine to coarse.		
1.30 - 2.00	B2									
1.50	ES22					(1.00)				
2.00	D11									
2.00 - 2.45	SPT (S) N=11	2.00		N=11 (1,1/2,3,3,3)	-3.18	2.30		Firm to stiff grey slightly sandy CLAY. Sand is fine to coarse.		
2.30 - 3.00	B3									
2.50	ES23									
3.00 - 3.45	UT18			Ublow=89 100%						
3.00 - 4.00	B4									
3.50	D12									
	ES24									
4.00	D13									
4.00 - 5.00	B5									
4.00 - 4.45	SPT (S) N=37	4.00		N=37 (5,6/7,8,9,13)						
4.50	ES25									
5.00 - 5.45	UT19			Ublow=83 100%						
5.50	D14					(6.10)				
	ES26									
5.50 - 6.50	B6									
6.50	D15									
6.50 - 6.95	SPT (S) N=32	6.50		N=32 (5,4/6,8,8,10)						
7.00 - 8.00	B7									
8.00 - 8.45	UT20			Ublow=61 100%						
8.40 - 9.50	B8									
8.50	D16				-9.28	8.40		Brown sandy silty subangular to subrounded fine GRAVEL. Sand is fine to coarse.		
						(1.10)				
9.50	D17									
9.50 - 10.50	B9				-10.38	9.50		Firm brown slightly sandy slightly gravelly CLAY. Sand is fine to coarse.		
9.50 - 9.95	SPT (S) N=11	9.50		N=11 (2,2/2,3,3,3)		(1.00)		Gravel is subangular to subrounded fine to medium.		

<b>Remarks</b> Deck to Bed = 2.60m   Terminated at scheduled depth	<b>Water Strikes</b>				<b>Chiselling Details</b>		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
	<b>Water Added</b>		<b>Casing Details</b>				
	From (m)	To (m)	To (m)	Diam (mm)			
	1.50	9.50					



17-0167

Arklow Sewerage Scheme Marine Outfall GI

**BH12**

324821.38 E

## Irish Water

Sheet 2 of 2

Base
10.50

173389.74 N

Byrne Looby ARUP J.V.

**Scale:** 1:50

Driller: CC


**Ground Level:**

**Dates:**

24/08/2017





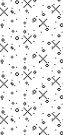

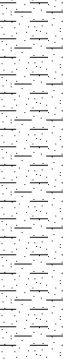
**Logger:** SG

<b>Remarks</b> Deck to Bed = 2.60m     Terminated at scheduled depth	<b>Water Strikes</b>				<b>Chiselling Details</b>		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
	<b>Water Added</b>		<b>Casing Details</b>				
	From (m)	To (m)	To (m)	Diam (mm)			
			10.50	200			

 <b>CAUSEWAY</b> GEOTECH				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI		<b>Borehole No.:</b> BH13																																													
				<b>Coordinates:</b> 324837.57 E 173357.32 N		<b>Client:</b> Irish Water		Sheet 1 of 2																																													
<b>Method</b> Cable Percussion	<b>Plant Used</b> Dando 3000	<b>Top</b> 0.00	<b>Base</b> 10.50	<b>Ground Level:</b> -0.95 mOD		<b>Client's Representative:</b> Byrne Looby ARUP J.V.		<b>Scale:</b> 1:50																																													
						<b>Dates:</b> 23/08/2017		<b>Driller:</b> CC																																													
								<b>Logger:</b> SG																																													
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill																																											
0.00 - 1.00	B1							Medium dense brown sandy slightly silty subangular to subrounded fine GRAVEL. Sand is fine to coarse.																																													
0.50	ES20					(1.60)				0.5																																											
1.00	D9									1.0																																											
1.00 - 1.45	SPT (S) N=17	1.00		N=17 (2,3/4,4,4,5)						1.5																																											
1.50	ES21				-2.55	1.60				2.0																																											
1.60 - 2.00	B2							Medium dense brown very sandy slightly silty subangular to subrounded fine to medium GRAVEL with low cobble content. Sand is fine to coarse. Cobbles are subrounded.		2.5																																											
2.00	D10									3.0																																											
2.00 - 2.45	SPT (S) N=23	2.00		N=23 (3,4/5,6,6,6)		(1.30)				3.5																																											
2.50	ES22									4.0																																											
2.90 - 4.00	B3				-3.85	2.90		Stiff grey slightly sandy CLAY. Sand is fine to coarse.		4.5																																											
3.00 - 3.45	UT17			Ublow=86 100%						5.0																																											
3.50	D11									5.5																																											
	ES23									6.0																																											
4.00	D12									6.5																																											
4.00 - 5.00	B4									7.0																																											
4.00 - 4.45	SPT (S) N=43	4.00		N=43 (5,5/8,8,12,15)		(4.10)				7.5																																											
4.50	ES24									8.0																																											
5.00 - 5.45	UT18			Ublow=83 100%						8.5																																											
5.50	D13									9.0																																											
5.50 - 6.50	ES25 B5									9.5																																											
6.50	D14																																																				
6.50 - 6.95	SPT (S) N=37	6.50		N=37 (4,6/6,8,10,13)																																																	
7.00 - 8.00	B6				-7.95	7.00		Stiff grey CLAY.																																													
8.00 - 8.45	UT19			Ublow=31 100%		(1.90)																																															
8.50	D15																																																				
8.90 - 9.40	B7				-9.85	8.90		Brown sandy silty subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.																																													
9.40 - 10.50	B8				-10.35	9.40																																															
9.50	D16																																																				
9.50 - 9.95	SPT (S) N=10	9.50		N=10 (1,2/2,2,3,3)		(1.10)		Firm slightly sandy CLAY. Sand is fine to coarse.																																													
<b>Remarks</b> Deck to Bed = 2.50m  Terminated at scheduled depth										<table border="1"> <tr> <th colspan="4">Water Strikes</th> <th colspan="3">Chiselling Details</th> </tr> <tr> <td>Struck at (m)</td> <td>Casing to (m)</td> <td>Time (min)</td> <td>Rose to (m)</td> <td>From (m)</td> <td>To (m)</td> <td>Time (hh:mm)</td> </tr> <tr> <td colspan="4"></td> <td colspan="3"></td> </tr> <tr> <th colspan="2">Water Added</th> <th colspan="2">Casing Details</th> <td colspan="3"></td> </tr> <tr> <td>From (m)</td> <td>To (m)</td> <td>To (m)</td> <td>Diam (mm)</td> <td colspan="3"></td> </tr> <tr> <td>1.60</td> <td>9.00</td> <td></td> <td></td> <td colspan="3"></td> </tr> </table>		Water Strikes				Chiselling Details			Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)								Water Added		Casing Details					From (m)	To (m)	To (m)	Diam (mm)				1.60	9.00					
Water Strikes				Chiselling Details																																																	
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)																																															
Water Added		Casing Details																																																			
From (m)	To (m)	To (m)	Diam (mm)																																																		
1.60	9.00																																																				






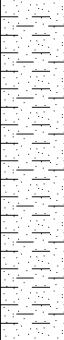

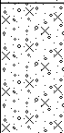



<b>Remarks</b> Deck to Bed = 2.50m     Terminated at scheduled depth	<b>Water Strikes</b>				<b>Chiselling Details</b>		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
	<b>Water Added</b>		<b>Casing Details</b>				
	From (m)	To (m)	To (m)	Diam (mm)			
			10.50	200			

<div> CAUSEWAY GEOTECH</div>				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH14																																																	
<b>Method</b> Cable Percussion		<b>Plant Used</b> Dando 3000		<b>Top</b> 0.00		<b>Base</b> 10.00		<b>Coordinates:</b> 324901.92 E		<b>Client:</b> Irish Water		Sheet 1 of 2																																															
								173307.18 N		<b>Client's Representative:</b> Byrne Looby ARUP J.V.		<b>Scale:</b> 1:50																																															
								<b>Ground Level:</b> -1.55 mOD		<b>Dates:</b> 02/08/2017		<b>Driller:</b> CC																																															
										<b>Logger:</b> SG																																																	
<b>Depth (m)</b>		<b>Sample / Tests</b>		<b>Casing Depth (m)</b>	<b>Water Depth (m)</b>	<b>Field Records</b>		<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Legend</b>	<b>Description</b>		<b>Water</b>	<b>Backfill</b>																																													
0.00 - 0.90 0.25		B1 ES19				N=15 (2,3/4,4,4)	-2.44	(0.90)			Black very sandy silty subangular to subrounded fine to medium GRAVEL. Sand is fine to coarse.																																																
0.75 0.90 - 1.50		ES20 B2 D11									Medium dense black very sandy slightly silty subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.																																																
1.00 - 1.45		SPT (S) N=15		1.00							(1.60)																																																
1.25		ES21																																																									
1.75		ES22																																																									
2.00 2.00 - 2.50		D12 B3		2.00	N=12 (1,2/3,3,3,3)	-4.04	2.50			Stiff grey slightly sandy CLAY. Sand is fine to coarse.																																																	
2.00 - 2.45		SPT (S) N=12																																																									
2.25		ES23																																																									
2.50 - 3.00		B4																																																									
2.75		ES24																																																									
3.00 - 3.45		UT17			Ublow=83 100%																																																						
3.50 3.50 - 4.00		D13 B5		4.00	N=37 (6,6/7,8,10,12)		(5.20)																																																				
4.00		D14																																																									
4.00 - 4.45		ES25																																																									
4.00 - 4.45		SPT (S) N=37																																																									
4.50 - 5.00		B6																																																									
5.00 5.00 - 5.45		ES26 UT18		6.50	N=33 (4,5/6,8,9,10)	-9.24	7.70			Medium dense brown very silty sandy subangular to subrounded fine to medium GRAVEL. Sand is fine to coarse																																																	
5.50		D15																																																									
5.50 - 6.00		B7																																																									
6.50 - 6.95		SPT (S) N=33																																																									
7.00 - 7.70		B8																																																									
7.70 - 8.50		B9			N=14 (1,2/3,3,4,4)		(2.30)																																																				
8.00 - 8.45		SPT (S) N=14		8.00																																																							
9.00 - 10.00		B10																																																									
9.50 9.50 - 9.95		D16 SPT (S) N=25		9.50	N=25 (3,4/5,5,7,8)		-11.54	10.00																																																			
<b>Remarks</b> Deck to Bed = 3.20m														<table><tr><th colspan="4">Water Strikes</th><th colspan="3">Chiselling Details</th></tr><tr><td>Struck at (m)</td><td>Casing to (m)</td><td>Time (min)</td><td>Rose to (m)</td><td>From (m)</td><td>To (m)</td><td>Time (hh:mm)</td></tr><tr><td></td><td></td><td></td><td></td><td>2.30</td><td>2.50</td><td>01:00</td></tr><tr><th colspan="2">Water Added</th><th colspan="2">Casing Details</th><td colspan="3"></td></tr><tr><td>From (m)</td><td>To (m)</td><td>To (m)</td><td>Diam (mm)</td><td colspan="3"></td></tr><tr><td>2.00</td><td>10.00</td><td>10.00</td><td>200</td><td colspan="3"></td></tr></table>				Water Strikes				Chiselling Details			Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)					2.30	2.50	01:00	Water Added		Casing Details					From (m)	To (m)	To (m)	Diam (mm)				2.00	10.00	10.00	200			
Water Strikes				Chiselling Details																																																							
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)																																																					
				2.30	2.50	01:00																																																					
Water Added		Casing Details																																																									
From (m)	To (m)	To (m)	Diam (mm)																																																								
2.00	10.00	10.00	200																																																								
Terminated at scheduled depth																																																											





































<div></div> <div>CAUSEWAY GEOTECH</div>				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH15				
<b>Method</b> Cable Percussion		<b>Plant Used</b> Dando 3000		<b>Top</b> 0.00		<b>Base</b> 12.38		<b>Coordinates:</b> 325015.88 E		<b>Client:</b> Irish Water		Sheet 1 of 2		
								173192.19 N		<b>Client's Representative:</b> Byrne Looby ARUP J.V.		<b>Scale:</b> 1:50		
								<b>Ground Level:</b> -2.16 mOD		<b>Dates:</b> 25/08/2017		<b>Driller:</b> CC		
										<b>Logger:</b> SG				
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Casing Depth (m)</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Legend</b>	<b>Description</b>				<b>Water</b>	<b>Backfill</b>	
0.00 - 1.00	B1			N=10 (2,2/2,2,3,3)				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					(1.50)						0.5		
1.00	D12	1.00										1.0		
1.00 - 1.45	SPT (S) N=10													
1.50	ES29													
1.50 - 2.00	B2			N=9 (1,2/2,2,2,3)	-3.66	1.50		Grey very gravelly slightly silty fine to coarse SAND with low cobble content and occasional shells. Gravel is subrounded fine to coarse.						1.5
2.00	D13											2.0		
2.00 - 2.50	B3													
2.00 - 2.45	SPT (S) N=9	2.00										2.5		
2.50	ES30													
3.00	D14			N=15 (2,3/3,4,4,4)								3.0		
3.00 - 3.45	SPT (S) N=15													
3.50	ES31											3.5		
3.50 - 4.00	B4													
4.00	D15				N=20 (3,4/4,5,5,6)								4.0	
4.00 - 4.20	B5													
4.00 - 4.45	SPT (S) N=20	4.00										4.5		
4.50	ES32													
4.70 - 6.00	B6					-6.86	4.70		Stiff grey slightly sandy CLAY. Sand is fine to coarse.					
5.00 - 5.45	UT25			Ublow=92 100%										
5.50	D16			N=44 (7,7/8,11,11,14)								5.5		
	ES33													
6.00 - 7.00	B7						(2.30)						6.0	
6.50	D17												6.5	
6.50 - 6.95	SPT (S) N=44	6.50												
7.00 - 8.00	B8					-9.16	7.00		Medium dense brown very sandy slightly silty subangular to subrounded fine to coarse GRAVEL. Sand is fine to coarse.					
7.50	D18			N=15 (1,2/3,3,4,5)								7.5		
7.50 - 7.95	SPT (S) N=15						(1.50)							
8.50	D19												8.5	
8.50 - 9.50	B9													
8.50 - 8.95	SPT (S) N=22	8.50			N=22 (3,3/4,5,6,7)		(1.00)						9.0	
9.00 - 9.45	UT26				Ublow=57 100%									
9.50	D20											9.5		
9.50 - 10.00	B10													
10.00 - 11.00	B11													
<b>Remarks</b> Deck to Bed = 4.00m  <														



















<div>Remarks</div> <div>Deck to Bed = 4.00m</div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> <div></div> 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 <b>CAUSEWAY</b> GEOTECH				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI		<b>Borehole No.:</b> BH16					
				<b>Coordinates:</b> 324725.91 E 173484.90 N		<b>Client:</b> Irish Water		Sheet 1 of 2					
<b>Method</b> Cable Percussion	<b>Plant Used</b> Dando 3000	<b>Top</b> 0.00	<b>Base</b> 11.50	<b>Client's Representative:</b> Byrne Looby ARUP J.V.		<b>Scale:</b> 1:50		<b>Driller:</b> AH					
				<b>Ground Level:</b> -4.33 mOD		<b>Dates:</b> 05/11/2017		<b>Logger:</b> LN					
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill			
0.50	D20 ES1			N=5 (1,2/1,1,2,1)	-5.13	(0.80)		Grey 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.					
0.80 - 1.20	B7					0.80		(1.00)				Soft grey sandy slightly gravelly silty CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.	
1.00 - 1.45	SPT (S) N=5												
1.50	D21 ES2			Ublow=8 89%	-6.13	1.80		Very soft grey slightly sandy clayey SILT. Sand is fine to coarse.					
1.80 - 2.20	B8												
2.00 - 2.50	UT18												
2.50	D22 ES3			N=6 (1,1/2,1,1,2)		(2.70)		Loose grey gravelly very silty fine to coarse SAND. Gravel is subangular to subrounded fine.					
2.80 - 3.20	B9												
3.00 - 3.45	SPT (S) N=6												
3.50	D23 ES4			Ublow=10 93%		4.50		Loose grey gravelly very silty fine to coarse SAND. Gravel is subangular to subrounded fine.					
3.80 - 4.00	B10												
4.00 - 4.50	UT17												
4.50	D24 ES5			N=7 (5,2/2,2,1,2)	-8.83	(1.40)		Loose grey gravelly very silty fine to coarse SAND. Gravel is subangular to subrounded fine.					
4.80 - 5.20	B11												
5.00 - 5.45	SPT (S) N=7												
5.50	D25 ES6			N=20 (3,4/4,5,5,6)	-10.23	5.90		Medium dense grey 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 subrounded to rounded.					
5.80 - 6.20	B12												
6.00 - 6.45	SPT (C) N=20												
6.50	D26			N=23 (4,4/5,6,5,7)		(3.40)		Medium dense grey 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 subrounded to rounded.					
6.80 - 7.20	B13												
7.00 - 7.45	SPT (C) N=23												
7.50	D27			N=31 (4,5/6,7,8,10)				Medium dense grey 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 subrounded to rounded.					
7.80 - 8.20	B19												
8.00 - 8.45	SPT (C) N=31												
8.50	D28			N=39 (6,5/8,10,11,10)	-13.63	9.30		Medium dense to dense grey slightly gravelly slightly silty fine to coarse SAND. Gravel is subangular to subrounded fine to medium.					
8.80 - 9.20	B14												
9.00 - 9.45	SPT (C) N=39												
9.50	D29							Medium dense to dense grey slightly gravelly slightly silty fine to coarse SAND. Gravel is subangular to subrounded fine to medium.					
9.80 - 10.20	B15												
<b>Remarks</b> Drilled from floating platform    Terminated at virtual refusal in granular material							<b>Water Strikes</b>		<b>Chiselling Details</b>				
							Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
							<b>Water Added</b>		<b>Casing Details</b>				
							From (m)	To (m)	To (m)	Diam (mm)			
















<div>Remarks</div> <div>Drilled from floating platform</div> <div></div> <div></div> <div></div> <div></div> <div>Terminated at virtual refusal in granular material</div>	Water Strikes				Chiselling Details		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
	Water Added		Casing Details				
	From (m)	To (m)	To (m)	Diam (mm)			
			11.50	200			



 <b>CAUSEWAY</b> GEOTECH				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH17																																																	
<b>Coordinates:</b> 324761.67 E		<b>Client:</b> Irish Water								Sheet 1 of 2																																																	
<b>Method</b> Cable Percussion		<b>Plant Used</b> Dando 3000		<b>Top</b> 0.00		<b>Base</b> 12.90		<b>Client's Representative:</b> Byrne Looby ARUP J.V.		<b>Scale:</b> 1:50																																																	
								<b>Dates:</b> 03/11/2017		<b>Driller:</b> AH																																																	
										<b>Logger:</b> LN																																																	
<b>Ground Level:</b> -0.96 mOD																																																											
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Casing Depth (m)</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Legend</b>	<b>Description</b>	<b>Water</b>	<b>Backfill</b>																																																	
0.50	D1 ES29 B15			N=27 (3,8/4,7,8,8)				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 mixed lithologies.			0.5																																																
0.80 - 1.20	SPT (C) N=27										1.0																																																
1.00 - 1.45											1.5																																																
1.50	D2 ES30 B16			N=20 (4,3/4,5,5,6)		(4.10)					1.5																																																
1.80 - 2.20	SPT (C) N=20										2.0																																																
2.00 - 2.45											2.5																																																
2.50	D3 ES31 B17			N=22 (4,5/5,6,6,5)							2.5																																																
2.80 - 3.20	SPT (C) N=22										3.0																																																
3.00 - 3.45											3.5																																																
3.50	D4 ES32 B18			N=21 (3,4/5,5,6,5) Water strike at 4.10m	-5.06	4.10		Medium dense grey sandy slightly silty subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and boulders are subangular to subrounded of mixed lithologies.			4.0																																																
3.80 - 4.20	SPT (C) N=21					(1.10)					4.5																																																
4.00 - 4.45											5.0																																																
4.50	D5 ES33 B19			N=11 (3,4/5,2,2,2)	-6.16	5.20		Very soft grey silty sandy slightly gravelly clayey SILT . Sand is fine to coarse. Gravel is subangular to subrounded fine to medium.			5.0																																																
4.80 - 5.20	SPT (C) N=11										5.5																																																
5.00 - 5.45											6.0																																																
5.50	D7 ES34 B20			Ublow=12 98%		(1.60)					6.0																																																
5.80 - 6.00	UT27										6.5																																																
6.00 - 6.50											7.0																																																
6.50	D8			N=9 (2,3/2,2,3,2)	-7.76	6.80		Soft to firm grey slightly sandy slightly clayey SILT . Sand is fine to coarse.			6.5																																																
6.80 - 7.20	B21										7.0																																																
7.00 - 7.45	SPT (S) N=9										7.5																																																
7.50	D9			Ublow=15 98%		(2.90)					7.5																																																
7.80 - 8.00	B22										8.0																																																
8.00 - 8.50	UT28										8.5																																																
8.50	D10			N=16 (3,3/4,4,4,4)				Dense grey slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble and boulder content. Sand is fine to coarse. Cobbles and			8.5																																																
8.80 - 9.20	B23										9.0																																																
9.00 - 9.45	SPT (S) N=16										9.5																																																
9.50	D11				-10.66	9.70					9.5																																																
9.80 - 10.20	B24																																																										
<b>Remarks</b> Drilled from floating platform																																																											
<table><tr><td colspan="4"><b>Water Strikes</b></td><td colspan="4"><b>Chiselling Details</b></td></tr><tr><td>Struck at (m)</td><td>Casing to (m)</td><td>Time (min)</td><td>Rose to (m)</td><td>From (m)</td><td>To (m)</td><td colspan="2">Time (hh:mm)</td></tr><tr><td>4.10</td><td>4.10</td><td></td><td></td><td>12.90</td><td>12.90</td><td colspan="2">01:00</td></tr><tr><td colspan="4"><b>Water Added</b></td><td colspan="4"><b>Casing Details</b></td></tr><tr><td>From (m)</td><td>To (m)</td><td>To (m)</td><td>Diam (mm)</td><td></td><td></td><td colspan="2"></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2"></td></tr></table>												<b>Water Strikes</b>				<b>Chiselling Details</b>				Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)		4.10	4.10			12.90	12.90	01:00		<b>Water Added</b>				<b>Casing Details</b>				From (m)	To (m)	To (m)	Diam (mm)												
<b>Water Strikes</b>				<b>Chiselling Details</b>																																																							
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)																																																					
4.10	4.10			12.90	12.90	01:00																																																					
<b>Water Added</b>				<b>Casing Details</b>																																																							
From (m)	To (m)	To (m)	Diam (mm)																																																								
Terminated at refusal on large boulder																																																											




 <b>CAUSEWAY</b> GEOTECH				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI		<b>Borehole No.:</b> BH18																								
				<b>Coordinates:</b> 324791.47 E 173547.27 N		<b>Client:</b> Irish Water		Sheet 1 of 2																								
<b>Method</b> Cable Percussion	<b>Plant Used</b> Dando 3000	<b>Top</b> 0.00	<b>Base</b> 11.30	<b>Ground Level:</b> -0.72 mOD		<b>Client's Representative:</b> Byrne Looby ARUP J.V.		<b>Scale:</b> 1:50																								
						<b>Dates:</b> 06/11/2017		<b>Driller:</b> AH																								
								<b>Logger:</b> LN																								
Depth (m)	Sample / Tests	Casing Depth (m)	Water Depth (m)	Field Records	Level (mOD)	Depth (m) (Thickness)	Legend	Description	Water	Backfill																						
0.50	D18							Medium Dense greyish black 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 mixed lithologies.																								
0.80 - 2.20	ES9																															
1.00 - 1.45	B1			N=11 (3,4/3,3,2,3)																												
	SPT (C) N=11																															
1.50	D19					(3.00)																										
	ES10																															
2.00 - 2.50	UT15			Ublow=11 98%																												
2.50	D20																															
	ES11																															
2.80 - 4.20	B2			N=7 (1,1/1,2,2,2)	-3.72	3.00																										
	SPT (S) N=7																															
3.00 - 3.45																																
3.50	D21																															
	ES12																															
4.00 - 4.50	UT16			Ublow=14 97%																												
4.50	D22																															
	ES13																															
4.80 - 6.20	B3			N=9 (1,1/2,2,2,3)		(3.80)																										
5.00 - 5.45	SPT (S) N=9																															
5.50	D23																															
	ES14																															
6.00 - 6.50	UT17			Ublow=16 88%																												
6.50	D24																															
6.80 - 7.20	B4			N=7 (2,2/1,2,2,2)	-7.52	6.80																										
	SPT (S) N=7																															
7.00 - 7.45																																
7.50	D25					(1.50)																										
7.80 - 8.20	B5			N=24 (2,3/4,5,7,8)																												
8.00 - 8.45	SPT (C) N=24																															
8.50	D26																															
8.80 - 9.20	B6			N=41 (6,8/8,10,10,13)	-9.02	8.30																										
	SPT (C) N=41																															
9.00 - 9.45																																
9.50	D27					(3.00)																										
9.80 - 10.20	B7																															
<div> <div>Remarks</div> <div>Drilled from floating platform</div> <div>Terminated at virtual refusal in granular material</div> </div> <div> <div>Water Strikes</div> <table border="1"> <tr> <td>Struck at (m)</td> <td>Casing to (m)</td> <td>Time (min)</td> <td>Rose to (m)</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table> </div> <div> <div>Chiselling Details</div> <table border="1"> <tr> <td>From (m)</td> <td>To (m)</td> <td>Time (hh:mm)</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table> </div> <div> <div>Water Added</div> <table border="1"> <tr> <td>From (m)</td> <td>To (m)</td> </tr> <tr> <td></td> <td></td> </tr> </table> </div> <div> <div>Casing Details</div> <table border="1"> <tr> <td>To (m)</td> <td>Diam (mm)</td> </tr> <tr> <td></td> <td></td> </tr> </table> </div>											Struck at (m)	Casing to (m)	Time (min)	Rose to (m)					From (m)	To (m)	Time (hh:mm)				From (m)	To (m)			To (m)	Diam (mm)		
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)																													
From (m)	To (m)	Time (hh:mm)																														
From (m)	To (m)																															
To (m)	Diam (mm)																															



<b>Remarks</b> Drilled from floating platform     Terminated at virtual refusal in granular material	<b>Water Strikes</b>				<b>Chiselling Details</b>		
	Struck at (m)	Casing to (m)	Time (min)	Rose to (m)	From (m)	To (m)	Time (hh:mm)
	<b>Water Added</b>		<b>Casing Details</b>				
	From (m)	To (m)	To (m)	Diam (mm)			
			11.30	200			



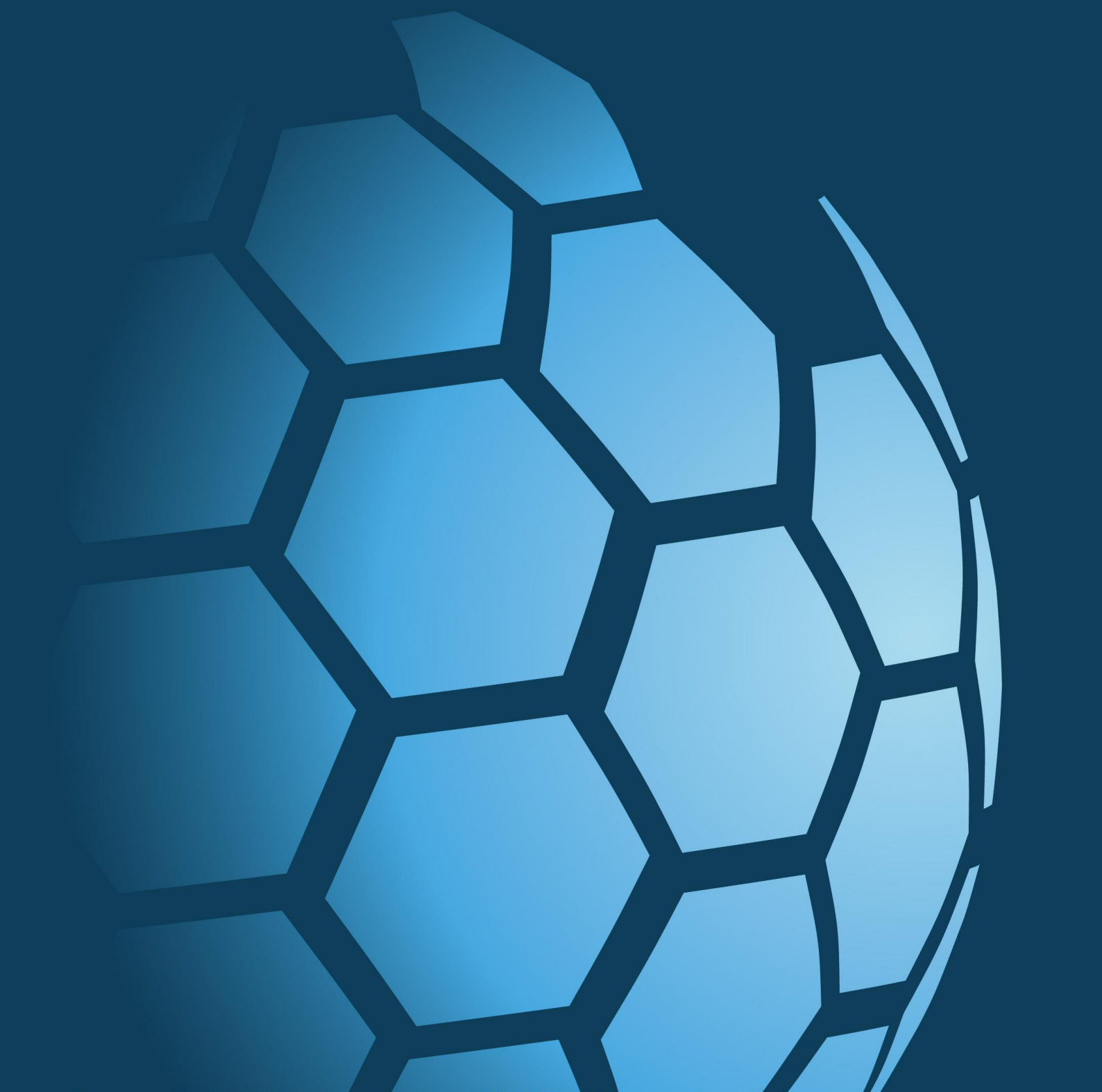
 <b>CAUSEWAY</b> GEOTECH				<b>Project No.:</b> 17-0167		<b>Project Name:</b> Arklow Sewerage Scheme Marine Outfall GI				<b>Borehole No.:</b> BH19																									
				<b>Coordinates:</b> 324266.57 E		<b>Client:</b> Irish Water				Sheet 1 of 1																									
				<b>Method</b> Cable Percussion		<b>Plant Used</b> Dando 3000		<b>Top</b> 0.00		<b>Base</b> 6.50		<b>Client's Representative:</b> Byrne Looby ARUP J.V.		<b>Scale:</b> 1:50																					
				<b>Ground Level:</b> -1.20 mOD		<b>Dates:</b> 07/11/2017				<b>Driller:</b> AH		<b>Logger:</b> LN																							
<b>Depth (m)</b>	<b>Sample / Tests</b>	<b>Casing Depth (m)</b>	<b>Water Depth (m)</b>	<b>Field Records</b>	<b>Level (mOD)</b>	<b>Depth (m) (Thickness)</b>	<b>Legend</b>	<b>Description</b>	<b>Water</b>	<b>Backfill</b>																									
0.50	D15 ES7							Medium dense grey very sandy slightly silty subangular to subrounded fine 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																								
0.80 - 1.20	B1					(1.80)					1.0																								
1.00 - 1.45	SPT (S) N=24			N=24 (4,6/5,8,6,5)							1.5																								
1.50	D16 ES8										2.0																								
1.80 - 2.20	B2					-3.00	1.80	Very soft greyish brown sandy organic silty CLAY. Sand is fine to coarse.			2.5																								
2.00 - 2.50	UT13			Ublow=12 100%		(0.80)					3.0																								
2.50	D17 ES9					-3.80	2.60	Loose grey slightly gravelly very silty fine to coarse SAND. Gravel is subangular to subrounded fine to medium.			3.5																								
2.80 - 3.20	B3						(0.90)				4.0																								
3.00 - 3.45	SPT (S) N=8			N=8 (2,1/2,2,2,2)							4.5																								
3.50	D18 ES10					-4.70	3.50	Very soft greyish brown sandy slightly gravelly clayey SILT. Sand is fine to coarse. Gravel is subangular to subrounded fine.			5.0																								
3.80 - 4.20	B4						(1.80)				5.5																								
4.00 - 4.50	UT14			Ublow=15 100%							6.0																								
4.50	D19 ES11										6.5																								
4.80 - 5.20	B5						(1.20)				7.0																								
5.00 - 5.45	SPT (S) N=17			N=17 (2,2/4,3,5,5)		-6.50	5.30	Weathered grey AMPHIBOLITE recovered as sandy slightly silty angular to subangular medium to coarse GRAVEL and low cobble content. Sand is fine to coarse. Gravel is composed exclusively of amphibolite. Cobbles are angular to subangular of amphibolite.			7.5																								
5.50	D20 ES12										8.0																								
5.80 - 6.20	B6						(1.20)				8.5																								
6.00 - 6.45	SPT (C) N=45			N=45 (4,5/8,10,12,15)		-7.70	6.50				9.0																								
								End of Borehole at 6.50m			9.5																								
<div> <div>Remarks</div> <div>Drilled from floating platform</div> <div>Terminated on large boulder/weathered bedrock</div> </div> <div> <div>Water Strikes</div> <table border="1"> <tr> <td>Struck at (m)</td> <td>Casing to (m)</td> <td>Time (min)</td> <td>Rose to (m)</td> </tr> <tr> <td></td> <td></td> <td></td> <td></td> </tr> </table> </div> <div> <div>Chiselling Details</div> <table border="1"> <tr> <td>From (m)</td> <td>To (m)</td> <td>Time (hh:mm)</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table> </div> <div> <div>Water Added</div> <table border="1"> <tr> <td>From (m)</td> <td>To (m)</td> <td>Time (min)</td> </tr> <tr> <td></td> <td></td> <td></td> </tr> </table> </div> <div> <div>Casing Details</div> <table border="1"> <tr> <td>To (m)</td> <td>Diam (mm)</td> </tr> <tr> <td>6.50</td> <td>200</td> </tr> </table> </div>												Struck at (m)	Casing to (m)	Time (min)	Rose to (m)					From (m)	To (m)	Time (hh:mm)				From (m)	To (m)	Time (min)				To (m)	Diam (mm)	6.50	200
Struck at (m)	Casing to (m)	Time (min)	Rose to (m)																																
From (m)	To (m)	Time (hh:mm)																																	
From (m)	To (m)	Time (min)																																	
To (m)	Diam (mm)																																		
6.50	200																																		

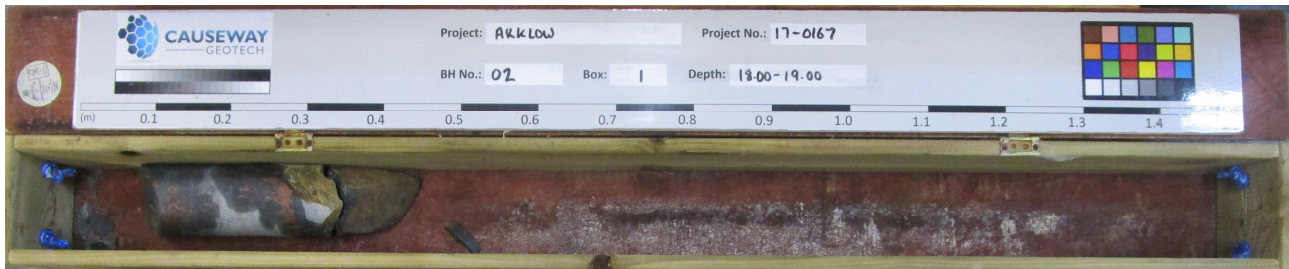


**CAUSEWAY**  
— GEOTECH

## APPENDIX C

### Core photographs

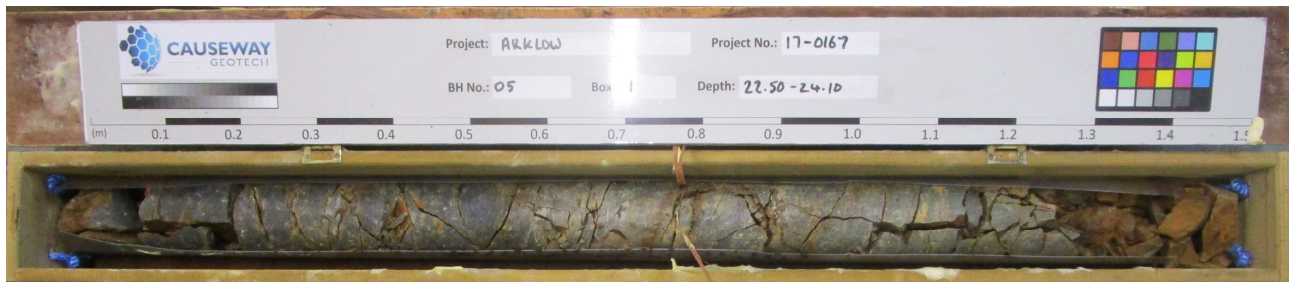




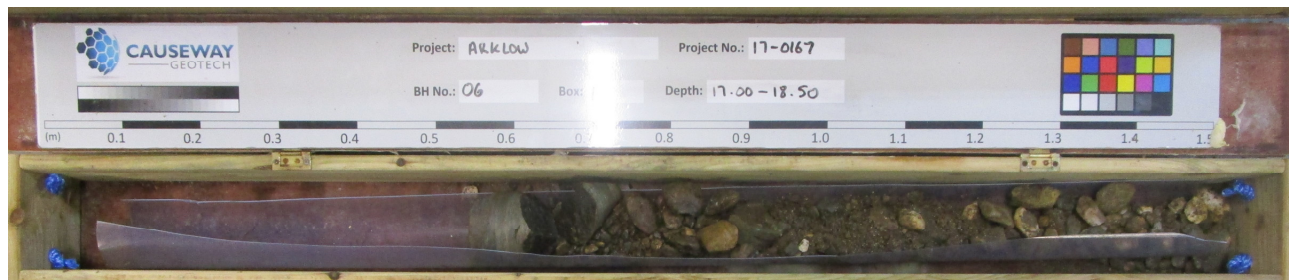
BH02 18.00m to 19.00m



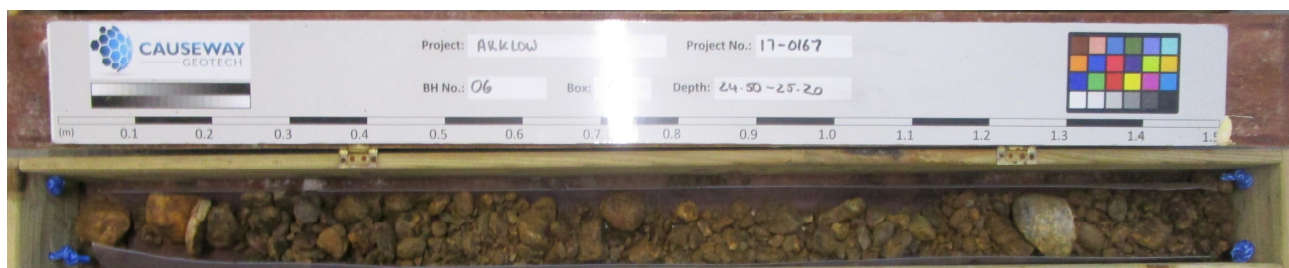
BH02 23.50m to 25.00m



BH05 22.50m to 24.10m

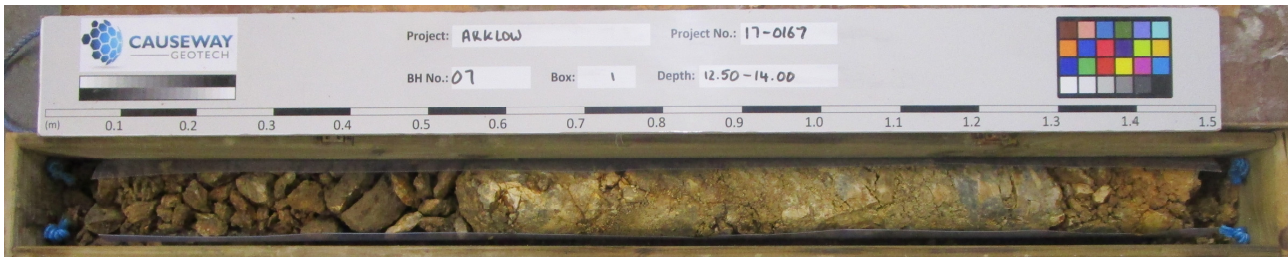


BH06 17.00m to 18.50m



BH06 24.50m to 25.20m

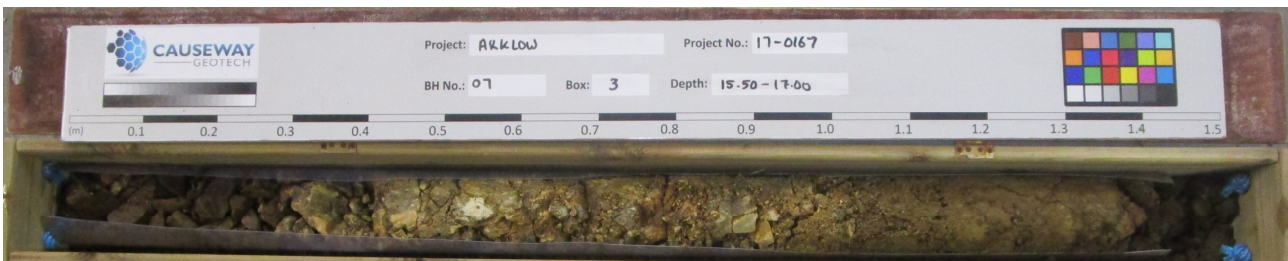




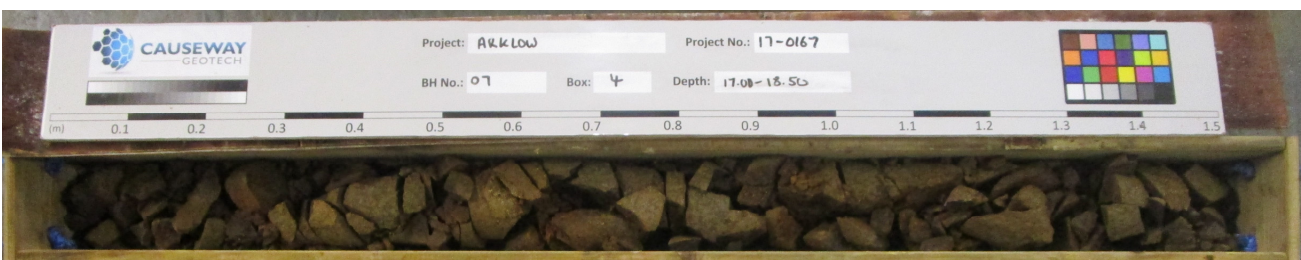
BH07 12.50m to 14.00m



BH07 14.00m to 15.50m

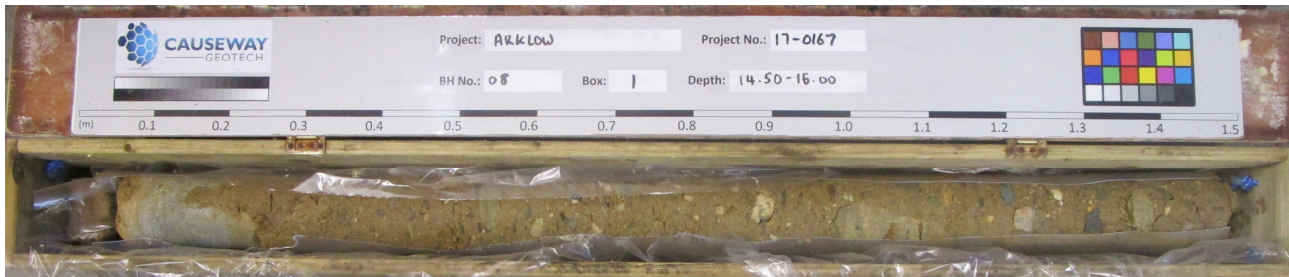


BH07 15.50m to 17.00m

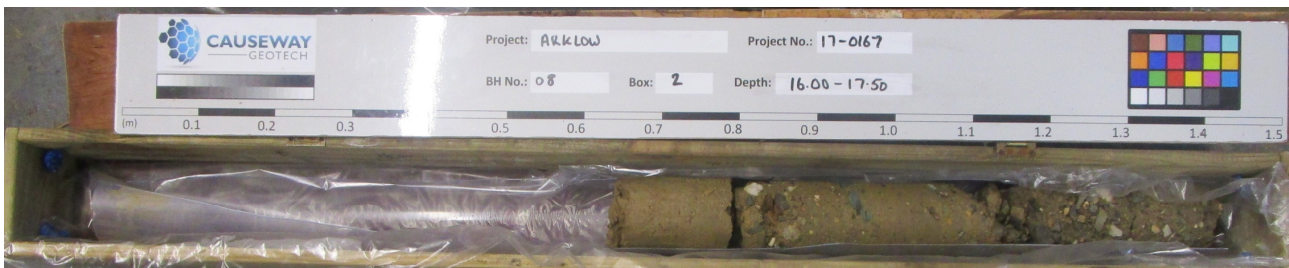


BH07 17.00m to 18.50m

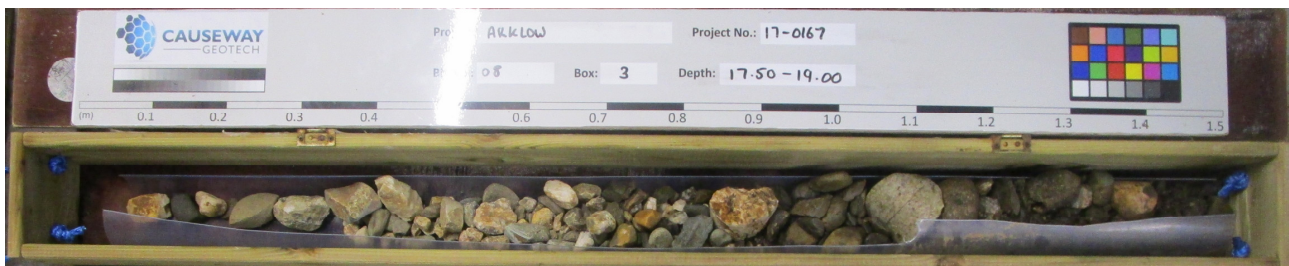




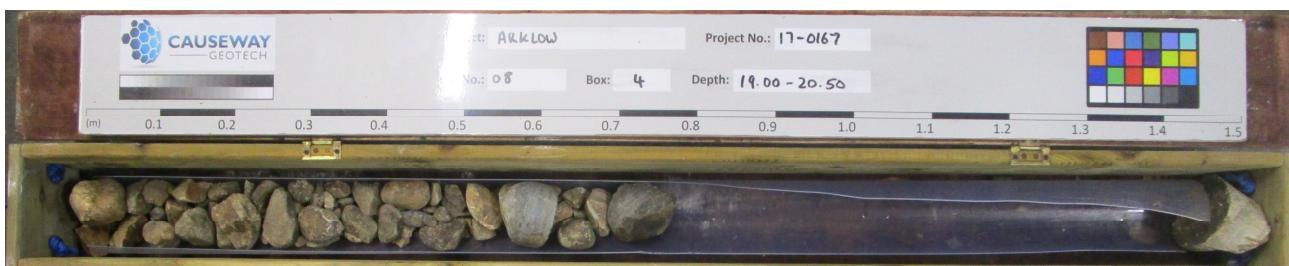
BH08 14.50m to 16.00m



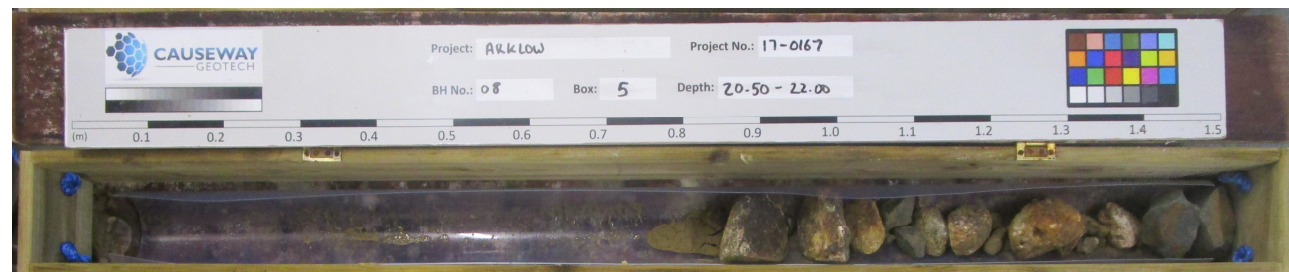
BH08 16.00m to 17.50m



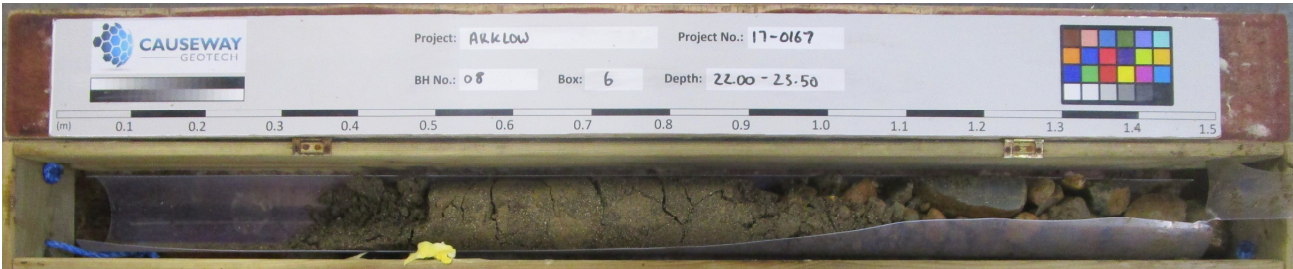
BH08 17.50m to 19.00m



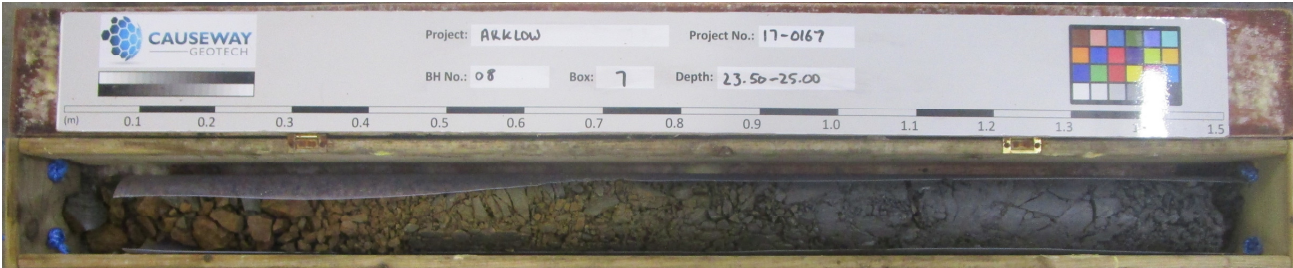
BH08 19.00m to 20.50m



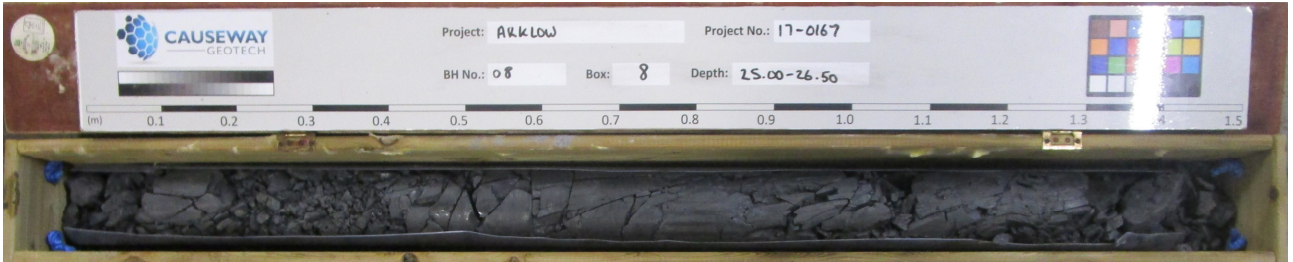
BH08 20.50m to 22.00m



BH08 22.00m to 23.50m



BH08 23.50m to 25.00m

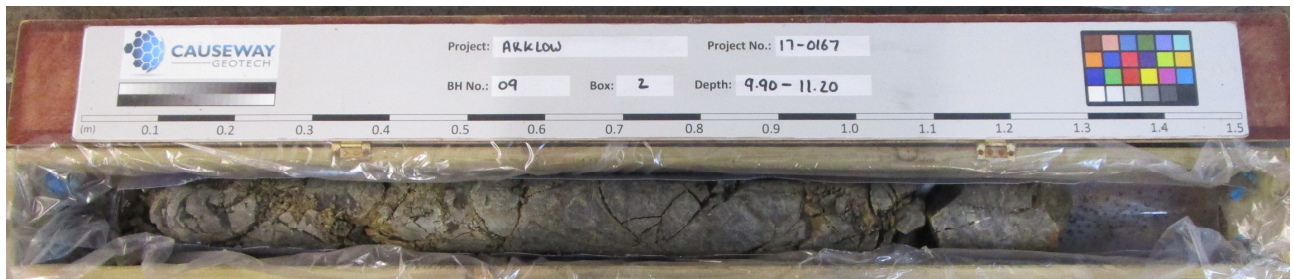


BH08 25.00m to 26.50m

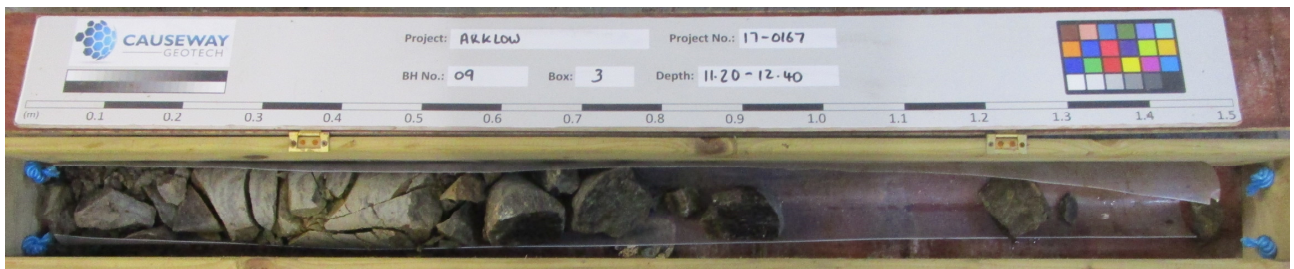




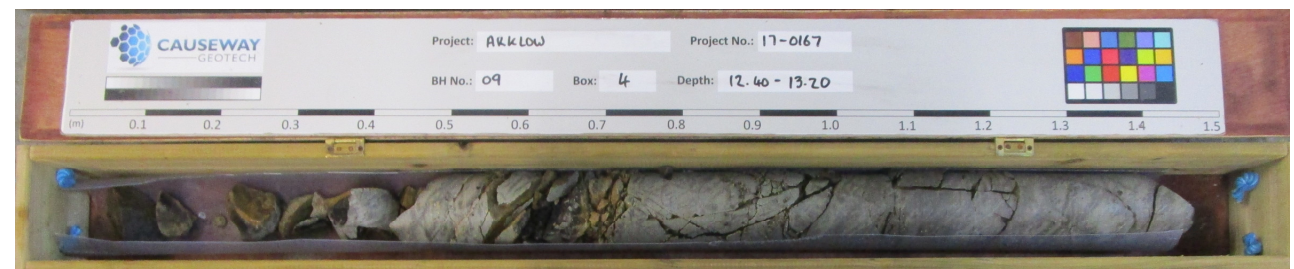
BH09 8.90m to 9.90m



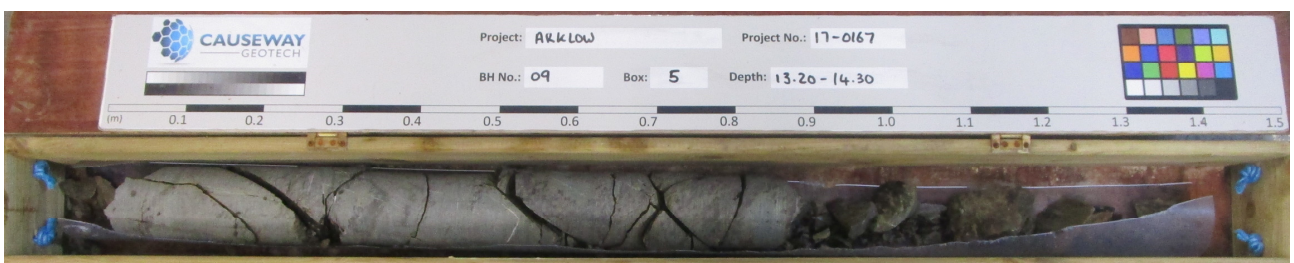
BH09 9.90m to 11.20m



BH09 11.20m to 12.40m

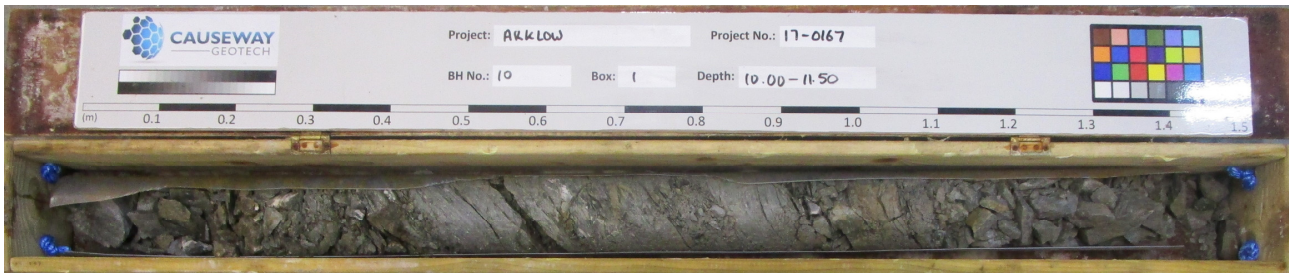


BH09 12.40m to 13.20m



BH09 13.20m to 14.30m

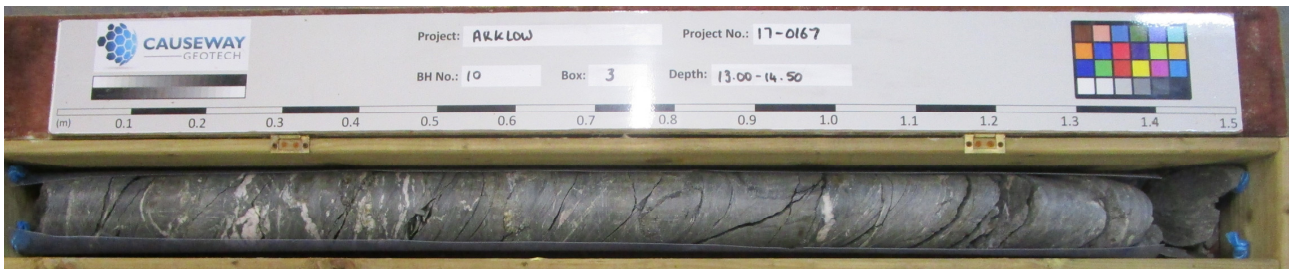




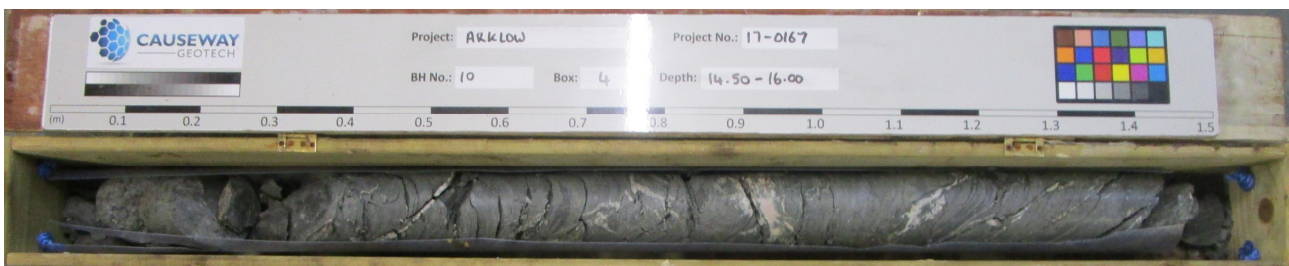
BH10 10.00m to 11.50m



BH10 11.50m to 13.00m



BH10 13.00m to 14.50m



BH10 14.50m to 16.00m





**CAUSEWAY**  
— GEOTECH

## APPENDIX D

### Geotechnical laboratory test results



**SOIL AND ROCK SAMPLE ANALYSIS  
LABORATORY TEST REPORT**

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

---

**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:

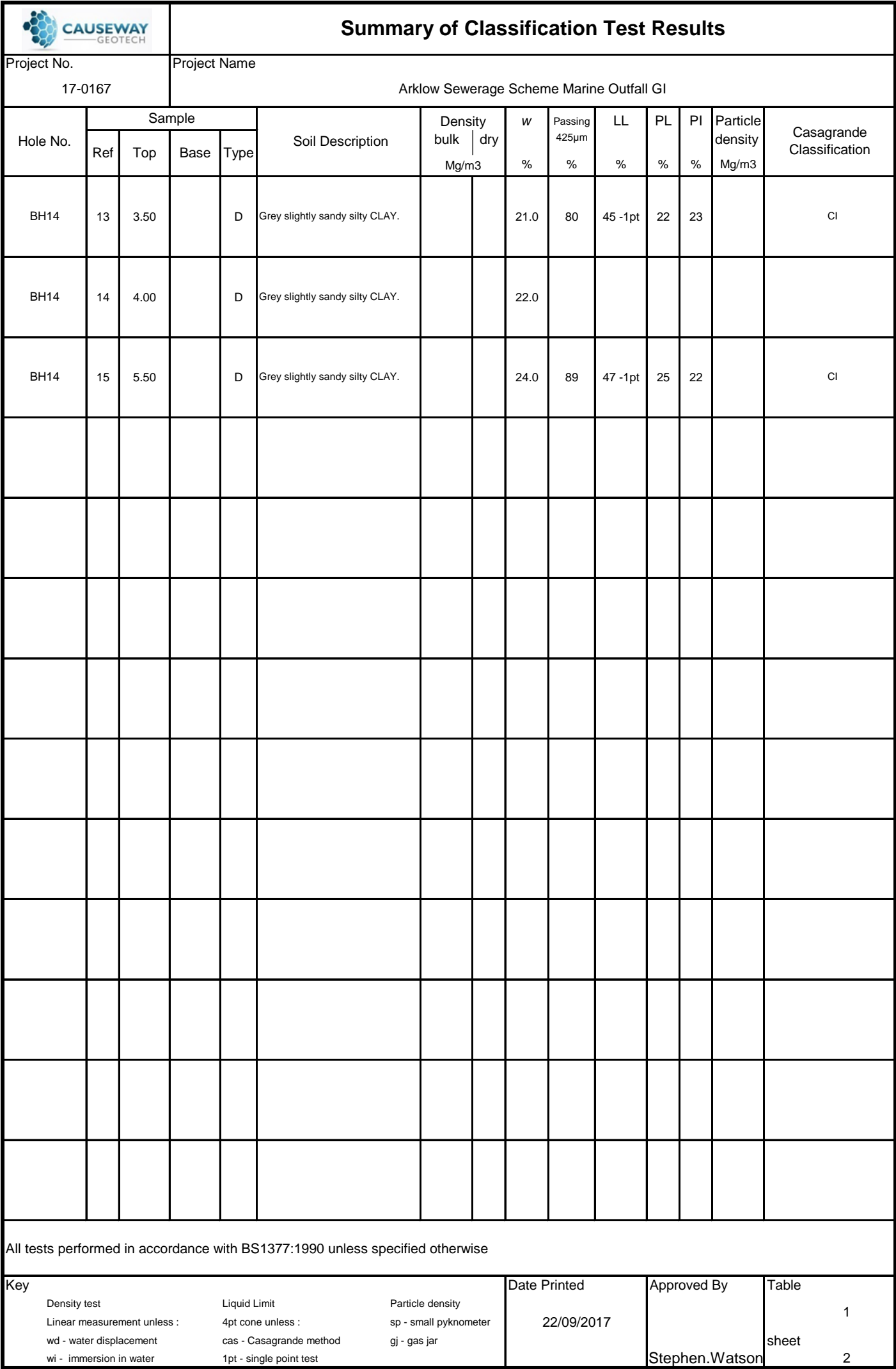
Material tested	Type of test/Properties measured/Range of measurement	Standard specifications	Number of test results included in the report
SOIL	Moisture content - oven drying method	BS 1377-2:1990	16
SOIL	Liquid limit - cone penetrometer	BS 1377-2:1990	10
SOIL	Liquid limit - cone penetrometer - one 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. 17-0167		Project Name Arklow Sewerage Scheme Marine Outfall GI												
Hole No.	Sample				Soil Description	Density		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type		bulk Mg/m3	dry Mg/m3							
BH12	3	2.30		B	Grey slightly sandy silty CLAY.			23.0	96	50 -1pt	21	29		CH
BH12	4	3.00		B	Grey slightly sandy slightly 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 performed in accordance with BS1377:1990 unless specified otherwise

Key				Date Printed	Approved By	Table
Density test	Liquid Limit	Particle density		22/09/2017	Stephen.Watson	1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer				sheet
wd - water displacement	cas - Casagrande method	gj - gas jar				
wi - immersion in water	1pt - single point test					1





## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH12

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

1

Soil Description

Brown slightly sandy subangular to subrounded fine GRAVEL.

Depth, m

0.00

Specimen Reference

3

Specimen  
Depth

m

Sample Type

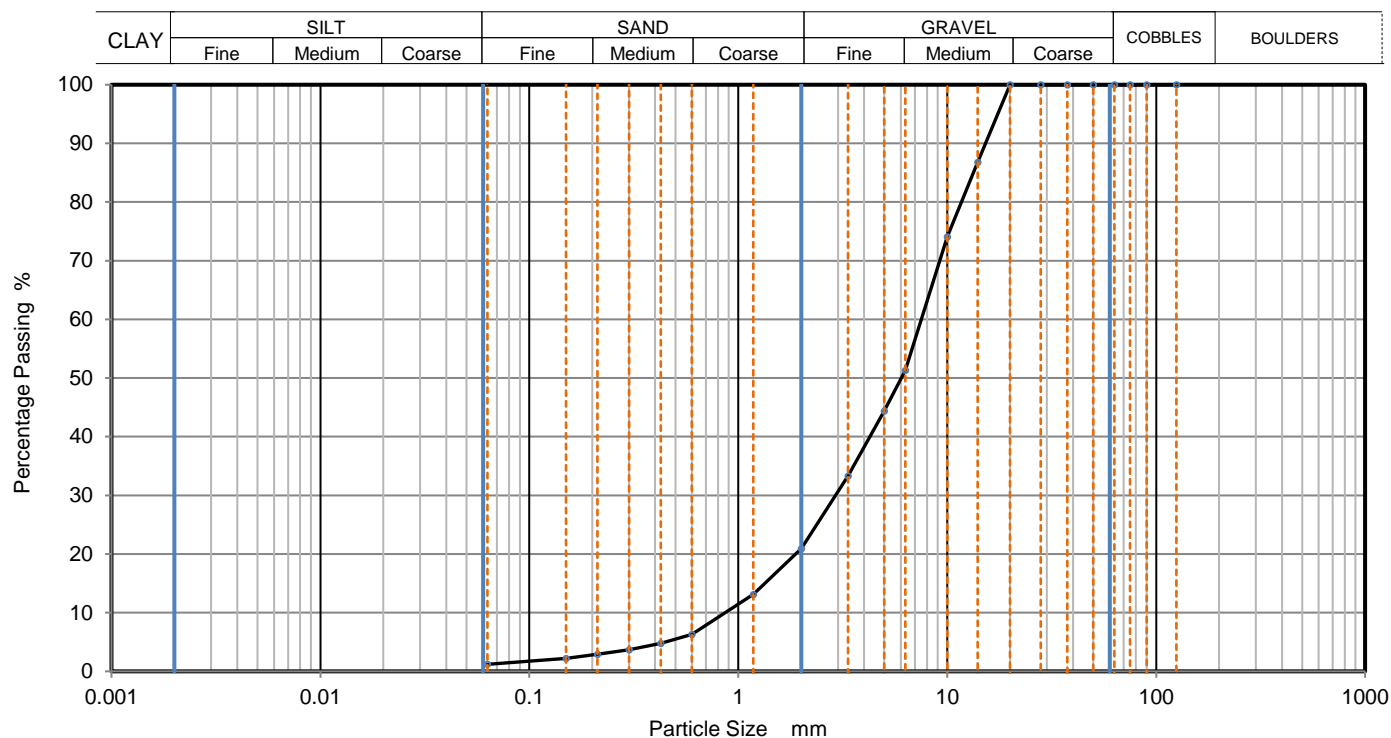
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201709070



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	8.7
Curvature Coefficient	1.3

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

Sheet printed

22/09/2017 15:23

Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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  
Depth

m

Sample Type

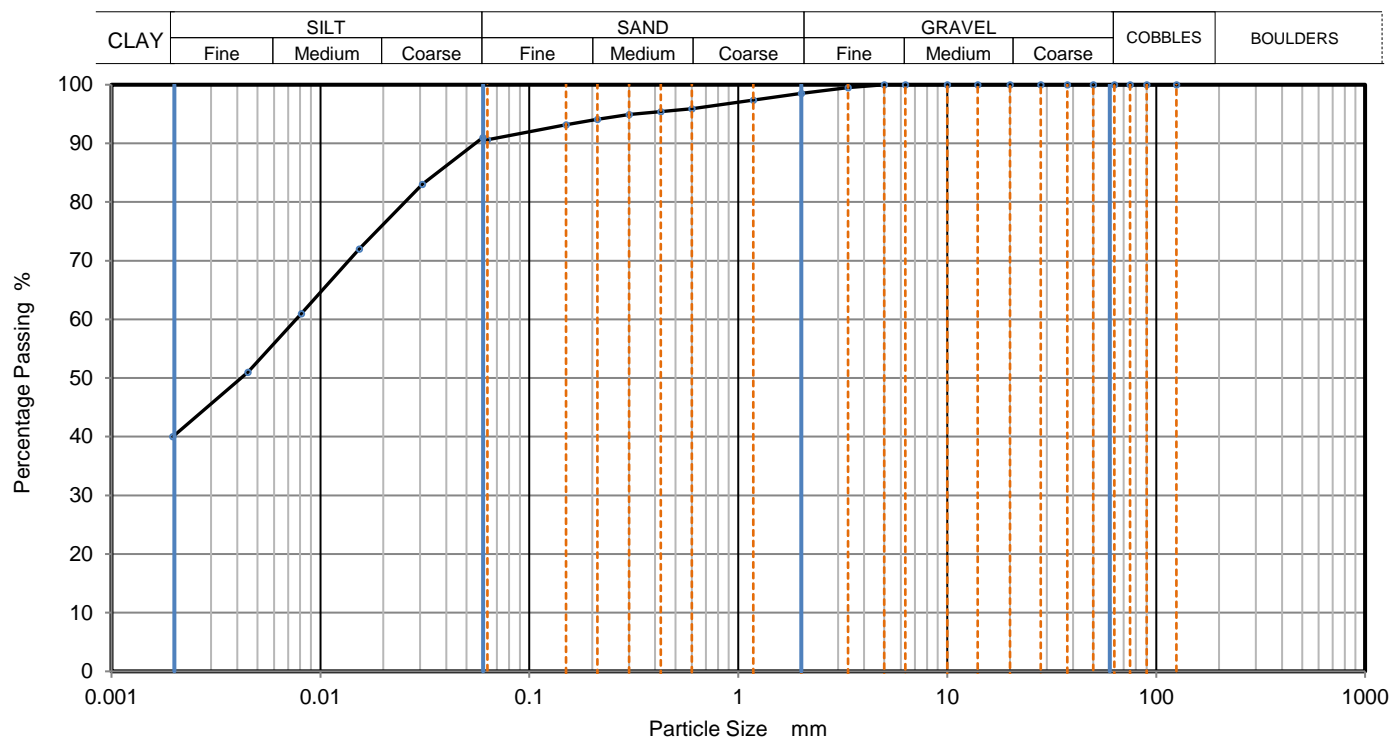
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201709072



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	95		
0.3	95		
0.212	94		
0.15	93		
0.063	91		

Dry Mass of sample, g

1815

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	8
Silt	50
Clay	40

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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22/09/2017 15:23

Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

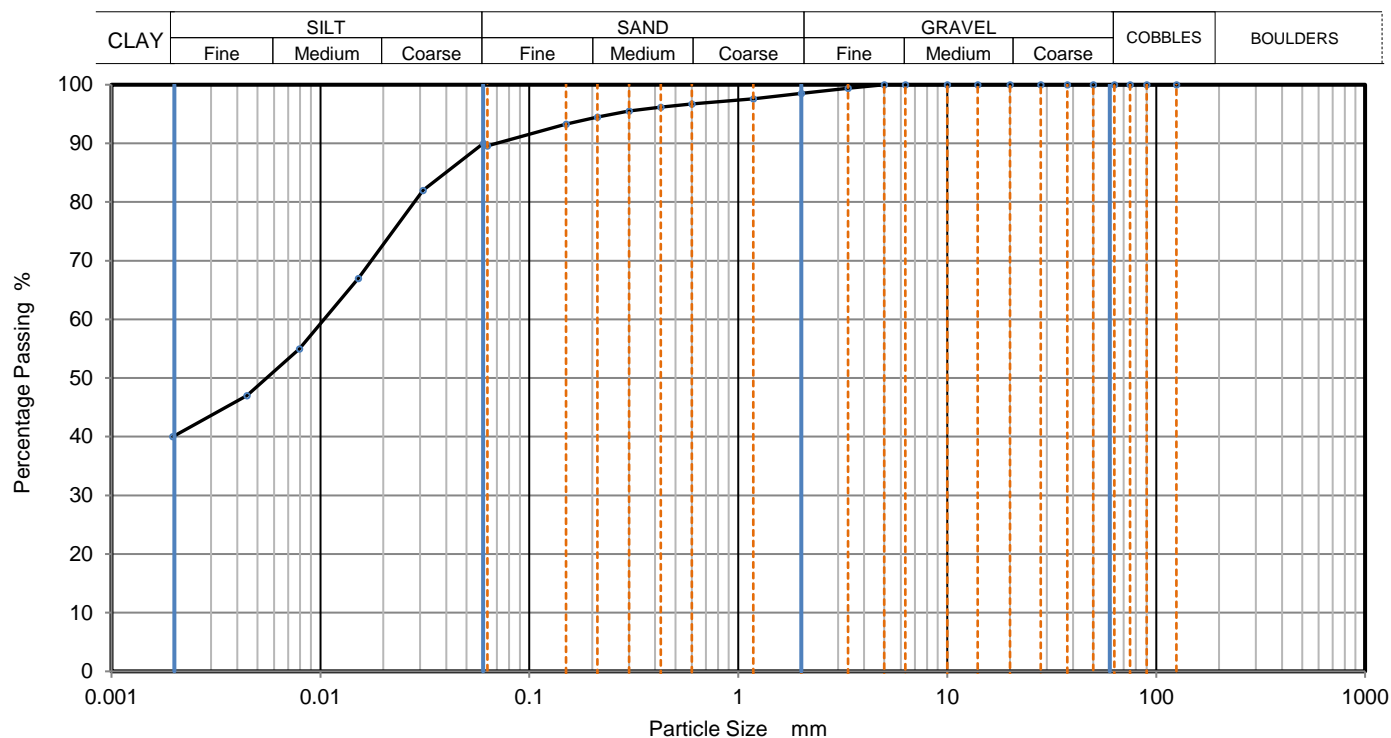
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201709077



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	96		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

Sheet





## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH12

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

6

Soil Description

Grey slightly sandy slightly gravelly silty CLAY.

Depth, m

5.50

Specimen Reference

3

Specimen  
Depth

m

Sample Type

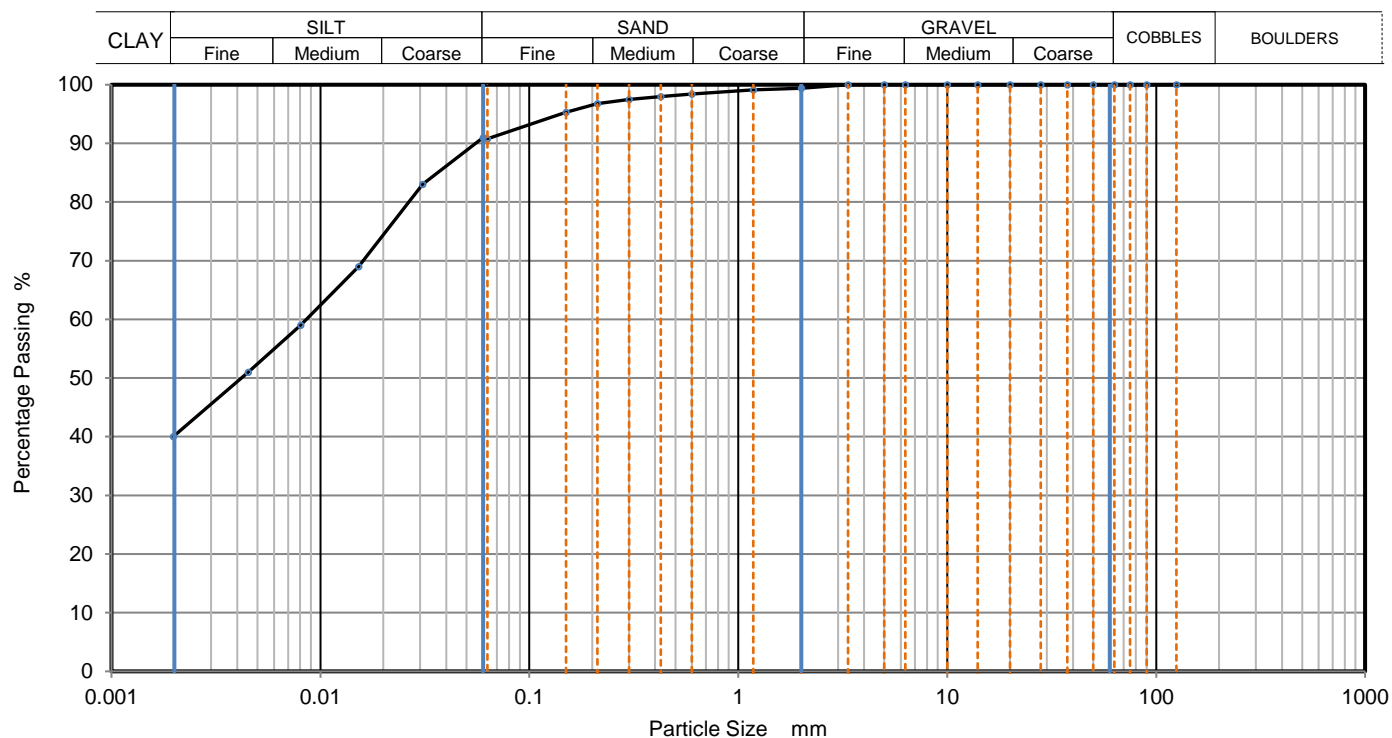
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201709079



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	98		
0.3	98		
0.212	97		
0.15	95		
0.063	91		

Dry Mass of sample, g

1245

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	9
Silt	51
Clay	40

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH12

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

7

Soil Description

Grey slightly sandy silty CLAY.

Depth, m

7.00

Specimen Reference

3

Specimen  
Depth

m

Sample Type

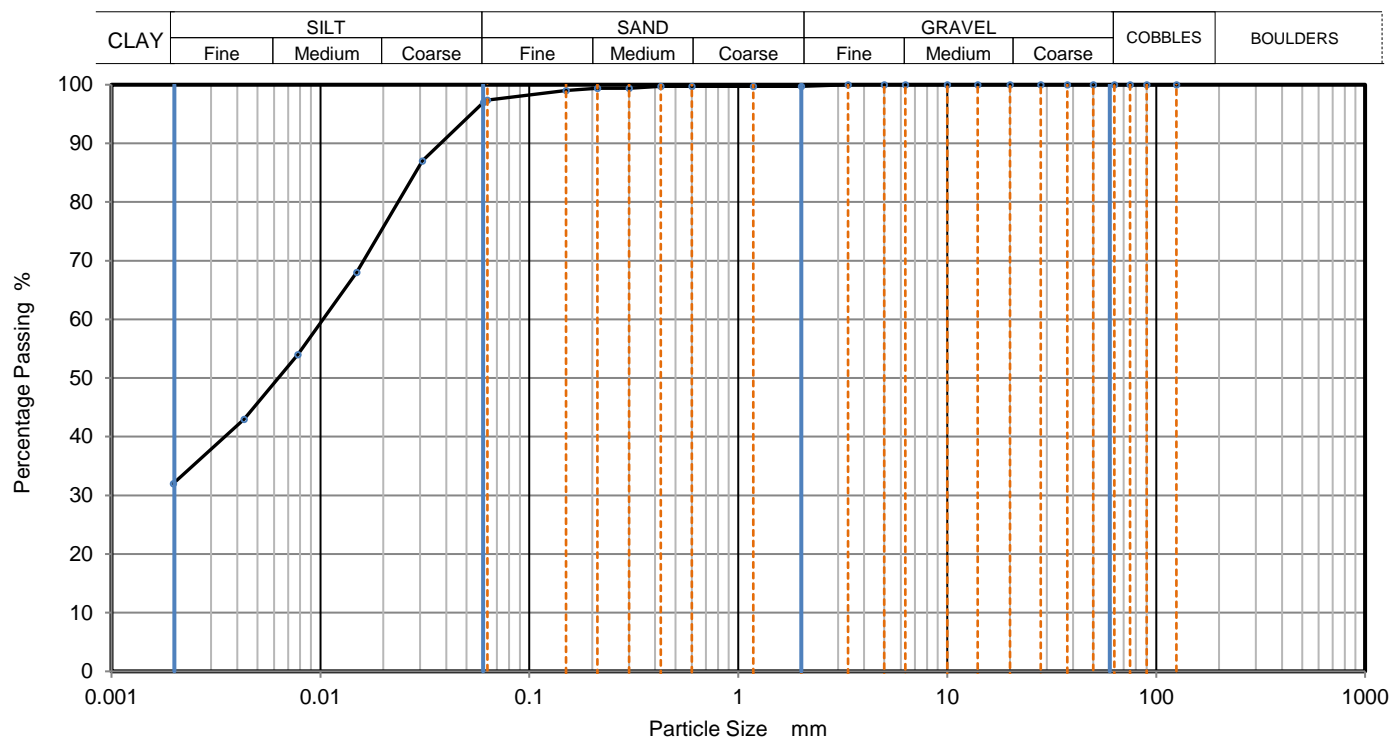
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090712



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	100		
0.3	99		
0.212	99		
0.15	99		
0.063	97		

Dry Mass of sample, g

1275

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	2
Silt	65
Clay	33

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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  
Depth

m

Sample Type

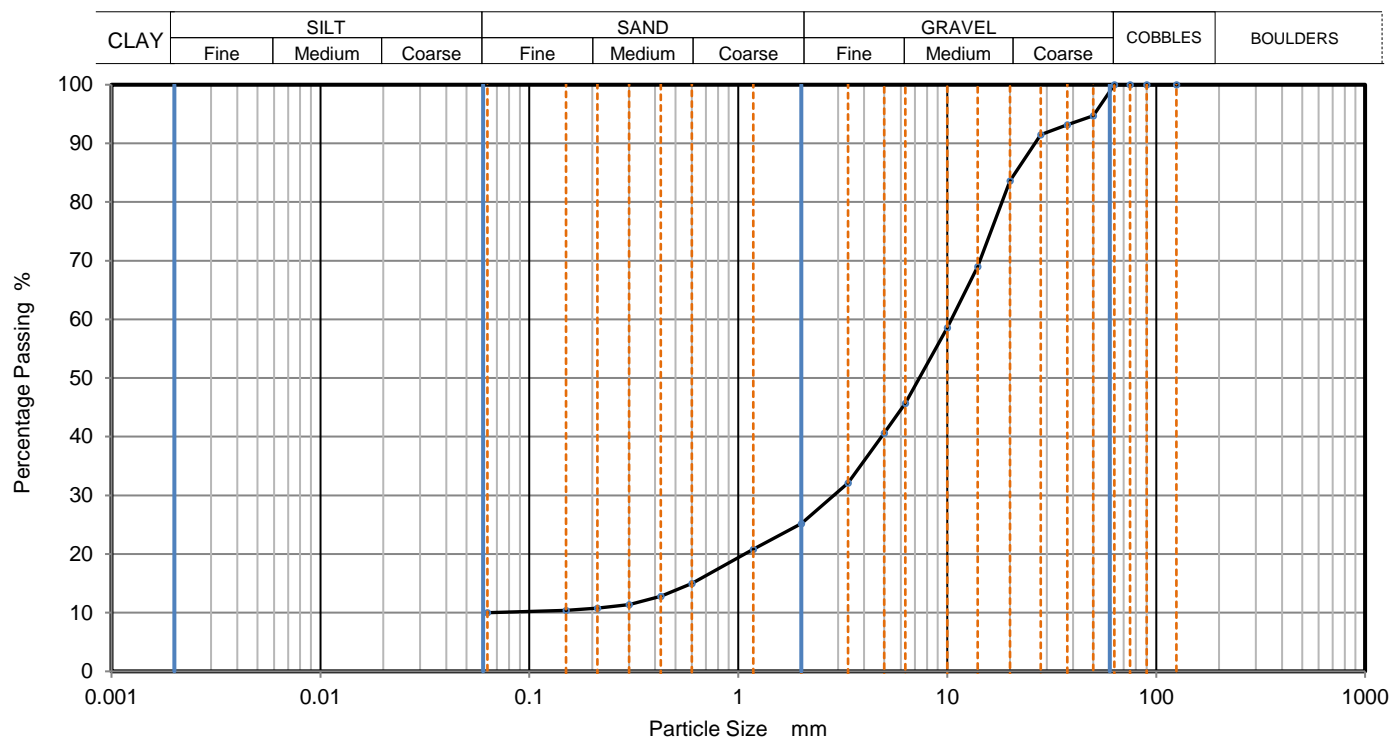
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090714



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

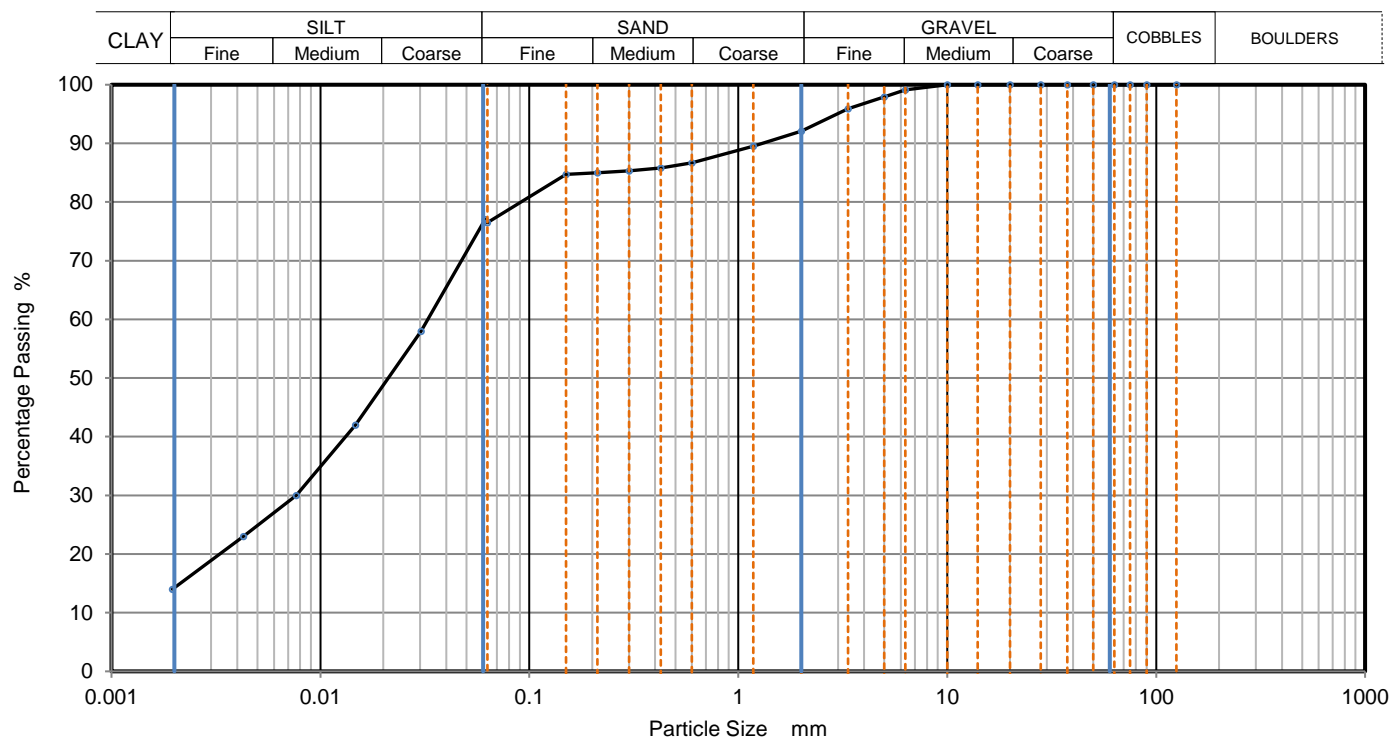
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090716



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	86		
0.3	85		
0.212	85		
0.15	85		
0.063	77		

Dry Mass of sample, g

1790

Sample Proportions	% dry mass
Cobbles	0
Gravel	8
Sand	16
Silt	62
Clay	14

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

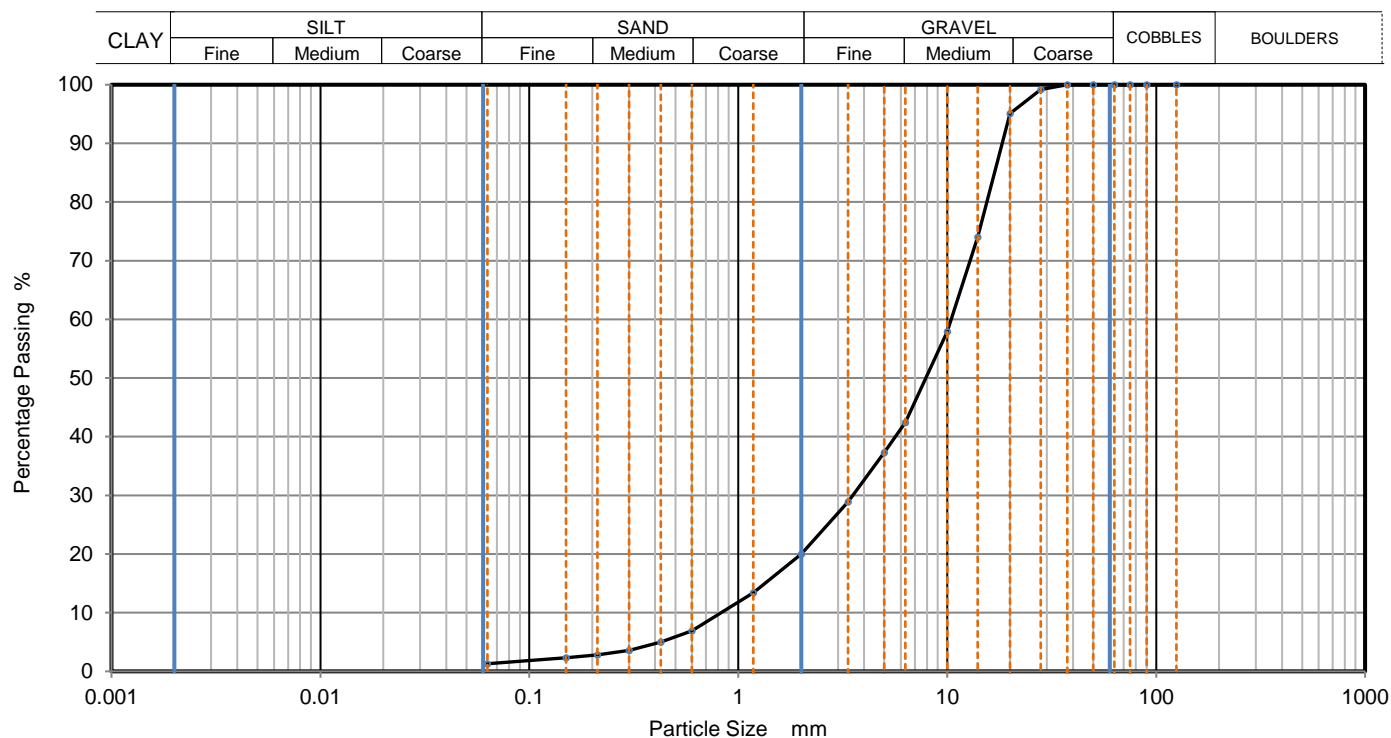
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090717



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	80
Sand	19
Fines <0.063mm	1

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

Remarks

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Job Ref

17-0167

Borehole/Pit No.

BH13

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

3

Soil Description

Grey slightly sandy silty CLAY.

Depth, m

2.90

Specimen Reference

3

Specimen  
Depth

m

Sample Type

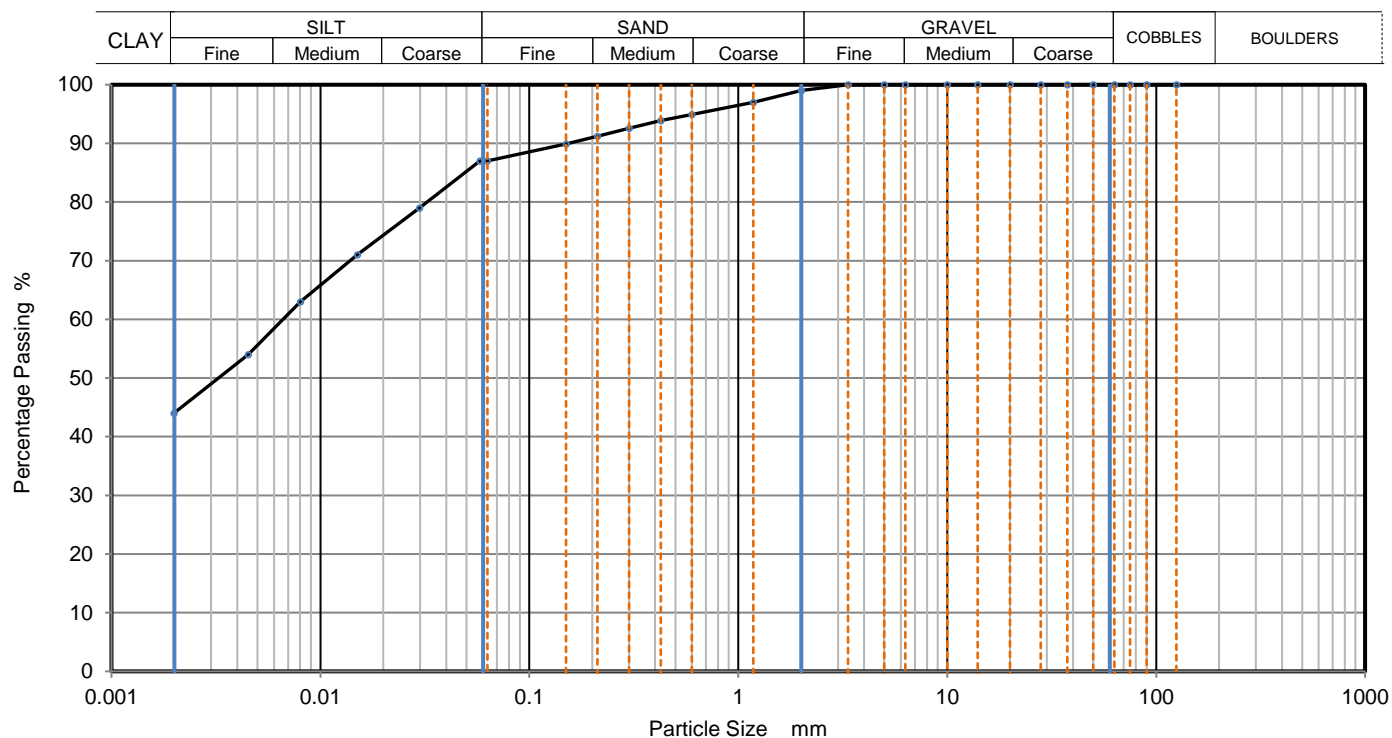
B

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) 2.90 Mg/m <sup>3</sup>	
0.425	94		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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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

3

Specimen  
Depth

m

Sample Type

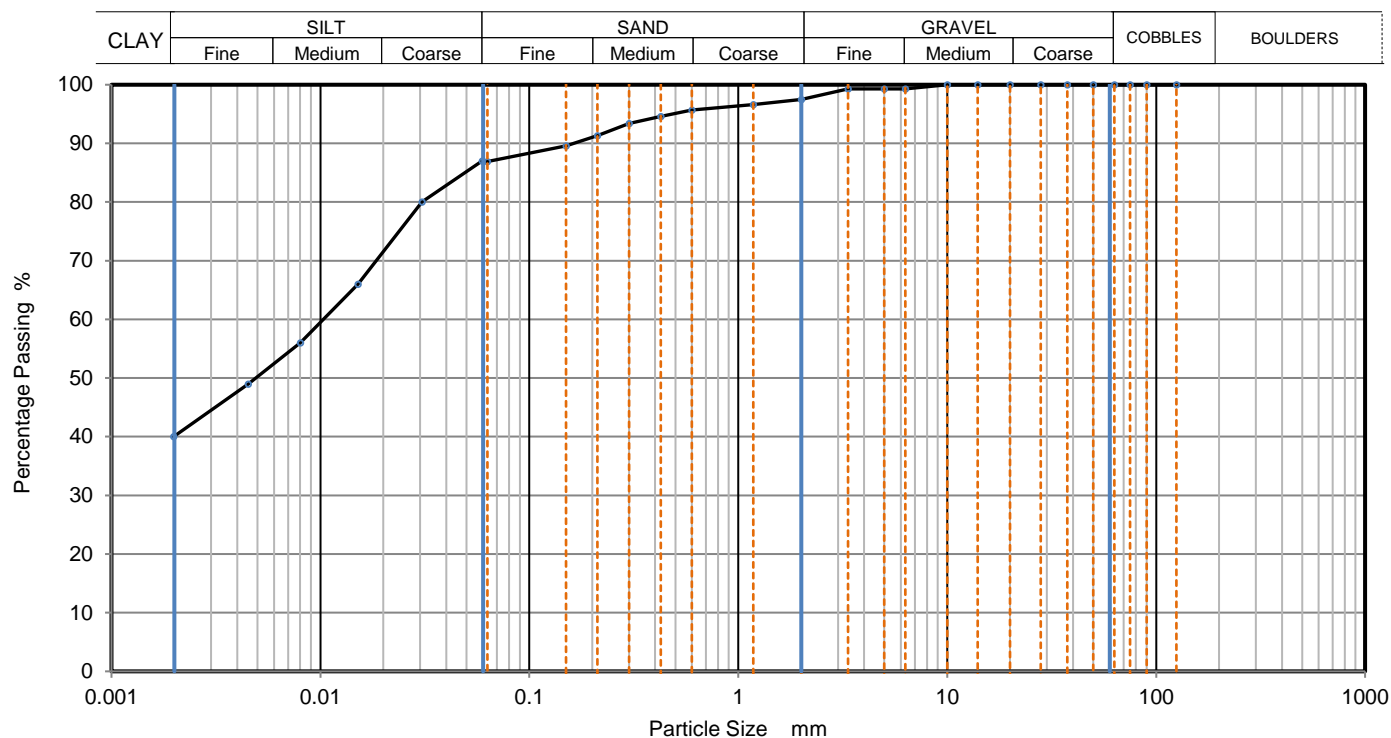
B

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) 2.90 Mg/m <sup>3</sup>	
0.425	95		
0.3	93		
0.212	91		
0.15	90		
0.063	87		

Dry Mass of sample, g

1435

Sample Proportions	% dry mass
Cobbles	0
Gravel	3
Sand	11
Silt	47
Clay	40

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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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

3

Specimen  
Depth

m

Sample Type

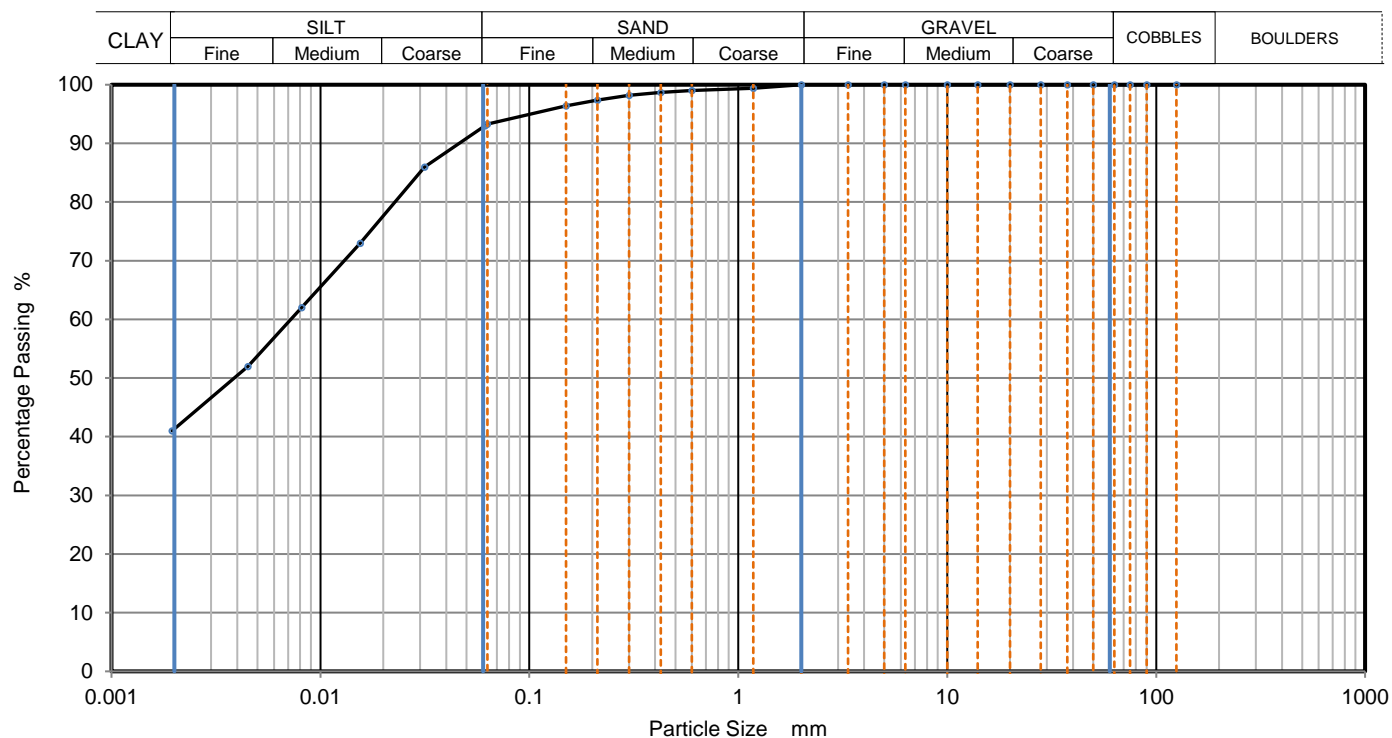
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090725



Sieving		Sedimentation	
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) 2.90 Mg/m <sup>3</sup>	
0.425	99		
0.3	98		
0.212	97		
0.15	96		
0.063	93		

Dry Mass of sample, g

1075

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	7
Silt	52
Clay	42

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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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  
Depth

m

Sample Type

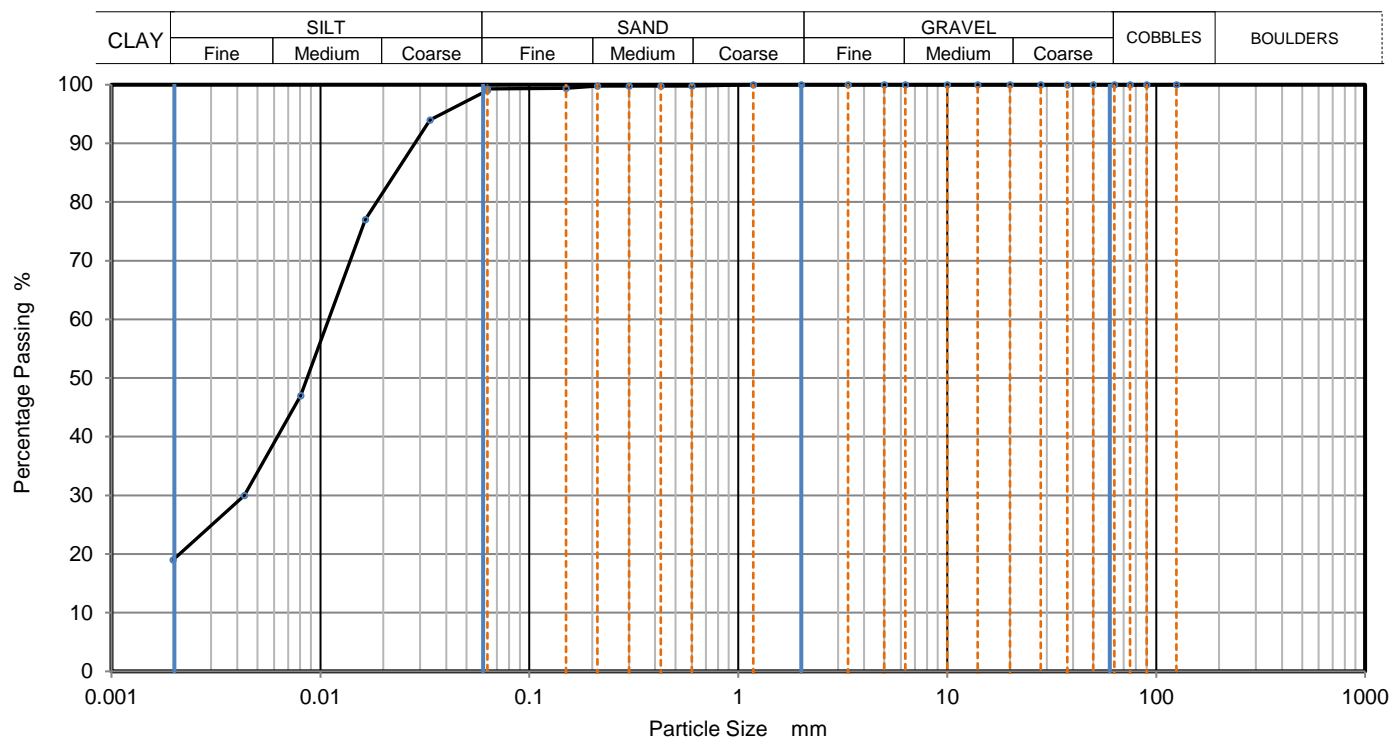
B

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) 2.90 Mg/m <sup>3</sup>	
0.425	100		
0.3	100		
0.212	100		
0.15	99		
0.063	99		

Dry Mass of sample, g

1580

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

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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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  
Depth

m

Sample Type

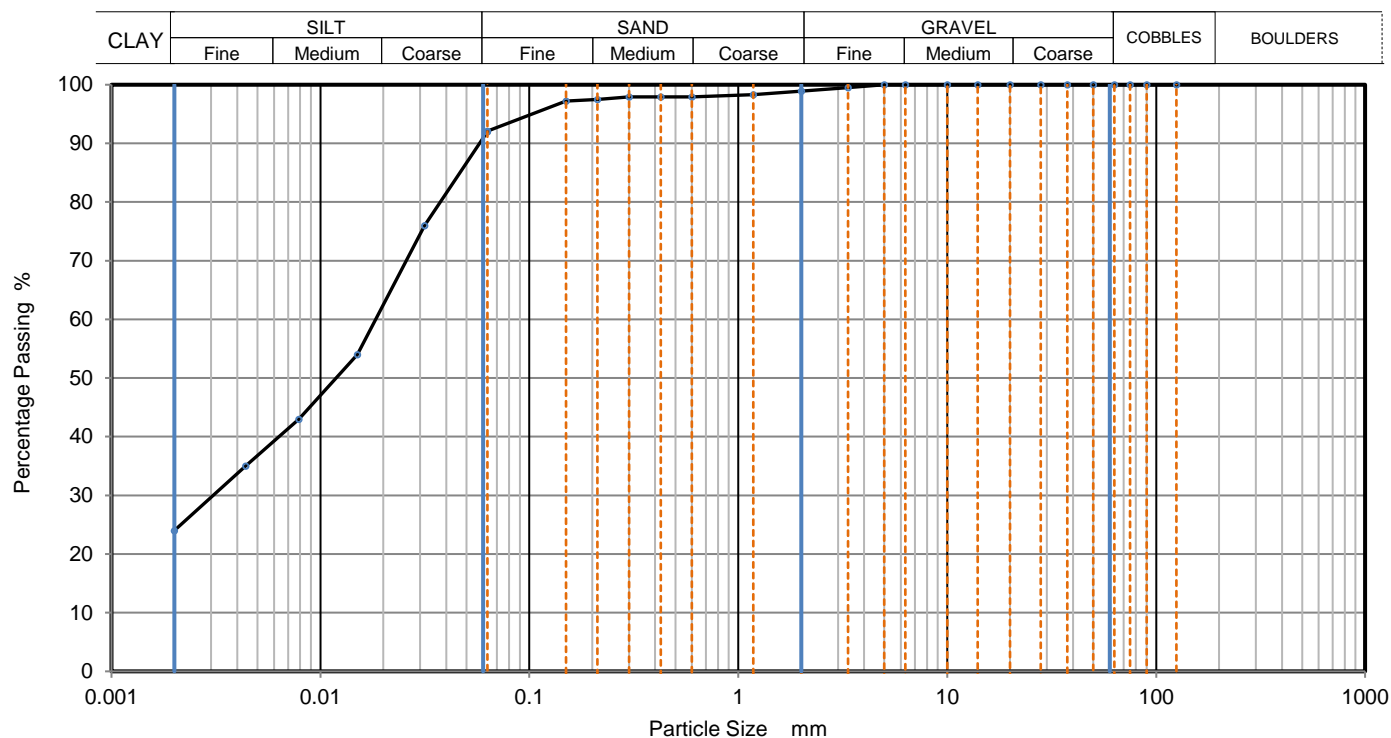
B

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) 2.90 Mg/m <sup>3</sup>	
0.425	98		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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Borehole/Pit No.

BH14

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

1

Soil Description

Black slightly gravelly subangular fine to coarse GRAVEL.

Depth, m

0.00

Specimen Reference

1

Specimen  
Depth

m

Sample Type

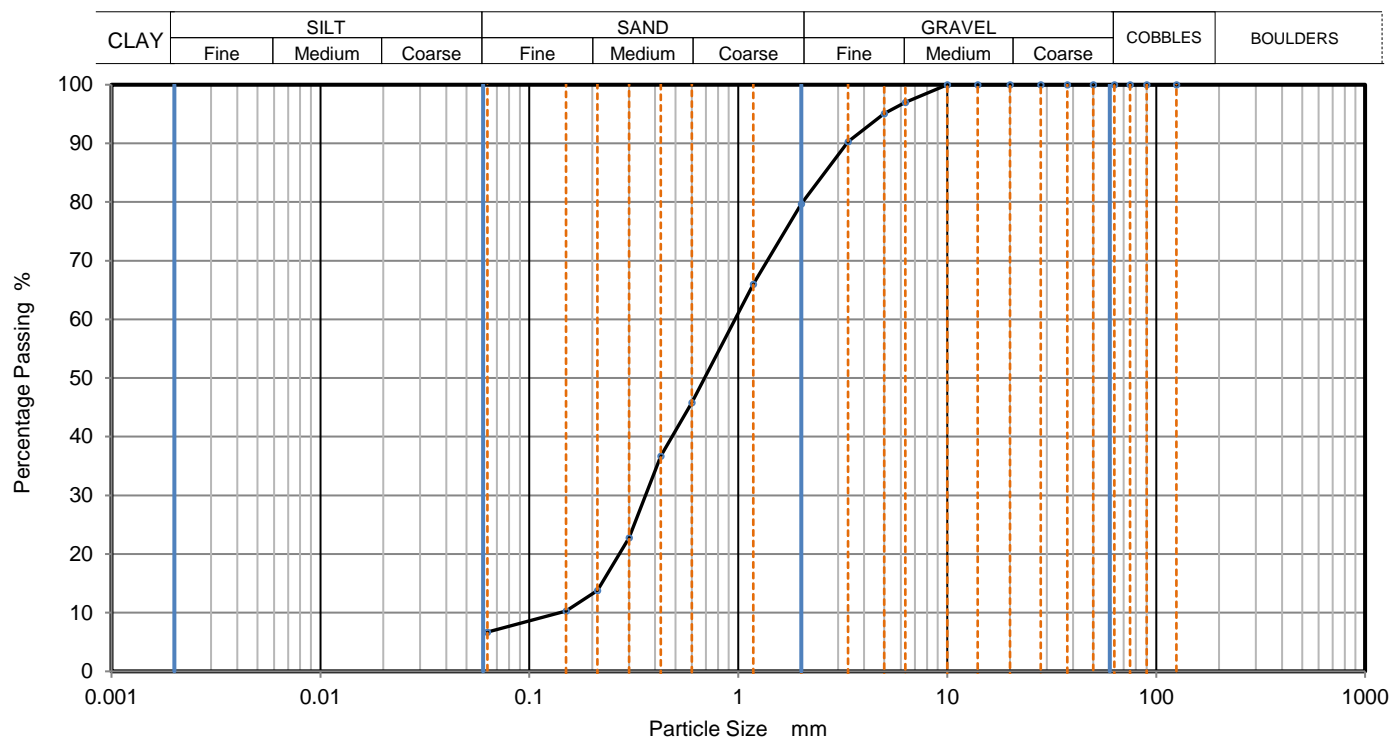
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017091222



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	6.8
Curvature Coefficient	0.95

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH14

Site Name

Arklow 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

3

Specimen  
Depth

m

Sample Type

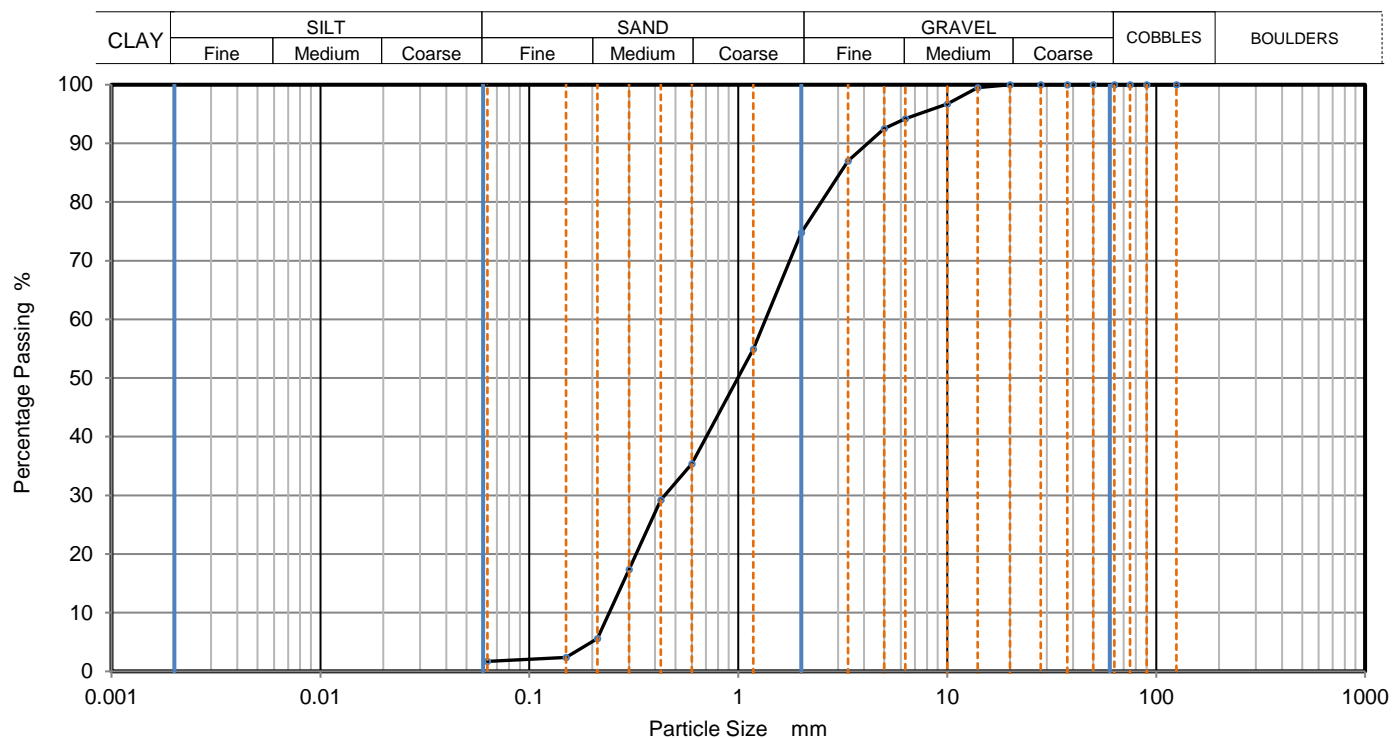
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090733



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	25
Sand	73
Fines <0.063mm	2

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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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

3

Specimen  
Depth

m

Sample Type

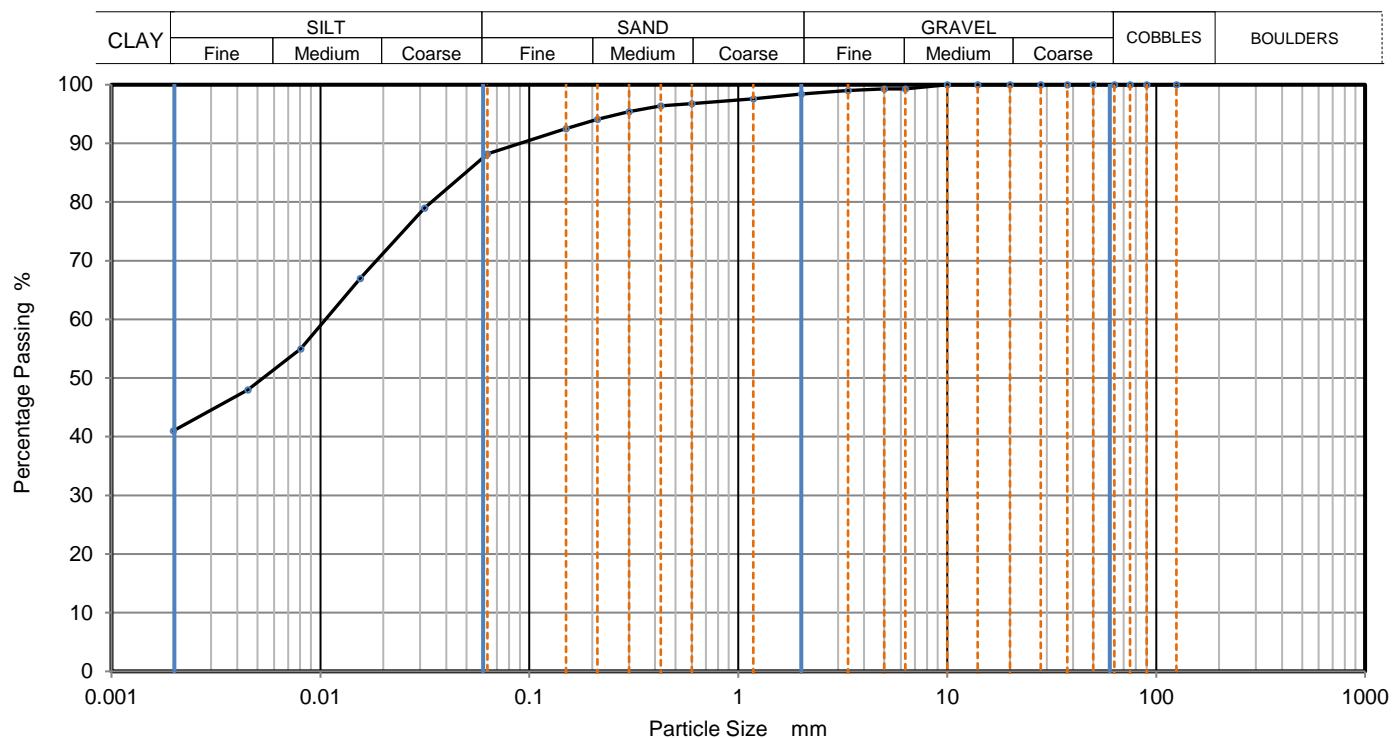
B

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) 2.90 Mg/m <sup>3</sup>	
0.425	96		
0.3	95		
0.212	94		
0.15	93		
0.063	88		

Dry Mass of sample, g

1120

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	10
Silt	48
Clay	41

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

Remarks

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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

3

Specimen  
Depth

m

Sample Type

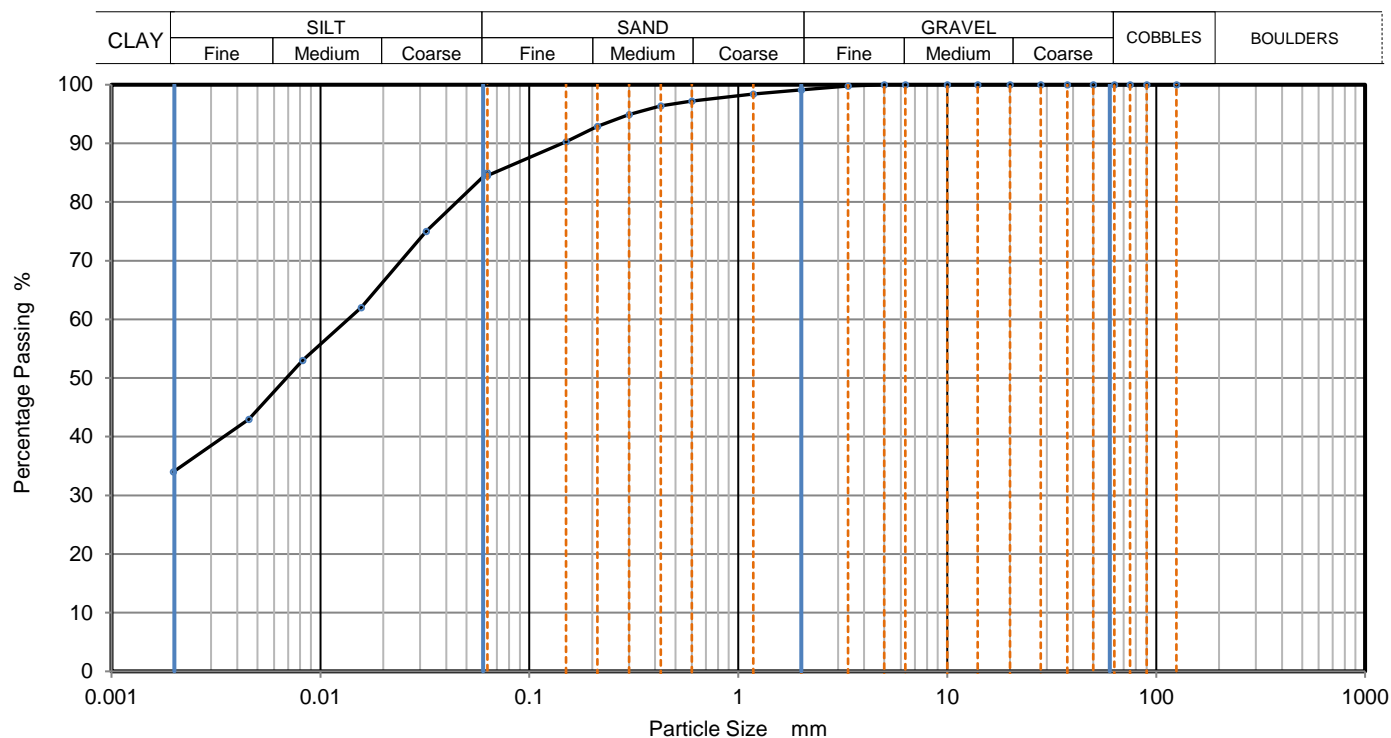
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090737



Sieving		Sedimentation	
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) 2.90 Mg/m <sup>3</sup>	
0.425	96		
0.3	95		
0.212	93		
0.15	90		
0.063	85		

Dry Mass of sample, g

1325

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	15
Silt	50
Clay	34

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

Remarks

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Job Ref

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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  
Depth

m

Sample Type

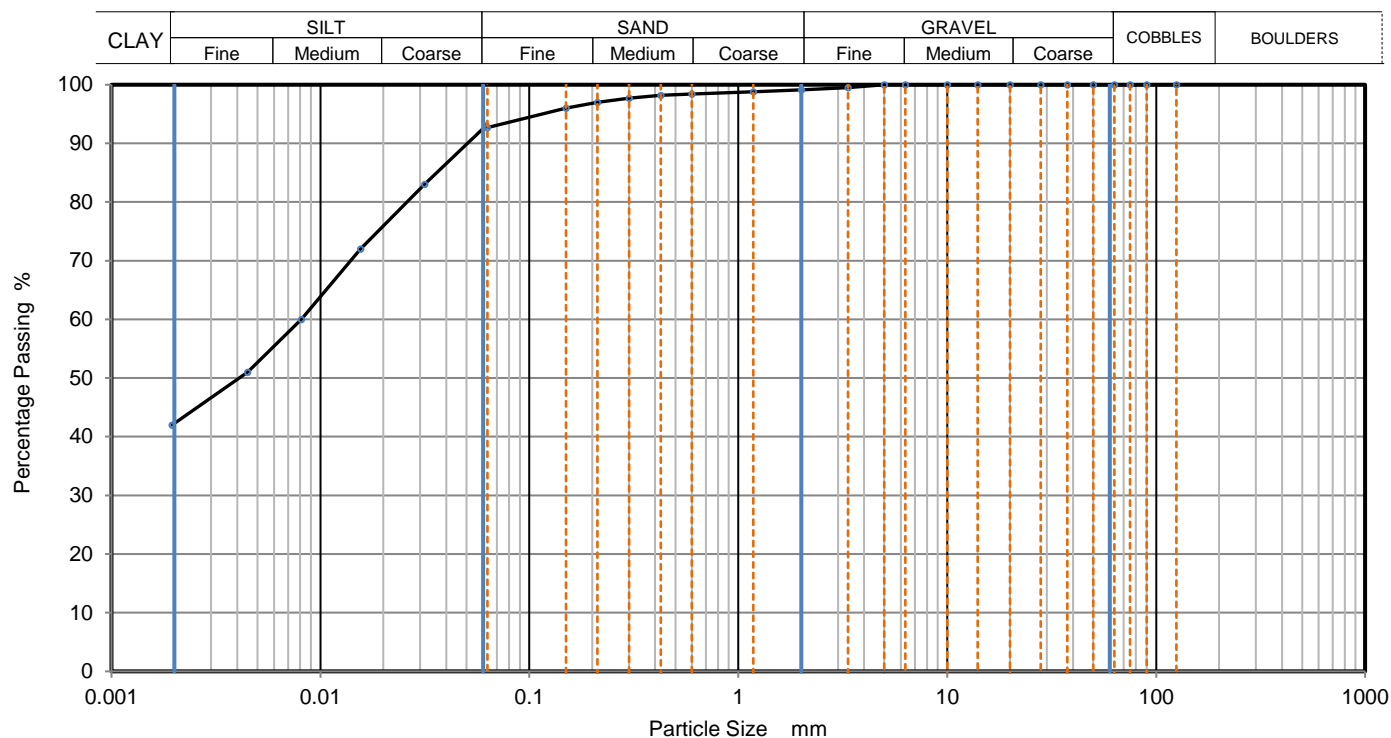
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090739



Sieving		Sedimentation	
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) 3.00 Mg/m <sup>3</sup>	
0.425	98		
0.3	98		
0.212	97		
0.15	96		
0.063	93		

Dry Mass of sample, g

1415

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	6
Silt	51
Clay	42

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

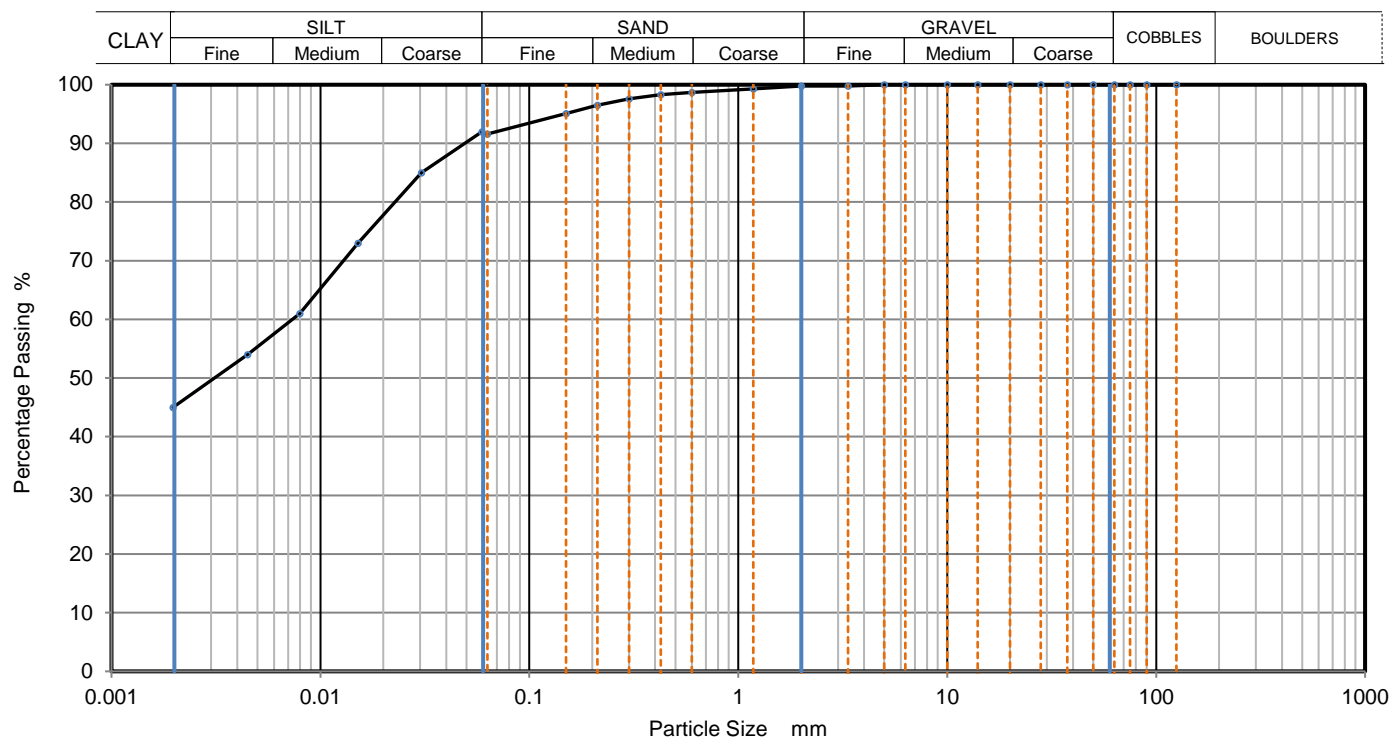
B

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) 2.90 Mg/m <sup>3</sup>	
0.425	98		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

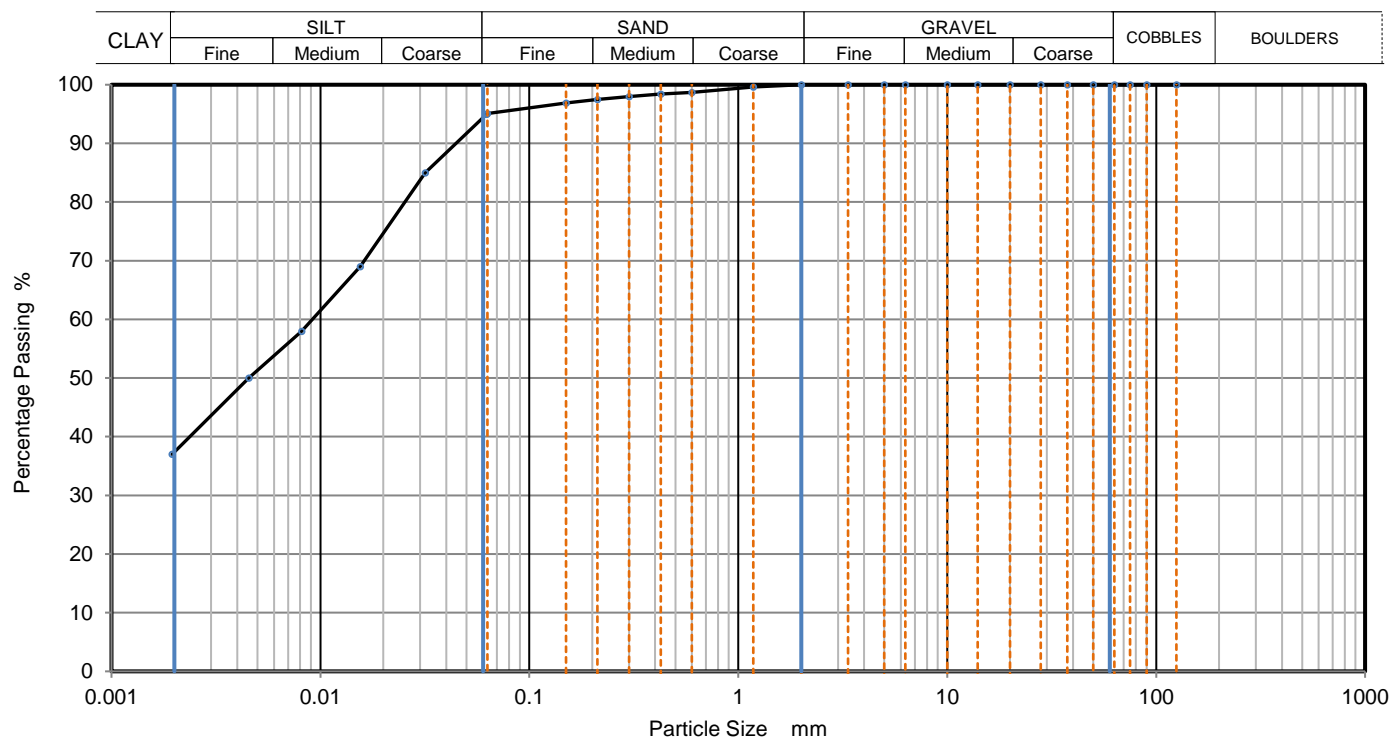
B

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) 2.90 Mg/m <sup>3</sup>	
0.425	98		
0.3	98		
0.212	98		
0.15	97		
0.063	95		

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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

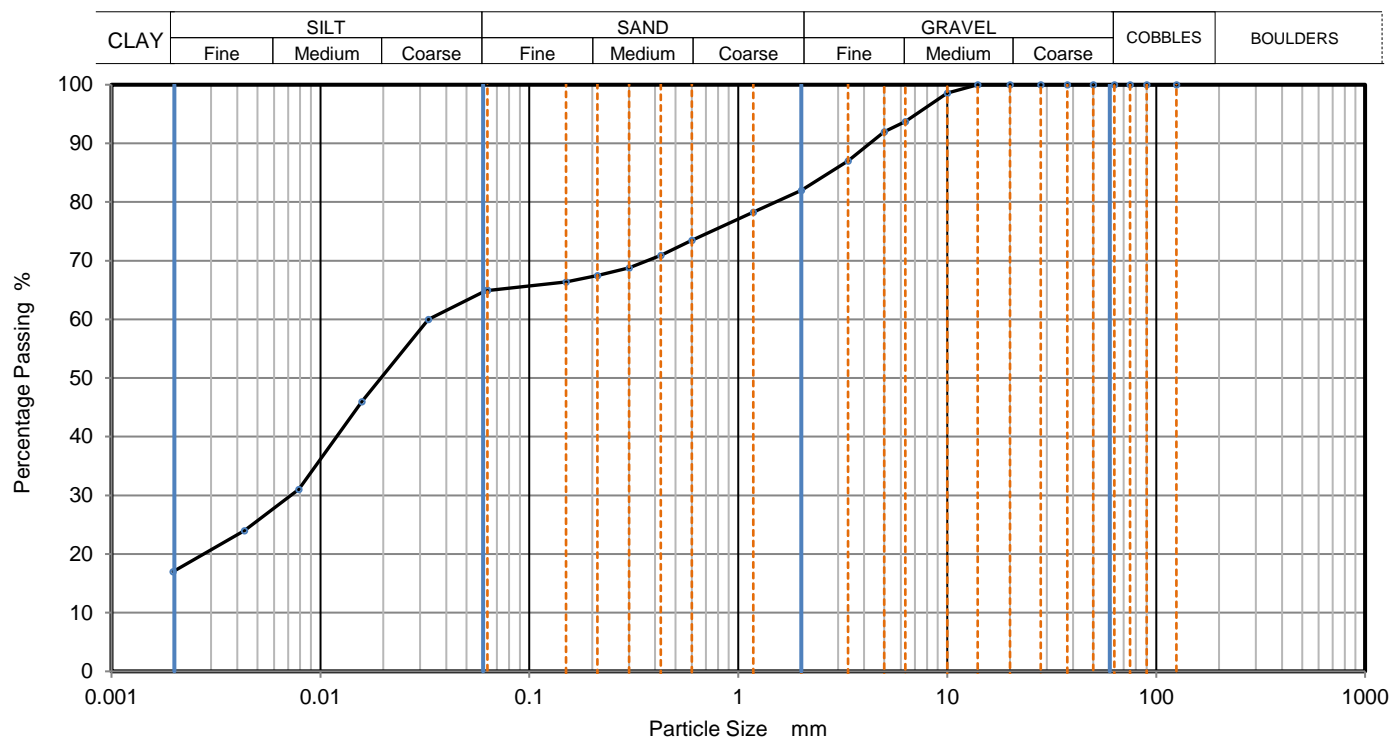
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090744



Sieving		Sedimentation	
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) 2.90 Mg/m <sup>3</sup>	
0.425	71		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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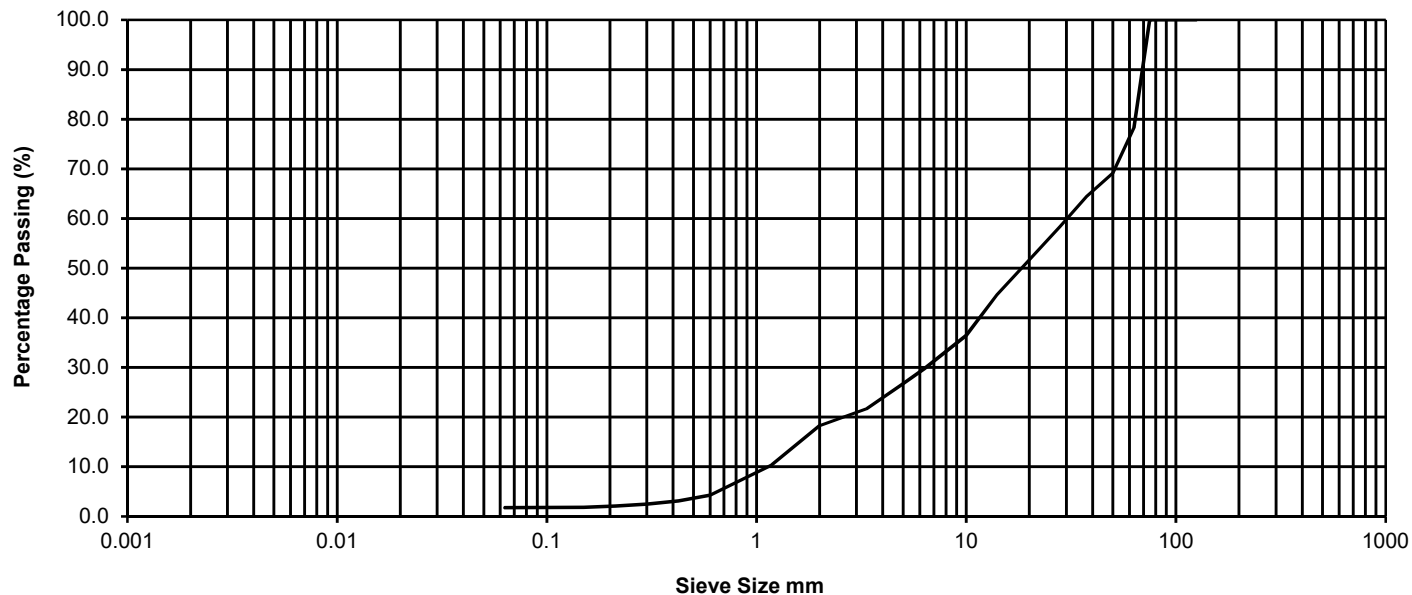
Fig 1

Sheet

# VINI Geotechnical Testing

## 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			0.0	0.0
	1.8			16.5			60.1				

Sample Description Sandy GRAVEL

Project No. 17-0167

BH/TP No. BH12

Project Arklow sewerage Scheme

Sample No.

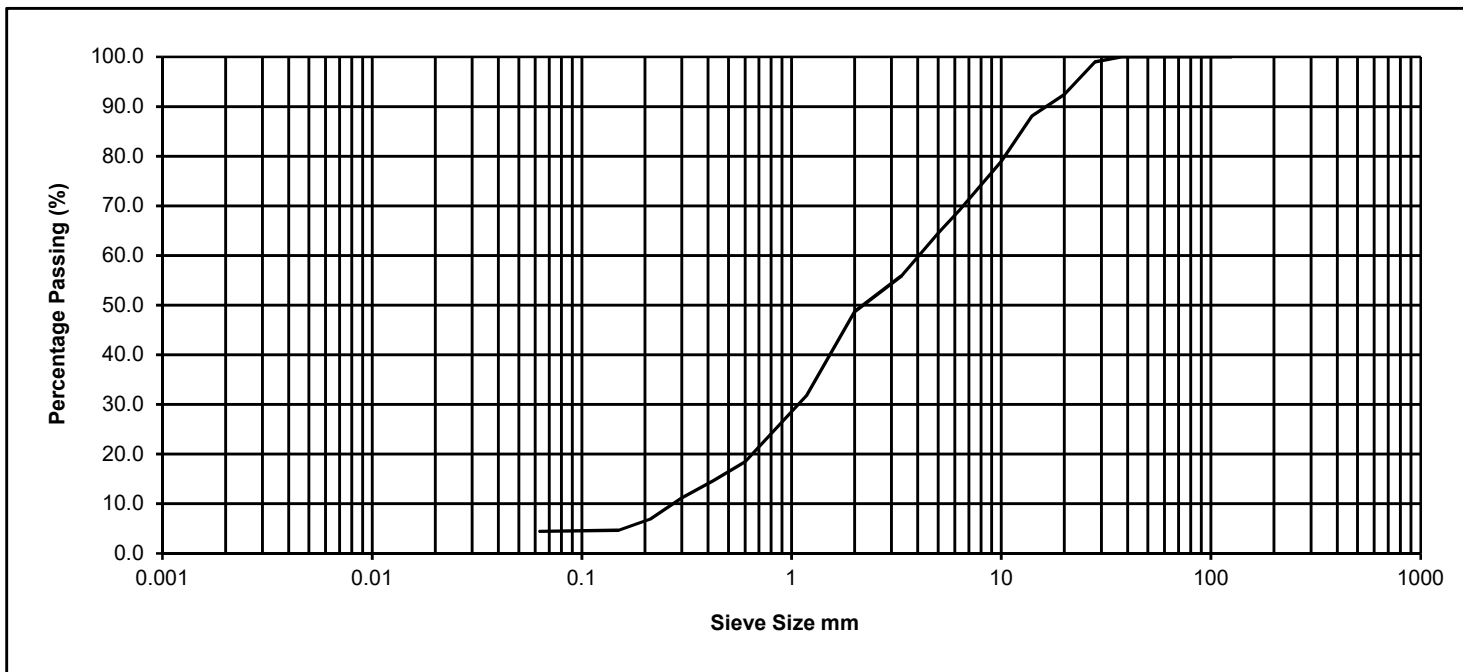
Operator	SS	Checked	VS	Approved	VS	Date sample tested	25/09/2017	Depth	1.3m
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# VINI Geotechnical Testing

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

Sample Description Sandy GRAVEL

Project No. 17-0167

BH/TP No. BH13

Project Arklow sewerage Scheme

Sample No.

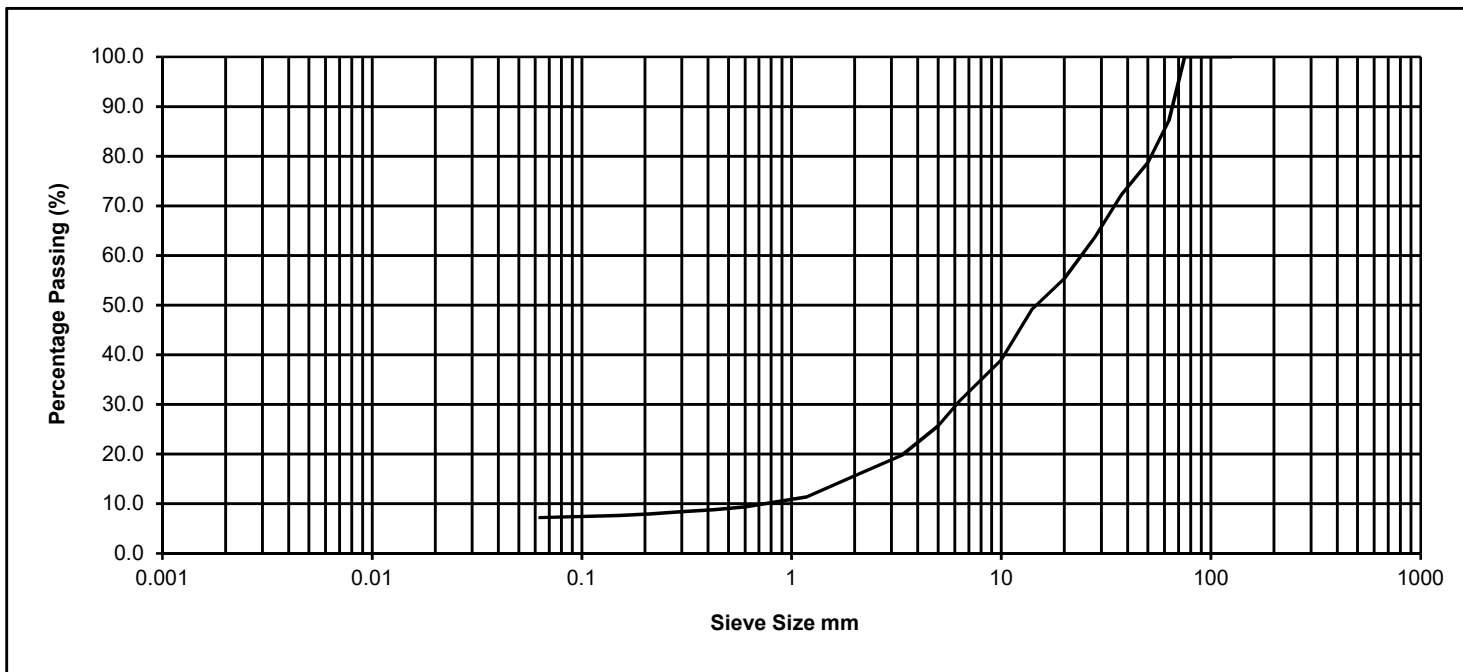
Operator	SS	Checked	VS	Approved	VS	Date sample tested	25/09/2017	Depth	1.6m
----------	----	---------	----	----------	----	--------------------	------------	-------	------

# VINI Geotechnical Testing

Sieve	%
Size mm	Passing
125.000	100.0
75.000	100.0
63.000	87.2
50.000	78.7
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
0.150	7.7
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	
	Silt			Sand			Gravel			
	7.2			8.4			71.6			

Sample Description Silty sandy GRAVEL

Project No. 17-0167

BH/TP No. BH13

Project Arklow sewerage Scheme

Sample No.

Operator

SS

Checked

VS

Approved

VS

Date sample tested

25/09/2017

Depth

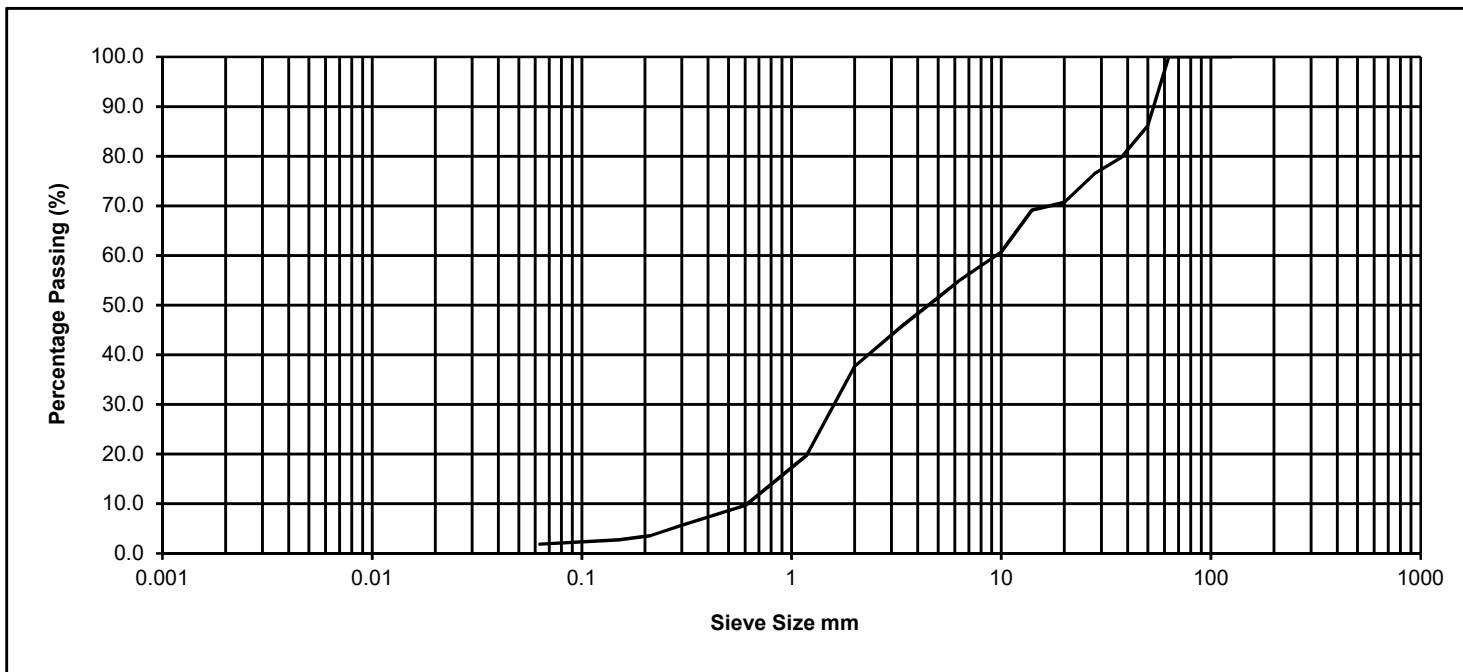
8.9m

# VINI Geotechnical Testing

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
0.150	2.7
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	
	Silt			Sand			Gravel			
	1.8			35.8			62.3			

Sample Description Sandy GRAVEL

Project No. 17-0167

BH/TP No. BH14

Project Arklow sewerage Scheme

Sample No.

Operator	SS	Checked	VS	Approved	VS	Date sample tested	25/09/2017	Depth	0.9m
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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

Borehole/Pit No. BH12

Site Name Arklow Sewerage Scheme Marine Outfall 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 : 1990, clause 8, single specimen

Date of test 19/09/2017

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

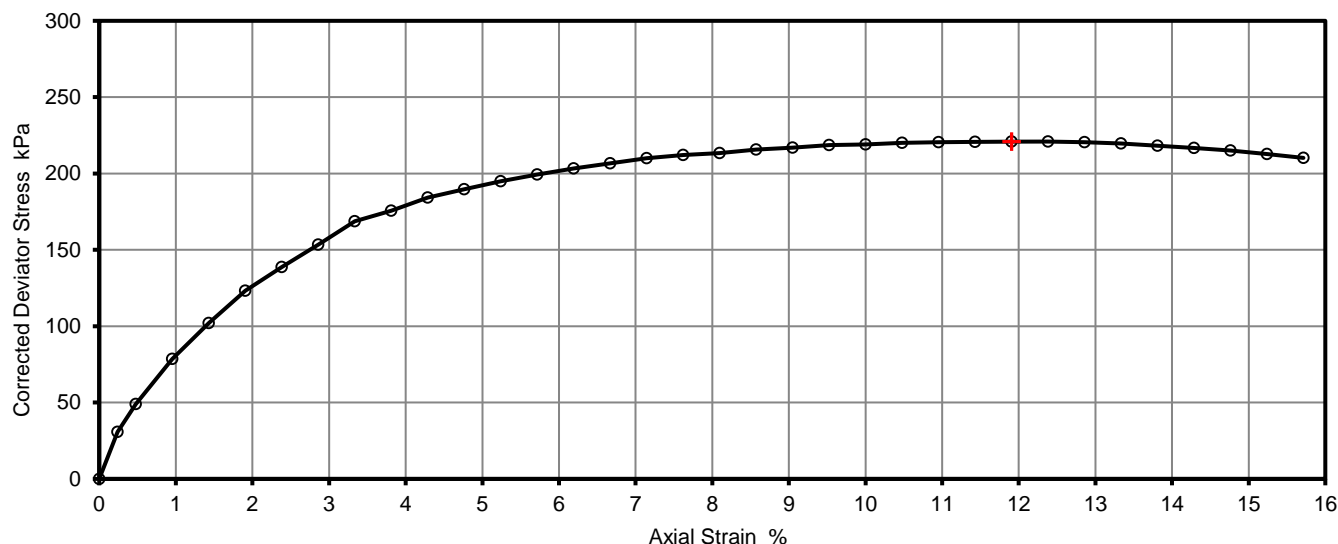
1	
210.0	mm
105.2	mm
2.02	Mg/m3
23.9	%
1.63	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

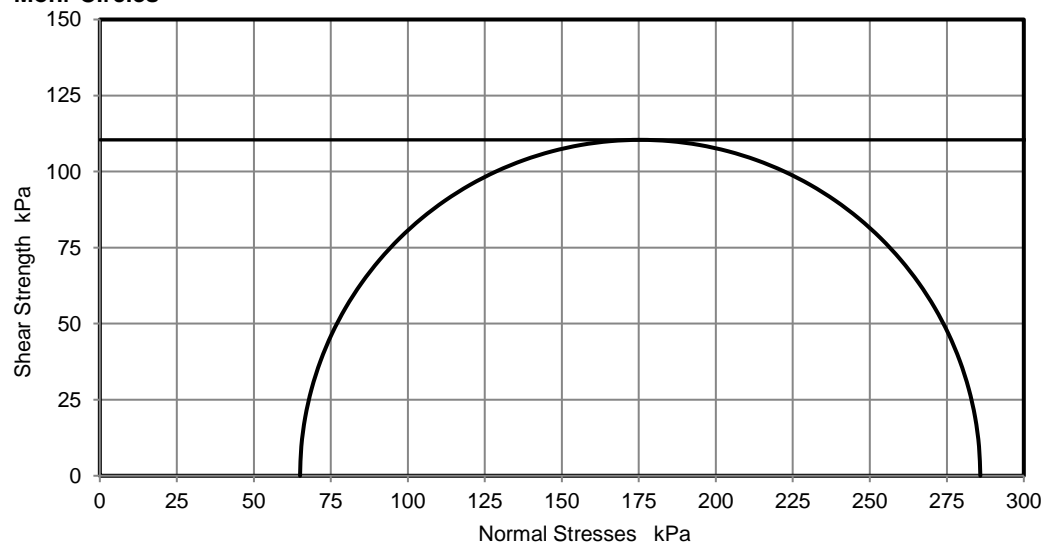
Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

2.0	%/min
65	kPa
11.9	%
221	kPa
110	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Brittle	

Deviator Stress v Axial Strain



Mohr Circles



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

Stephen.Watson

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Lab Sheet Reference :

Fig. No.

1

Sheet

1

	<b>Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen</b>			Job Ref	17-0167
				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 : 1990, clause 8, single specimen			Date of test	19/09/2017

Test Number  
 Length  
 Diameter  
 Bulk Density  
 Moisture Content  
 Dry Density

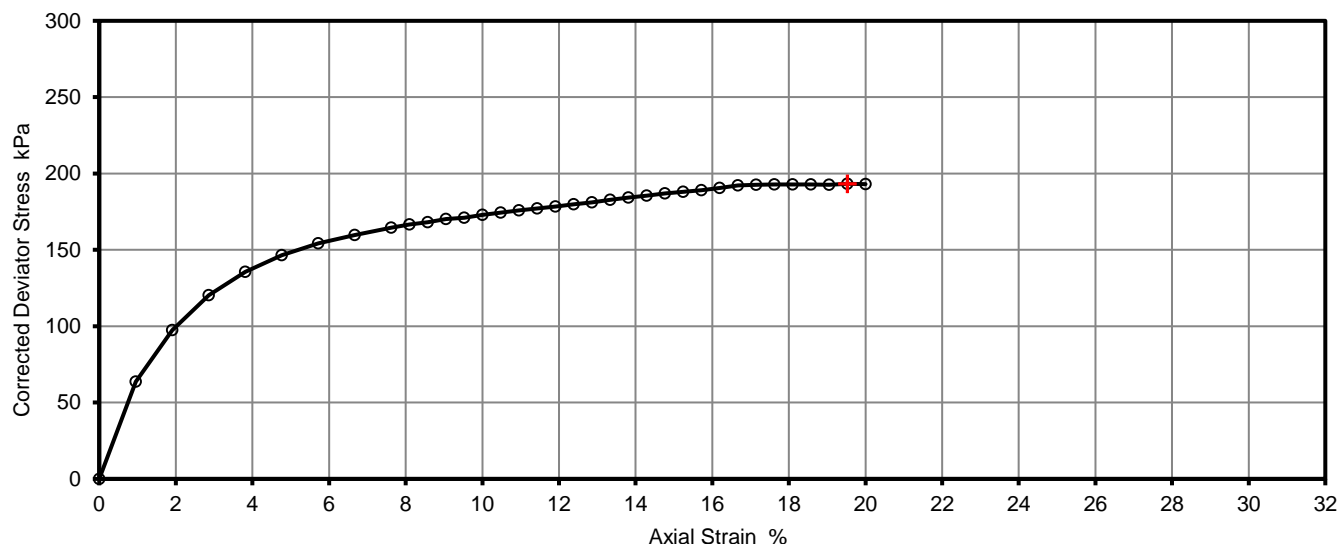
1	
210.0	mm
105.2	mm
2.01	Mg/m3
22.4	%
1.64	Mg/m3

Rate of Strain  
 Cell Pressure  
 At failure

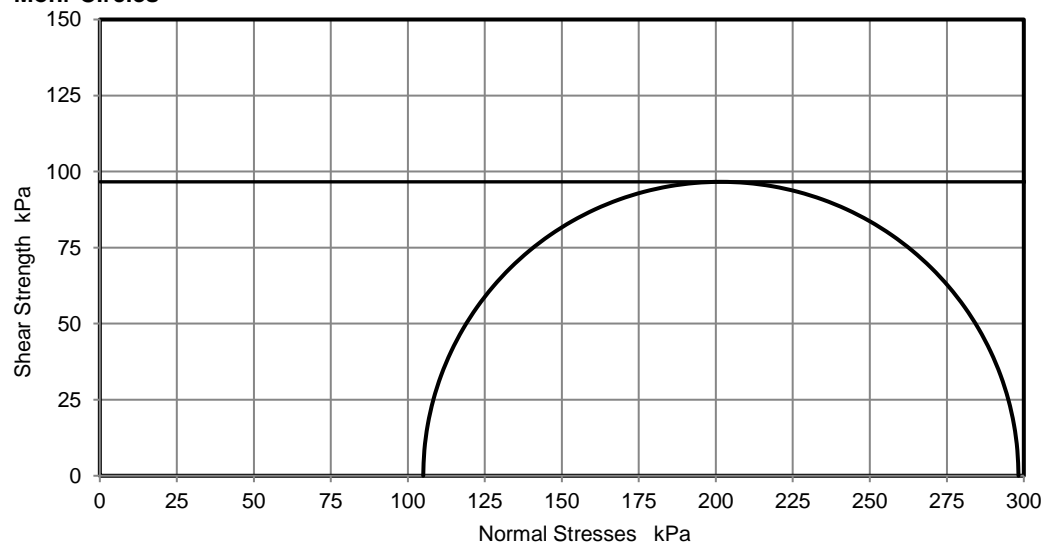
Axial Strain  
 Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
 Undrained Shear Strength,  $c_u$   
 Mode of Failure

2.0	%/min
105	kPa
19.5	%
193	kPa
97	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Brittle	

**Deviator Stress v Axial Strain**



**Mohr Circles**



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

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Lab Sheet Reference :





# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

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

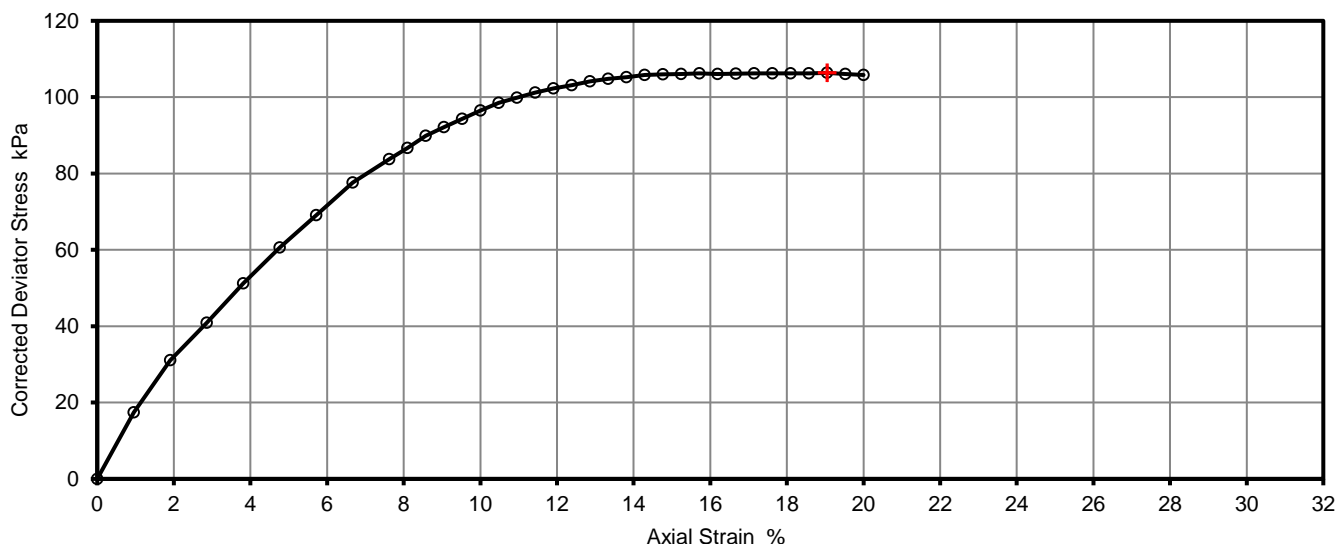
1	
210.0	mm
105.2	mm
2.03	Mg/m3
21.9	%
1.66	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

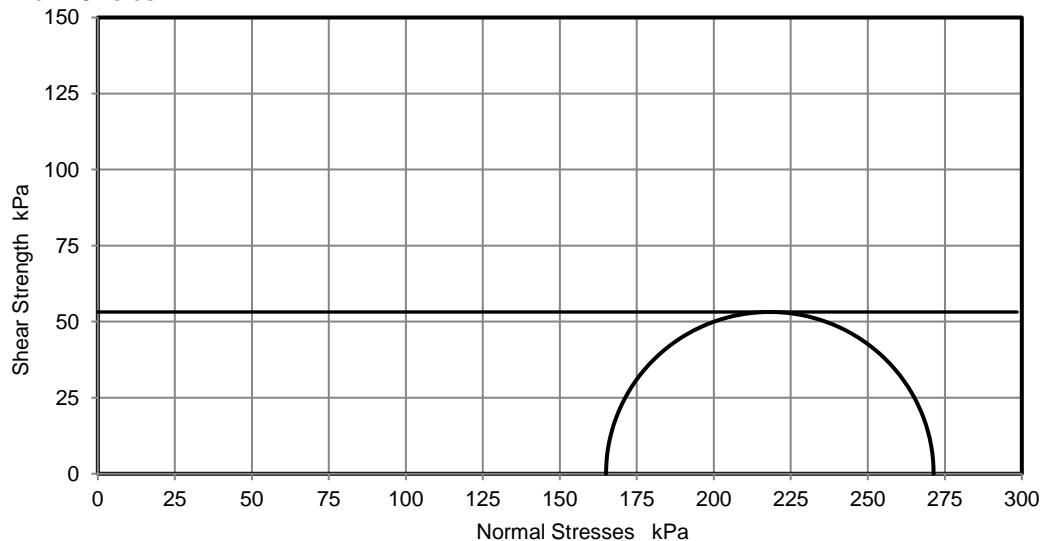
2.0	%/min
165	kPa
19.0	%
106	kPa
53	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Brittle	

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength, cu  
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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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Lab Sheet Reference :

Fig. No.

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Sheet

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH13
Sample No.	17
Depth	3.00
Sample Type	UT
KeyLAB ID	Caus2017090720
Date of test	19/09/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey slightly sandy silty CLAY.		
Specimen Reference	3	Specimen Depth	m
Specimen Description	Stiff grey slightly sandy silty CLAY.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

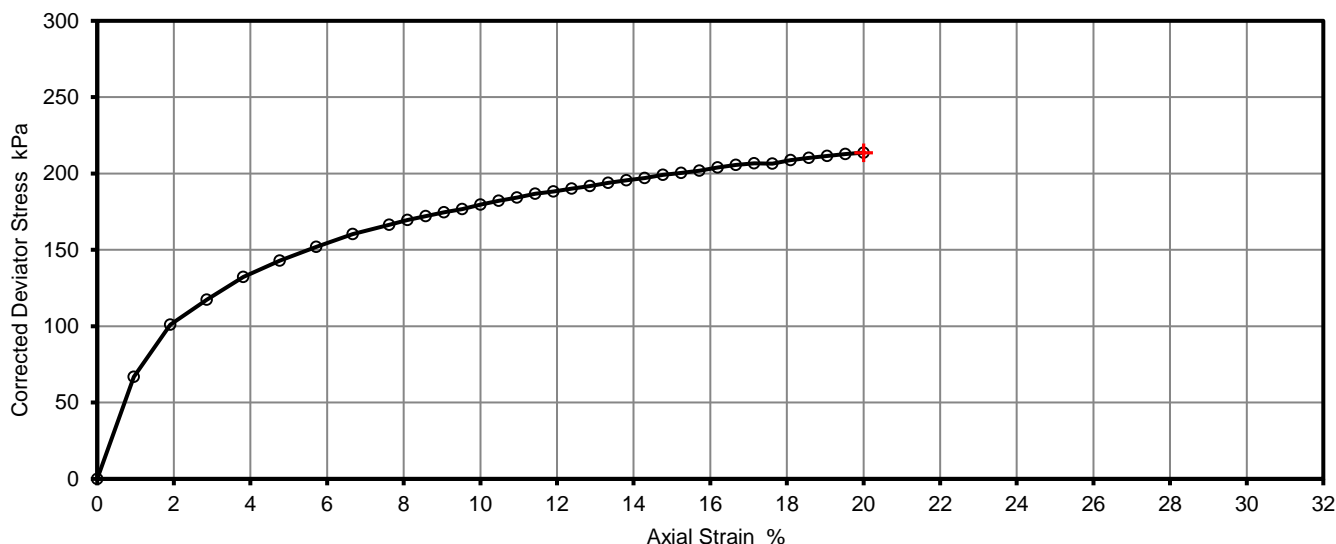
1	
210.0	mm
105.2	mm
2.07	Mg/m3
26.9	%
1.63	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

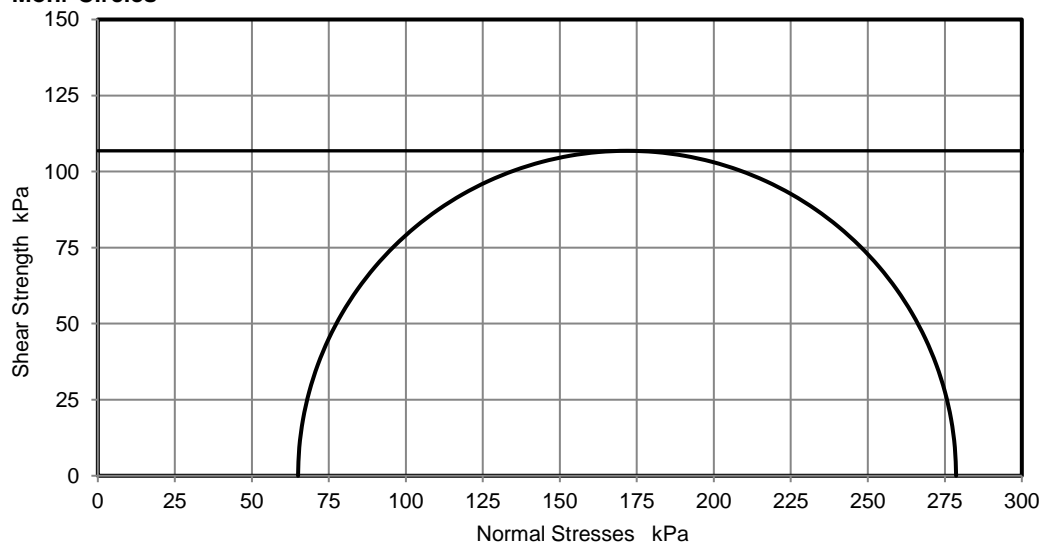
2.0	%/min
65	kPa
20.0	%
214	kPa
107	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

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Fig. No.

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

Borehole/Pit No. BH13

Site Name Arklow Sewerage Scheme Marine Outfall GI

Sample No. 18

Soil Description Grey slightly sandy silty CLAY.

Depth 5.00

Specimen Reference 3 Specimen Depth m

Sample Type UT

Specimen Description Stiff grey slightly sandy silty CLAY.

KeyLAB ID Caus2017090724

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

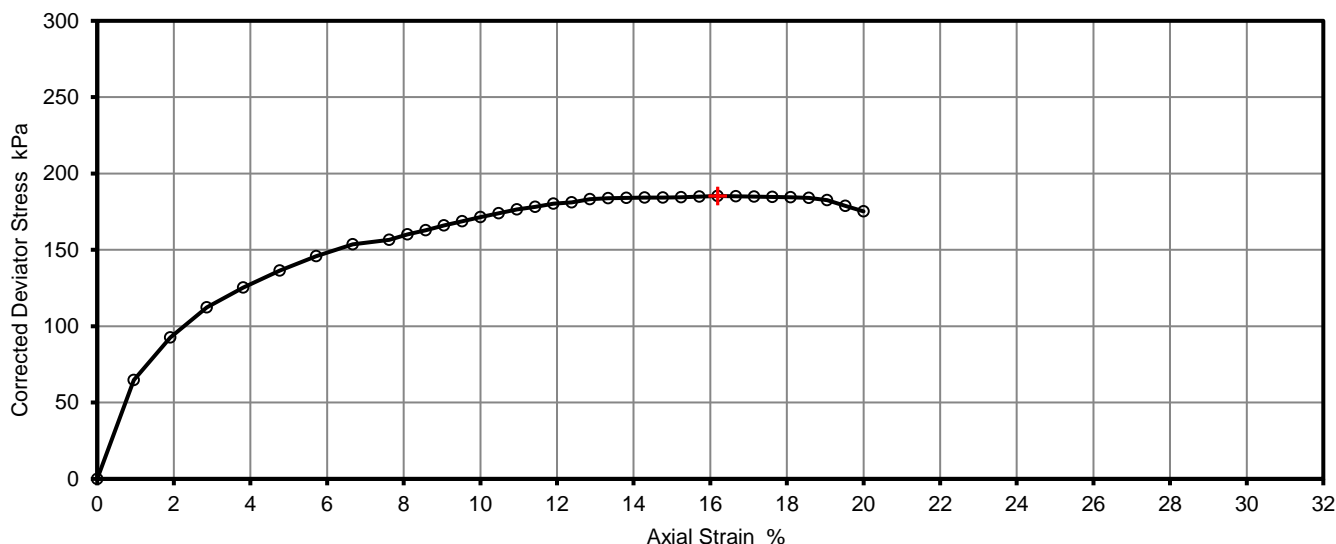
1	
210.0	mm
105.2	mm
2.01	Mg/m3
23.0	%
1.64	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

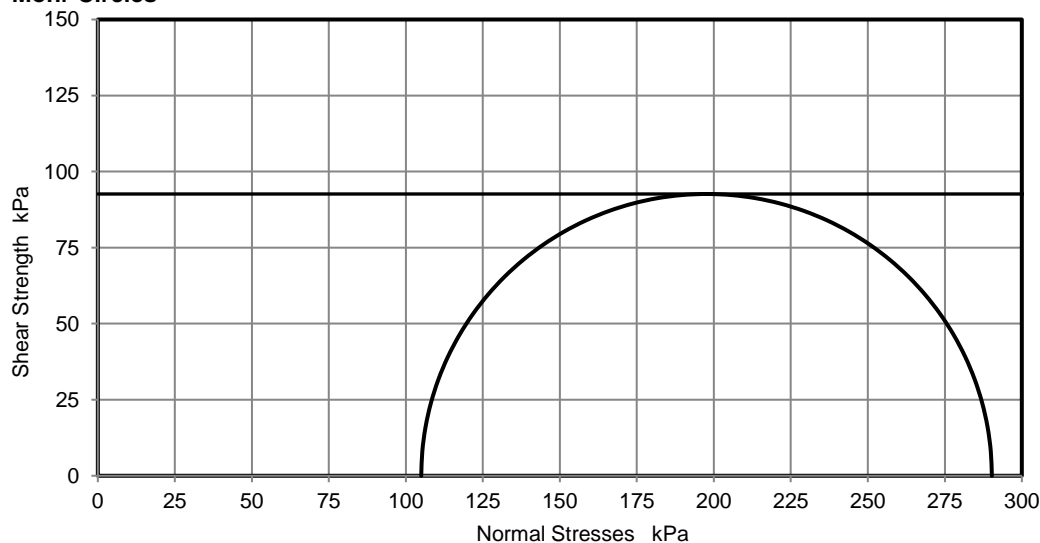
2.0	%/min
105	kPa
16.2	%
185	kPa
93	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Brittle	

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength, cu  
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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.

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

Borehole/Pit No. BH13

Site Name Arklow Sewerage Scheme Marine Outfall GI

Sample No. 19

Soil Description Grey slightly sandy 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, single specimen

Date of test 20/09/2017

Test Number

1

Length

210.0 mm

Diameter

105.2 mm

Bulk Density

2.03 Mg/m3

Moisture Content

21.8 %

Dry Density

1.67 Mg/m3

Rate of Strain

2.0 %/min

Cell Pressure

165 kPa

At failure

15.2 %

Axial Strain

152 kPa

Deviator Stress,  $(\sigma_1 - \sigma_3)_f$

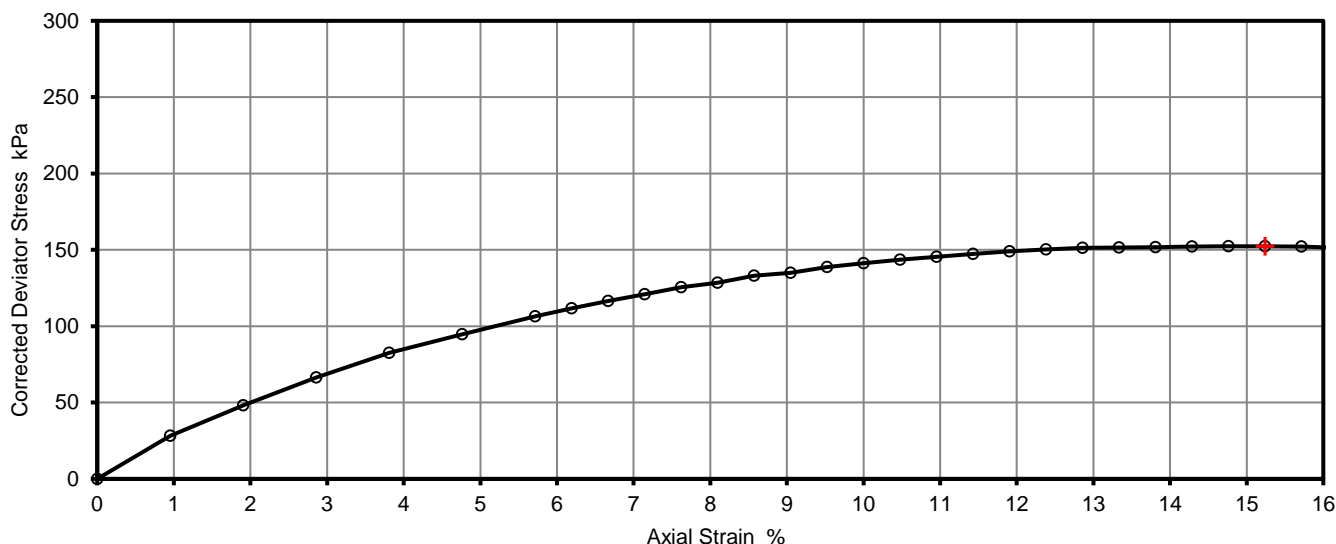
76 kPa  $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Undrained Shear Strength,  $c_u$

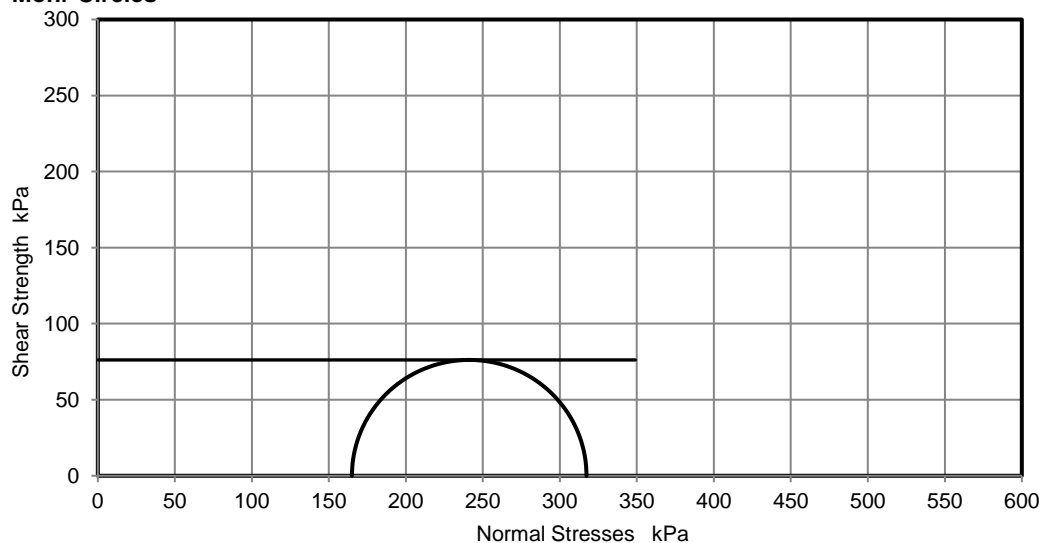
Brittle

Mode of Failure

## Deviator Stress v Axial Strain



## Mohr Circles



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.

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH14
Sample No.	17
Depth	3.00
Sample Type	UT
KeyLAB ID	Caus2017090735
Date of test	20/09/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey slightly sandy silty CLAY.		
Specimen Reference	3	Specimen Depth	m
Specimen Description	Stiff grey slightly sandy silty CLAY.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

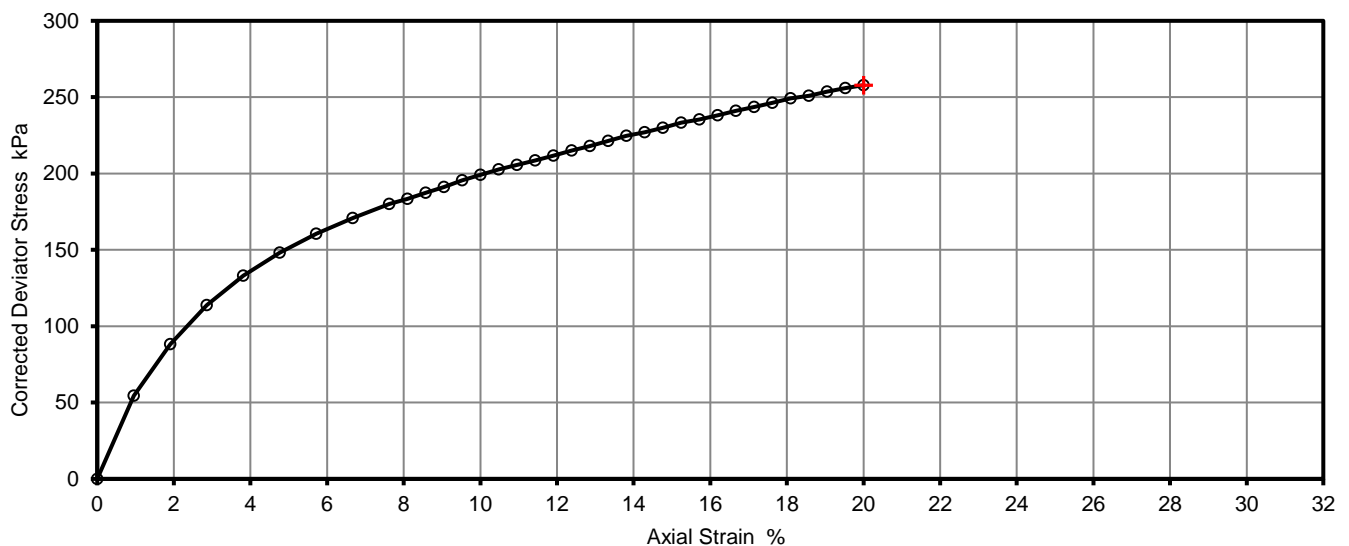
1	
210.0	mm
105.2	mm
2.05	Mg/m3
23.4	%
1.66	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

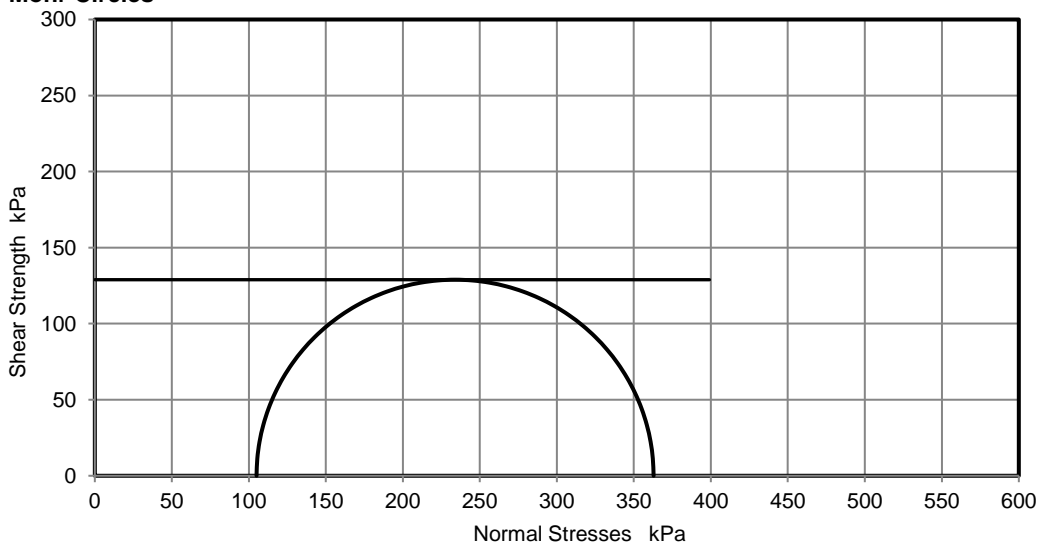
Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

2.0	%/min
105	kPa
20.0	%
258	kPa
129	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

Stephen.Watson

## Printed

22/09/2017 14:55

Lab Sheet Reference :

Fig. No.

1

Sheet

7



# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH14
Sample No.	18
Depth	5.00
Sample Type	UT
KeyLAB ID	Caus2017090740
Date of test	20/09/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey slightly sandy silty CLAY.		
Specimen Reference	3	Specimen Depth	m
Specimen Description	Stiff grey slightly sandy silty CLAY.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

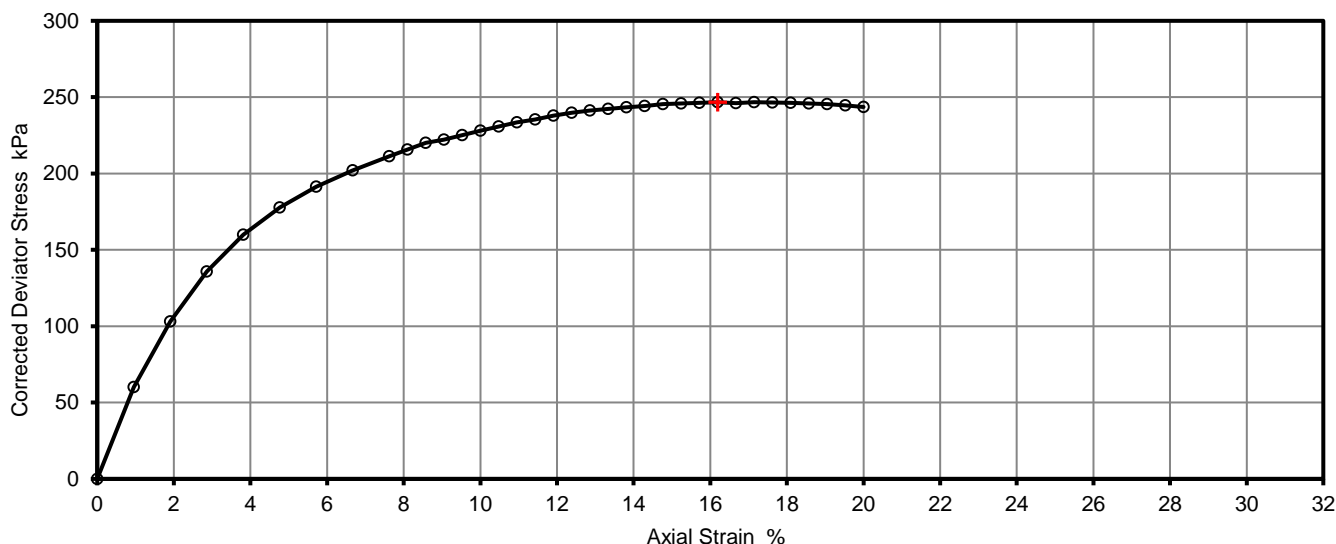
1	
210.0	mm
105.2	mm
2.00	Mg/m <sup>3</sup>
23.5	%
1.62	Mg/m <sup>3</sup>

Rate of Strain  
Cell Pressure  
At failure

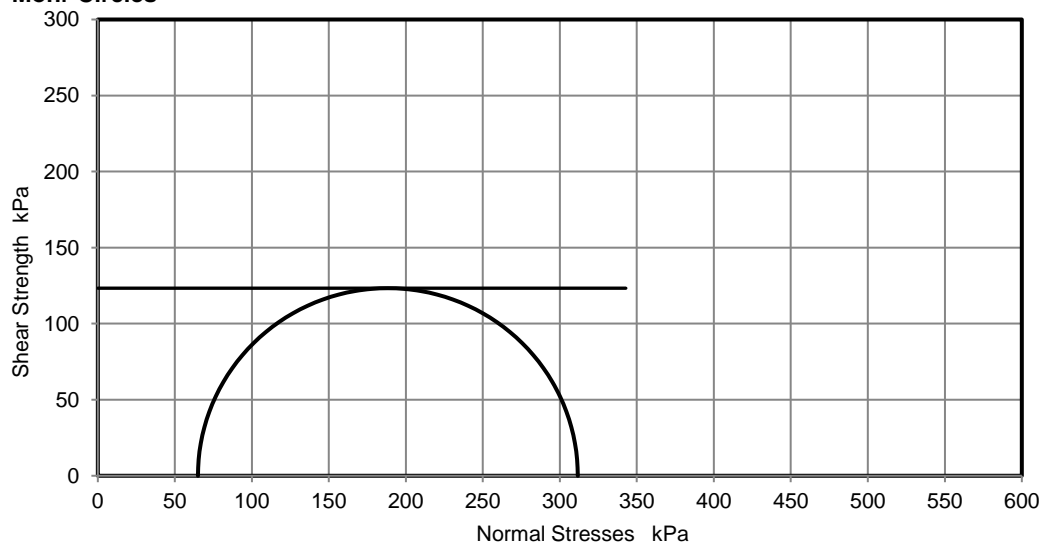
2.0	%/min
65	kPa
16.2	%
247	kPa
123	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Brittle	

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Stephen.Watson

## Printed

22/09/2017 14:55

Lab Sheet Reference :

Fig. No.

1

Sheet

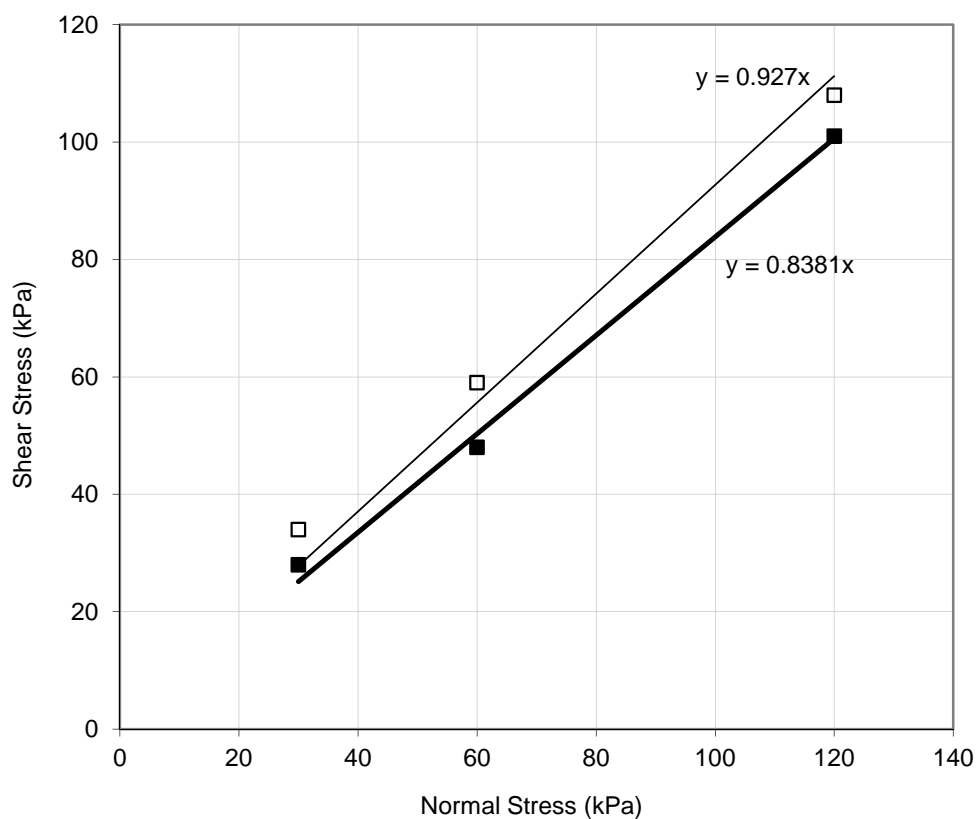
8

<b>QUB</b>	<b>Geotechnical Testing Laboratory</b>
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## Arklow Sewerage Scheme

Ref:	17-0167	Size mm	100	Initial wet mass g	674
BH	BH12	Thickness mm	35.25	Bulk Density mg/m3	1912
Depth m	1.3m				
Our Ref	Q			$\sigma'_v$ kPa	
Soil type	Sandy GRAVEL				
Rate of shearing mm/min	0.5		30		
>10 mm removed			60		
			120		
Peak		Ultimate			
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ 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

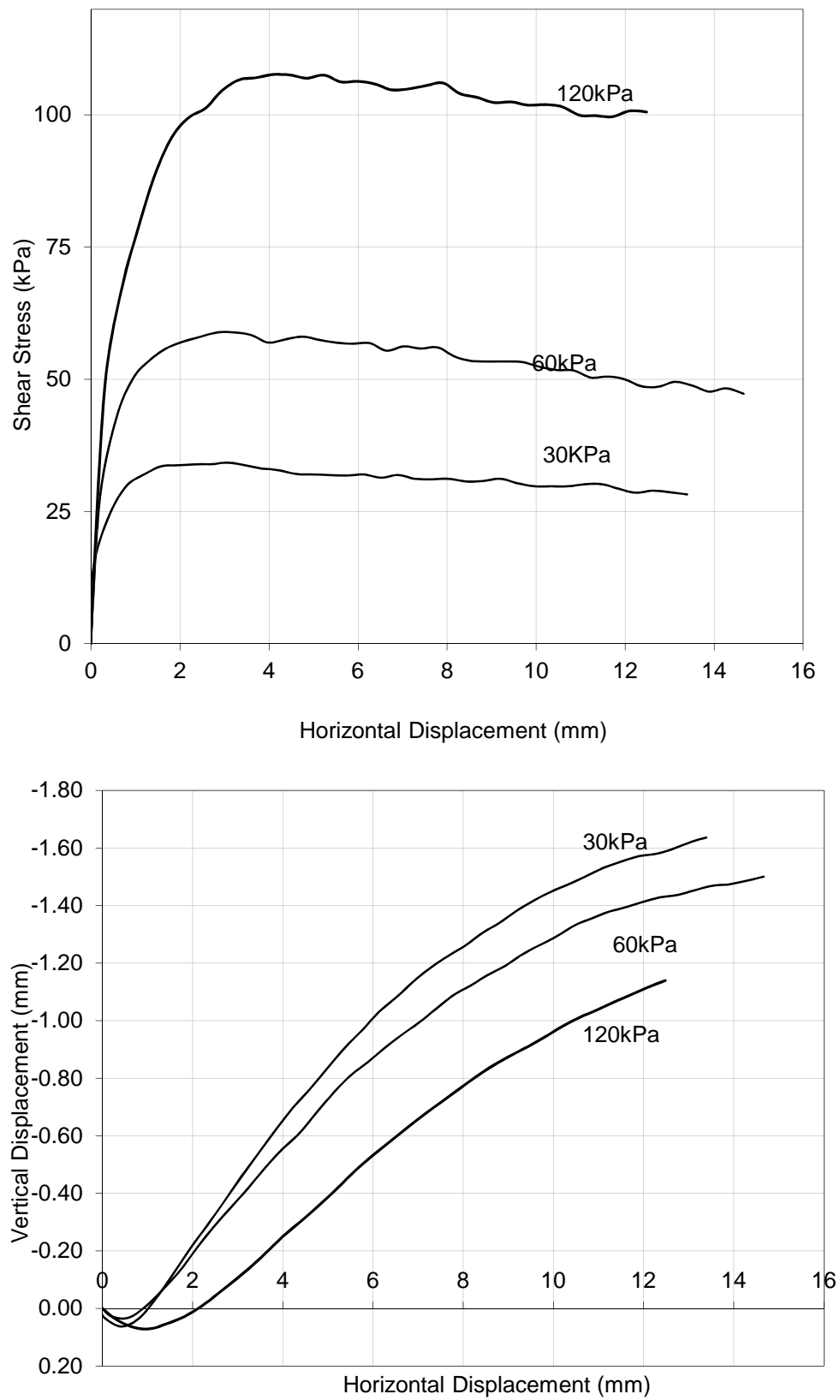


Figure 2 Stress-strain behaviour



<b>QUB</b>	<b>Geotechnical Testing Laboratory</b>
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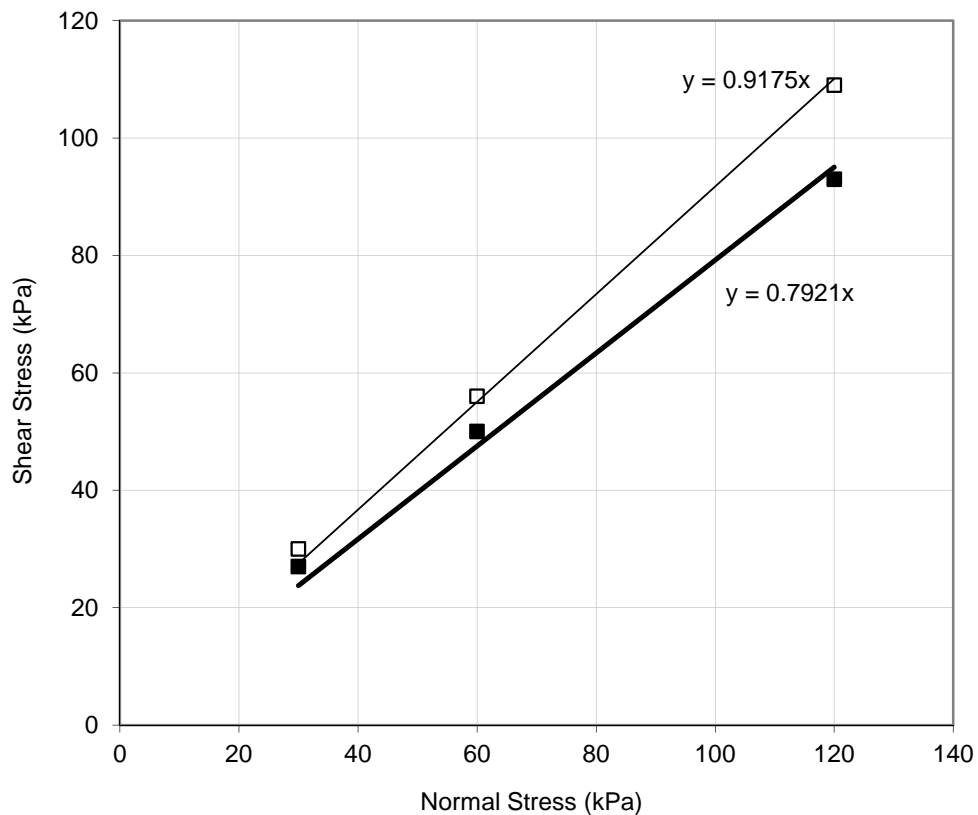
### Arklow Sewerage Scheme

Ref:	17-0167	Size mm	100	Initial wet mass g	712
BH	BH13	Thickness mm	35.25	Bulk Density mg/m3	2020

Depth m	1.3m		
Our Ref	R		$\sigma'_v$ kPa
Soil type	Sandy GRAVEL		
Rate of shearing mm/min		0.5	30
>10 mm removed			60
			120

Peak		Ultimate	
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ kPa
30	30	30	27
60	56	60	50
120	109	120	93

Peak angle of internal friction **42**  
Cohesion kPa  
Ultimate angle of internal friction **38**



**Figure 1 Failure Envelope**

## Arklow Sewerage Scheme

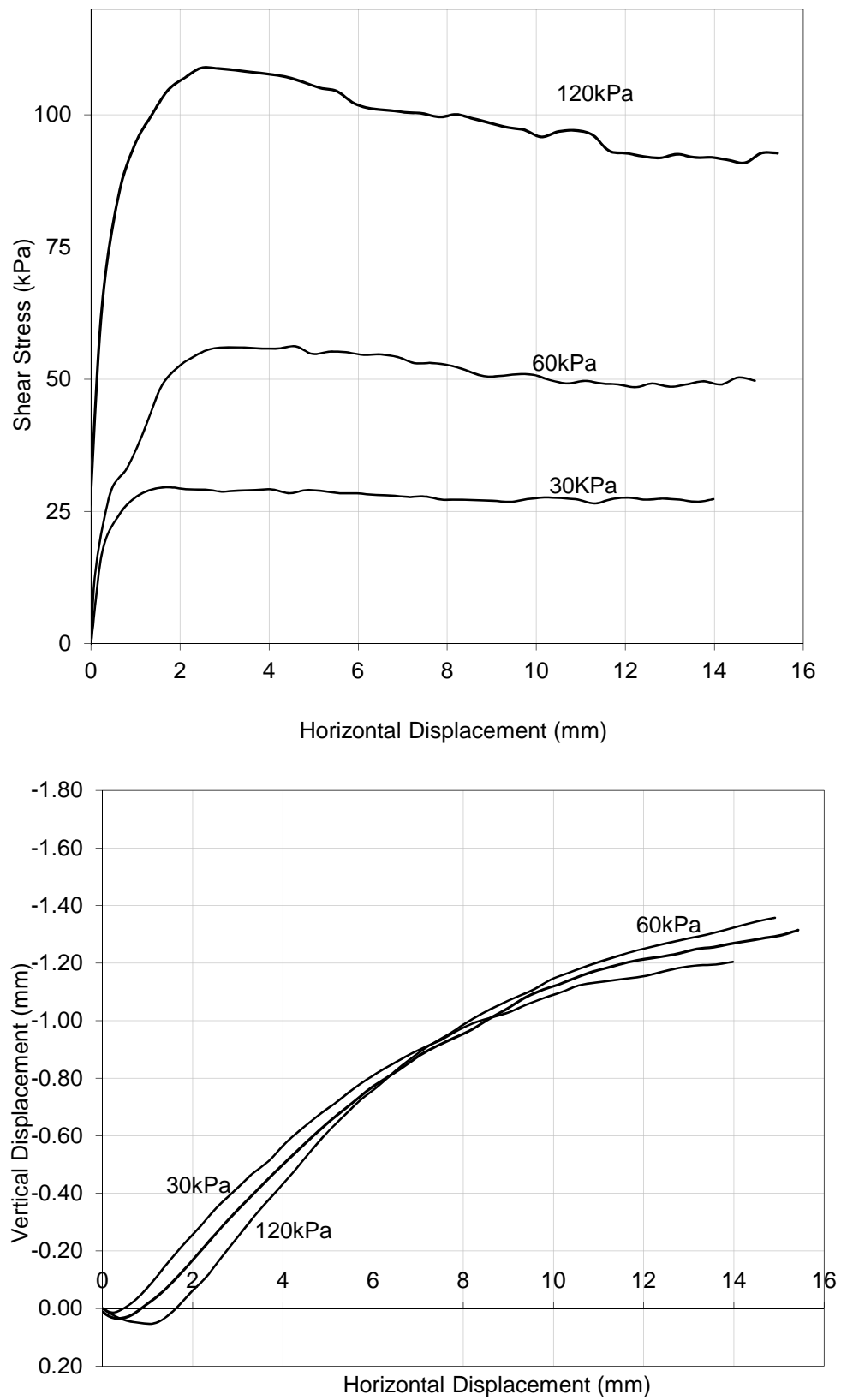


Figure 2 Stress-strain behaviour

QUB	Geotechnical Testing Laboratory
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## 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		$\sigma'_v$ kPa
Soil type	Sandy GRAVEL		
Rate of shearing mm/min	0.5	40	
>10 mm removed		80	
		160	

Peak		Ultimate	
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ kPa
40		40	39
80		80	81
160		160	154

Peak angle of internal friction

Cohesion kPa

Ultimate angle of internal friction

44

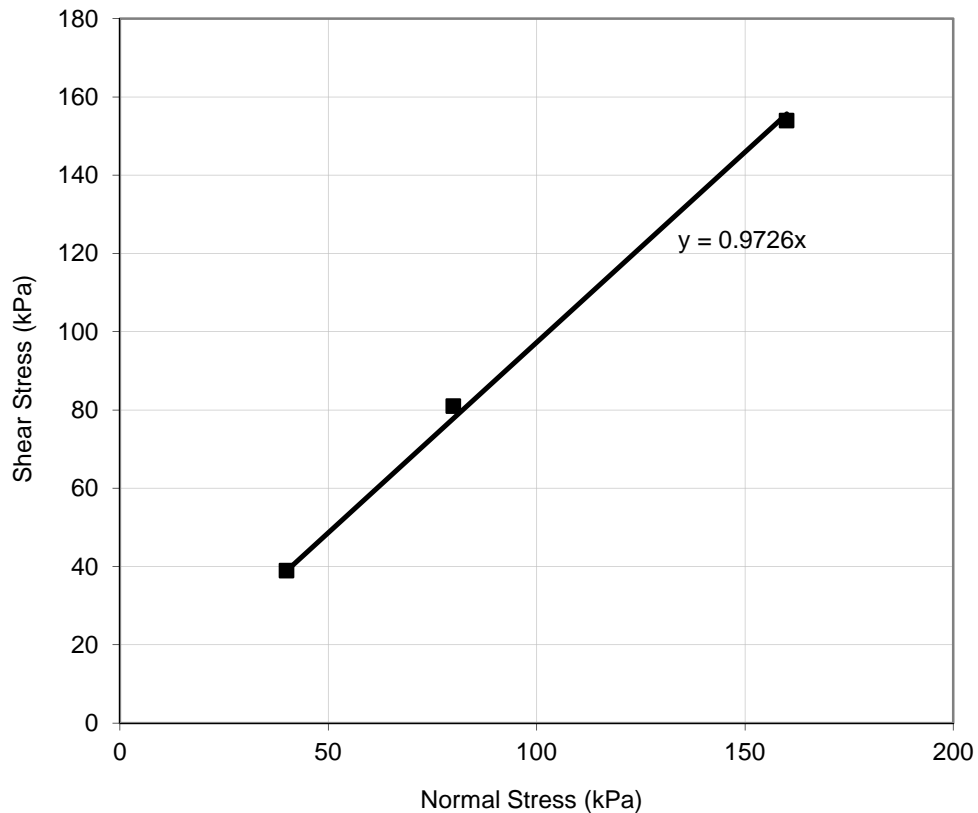


Figure 1 Failure Envelope

## Arklow Sewerage Scheme

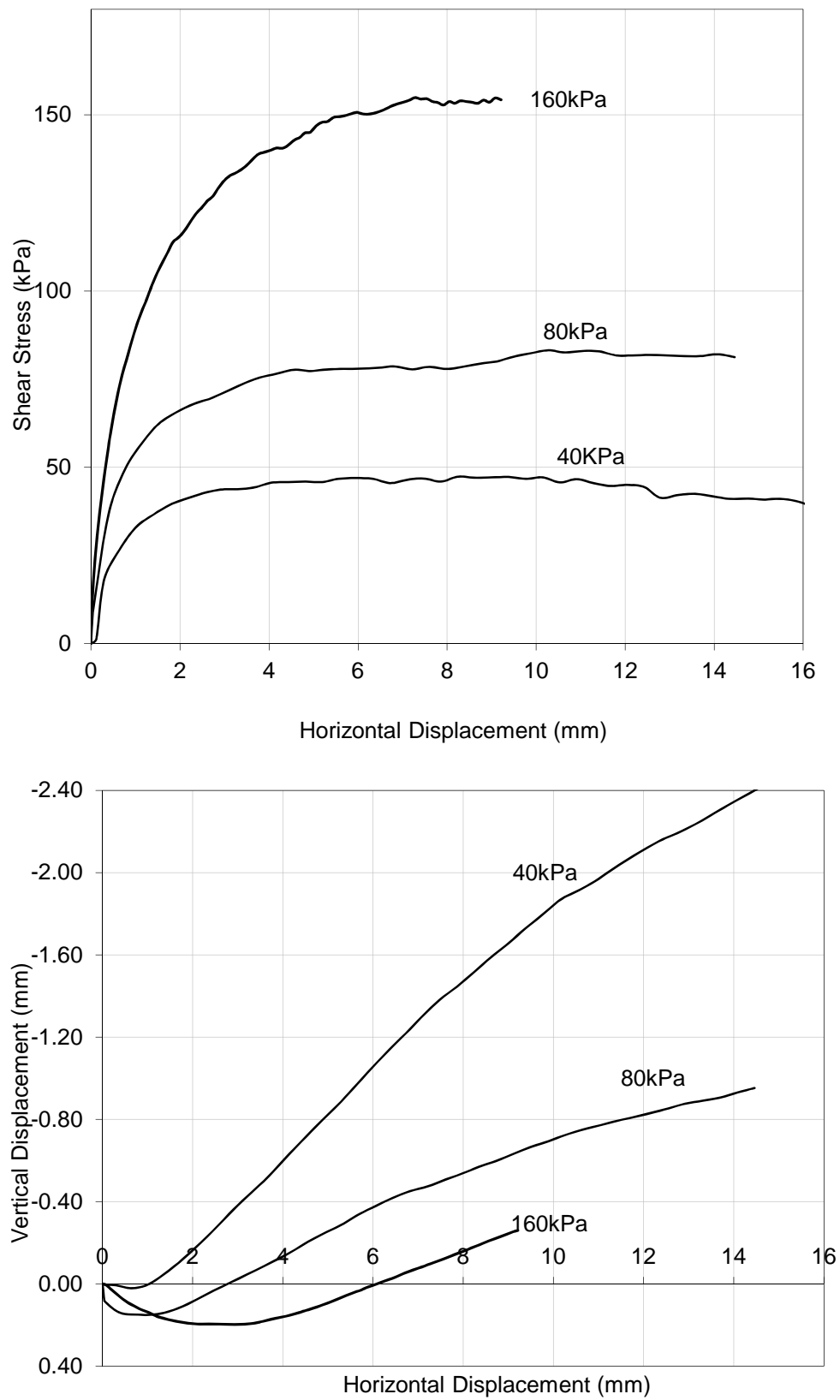


Figure 2 Stress-strain behaviour

<b>QUB</b>	<b>Geotechnical Testing Laboratory</b>
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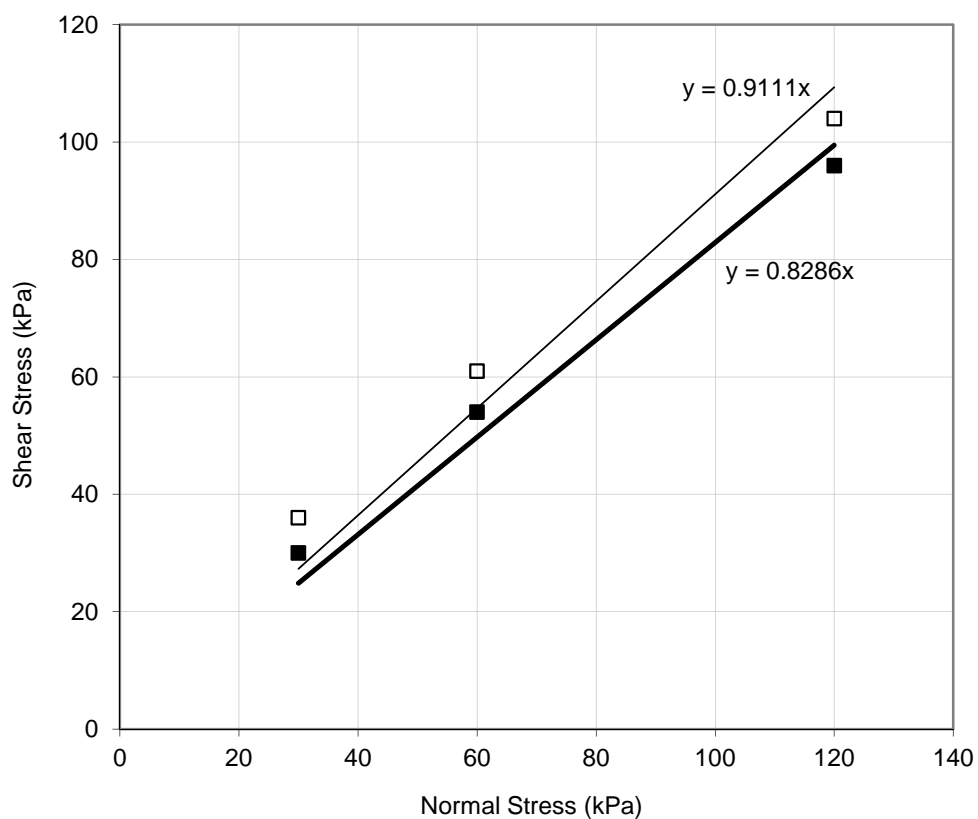
## Arklow Sewerage Scheme

Ref:	17-0167	Size mm	100	Initial wet mass g	662
BH	BH14	Thickness mm	34.75	Bulk Density mg/m3	1905

Depth m	0.9m		
Our Ref	P		$\sigma'_v$ kPa
Soil type	Sandy GRAVEL		
Rate of shearing mm/min	0.5		30
>10 mm removed			60
			120

Peak		Ultimate	
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ kPa
30	36	30	30
60	61	60	54
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

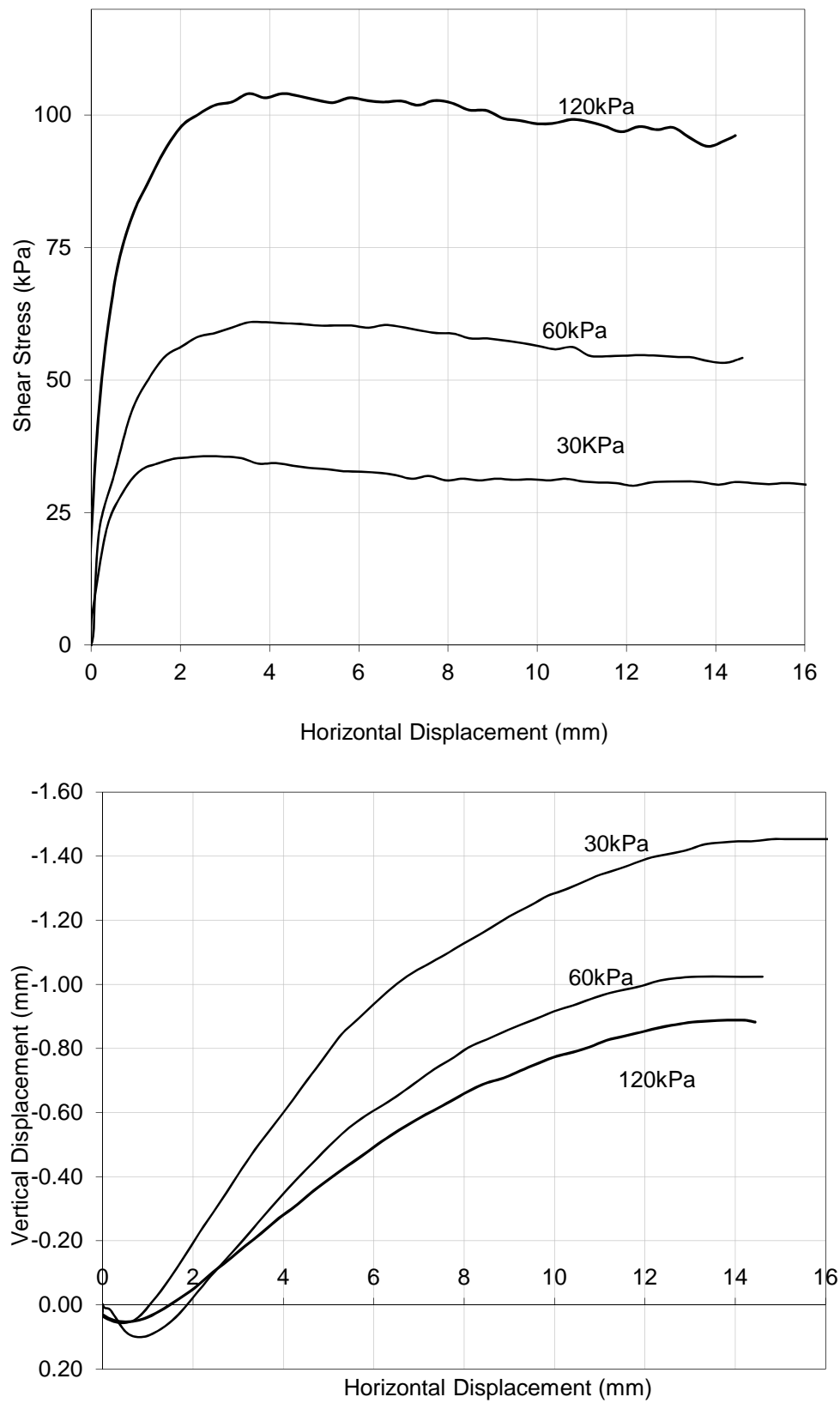


Figure 2 Stress-strain behaviour

<b>QUB</b>	<b>Geotechnical Testing Laboratory</b>
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## Arklow Sewerage Scheme

Ref:	17-0167	Size mm	100	Initial wet mass g	680
BH	BH14	Thickness mm	35.25	Bulk Density mg/m3	1929

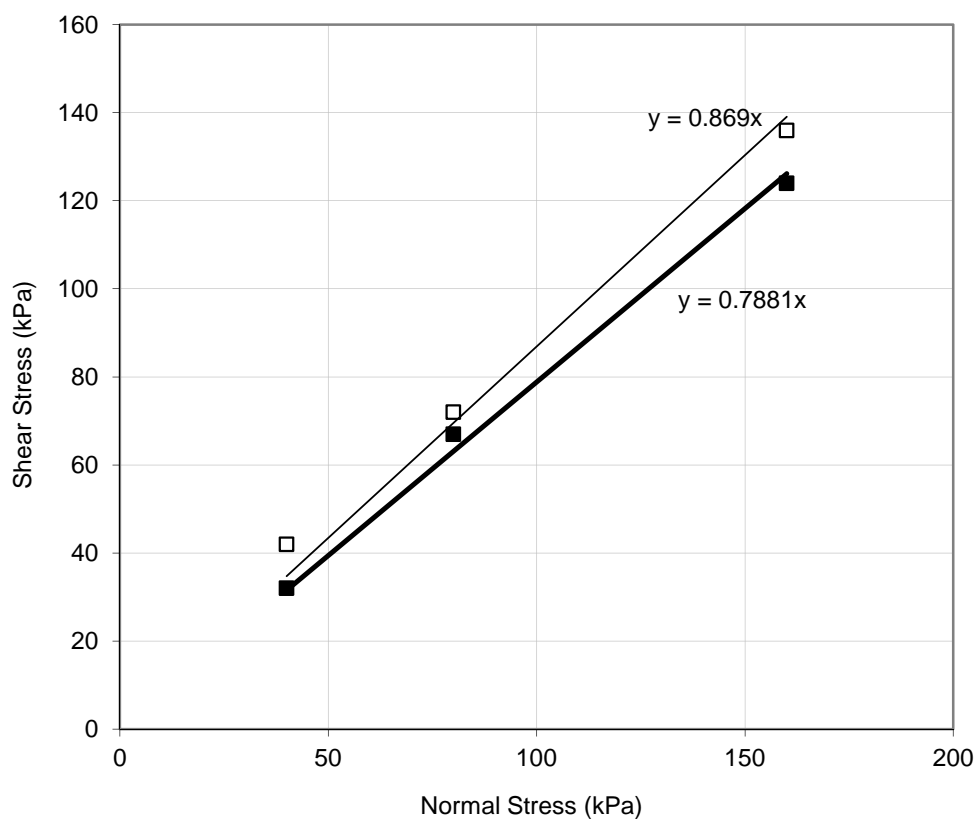
Depth m	9.0m		
Our Ref	T		$\sigma'_v$ kPa
Soil type	Sandy GRAVEL		
Rate of shearing mm/min	0.5		40
>10 mm removed			80
			160

Peak		Ultimate	
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ kPa
40	42	40	32
80	72	80	67
160	136	160	124

Peak angle of internal friction **40**

Cohesion kPa

Ultimate angle of internal friction **38**



**Figure 1 Failure Envelope**

## Arklow Sewerage Scheme

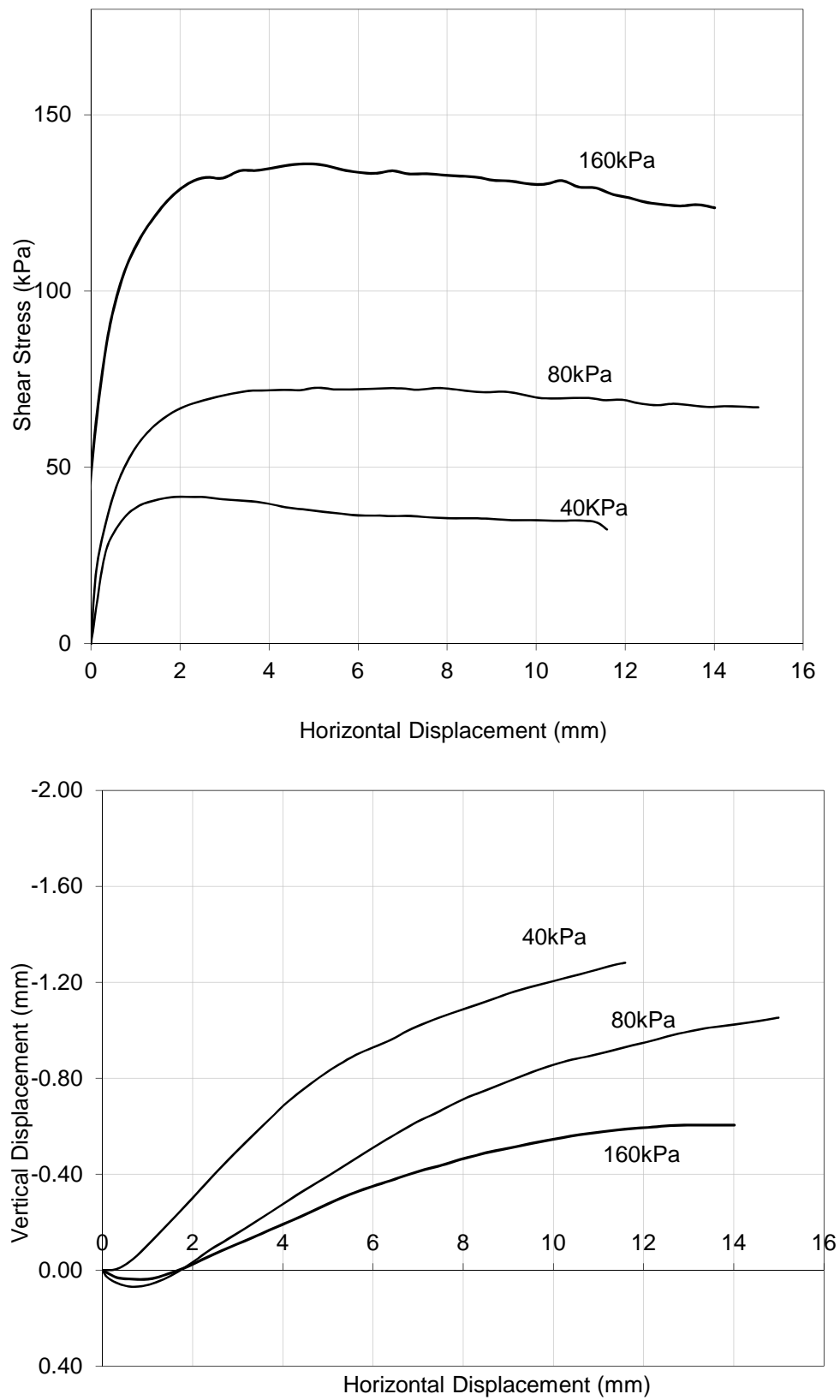


Figure 2 Stress-strain behaviour





2183

# Final Report

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**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**

<b>Client: Causeway Geotech Ltd</b>	<b>Chemtest Job No.:</b>				17-24130	17-24130	17-24130	17-24130	17-24130	17-24130
Quotation No.:	<b>Chemtest Sample ID.:</b>				510601	510602	510603	510604	510605	510606
Order No.:	Client Location ID.:				D10	D12	D9	D12	D1	D11
	Client Sample 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
	Bottom Depth (m):								0.90	
	Date Sampled:				12-Sep-2017	12-Sep-2017	12-Sep-2017	12-Sep-2017	12-Sep-2017	12-Sep-2017
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>						
Moisture	N	2030	%	0.020	12	18	12	16	48	18
pH	U	2010		N/A	9.0	8.3	8.5	8.5	7.4	6.7
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	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**

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All soil samples will be retained for a period of 45 days from the date of receipt

All water samples will be retained for 14 days from the date of receipt

Charges may apply to extended sample storage

If you require extended retention of samples, please email your requirements to:

[customerservices@chemtest.co.uk](mailto:customerservices@chemtest.co.uk)

**SOIL AND ROCK SAMPLE ANALYSIS  
LABORATORY TEST REPORT**

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

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**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. 17-0167		Project Name Arklow Sewerage Scheme Marine Outfall GI												
Hole No.	Sample				Soil Description	Density		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type		bulk Mg/m3	dry 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 performed in accordance with BS1377:1990 unless specified otherwise

Key					Date Printed	Approved By	Table
Density test	Liquid Limit	Particle density			23/09/2017	Stephen.Watson	1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer					sheet
wd - water displacement	cas - Casagrande method	gj - gas jar					1
wi - immersion in water	1pt - single point test						

## Summary of Classification Test Results

Project No.

17-0167

Project Name
--------------

## Arklow Sewerage Scheme Marine Outfall GI

[illegible]

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

Key

### Density test

Linear measurement unless :

wd - water displacement

wi - immersion in water

Liquid Limit

4pt cone unless :

cas - Casagrande method

1pt - single point test

Particle density

sp - small pyknometer

qj - qas jar

Date Printed

23/09/2017

Approved By	
-------------	--

Stephen.Watson

Table
-------

sheet

1

2



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH02

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

1

Soil Description

Black slightly sandy subrounded to rounded fine to coarse GRAVEL.

Depth, m

0.00

Specimen Reference

2

Specimen  
Depth

m

Sample Type

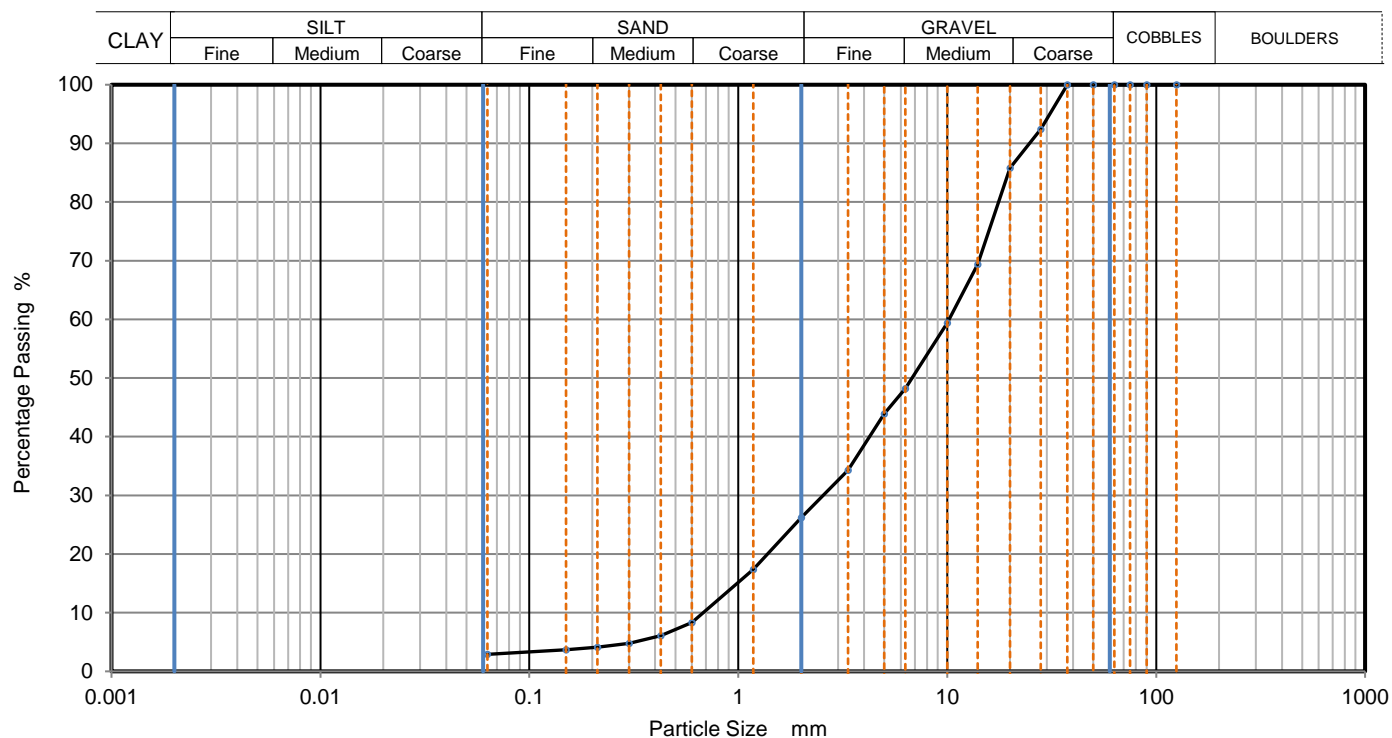
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090745



Sieving		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
D30	mm
D10	mm
Uniformity Coefficient	15
Curvature Coefficient	0.94

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Sheet printed

23/10/2017 17:19

Fig 1

Sheet





## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH02

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

2

Soil Description

Black slightly silty slightly gravelly fine to coarse SAND.

Depth, m

1.00

Specimen Reference

2

Specimen  
Depth

m

Sample Type

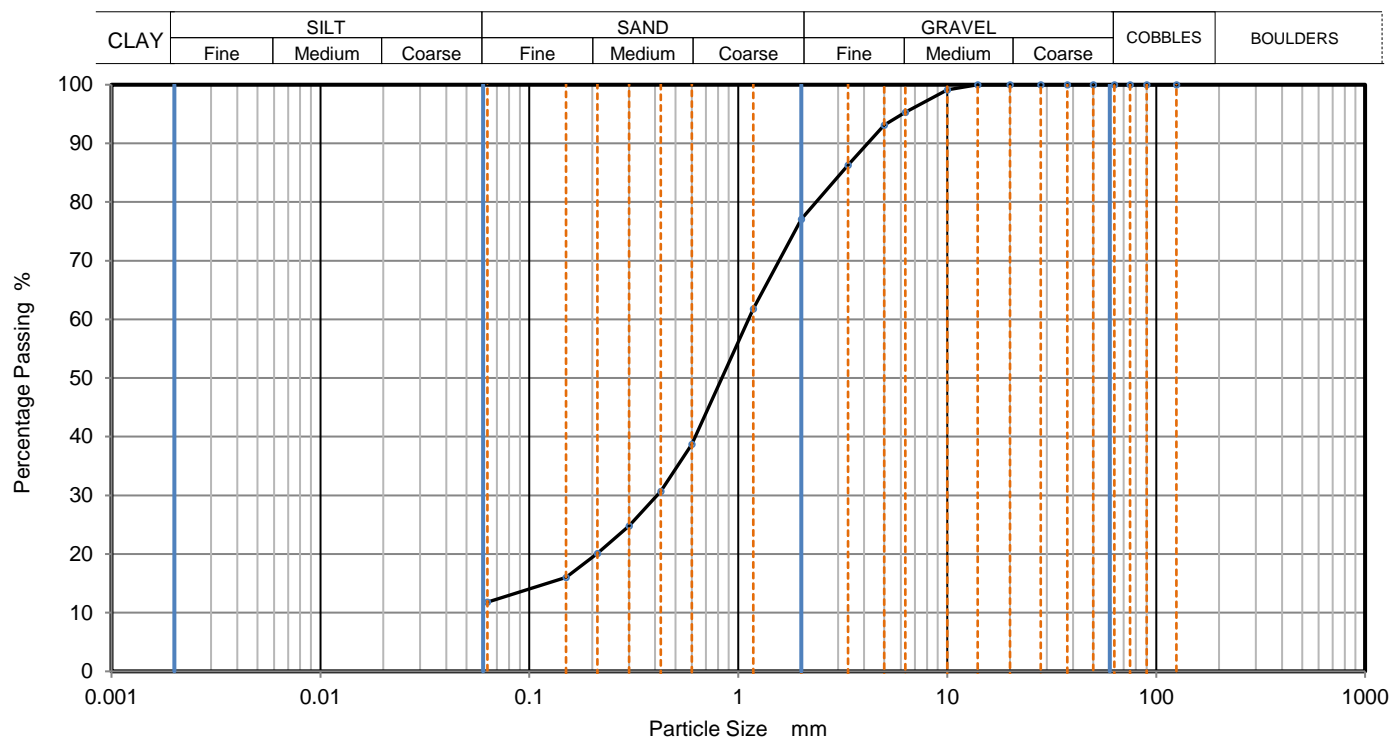
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090746



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

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23/10/2017 17:19

Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH02

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

3

Soil Description

Black slightly sandy subrounded to rounded fine to coarse GRAVEL.

Depth, m

2.30

Specimen Reference

2

Specimen  
Depth

m

Sample Type

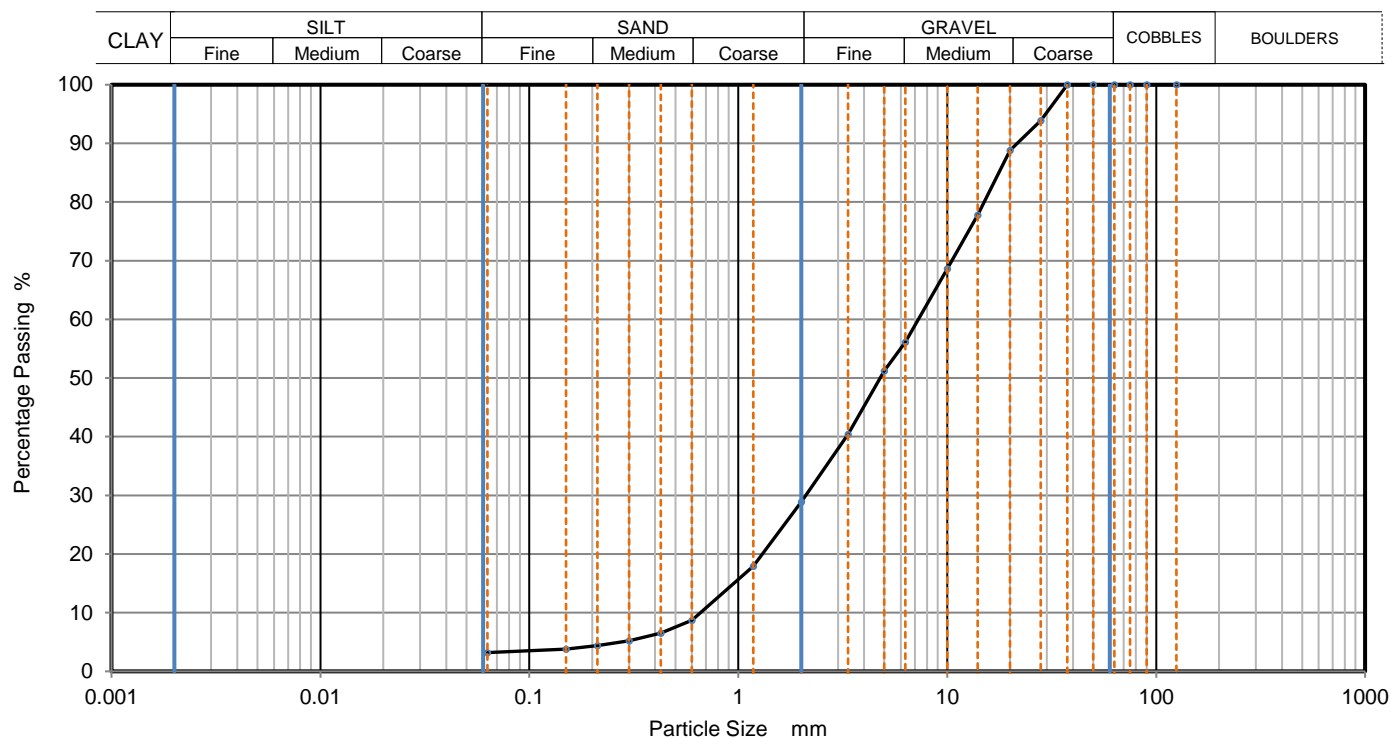
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090749



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	11
Curvature Coefficient	0.92

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Sheet printed

23/10/2017 17:19

Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH02

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

5

Soil Description

Brown slightly sandy silty CLAY.

Depth, m

4.90

Specimen Reference

2

Specimen  
Depth

m

Sample Type

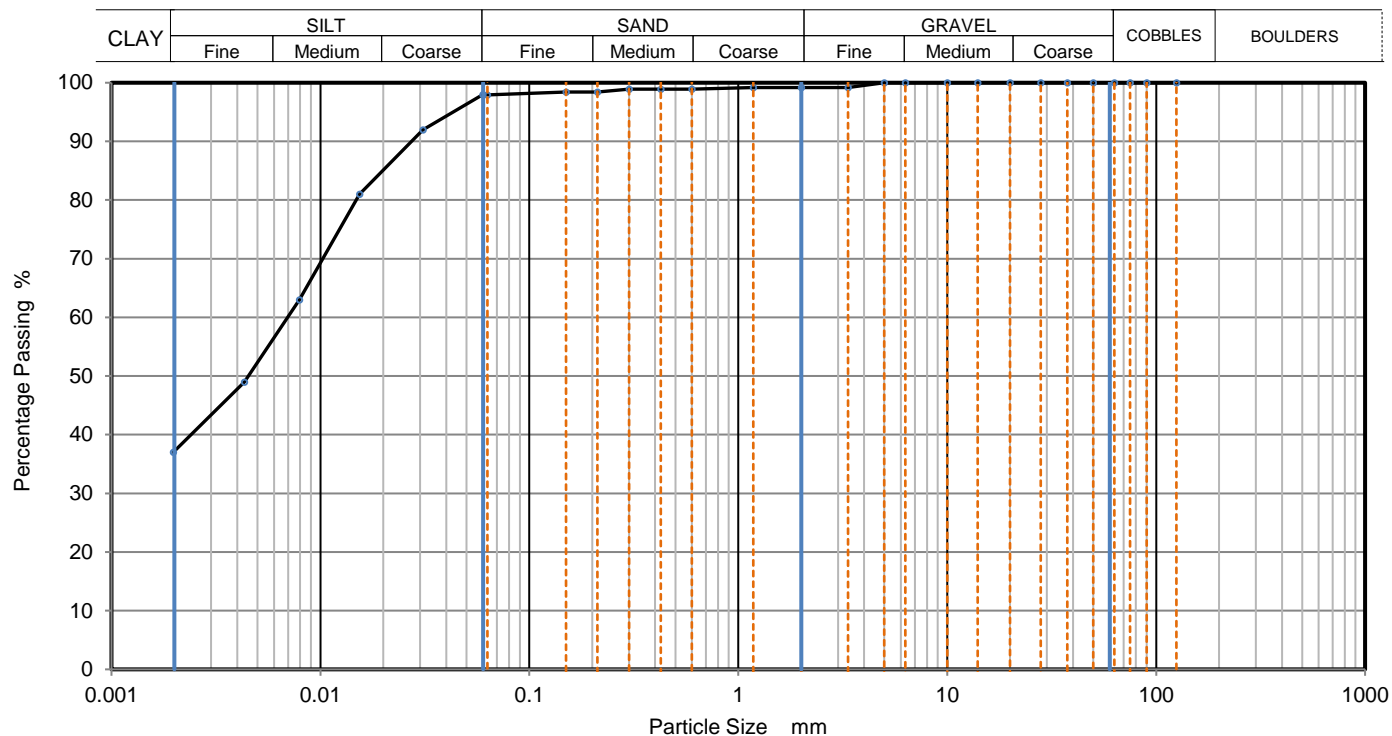
B

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) 3.00 Mg/m <sup>3</sup>	
0.425	99		
0.3	99		
0.212	98		
0.15	98		
0.063	98		

Dry Mass of sample, g

514

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	1
Silt	60
Clay	38

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH02

Site Name

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  
Depth

m

Sample Type

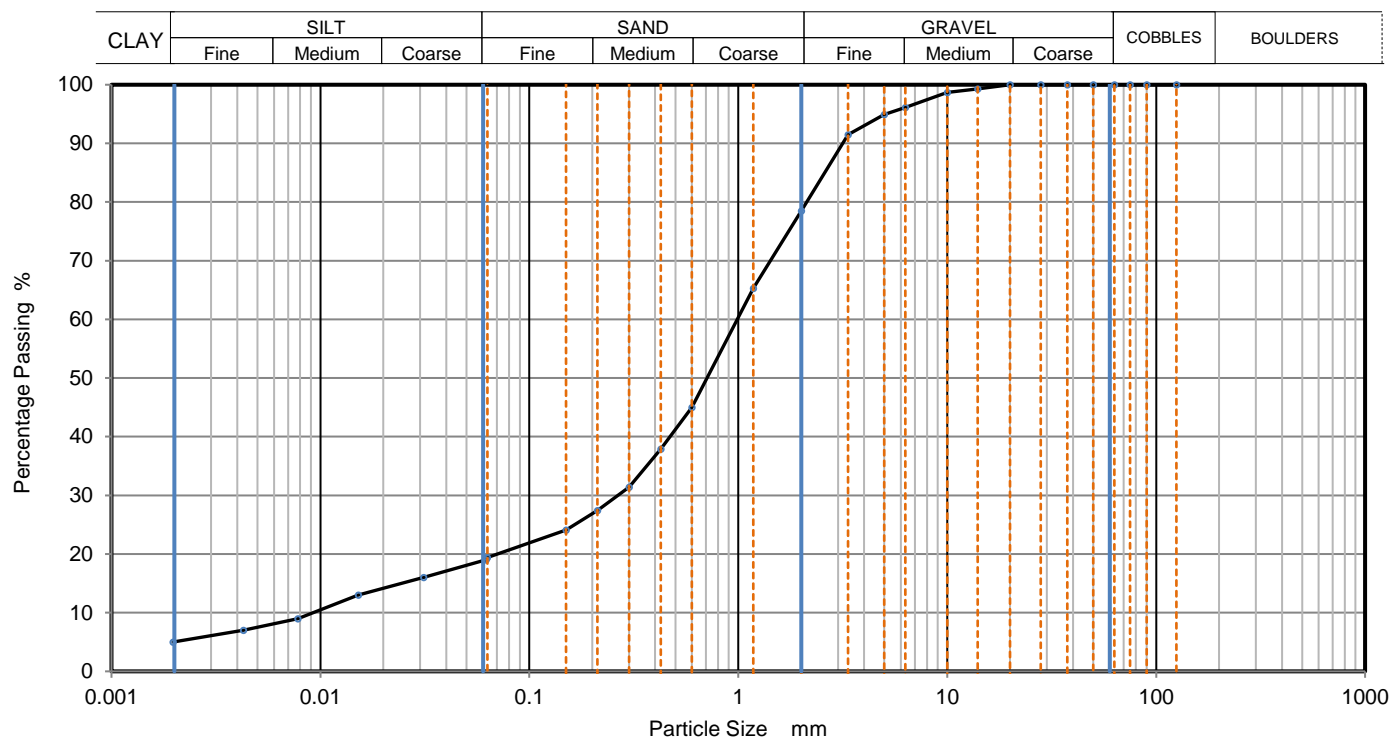
B

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) 2.90 Mg/m <sup>3</sup>	
0.425	38		
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
D30	mm
D10	mm
Uniformity Coefficient	110
Curvature Coefficient	8.2

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH02

Site Name

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  
Depth

m

Sample Type

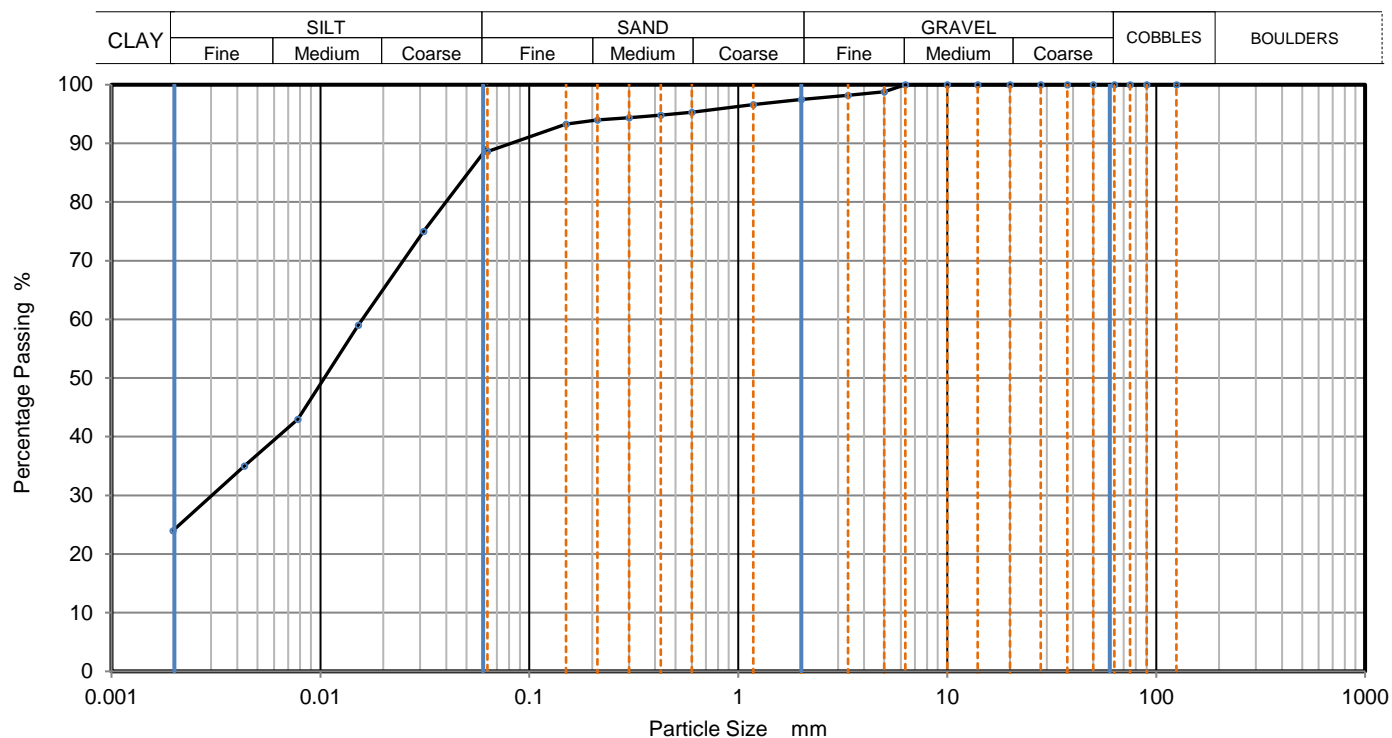
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090755



Sieving		Sedimentation	
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) 2.90 Mg/m <sup>3</sup>	
0.425	95		
0.3	94		
0.212	94		
0.15	93		
0.063	89		

Dry Mass of sample, g

1392

Sample Proportions	% dry mass
Cobbles	0
Gravel	3
Sand	9
Silt	64
Clay	24

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH02

Site Name

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  
Depth

m

Sample Type

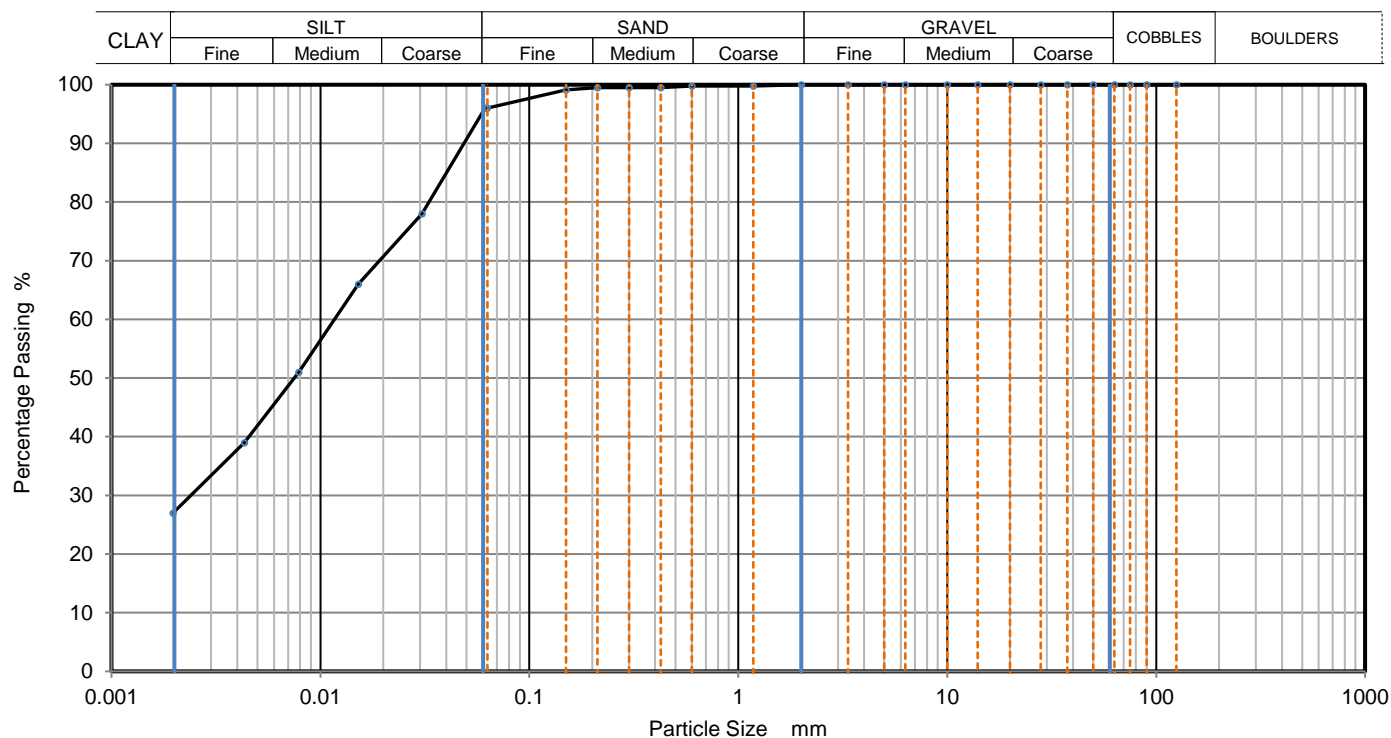
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090756



Sieving		Sedimentation	
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) 2.90 Mg/m <sup>3</sup>	
0.425	100		
0.3	100		
0.212	100		
0.15	99		
0.063	96		

Dry Mass of sample, g

896

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	4
Silt	69
Clay	27

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH02

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

3

Specimen  
Depth

m

Sample Type

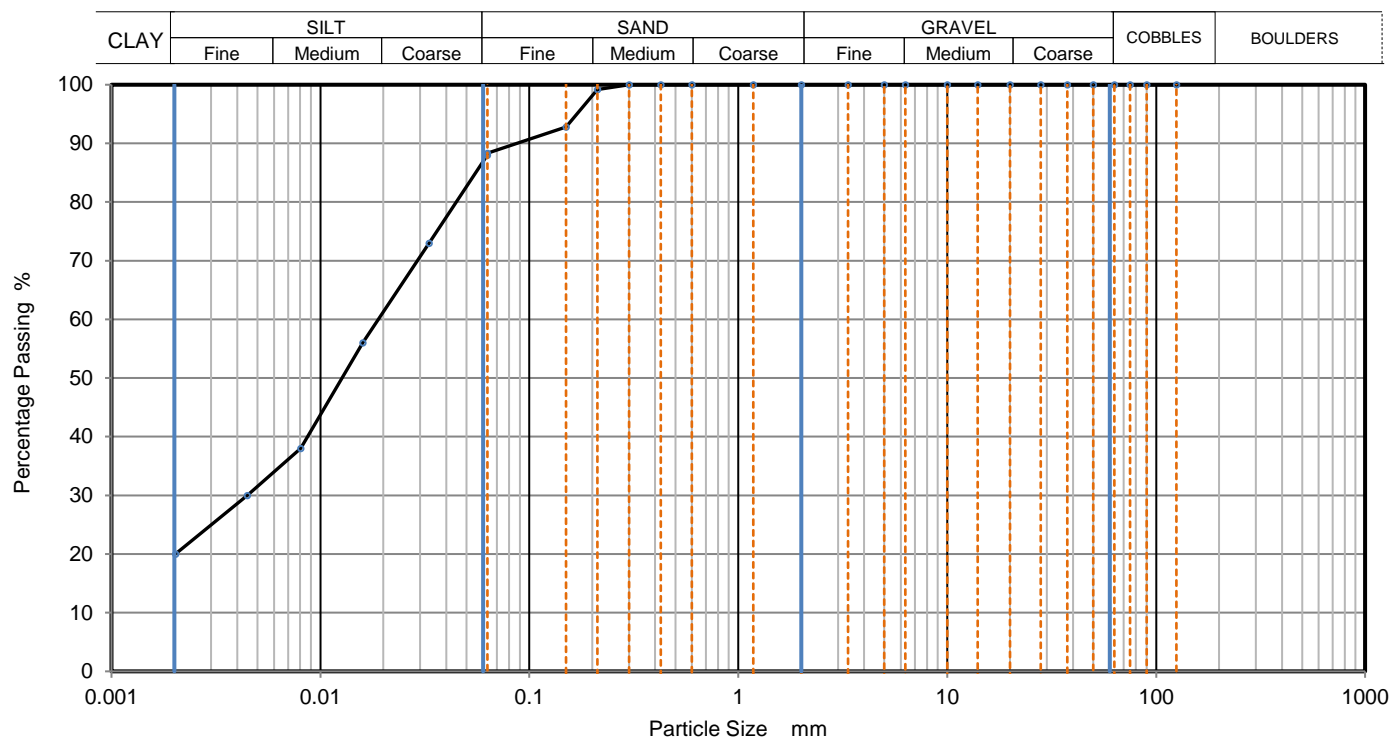
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090759



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	100		
0.3	100		
0.212	99		
0.15	93		
0.063	88		

Dry Mass of sample, g

1520

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	12
Fines <0.063mm	88

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

Remarks

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Stephen.Watson

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH02

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  
Depth

m

Sample Type

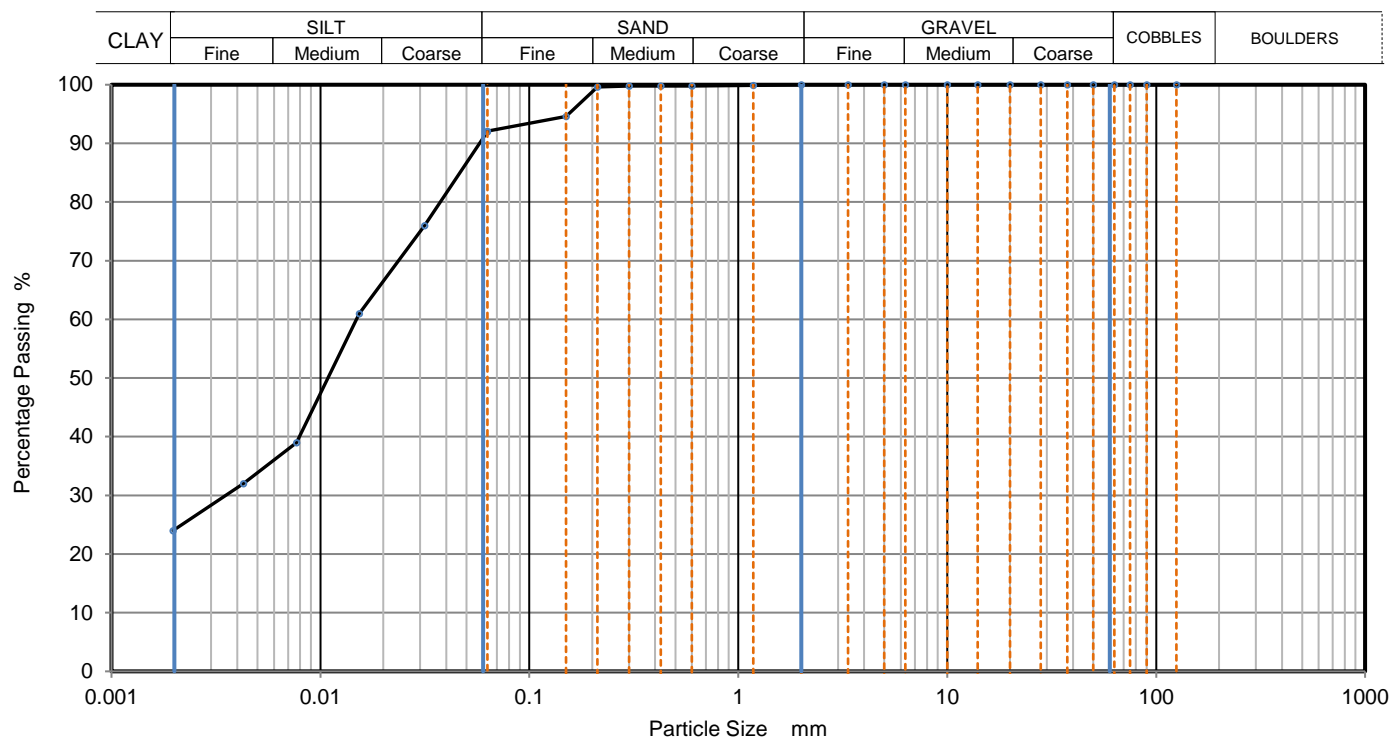
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090761



Sieving		Sedimentation	
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) 2.90 Mg/m <sup>3</sup>	
0.425	100		
0.3	100		
0.212	100		
0.15	95		
0.063	92		

Dry Mass of sample, g

1527

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	8
Silt	68
Clay	24

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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Borehole/Pit No.

BH02

Site Name

Arklow Sewerage Scheme Marine Outfall 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  
Depth

m

Sample Type

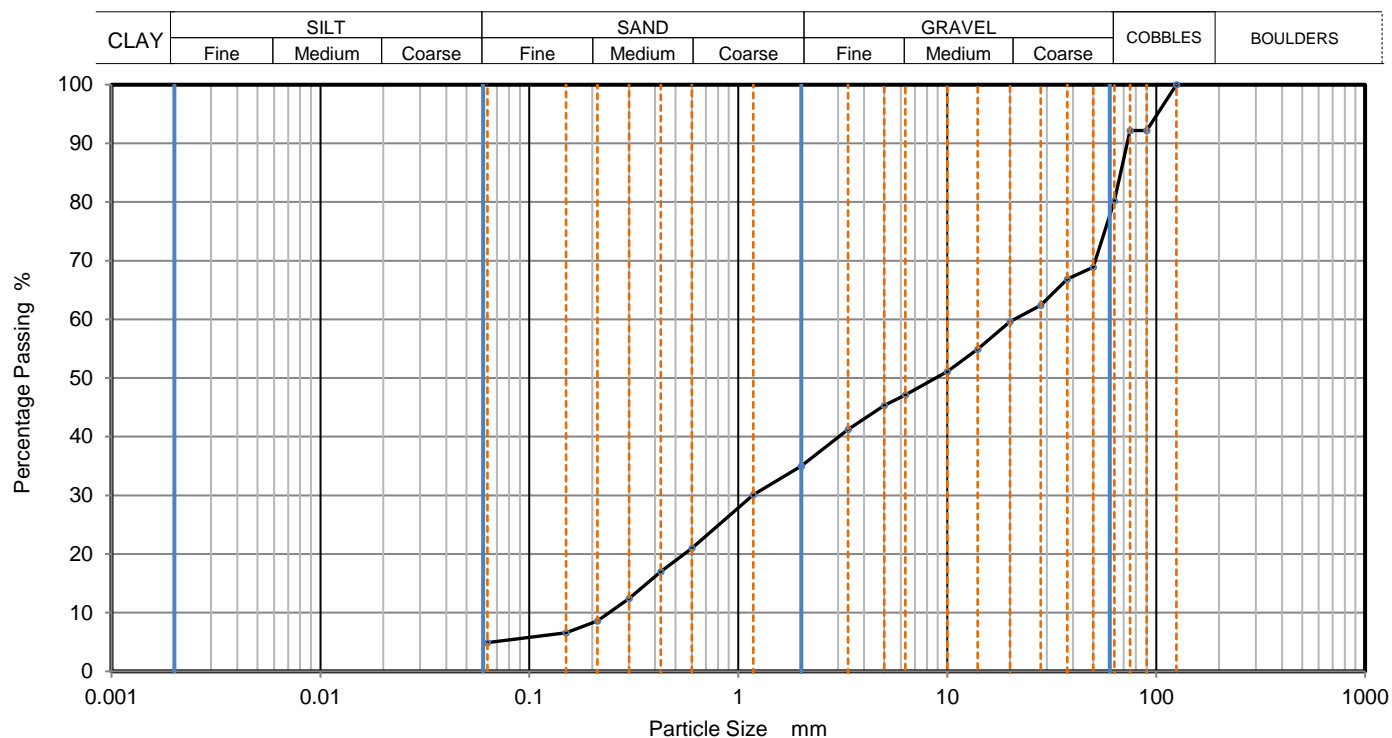
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090765



Sieving		Sedimentation	
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

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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Borehole/Pit No.

BH02

Site Name

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  
Depth

m

Sample Type

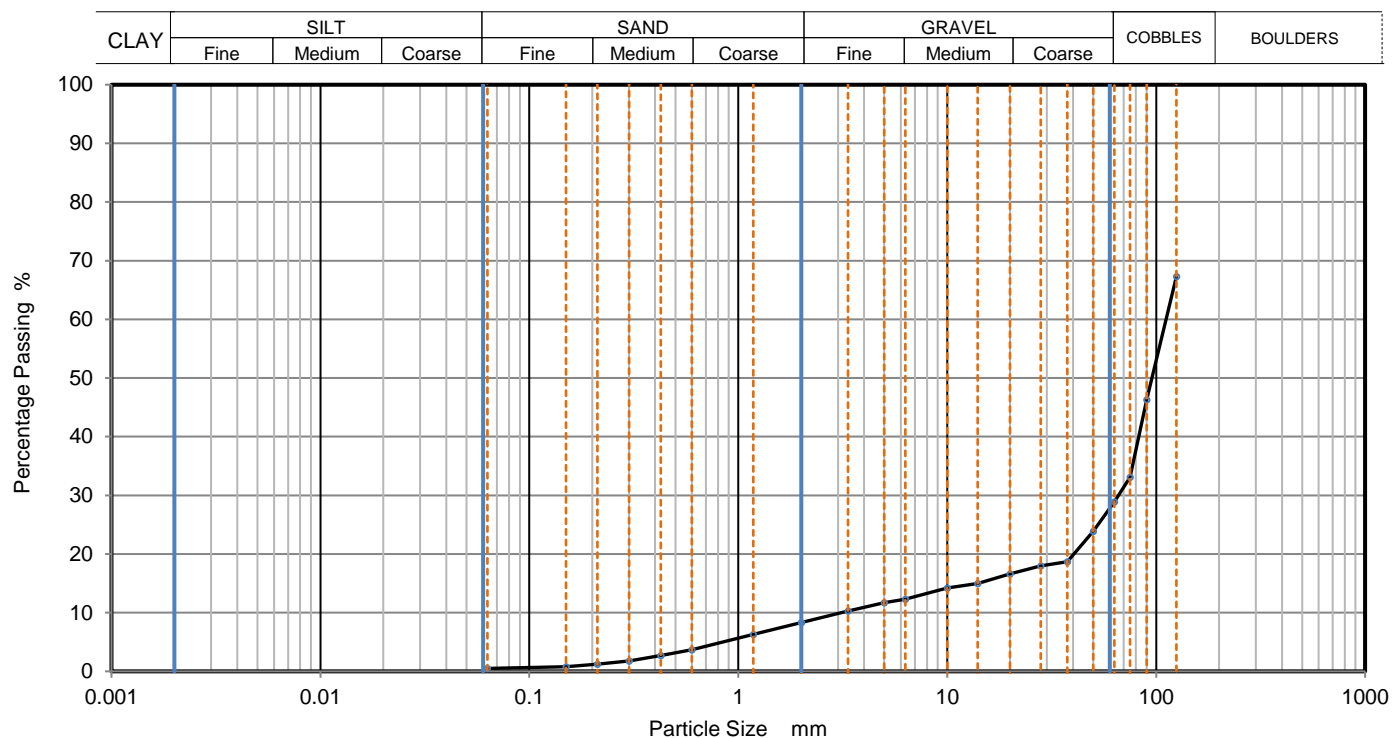
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090766



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	36
Curvature Coefficient	12

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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Borehole/Pit No.

BH02

Site Name

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

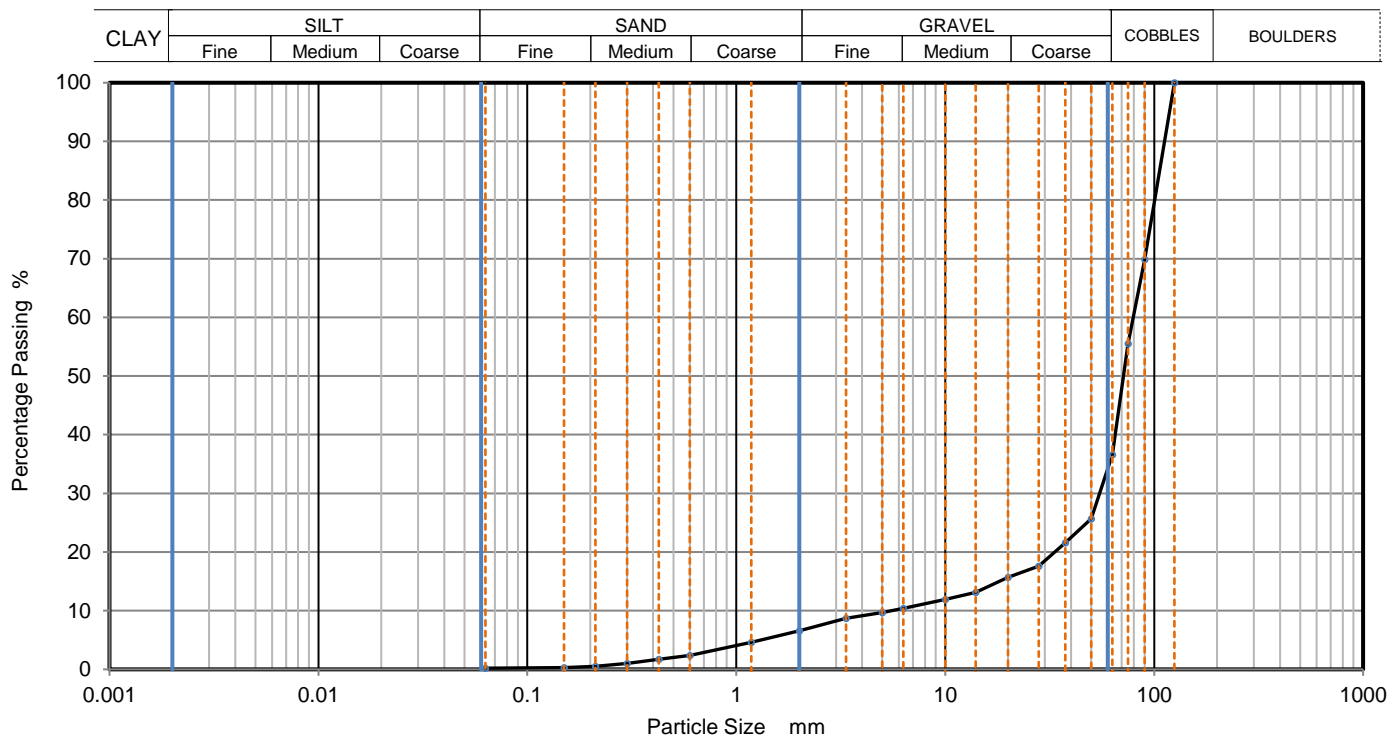
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090767



Sieving		Sedimentation	
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		

Dry Mass of sample, g

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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Borehole/Pit No.

BH02

Site Name

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

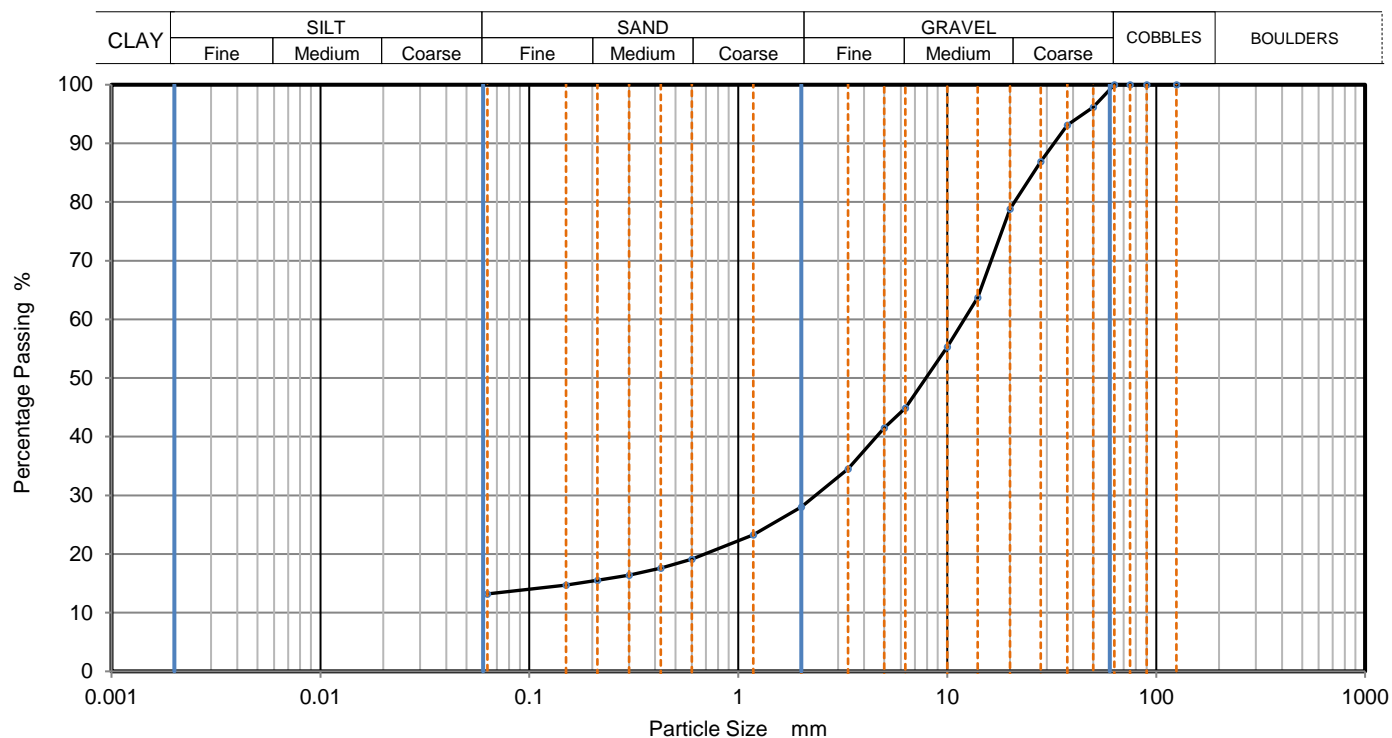
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090768



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH15

Site Name

Arklow Sewerage Scheme Marine Outfall 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  
Depth

m

Sample Type

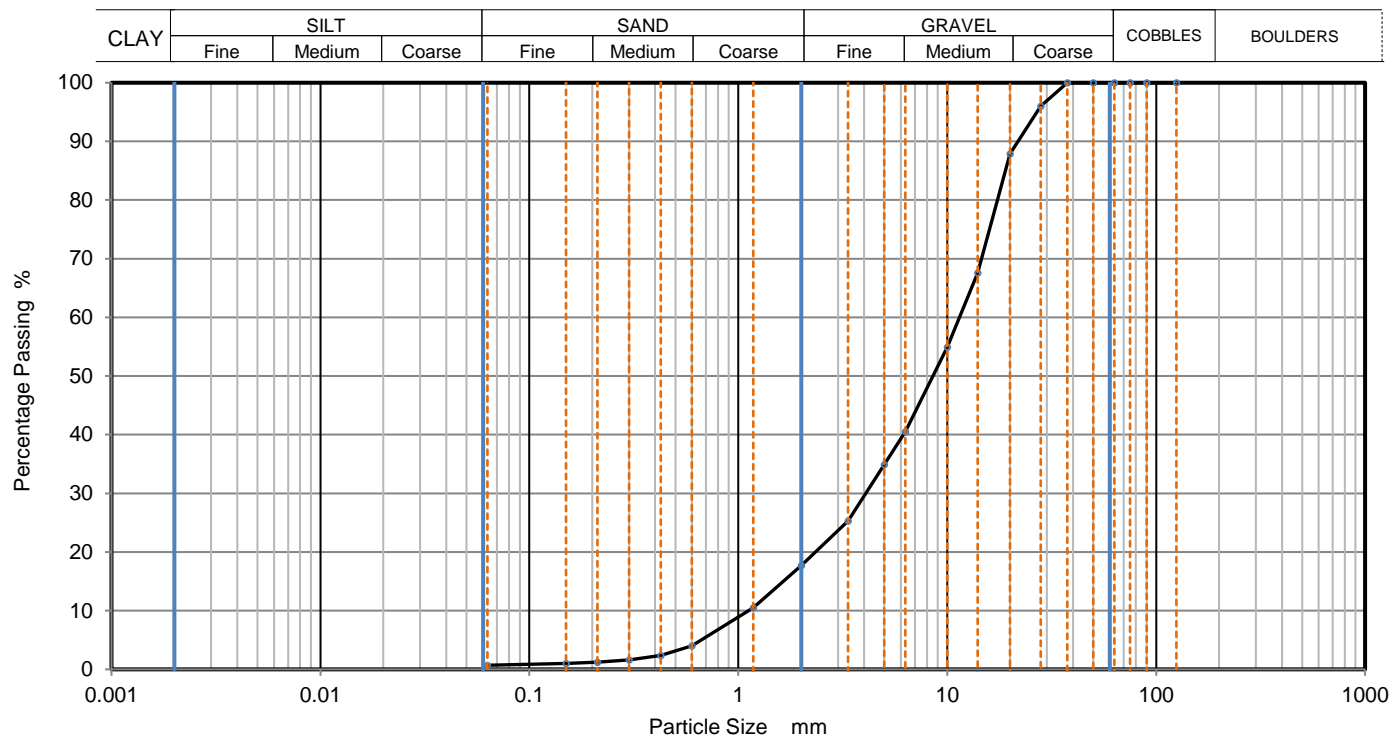
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090770



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	82
Sand	17
Fines <0.063mm	1

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH15

Site Name

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

Specimen  
Depth

m

Sample Type

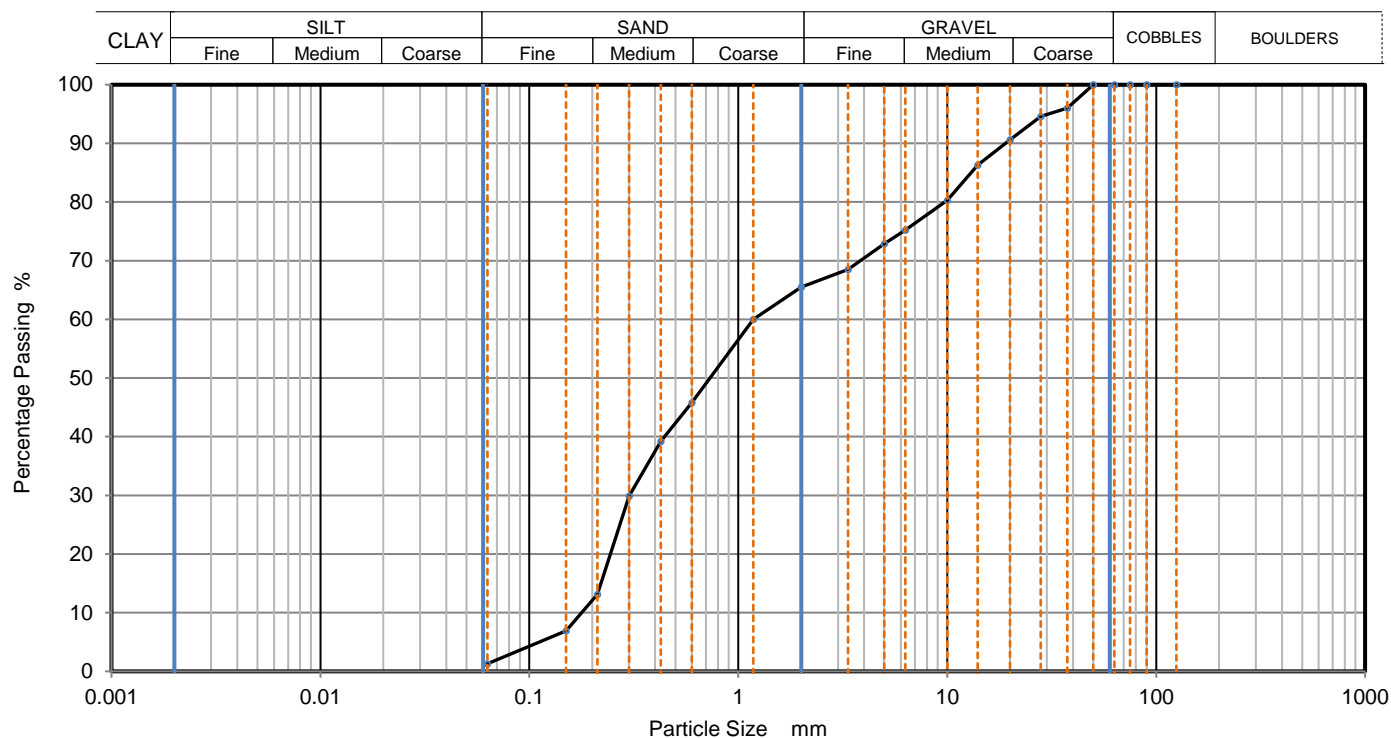
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090772



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	6.6
Curvature Coefficient	0.43

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH15

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

3

Soil Description

Grey slightly gravelly fine to medium SAND.

Depth, m

2.00

Specimen Reference

2

Specimen  
Depth

m

Sample Type

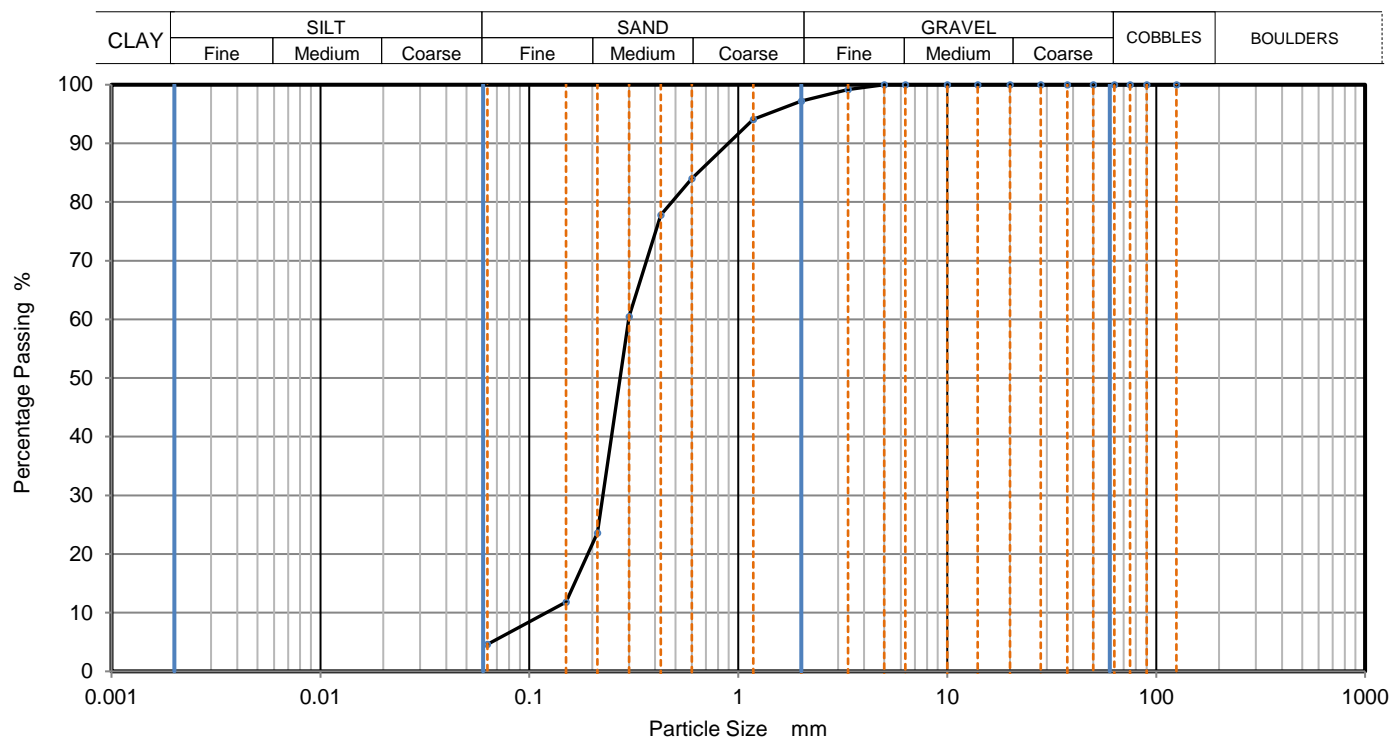
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090773



Sieving		Sedimentation	
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

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

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH15

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

6

Soil Description

Grey slightly sandy silty CLAY.

Depth, m

4.70

Specimen Reference

2

Specimen  
Depth

m

Sample Type

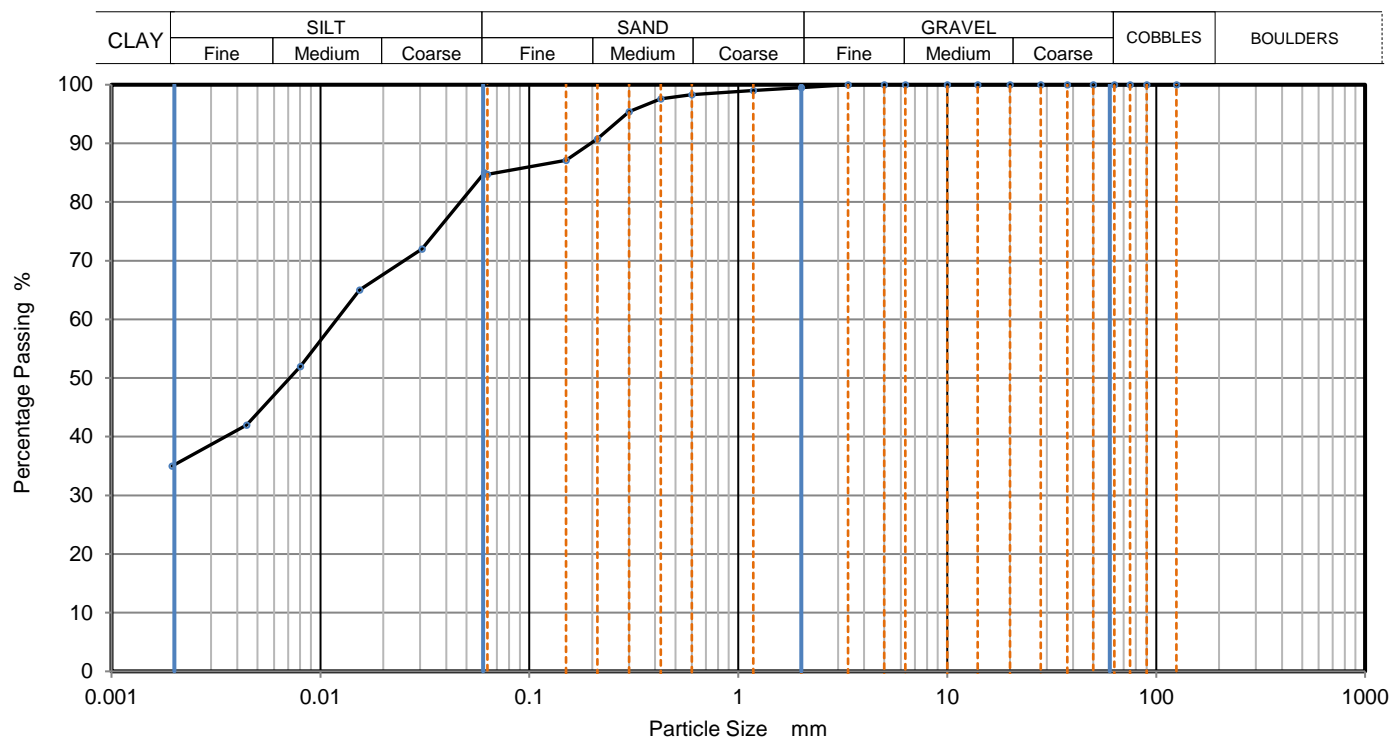
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090775



Sieving		Sedimentation	
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) 3.00 Mg/m <sup>3</sup>	
0.425	98		
0.3	95		
0.212	91		
0.15	87		
0.063	85		

Dry Mass of sample, g

1903

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	15
Silt	50
Clay	35

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH15

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

7

Soil Description

Grey slightly sandy silty CLAY.

Depth, m

6.00

Specimen Reference

2

Specimen  
Depth

m

Sample Type

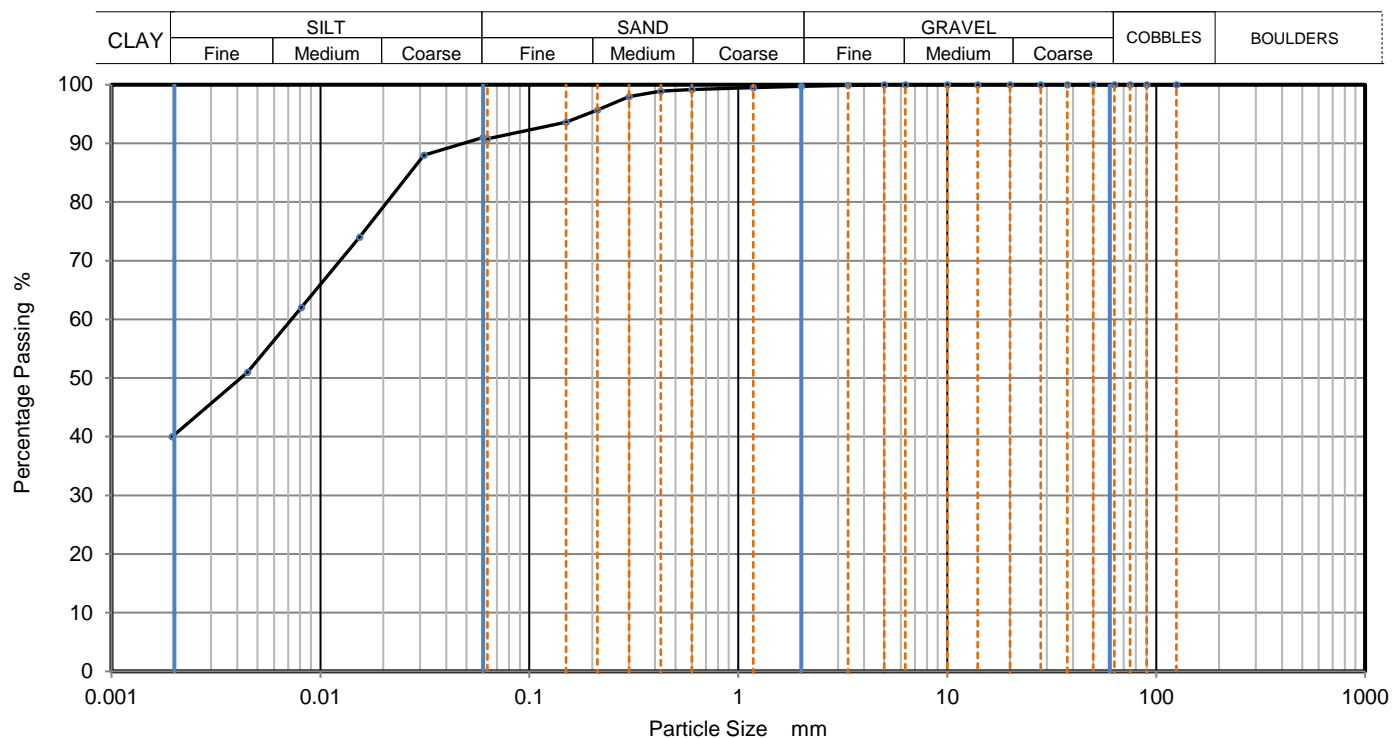
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090778



Sieving		Sedimentation	
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) 3.00 Mg/m <sup>3</sup>	
0.425	99		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH15

Site Name

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  
Depth

m

Sample Type

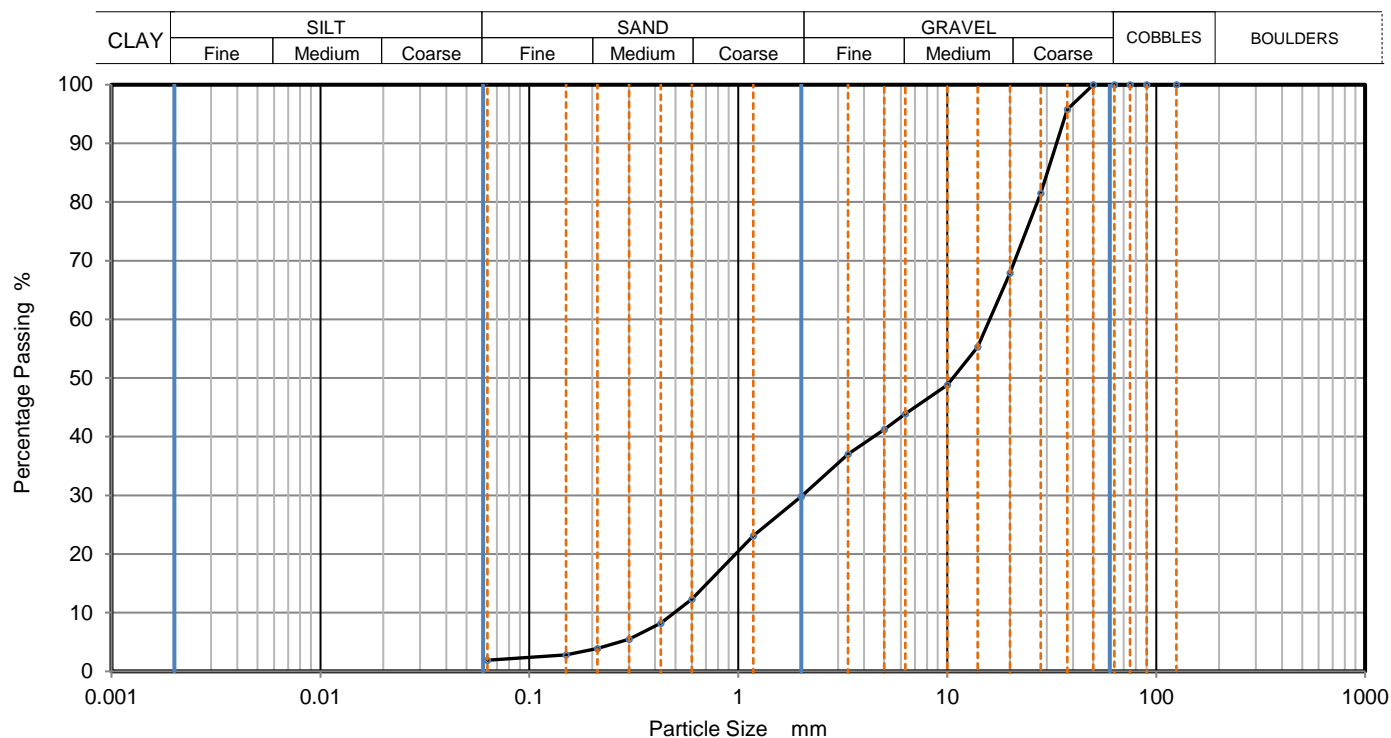
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017090780



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	32
Curvature Coefficient	0.52

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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  
Depth

m

Sample Type

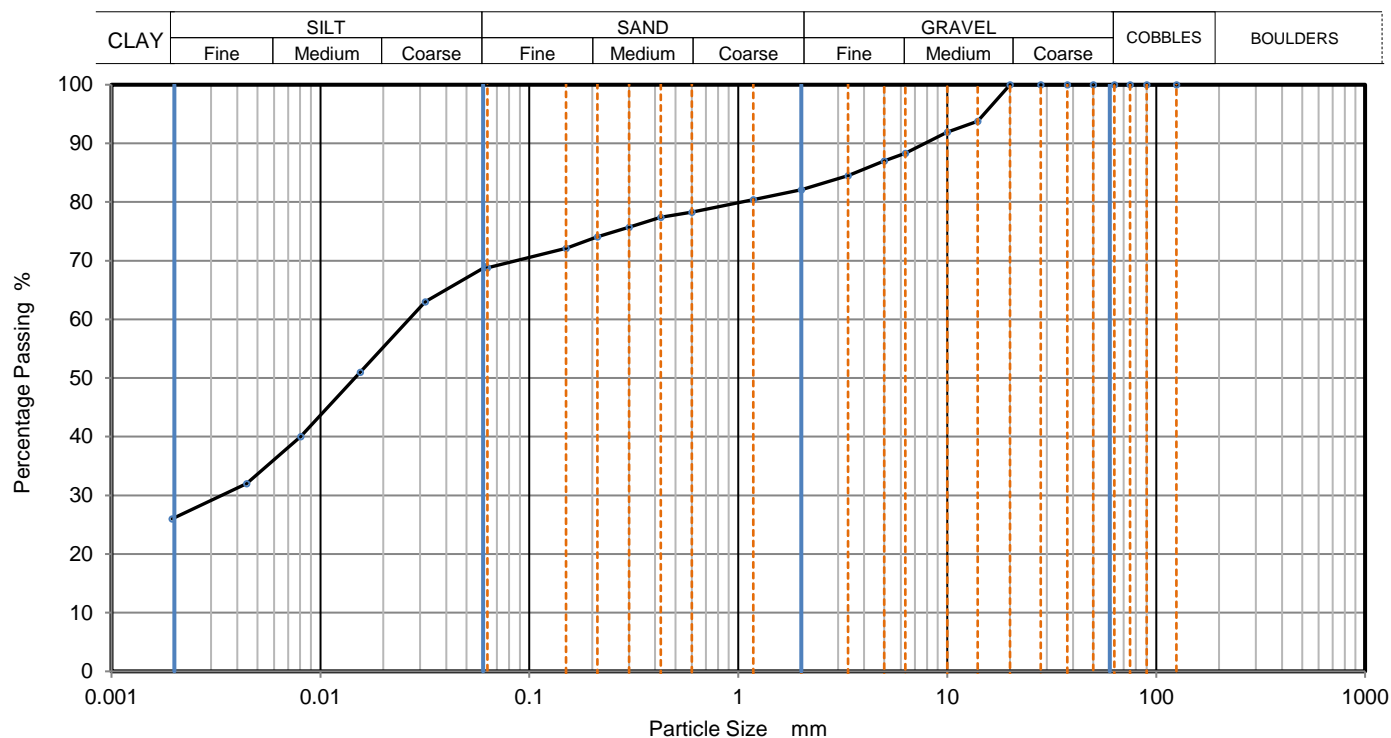
B

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) 2.90 Mg/m <sup>3</sup>	
0.425	77		
0.3	76		
0.212	74		
0.15	72		
0.063	69		

Dry Mass of sample, g

1180

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

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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  
Depth

m

Sample Type

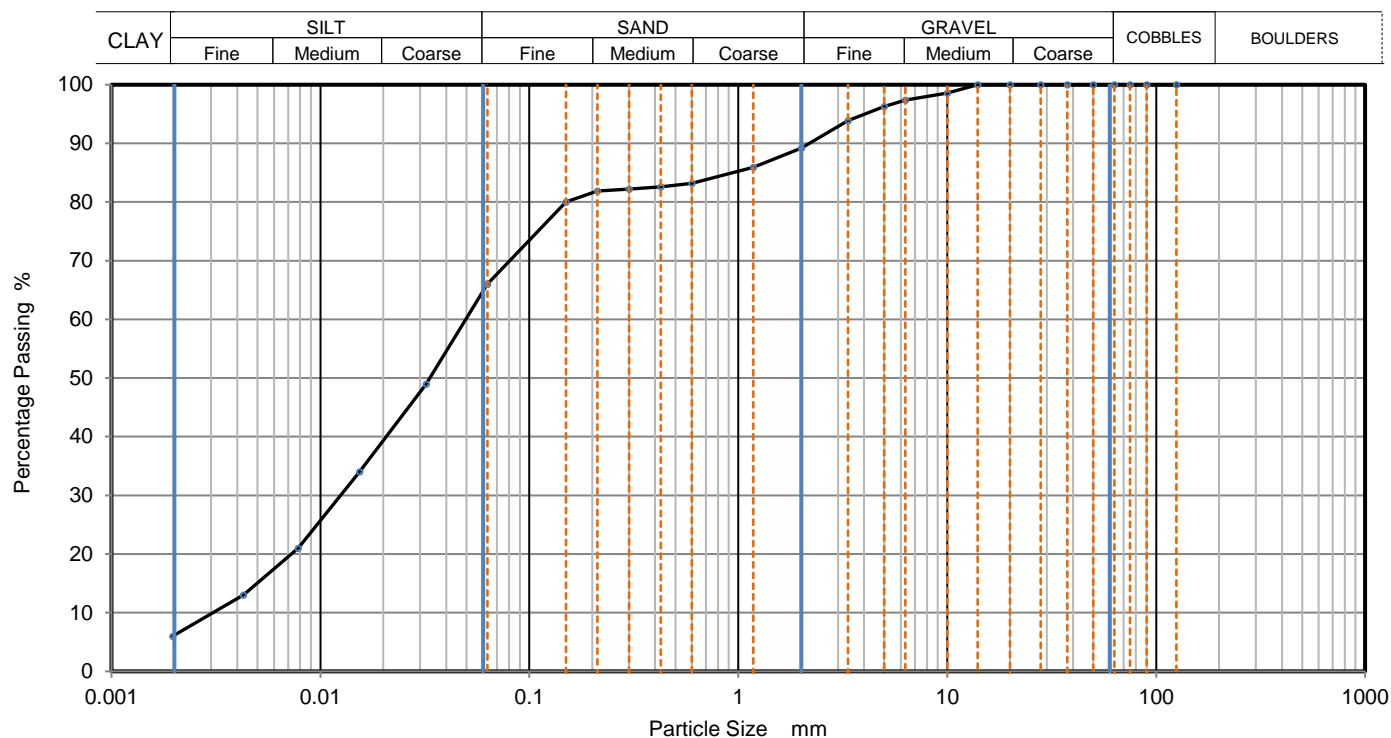
B

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) 2.70 Mg/m <sup>3</sup>	
0.425	83		
0.3	82		
0.212	82		
0.15	80		
0.063	66		

Dry Mass of sample, g

1713

Sample Proportions	% dry mass
Cobbles	0
Gravel	11
Sand	23
Silt	60
Clay	7

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH15

Site Name

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  
Depth

m

Sample Type

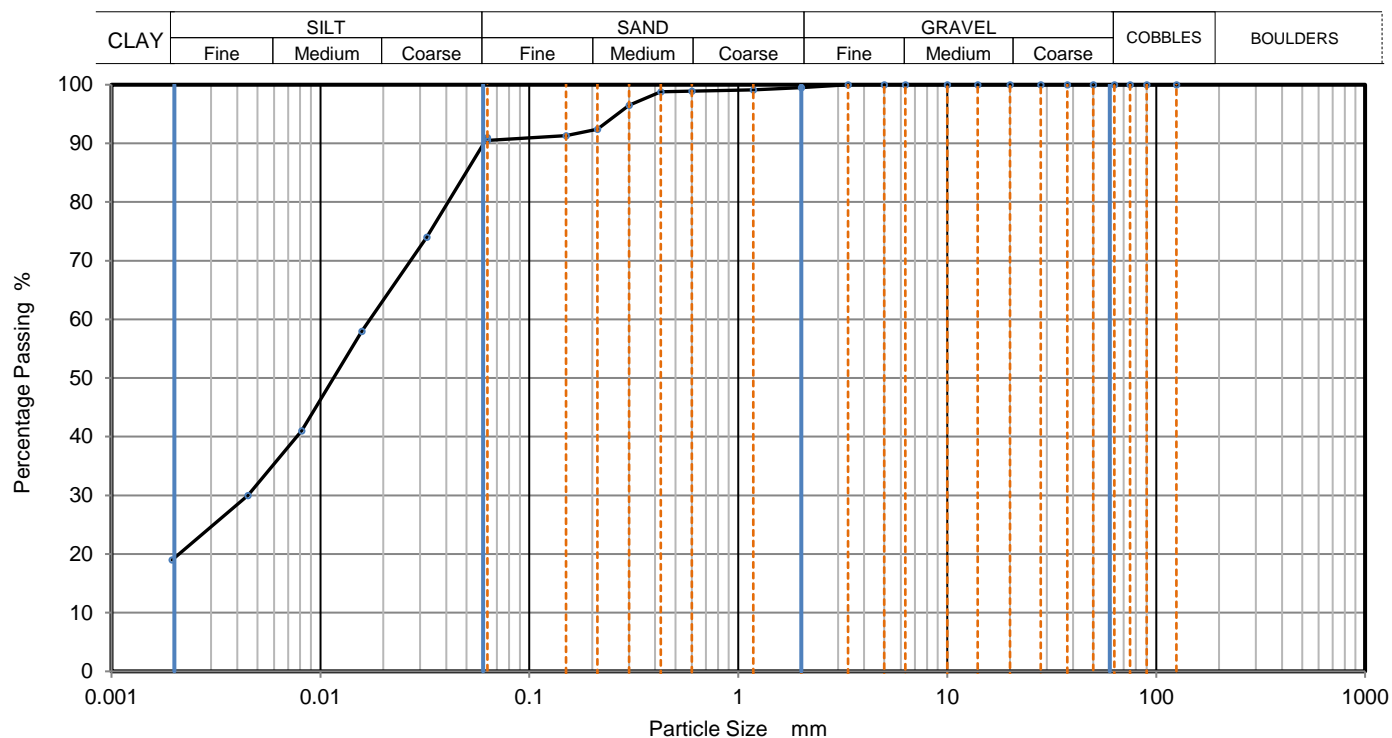
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090785



Sieving		Sedimentation	
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) 2.90 Mg/m <sup>3</sup>	
0.425	99		
0.3	97		
0.212	92		
0.15	91		
0.063	91		

Dry Mass of sample, g

1785

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	9
Silt	71
Clay	20

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH15

Site Name

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  
Depth

m

Sample Type

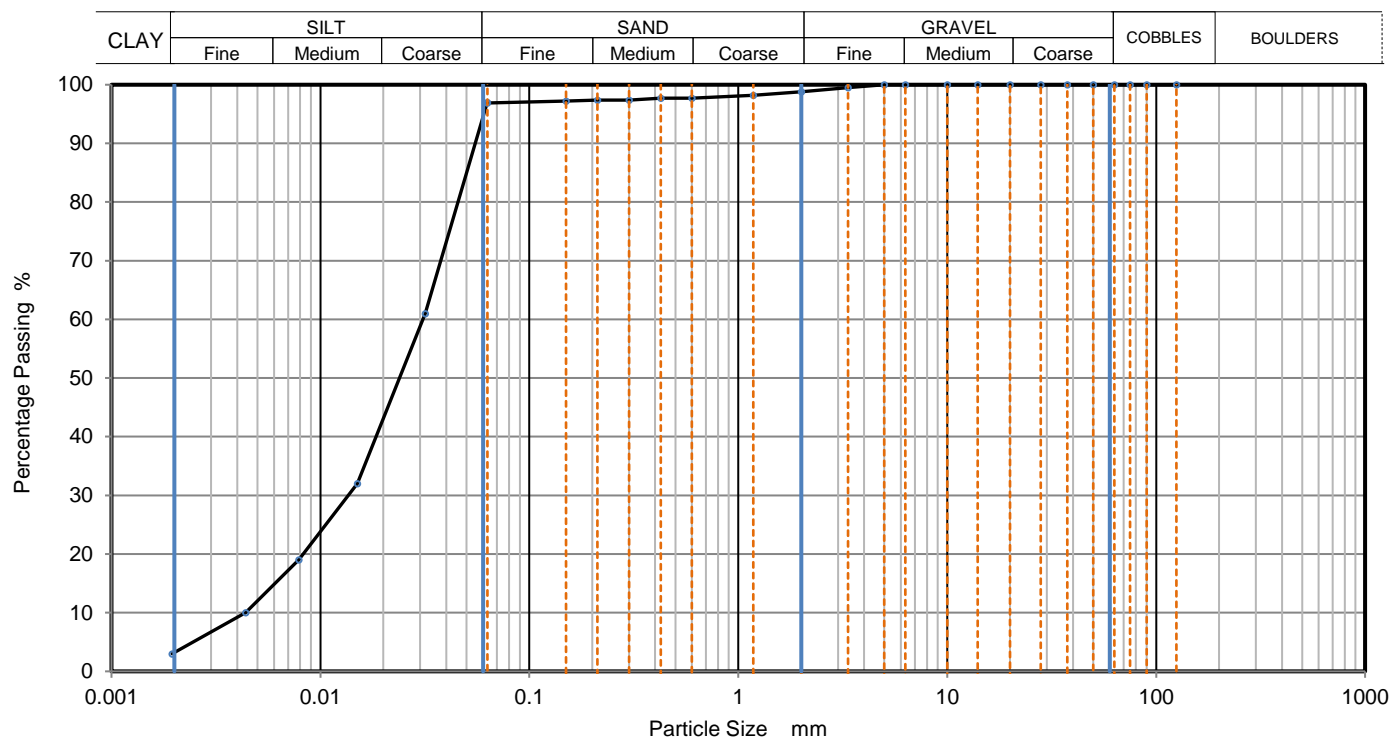
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017090788



Sieving		Sedimentation	
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) 2.90 Mg/m <sup>3</sup>	
0.425	98		
0.3	97		
0.212	97		
0.15	97		
0.063	97		

Dry Mass of sample, g

939

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	2
Silt	94
Clay	3

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

Remarks

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Fig 1

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

Borehole/Pit No. BH02

Site Name Arklow Sewerage Scheme Marine Outfall GI

Sample No. 24

Soil Description Brown slightly sandy silty CLAY.

Depth 5.00

Specimen Reference 2 Specimen Depth m

Sample Type UT

Specimen Description Firm brown slightly sandy silty CLAY.

KeyLAB ID Caus2017090753

Test Method BS1377 : Part 7 : 1990, clause 8, single specimen

Date of test 21/09/2017

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

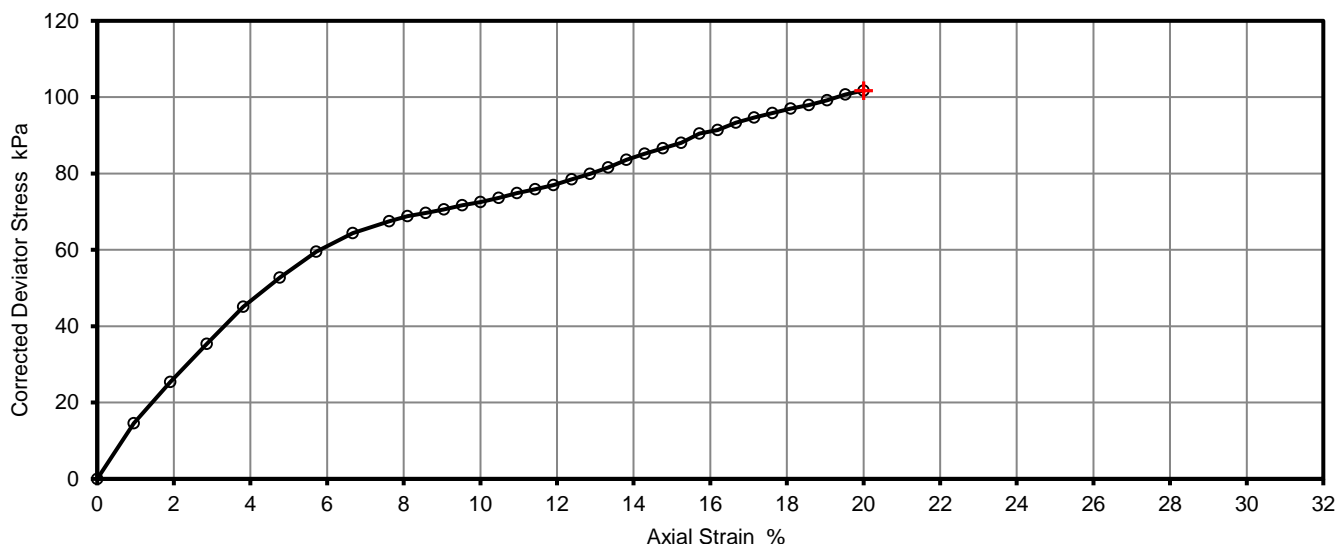
1	
210.0	mm
105.2	mm
2.00	Mg/m3
27.1	%
1.58	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

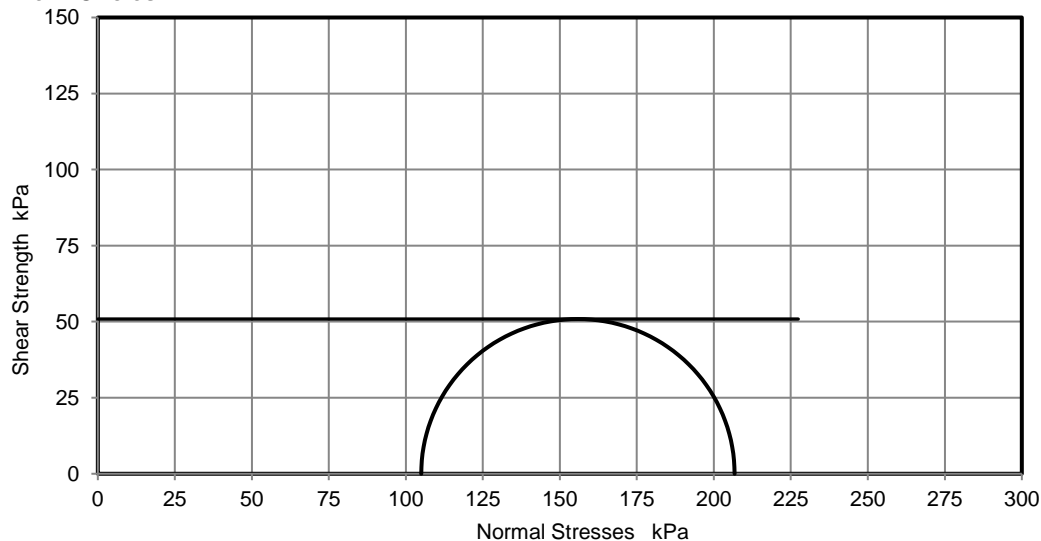
2.0	%/min
105	kPa
20.0	%
102	kPa
51	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

Borehole/Pit No. BH02

Site Name Arklow Sewerage Scheme Marine Outfall GI

Sample No. 25

Soil Description Brown slightly sandy slightly gravelly silty CLAY.

Depth 7.00

Specimen Reference 2 Specimen Depth m

Sample Type UT

Specimen Description Firm brown slightly sandy slightly gravelly silty CLAY.

KeyLAB ID Caus2017090757

Test Method BS1377 : Part 7 : 1990, clause 8, single specimen

Date of test 21/09/2017

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

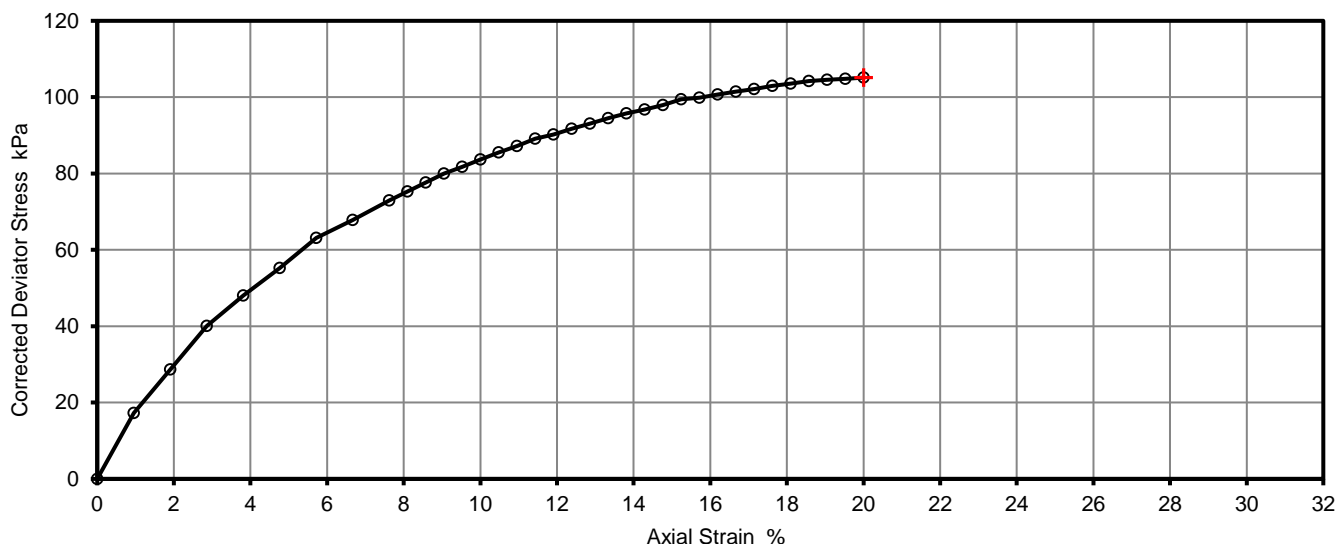
1	
210.0	mm
105.2	mm
1.98	Mg/m3
18.7	%
1.67	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

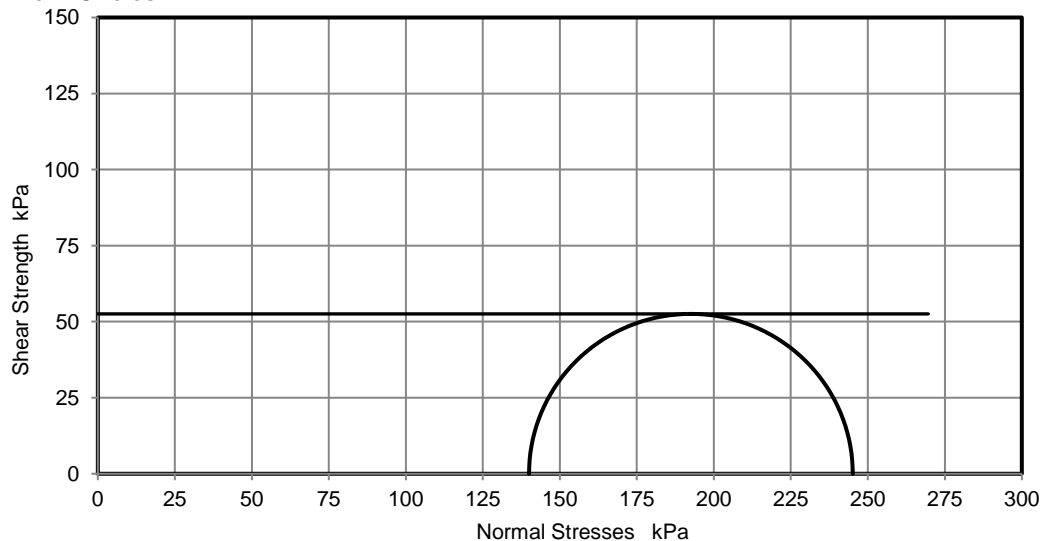
2.0	%/min
140	kPa
20.0	%
105	kPa
53	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength, cu  
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

Borehole/Pit No. BH02

Site Name Arklow Sewerage Scheme Marine Outfall GI

Sample No. 27

Soil Description Brownish grey slightly sandy silty CLAY.

Depth 10.50

Specimen Reference 2 Specimen Depth m

Sample Type UT

Specimen Description Firm brownish grey slightly sandy silty CLAY.

KeyLAB ID Caus2017090763

Test Method BS1377 : Part 7 : 1990, clause 8, single specimen

Date of test 21/09/2017

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

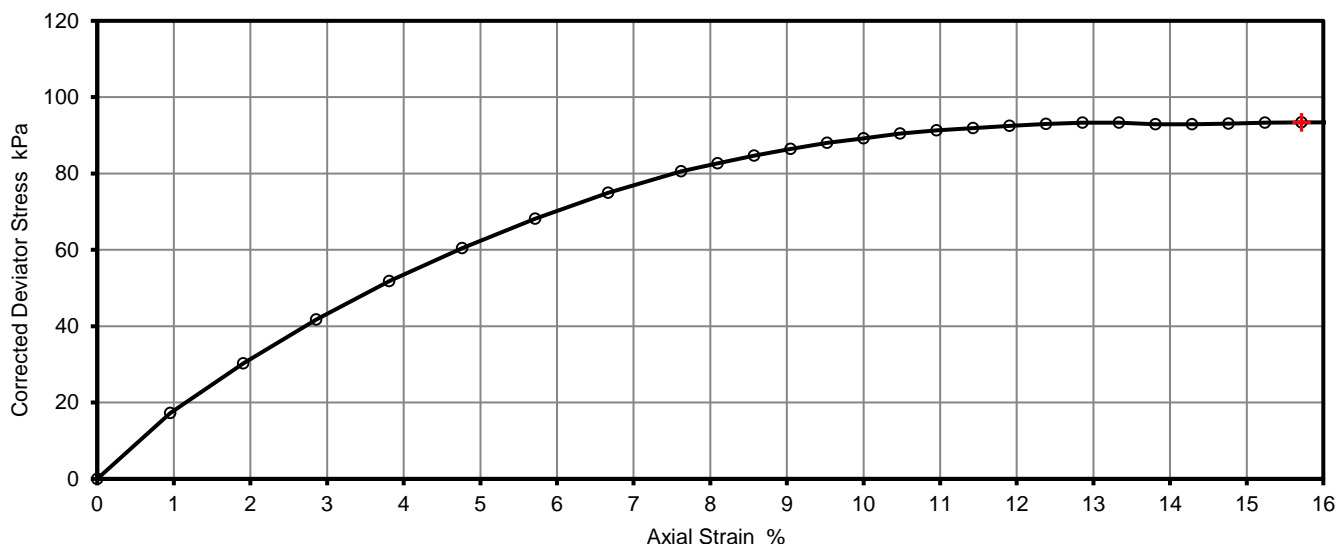
1	
210.0	mm
105.2	mm
1.96	Mg/m3
28.9	%
1.52	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

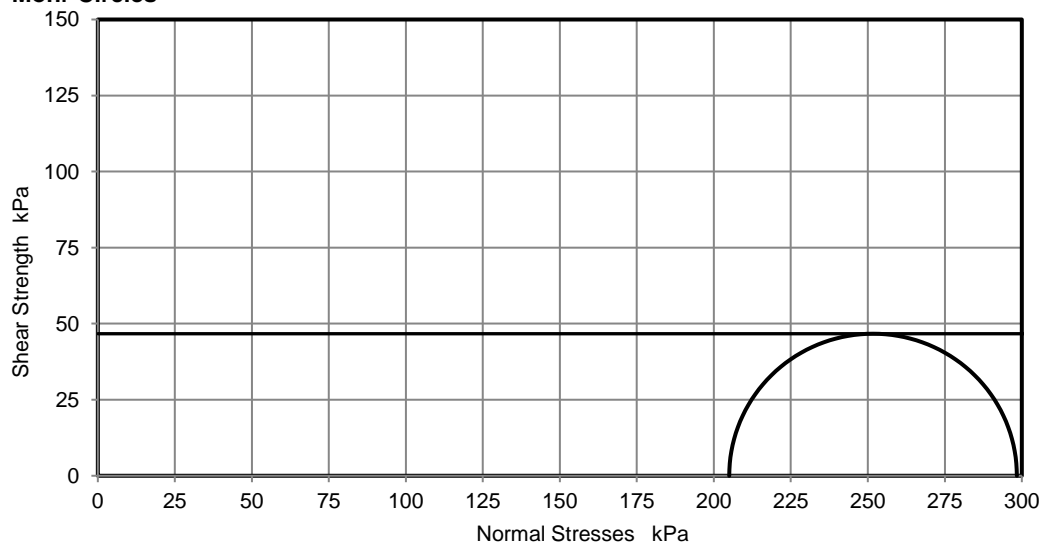
2.0	%/min
205	kPa
15.7	%
93	kPa
47	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Plastic	

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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.

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH15
Sample No.	25
Depth	5.00
Sample Type	UT
KeyLAB ID	Caus2017090776
Date of test	21/09/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey slightly sandy silty CLAY.		
Specimen Reference	2	Specimen Depth	m
Specimen Description	Stiff grey slightly sandy silty CLAY.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

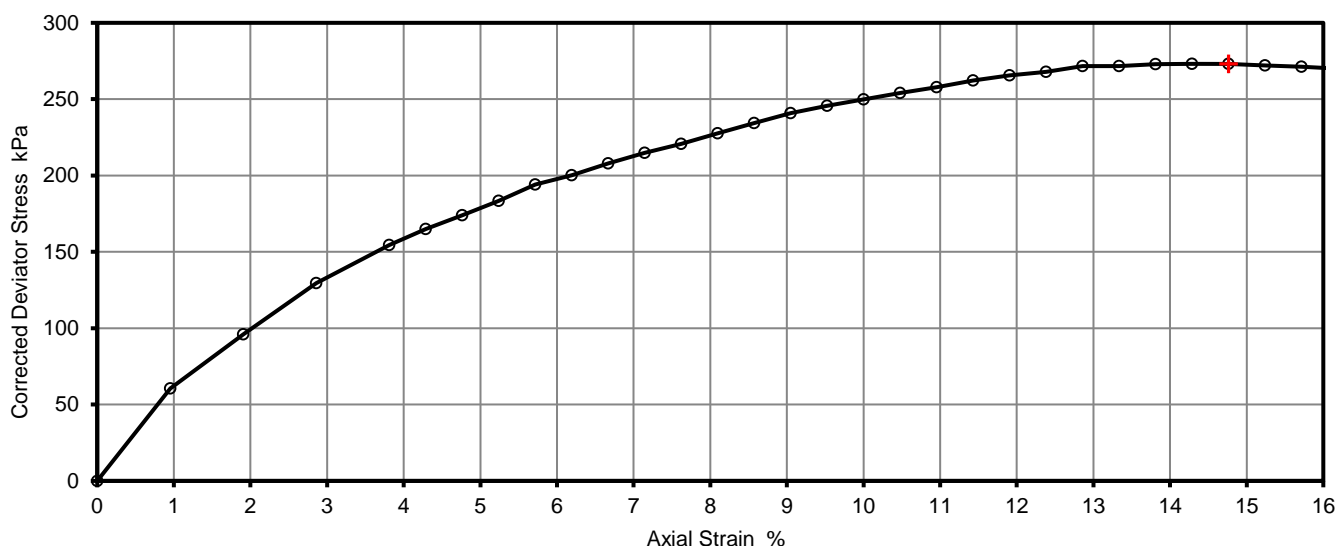
1	
210.0	mm
105.2	mm
1.99	Mg/m3
23.9	%
1.61	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

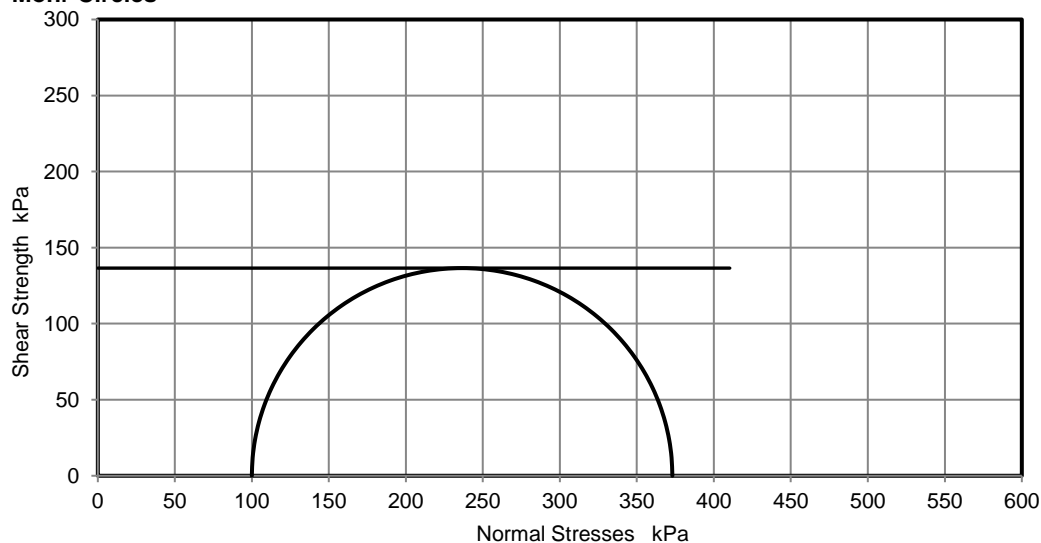
Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

2.0	%/min
100	kPa
14.8	%
273	kPa
137	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Brittle	

Deviator Stress v Axial Strain



Mohr Circles



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.

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH15
Sample No.	26
Depth	9.00
Sample Type	UT
KeyLAB ID	Caus2017090782
Date of test	21/09/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Brown slightly sandy slightly gravelly silty CLAY.		
Specimen Reference	2	Specimen Depth	m
Specimen Description	Firm brown slightly sandy slightly gravelly silty CLAY.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

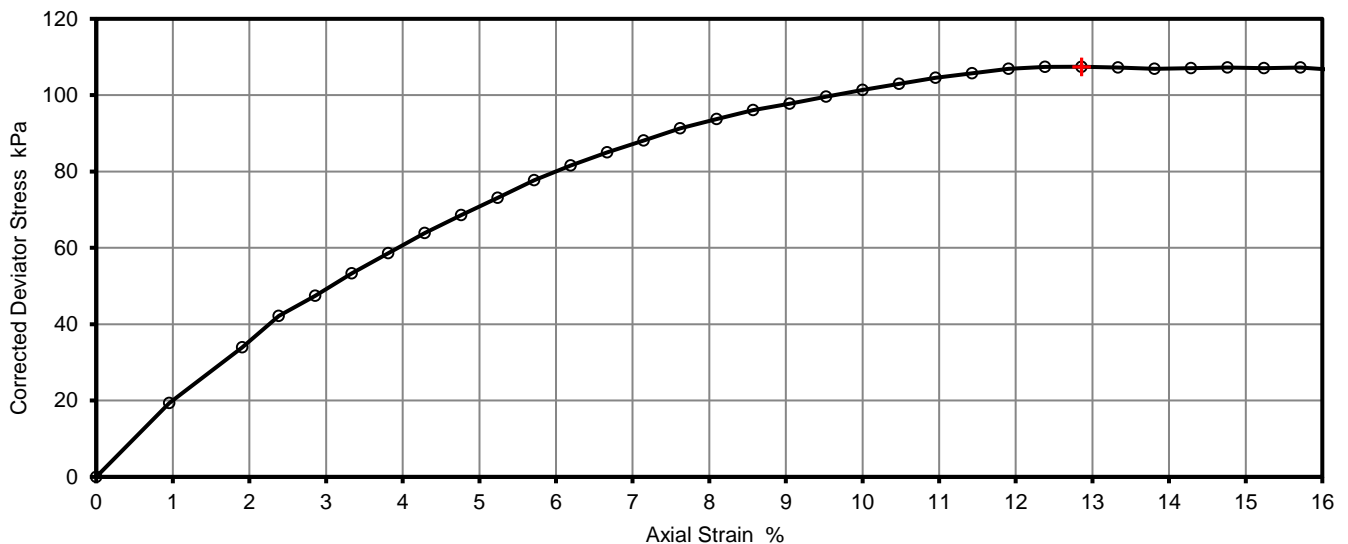
1	
210.0	mm
105.2	mm
2.05	Mg/m3
30.4	%
1.57	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

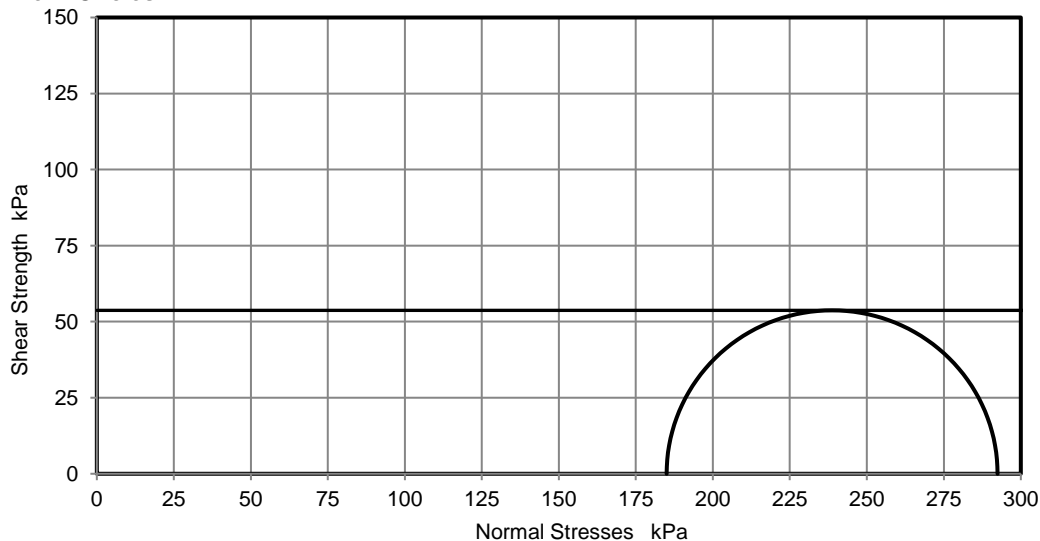
Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

2.0	%/min
185	kPa
12.9	%
107	kPa
54	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Brittle	

Deviator Stress v Axial Strain



Mohr Circles



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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## Arklow Sewerage Scheme

Ref:	17-0167	Size mm	100	Initial wet mass g	781
BH	BH02	Thickness mm	35.25	Bulk Density mg/m3	2215

Depth m	3.0m		
Our Ref	Y		$\sigma'_v$ kPa
Soil type	Sandy GRAVEL		
Rate of shearing mm/min	0.5		30
>10 mm removed			30
			120

Peak		Ultimate	
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ kPa
30		30	38
30		30	38
120		120	108

Peak angle of internal friction

Cohesion kPa

Ultimate angle of internal friction

43

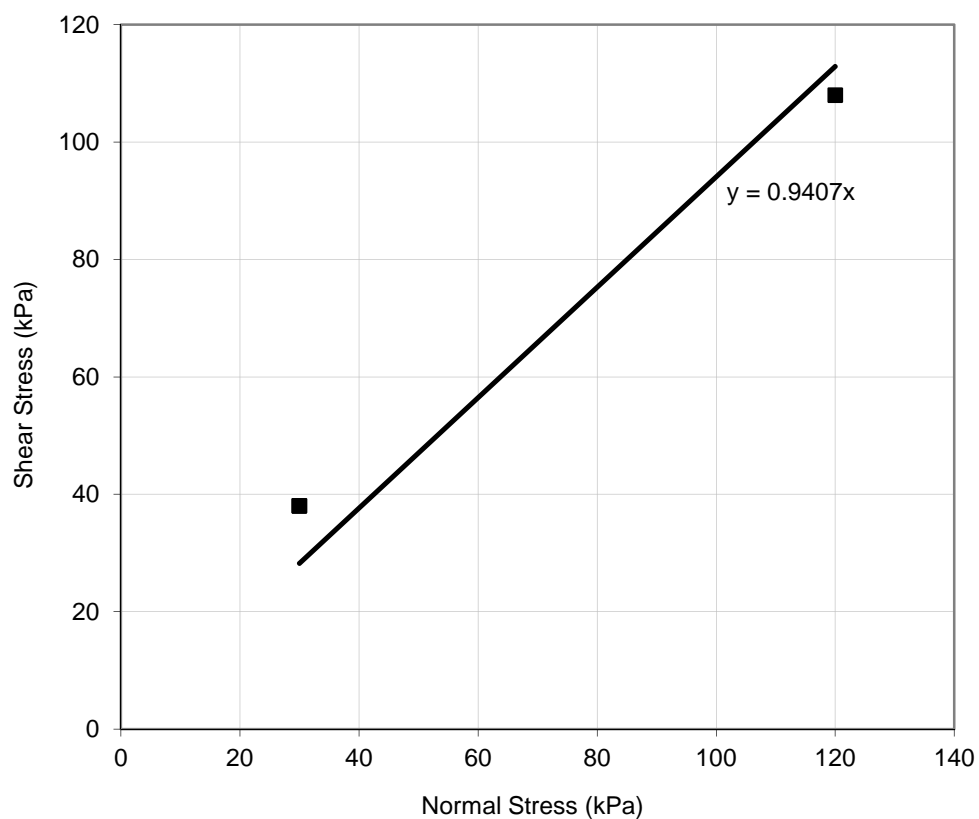


Figure 1 Failure Envelope

## Arklow Sewerage Scheme

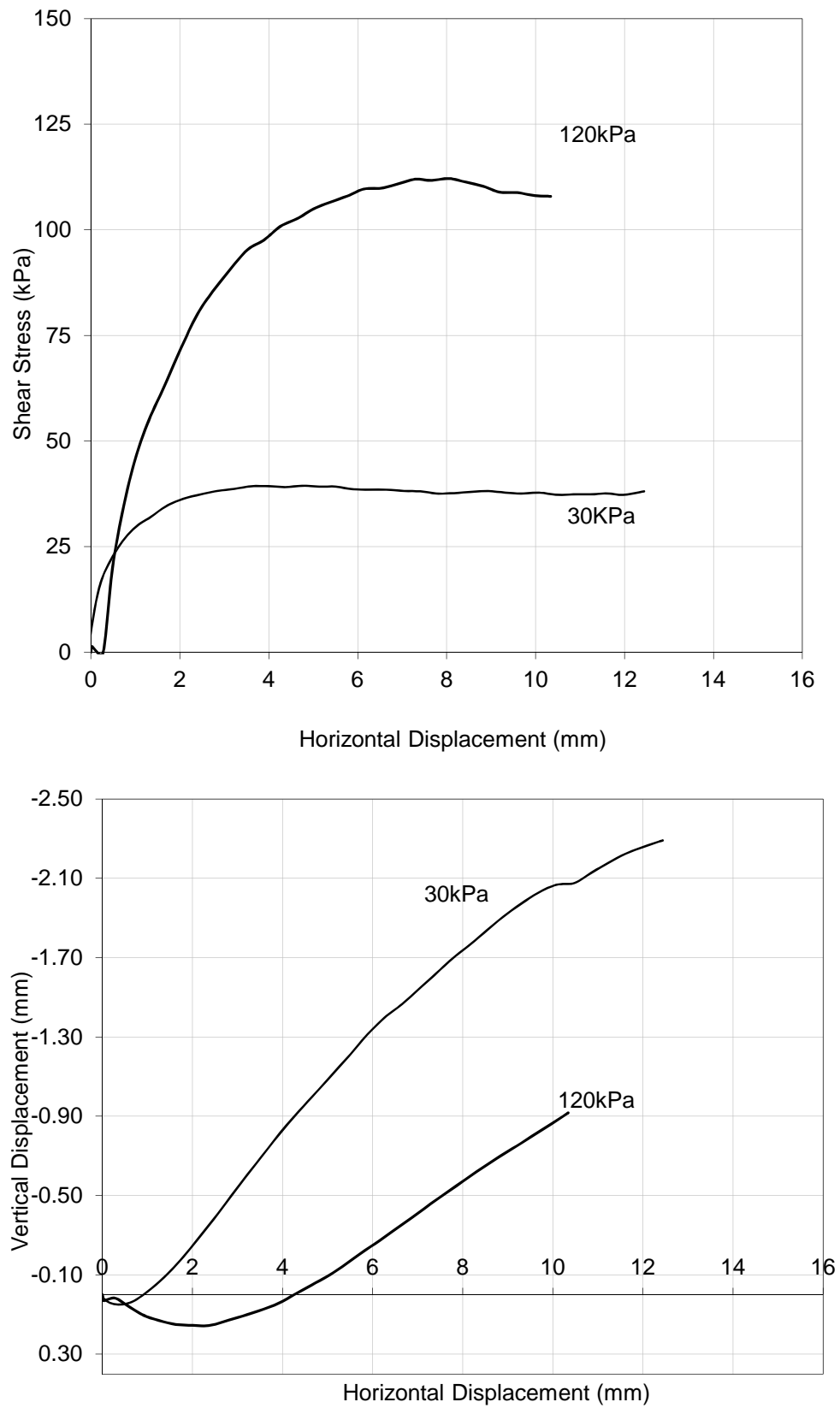


Figure 2 Stress-strain behaviour

<b>Arklow Sewerage Scheme</b>
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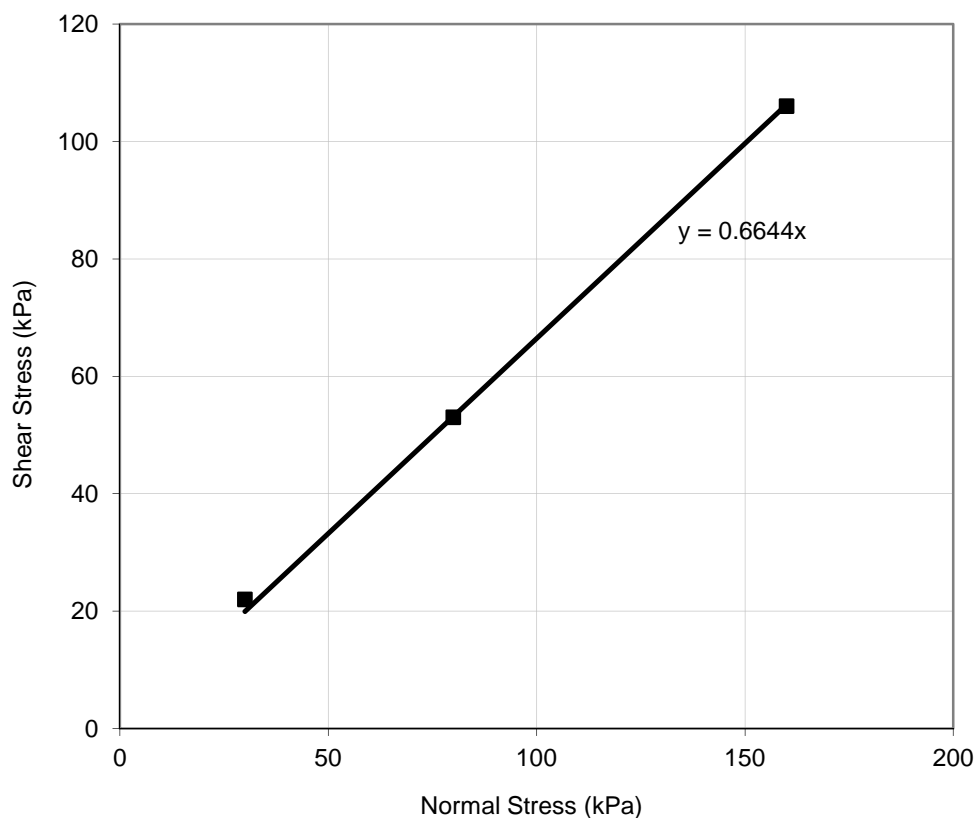
				Loading 30 kPa	
Ref:	17-0167	Size mm	100	Initial wet mass g	719
BH	BH02	Thickness mm	35.75	Bulk Density mg/m <sup>3</sup>	1804
Depth m	9.0m			Final wet mass g	685
Our Ref	Z			Dry mass g	615
Soil type	Clayey sandy SILT		$\sigma'_v$ kPa	Initial water content %	16.9
Rate of shearing mm/min		0.015	30	Final water content %	11.4
			80	Loading 80 kPa	
			160	Initial wet mass g	793
				Bulk Density mg/m <sup>3</sup>	1804
				Final wet mass g	751
				Dry mass g	641
				Initial water content %	23.7
				Final water content %	17.2
				Loading 160 kPa	
				Initial wet mass g	771
				Bulk Density mg/m <sup>3</sup>	1804
				Final wet mass g	714
				Dry mass g	601
				Initial water content %	28.3
				Final water content %	18.8

Peak		Ultimate	
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ kPa
30		30	22
80		80	53
160		160	106

Peak angle of internal friction	0
Cohesion kPa	33
Ultimate angle of internal friction	33



**Figure 1 Failure Envelope**

## Arklow Sewerage Scheme

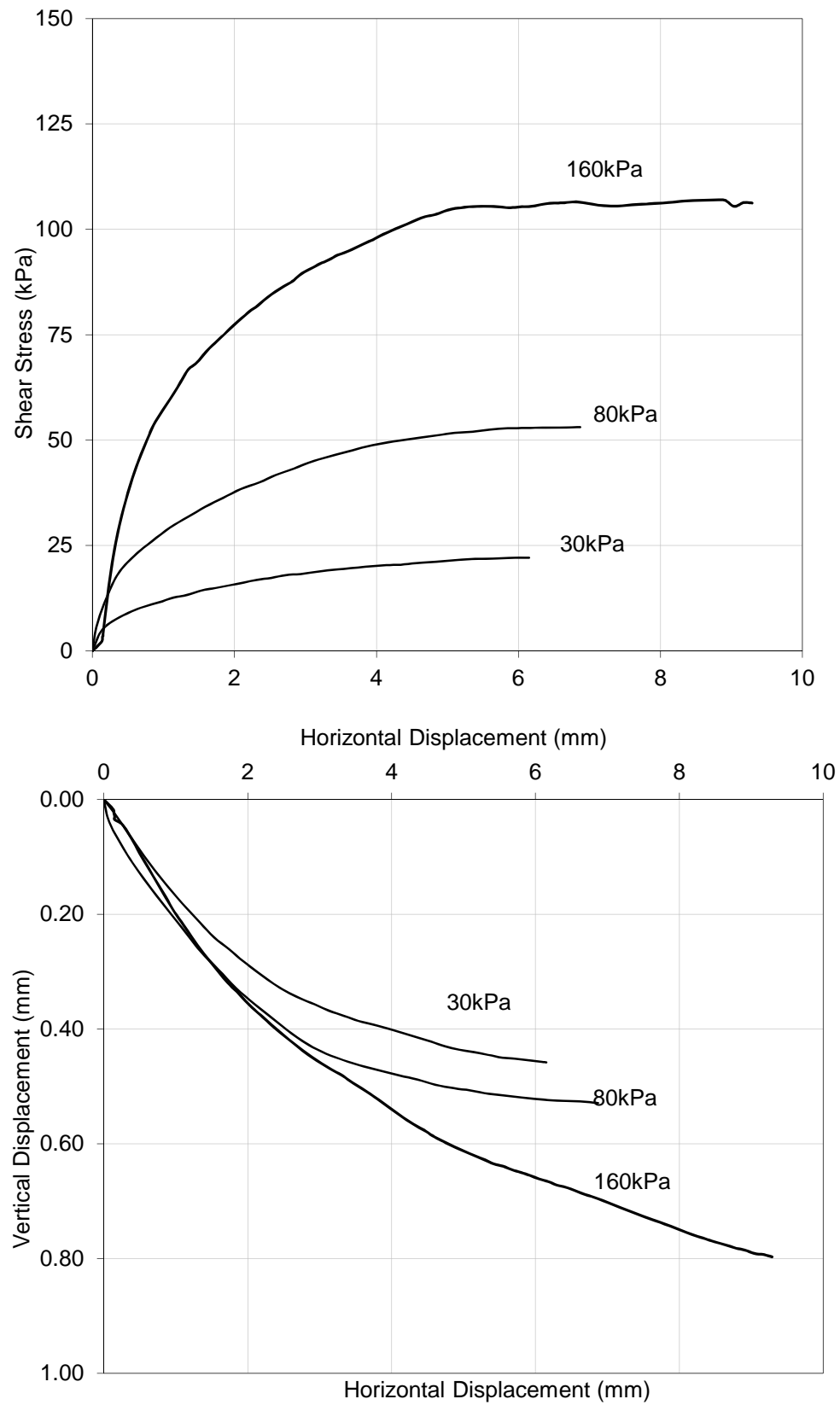


Figure 2 Stress-strain behaviour

QUB	Geotechnical Testing Laboratory
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## Arklow Sewerage Scheme

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		$\sigma'_v$ kPa
Soil type	SAND		
Rate of shearing mm/min	0.5		70
>10 mm removed			140
			210

Peak		Ultimate	
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ kPa
70		70	59
140		140	124
210		210	180

Peak angle of internal friction

Cohesion kPa

Ultimate angle of internal friction

40

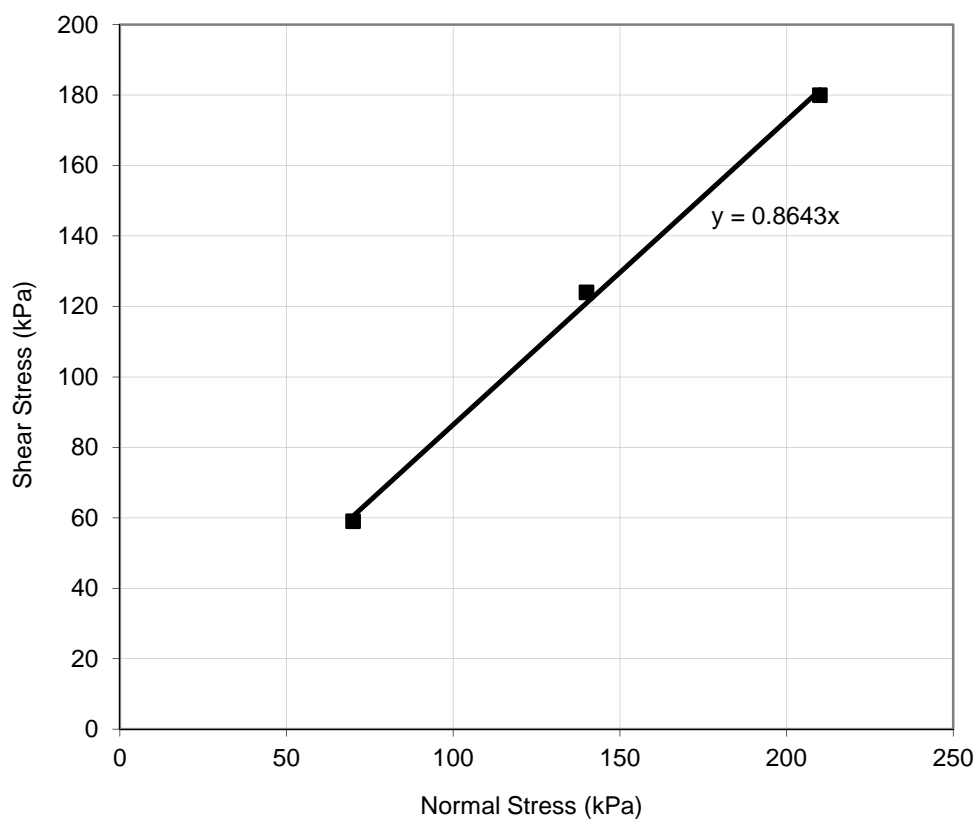


Figure 1 Failure Envelope



## Arklow Sewerage Scheme

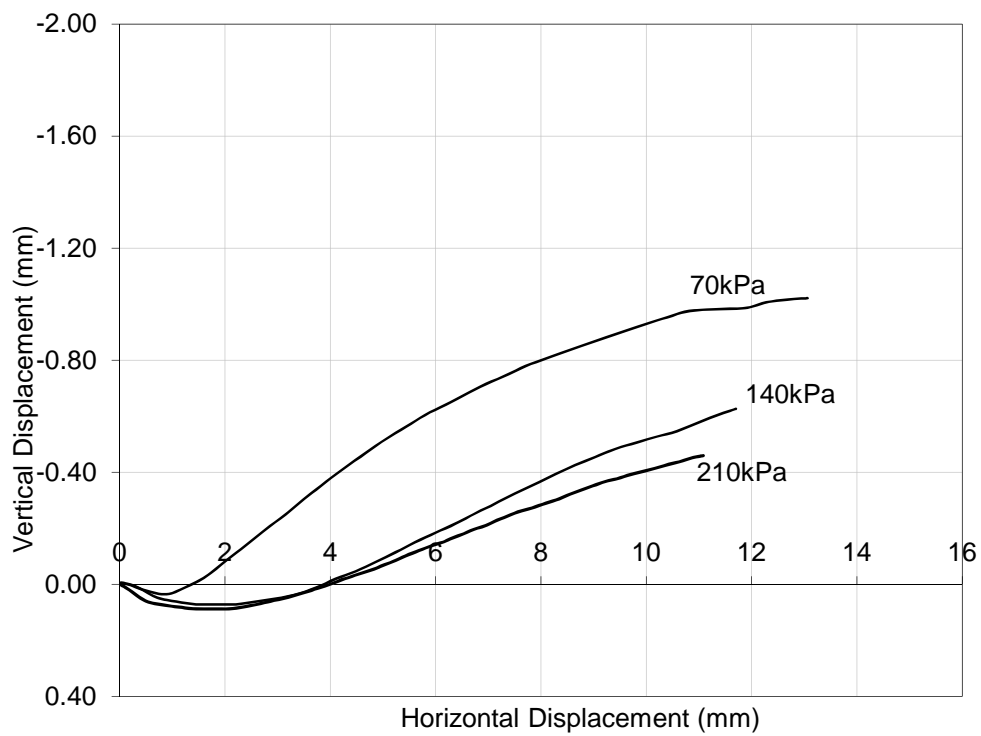
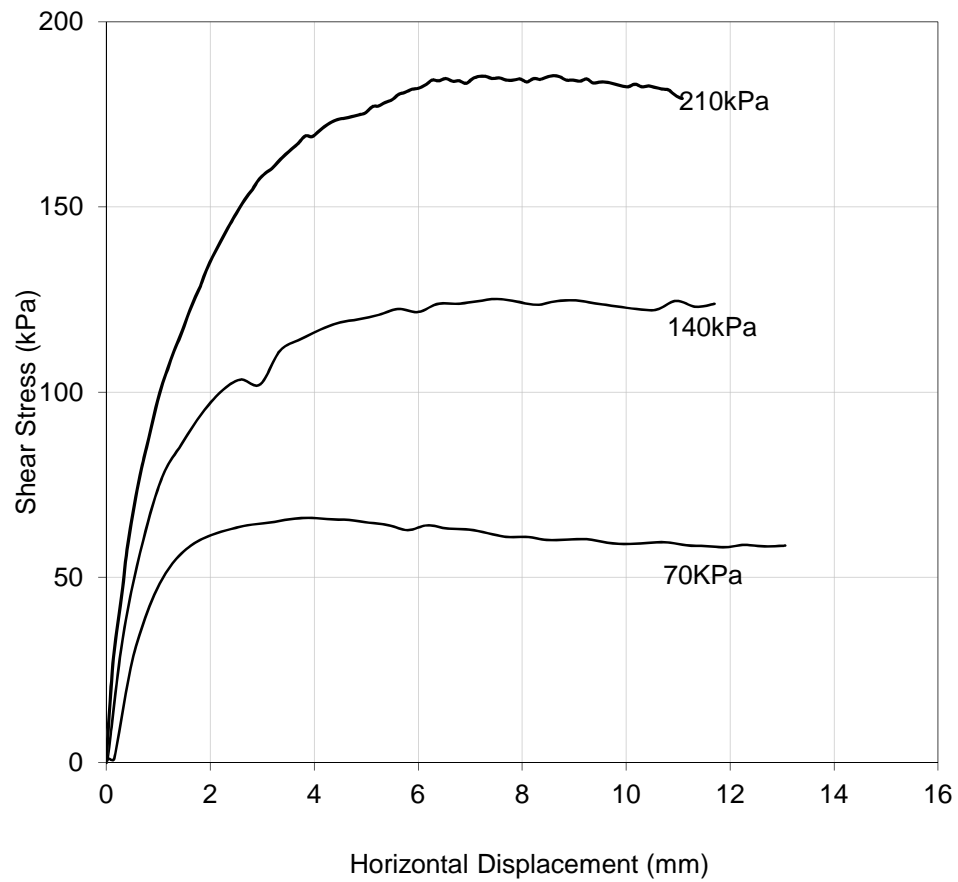


Figure 2 Stress-strain behaviour

<b>QUB</b>	<b>Geotechnical Testing Laboratory</b>
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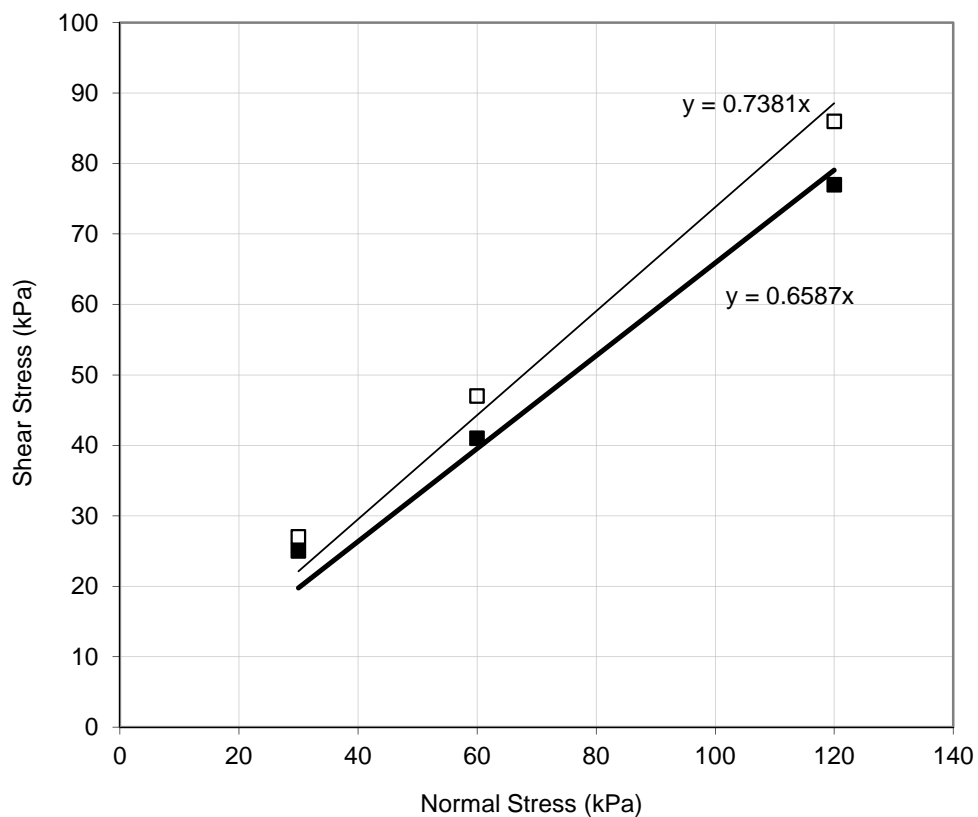
### Arklow Sewerage Scheme

Ref:	17-0167	Size mm	100	Initial wet mass g	616
BH	BH15	Thickness mm	33.25	Bulk Density mg/m3	1852

Depth m	3.5m		
Our Ref	U		$\sigma'_v$ kPa
Soil type	SAND		
Rate of shearing mm/min	0.5	30	
>10 mm removed		60	
		120	

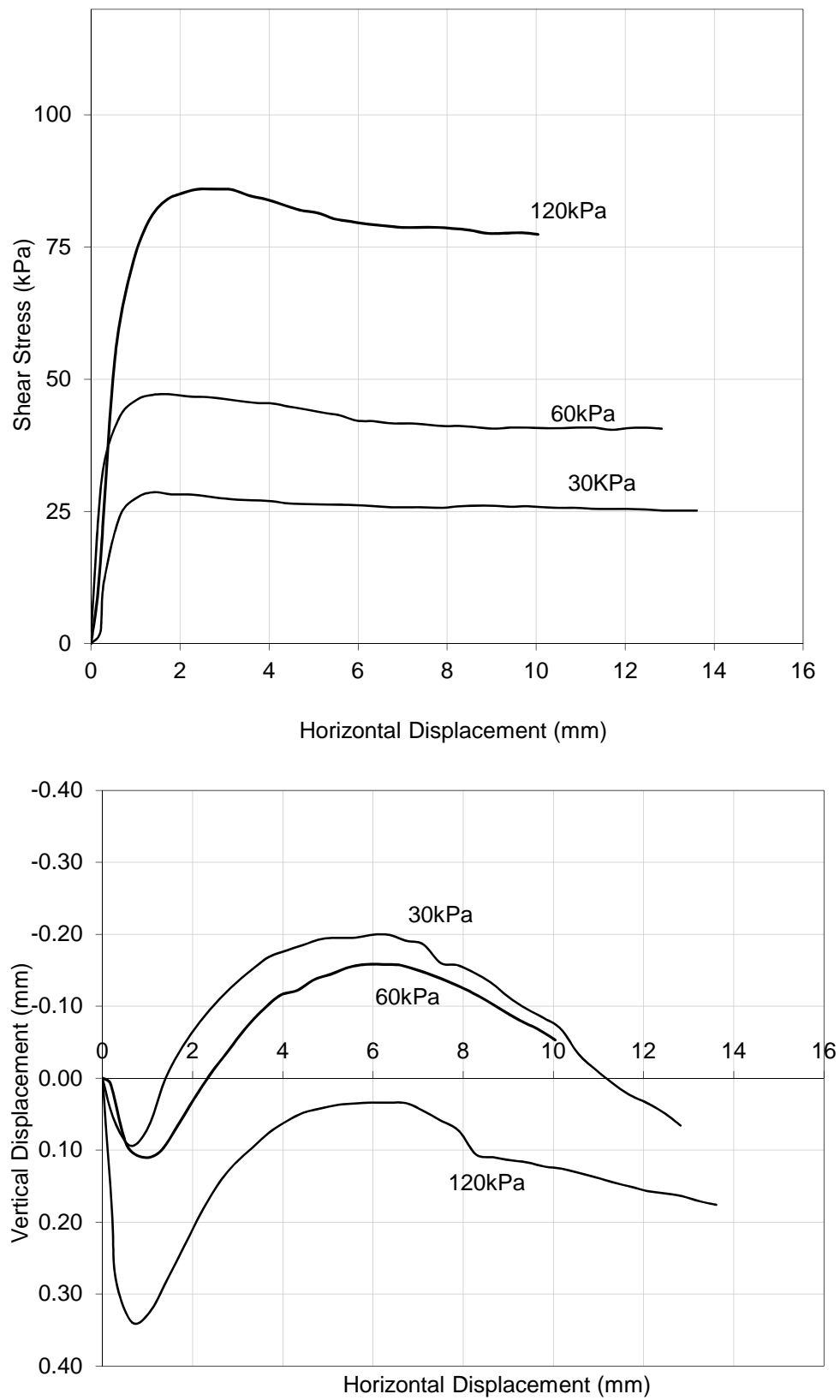
Peak		Ultimate	
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ kPa
30	27	30	25
60	47	60	41
120	86	120	77

Peak angle of internal friction **36**  
Cohesion kPa  
Ultimate angle of internal friction **33**



**Figure 1 Failure Envelope**

## Arklow Sewerage Scheme



**Figure 2 Stress-strain behaviour**



2183

# 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.:**


**Order No.:**

**No. of Samples:** 2

**Turnaround (Wkdays):** 5

**Date Approved:** 22-Sep-2017

**Approved By:**



**Details:** Keith Jones, Technical Manager

**Date Received:** 18-Sep-2017**Date Instructed:** 18-Sep-2017**Results Due:** 22-Sep-2017

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

<b>Client: Causeway Geotech Ltd</b>	<b>Chemtest Job No.:</b>				17-24593	17-24593
Quotation No.:	<b>Chemtest Sample ID.:</b>				512740	512741
Order No.:	Client Location ID.:				BH02	BH02
	Client Sample Ref.:				14	15
	Sample Type:				SOIL	SOIL
	Top Depth (m):				1.00	2.00
	Date Sampled:				15-Sep-2017	15-Sep-2017
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>		
Moisture	N	2030	%	0.020	41	35
pH	U	2010		N/A		8.7
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	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:

[customerservices@chemtest.co.uk](mailto:customerservices@chemtest.co.uk)

# LABORATORY RESTRICTION REPORT

Project Reference	17-0167	To	Darren O'Mahony
Project Name	Arklow Sewerage Scheme Marine Outfall GI	Position	Project Manager
TR reference	17-0167 / 2	From	Stephen Watson
		Position	Laboratory Manager

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

Hole Number	Sample			Test Type	Reason for Restriction	Required Action
	Number	Depth (m)	Type			
BH02	16	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	B	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

Laboratory Signature Stephen Watson	Project Manager Signature Darren O'Mahony
Date 25 September 2017	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

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

---

### 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

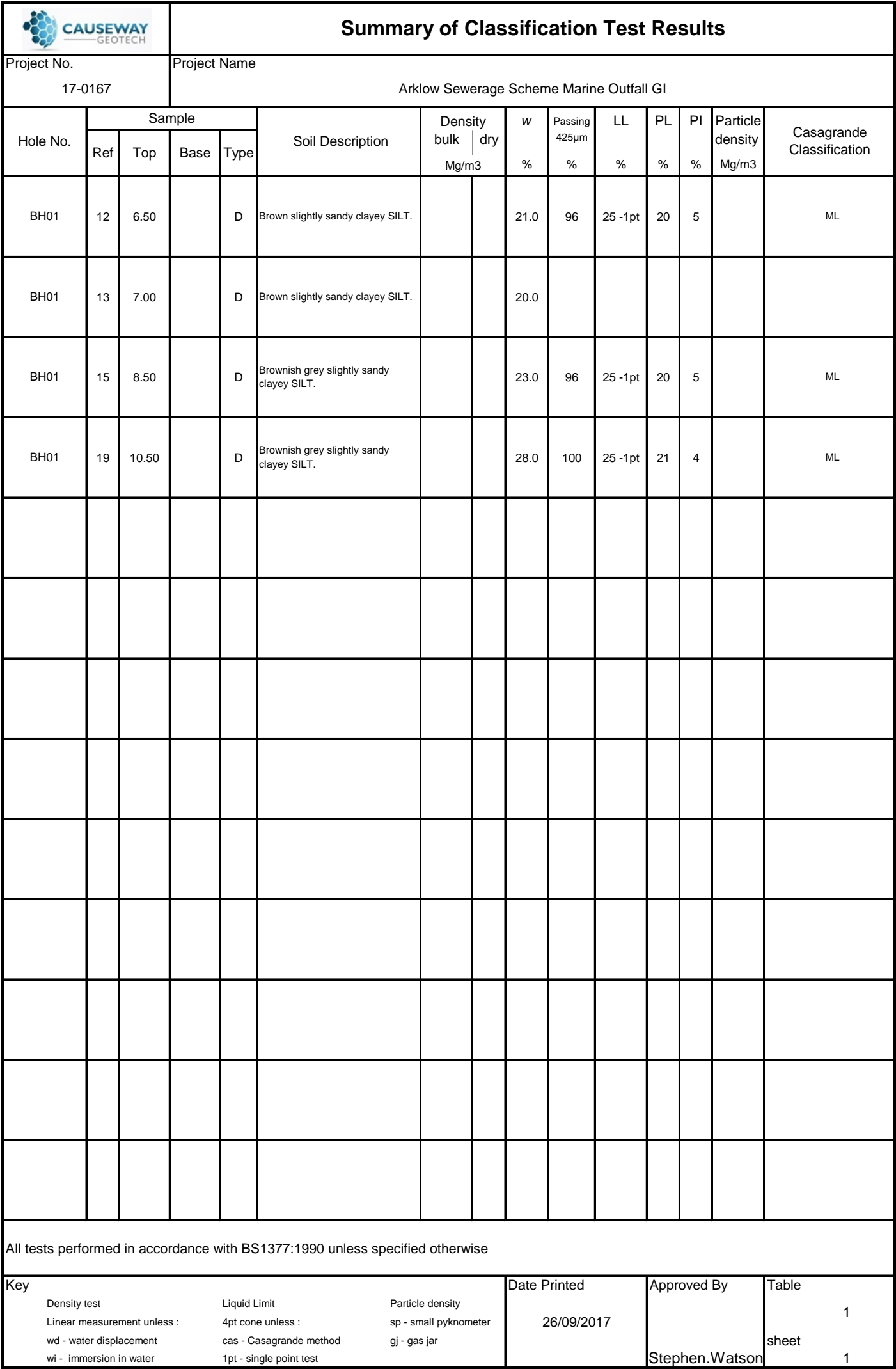


**Project Name**                **Arklow Sewerage Scheme Marine Outfall GI**

**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





## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH01

Site Name

Arklow Sewerage Scheme Marine Outfall 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

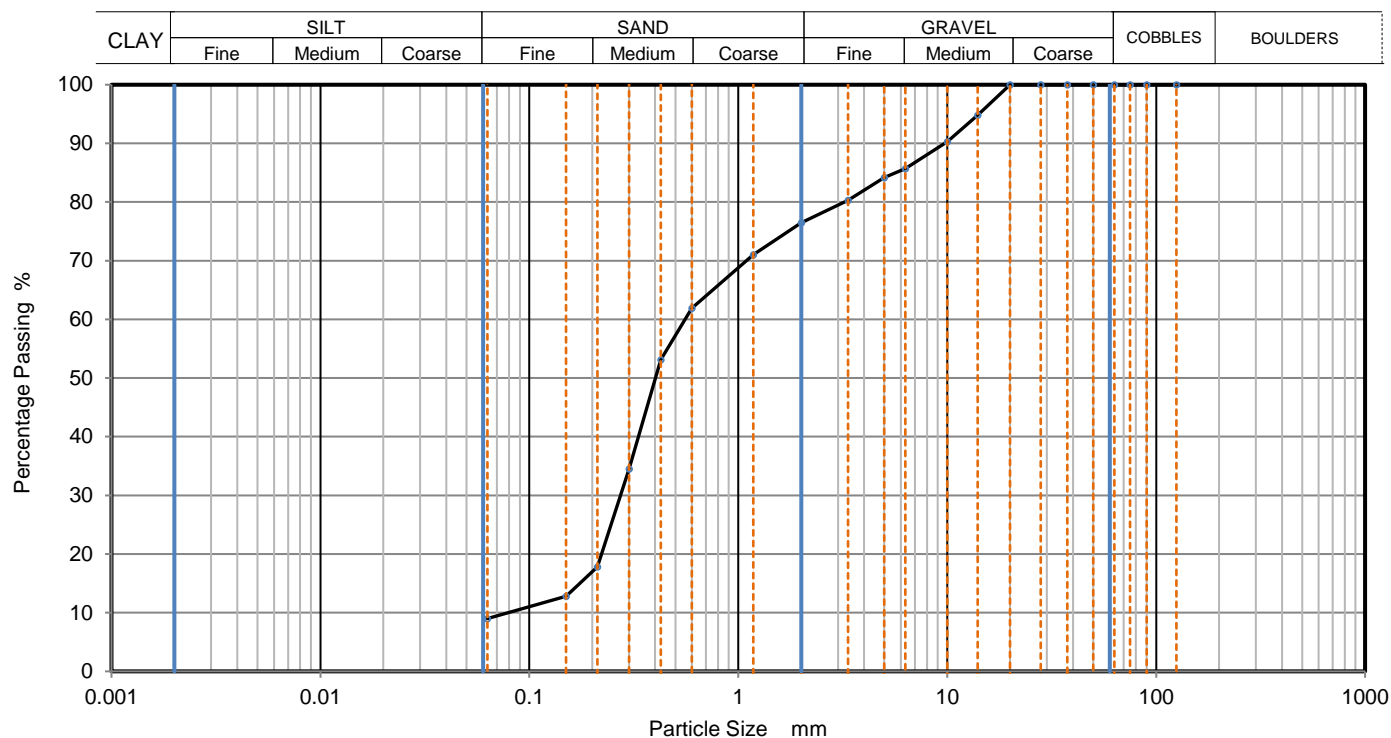
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201709120



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	24
Sand	68
Fines <0.063mm	9

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

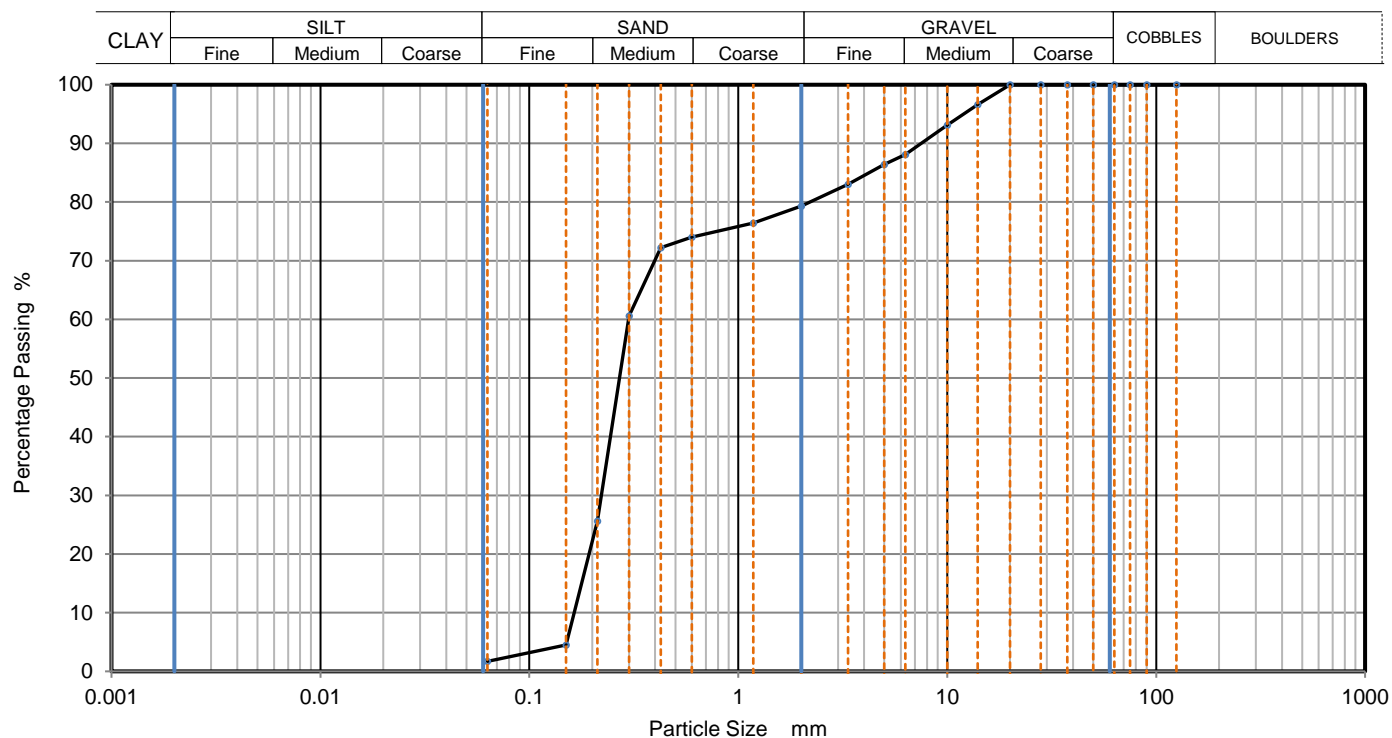
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201709121



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	21
Sand	78
Fines <0.063mm	2

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

Remarks

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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  
Depth

m

Sample Type

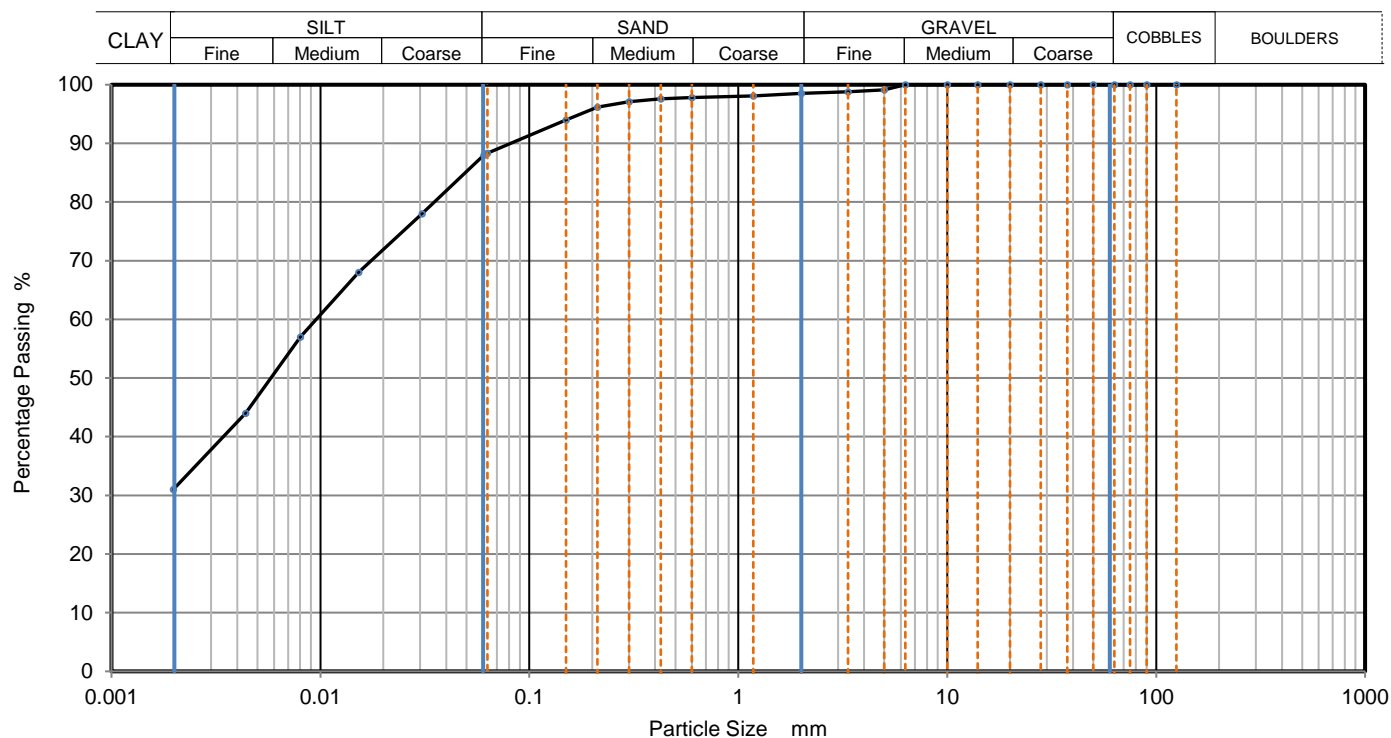
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201709122



Sieving		Sedimentation	
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) 3.00 Mg/m <sup>3</sup>	
0.425	98		
0.3	97		
0.212	96		
0.15	94		
0.063	88		

Dry Mass of sample, g

1447

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	10
Silt	57
Clay	31

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH01

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

10

Soil Description

Brown slightly sandy subrounded fine to coarse GRAVEL.

Depth, m

4.80

Specimen Reference

3

Specimen  
Depth

m

Sample Type

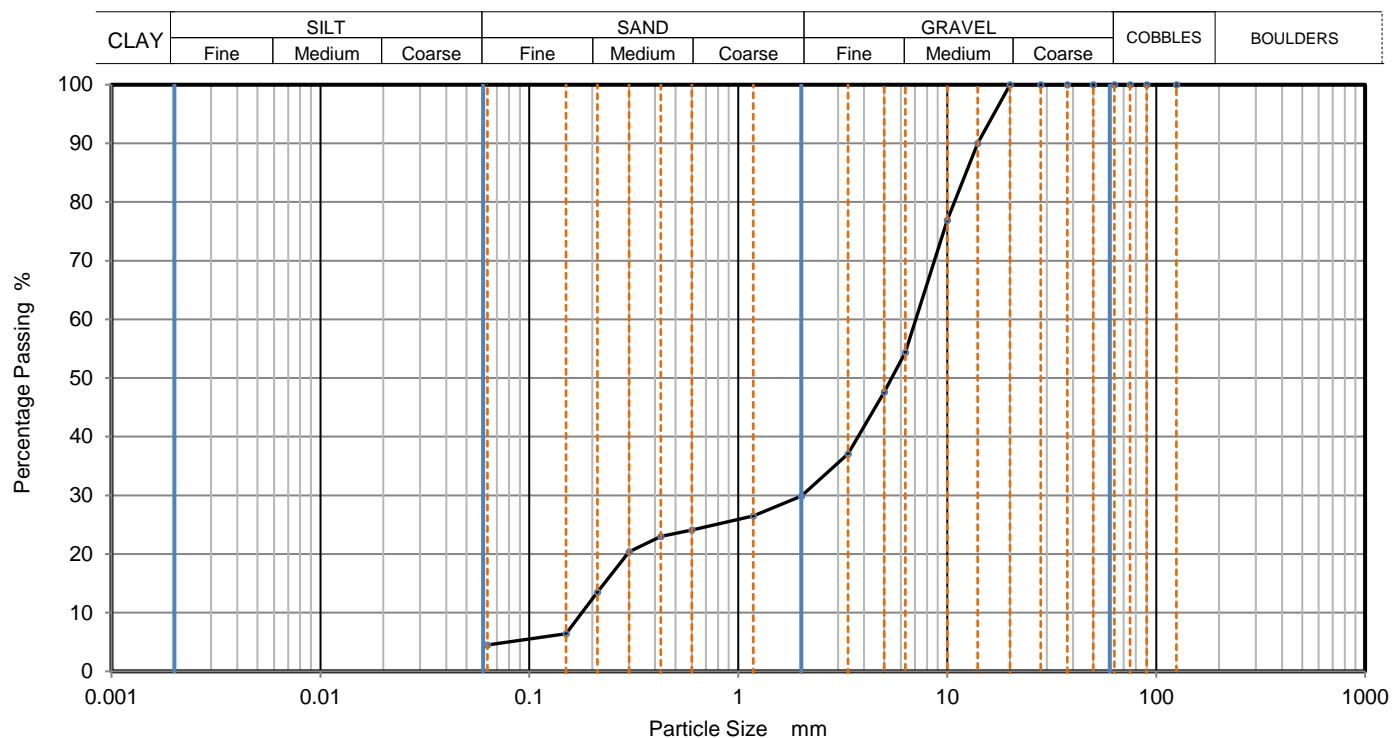
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201709123



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	39
Curvature Coefficient	3.2

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH01

Site Name

Arklow 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

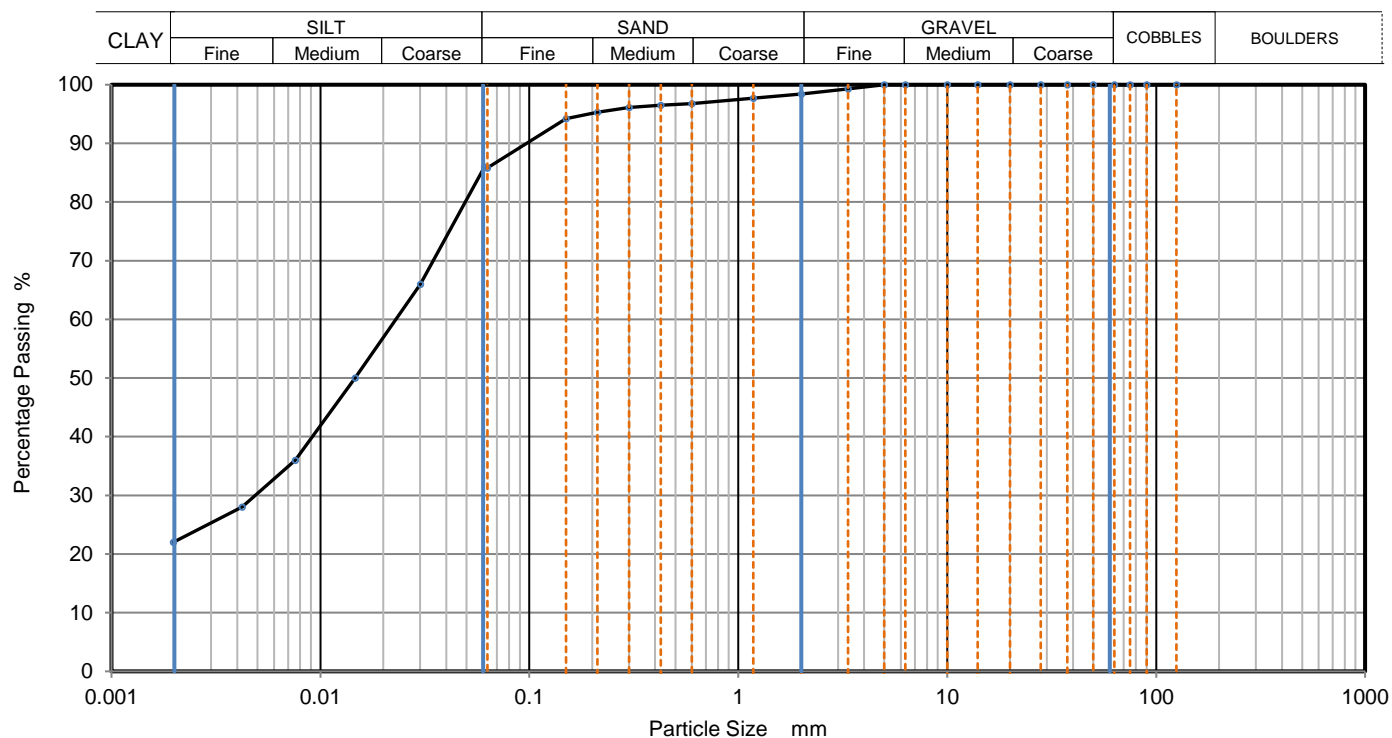
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201709124



Sieving		Sedimentation	
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) 3.00 Mg/m <sup>3</sup>	
0.425	97		
0.3	96		
0.212	95		
0.15	94		
0.063	86		

Dry Mass of sample, g

1107

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	13
Silt	64
Clay	22

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

Remarks

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

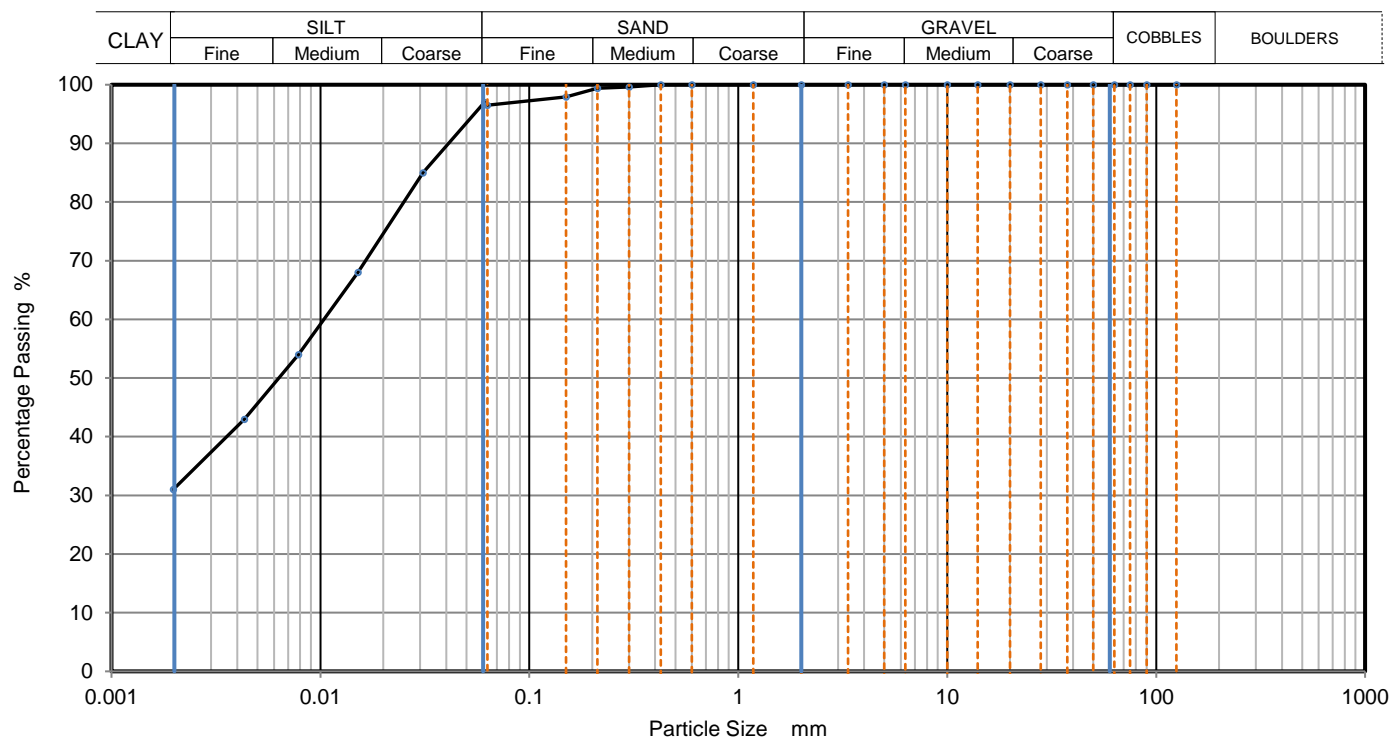
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201709127



Sieving		Sedimentation	
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) 3.00 Mg/m <sup>3</sup>	
0.425	100		
0.3	100		
0.212	99		
0.15	98		
0.063	97		

Dry Mass of sample, g

994

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	4
Silt	65
Clay	31

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

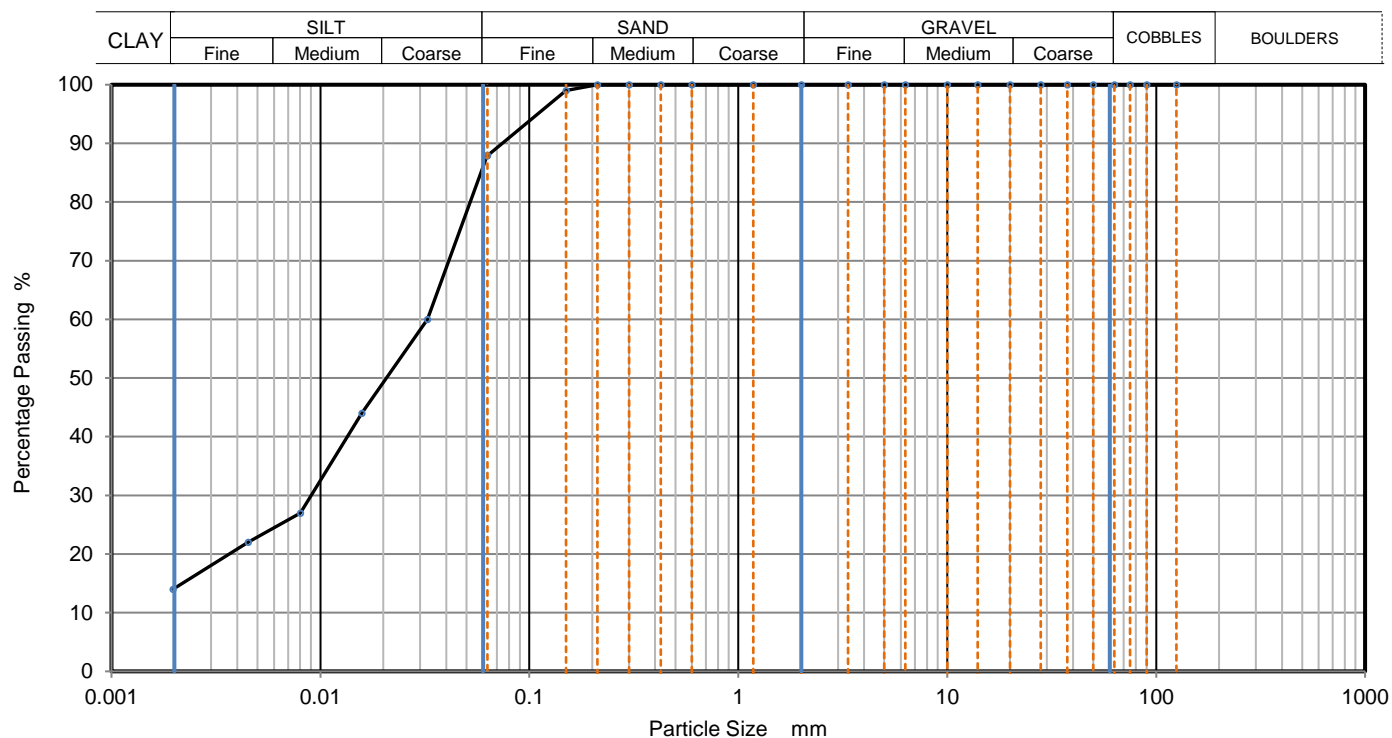
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017091210



Sieving		Sedimentation	
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) 3.00 Mg/m <sup>3</sup>	
0.425	100		
0.3	100		
0.212	100		
0.15	99		
0.063	88		

Dry Mass of sample, g

1561

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	12
Silt	74
Clay	14

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

Remarks

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

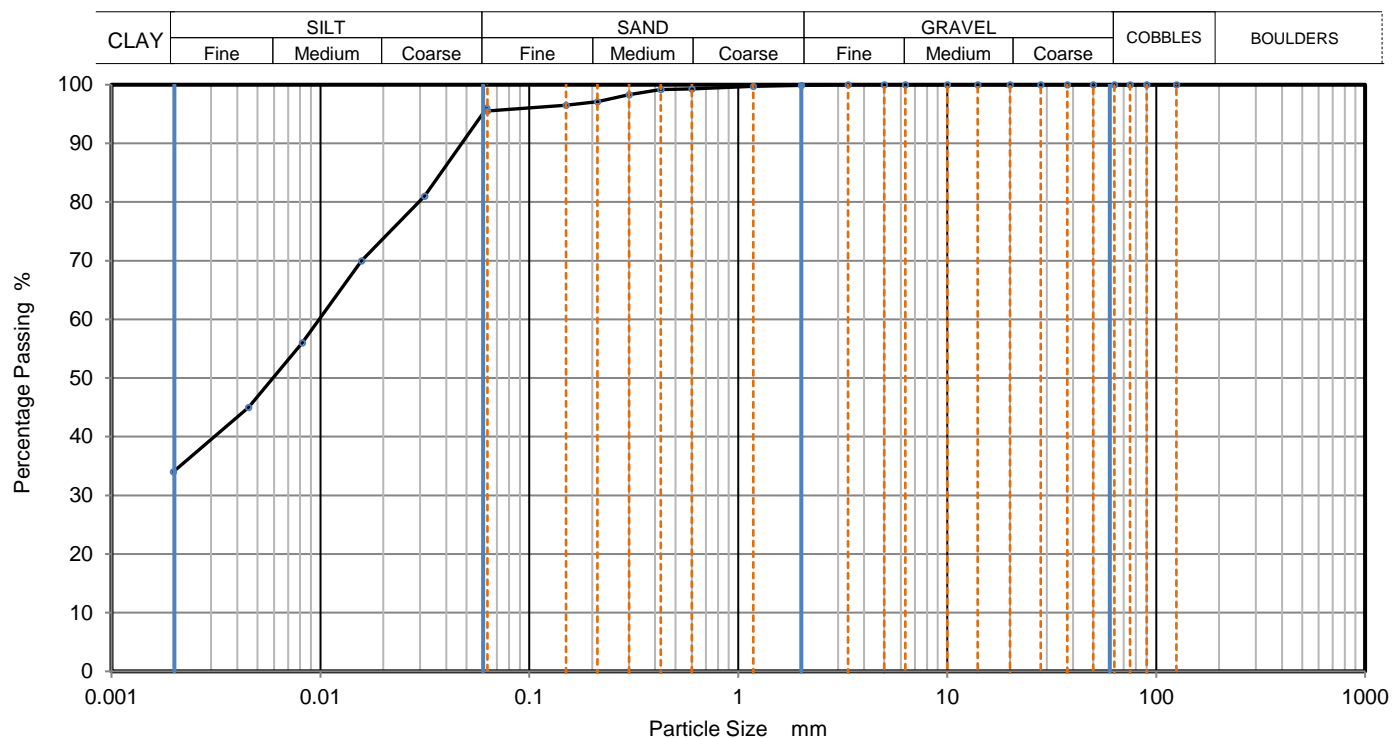
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017091212



Sieving		Sedimentation	
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) 3.00 Mg/m <sup>3</sup>	
0.425	99		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

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Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

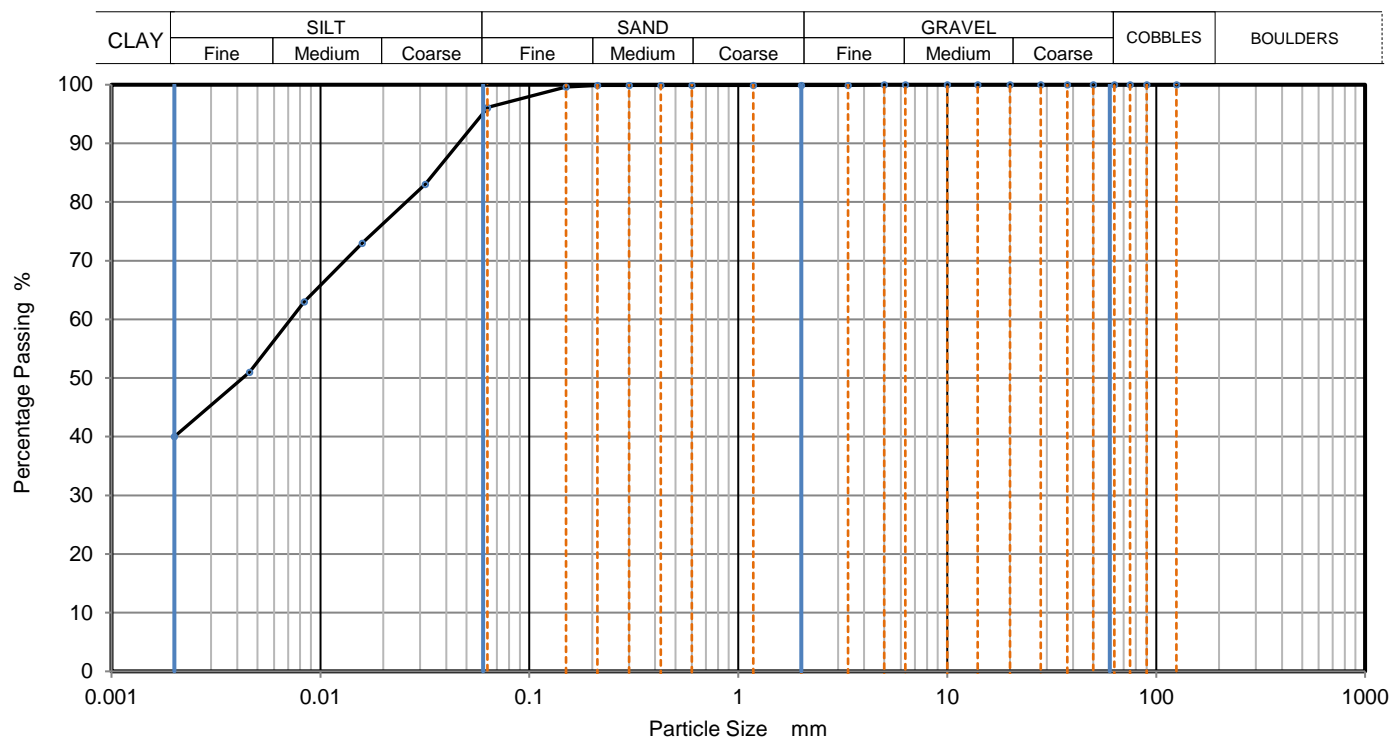
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017091214



Sieving		Sedimentation	
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) 3.00 Mg/m <sup>3</sup>	
0.425	100		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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  
Depth

m

Sample Type

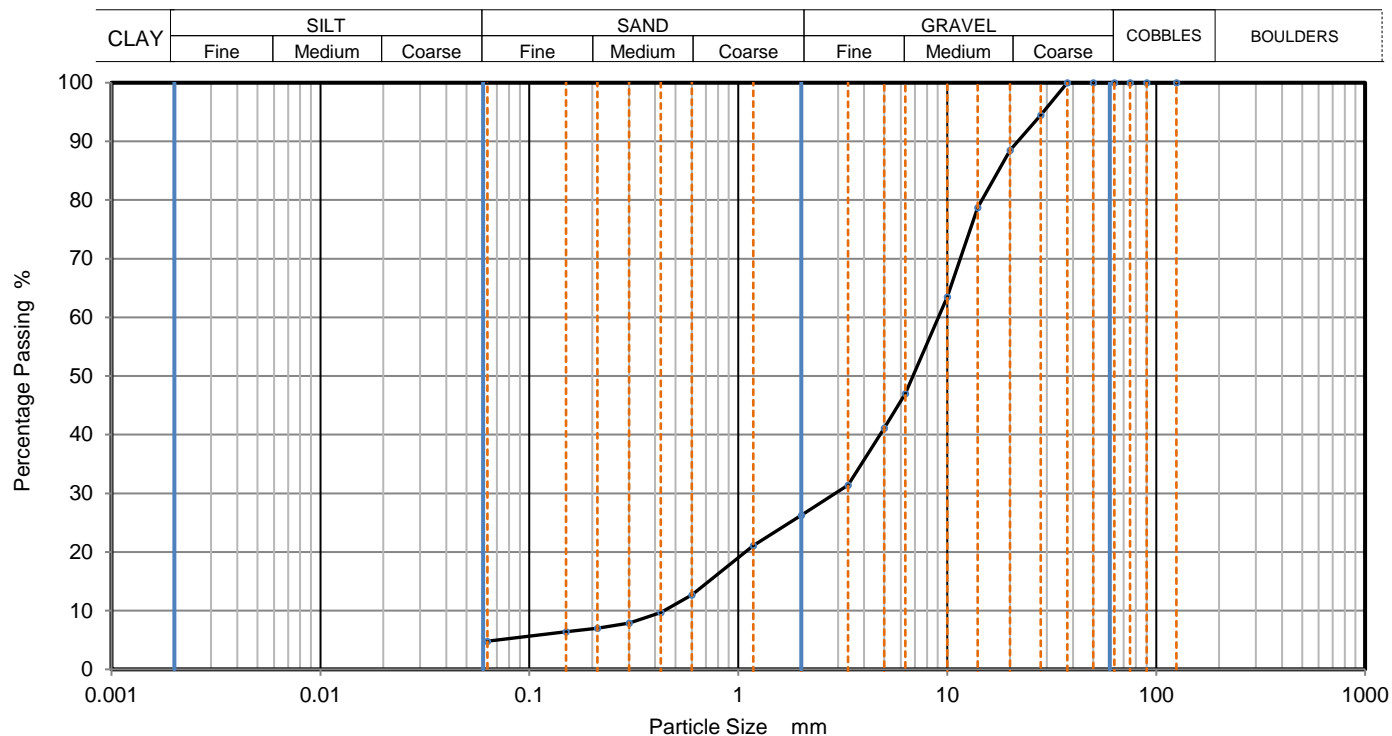
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017091215



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	21
Curvature Coefficient	2.1

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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26/09/2017 11:48

Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

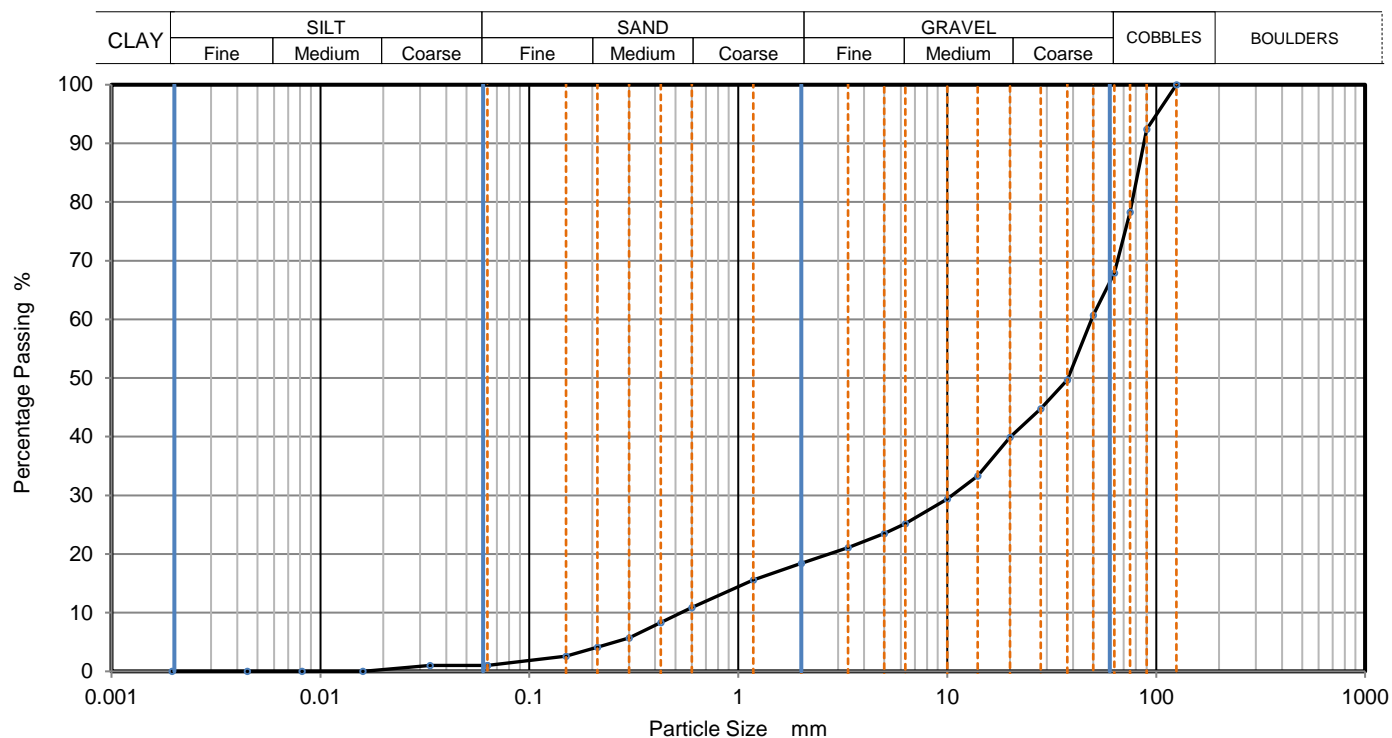
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017091216



Sieving		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) 2.65 Mg/m <sup>3</sup>	
0.425	8		
0.3	6		
0.212	4		
0.15	3		
0.063	1		

Dry Mass of sample, g

18464

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

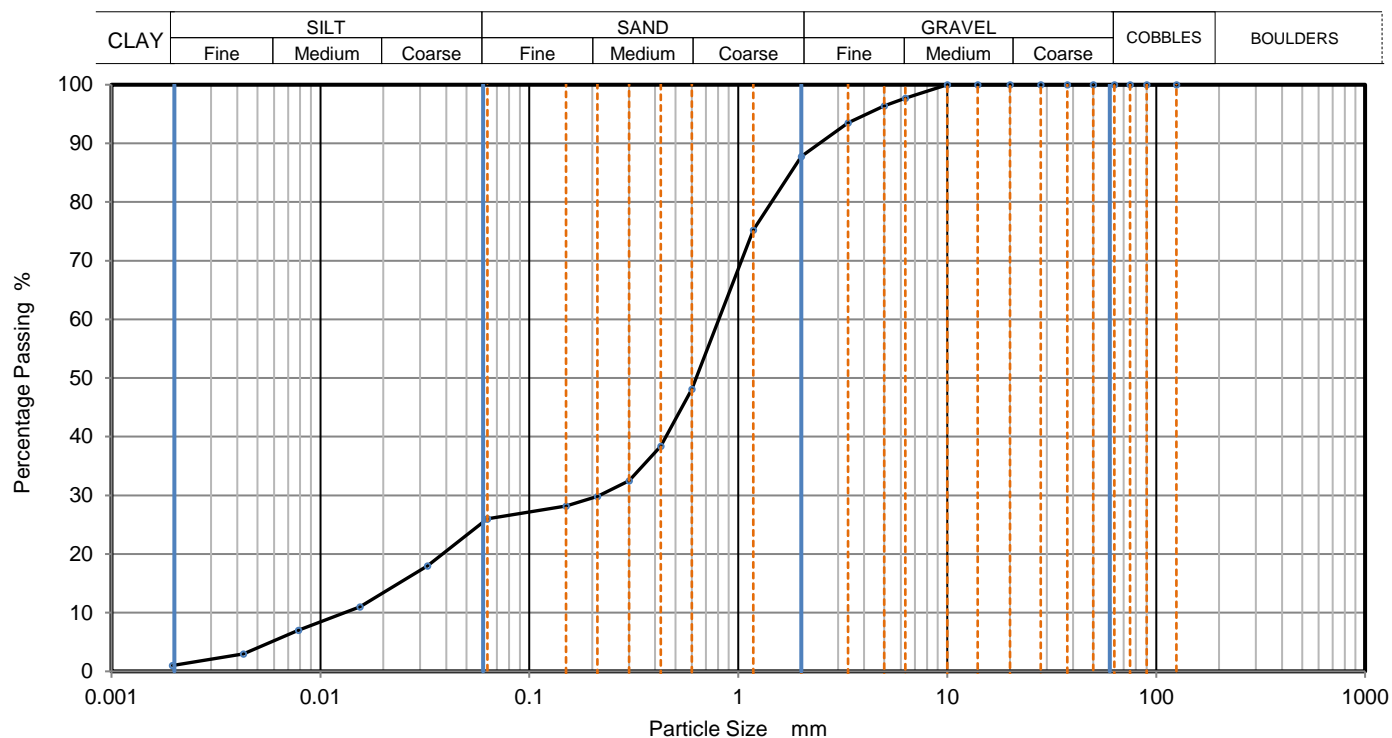
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017091217



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	38		
0.3	33		
0.212	30		
0.15	28		
0.063	26		

Dry Mass of sample, g

5626

Sample Proportions	% dry mass
Cobbles	0
Gravel	12
Sand	62
Silt	25
Clay	1

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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

3

Specimen  
Depth

m

Sample Type

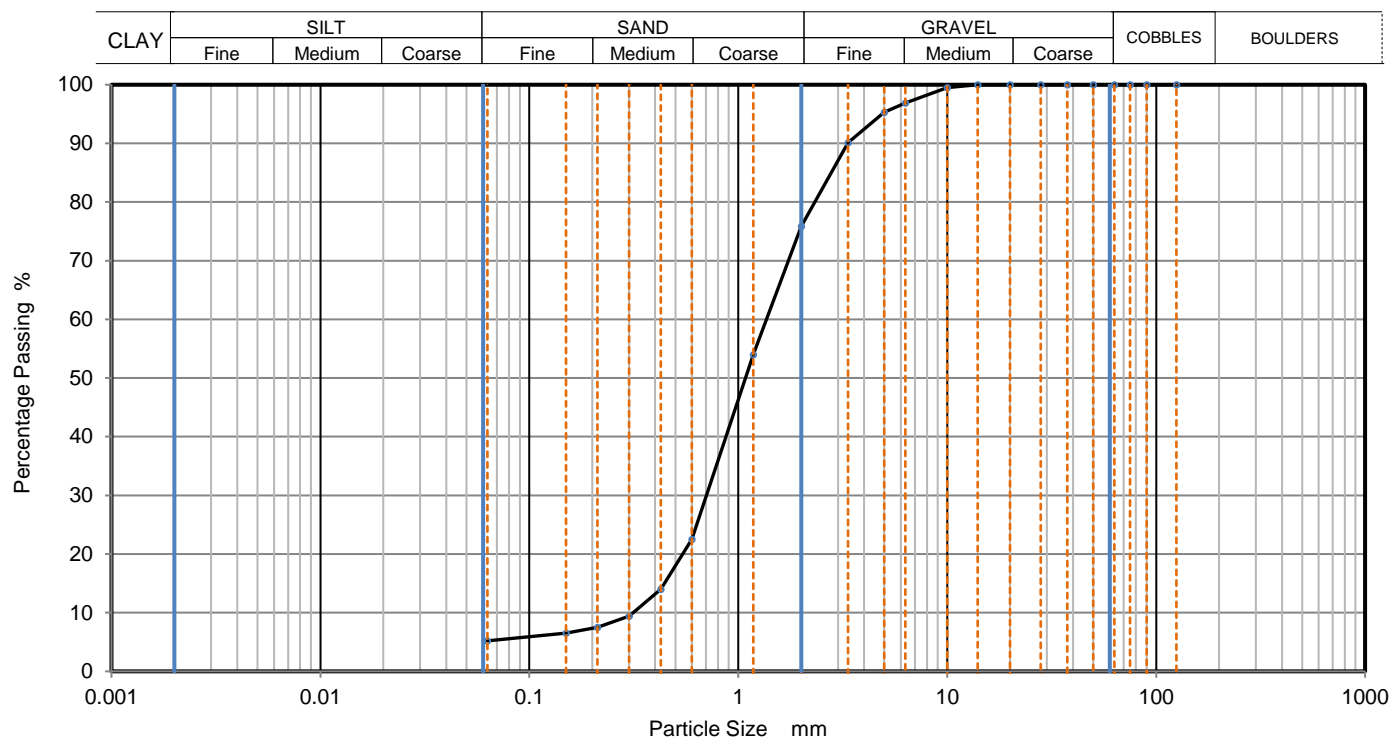
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017091218



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

Sheet



# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

Borehole/Pit No. BH01

Site Name Arklow Sewerage Scheme Marine Outfall GI

Sample No. 34

Soil Description Brown slightly sandy clayey SILT.

Depth 6.00

Specimen Reference 1 Specimen 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

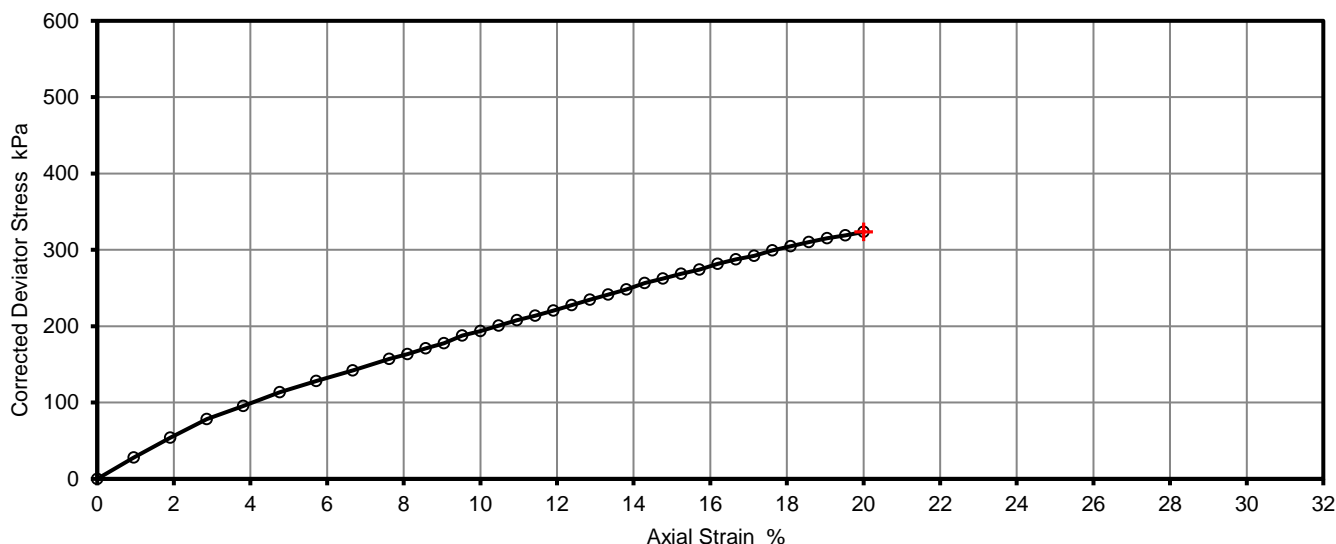
1	
210.0	mm
105.2	mm
2.21	Mg/m3
20.8	%
1.83	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

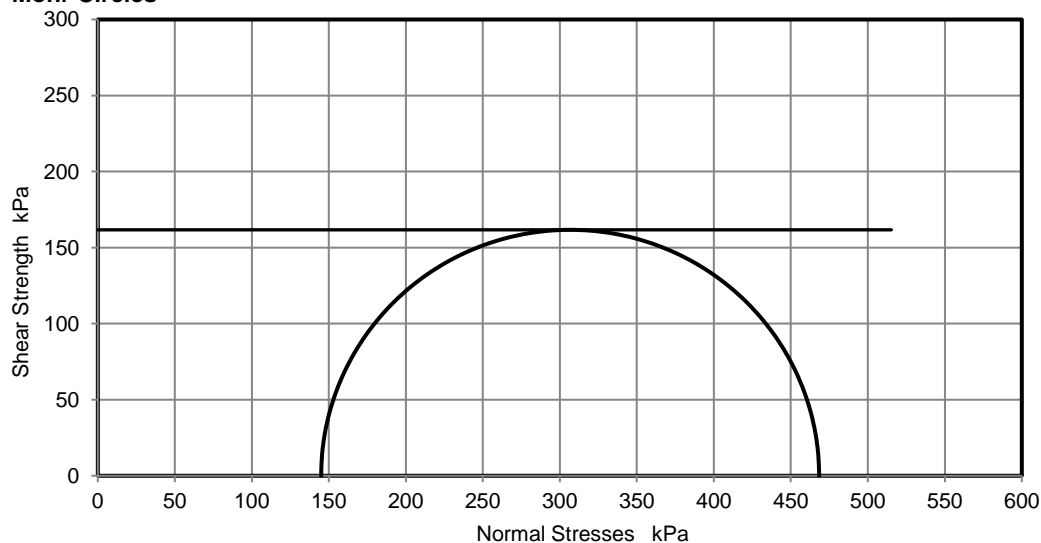
2.0	%/min
145	kPa
20.0	%
323	kPa
162	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

Stephen.Watson

## Printed

26/09/2017 11:53

Lab Sheet Reference :

Fig. No.

1

Sheet

1





# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

Borehole/Pit No. BH01

Site Name Arklow Sewerage Scheme Marine Outfall GI

Sample No. 35

Soil Description Brownish grey slightly sandy clayey SILT.

Depth 8.00

Specimen Reference 3 Specimen Depth m

Sample Type UT

Specimen Description Firm brownish grey slightly sandy clayey SILT.

KeyLAB ID Caus201709128

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

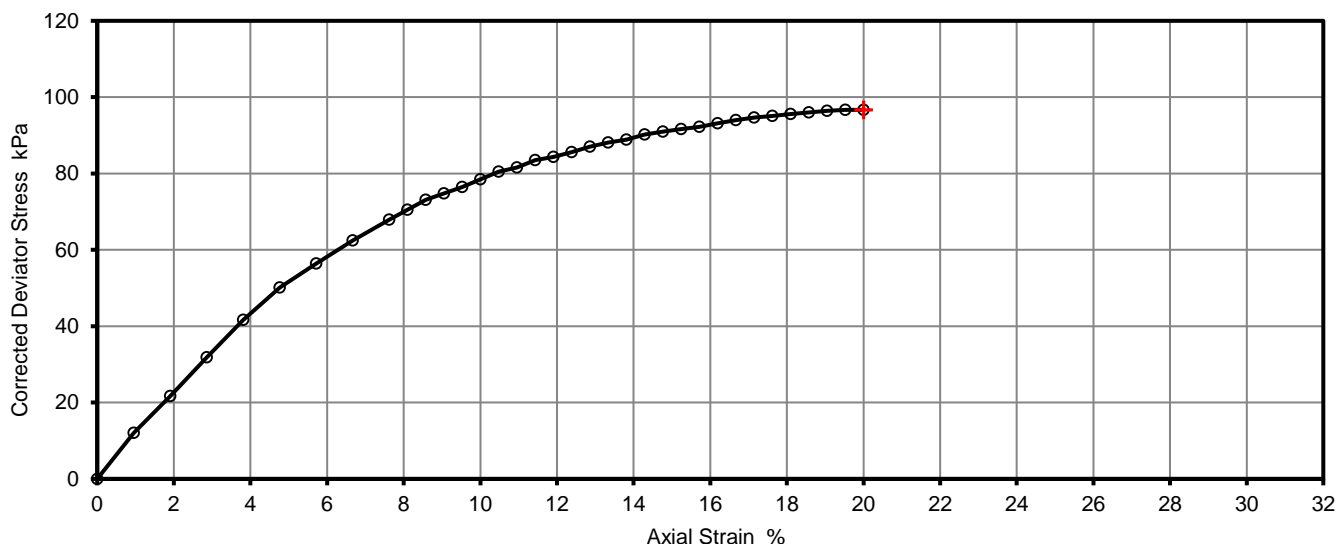
1	
210.0	mm
105.2	mm
1.99	Mg/m3
19.4	%
1.67	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

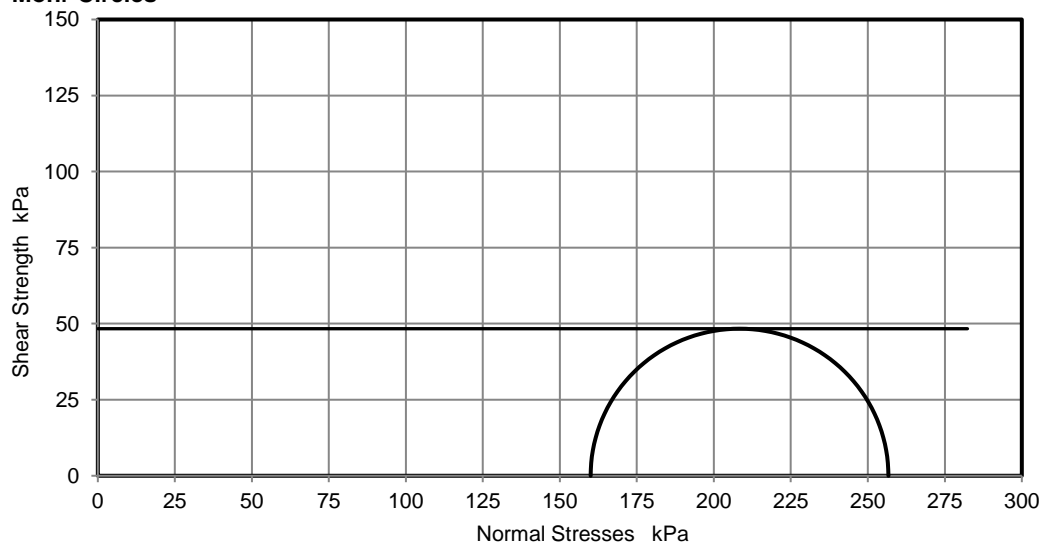
2.0	%/min
160	kPa
20.0	%
97	kPa
48	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

Stephen.Watson

## Printed

26/09/2017 11:53

Lab Sheet Reference :

Fig. No.

1

Sheet

2



# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

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  
Moisture Content  
Dry Density

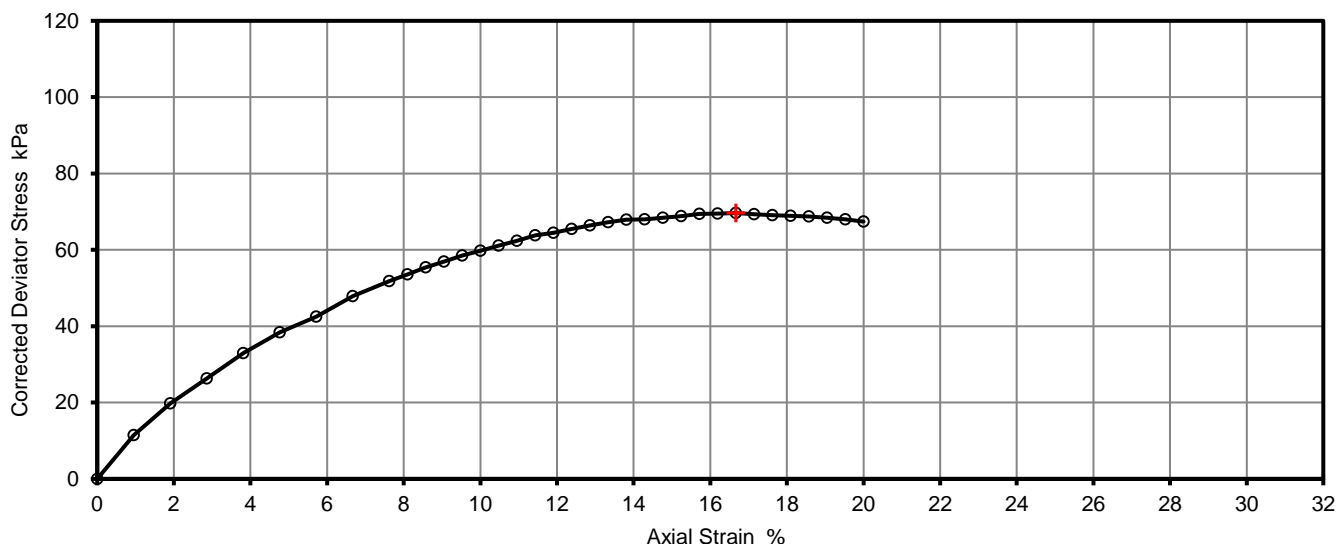
1	
210.0	mm
105.2	mm
1.92	Mg/m3
24.4	%
1.54	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

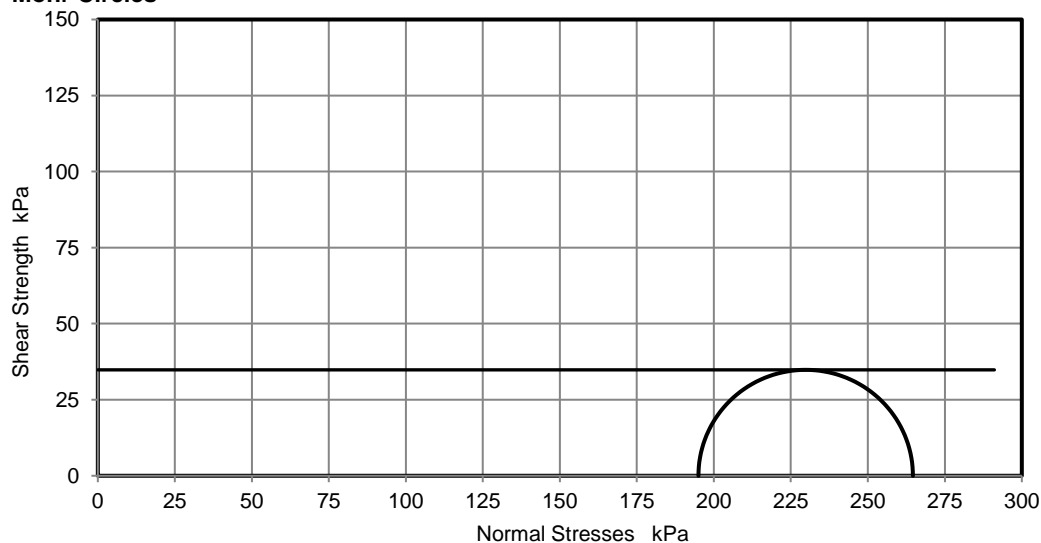
Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

2.0	%/min
195	kPa
16.7	%
70	kPa
35	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Brittle	

Deviator Stress v Axial Strain



Mohr Circles



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

Stephen.Watson

## Printed

26/09/2017 11:53

Lab Sheet Reference :

Fig. No.

1

Sheet

3

QUB	Geotechnical Testing Laboratory
-----	---------------------------------

## Arklow Sewerage Scheme

Ref:	17-0167	Size mm	100	Initial wet mass g	708
BH	BH01	Thickness mm	35.25	Bulk Density mg/m3	2008

Depth m	1.0m		
Our Ref	W		$\sigma'_v$ kPa
Soil type	SAND		
Rate of shearing mm/min	0.5		30
>10 mm removed			60
			120

Peak		Ultimate	
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ kPa
30		30	30
60		60	50
120		120	97

Peak angle of internal friction

Cohesion kPa

Ultimate angle of internal friction

39

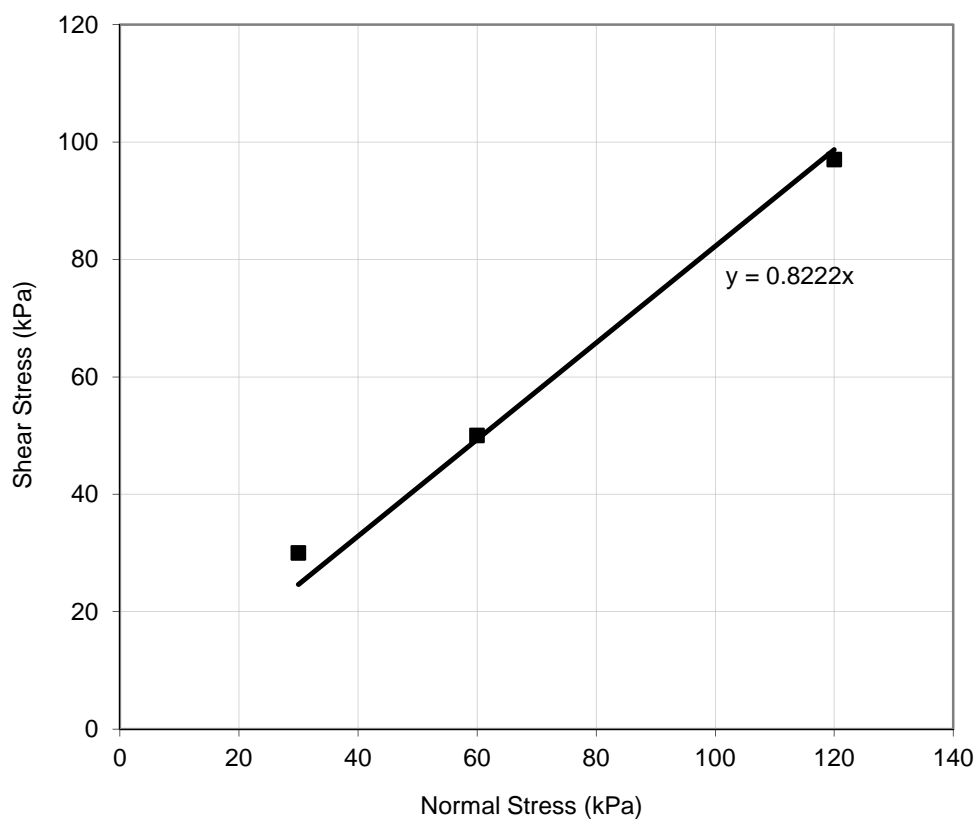
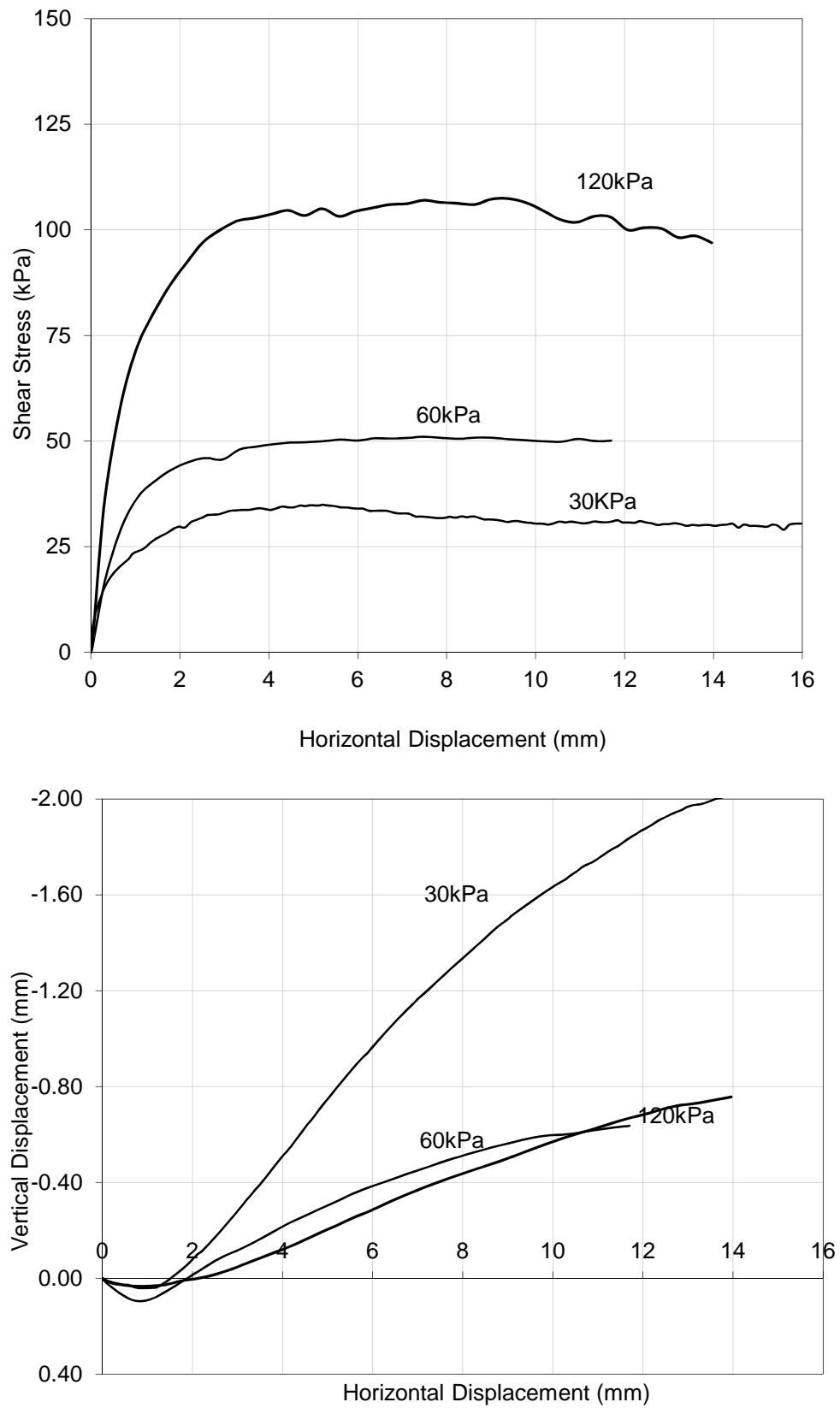


Figure 1 Failure Envelope

## Arklow Sewerage Scheme



**Figure 2 Stress-strain behaviour**

<b>QUB</b>	<b>Geotechnical Testing Laboratory</b>
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## Arklow Sewerage Scheme

Ref:	17-0167	Size mm	100	Initial wet mass g	683
BH	BH01	Thickness mm	33.25	Bulk Density mg/m3	2054

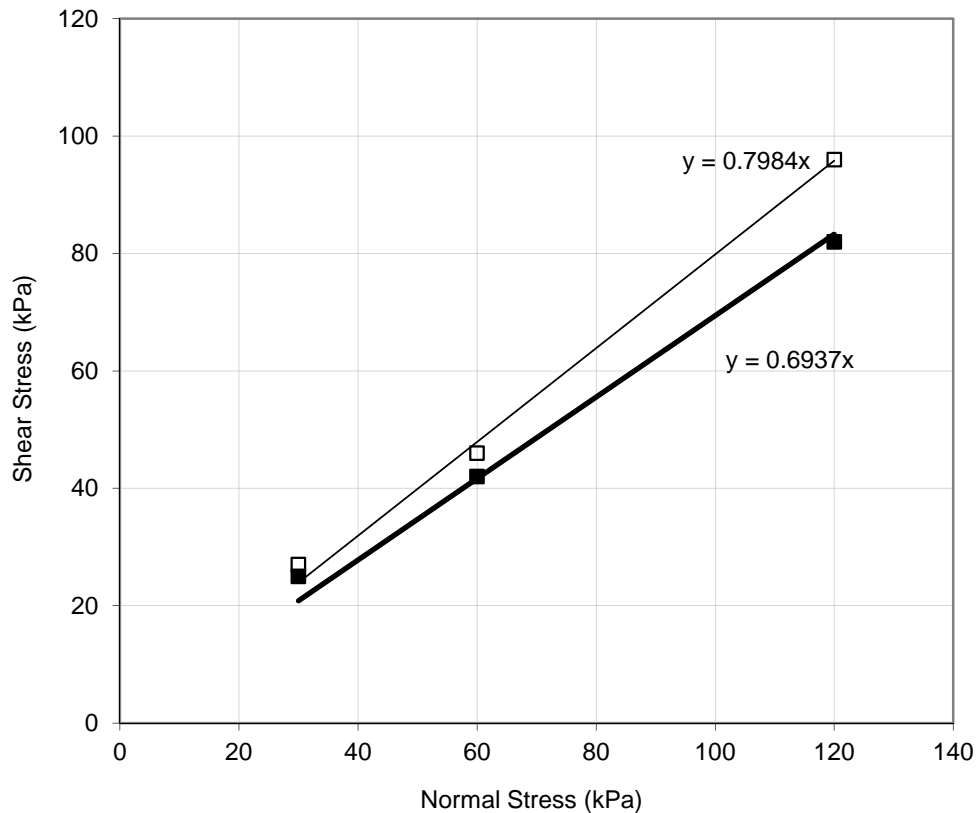
Depth m	3.5m		
Our Ref	V		$\sigma'_v$ kPa
Soil type	SAND		
Rate of shearing mm/min	0.5	30	
>10 mm removed		60	
		120	

Peak		Ultimate	
$\sigma'_n$ kPa	$\tau$ kPa	$\sigma'_n$ kPa	$\tau$ kPa
30	27	30	25
60	46	60	42
120	96	120	82

Peak angle of internal friction **38**

Cohesion kPa

Ultimate angle of internal friction **34**



**Figure 1 Failure Envelope**

## Arklow Sewerage Scheme

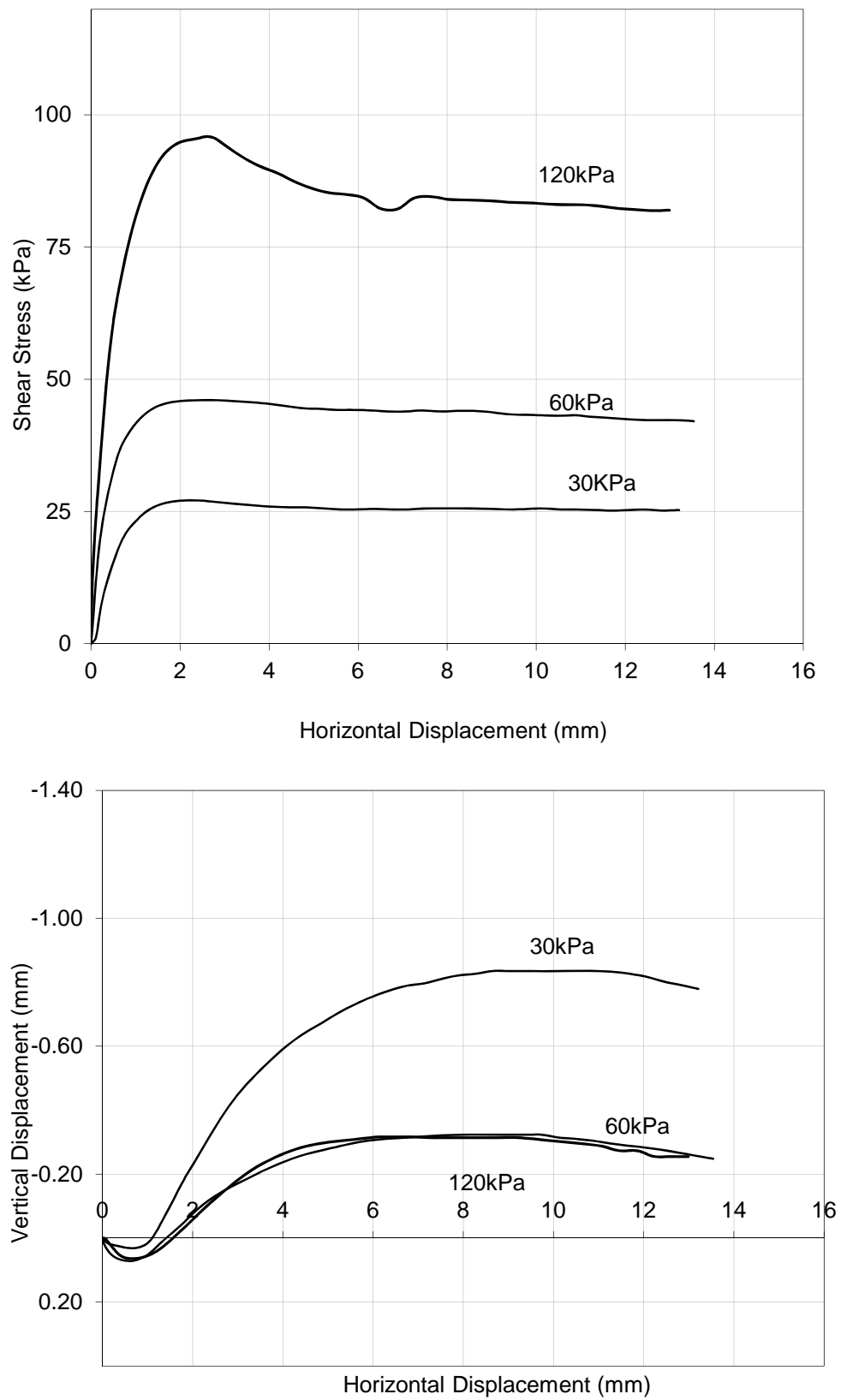


Figure 2 Stress-strain behaviour



2183

# 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.:**

**Order No.:**

**No. of Samples:** 3

**Turnaround (Wkdays):** 5

**Date Approved:** 25-Sep-2017

**Approved By:**  


**Details:** Keith Jones, Technical Manager

---

**Date Received:** 19-Sep-2017

**Date Instructed:** 19-Sep-2017

**Results Due:** 25-Sep-2017

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

<b>Client: Causeway Geotech Ltd</b>	<b>Chemtest Job No.:</b>				17-24692	17-24692	17-24692
Quotation No.:	<b>Chemtest Sample ID.:</b>				513162	513163	513164
Order No.:	Client Location ID.:				D2	D4	D8
	Client Sample Ref.:				BH01	BH01	BH01
	Sample Type:				SOIL	SOIL	SOIL
	Top Depth (m):				1.00	2.00	4.00
	Date Sampled:				18-Sep-2017	18-Sep-2017	18-Sep-2017
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>			
Moisture	N	2030	%	0.020	9.4	14	17
pH	U	2010		N/A	8.5	8.4	8.5
Sulphate (2:1 Water Soluble) as SO <sub>4</sub>	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:

[customerservices@chemtest.co.uk](mailto:customerservices@chemtest.co.uk)

**SOIL AND ROCK SAMPLE ANALYSIS  
LABORATORY TEST REPORT**

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

---

**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. 17-0167		Project Name Arklow Sewerage Scheme Marine Outfall GI												
Hole No.	Sample				Soil Description	Density		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type		bulk Mg/m3	dry 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		B	Grey brown slightly gravelly fine to medium SAND with shell fragments.			20.0						
BH04	22	5.80		B	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		B	Grey brown gravelly fine to coarse SAND.			6.2						
BH04	26	9.00		B	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		B	Grey brown slightly sandy silty CLAY.			22.0	99	23 -1pt	13	10		CL
BH04	5	17.00		B	Grey brown slightly sandy silty CLAY.			28.0	99	29 -1pt	19	10		CL

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

Key				Date Printed	Approved By	Table
Density test	Liquid Limit	Particle density	30/10/2017	Stephen.Watson	sheet	1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer				
wd - water displacement	cas - Casagrande method	gj - gas jar				
wi - immersion in water	1pt - single point test					

## Summary of Classification Test Results

Project No. 17-0167		Project Name Arklow Sewerage Scheme Marine Outfall GI												
Hole No.	Sample				Soil Description	Density		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type		bulk Mg/m3	dry Mg/m3							
BH04	12	19.00		D	Grey brown slightly sandy silty CLAY.			11.0						
BH04	6	19.60		B	Grey brown sandy slightly gravelly silty CLAY.			21.0	81	29 -1pt	19	10		CL
BH04	34	23.50		B	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		B	Grey brown slightly sandy fine to coarse subangular fine to coarse GRAVEL.			7.7						
BH05	11	7.40		B	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		B	Brown sandy gravelly silty CLAY.			13.0	53	30 -1pt	17	13		CL
BH05	25	14.00		B	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 performed in accordance with BS1377:1990 unless specified otherwise

<b>Key</b>  Density test Linear measurement unless : wd - water displacement wi - immersion in water					Liquid Limit 4pt cone unless : cas - Casagrande method 1pt - single point test					Particle density sp - small pyknometer gj - gas jar					Date Printed  30/10/2017		Approved By  Stephen.Watson		Table  1  sheet  2	
---	--	--	--	--	---	--	--	--	--	---	--	--	--	--	--------------------------------	--	-----------------------------------	--	--------------------------------------	--

## Density Tests - Summary of Results

Project No.

17-0167

Project Name

Arklow Sewerage Scheme Marine Outfall GI

[illegible]

Legend	w	moisture content of the density test specimen
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## Notes

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

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

Date Printed

30/10/2017

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

13

Soil Description

Grey brown fine to coarse SAND with shell fragments.

Depth, m

0.00

Specimen Reference

4

Specimen  
Depth

m

Sample Type

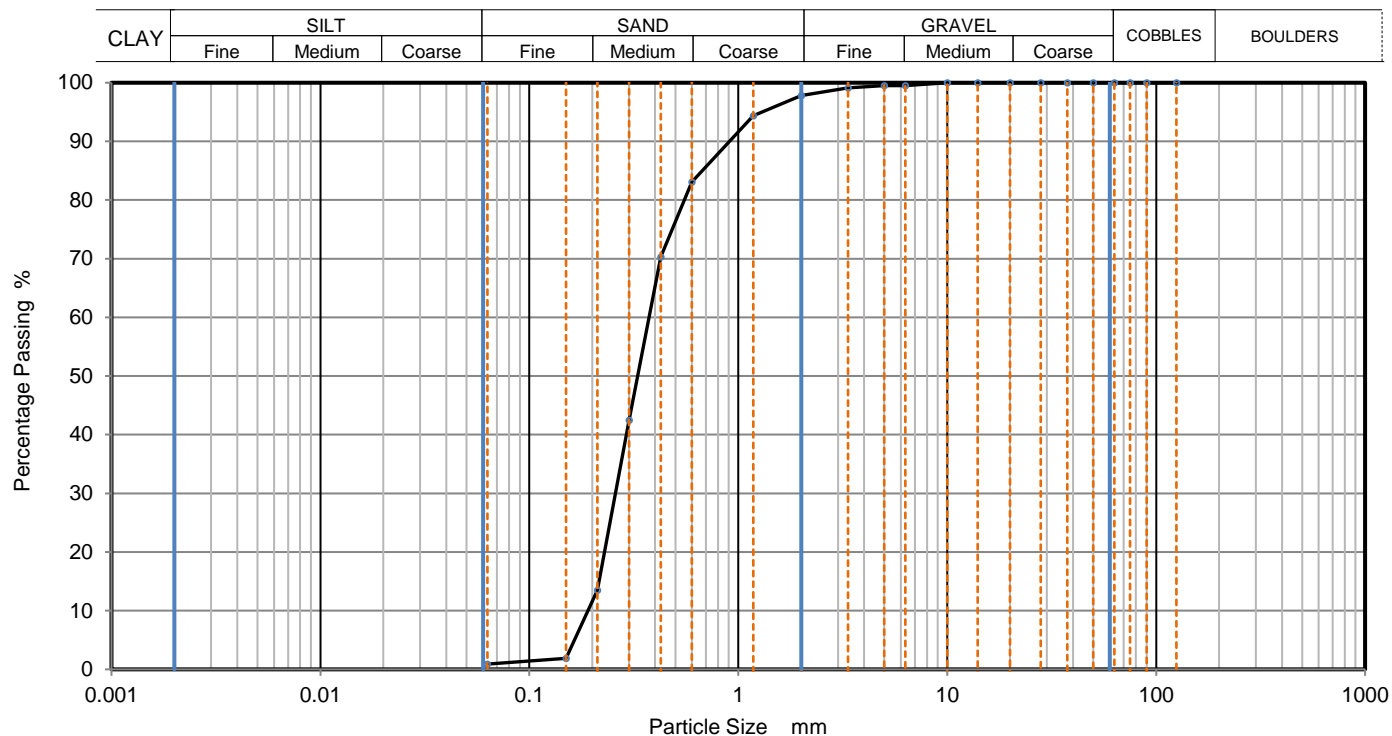
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201710039



Sieving		Sedimentation	
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 <0.063mm	1

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

Remarks

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

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  
Depth

m

Sample Type

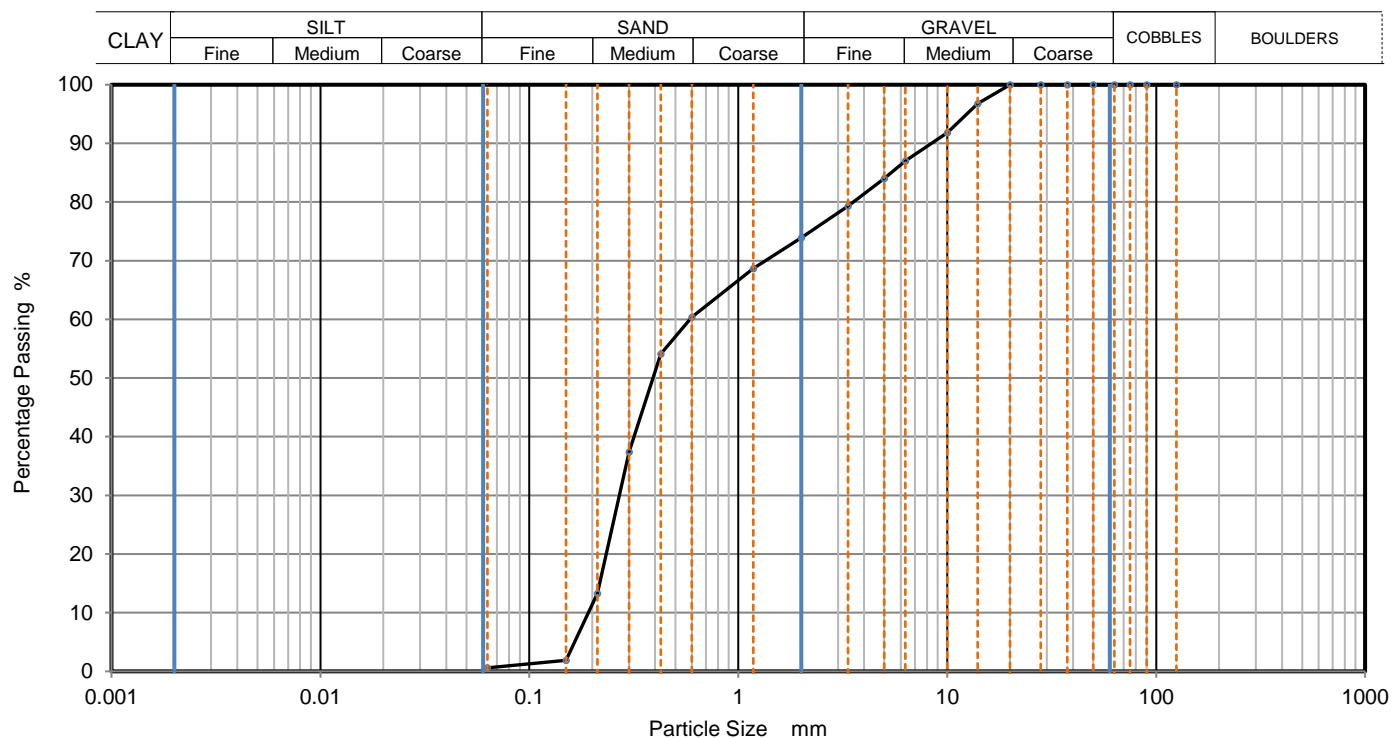
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017100311



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	3.1
Curvature Coefficient	0.64

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

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

3

Specimen  
Depth

m

Sample Type

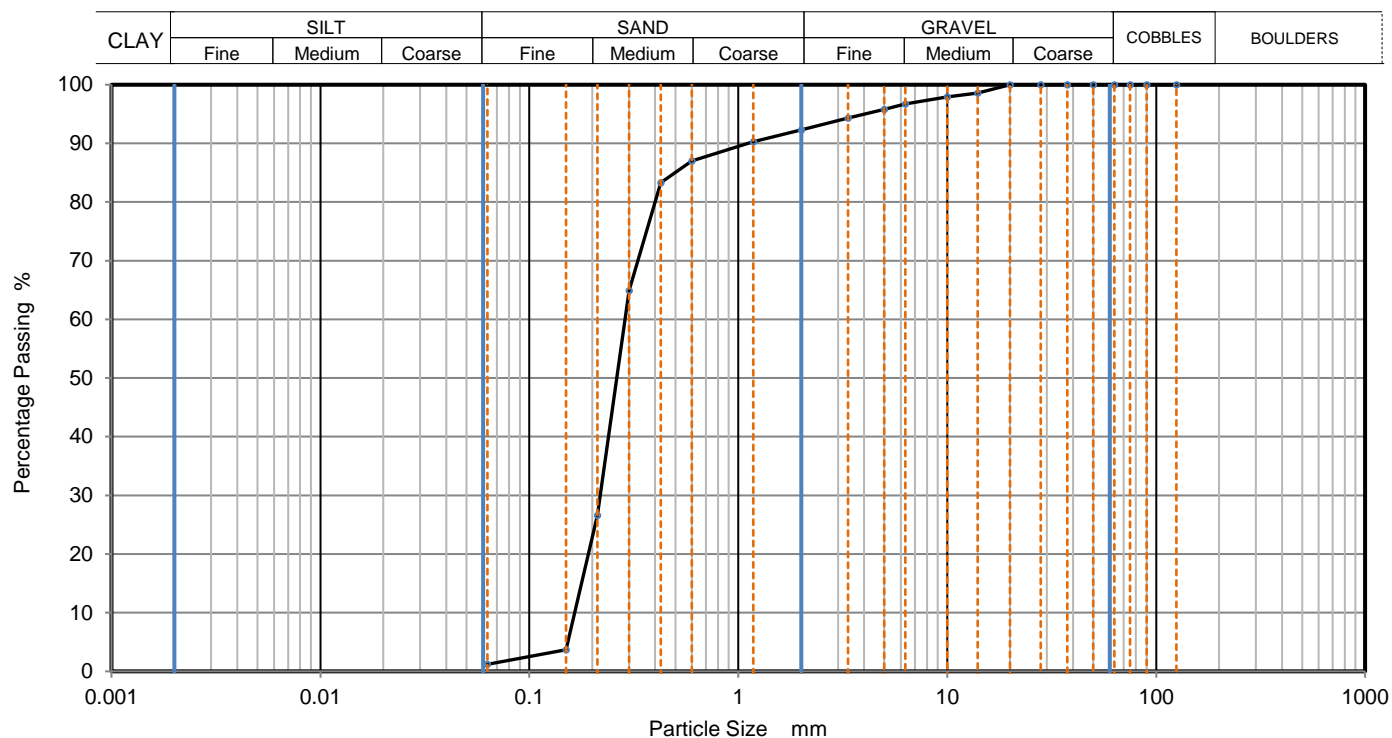
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017100313



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	1.7
Curvature Coefficient	1

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

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  
Depth

m

Sample Type

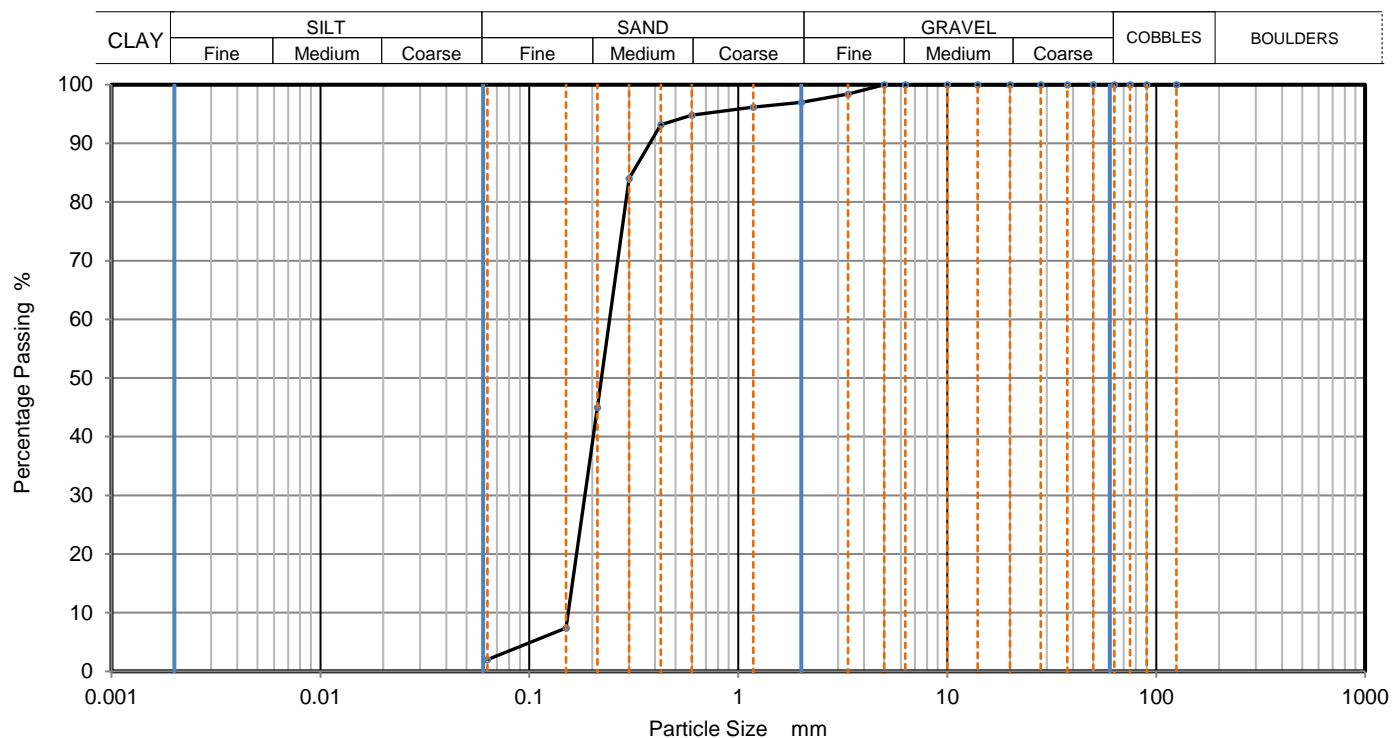
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017100316



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	1.6
Curvature Coefficient	0.92

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

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  
Depth

m

Sample Type

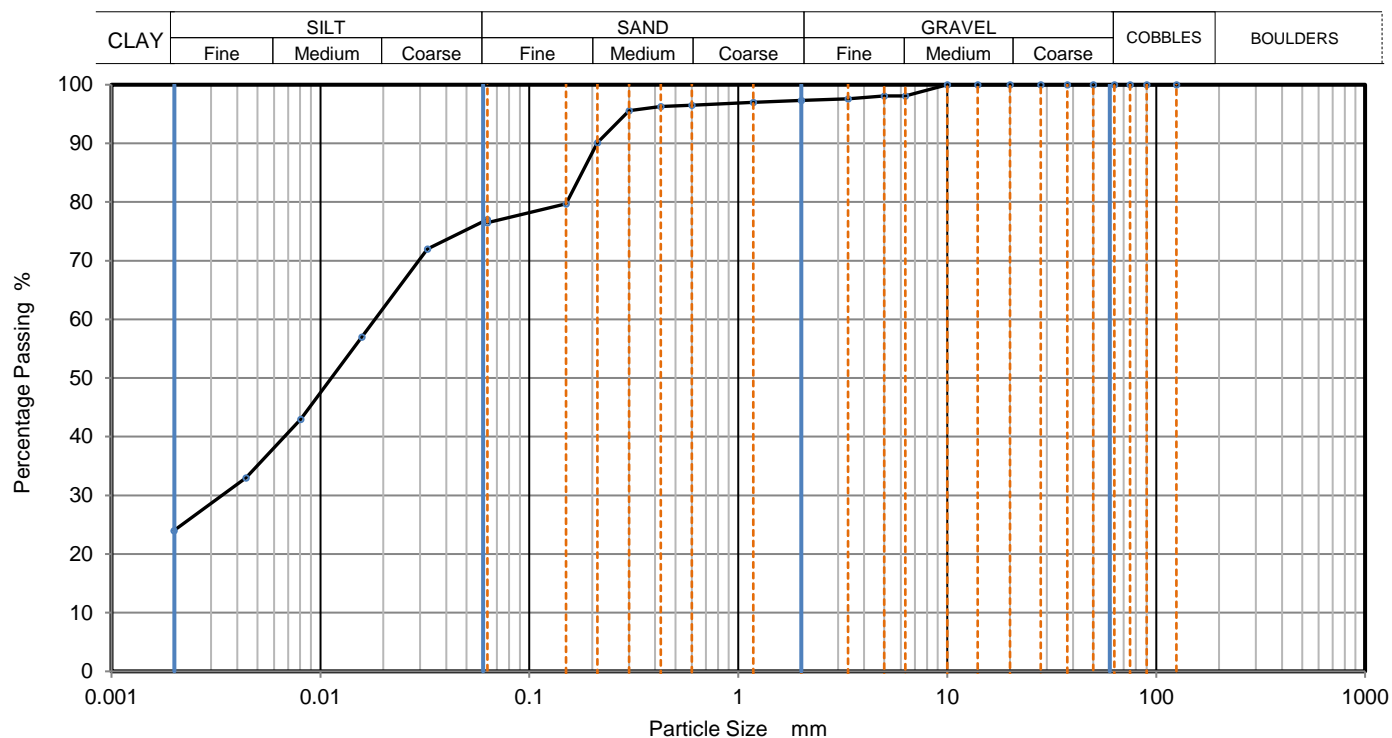
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017100317



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	96		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

25

Soil Description

Grey brown gravelly fine to coarse SAND.

Depth, m

7.00

Specimen Reference

5

Specimen  
Depth

m

Sample Type

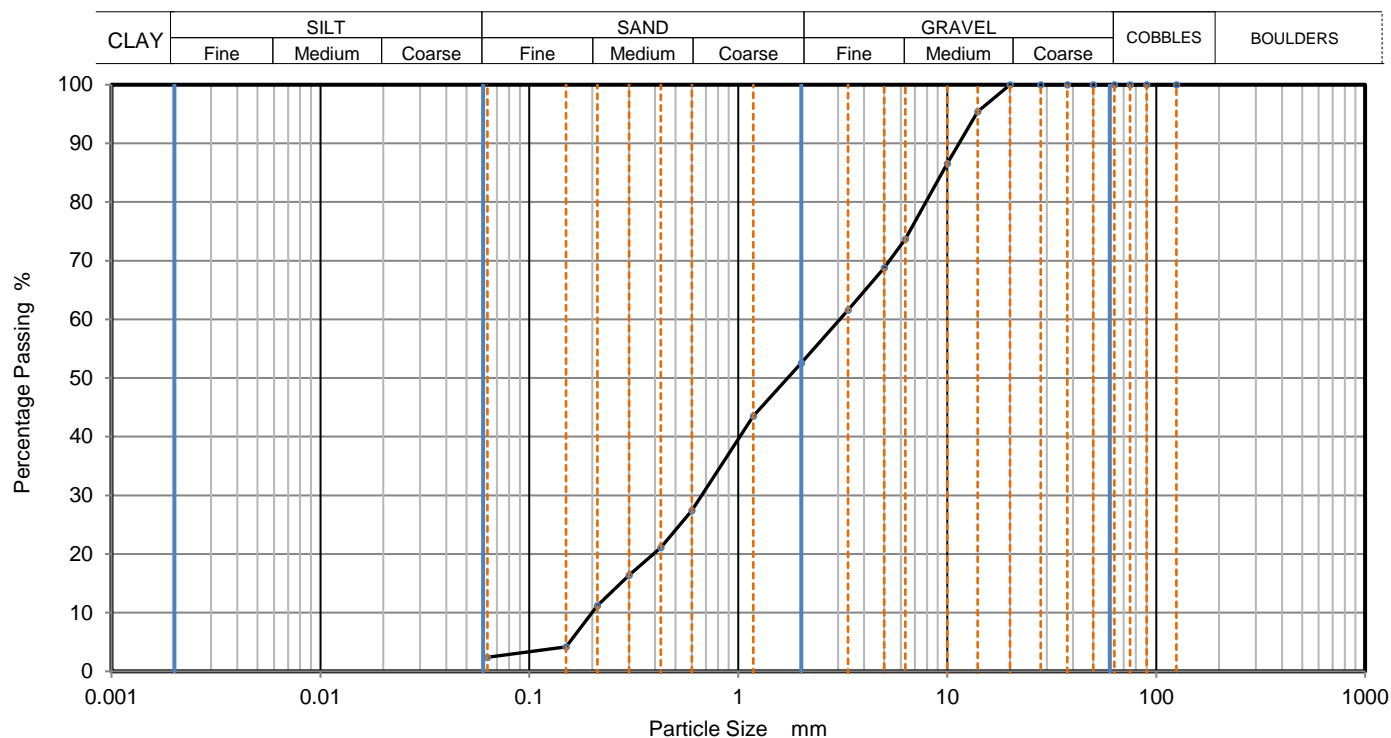
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017100319



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	47
Sand	50
Fines <0.063mm	2

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

26

Soil Description

Grey brown slightly gravelly fine to coarse SAND.

Depth, m

9.00

Specimen Reference

5

Specimen  
Depth

m

Sample Type

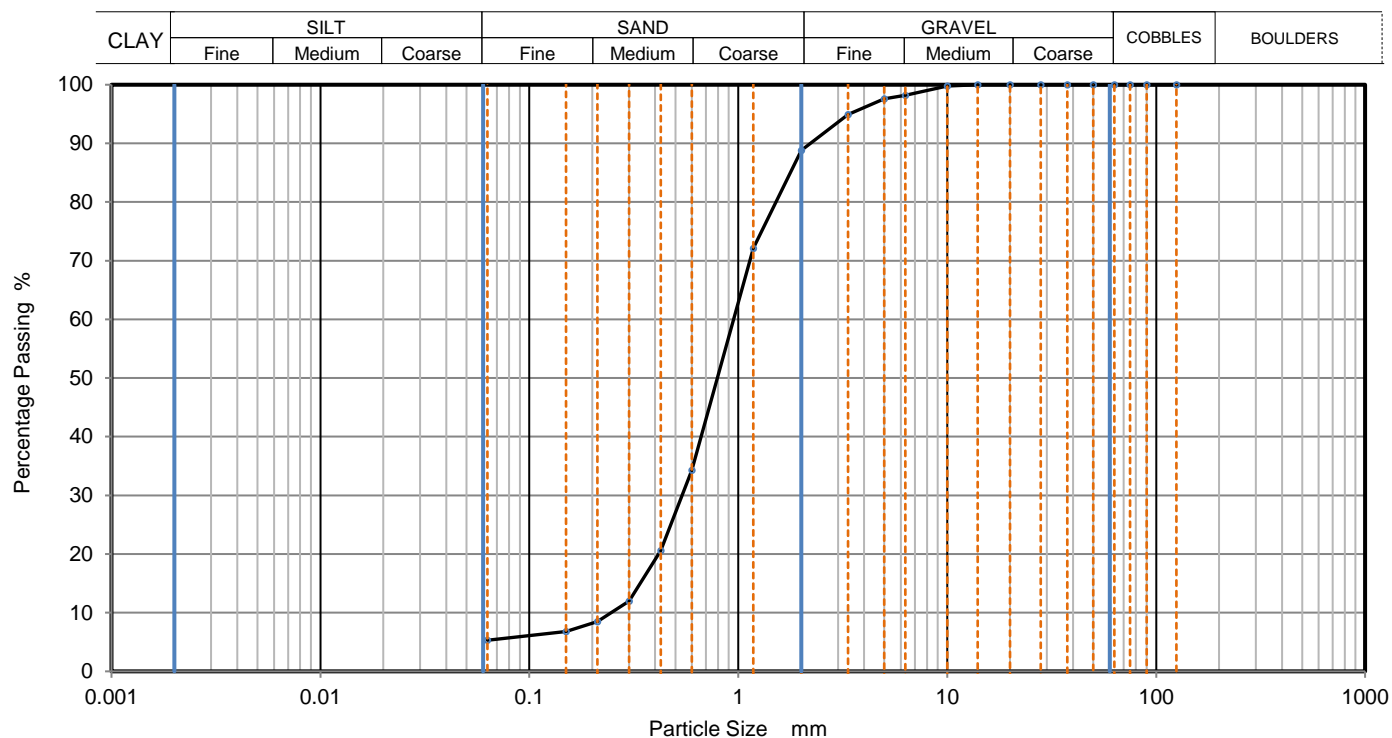
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017100320



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	11
Sand	84
Fines <0.063mm	5

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	3.9
Curvature Coefficient	1.2

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

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  
Depth

m

Sample Type

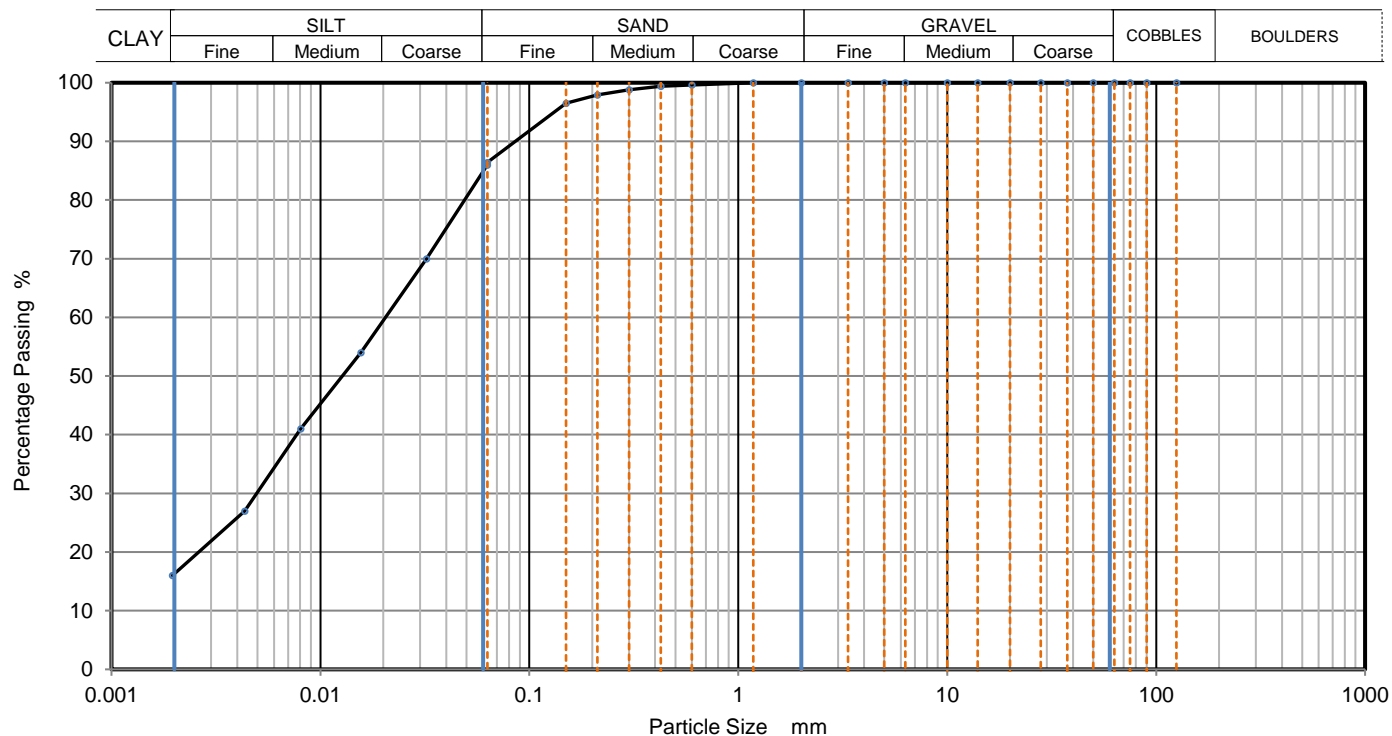
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017100323



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	99		
0.3	99		
0.212	98		
0.15	97		
0.063	86		

Dry Mass of sample, g

1656

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	14
Silt	70
Clay	17

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

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  
Depth

m

Sample Type

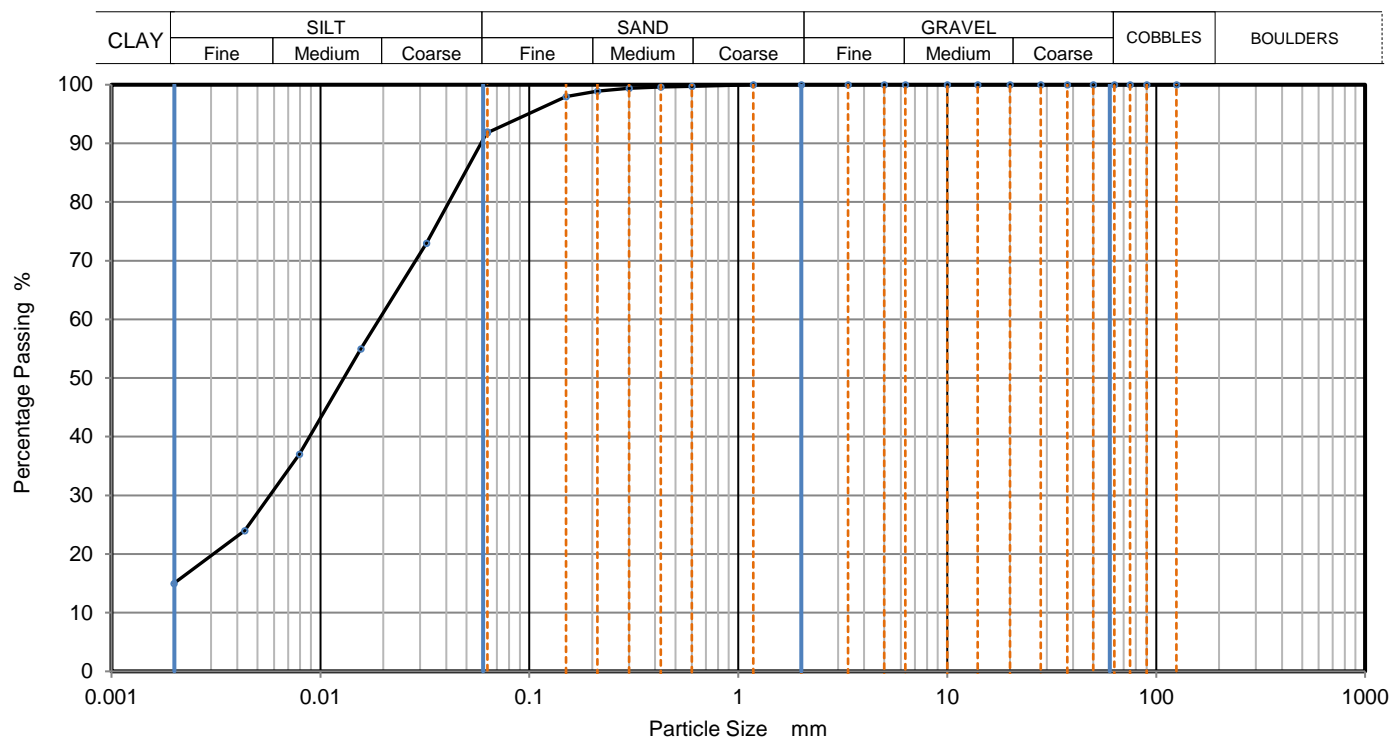
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017100324



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	100		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

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  
Depth

m

Sample Type

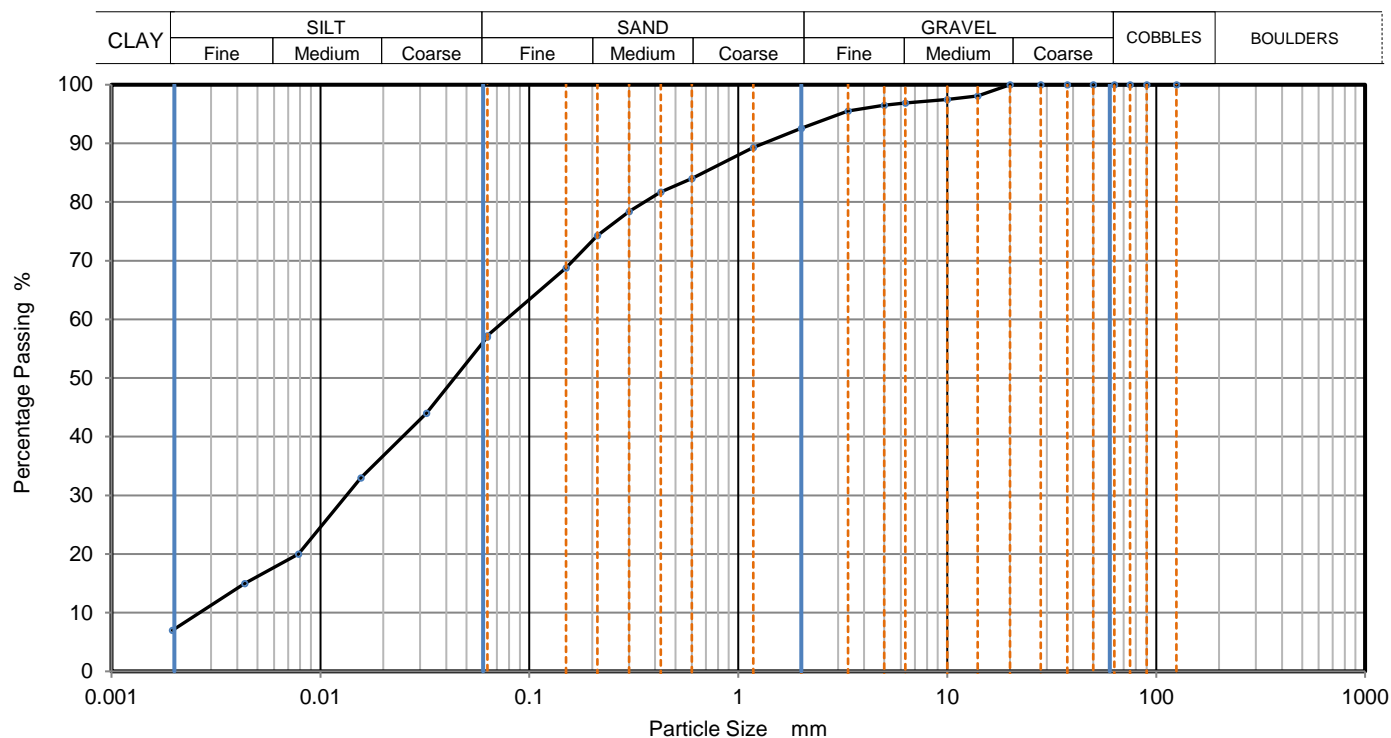
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017100326



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	82		
0.3	78		
0.212	74		
0.15	69		
0.063	57		

Dry Mass of sample, g

2397

Sample Proportions	% dry mass
Cobbles	0
Gravel	7
Sand	35
Silt	50
Clay	8

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH04

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

5

Specimen  
Depth

m

Sample Type

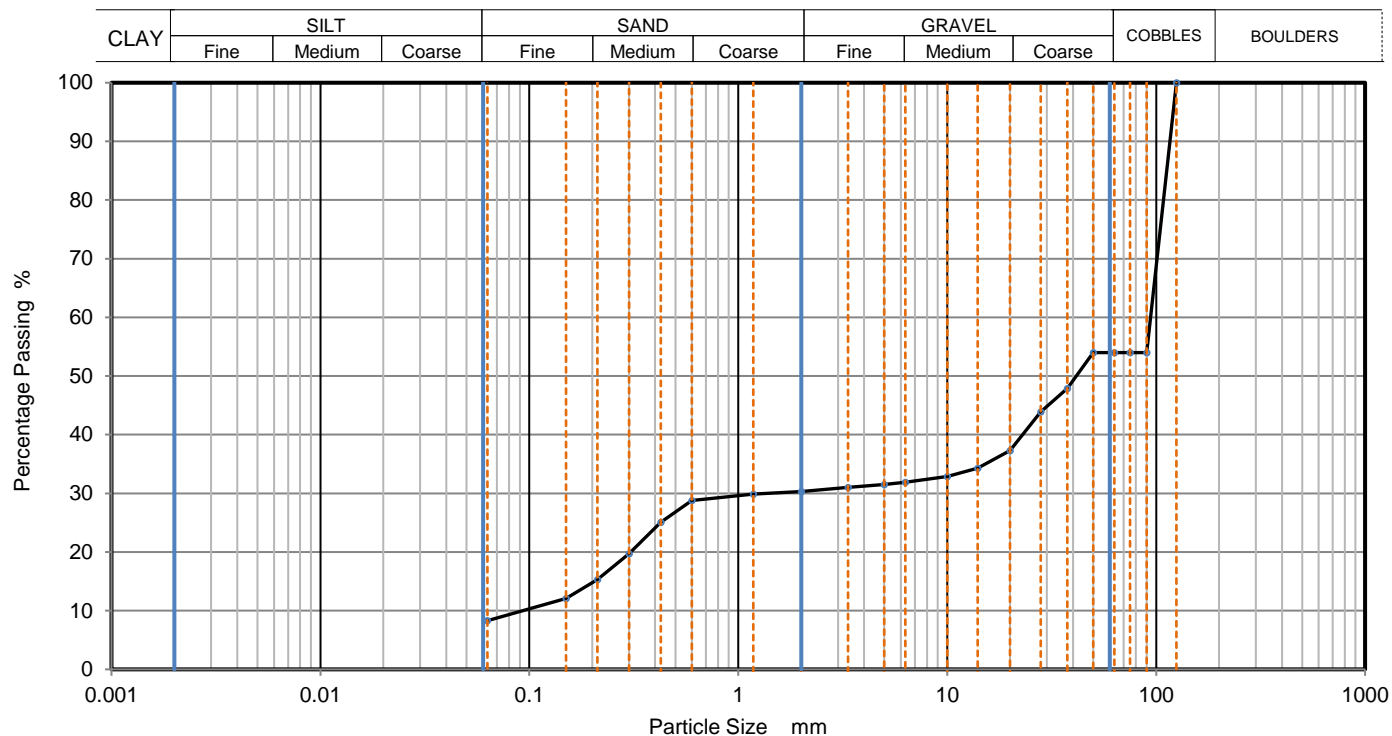
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017100327



Sieving		Sedimentation	
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

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH05

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

3

Specimen  
Depth

m

Sample Type

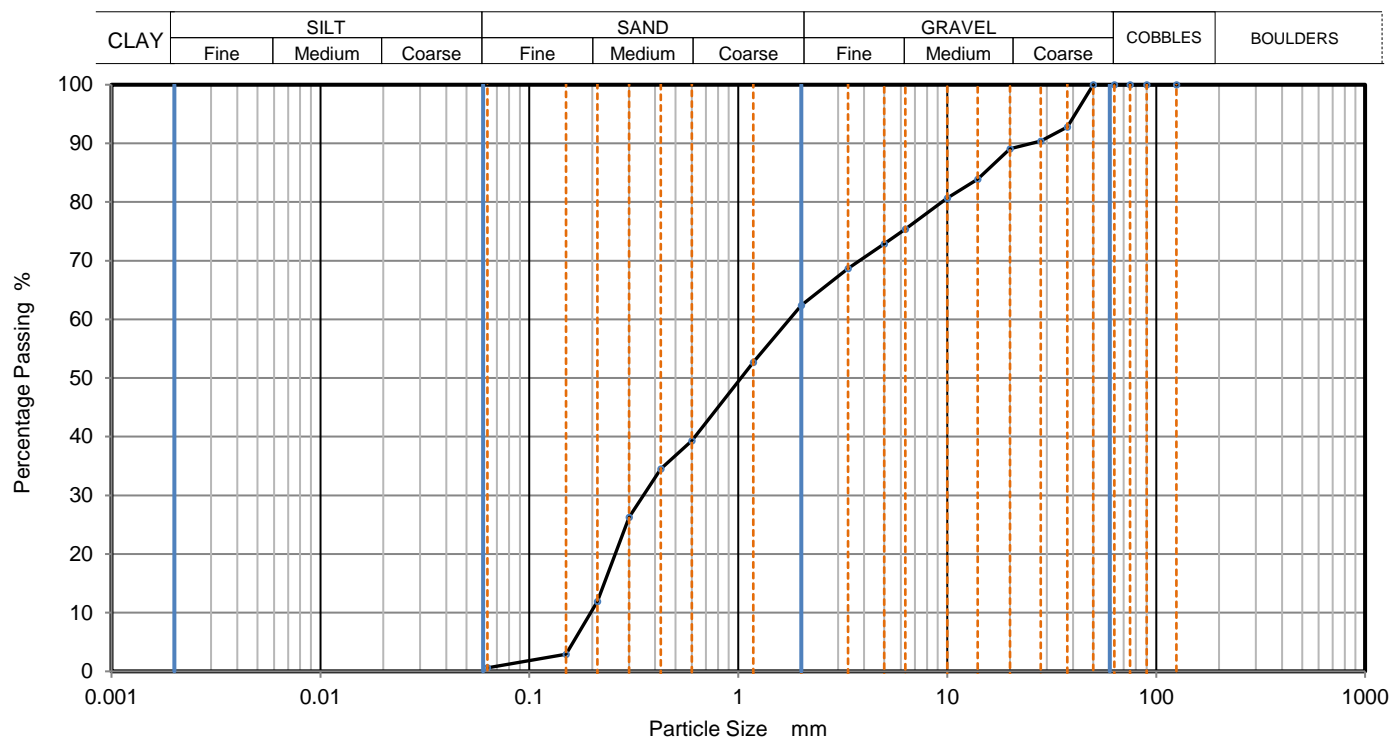
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017100328



Sieving		Sedimentation	
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

**Remarks**

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH05

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  
Depth

m

Sample Type

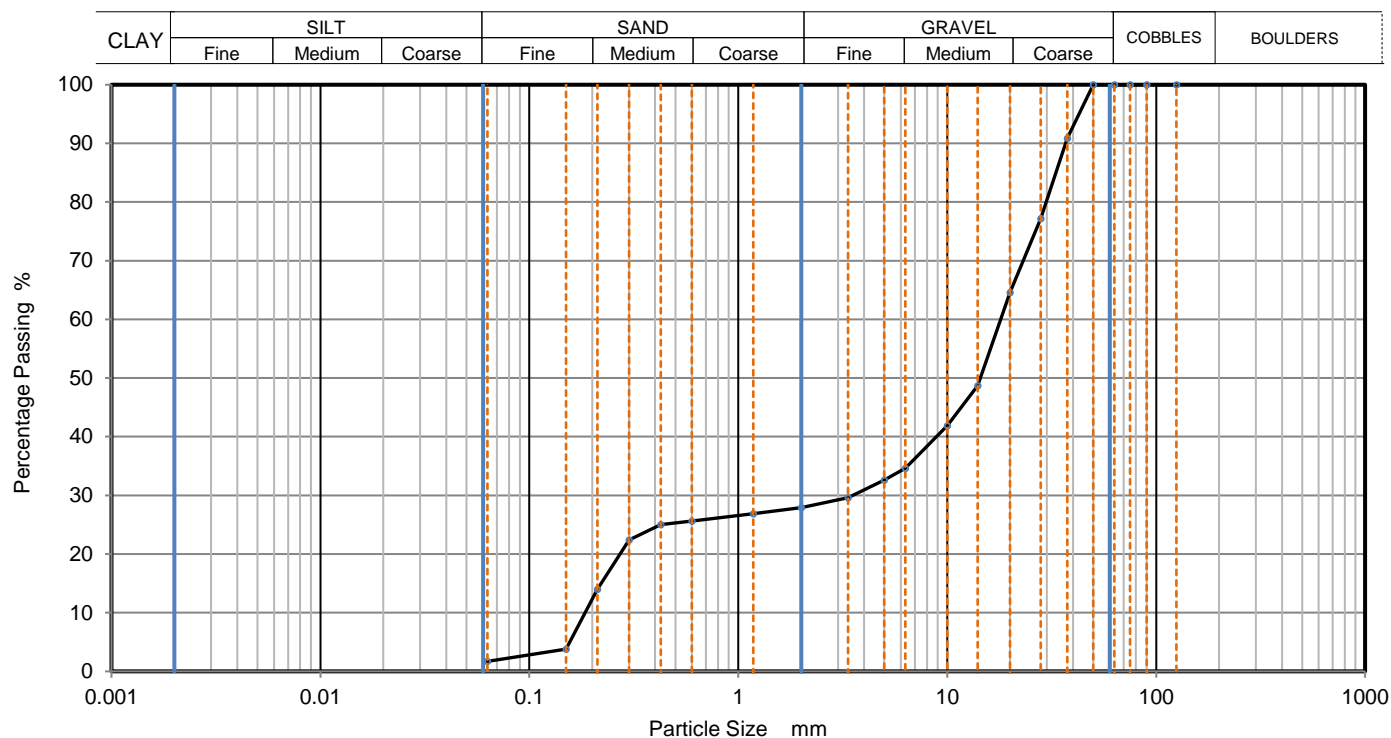
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017100332



Sieving		Sedimentation	
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		

Dry Mass of sample, g

6508

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

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

Remarks

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# PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH05

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  
Depth

m

Sample Type

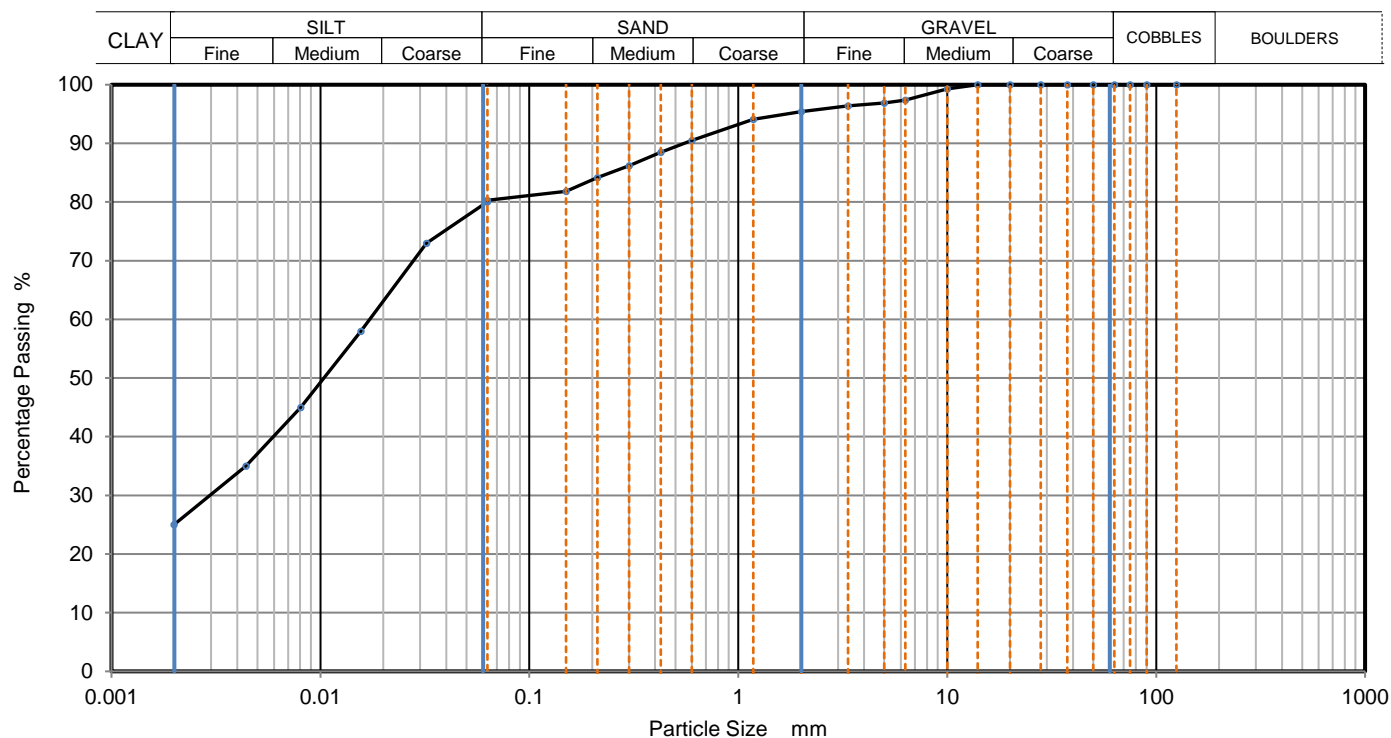
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017100333



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	89		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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Job Ref

17-0167

Borehole/Pit No.

BH05

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  
Depth

m

Sample Type

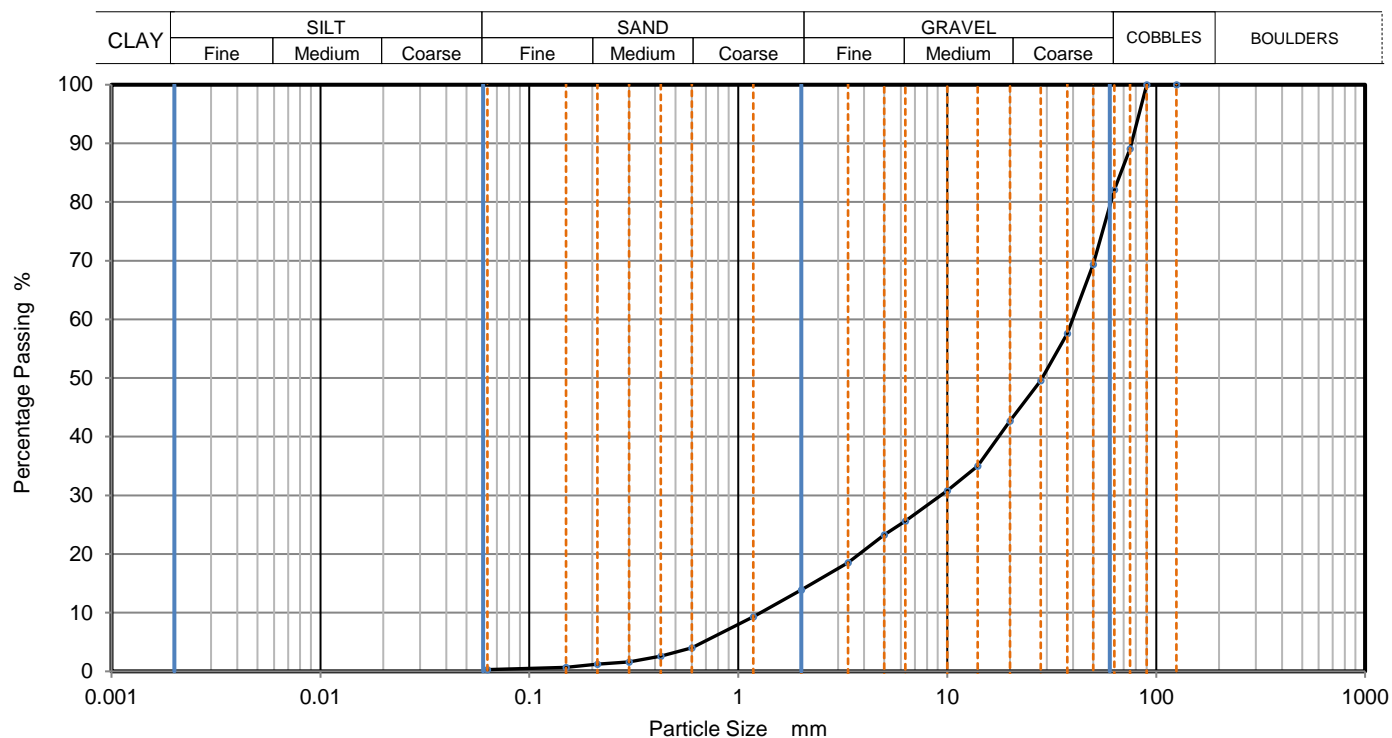
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017100335



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	31
Curvature Coefficient	1.7

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH05

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  
Depth

m

Sample Type

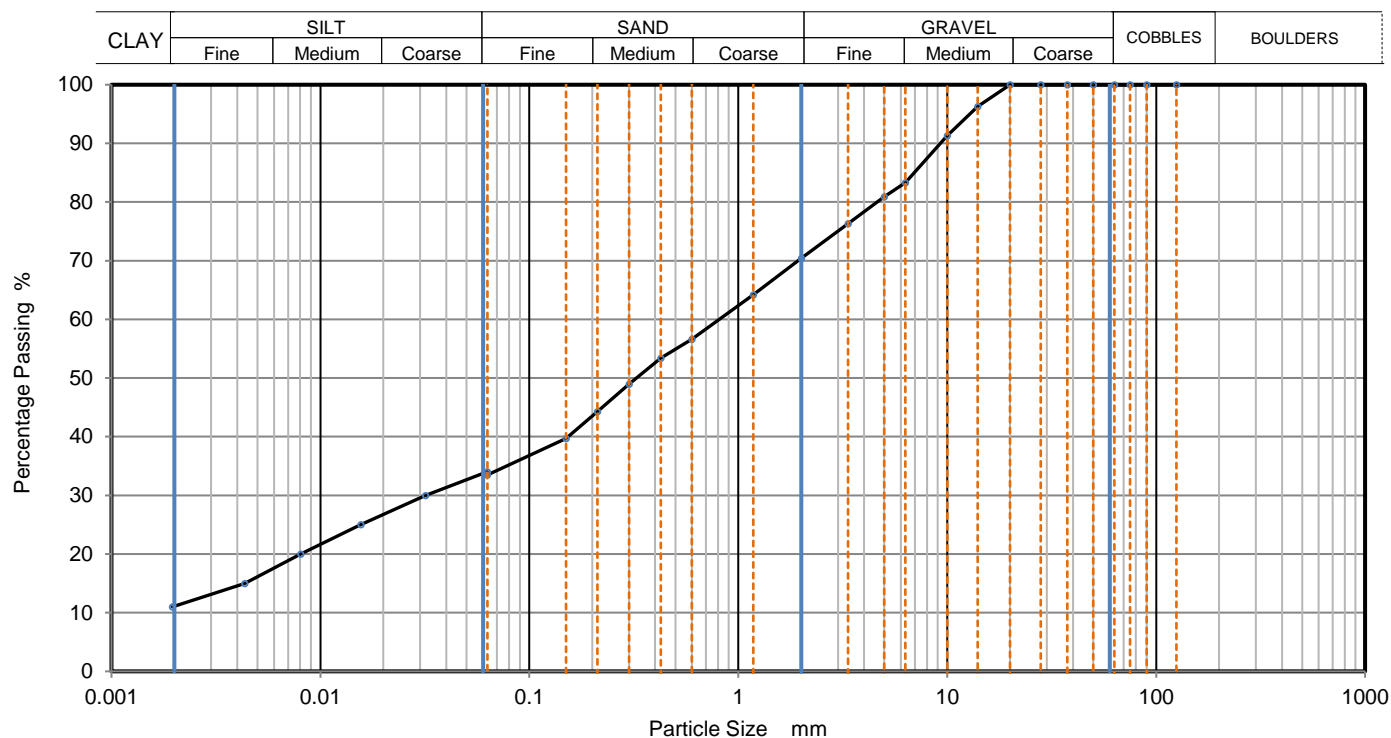
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017100336



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	53		
0.3	49		
0.212	44		
0.15	40		
0.063	34		

Dry Mass of sample, g

3292

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

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH05

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  
Depth

m

Sample Type

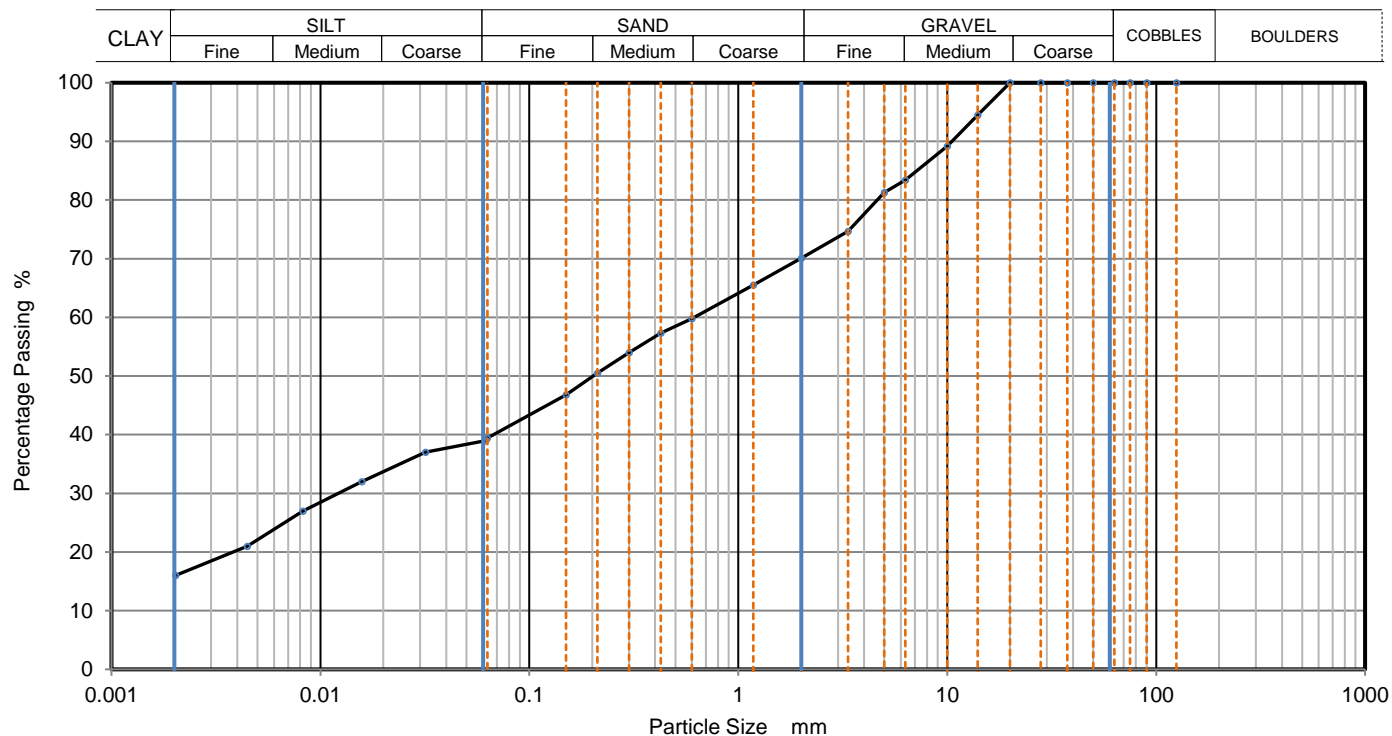
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017100337



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	57		
0.3	54		
0.212	51		
0.15	47		
0.063	39		

Dry Mass of sample, g

3474

Sample Proportions	% dry mass
Cobbles	0
Gravel	30
Sand	31
Fines <0.063mm	39

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH05

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

27

Soil Description

Brown slightly sandy subrounded fine to coarse GRAVEL with low cobble content.

Depth, m

17.00

Specimen Reference

3

Specimen  
Depth

m

Sample Type

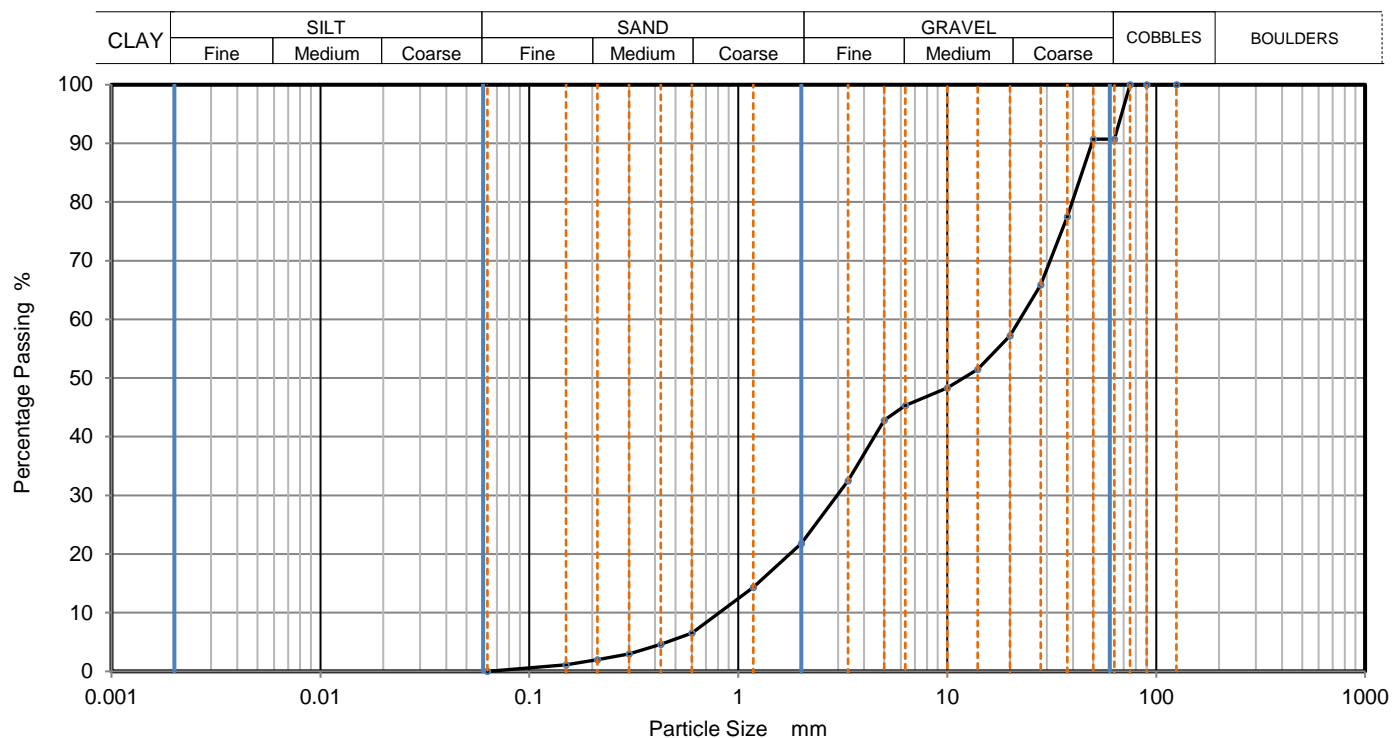
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017100338



Sieving		Sedimentation	
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

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

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

Remarks

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## LABORATORY RESTRICTION REPORT

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

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

Hole Number	Sample			Test Type	Reason for Restriction	Required Action
	Number	Depth (m)	Type			
BH04	20	4.20-5.00	B	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 30 October 2017	Date 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

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

---

### 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. 17-0167		Project Name Arklow Sewerage Scheme Marine Outfall GI												
Hole No.	Sample				Soil Description	Density		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type		bulk Mg/m3	dry Mg/m3							
BH06	1	0.00		B	Dark grey gravelly fine to medium SAND.			14.0						
BH06	3	1.30		B	Dark grey slightly gravelly fine medium SAND.			20.0						
BH06	7	3.00		B	Dark grey slightly gravelly fine to medium SAND.			19.0						
BH06	9	4.40		B	Dark grey gravelly fine to medium SAND.			14.0						
BH06	11	5.00		B	Brownish grey slightly sandy subrounded fine to coarse GRAVEL.			6.2						
BH06	13	6.20		B	Brown slightly sandy slightly gravelly silty CLAY.			16.0	68	34 -1pt	16	18		CL
BH06	20	9.00		B	Brown slightly sandy slightly gravelly silty CLAY.			18.0	67	34 -1pt	17	17		CL
BH06	15	12.60		B	Brown sandy subangular to subrounded fine to coarse GRAVEL.			8.6						
BH06	26	14.00		B	Brown slightly sandy subangular to subrounded fine to coarse GRAVEL.			5.1						
BH06	22	16.00		B	Brown slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble content.			3.8						

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

Key					Date Printed	Approved By	Table
Density test	Liquid Limit	Particle density			11/09/2017 00:00	Stephen.Watson	1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer					
wd - water displacement	cas - Casagrande method	gj - gas jar					sheet
wi - immersion in water	1pt - single point test						1



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH06

Site Name

Arklow Sewerage Scheme Marine Outfall 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

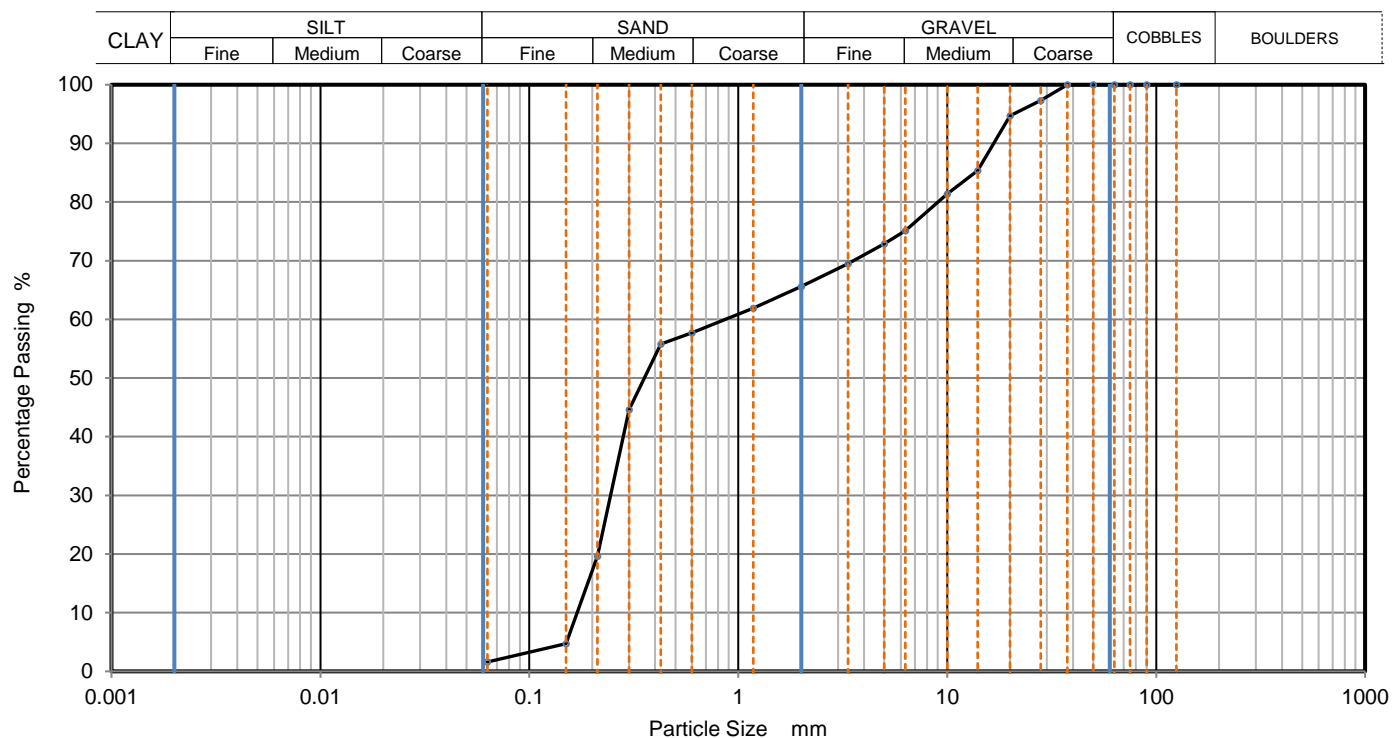
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201710090



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	5.1
Curvature Coefficient	0.41

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH06

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

3

Soil Description

Dark grey slightly gravelly fine medium SAND.

Depth, m

1.30

Specimen Reference

6

Specimen  
Depth

m

Sample Type

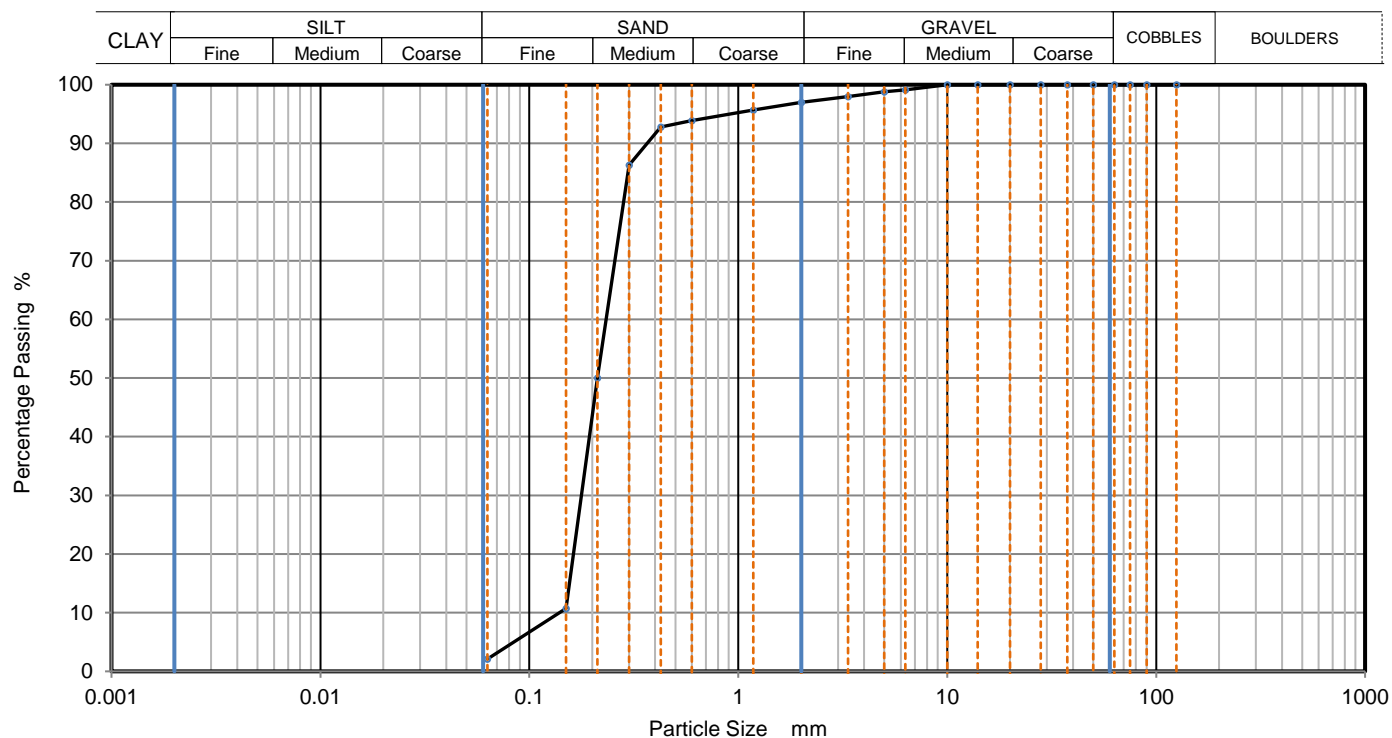
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201710091



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	1.7
Curvature Coefficient	0.97

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH06

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  
Depth

m

Sample Type

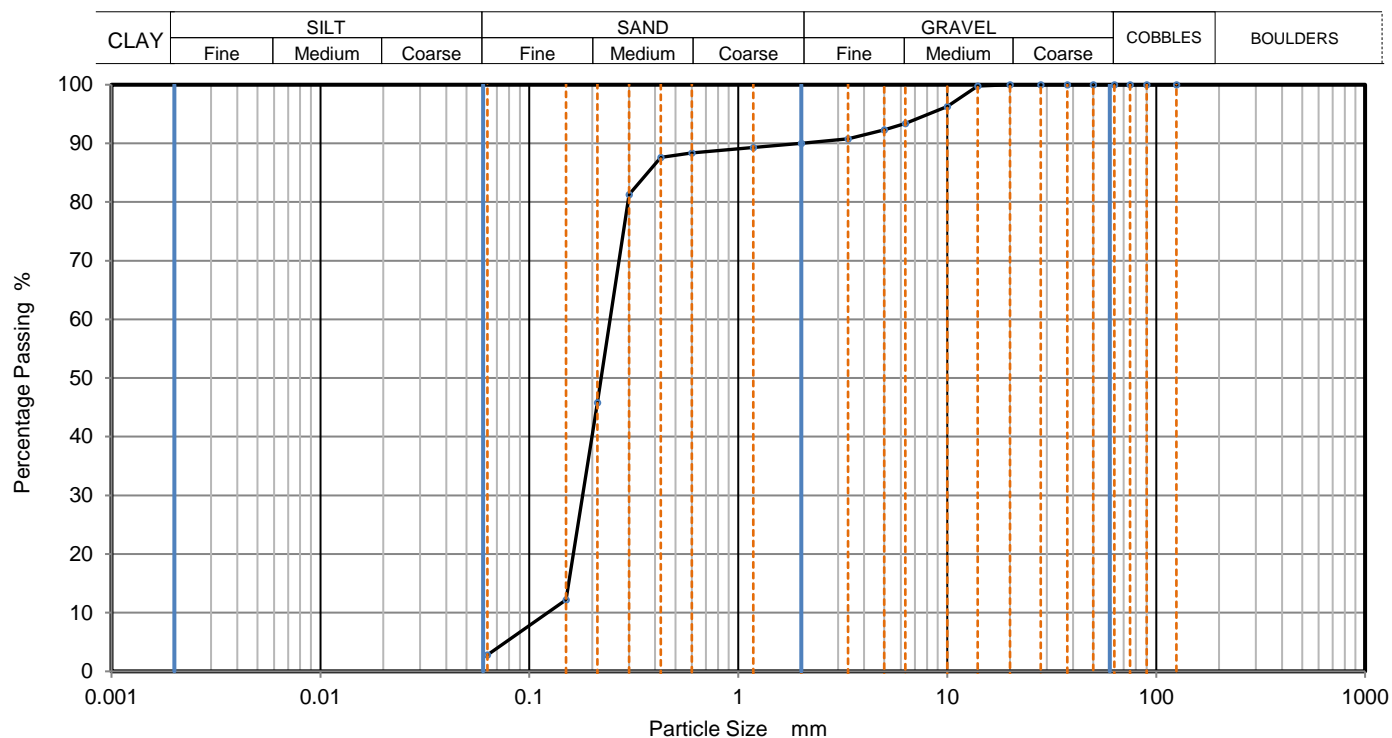
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201710092



Sieving		Sedimentation	
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

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

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH06

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  
Depth

m

Sample Type

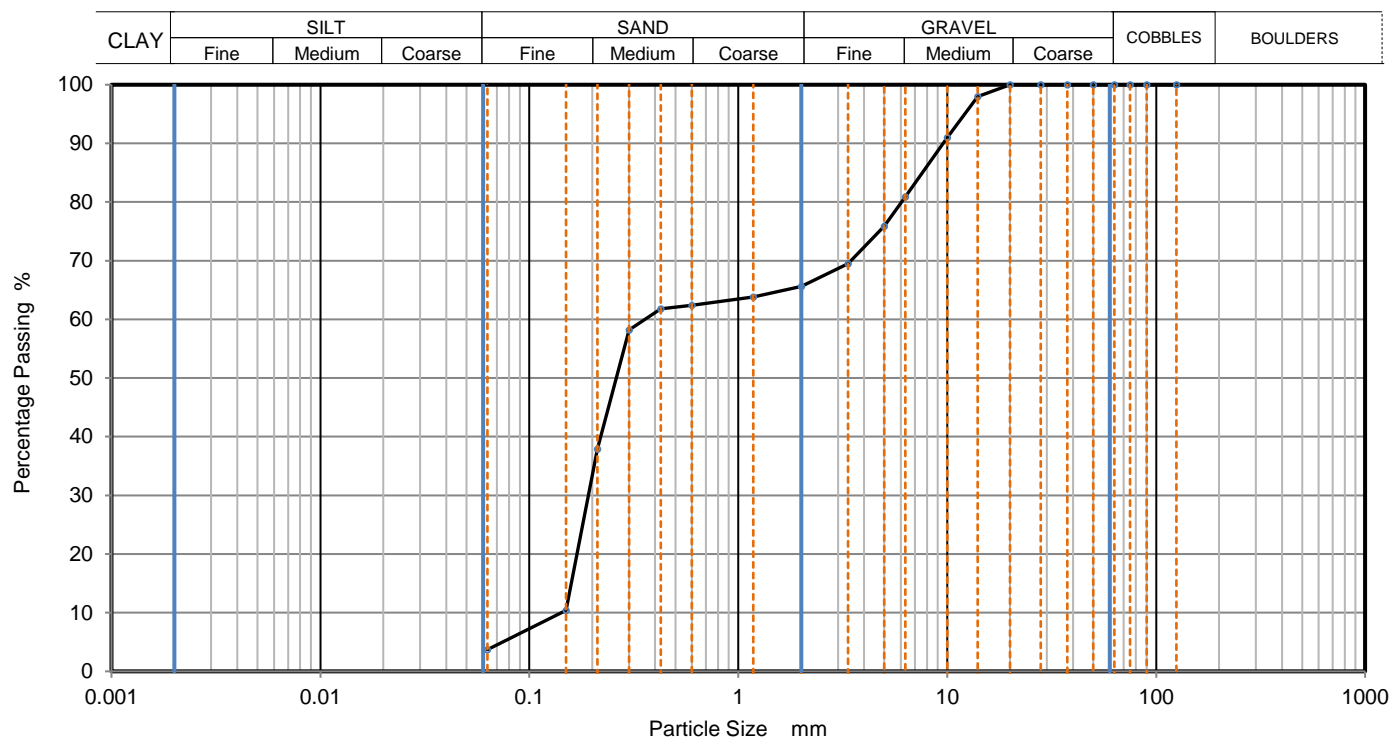
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201710093



Sieving		Sedimentation	
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

**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

**Remarks**

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH06

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  
Depth

m

Sample Type

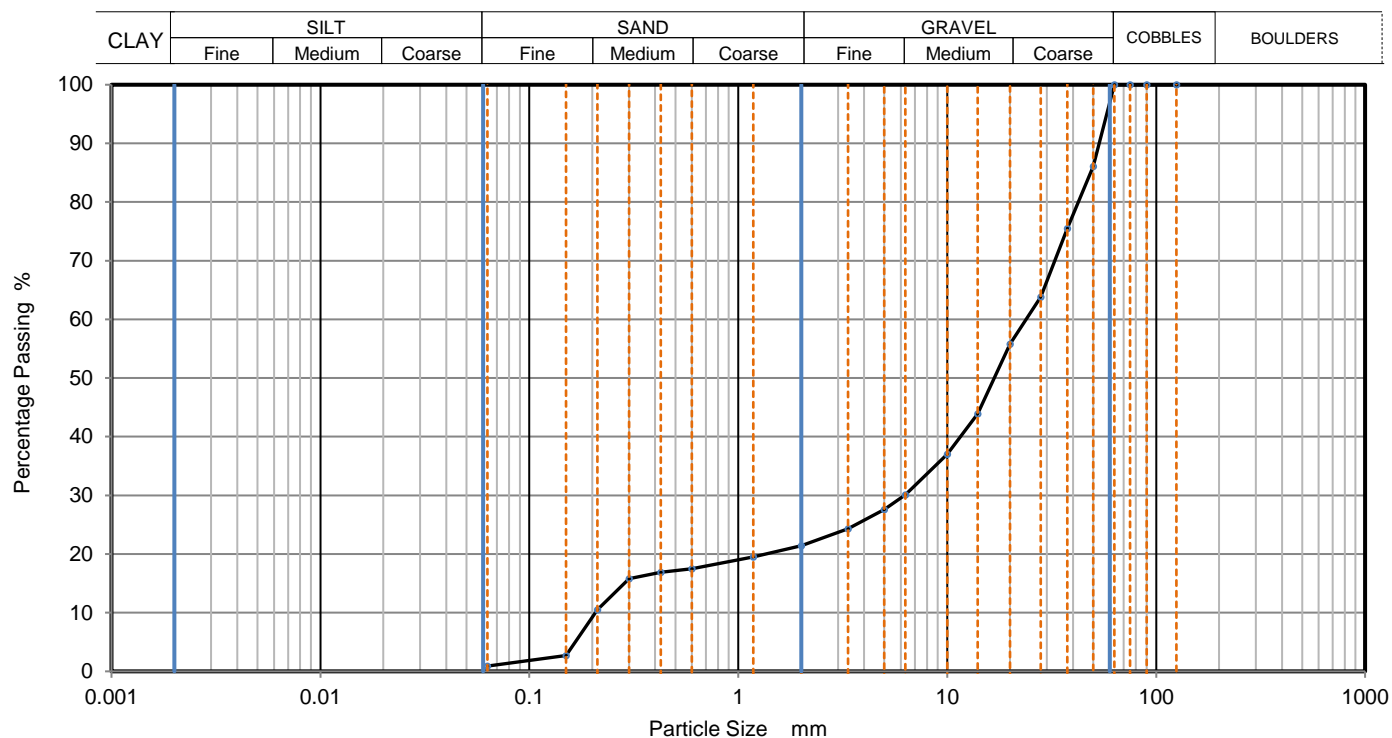
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201710094



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	79
Sand	21
Fines <0.063mm	1

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH06

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

8

Specimen  
Depth

m

Sample Type

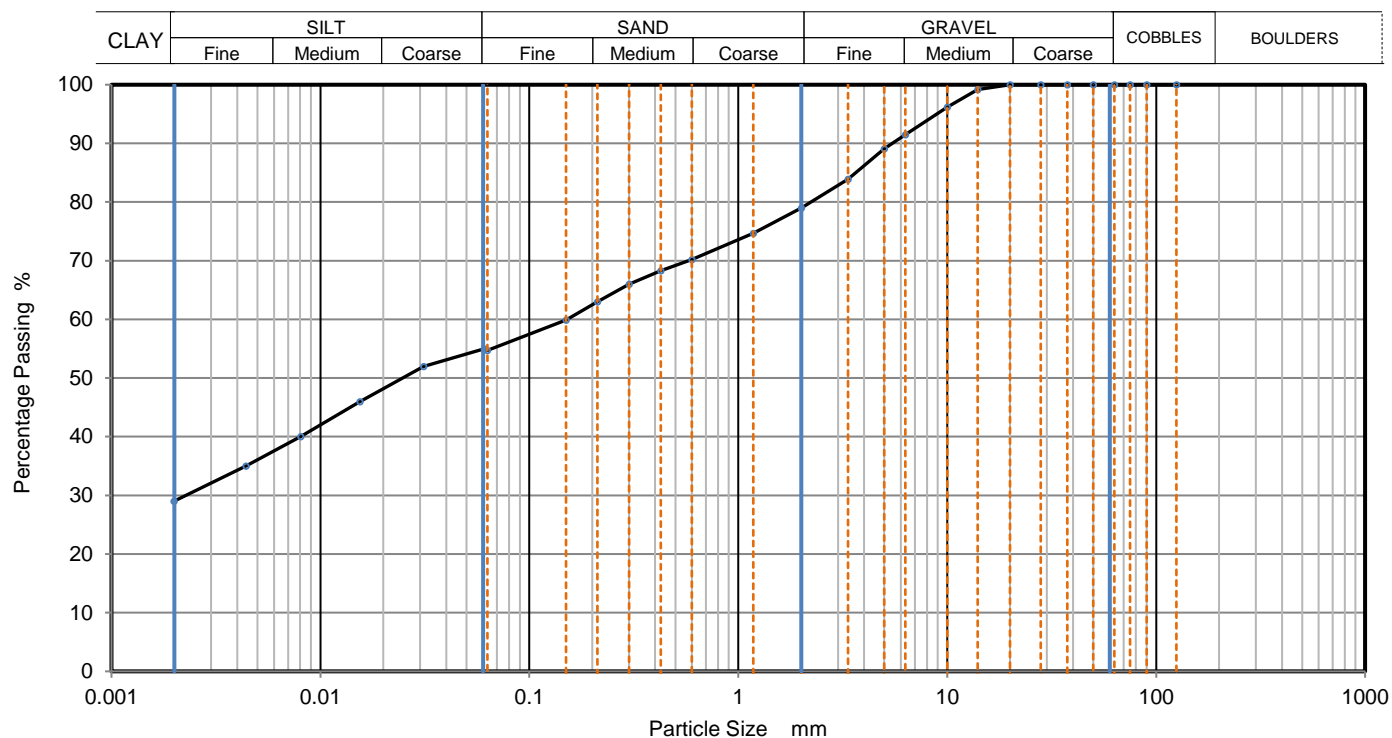
B

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) 2.65 Mg/m <sup>3</sup>	
0.425	68		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH06

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

8

Specimen  
Depth

m

Sample Type

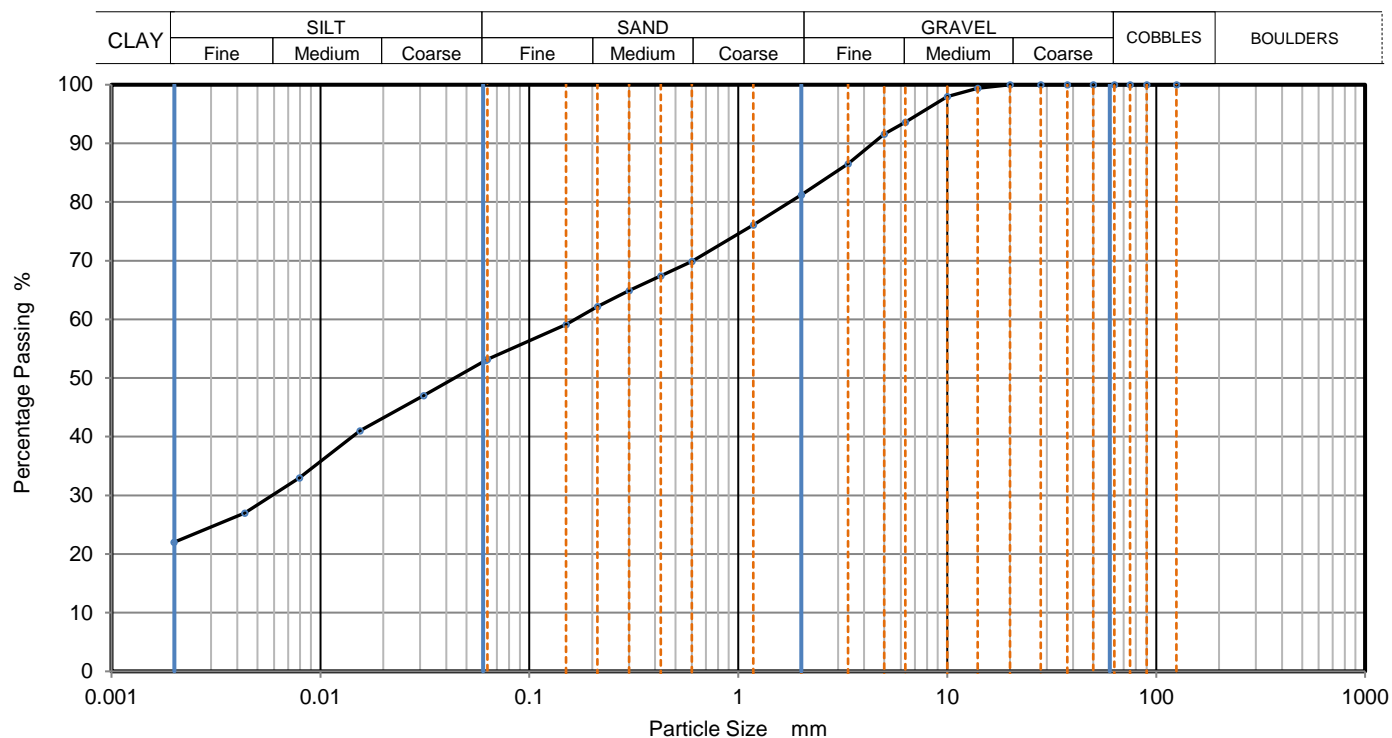
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201710096



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	67		
0.3	65		
0.212	62		
0.15	59		
0.063	53		

Dry Mass of sample, g

2465

Sample Proportions	% dry mass
Cobbles	0
Gravel	19
Sand	28
Silt	31
Clay	22

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH06

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  
Depth

m

Sample Type

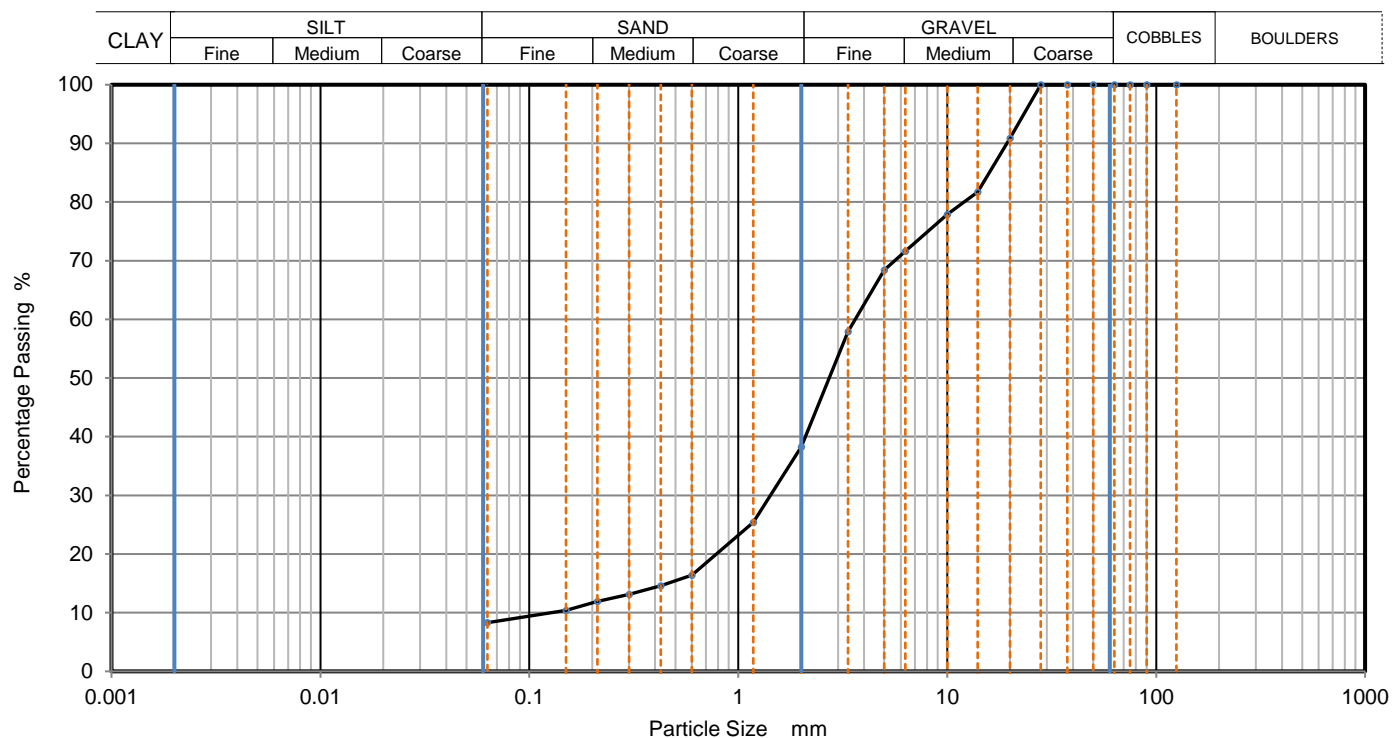
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201710097



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	62
Sand	30
Fines <0.063mm	8

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH06

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  
Depth

m

Sample Type

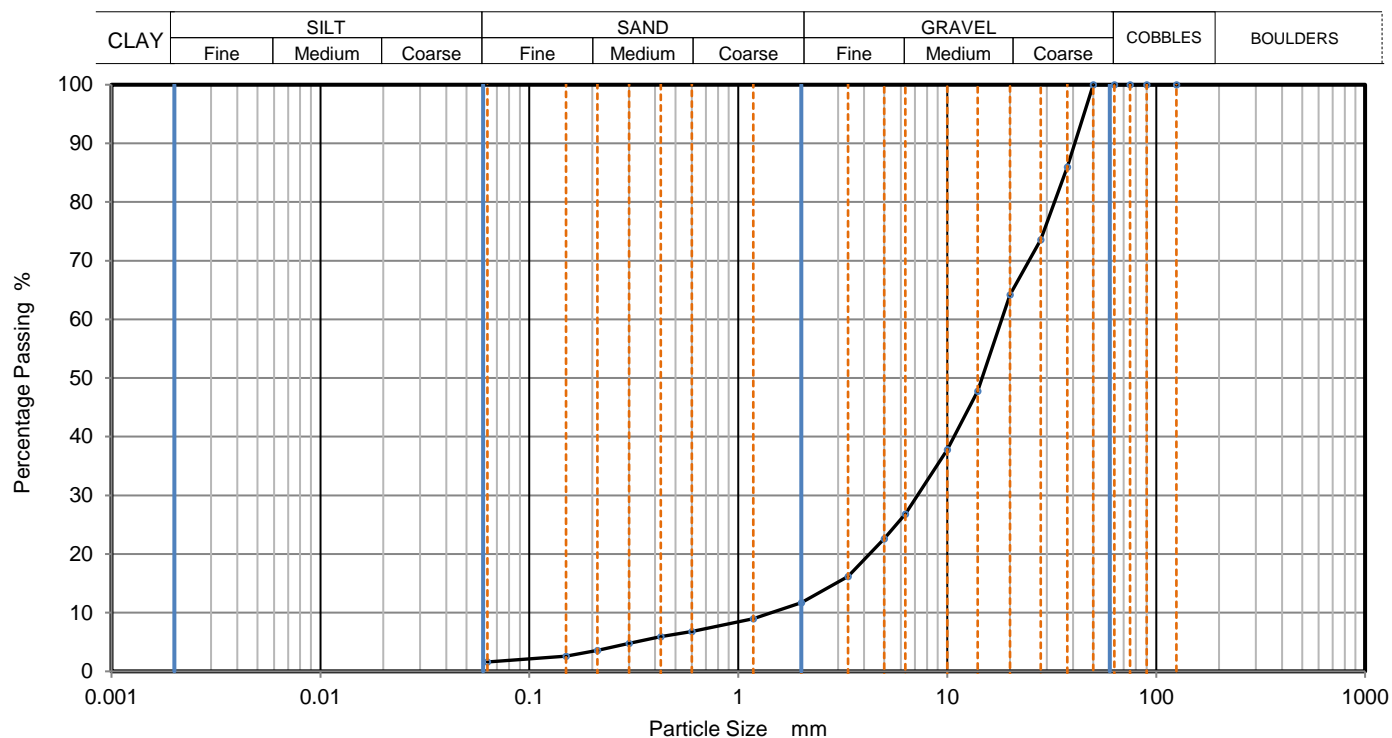
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201710098



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	13
Curvature Coefficient	2

Remarks

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH06

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  
Depth

m

Sample Type

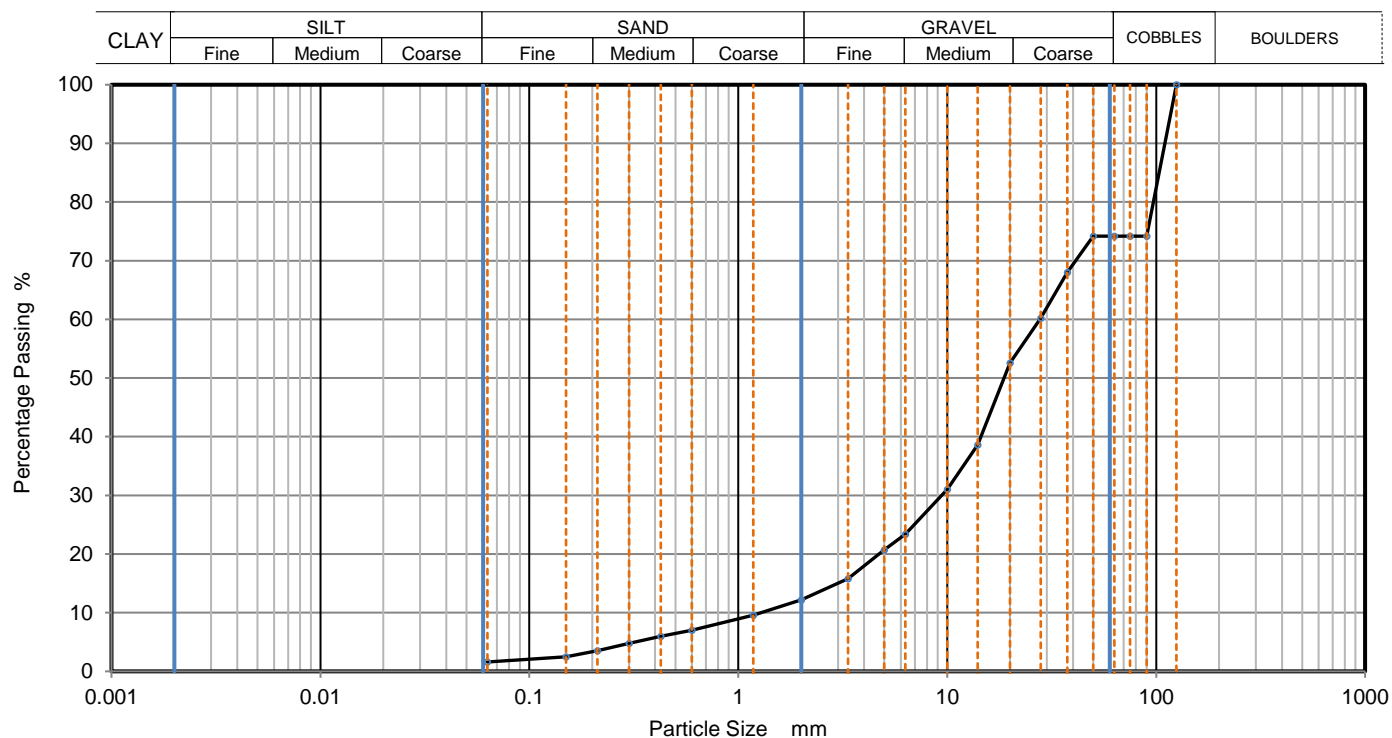
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201710099



Sieving		Sedimentation	
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

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

Remarks

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**SOIL AND ROCK SAMPLE ANALYSIS  
LABORATORY TEST REPORT**

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

---

**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

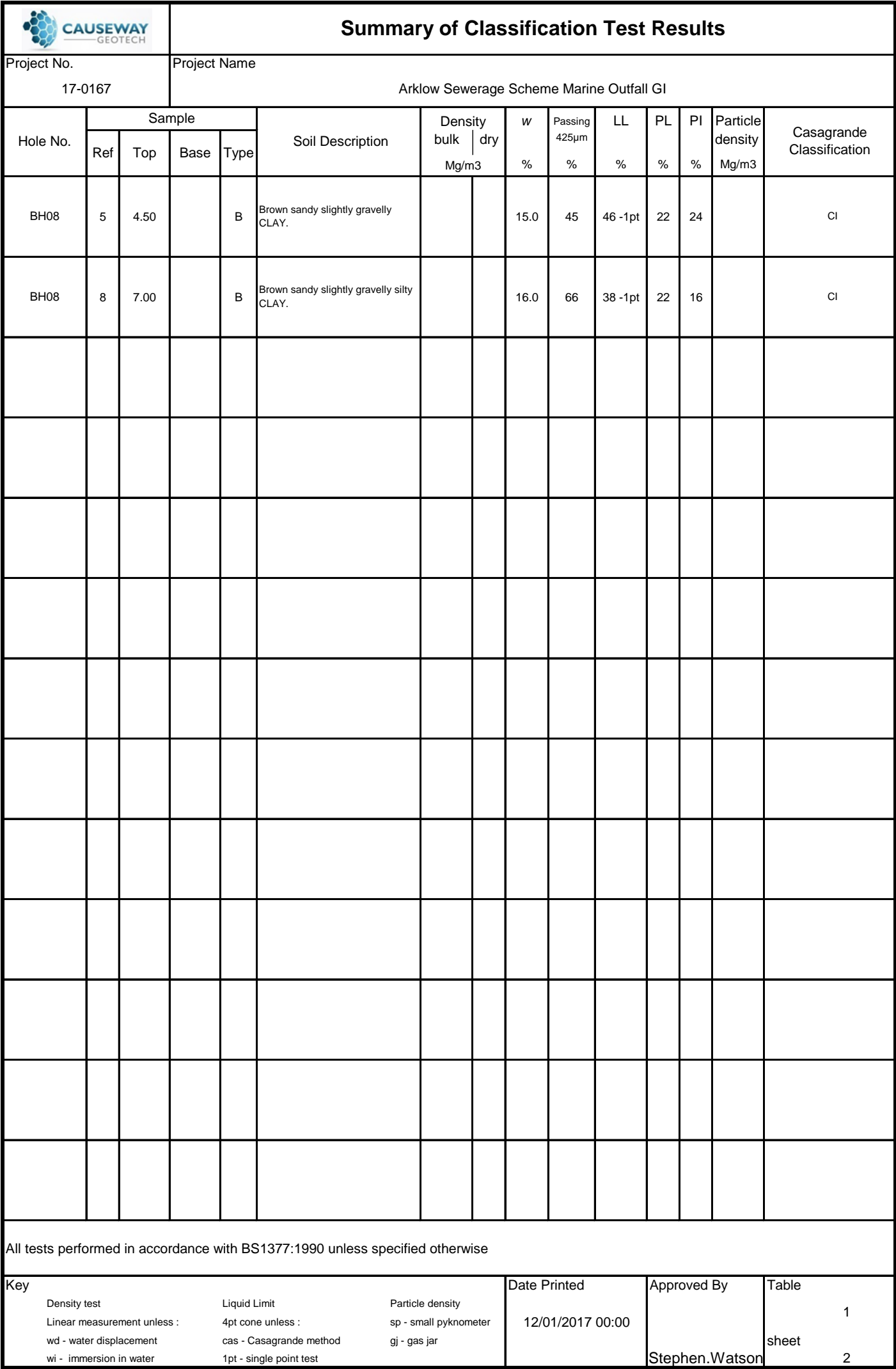


## Summary of Classification Test Results

Project No. 17-0167		Project Name Arklow Sewerage Scheme Marine Outfall GI												
Hole No.	Sample				Soil Description	Density		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type		bulk Mg/m3	dry Mg/m3							
BH07	1	0.00		B	Dark grey slightly sandy subrounded fine to coarse GRAVEL with shell fragments.			4.7						
BH07	2	1.00		B	Grey sandy subangular fine to coarse GRAVEL with shell fragments.			13.0						
BH07	3	2.50		B	Grey slightly sandy gravelly silty CLAY.			24.0						
BH07	5	3.50		B	Grey sandy subrounded fine to coarse GRAVEL with low cobble content.			4.1						
BH07	7	5.30		B	Brownish grey gravelly fine to coarse SAND.			16.0						
BH07	8	6.20		B	Greyish brown silty fine to medium SAND.			21.0	100	29 -1pt	NP			
BH07	9	6.60		B	Greyish brown slightly sandy slightly clayey SILT.			26.0						
BH07	17	7.00		D	Greyish brown slightly sandy silty CLAY.			23.0	98	30 -1pt	19	11		CL
BH07	18	8.00		D	Brown slightly sandy gravelly silty CLAY.			23.0	98	36 -1pt	20	16		CI
BH07	10	9.00		B	Brown slightly sandy silty CLAY.			25.0	97	30 -1pt	19	11		CL
BH08	1	0.00		B	Dark grey sandy subangular fine to coarse GRAVEL.			11.0						
BH08	2	1.50		B	Dark grey slightly gravelly fine to medium SAND with shell fragments.			17.0						
BH08	3	2.30		B	Dark grey slightly gravelly fine to medium SAND.			20.0						

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

Key				Date Printed	Approved By	Table
Density test	Liquid Limit	Particle density	12/01/2017 00:00	Stephen.Watson	sheet	1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer				
wd - water displacement	cas - Casagrande method	gj - gas jar				
wi - immersion in water	1pt - single point test					





## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH07

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

1

Soil Description

Dark grey slightly sandy subrounded fine to coarse GRAVEL with shell fragments.

Depth, m

0.00

Specimen Reference

6

Specimen  
Depth

m

Sample Type

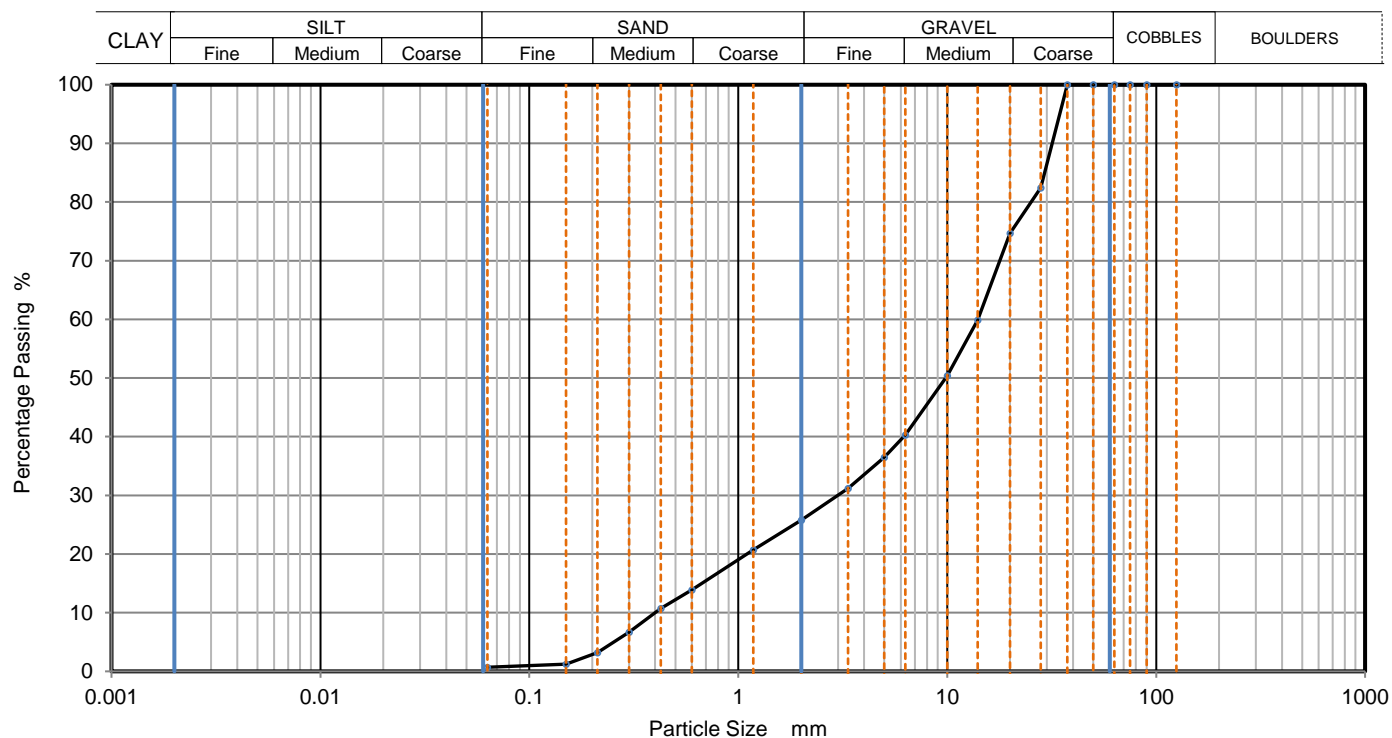
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017101848



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	35
Curvature Coefficient	1.6

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH07

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

2

Soil Description

Grey sandy subangular fine to coarse GRAVEL with shell fragments.

Depth, m

1.00

Specimen Reference

6

Specimen  
Depth

m

Sample Type

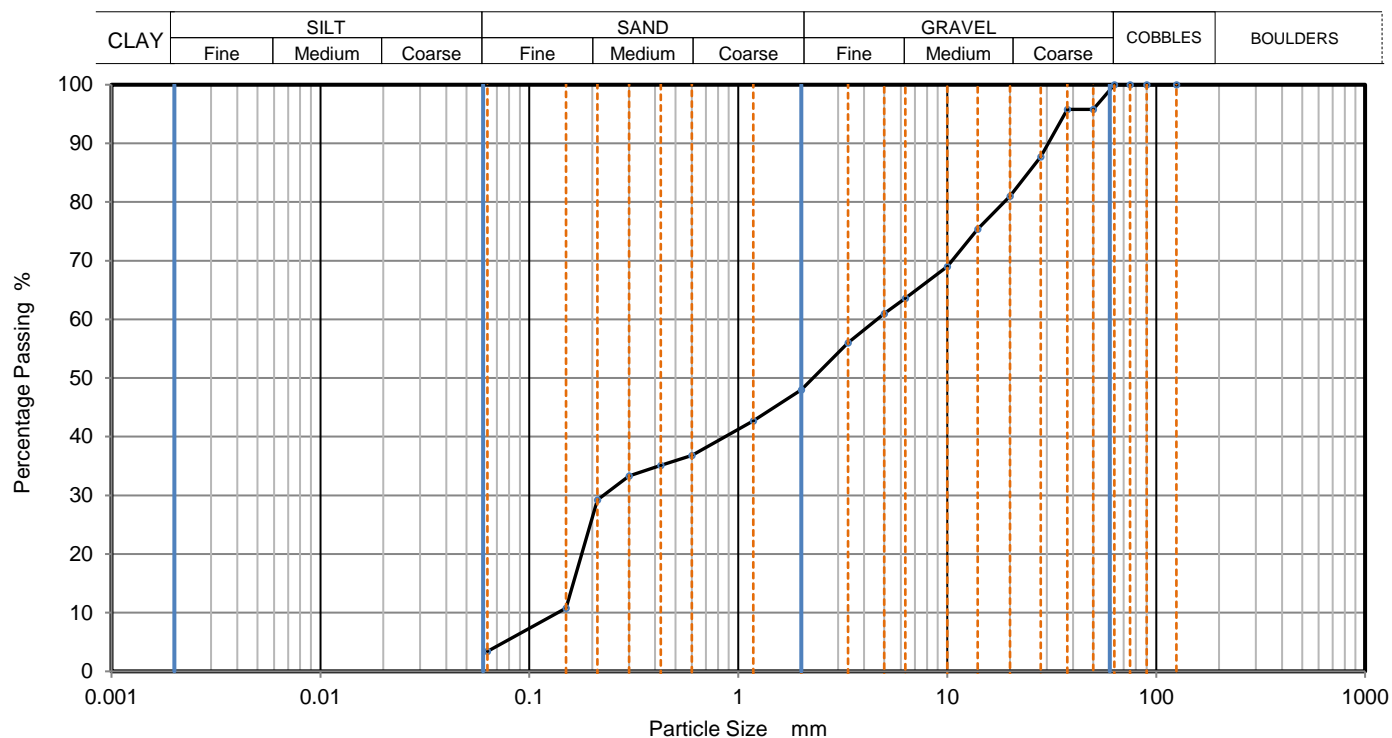
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017101849



Sieving		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

Sample Proportions	% dry mass
Cobbles	0
Gravel	52
Sand	45
Fines <0.063mm	3

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH07

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  
Depth

m

Sample Type

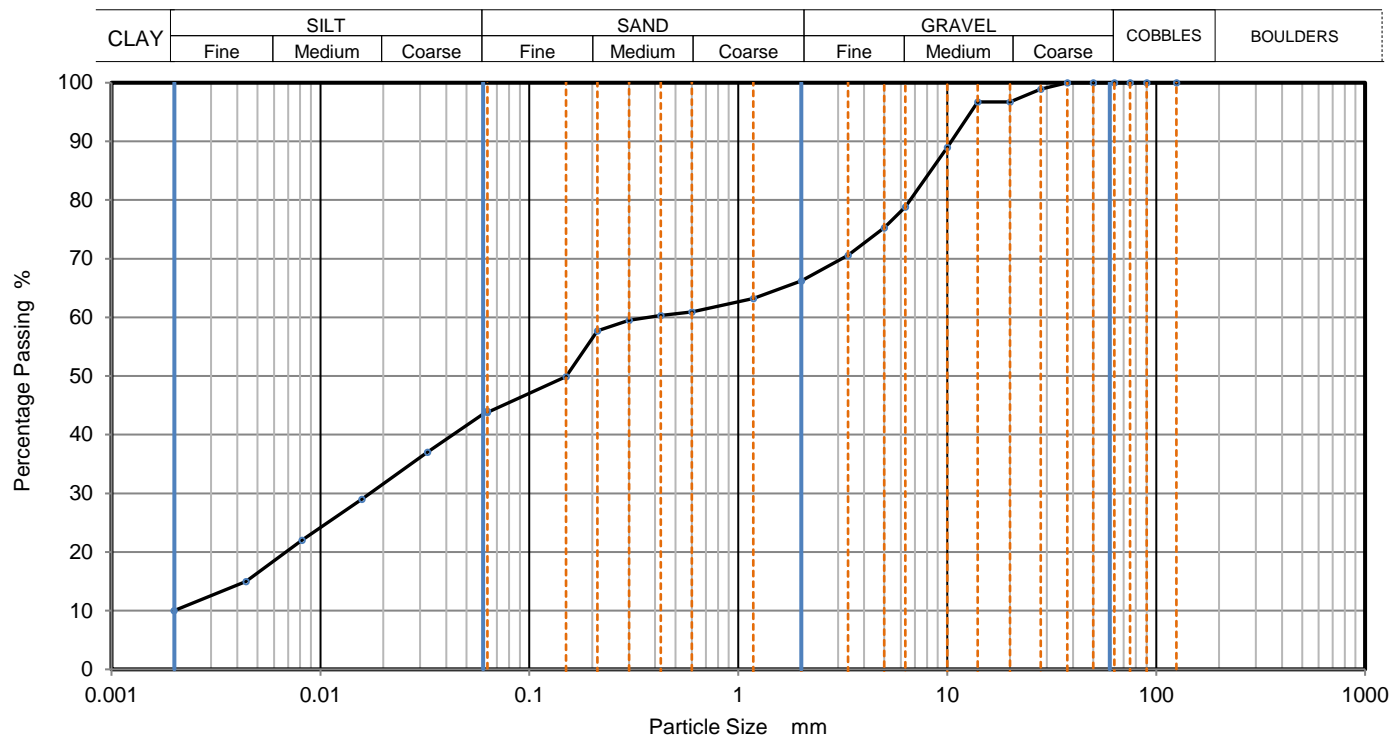
B

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) 2.65 Mg/m <sup>3</sup>	
0.425	60		
0.3	60		
0.212	58		
0.15	50		
0.063	44		

Dry Mass of sample, g

2748

Sample Proportions	% dry mass
Cobbles	0
Gravel	34
Sand	22
Silt	34
Clay	10

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH07

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  
Depth

m

Sample Type

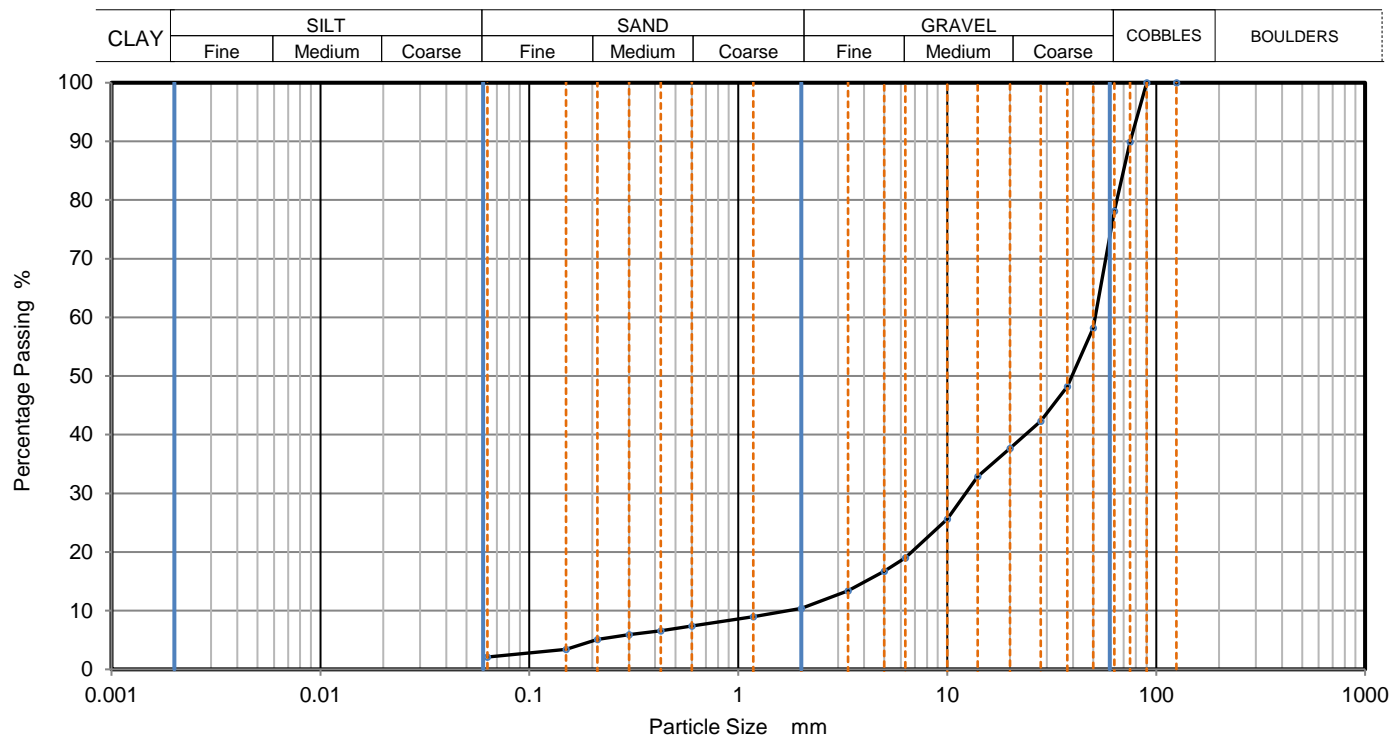
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017101851



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	22
Gravel	68
Sand	8
Fines <0.063mm	2

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH07

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

6

Specimen  
Depth

m

Sample Type

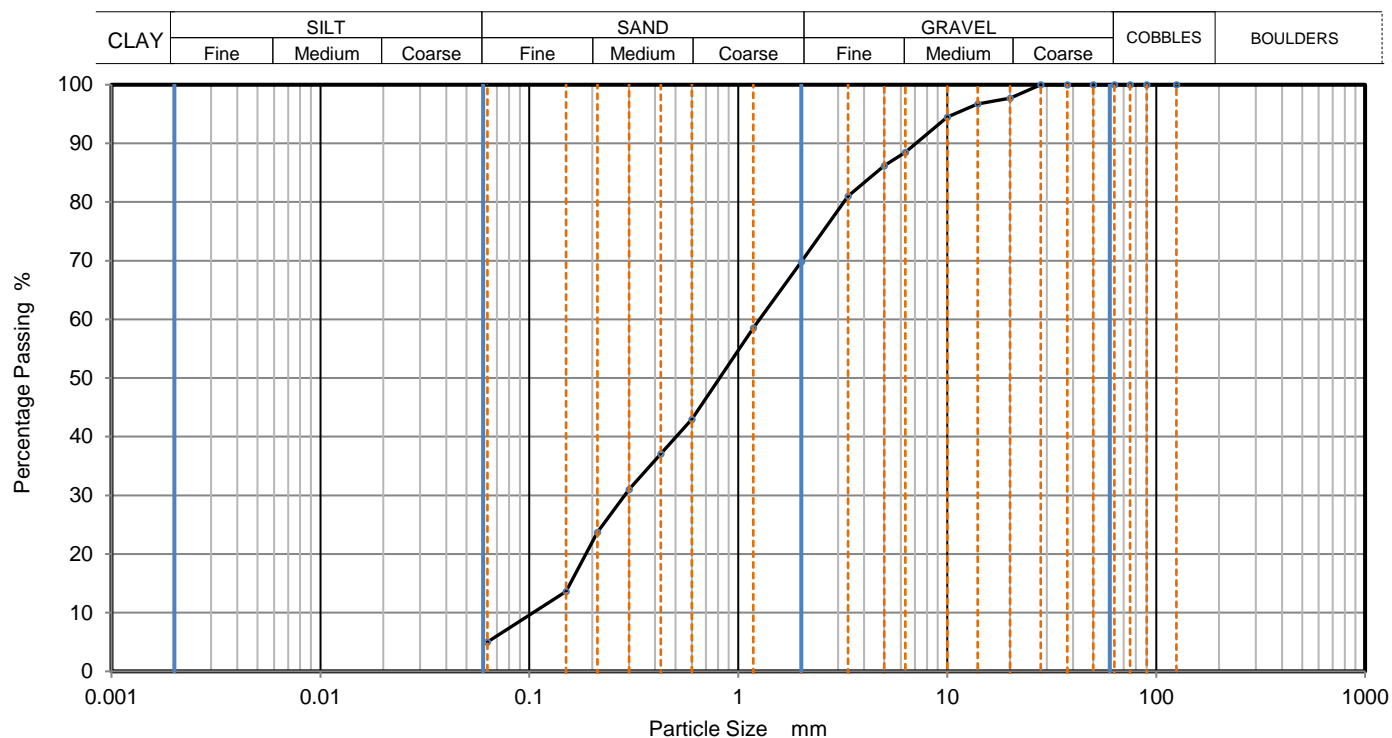
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017101852



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	30
Sand	65
Fines <0.063mm	5

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH07

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

8

Specimen  
Depth

m

Sample Type

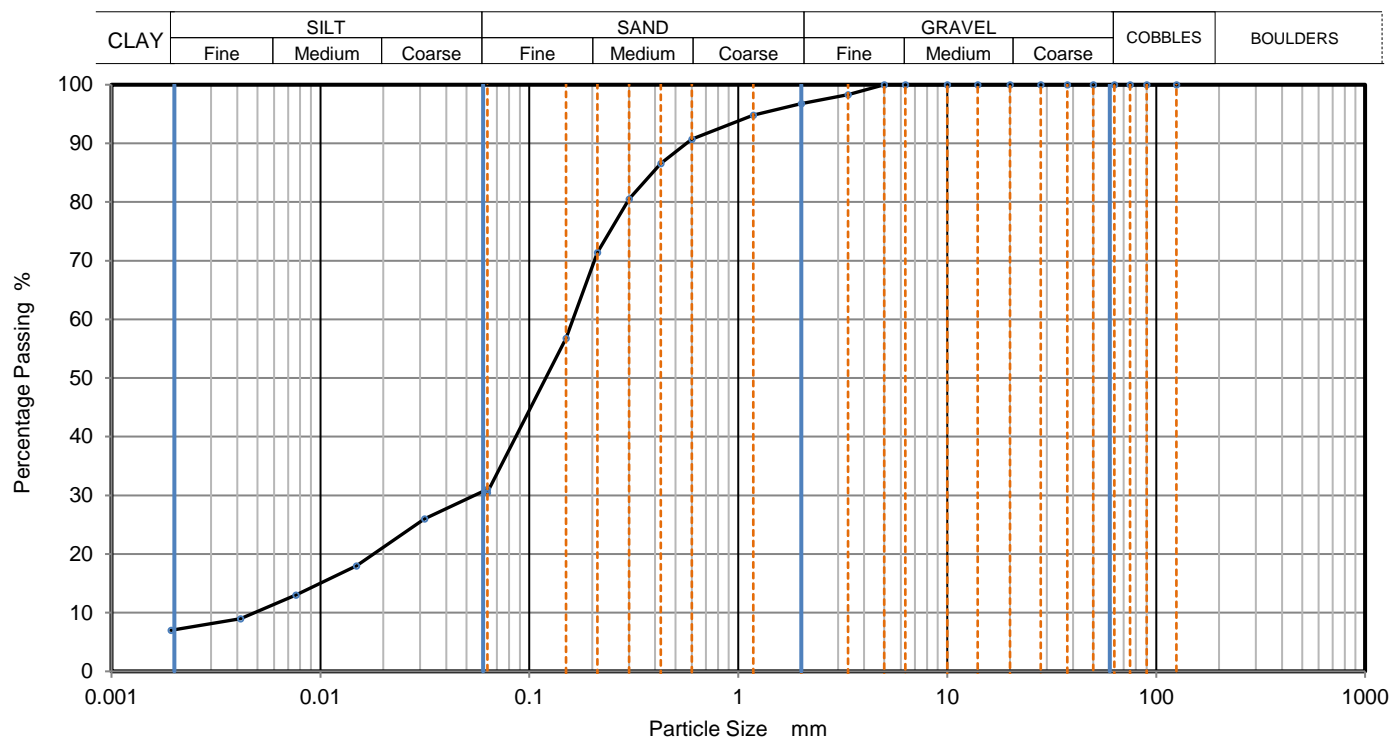
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017101853



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	87		
0.3	81		
0.212	71		
0.15	57		
0.063	31		

Dry Mass of sample, g

2231

Sample Proportions	% dry mass
Cobbles	0
Gravel	3
Sand	66
Silt	24
Clay	7

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH07

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  
Depth

m

Sample Type

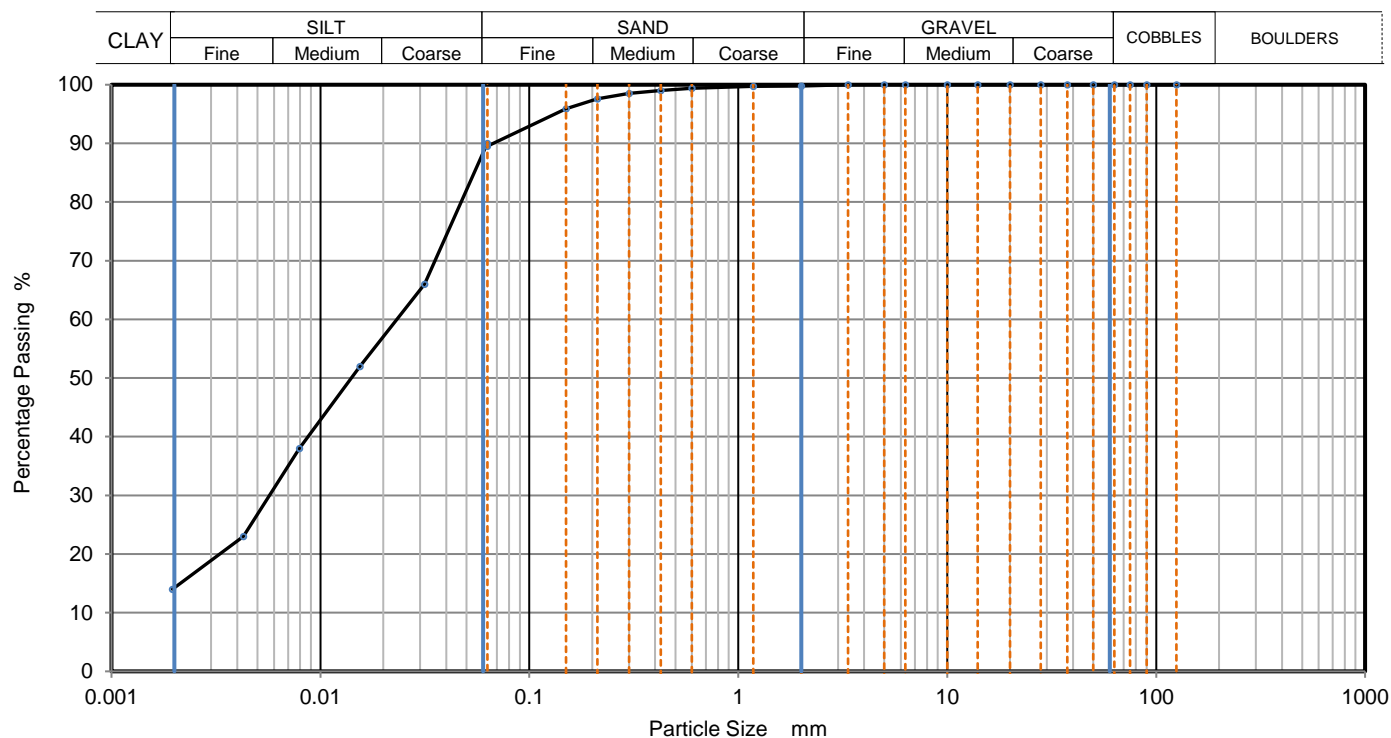
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017101854



Sieving		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) 2.65 Mg/m <sup>3</sup>	
0.425	99		
0.3	99		
0.212	98		
0.15	96		
0.063	90		

Dry Mass of sample, g

1617

**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		

**Remarks**

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH07

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

10

Soil Description

Brown slightly sandy silty CLAY.

Depth, m

9.00

Specimen Reference

8

Specimen  
Depth

m

Sample Type

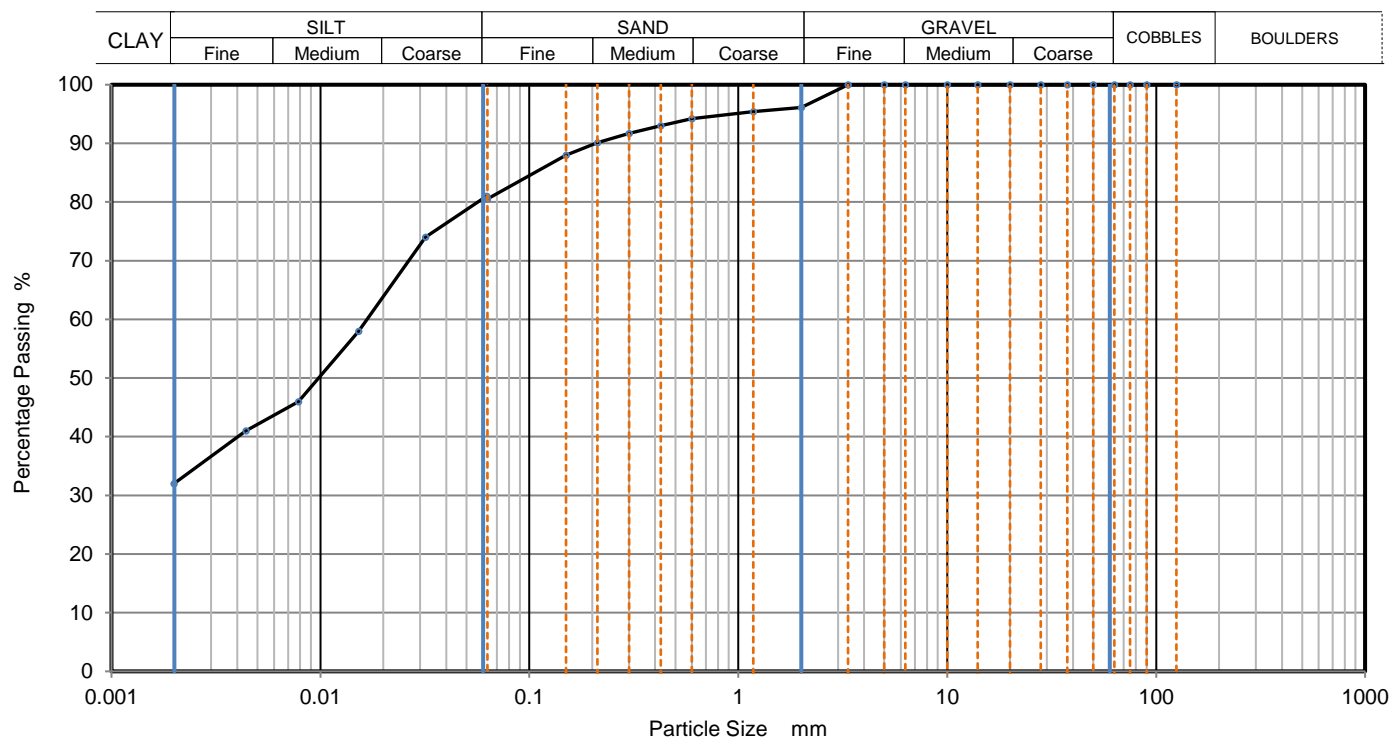
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017101857



Sieving		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) 2.65 Mg/m <sup>3</sup>	
0.425	93		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH08

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  
Depth

m

Sample Type

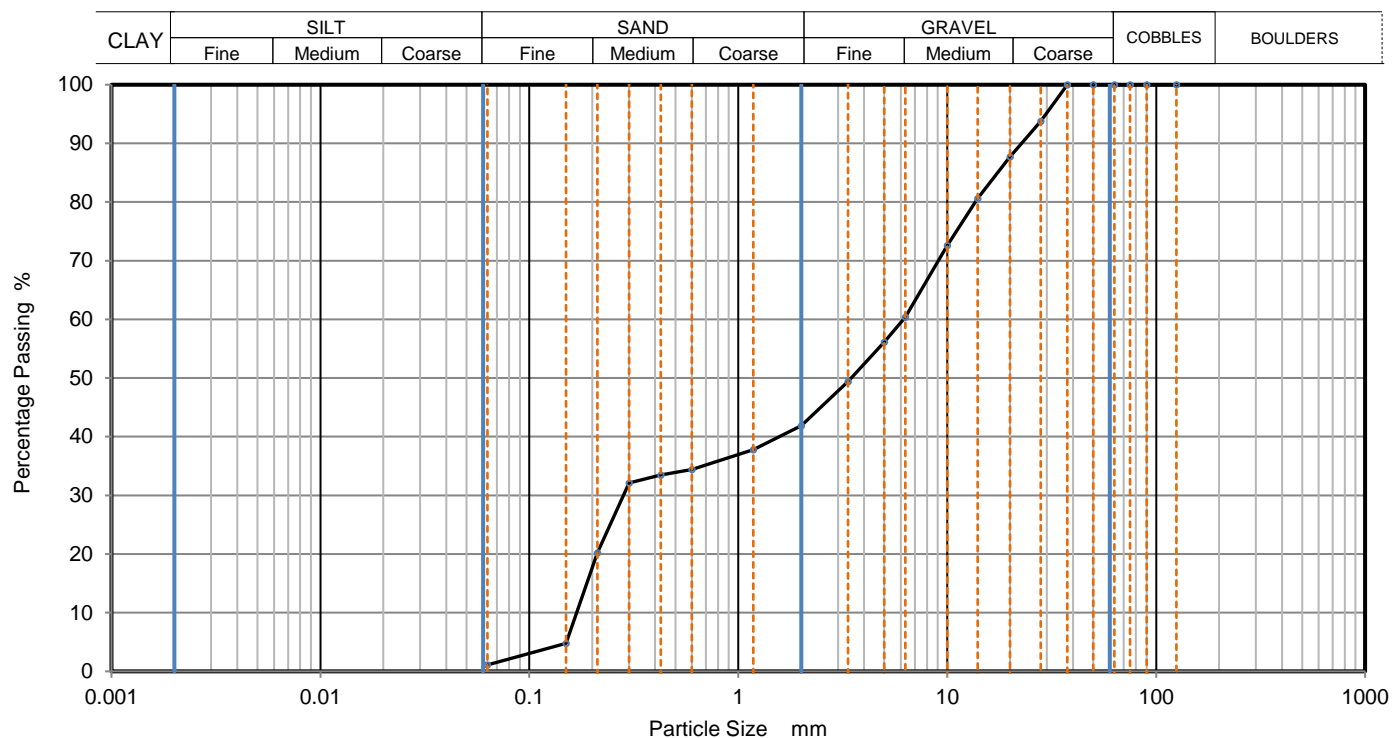
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017101858



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	58
Sand	41
Fines <0.063mm	1

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH08

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  
Depth

m

Sample Type

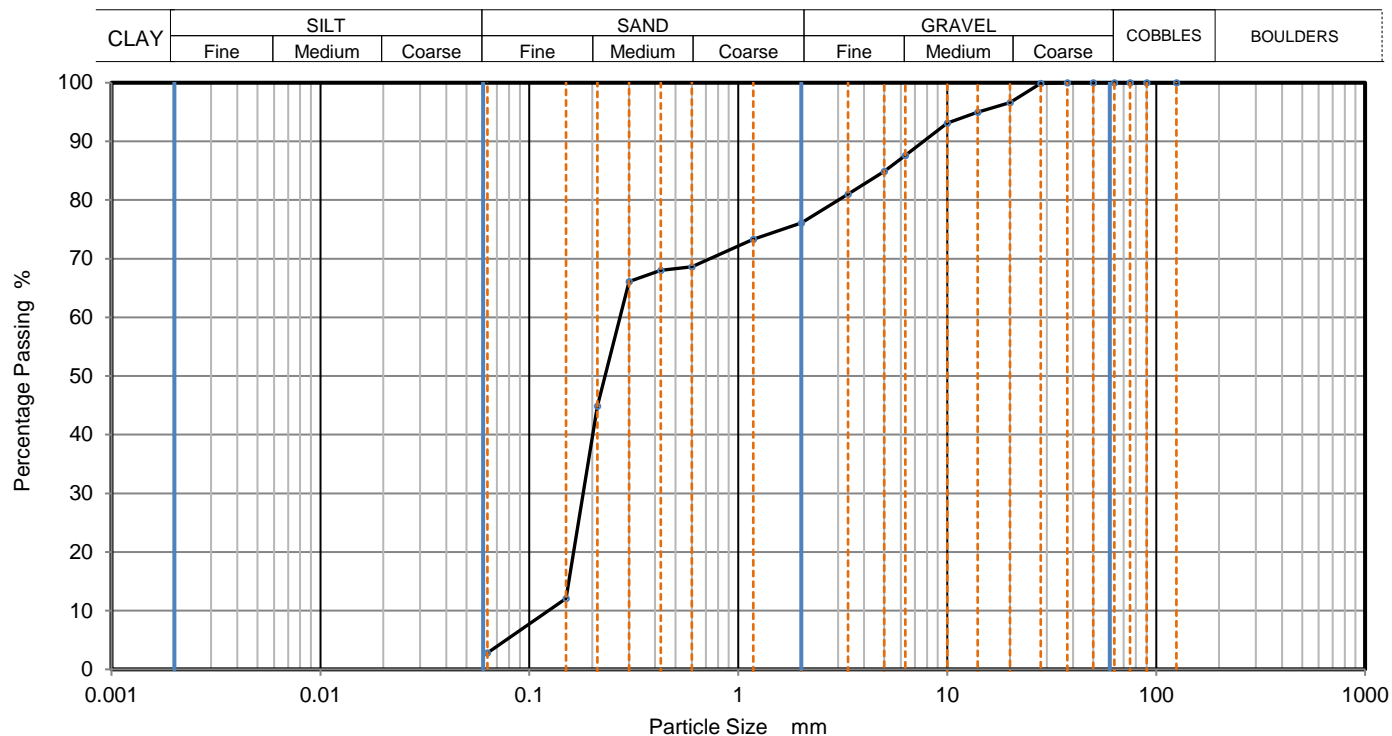
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017101859



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	24
Sand	73
Fines <0.063mm	3

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH08

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  
Depth

m

Sample Type

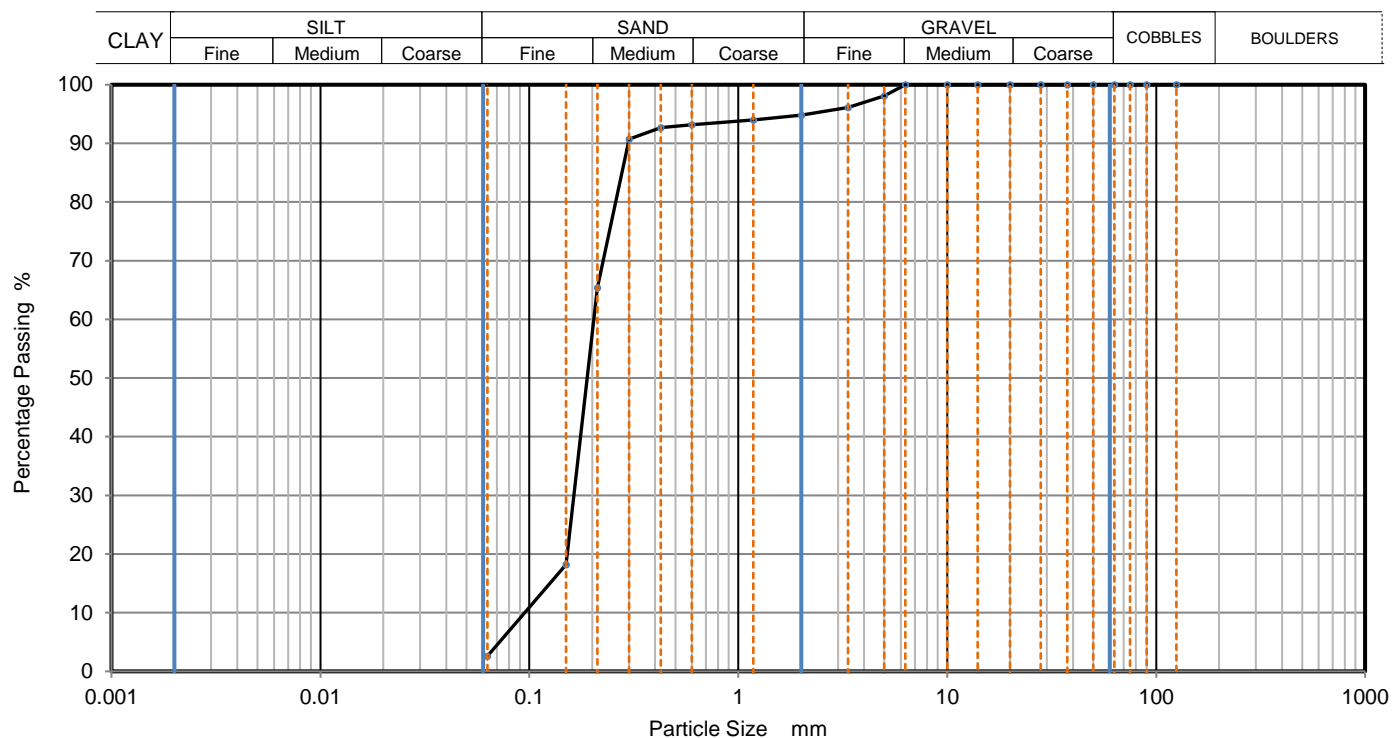
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017101860



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	2.1
Curvature Coefficient	1.4

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH08

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

5

Soil Description

Brown sandy slightly gravelly CLAY.

Depth, m

4.50

Specimen Reference

8

Specimen  
Depth

m

Sample Type

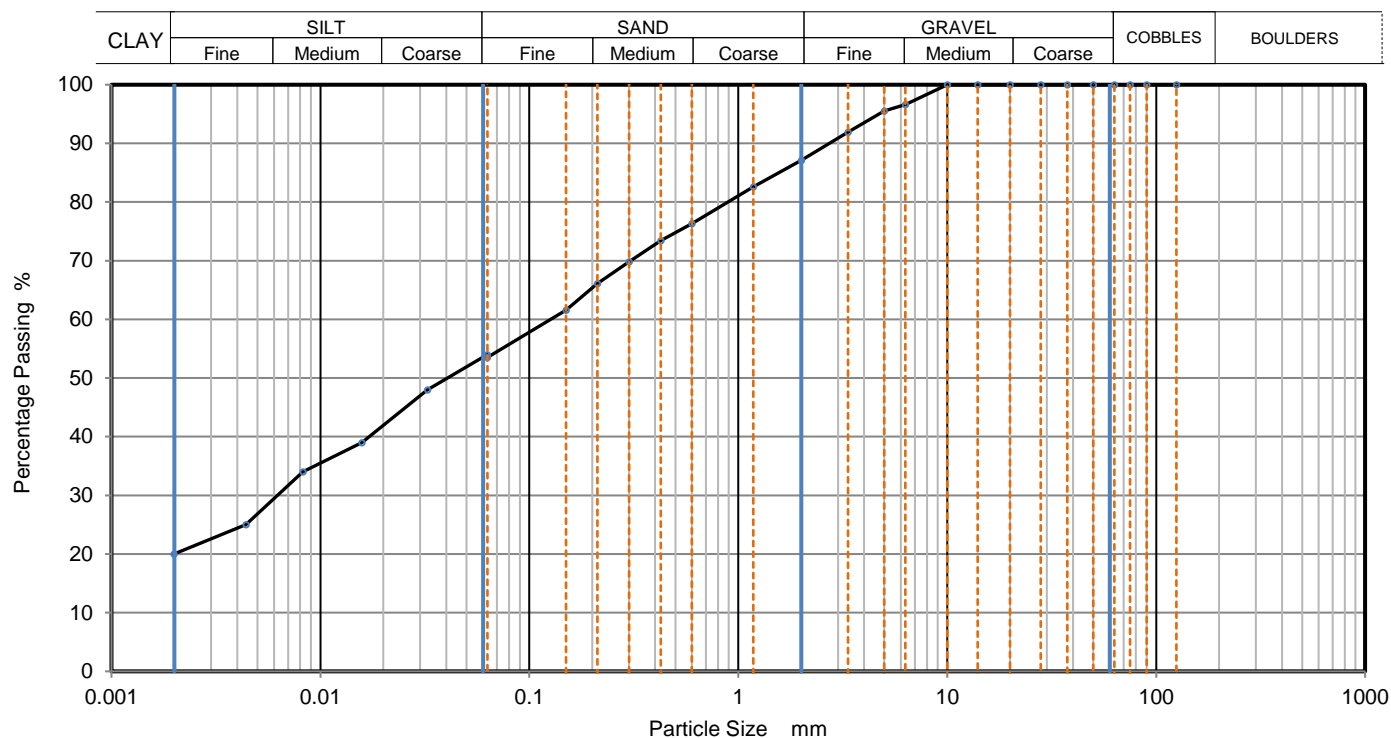
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Test Method

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) 2.65 Mg/m <sup>3</sup>	
0.425	73		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH08

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  
Depth

m

Sample Type

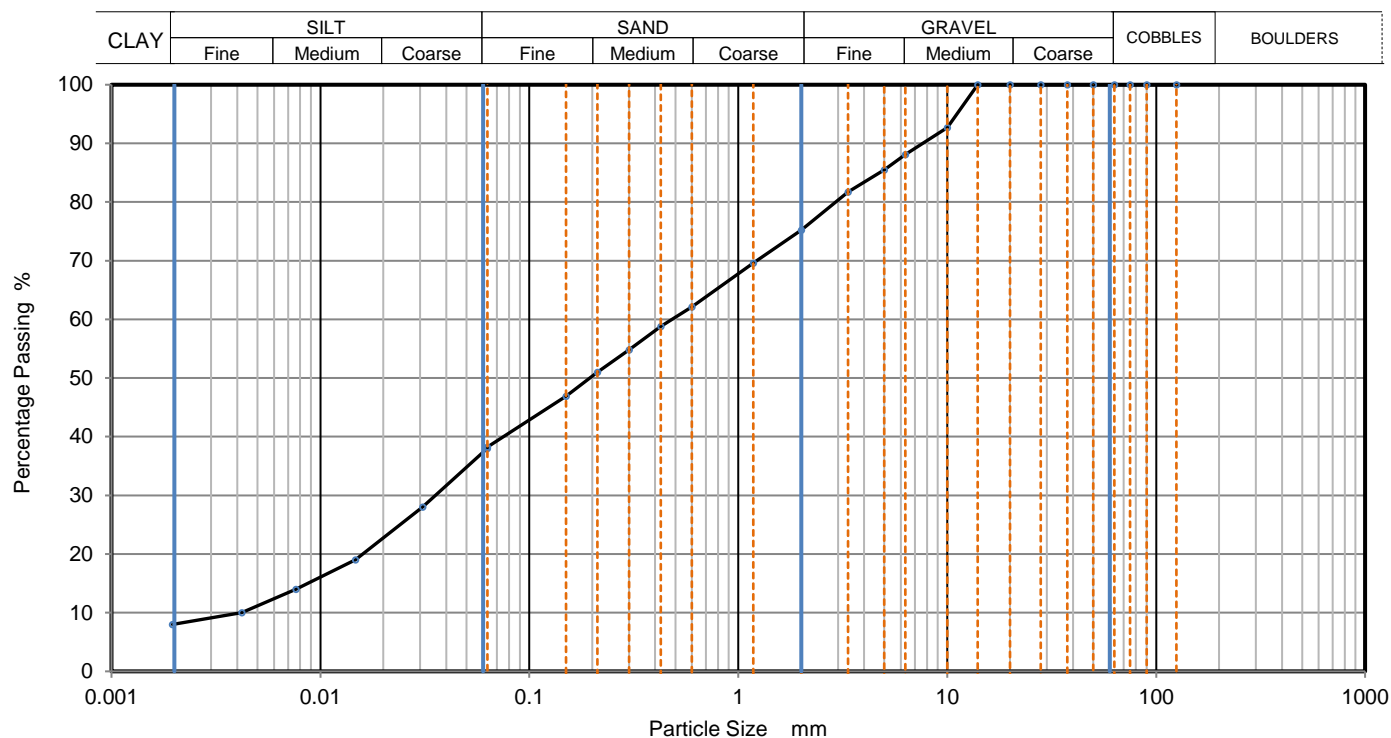
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Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017101862



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	59		
0.3	55		
0.212	51		
0.15	47		
0.063	38		

Dry Mass of sample, g

1859

Sample Proportions	% dry mass
Cobbles	0
Gravel	25
Sand	37
Silt	31
Clay	8

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

Sheet



# 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  
(Director)

A Watkins  
(Director)

R Berriman  
(Quality Manager)

L Knight  
(Senior Technician)

  
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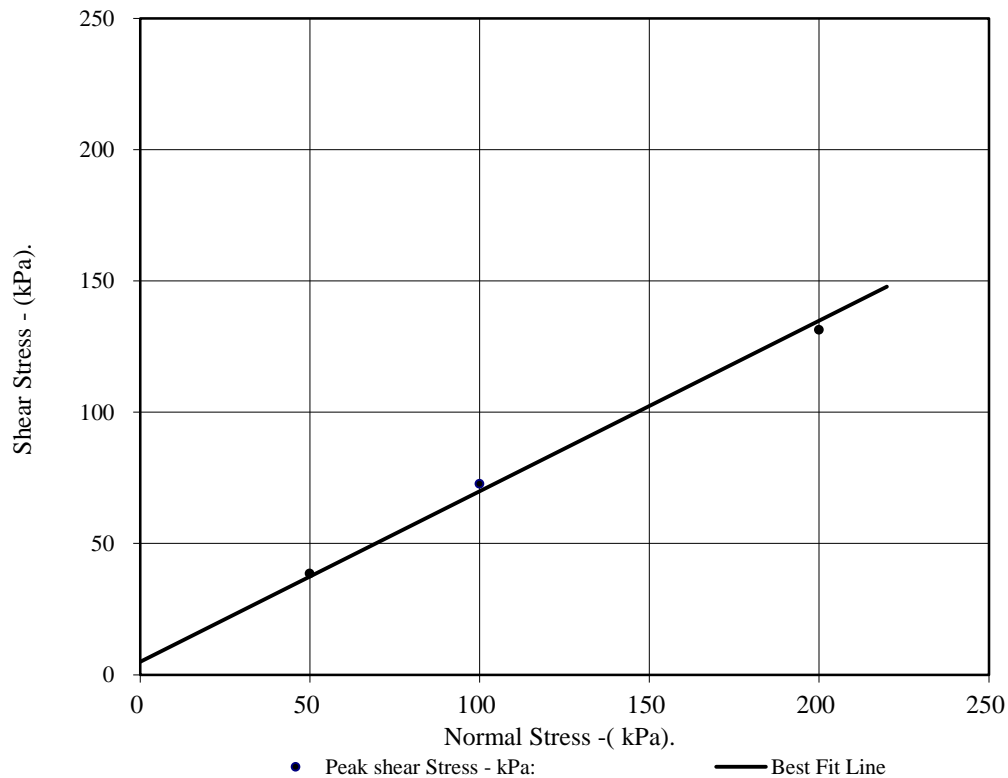
Page 1 of



# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH04		Top Depth:	4.20	
Sample Number:	20		Base Depth:	5.00	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	Brown slightly 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 stress (mm)			5.00	3.00	3.00
Peak shear Stress - kPa:			39	73	131
Final Consolidated Conditions					
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:( $\theta$ )			33		
Effective Cohesion - kPa:			5		



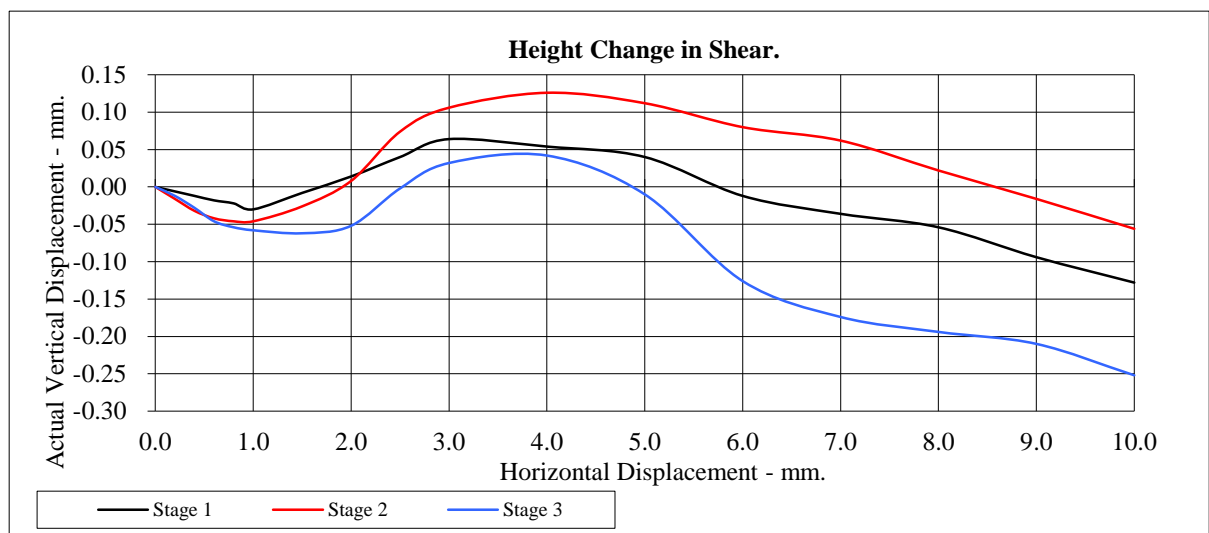
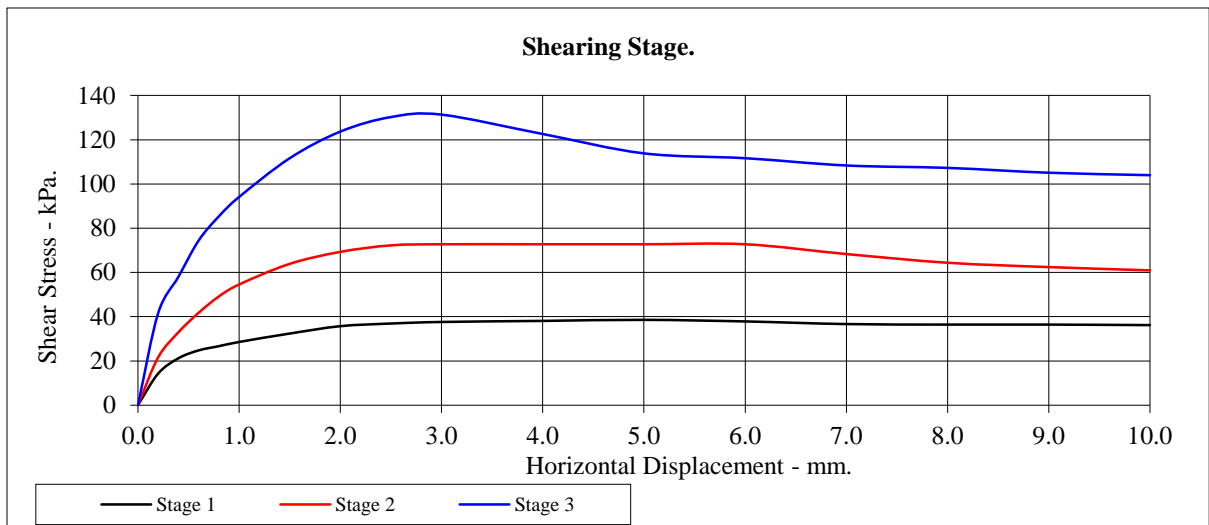
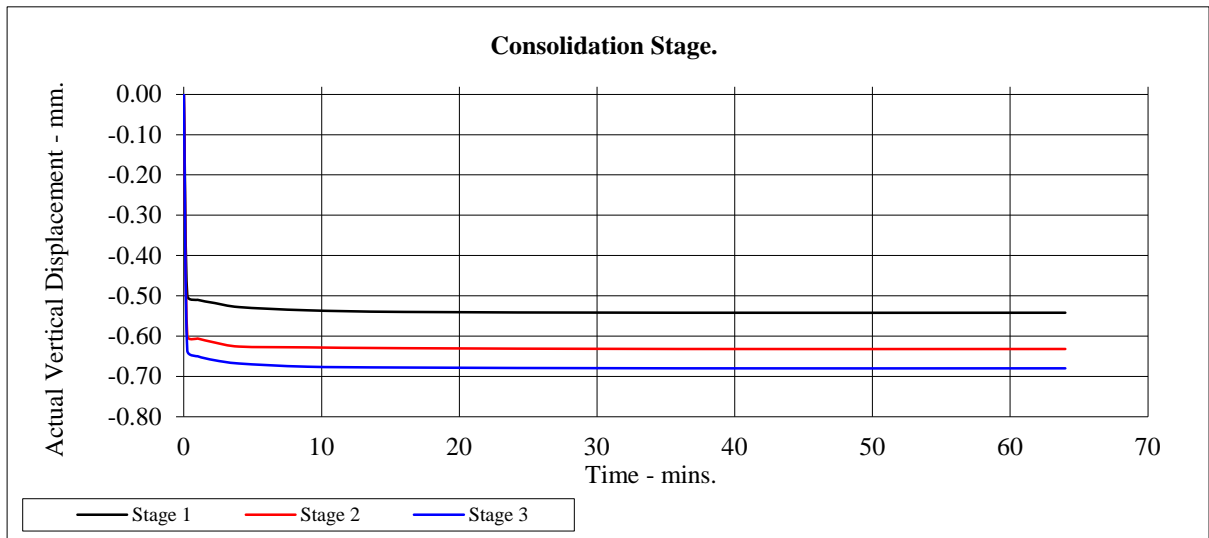
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5711
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

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



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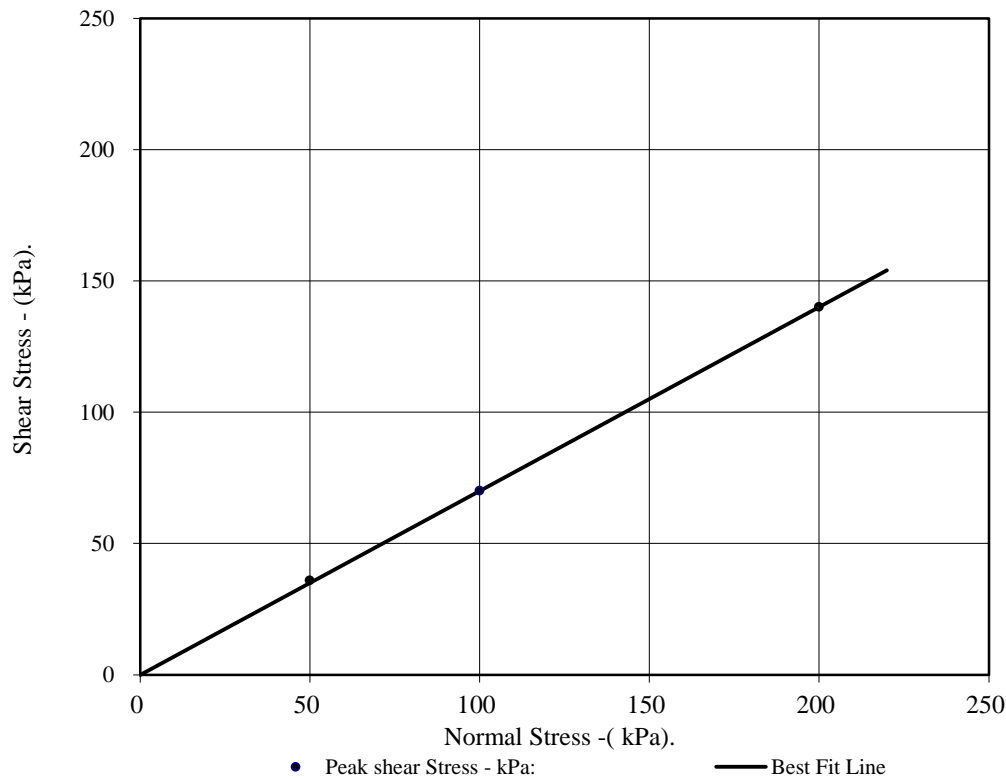
Arklow Sewerage Scheme Marine Outfall GI

<b>Contract No:</b>
<b>PSL17/5711</b>
<b>Client Ref:</b>
<b>17-0167</b>

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH04		Top Depth:	6.10	
Sample Number:	24		Base Depth:	7.00	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	Brown gravelly 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 stress (mm)			2.50	5.00	5.00
Peak shear Stress - kPa:			36	70	140
Final Consolidated Conditions					
Moisture Content - %:			18	18	16
Bulk Density - Mg/m3:			1.92	1.95	1.97
Dry Density - Mg/m3:			1.63	1.65	1.70
Peak					
Angle of Shearing Resistance:( $\theta$ )			35		
Effective Cohesion - kPa:			0		



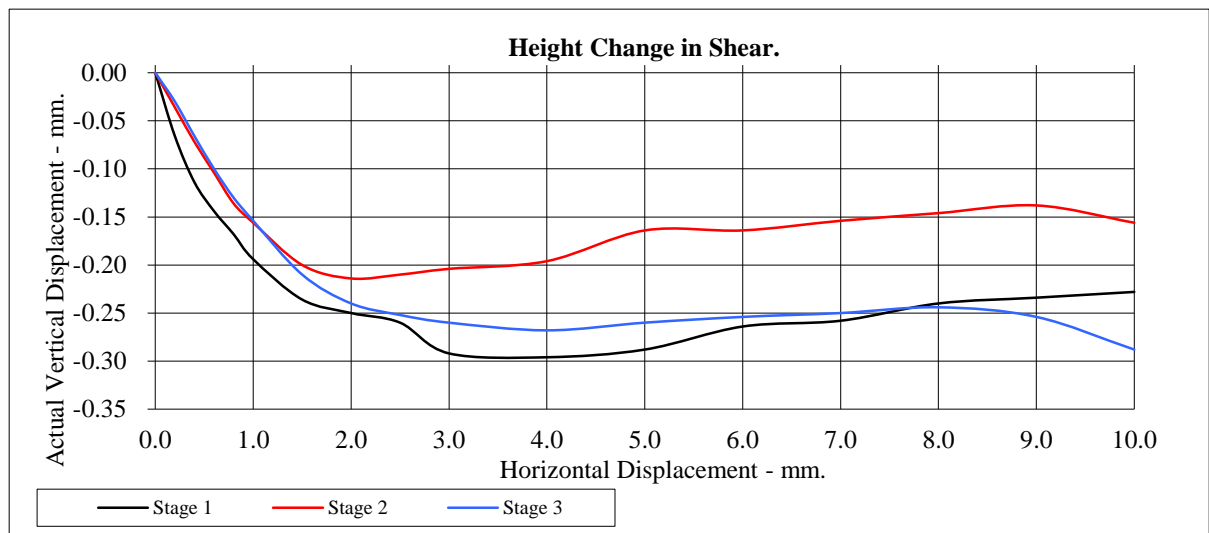
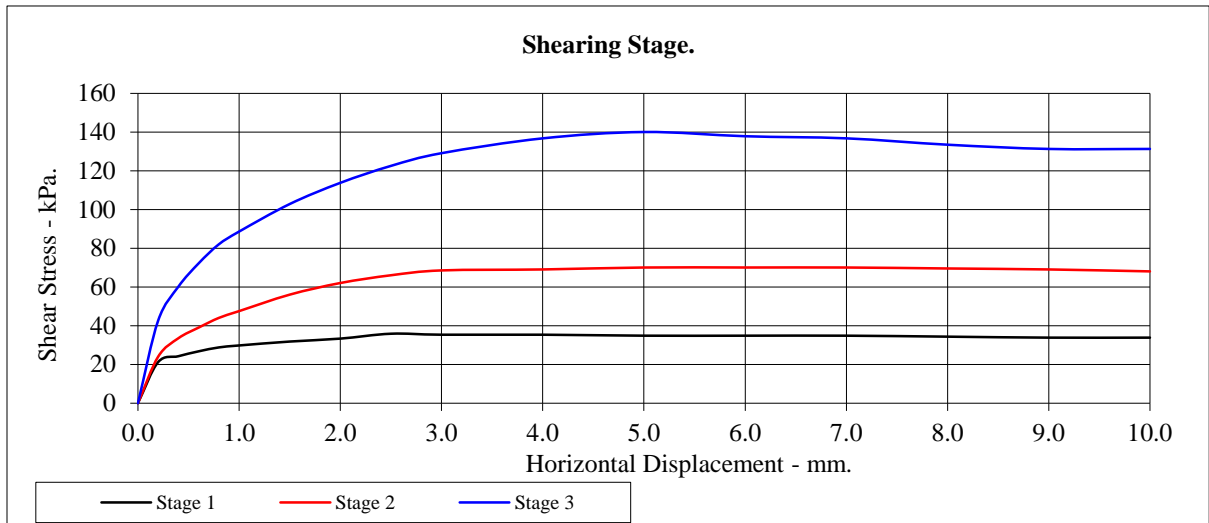
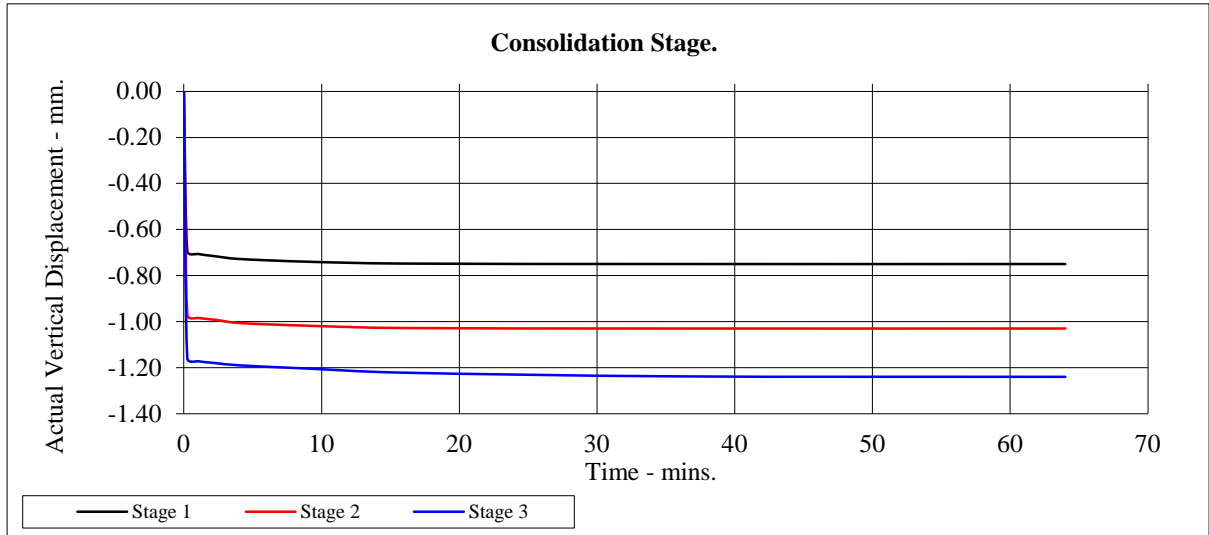
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5711
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

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



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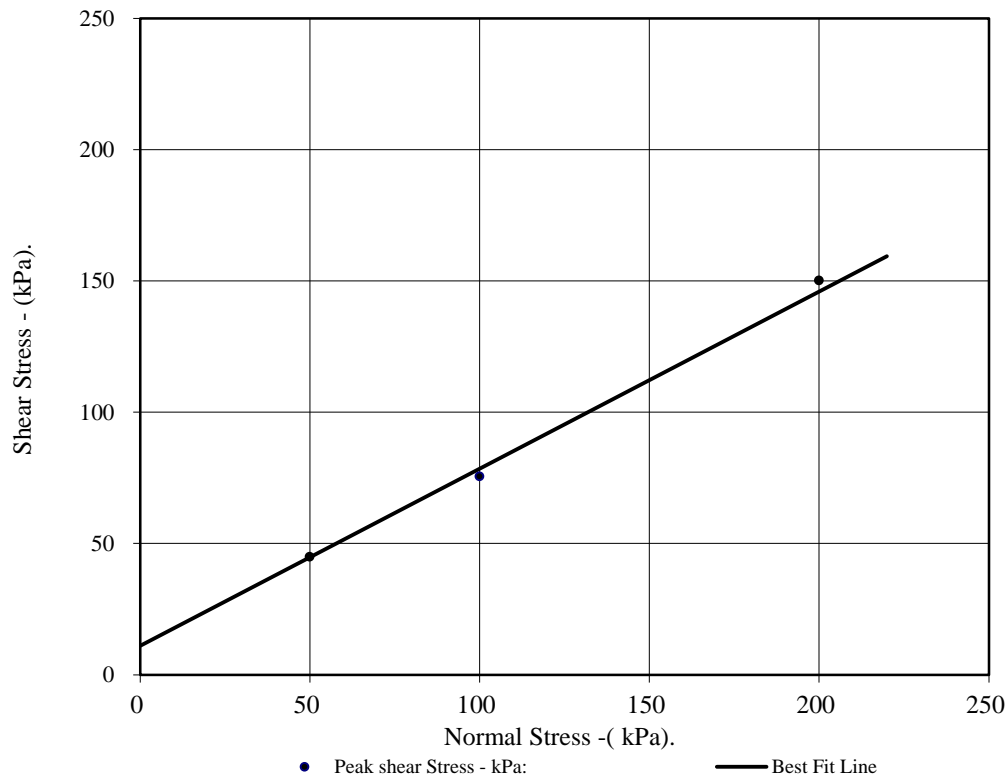
Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**  
PSL17/5711  
**Client Ref:**  
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH05		Top Depth:	2.20	
Sample Number:	9		Base Depth:	3.50	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	Brown slightly 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 stress - mm			1.50	1.50	1.50
Peak shear Stress - kPa:			45	76	150
Final Consolidated Conditions					
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:( $\theta$ )			34		
Effective Cohesion - kPa:			11		



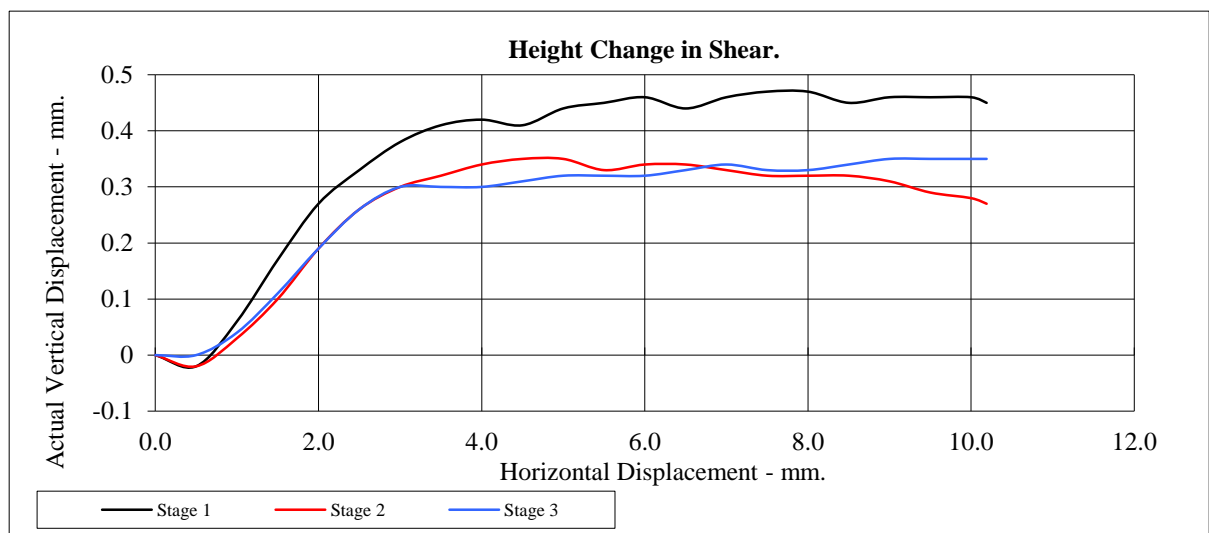
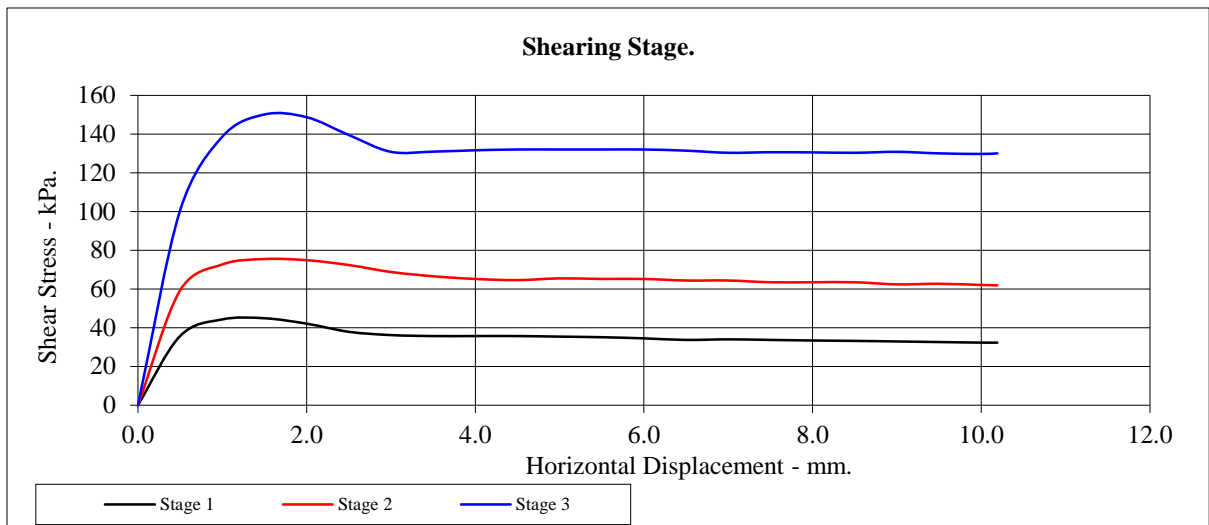
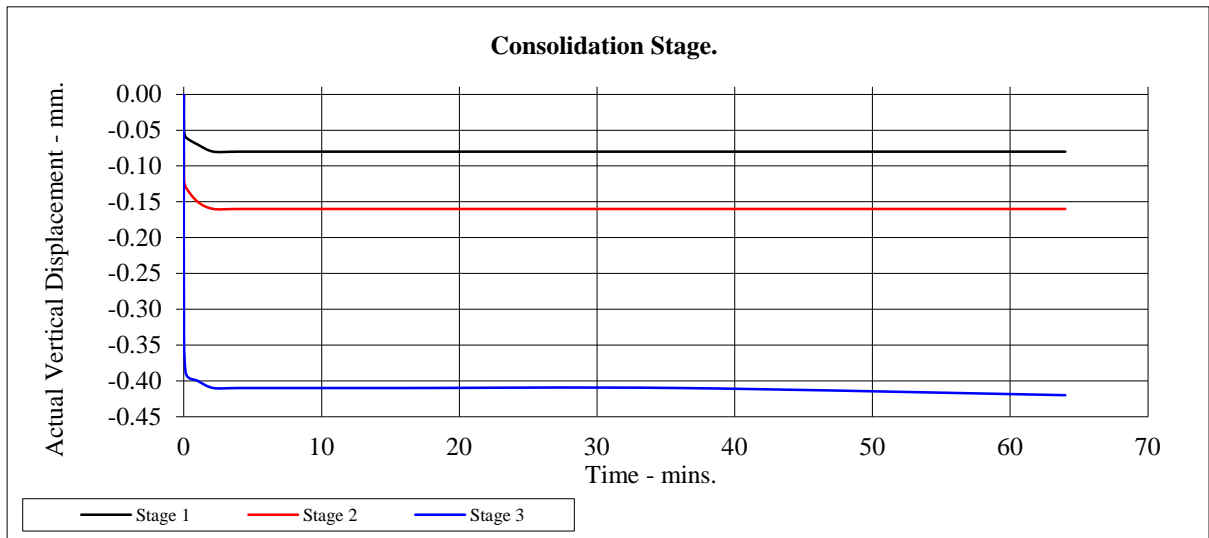
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5711
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

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



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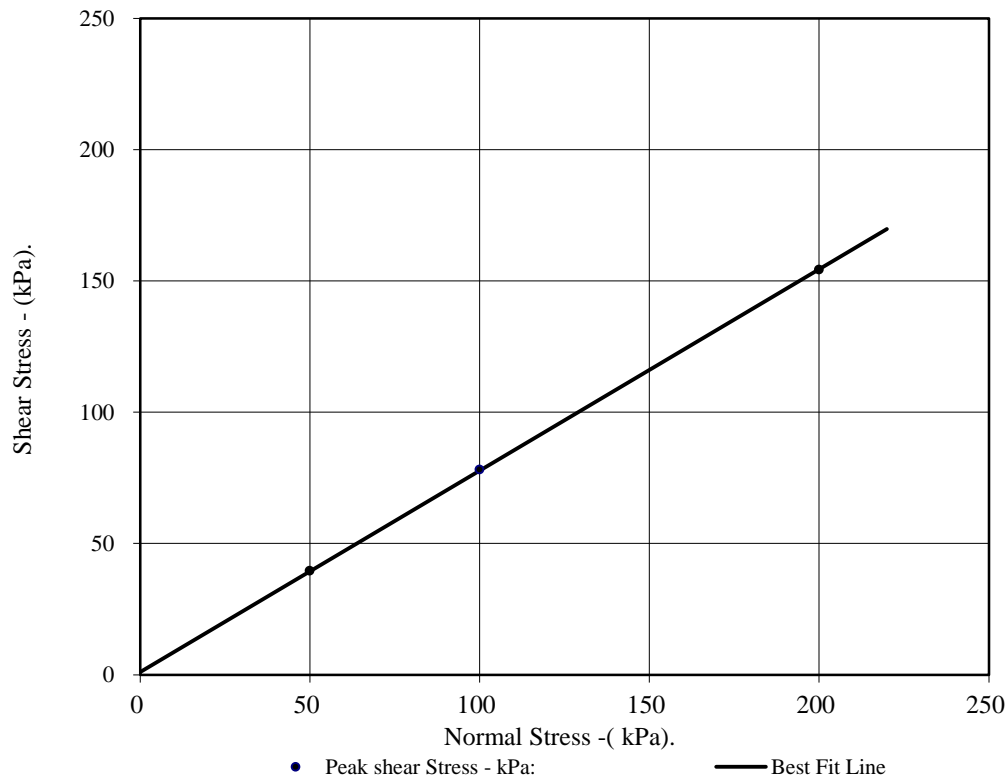
Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**  
PSL17/5711  
**Client Ref:**  
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH05		Top Depth:	7.90	
Sample Number:	12		Base Depth:	9.00	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	Brown gravelly 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 stress (mm)			4.00	6.00	7.00
Peak shear Stress - kPa:			40	78	154
Final Consolidated Conditions					
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:( $\theta$ )			38		
Effective Cohesion - kPa:			1		



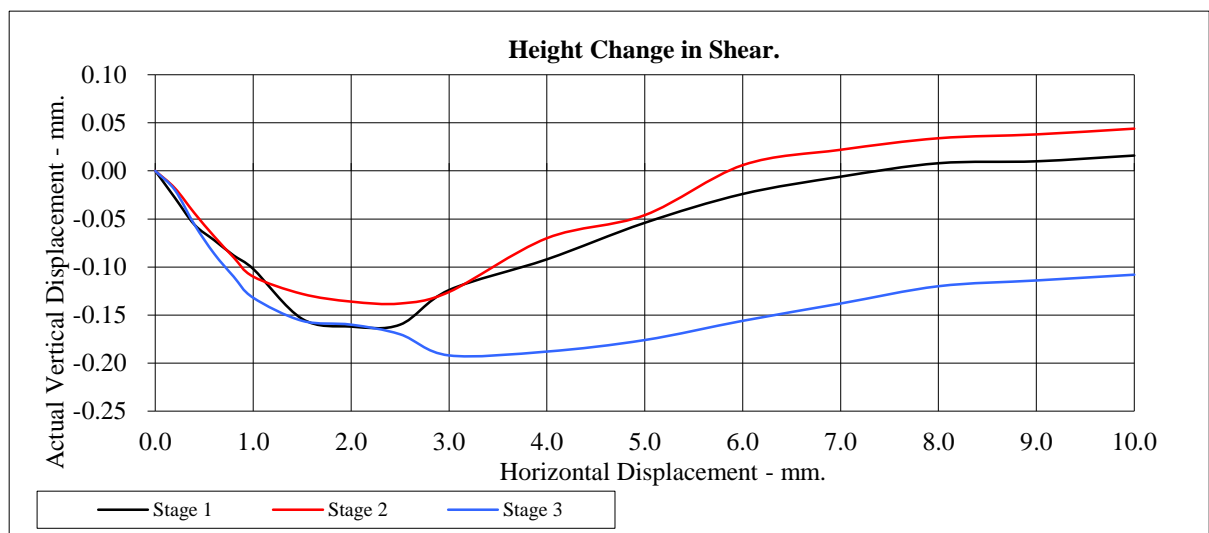
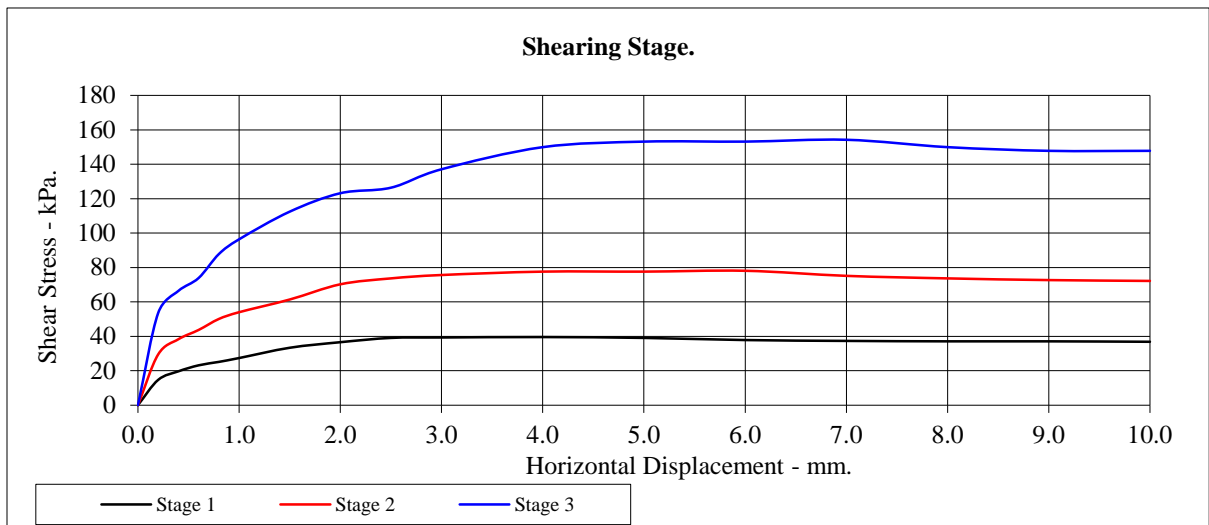
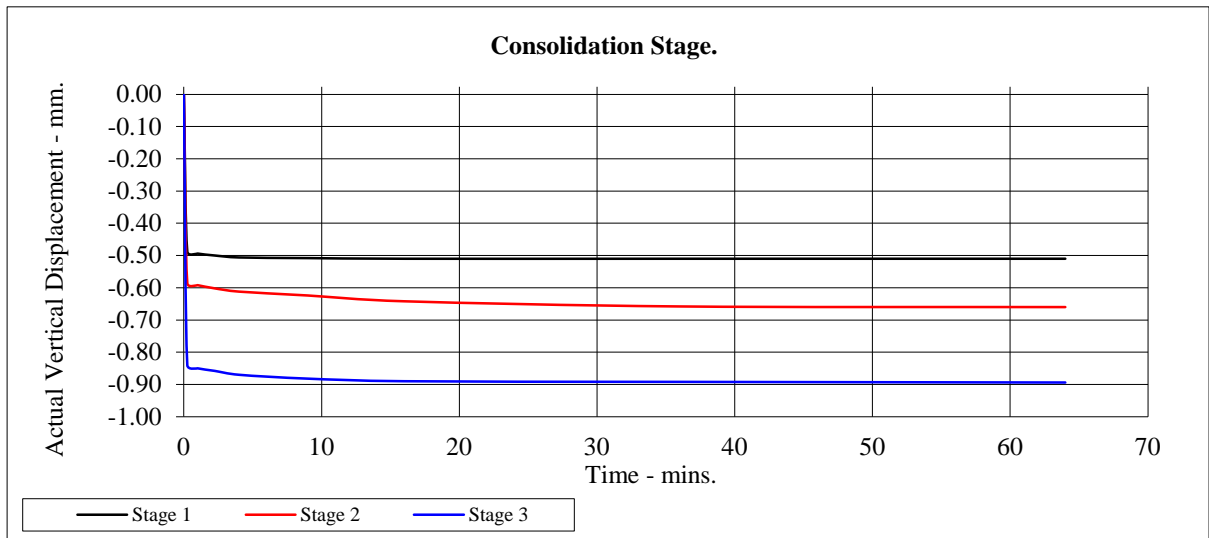
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5711
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

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



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Arklow Sewerage Scheme Marine Outfall GI

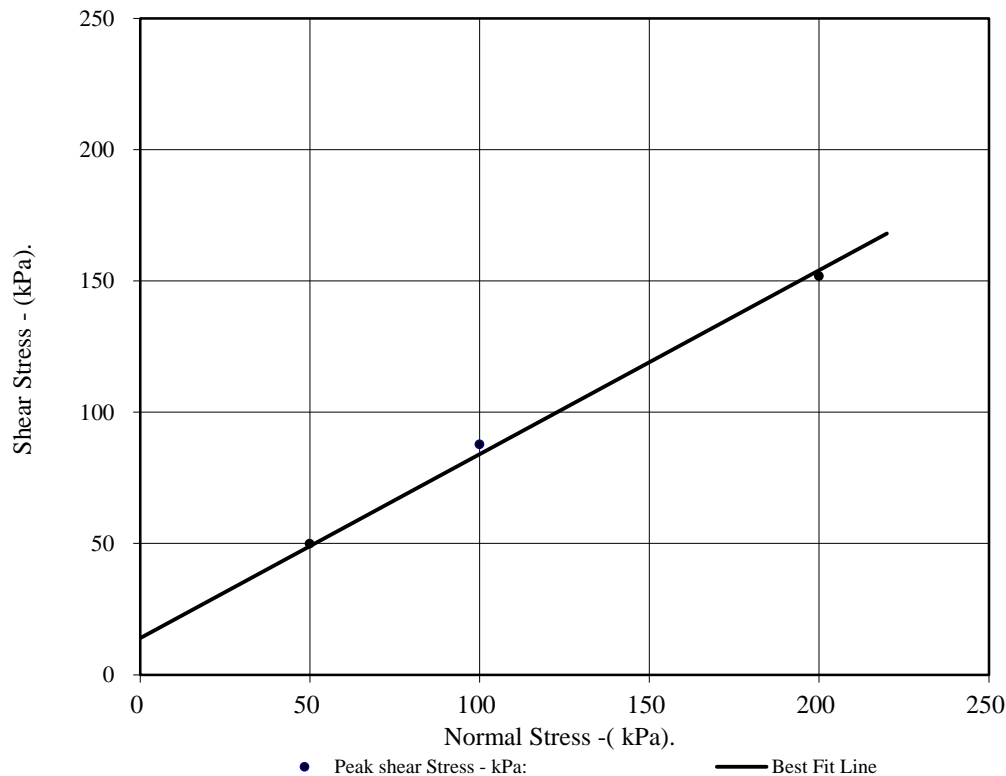
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<b>PSL17/5711</b>
<b>Client Ref:</b>
<b>17-0167</b>



# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH07		Top Depth:	3.00	
Sample Number:	4		Base Depth:	3.50	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using 2.5kg effort. Material tested passing 2mm sieve				
Sample Description:	Grey very gravelly sandy organic CLAY.				
STAGE			1	2	3
Initial Conditions					
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 Stage					
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 stress - mm			8.41	10.01	6.80
Peak shear Stress - kPa:			50	88	152
Final Consolidated Conditions					
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:( $\theta$ )			35		
Effective Cohesion - kPa:			14		



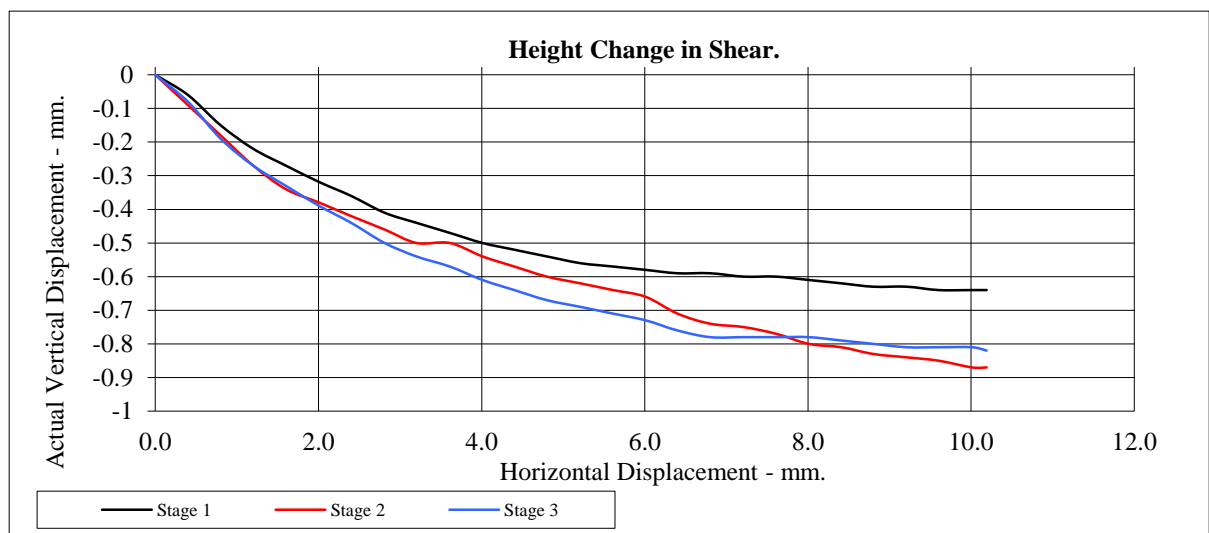
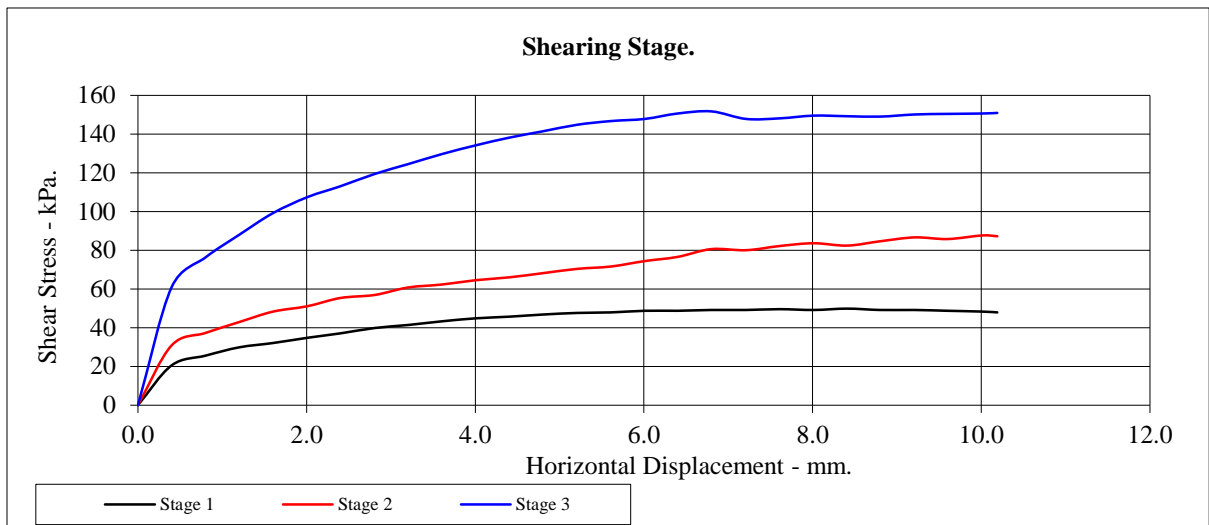
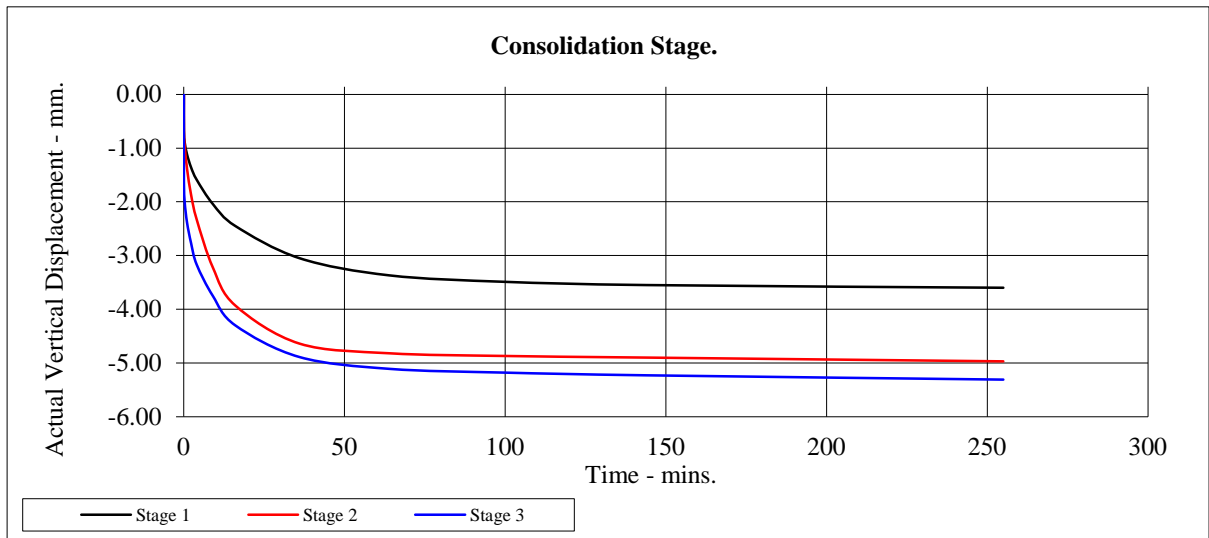
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5711
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

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



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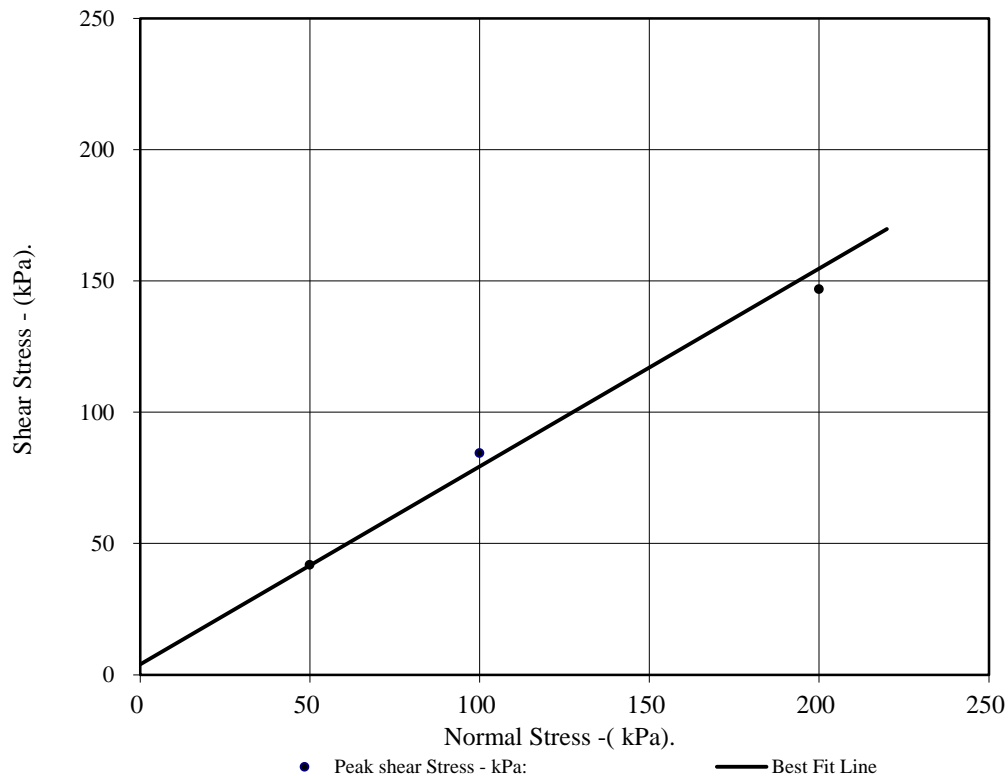
Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**  
PSL17/5711  
**Client Ref:**  
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH07		Top Depth:	4.00	
Sample Number:	6		Base Depth:	5.00	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested 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 stress - mm			4.50	9.50	8.50
Peak shear Stress - kPa:			42	84	147
Final Consolidated Conditions					
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
Peak					
Angle of Shearing Resistance:( $\theta$ )			37		
Effective Cohesion - kPa:			4		



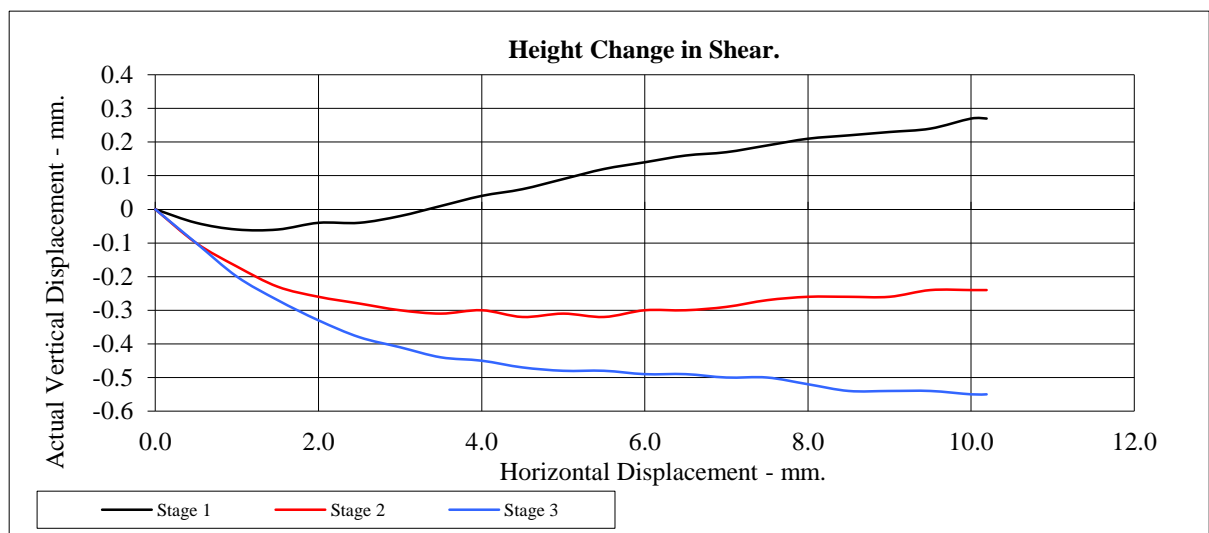
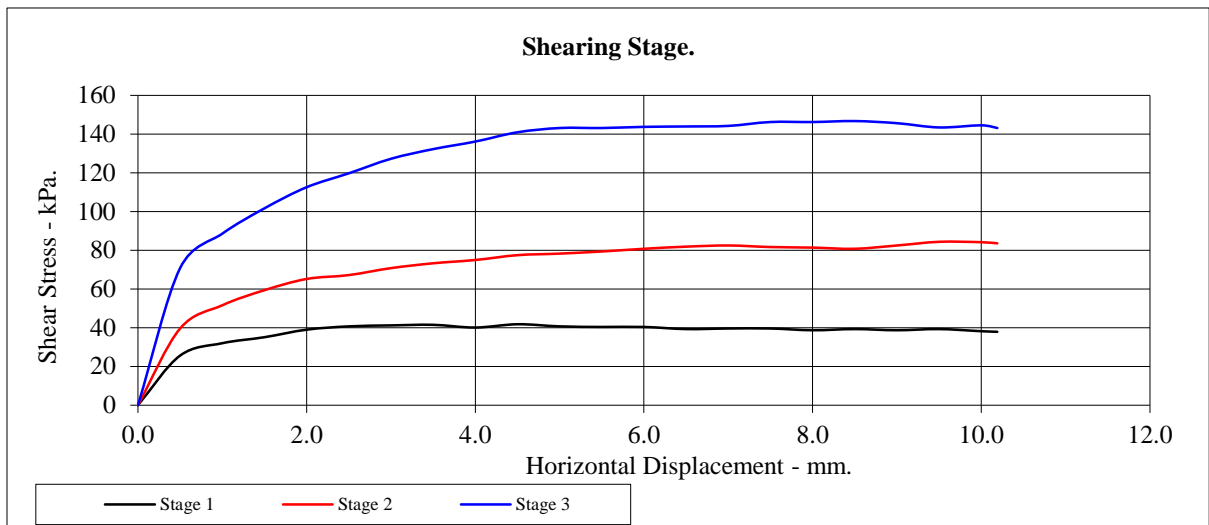
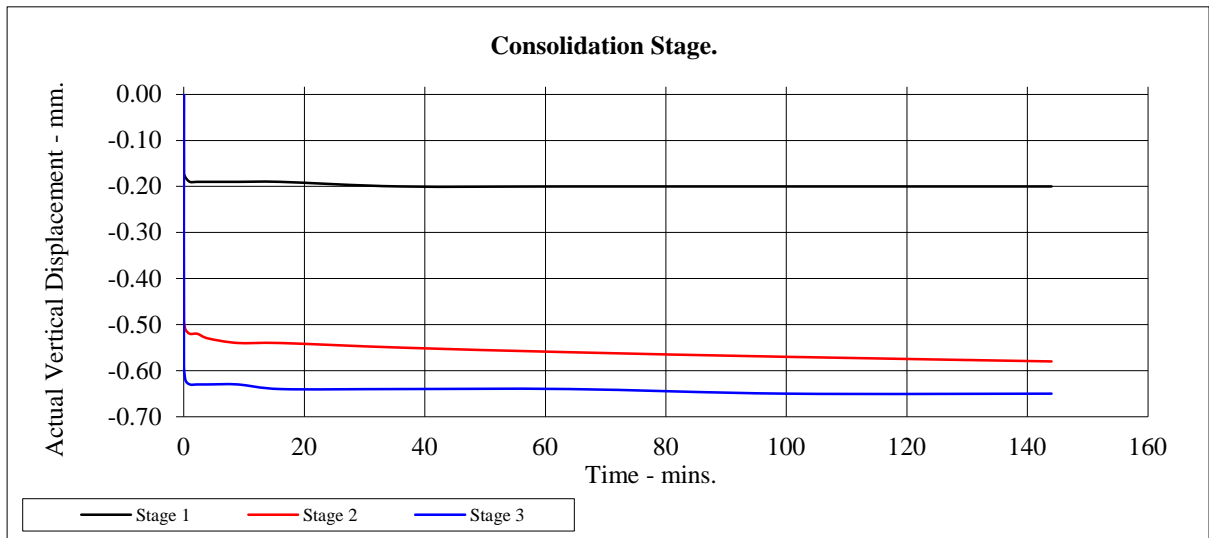
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5711
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

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

**Contract No:**  
PSL17/5711  
**Client Ref:**  
17-0167

**SOIL AND ROCK SAMPLE ANALYSIS  
LABORATORY TEST REPORT**

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

---

**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. 17-0167		Project Name Arklow Sewerage Scheme Marine Outfall GI												
Hole No.	Sample				Soil Description	Density		w %	Passing 425µm %	LL %	PL %	PI %	Particle density Mg/m3	Casagrande Classification
	Ref	Top	Base	Type		bulk Mg/m3	dry Mg/m3							
BH09	2	1.00		B	Grey slightly gravelly fine to medium SAND.			7.8						
BH09	4	3.00		B	Grey slightly sandy subangular to subrounded fine to coarse GRAVEL.			3.5						
BH09	6	5.00		B	Grey sandy gravelly silty CLAY.			14.0	61	33 -1pt	17	16		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.			12.0						
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.			4.1						
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

Key					Date Printed	Approved By	Table
Density test	Liquid Limit	Particle density			12/02/2017 00:00	Stephen.Watson	1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer					
wd - water displacement	cas - Casagrande method	gj - gas jar					sheet
wi - immersion in water	1pt - single point test						1



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH09

Site Name

Arklow 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  
Depth

m

Sample Type

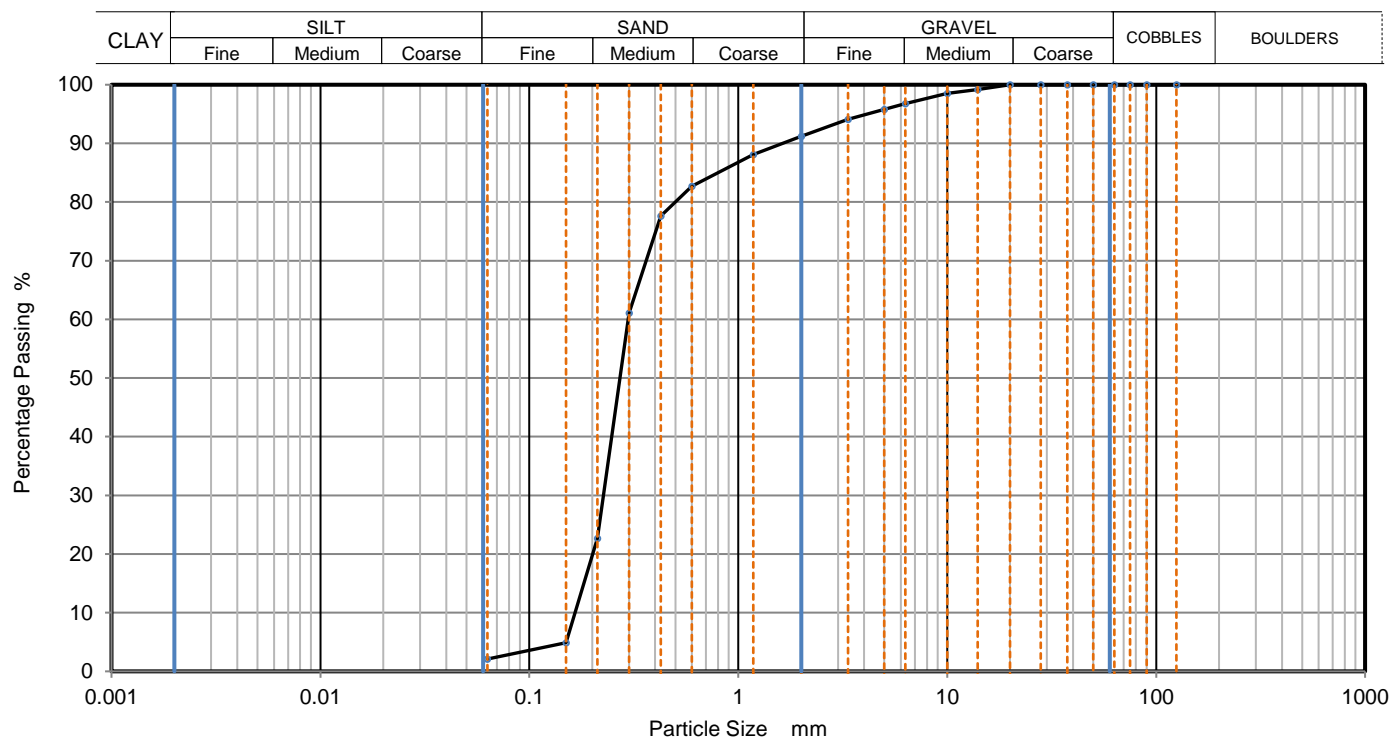
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201711090



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	9
Sand	89
Fines <0.063mm	2

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

Sheet





## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH09

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  
Depth

m

Sample Type

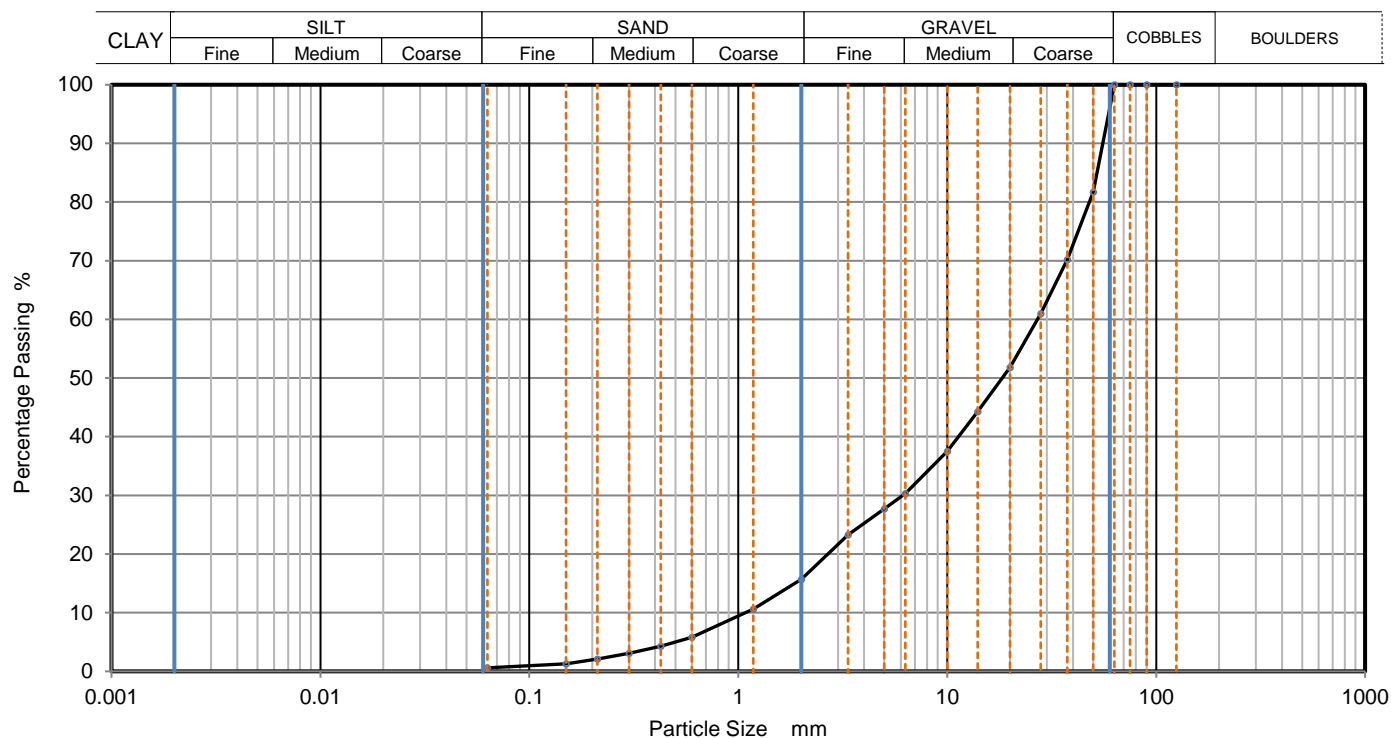
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201711091



Sieving		Sedimentation	
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

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

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH09

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

6

Soil Description

Grey sandy gravelly silty CLAY.

Depth, m

5.00

Specimen Reference

5

Specimen  
Depth

m

Sample Type

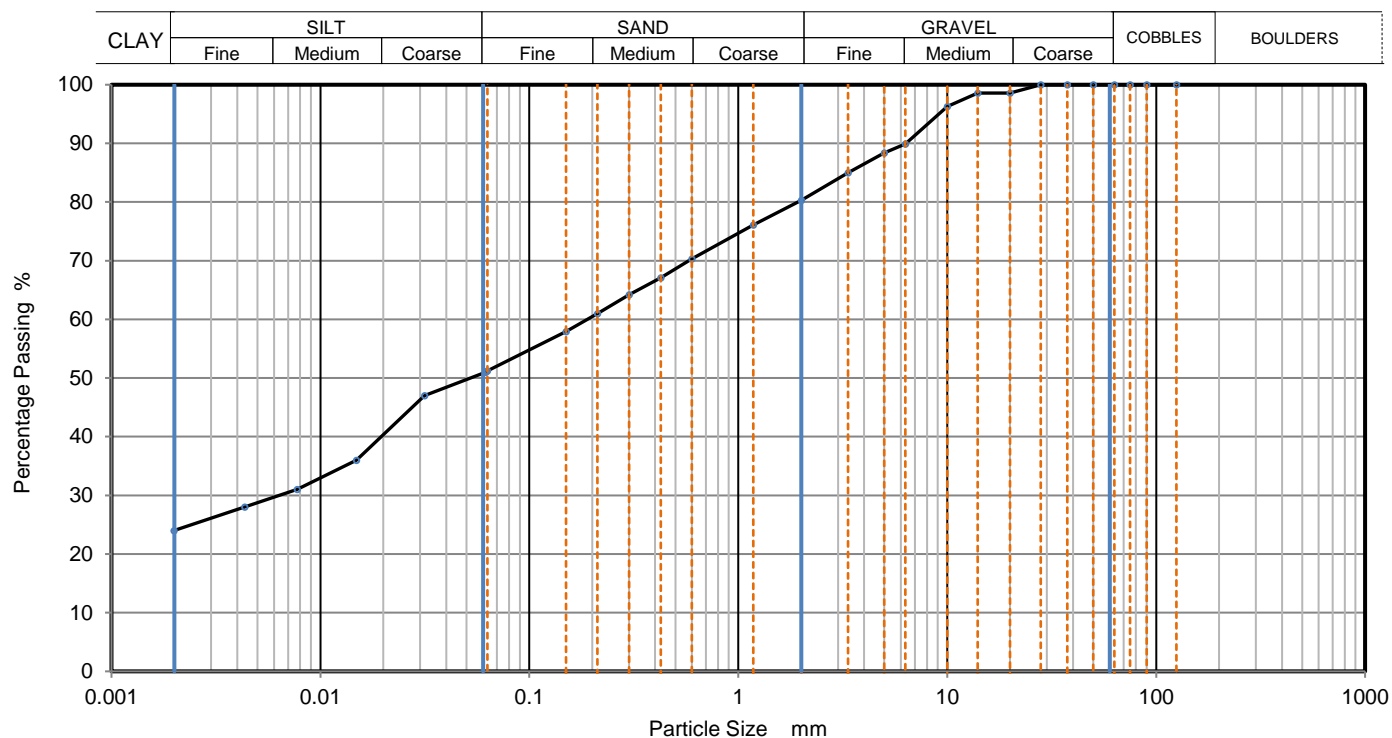
B

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) 2.65 Mg/m <sup>3</sup>	
0.425	67		
0.3	64		
0.212	61		
0.15	58		
0.063	51		

Dry Mass of sample, g

1623

Sample Proportions	% dry mass
Cobbles	0
Gravel	20
Sand	29
Silt	27
Clay	24

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH09

Site Name

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  
Depth

m

Sample Type

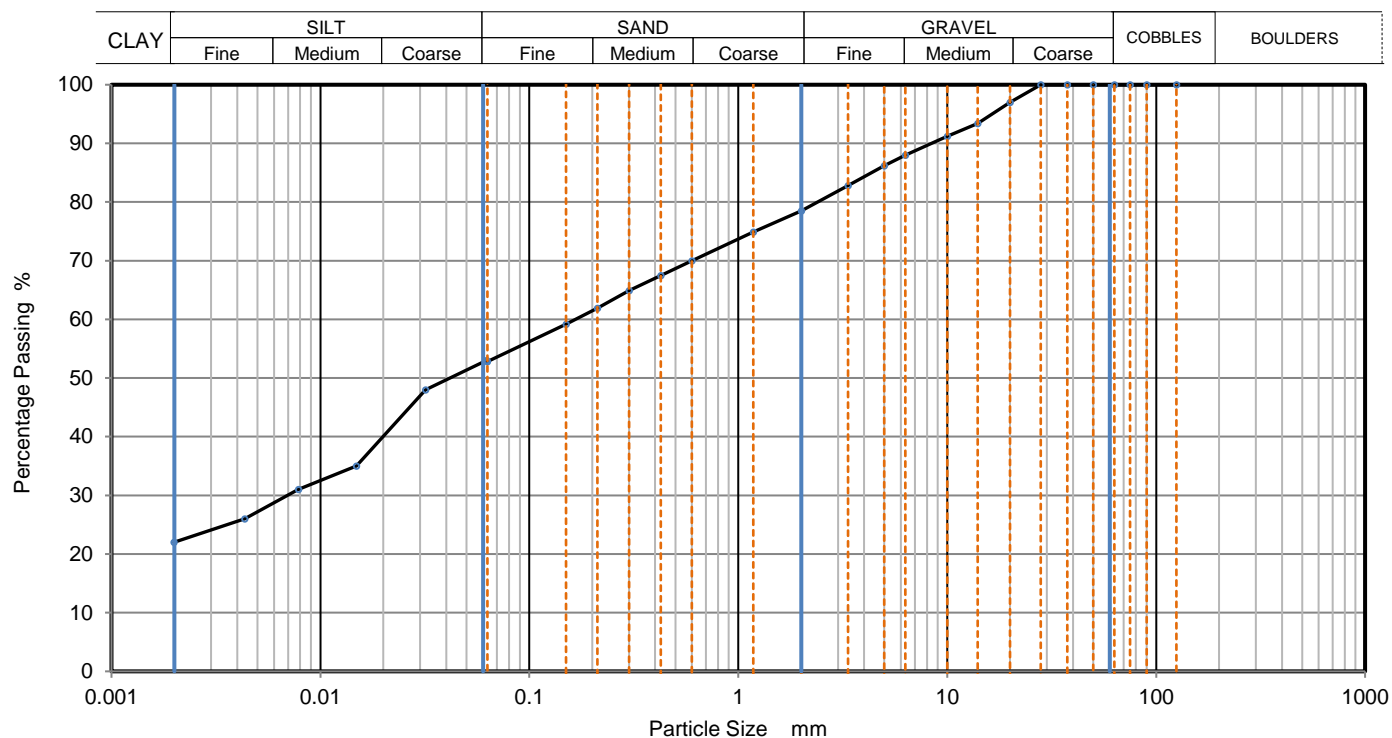
B

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) 2.65 Mg/m <sup>3</sup>	
0.425	68		
0.3	65		
0.212	62		
0.15	59		
0.063	53		

Dry Mass of sample, g

2017

Sample Proportions	% dry mass
Cobbles	0
Gravel	22
Sand	26
Silt	31
Clay	22

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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  
Depth

m

Sample Type

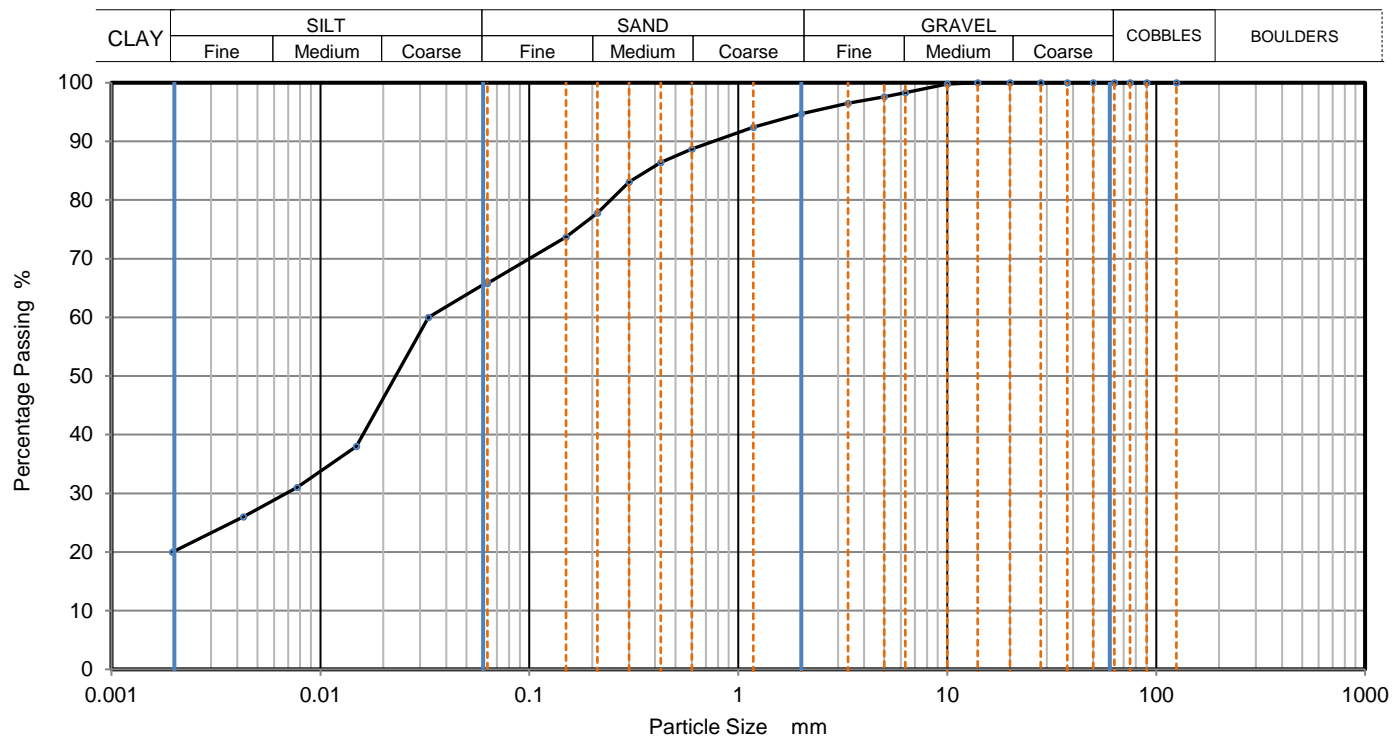
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201711094



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) 2.65 Mg/m <sup>3</sup>	
0.425	86		
0.3	83		
0.212	78		
0.15	74		
0.063	66		

Dry Mass of sample, g

661

Sample Proportions	% dry mass
Cobbles	0
Gravel	5
Sand	29
Silt	46
Clay	20

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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  
Depth

m

Sample Type

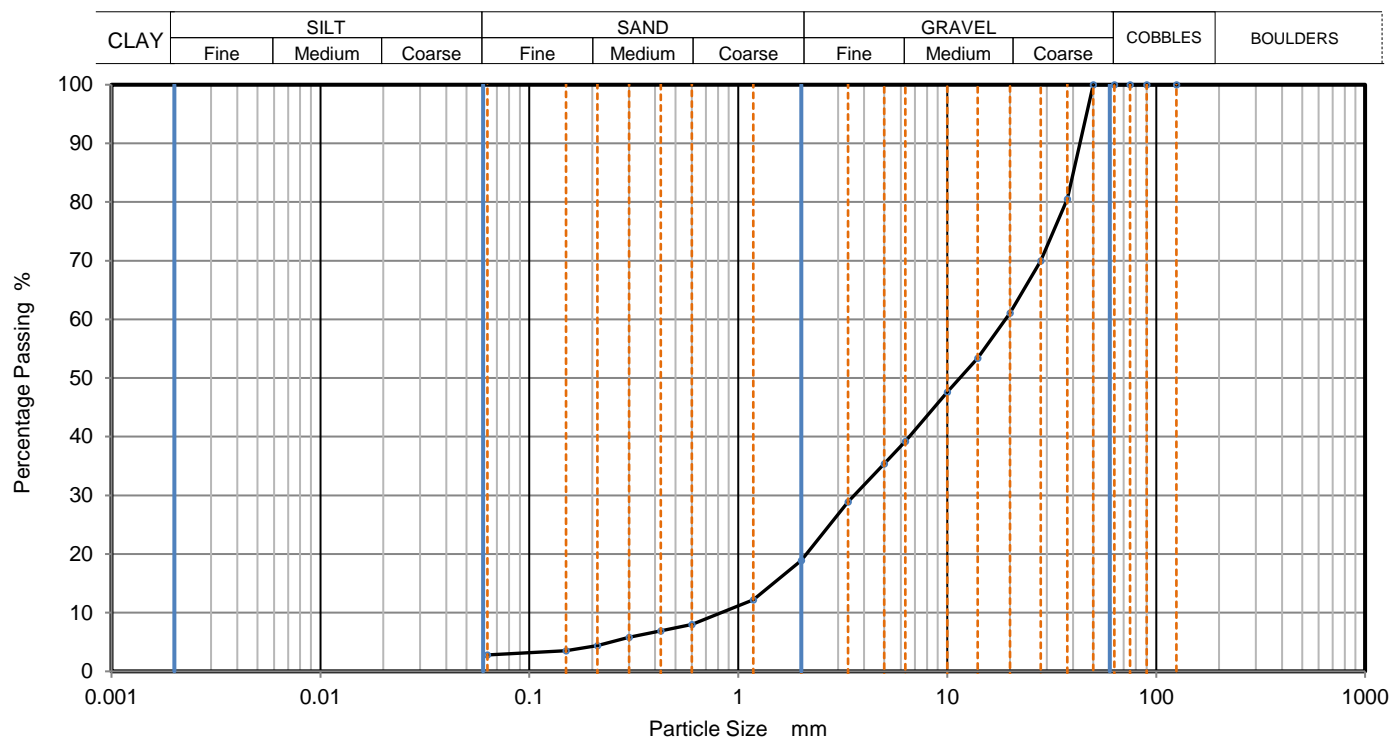
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201711096



Sieving		Sedimentation	
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

Sample Proportions	% dry mass
Cobbles	0
Gravel	81
Sand	16
Fines <0.063mm	3

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	23
Curvature Coefficient	0.82

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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  
Depth

m

Sample Type

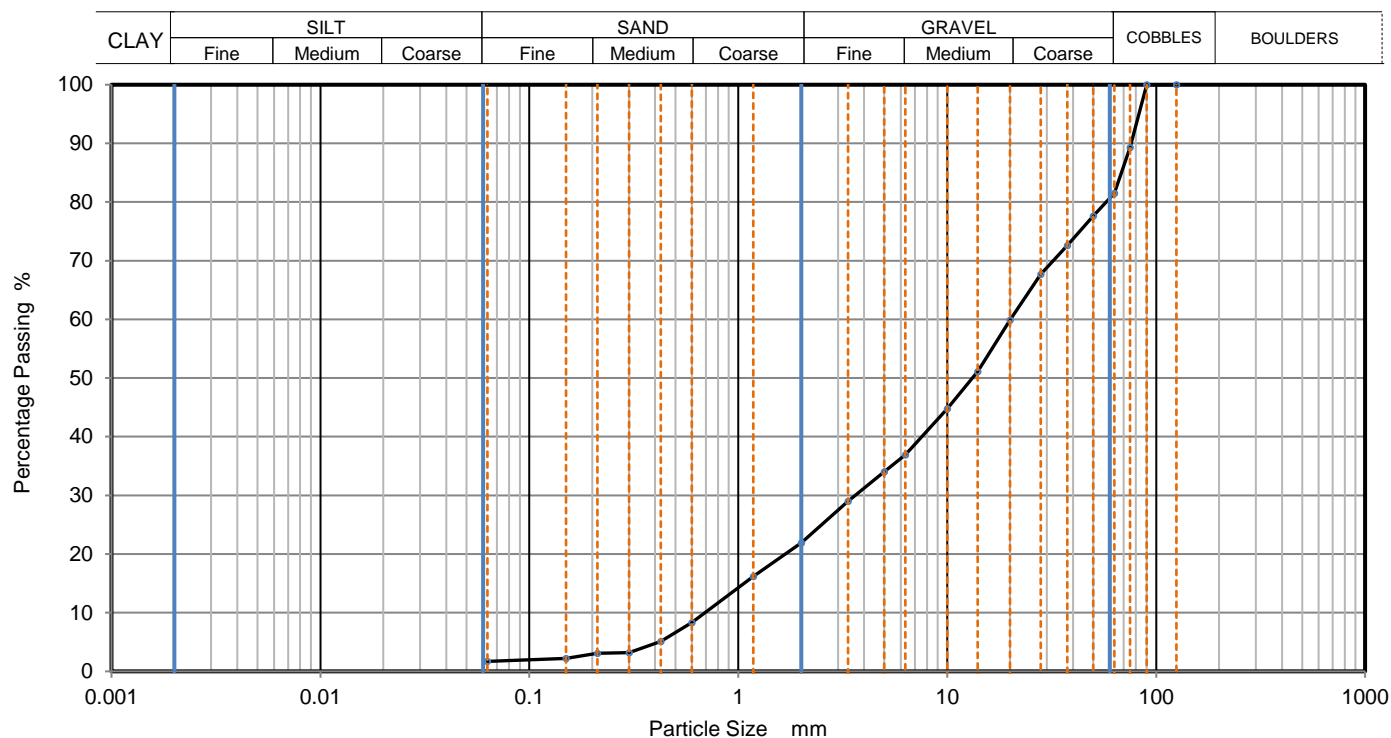
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201711097



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	29
Curvature Coefficient	0.95

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

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  
Depth

m

Sample Type

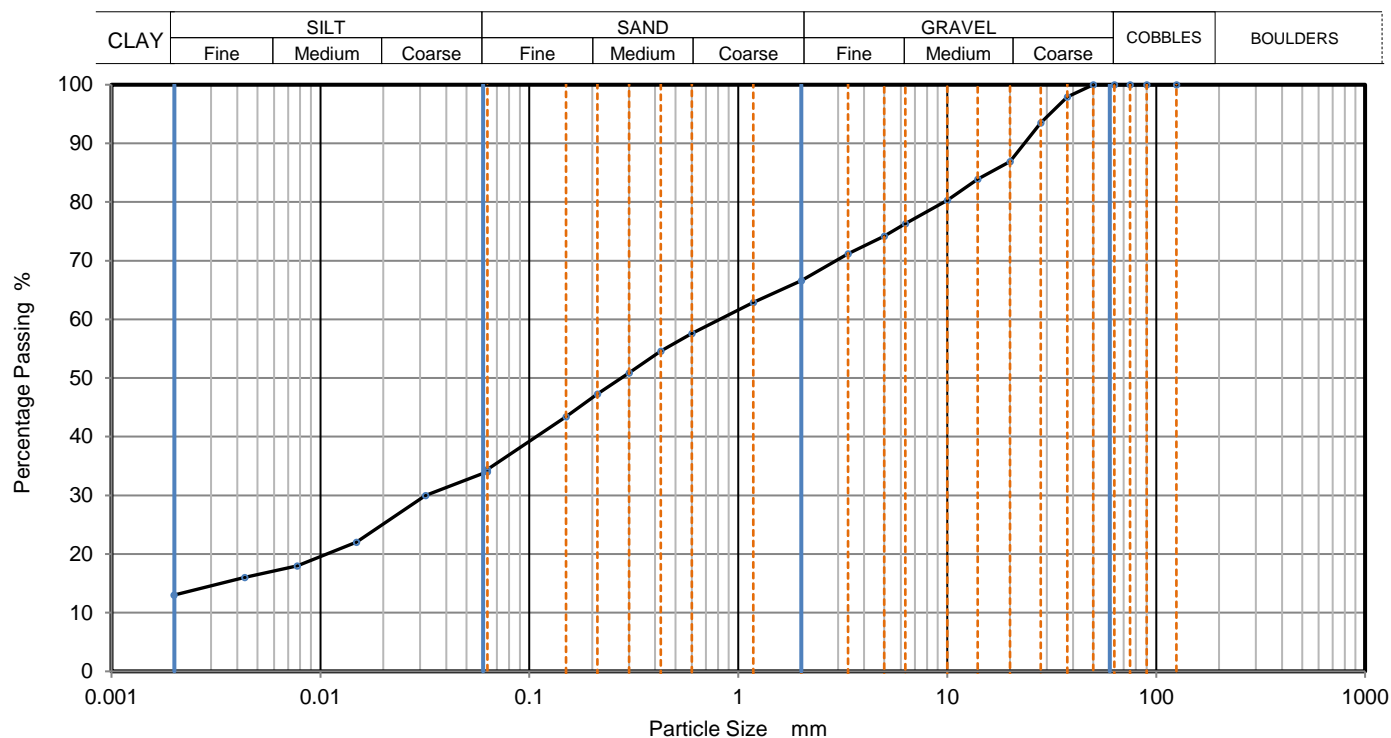
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201711098



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	55		
0.3	51		
0.212	47		
0.15	43		
0.063	34		

Dry Mass of sample, g

3400

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

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH10

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

9

Soil Description

Light brown sandy gravelly silty CLAY.

Depth, m

7.50

Specimen Reference

5

Specimen  
Depth

m

Sample Type

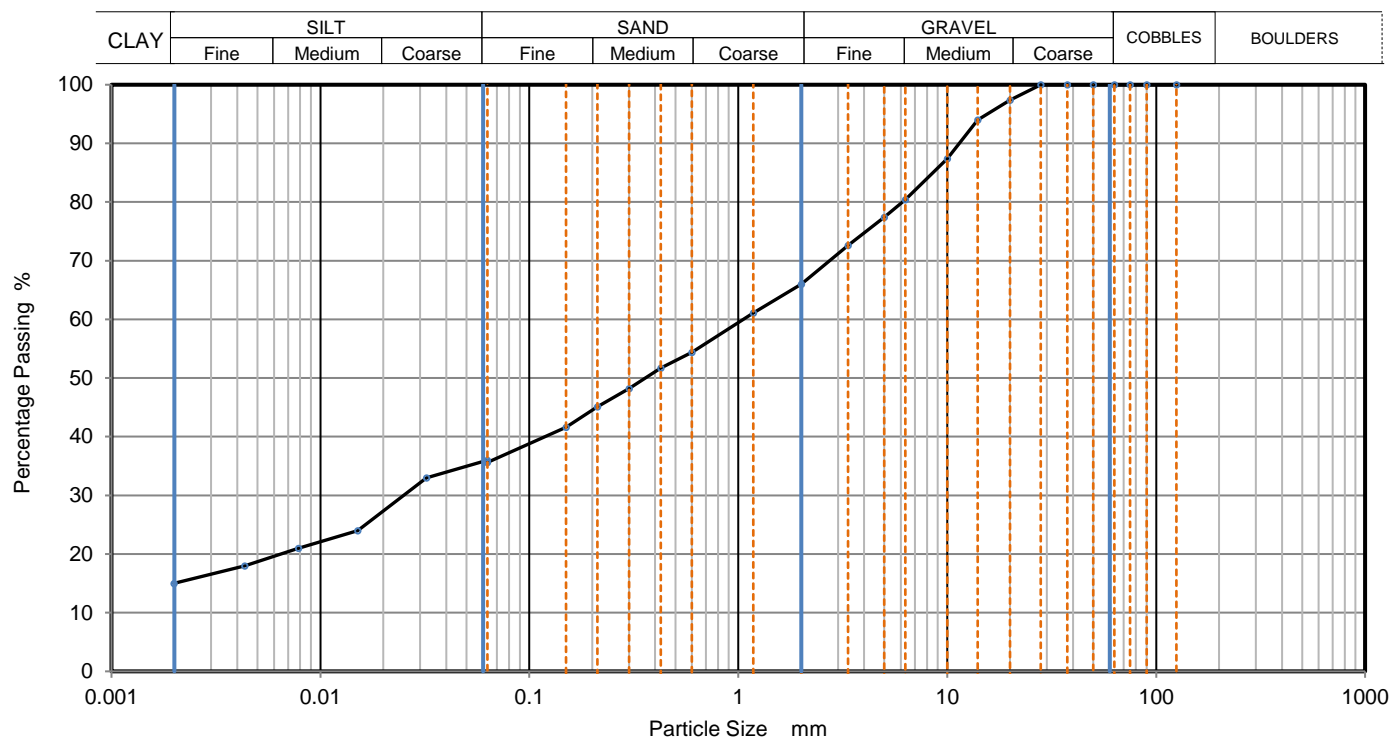
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201711099



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	52		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

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# 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  
(Director)

A Watkins  
(Director)

R Berriman  
(Quality Manager)

L Knight  
(Senior Technician)

  
S Eyre  
(Senior Technician)

A Fry  
(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

[illegible]

**PSL**  
Professional Soils Laboratory

## Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**

PSL17/5477

**Client Ref:**

**17-0167**

# PARTICLE SIZE DISTRIBUTION TEST

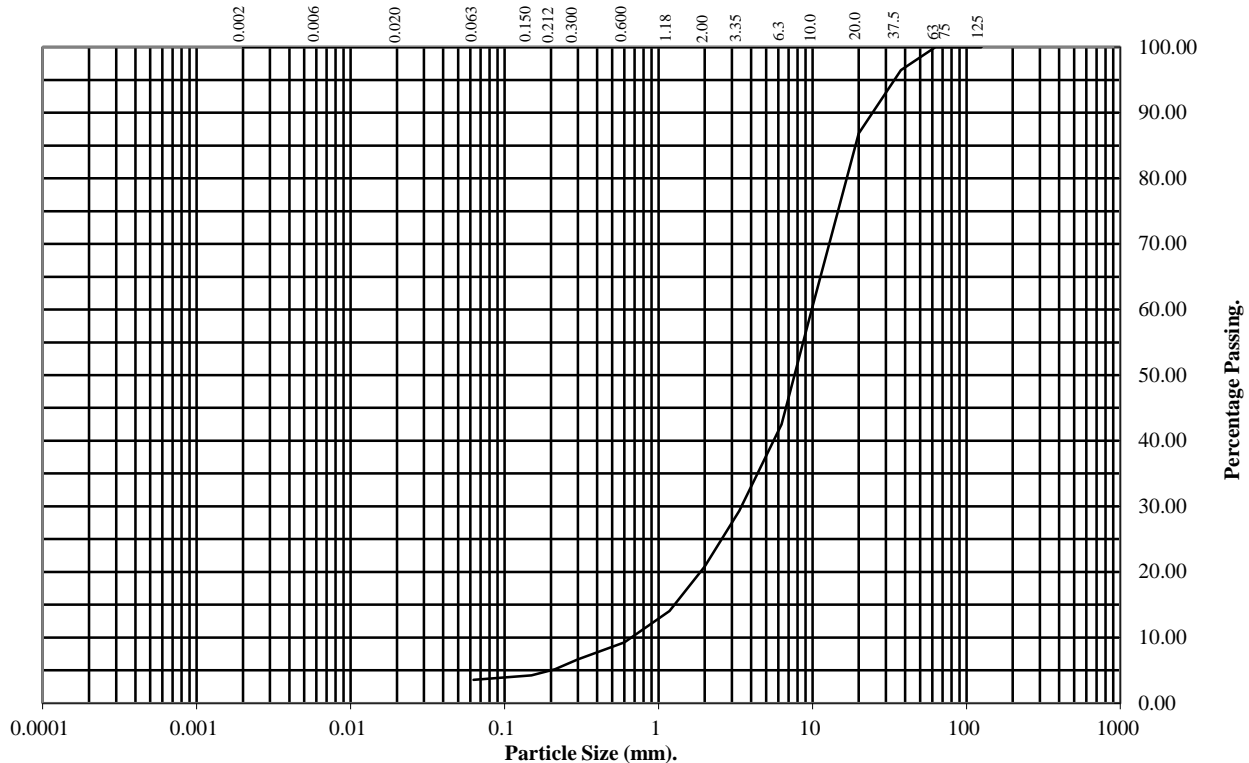
BS1377 : Part 2 : 1990

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 Sieve (mm)	Percentage 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 Fraction	Total Percentage
Cobbles	0
Gravel	79
Sand	17
Silt/Clay	4

**Remarks:**  
See Summary of Soil Descriptions



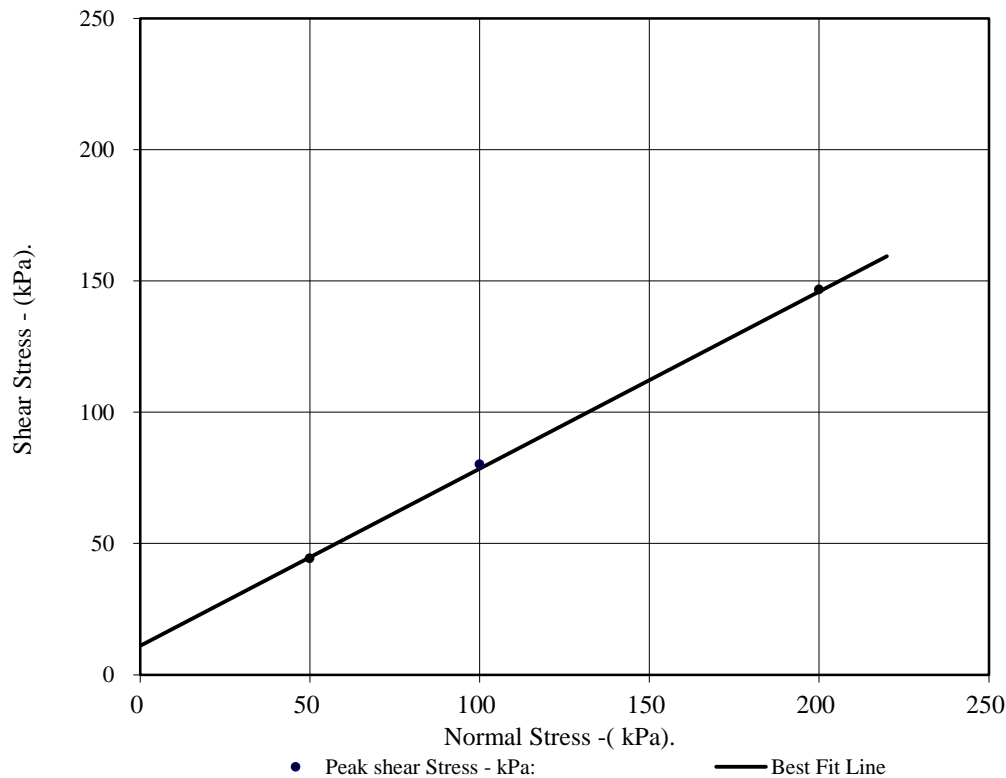
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5477
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH09		Top Depth:	2.00	
Sample Number:	3		Base Depth:	3.00	
Sample Conditions:	Submerged.		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress - mm			4.00	8.00	5.00
Peak shear Stress - kPa:			44	80	147
Final Consolidated Conditions					
Moisture Content - %:			18	18	17
Bulk Density - Mg/m3:			1.86	1.88	1.92
Dry Density - Mg/m3:			1.57	1.59	1.63
Peak					
Angle of Shearing Resistance:( $\theta$ )			34		
Effective Cohesion - kPa:			11		



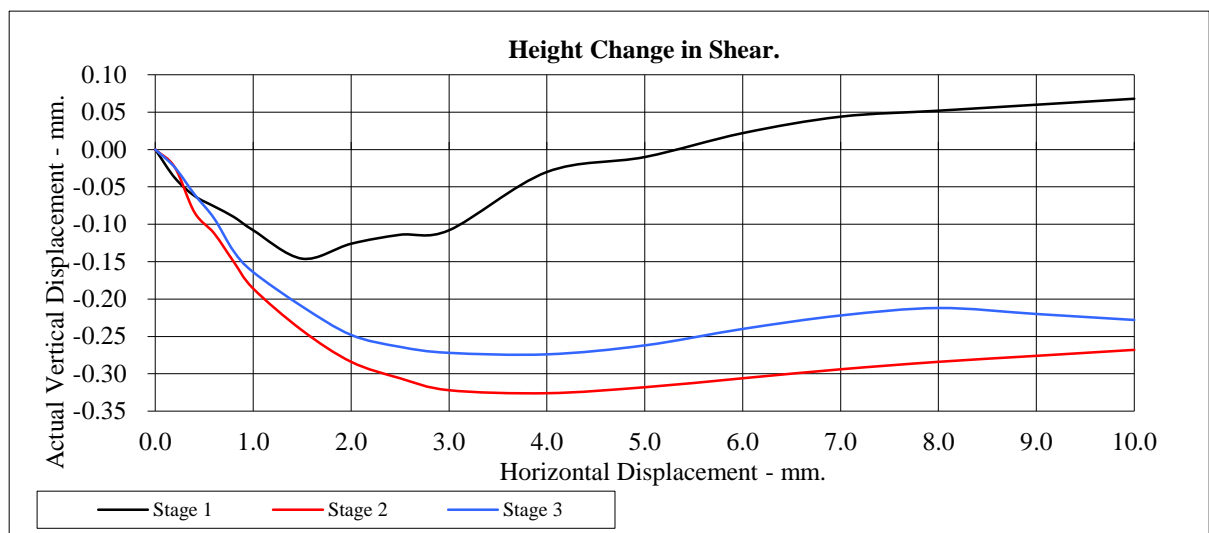
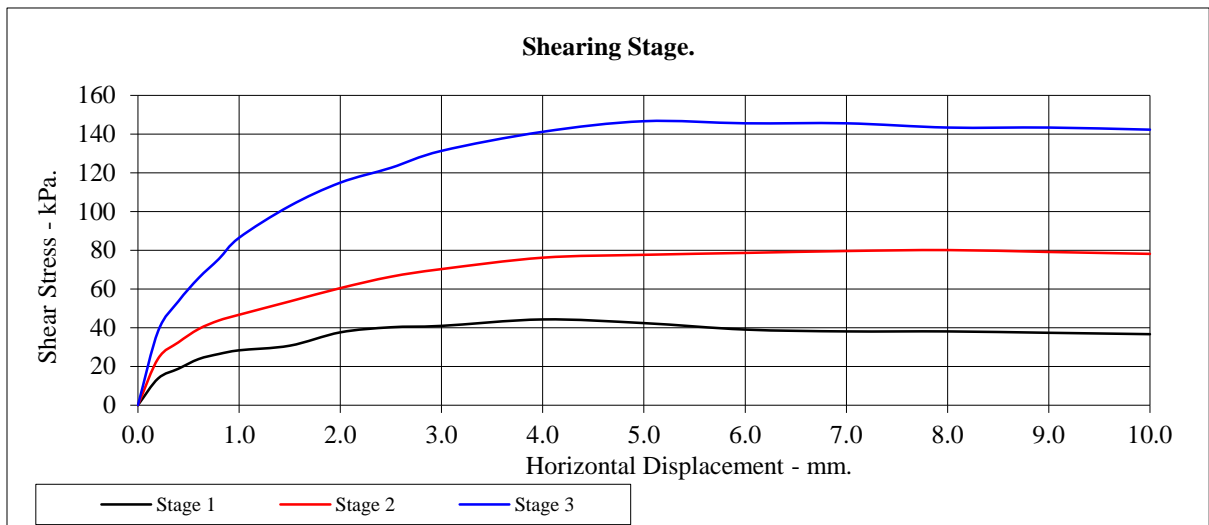
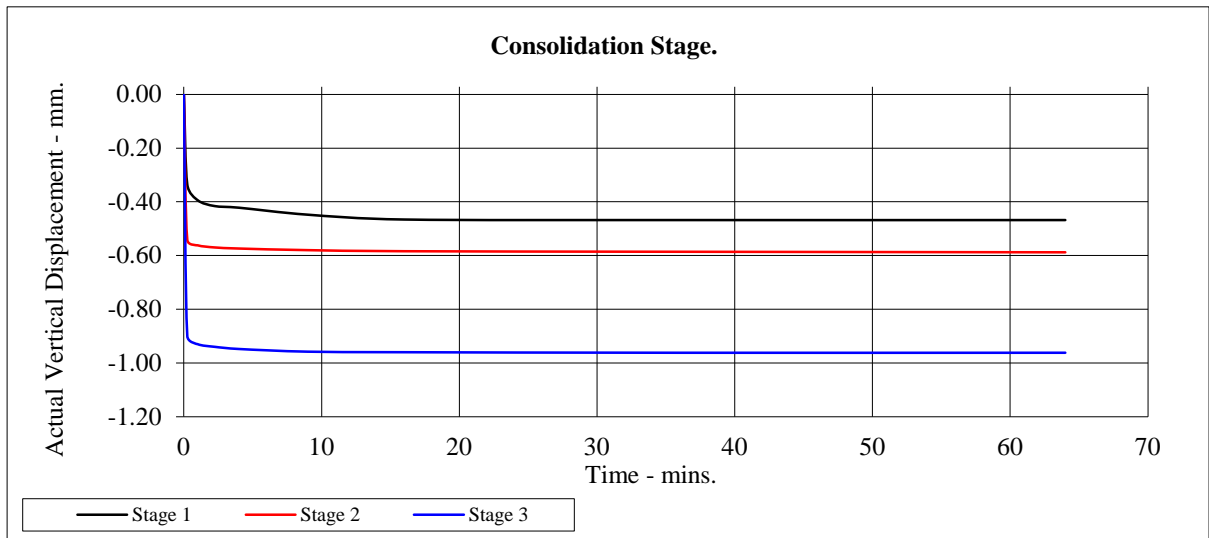
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5477
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH09	Top Depth:	2.00
Sample Number:	3	Base Depth:	3.00



**PSL**  
Professional Soils Laboratory

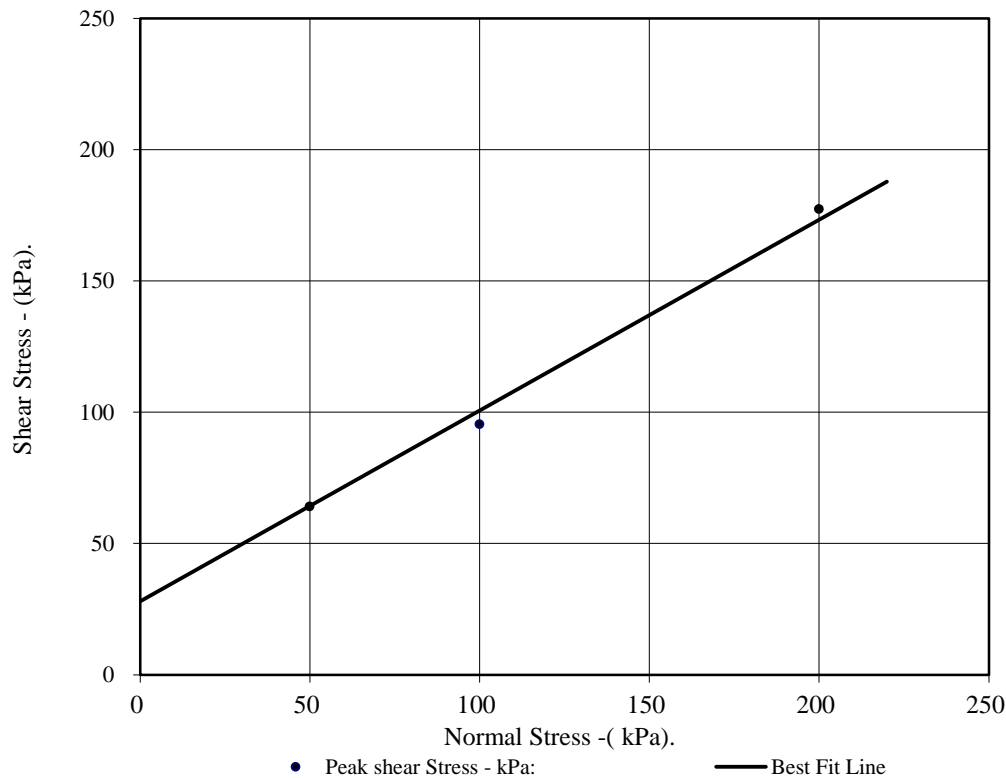
Arklow Sewerage Scheme Marine Outfall GI

<b>Contract No:</b>
<b>PSL17/5477</b>
<b>Client Ref:</b>
<b>17-0167</b>

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH10		Top Depth:	2.00	
Sample Number:	3		Base Depth:	3.00	
Sample Conditions:	Submerged.		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress - mm			5.00	3.00	6.00
Peak shear Stress - kPa:			64	95	177
Final Consolidated Conditions					
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 Resistance:( $\theta$ )			36		
Effective Cohesion - kPa:			28		



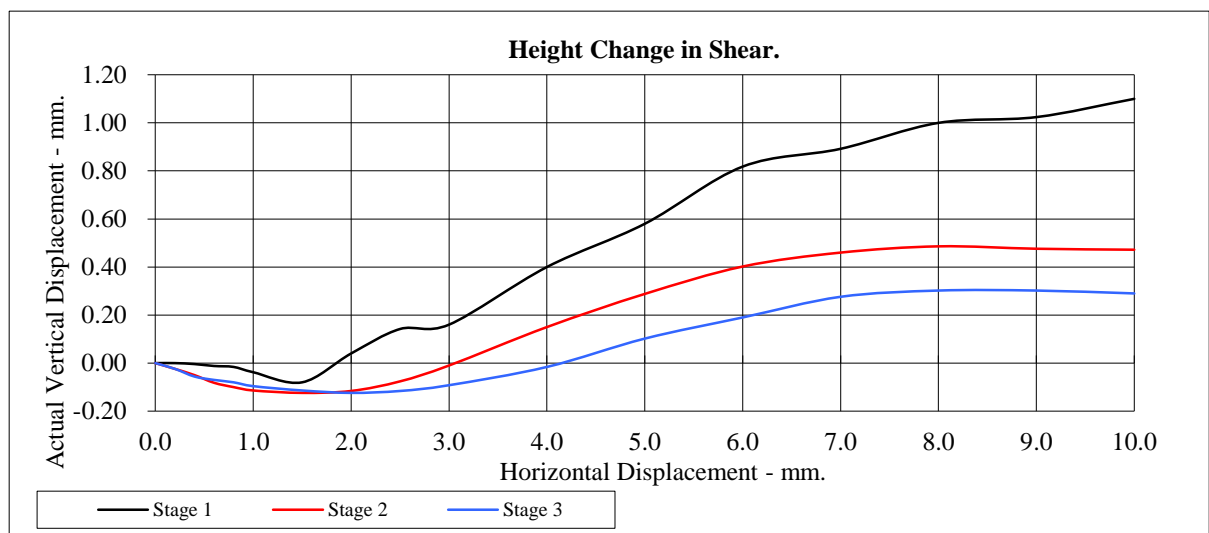
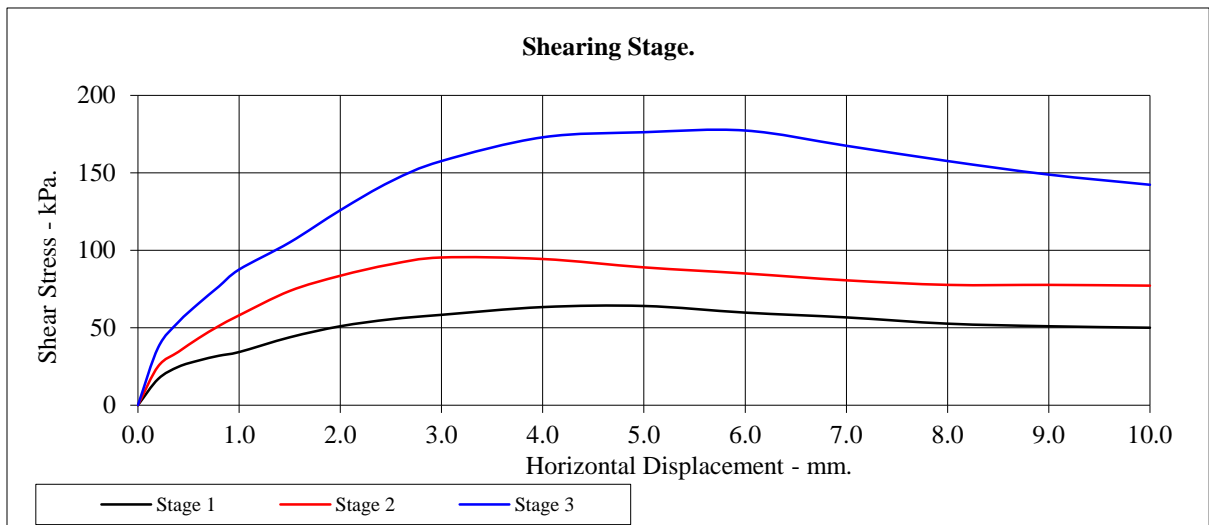
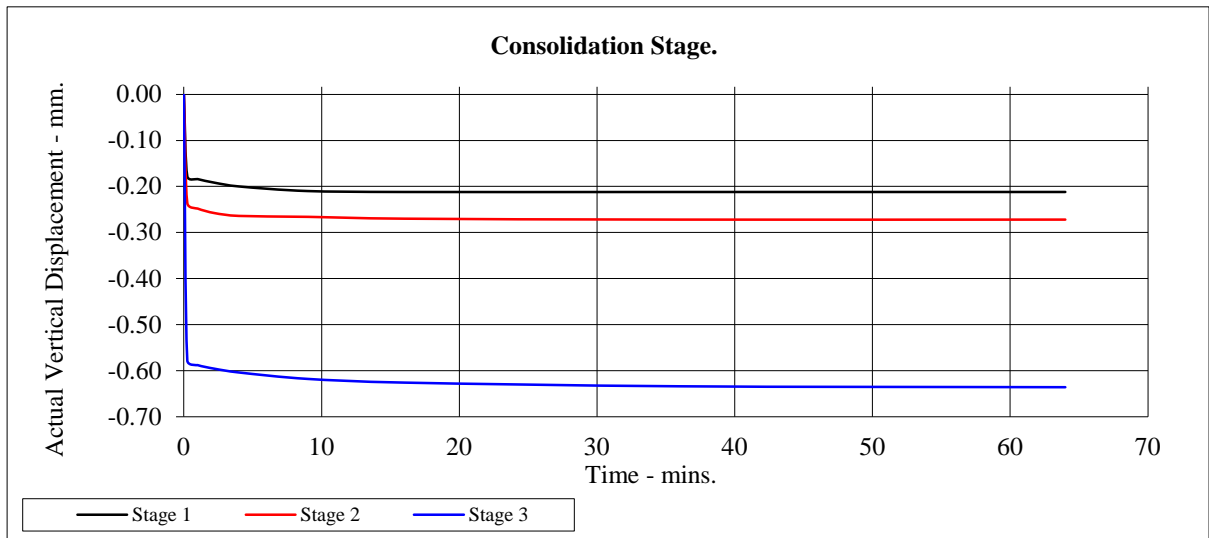
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5477
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH10	Top Depth:	2.00
Sample Number:	3	Base Depth:	3.00



**PSL**  
Professional Soils Laboratory

Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**  
PSL17/5477  
**Client Ref:**  
17-0167

**SOIL AND ROCK SAMPLE ANALYSIS  
LABORATORY TEST REPORT**

<b>Client:</b>	<b>Irish Water</b>
<b>Engineer:</b>	<b>Byrne Looby ARUP J.V.</b>
<b>From:</b>	<b>Stephen Watson Laboratory Manager Causeway Geotech Ltd</b>
<b>Tel:</b>	<b>+44(0)2827666640</b>
<b>E-mail:</b>	<b>stephen.watson@causewaygeotech.com</b>
<b>Date:</b>	<b>14/12/17</b>
<b>Ref:</b>	<b>17-0167 - Schedule 9</b>

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**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.

17-0167

Project Name
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Arklow Sewerage Scheme Marine Outfall GI

Hole No.	Sample				Soil Description	Density		w	Passing 425µm	LL	PL	PI	Particle density	Casagrande Classification
	Ref	Top	Base	Type		bulk	dry							
						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		CH
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		B	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 Printed	Approved By	Table
Density test	Liquid Limit	Particle density	14/12/2017	Stephen.Watson	1
Linear measurement unless :	4pt cone unless :	sp - small pyknometer			sheet
wd - water displacement	cas - Casagrande method	gj - gas jar			1
wi - immersion in water	1pt - single point test				



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH11

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

19

Soil Description

Grey slightly sandy subangular to subrounded fine to coarse GRAVEL.

Depth, m

0.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

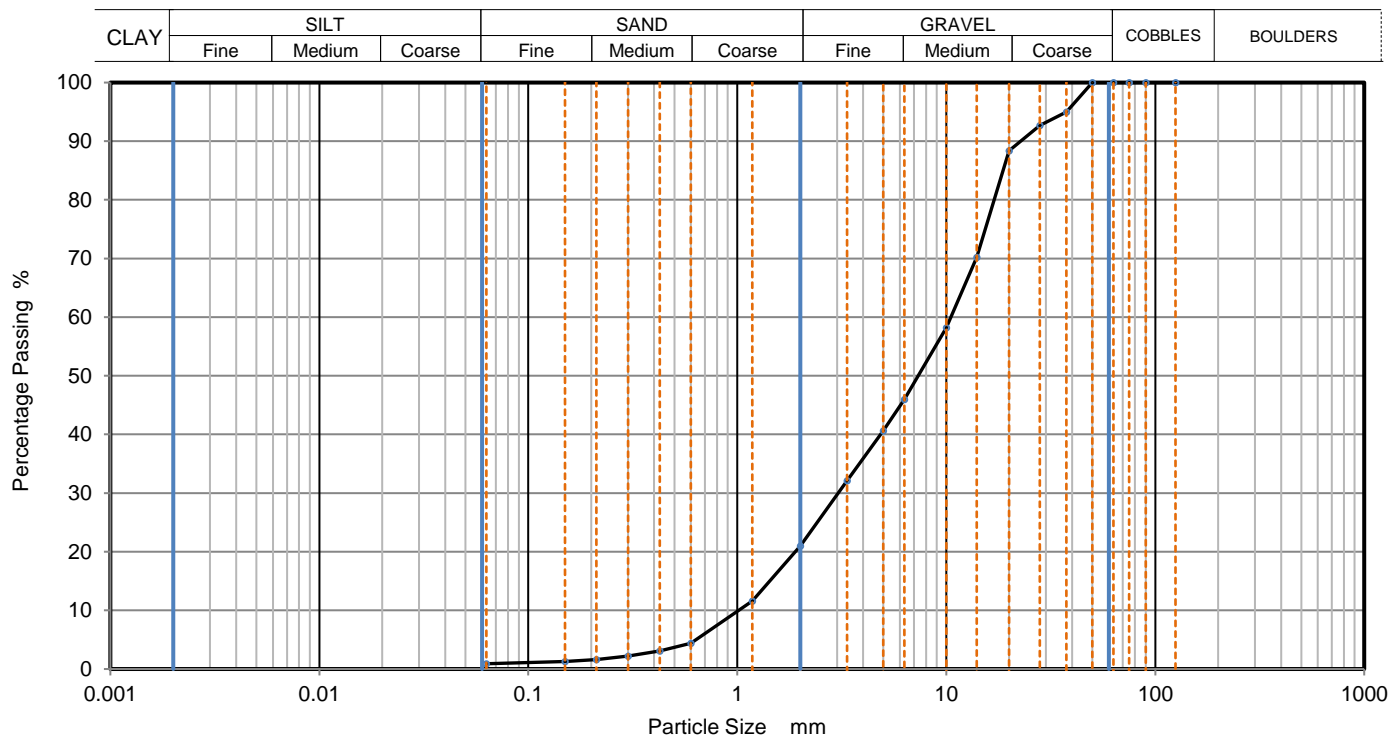
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201711200



Sieving		Sedimentation	
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		
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
D30	mm
D10	mm
Uniformity Coefficient	10
Curvature Coefficient	0.86

### Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

Sheet



## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH11

Site Name

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  
Depth

m

Sample Type

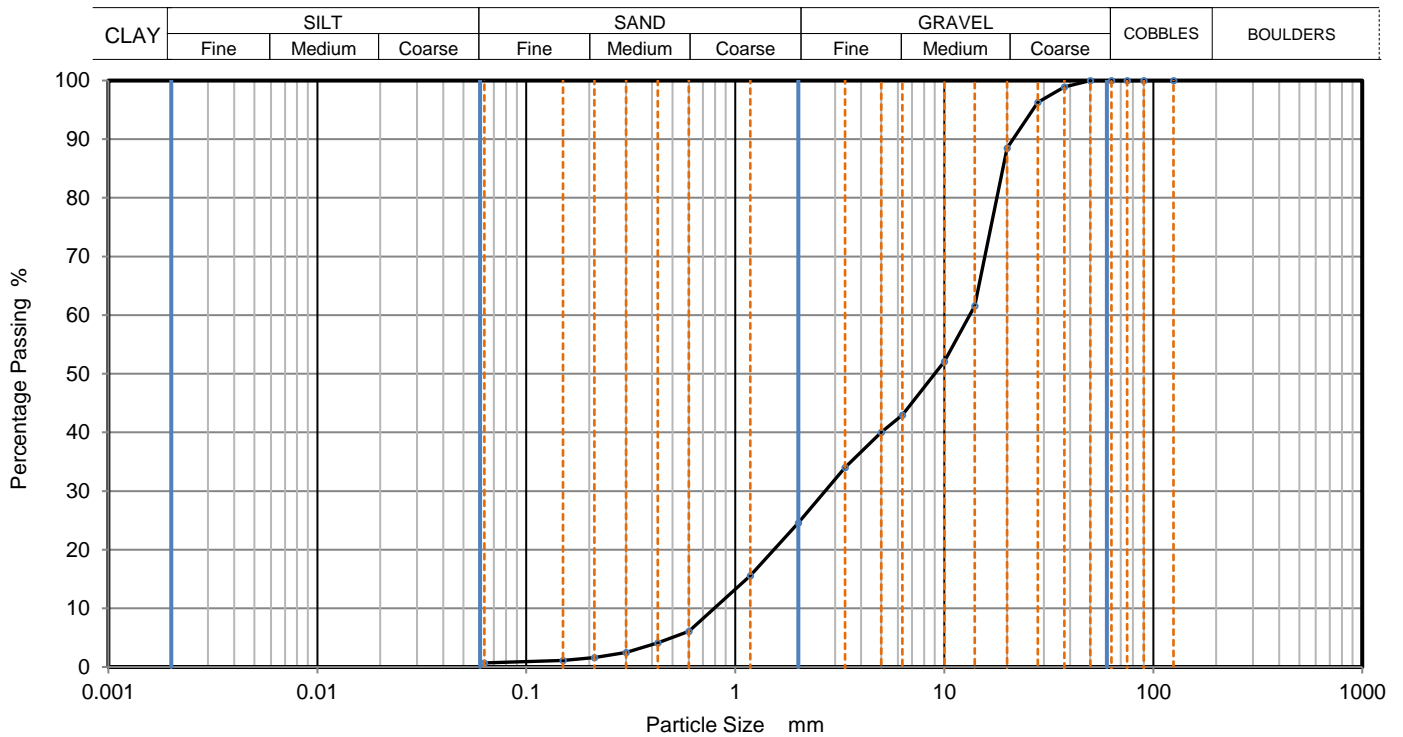
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201711201



Sieving		Sedimentation	
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		
0.3	3		
0.212	2		
0.15	1		
0.063	1		

Dry Mass of sample, g

12130

Sample Proportions	% dry mass
Cobbles	0
Gravel	75
Sand	24
Fines <0.063mm	1

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	17
Curvature Coefficient	0.69

### Remarks

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Fig 1

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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.

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  
Depth

m

Sample Type

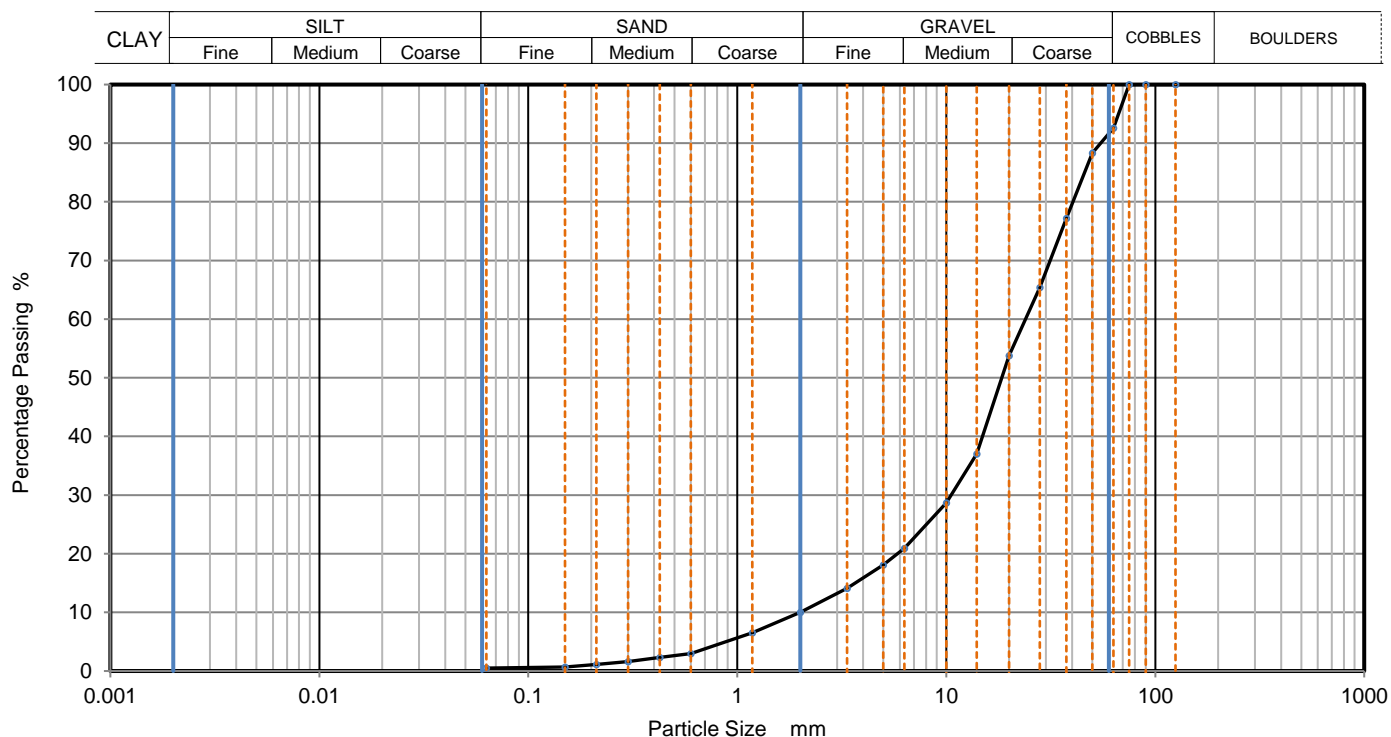
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus201711202



Sieving		Sedimentation	
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		
0.3	2		
0.212	1		
0.15	1		
0.063	1		

Dry Mass of sample, g

12619

Sample Proportions	% dry mass
Cobbles	7
Gravel	83
Sand	10
Fines <0.063mm	0

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	12
Curvature Coefficient	2.3

### Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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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  
Depth

m

Sample Type

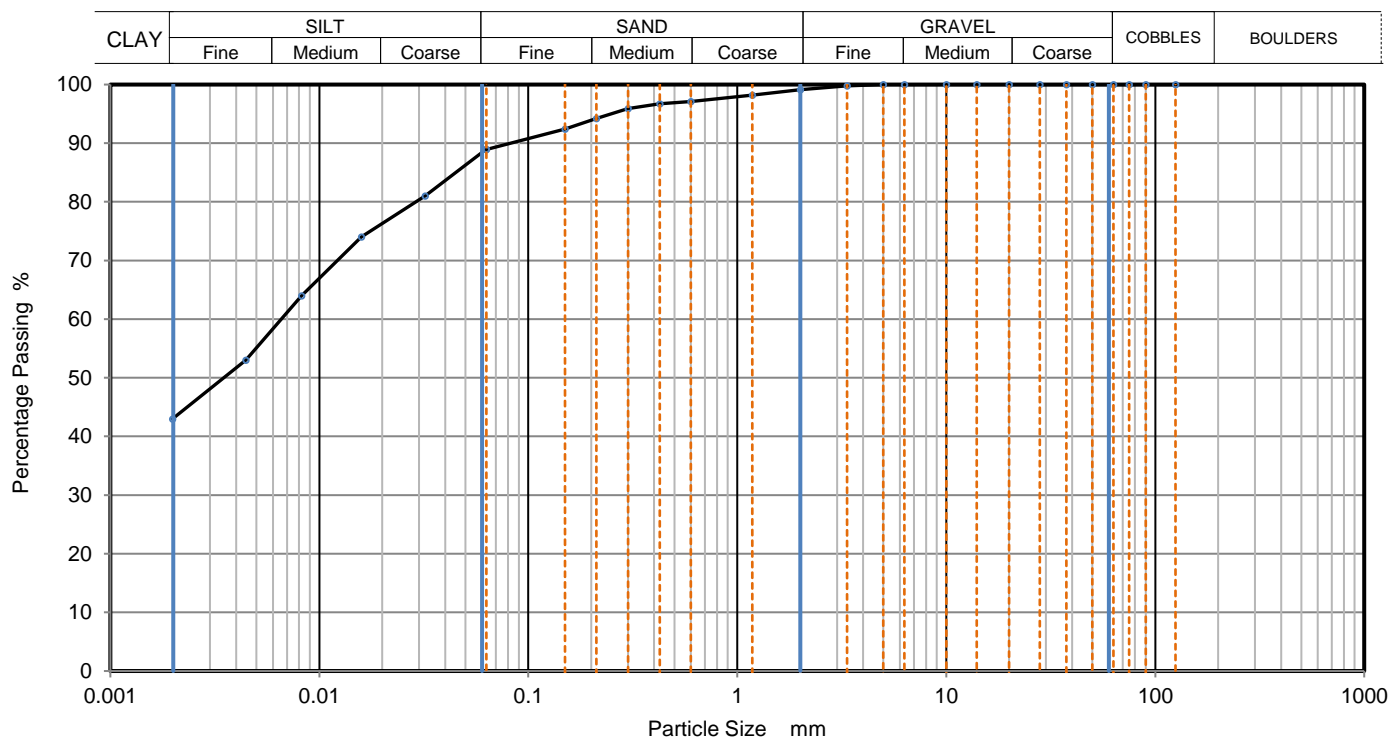
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201711204



Sieving		Sedimentation	
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) 2.65 Mg/m3	
0.425	97		
0.3	96		
0.212	94		
0.15	92		
0.063	89		

Dry Mass of sample, g

126

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	10
Silt	46
Clay	43

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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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.

25

Soil Description

Grey slightly sandy silty CLAY,

Depth, m

6.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

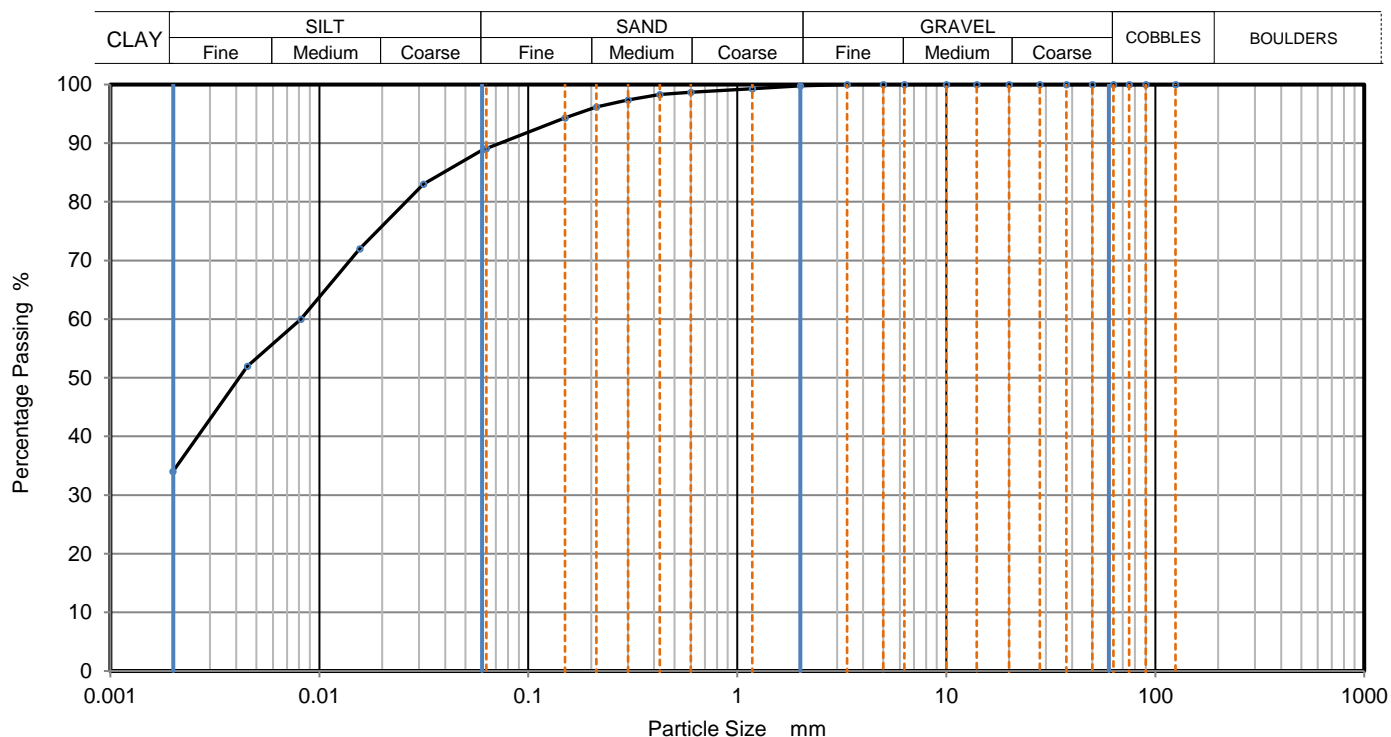
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201711206



Sieving		Sedimentation	
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) 2.65 Mg/m3	
0.425	98		
0.3	97		
0.212	96		
0.15	94		
0.063	89		

Dry Mass of sample, g

133

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	11
Silt	55
Clay	35

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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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.

26

Soil Description

Grey slightly sandy silty CLAY,

Depth, m

7.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

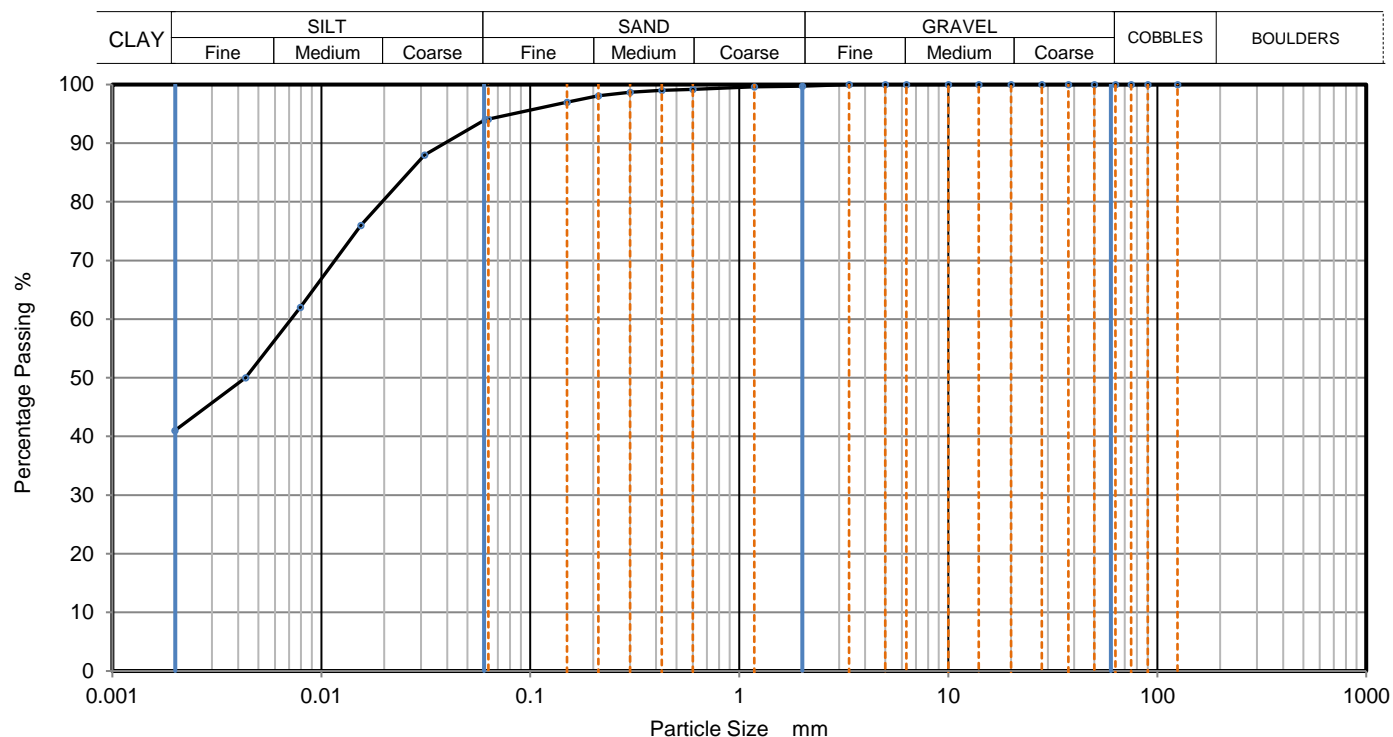
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus201711208



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	99		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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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.

27

Soil Description

Grey sandy CLAY,

Depth, m

8.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

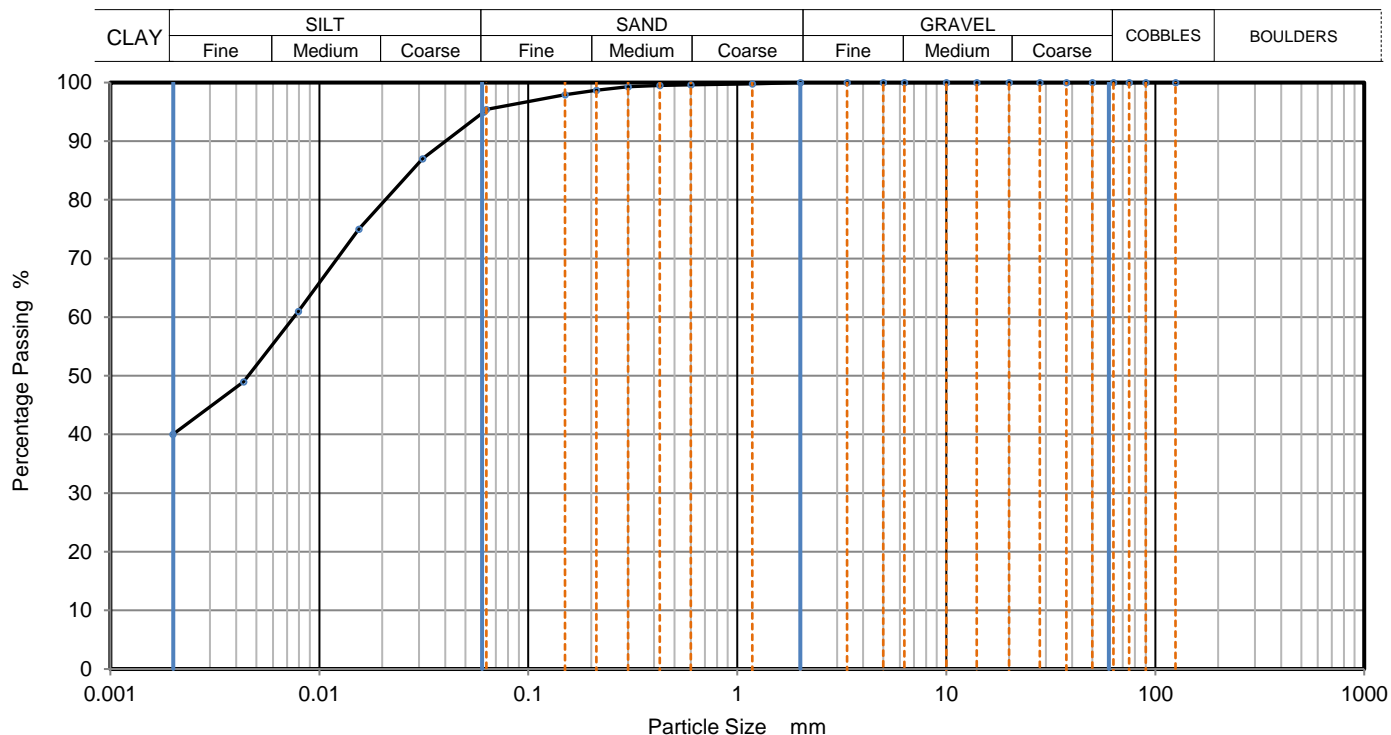
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112010



Sieving		Sedimentation	
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) 2.65 Mg/m3	
0.425	100		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

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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.

7

Soil Description

Grey sandy slightly gravelly silty CLAY.

Depth, m

0.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

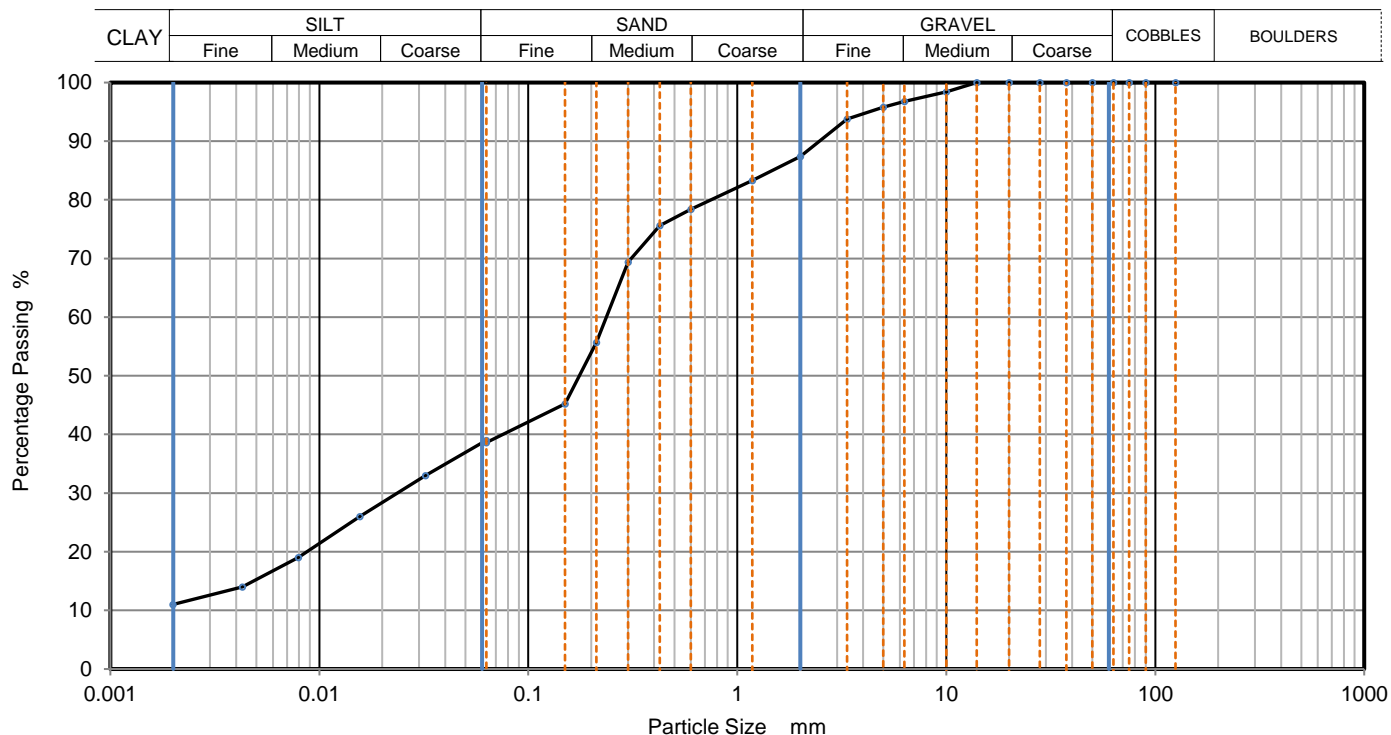
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112013



Sieving		Sedimentation	
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) 2.65 Mg/m3	
0.425	76		
0.3	69		
0.212	56		
0.15	45		
0.063	39		

Dry Mass of sample, g

109

Sample Proportions	% dry mass
Cobbles	0
Gravel	13
Sand	49
Silt	27
Clay	11

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

Approved

Stephen.Watson

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Fig 1

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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  
Depth

m

Sample Type

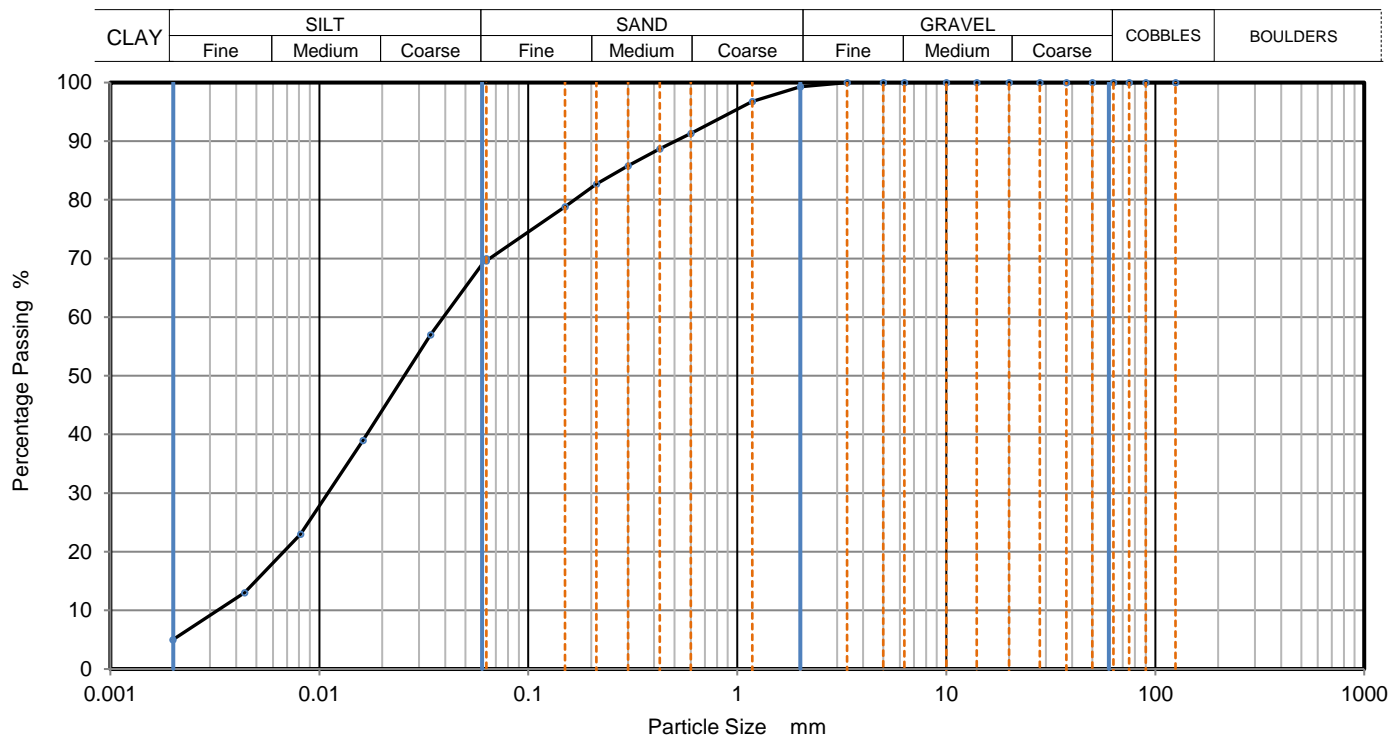
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112015



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	89		
0.3	86		
0.212	83		
0.15	79		
0.063	70		

Dry Mass of sample, g

70

Sample Proportions	% dry mass
Cobbles	0
Gravel	1
Sand	30
Silt	64
Clay	5

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	12
Curvature Coefficient	0.93

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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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.

9

Soil Description

Grey sandy slightly clayey SILT.

Depth, m

2.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

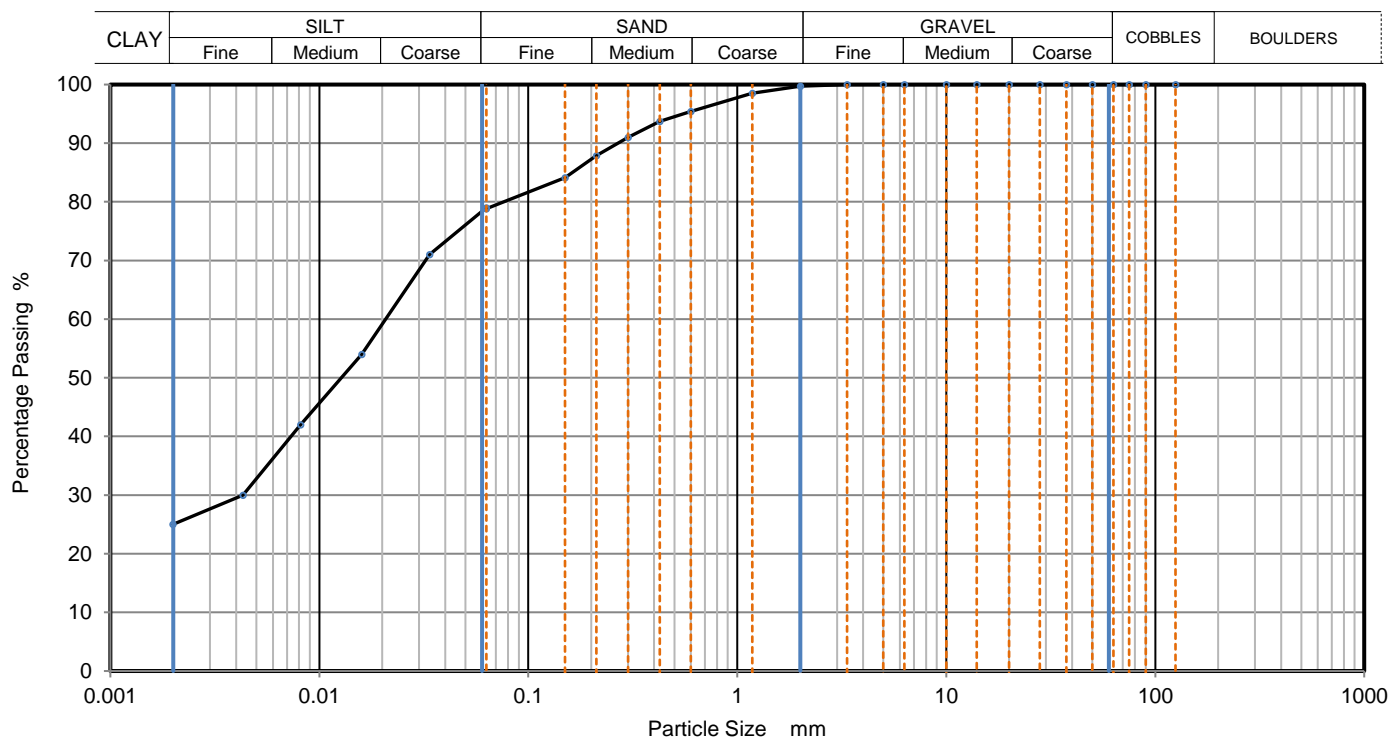
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112017



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	94		
0.3	91		
0.212	88		
0.15	84		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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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.

10

Soil Description

Grey sandy slightly clayey SILT.

Depth, m

3.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

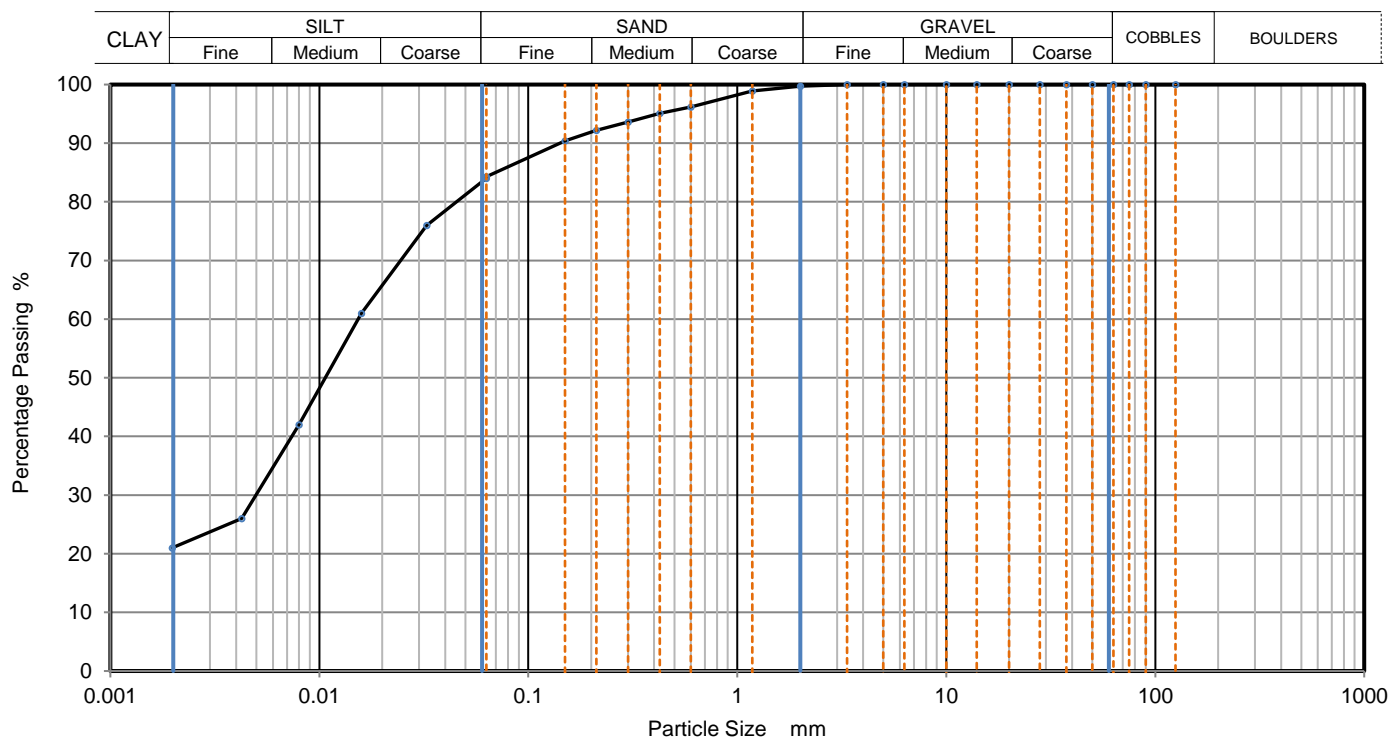
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112018



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	95		
0.3	94		
0.212	92		
0.15	90		
0.063	84		

Dry Mass of sample, g

66

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	15
Silt	63
Clay	21

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

Remarks

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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.

11

Soil Description

Grey slightly gravelly slightly silty fine to coarse SAND.

Depth, m

4.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

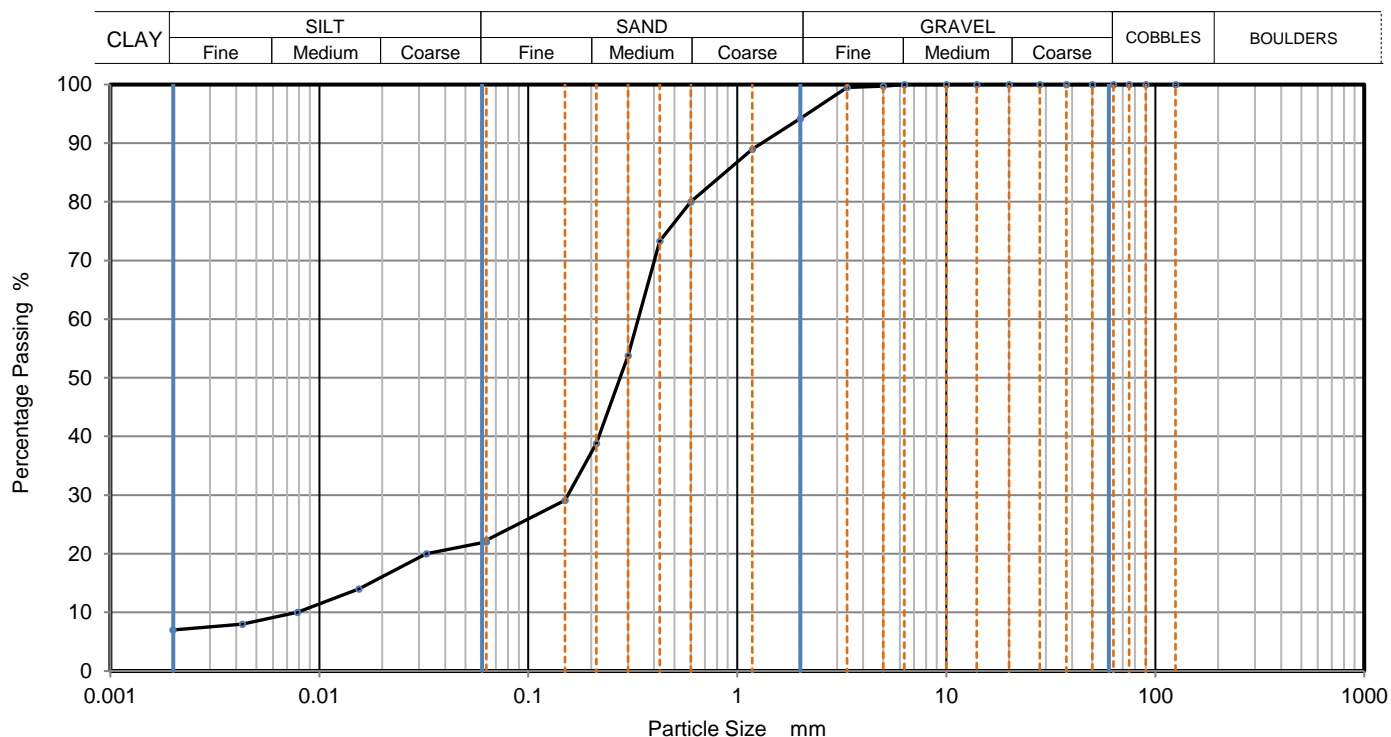
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112021



Sieving		Sedimentation	
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		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	94		
1.18	89		
0.6	80	Particle density (assumed) 2.65 Mg/m <sup>3</sup>	
0.425	73		
0.3	54		
0.212	39		
0.15	29		
0.063	22		

Dry Mass of sample, g

134

Sample Proportions	% dry mass
Cobbles	0
Gravel	6
Sand	72
Silt	16
Clay	7

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	48
Curvature Coefficient	10

Remarks

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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.

15

Soil Description

Grey fine to medium SAND.

Depth, m

9.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

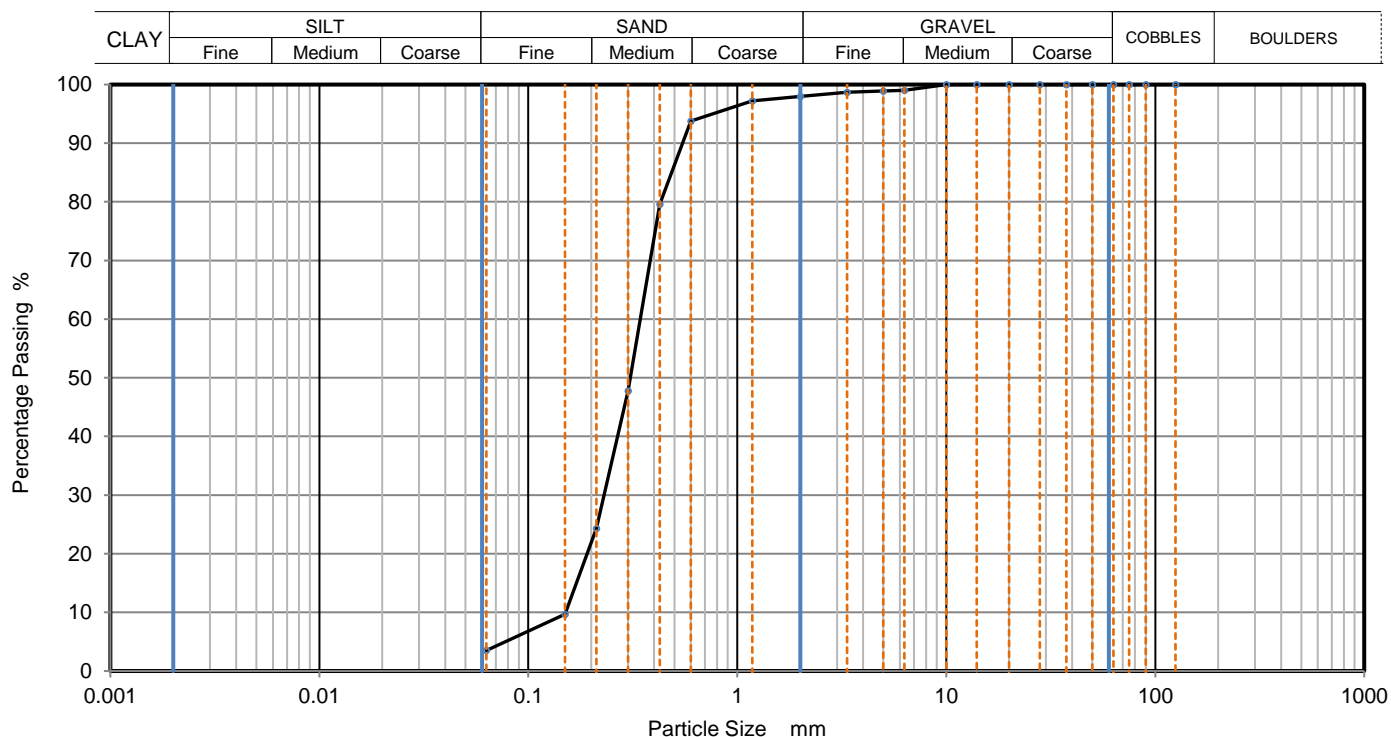
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017112024



Sieving		Sedimentation	
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		
0.3	48		
0.212	24		
0.15	10		
0.063	4		

Dry Mass of sample, g

131

Sample Proportions	% dry mass
Cobbles	0
Gravel	2
Sand	95
Fines <0.063mm	4

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	2.3
Curvature Coefficient	1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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Borehole/Pit No.

BH17

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

15

Soil Description

Grey slightly sandy subangular to subrounded medium to coarse GRAVEL.

Depth, m

0.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

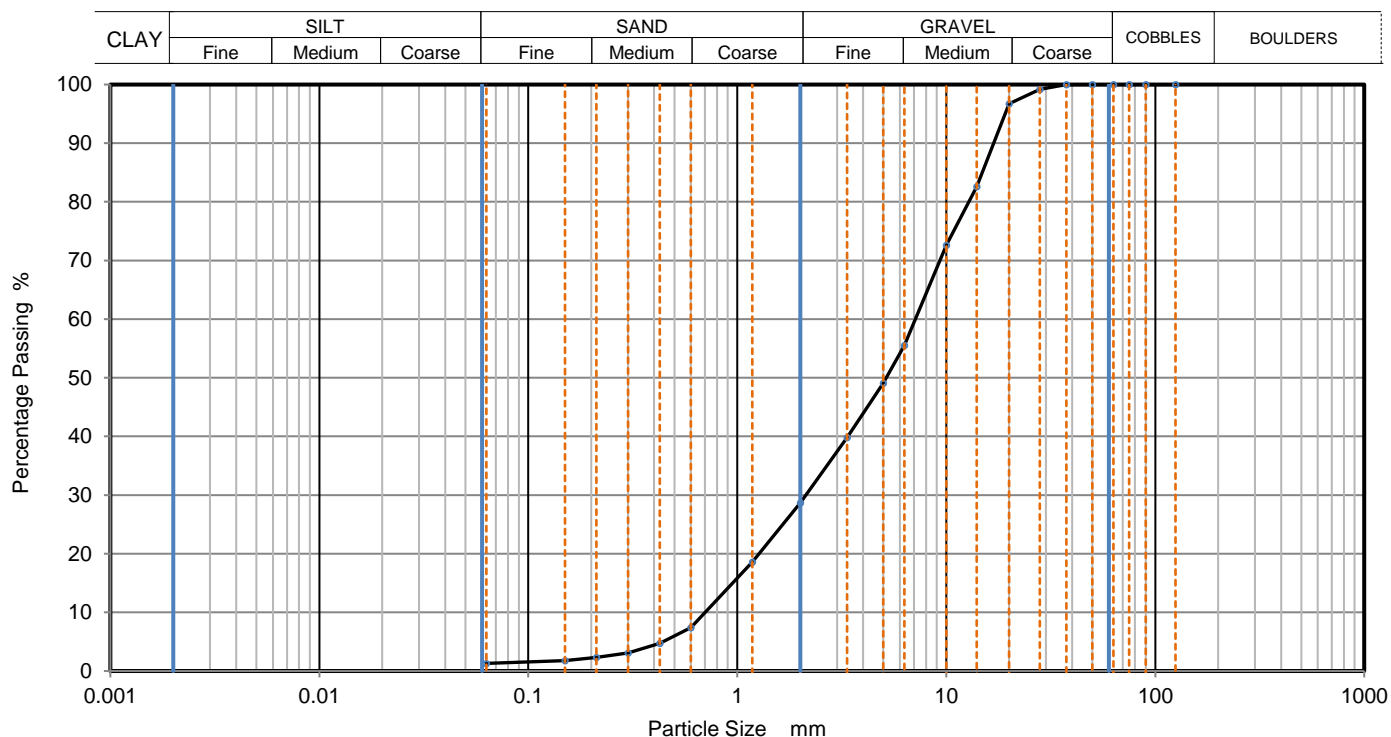
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017112025



Sieving		Sedimentation	
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		
0.3	3		
0.212	2		
0.15	2		
0.063	1		

Dry Mass of sample, g

5261

Sample Proportions	% dry mass
Cobbles	0
Gravel	71
Sand	27
Fines <0.063mm	1

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	10
Curvature Coefficient	0.9

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Borehole/Pit No.

BH17

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

17

Soil Description

Grey slightly sandy subangular to subrounded medium to coarse GRAVEL.

Depth, m

2.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

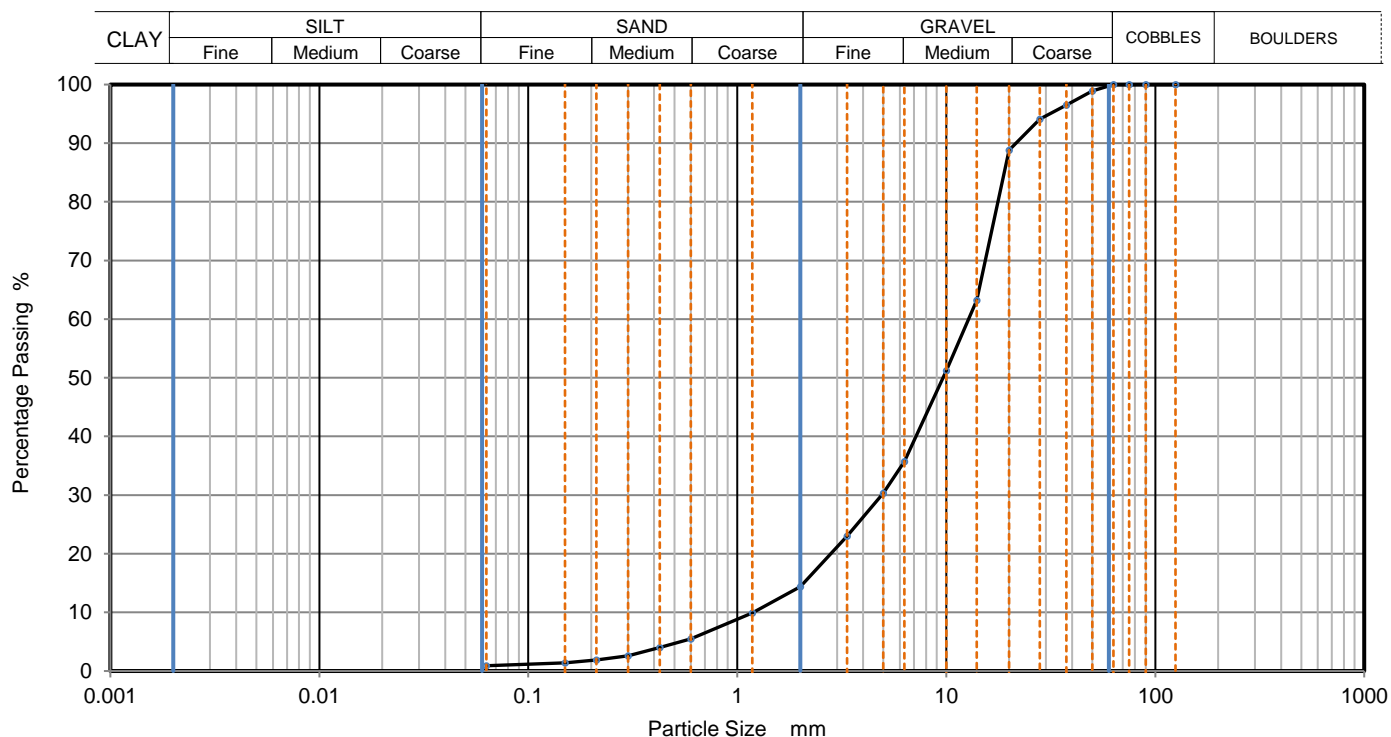
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017112026



Sieving		Sedimentation	
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		

Dry Mass of sample, g

8589

Sample Proportions	% dry mass
Cobbles	0
Gravel	86
Sand	14
Fines <0.063mm	1

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	11
Curvature Coefficient	1.6

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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Borehole/Pit No.

BH17

Site Name

Arklow Sewerage Scheme Marine Outfall 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  
Depth

m

Sample Type

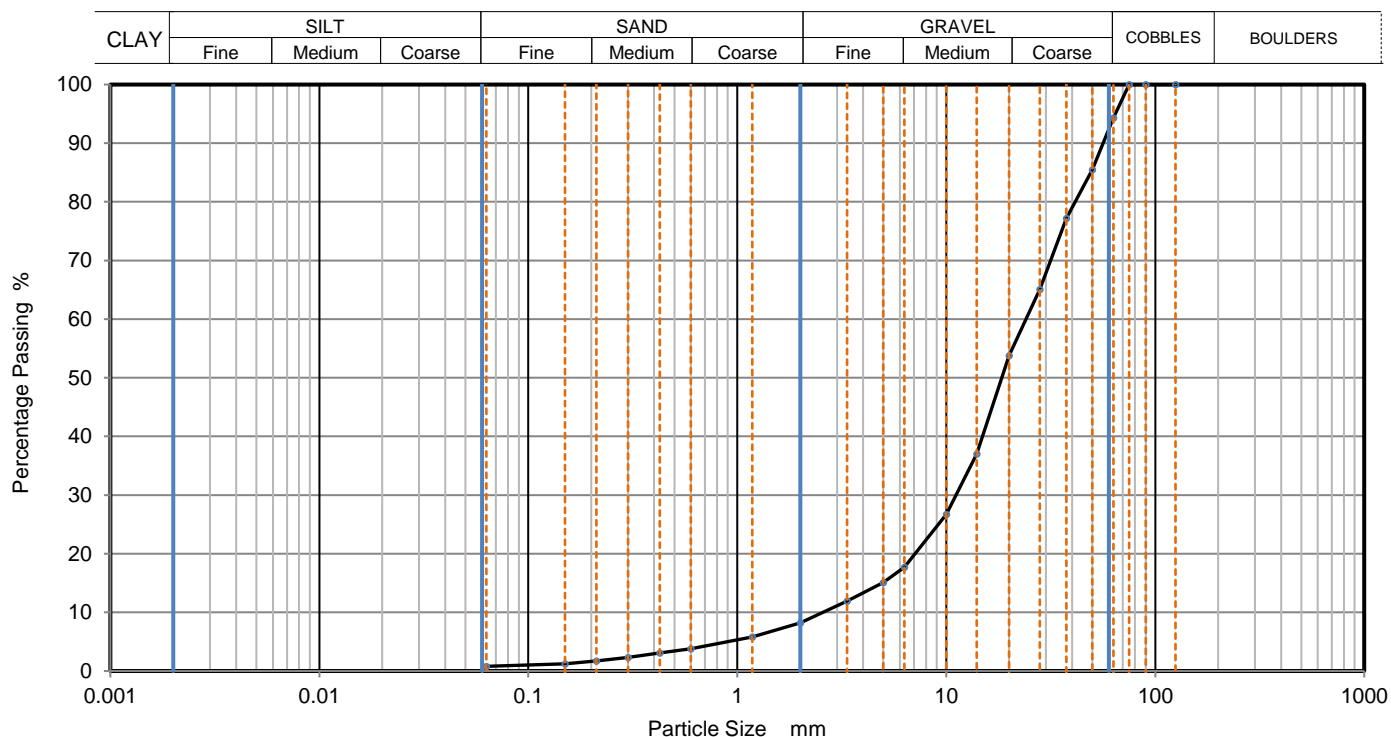
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017112027



Sieving		Sedimentation	
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		
0.3	2		
0.212	2		
0.15	1		
0.063	1		

Dry Mass of sample, g

13623

Sample Proportions	% dry mass
Cobbles	6
Gravel	86
Sand	7
Fines <0.063mm	1

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	9.4
Curvature Coefficient	2

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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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  
Depth

m

Sample Type

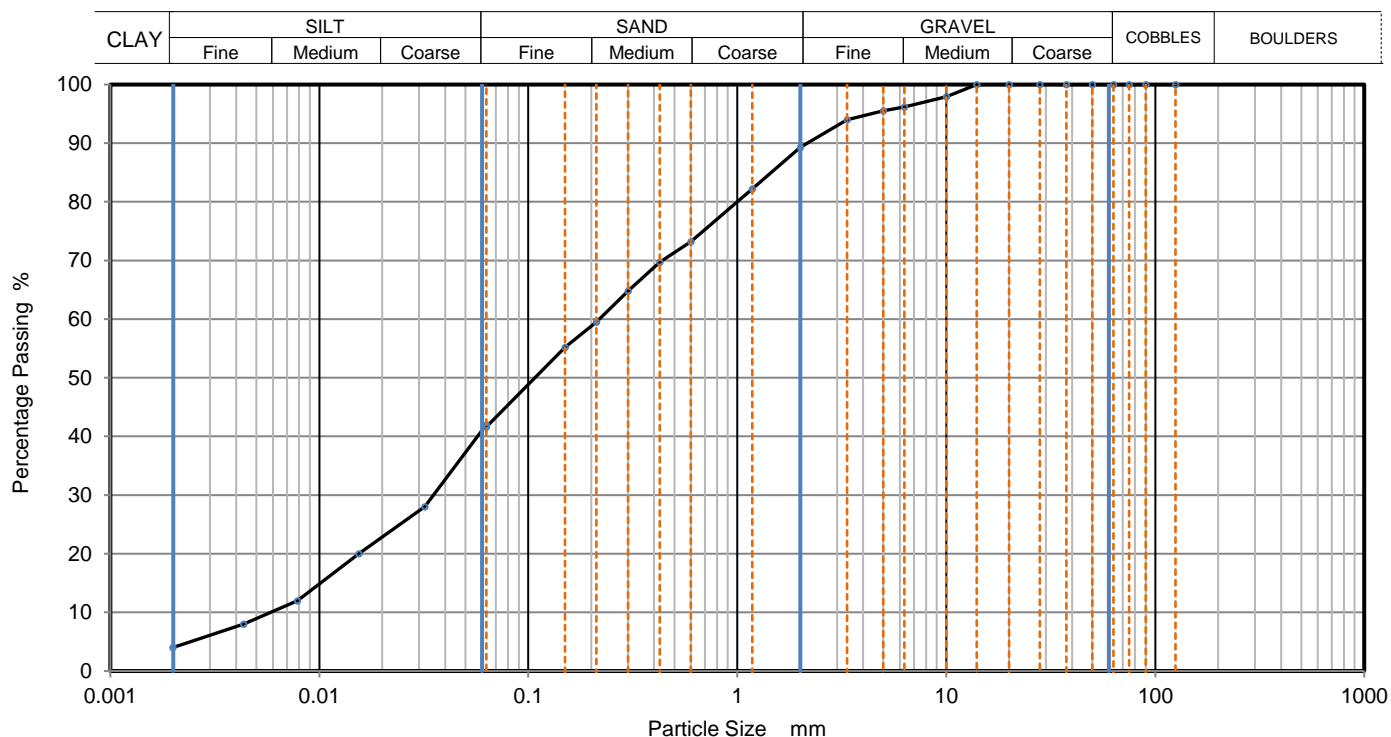
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112028



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	70		
0.3	65		
0.212	60		
0.15	55		
0.063	42		

Dry Mass of sample, g

109

Sample Proportions	% dry mass
Cobbles	0
Gravel	11
Sand	48
Silt	38
Clay	4

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	37
Curvature Coefficient	0.98

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

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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  
Depth

m

Sample Type

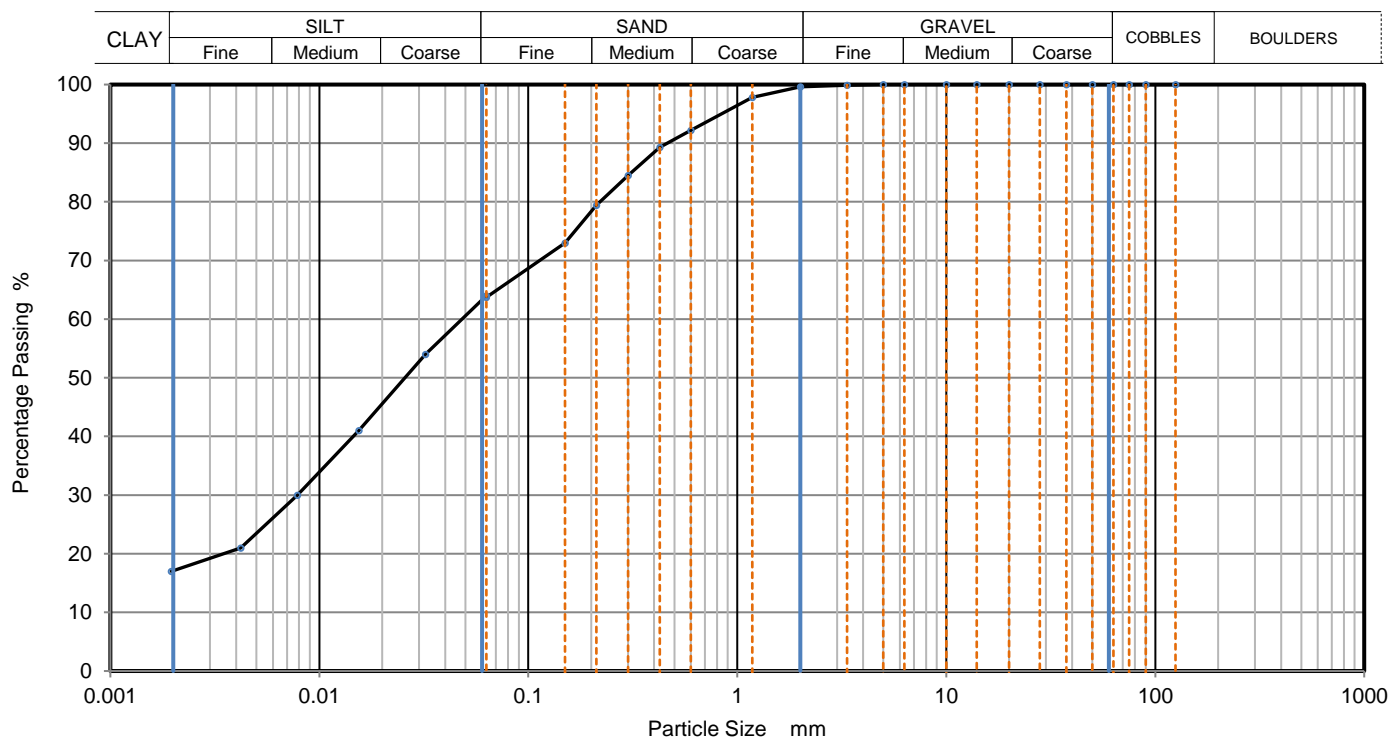
B

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) 2.65 Mg/m3	
0.425	89		
0.3	85		
0.212	79		
0.15	73		
0.063	64		

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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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Borehole/Pit No.

BH17

Site Name

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  
Depth

m

Sample Type

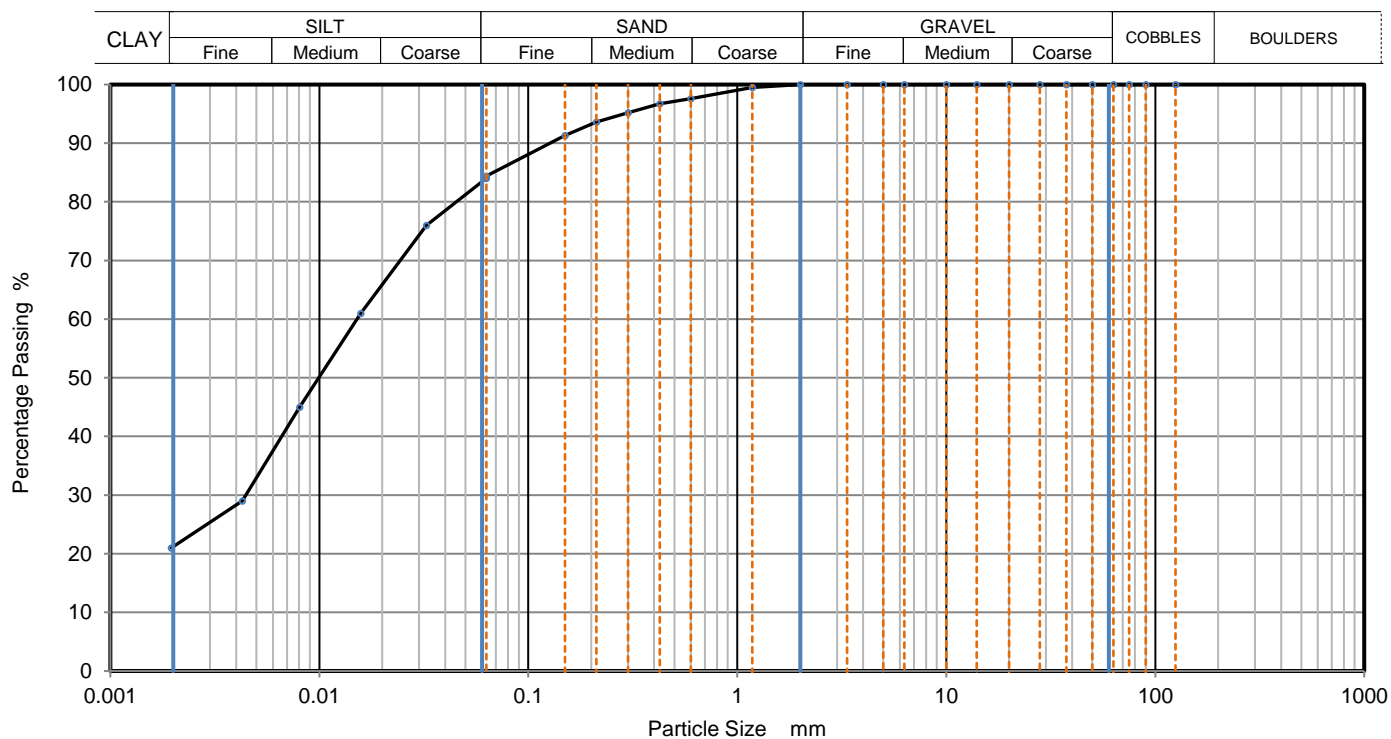
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112032



Sieving		Sedimentation	
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		
0.6	98	Particle density (assumed) 2.65 Mg/m <sup>3</sup>	
0.425	97		
0.3	95		
0.212	94		
0.15	91		
0.063	84		

Dry Mass of sample, g

63

Sample Proportions	% dry mass
Cobbles	0
Gravel	0
Sand	16
Silt	63
Clay	21

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH17

Site Name

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  
Depth

m

Sample Type

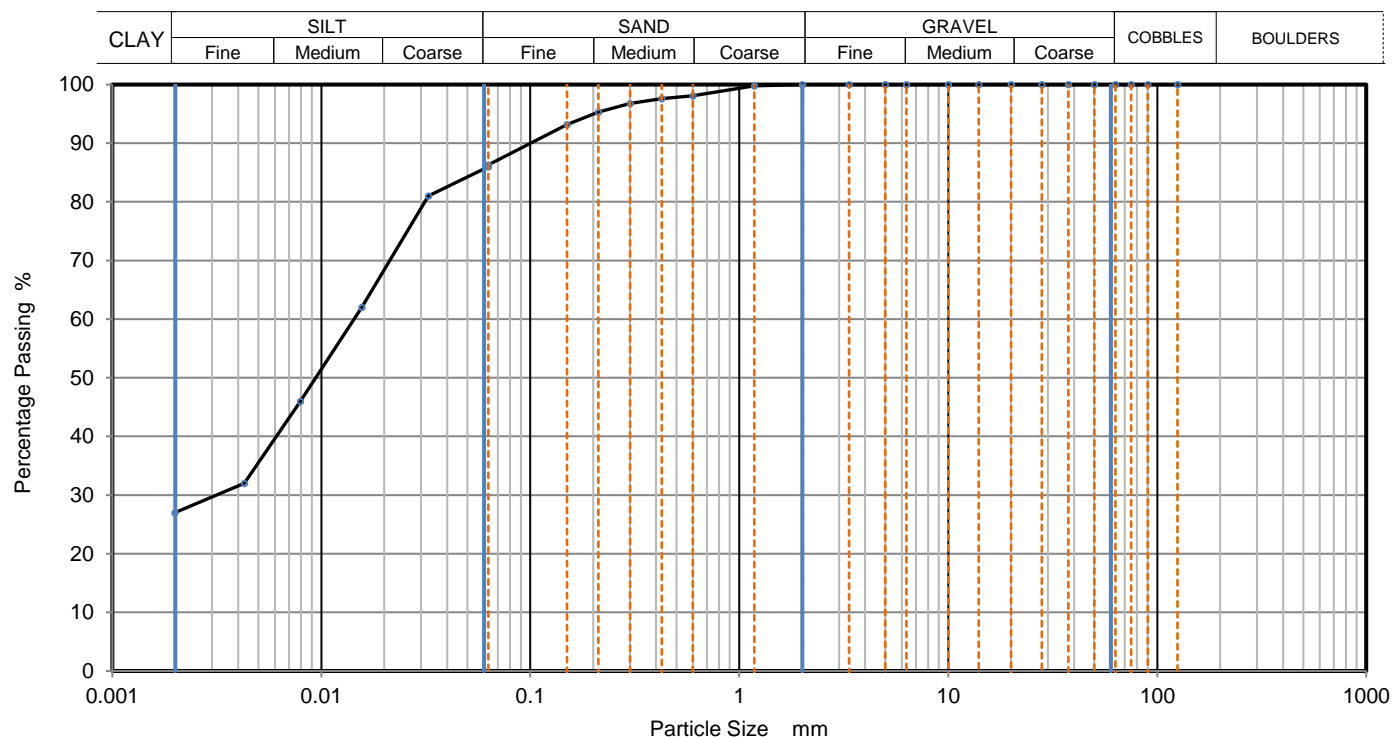
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112034



Sieving		Sedimentation	
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) 2.65 Mg/m3	
0.425	98		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH17

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

24

Soil Description

Grey slightly sandy subangular to subrounded GRAVEL.

Depth, m

9.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

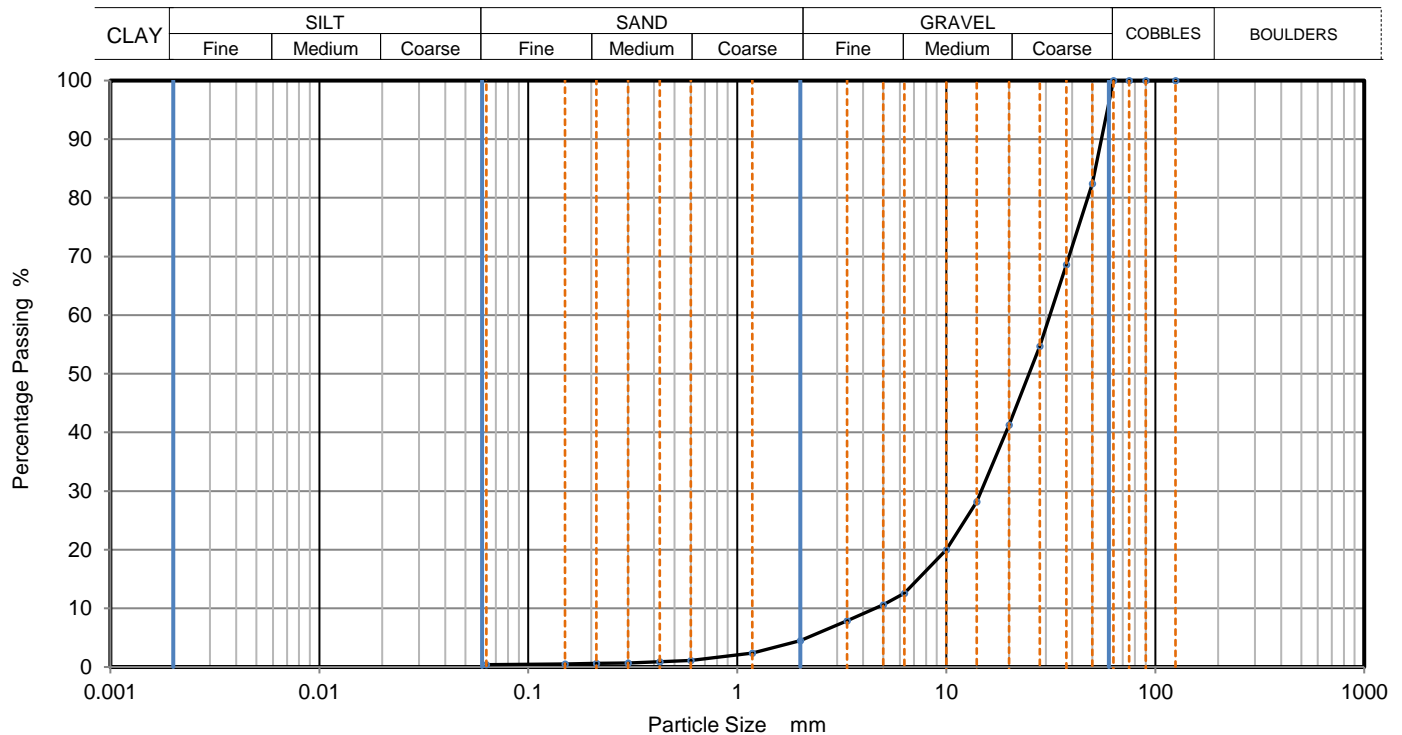
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017112036



Sieving		Sedimentation	
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		
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
D30	mm
D10	mm
Uniformity Coefficient	6.8
Curvature Coefficient	1.5

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH17

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

26

Soil Description

Grey slightly sandy clayey SILT,

Depth, m

11.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

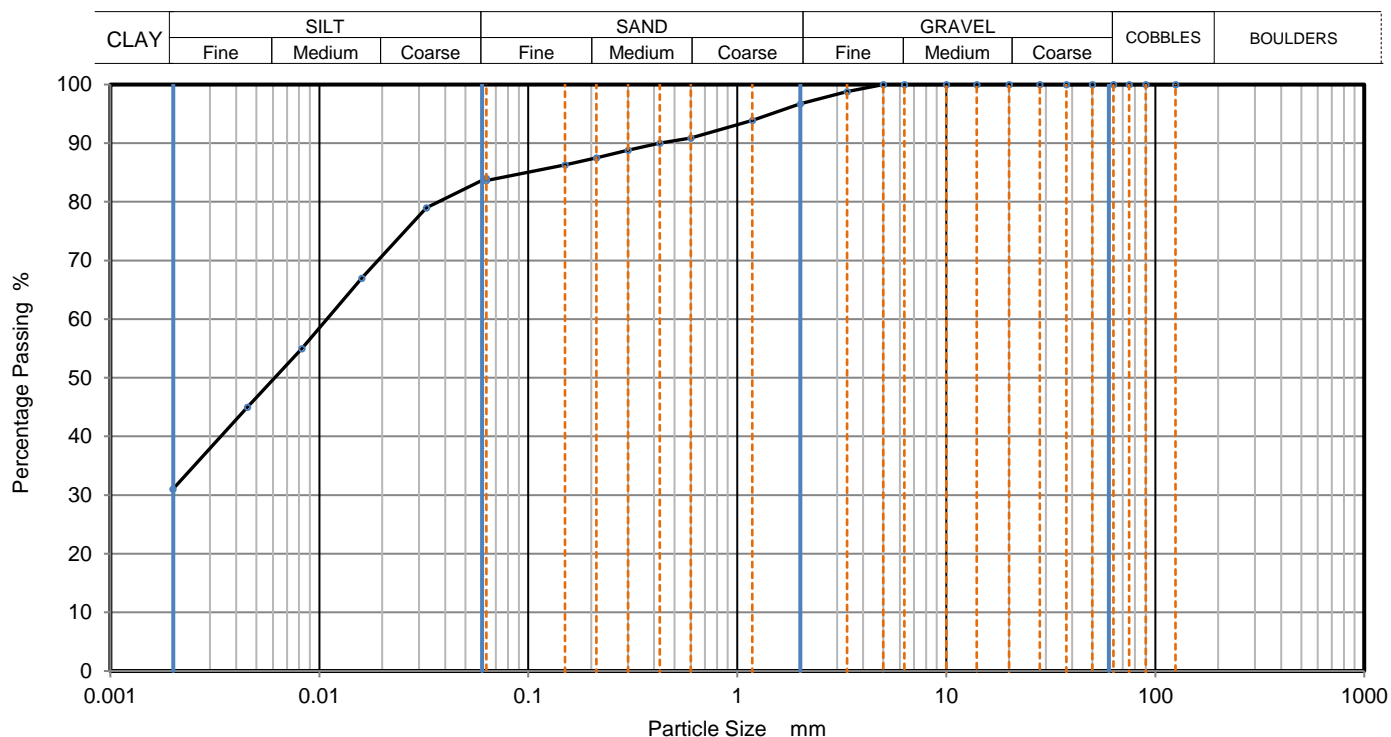
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112037



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	90		
0.3	89		
0.212	88		
0.15	86		
0.063	84		

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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH18

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

2

Soil Description

Grey slightly sandy subangular to subrounded GRAVEL with low cobble content.

Depth, m

2.80

Specimen Reference

4

Specimen  
Depth

m

Sample Type

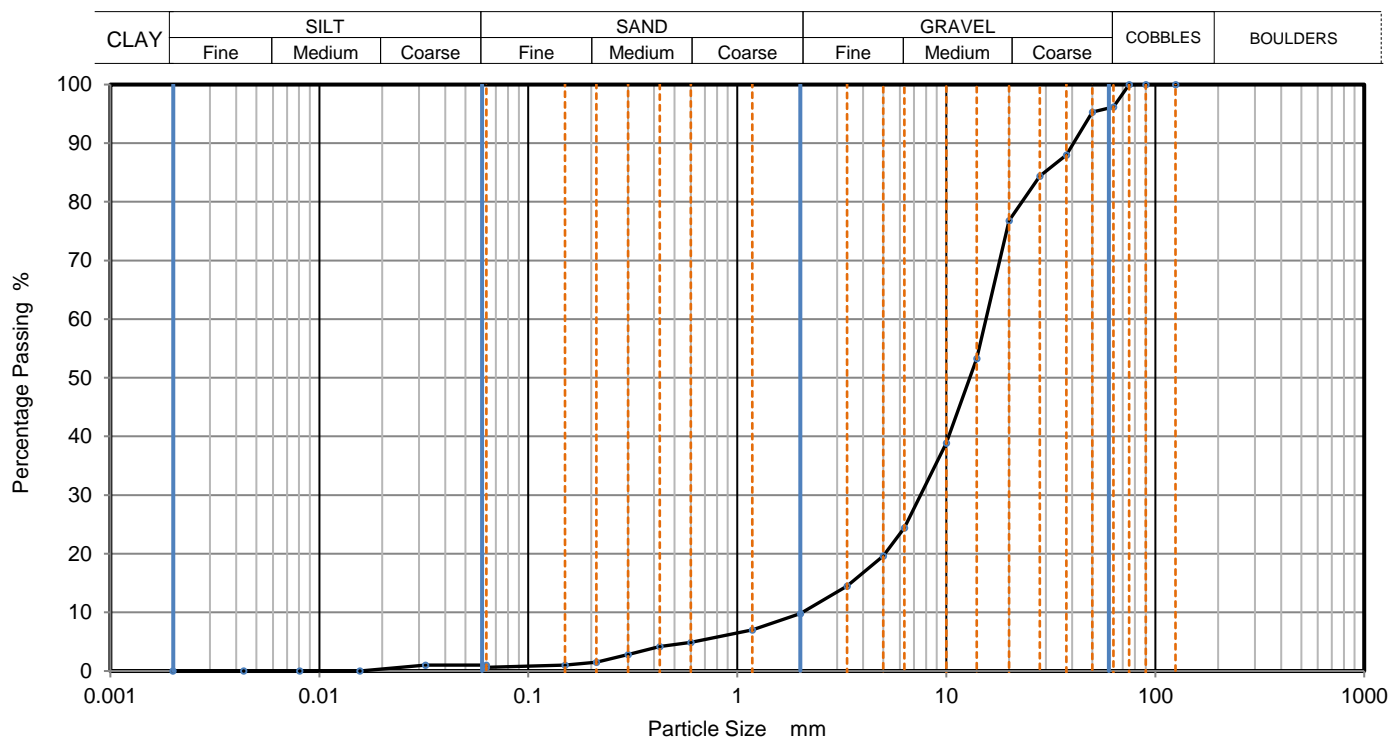
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112041



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	4		
0.3	3		
0.212	2		
0.15	1		
0.063	1		

Dry Mass of sample, g

17591

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

Remarks

Preparation and testing in accordance with BS1377 unless noted below

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH18

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

3

Soil Description

Grey sandy silty CLAY.

Depth, m

4.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

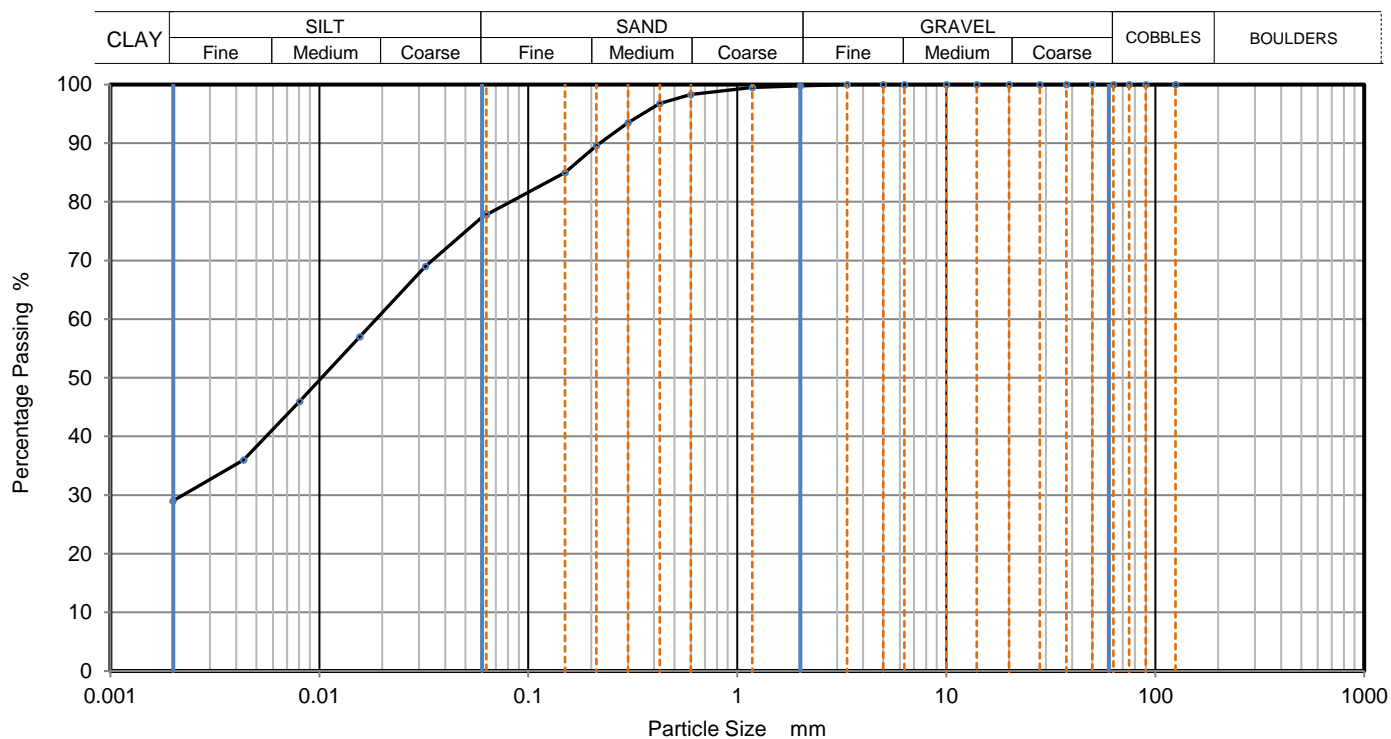
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112043



Sieving		Sedimentation	
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) 2.65 Mg/m3	
0.425	97		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH18

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

4

Soil Description

Grey sandy slightly gravelly silty CLAY.

Depth, m

6.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

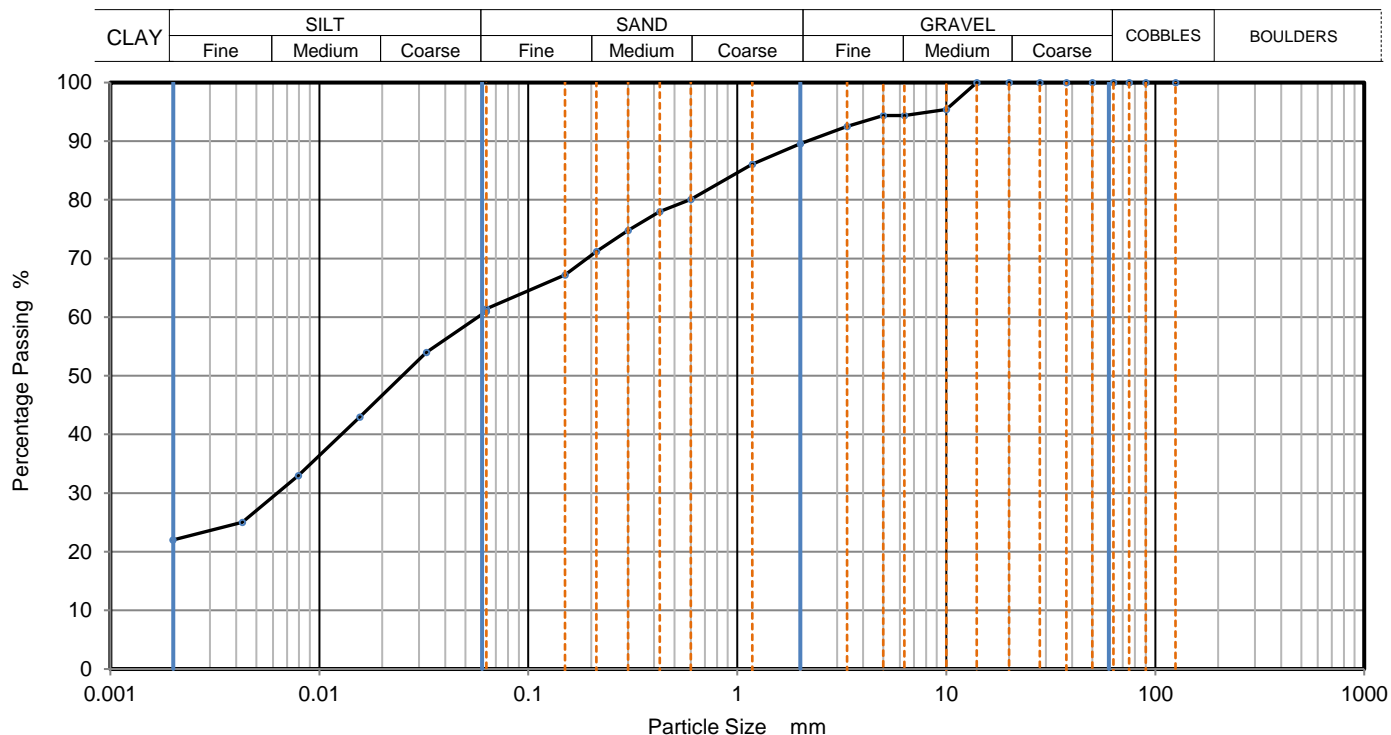
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112046



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	78		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH18

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

6

Soil Description

Grey slightly sandy subangular to subrounded fine to coarse GRAVEL with low cobble content.

Depth, m

8.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

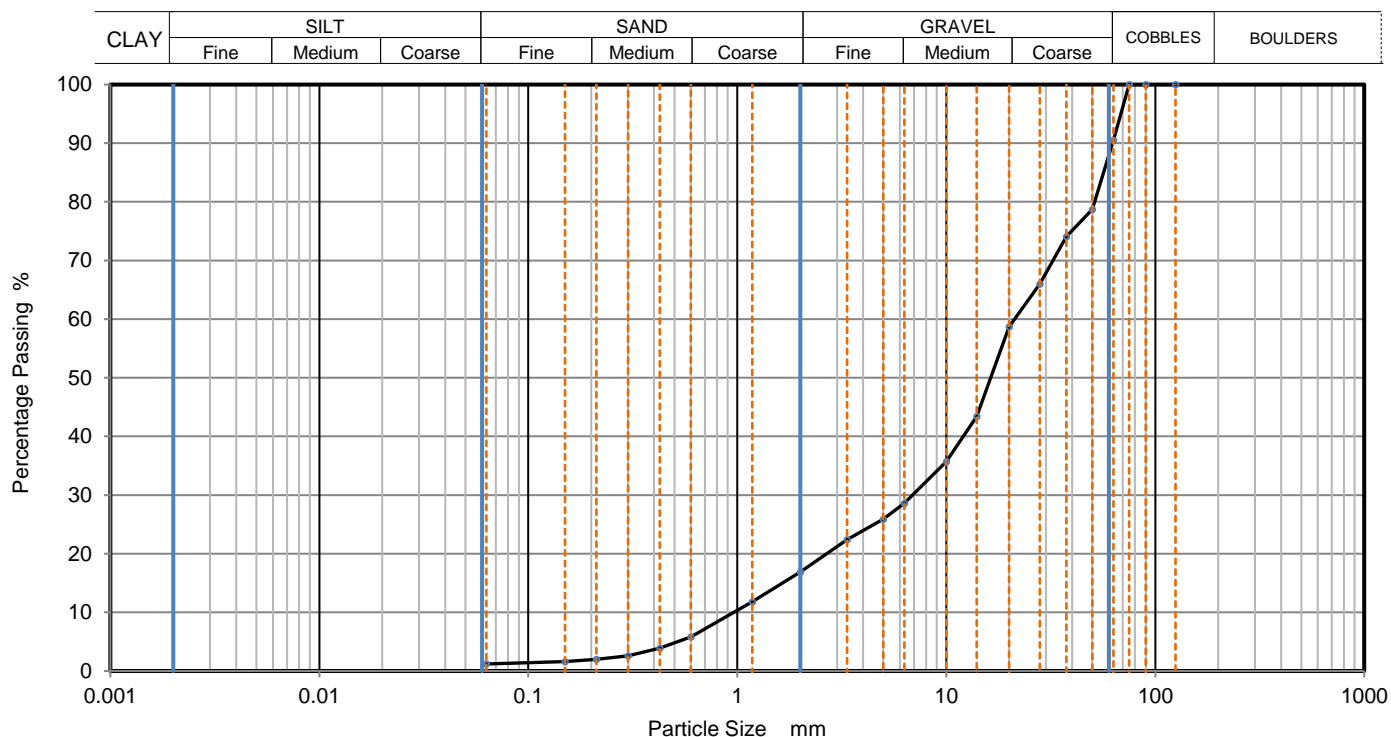
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017112048



Sieving		Sedimentation	
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
D30	mm
D10	mm
Uniformity Coefficient	22
Curvature Coefficient	2.3

### Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH18

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

8

Soil Description

Grey sandy subangular to subrounded fine to coarse GRAVEL.

Depth, m

10.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

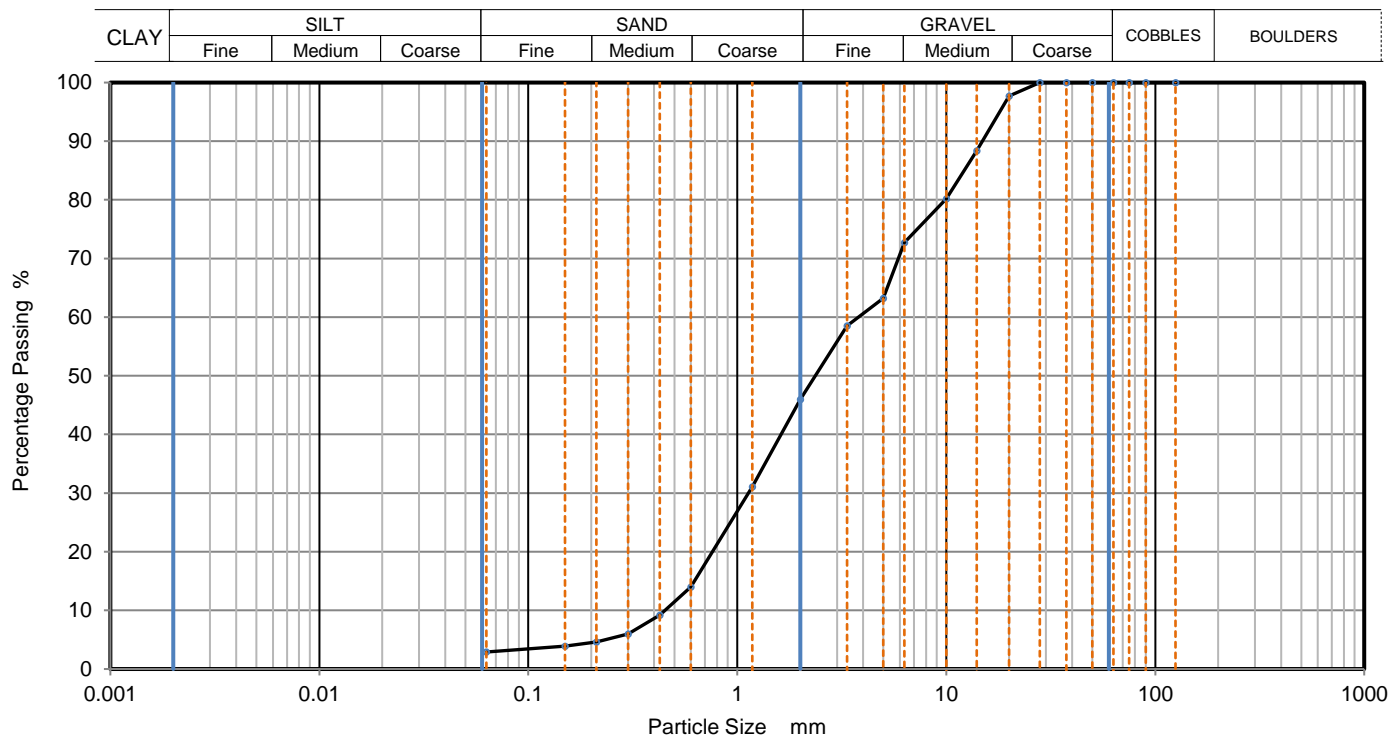
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017112049



Sieving		Sedimentation	
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		
0.3	6		
0.212	5		
0.15	4		
0.063	3		

Dry Mass of sample, g

5348

Sample Proportions	% dry mass
Cobbles	0
Gravel	54
Sand	43
Fines <0.063mm	3

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

### Remarks

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH19

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

2

Soil Description

Greyish brown slightly sandy subangular to subrounded fine to coarse GRAVEL.

Depth, m

1.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

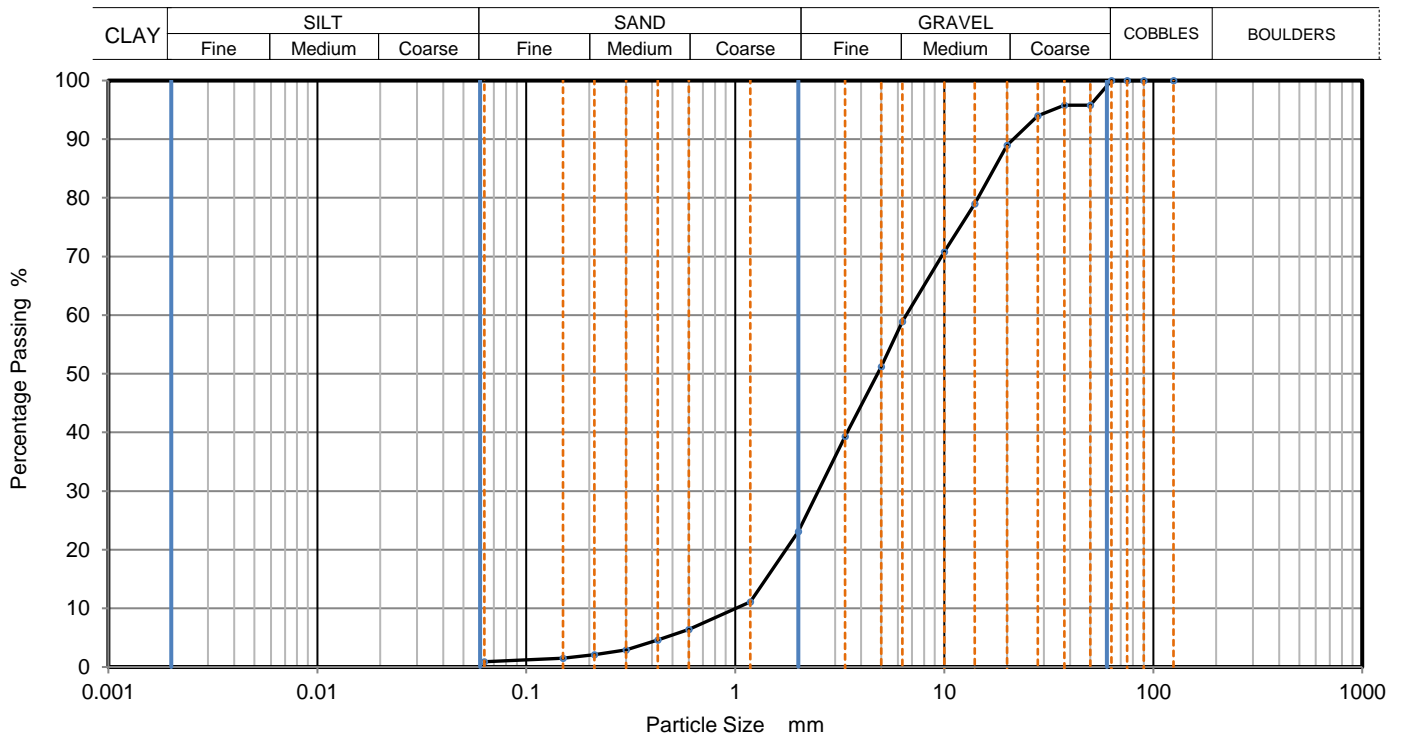
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017112051



Sieving		Sedimentation	
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		
0.3	3		
0.212	2		
0.15	2		
0.063	1		

Dry Mass of sample, g

7275

Sample Proportions	% dry mass
Cobbles	0
Gravel	77
Sand	22
Fines <0.063mm	1

Grading Analysis	
D100	mm
D60	mm
D30	mm
D10	mm
Uniformity Coefficient	6.5
Curvature Coefficient	0.93

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH19

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

3

Soil Description

Greyish brown slightly gravelly silty fine to coarse SAND.

Depth, m

2.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

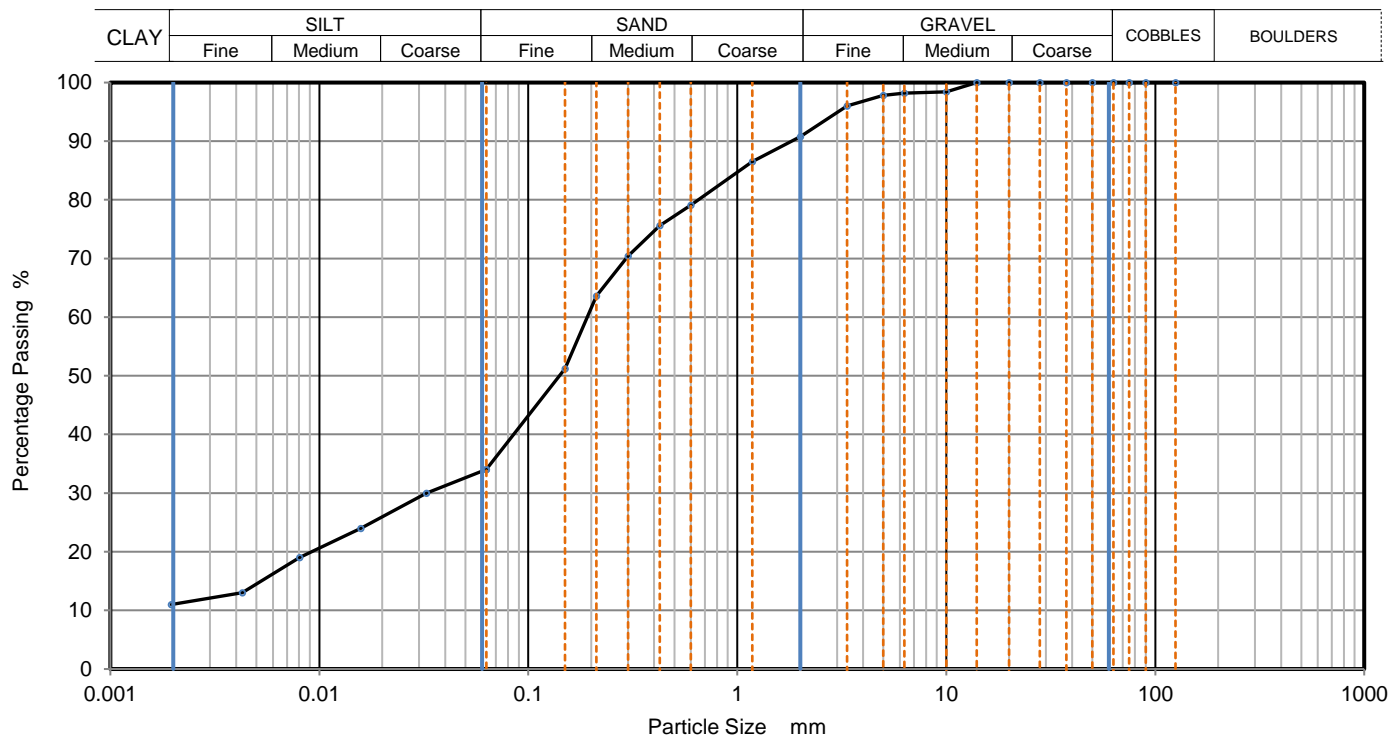
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112054



Sieving		Sedimentation	
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) 2.65 Mg/m3	
0.425	76		
0.3	70		
0.212	64		
0.15	51		
0.063	34		

Dry Mass of sample, g

77

Sample Proportions	% dry mass
Cobbles	0
Gravel	9
Sand	57
Silt	23
Clay	11

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

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH19

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

4

Soil Description

Greyish brown sandy organic clayey SILT.

Depth, m

3.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

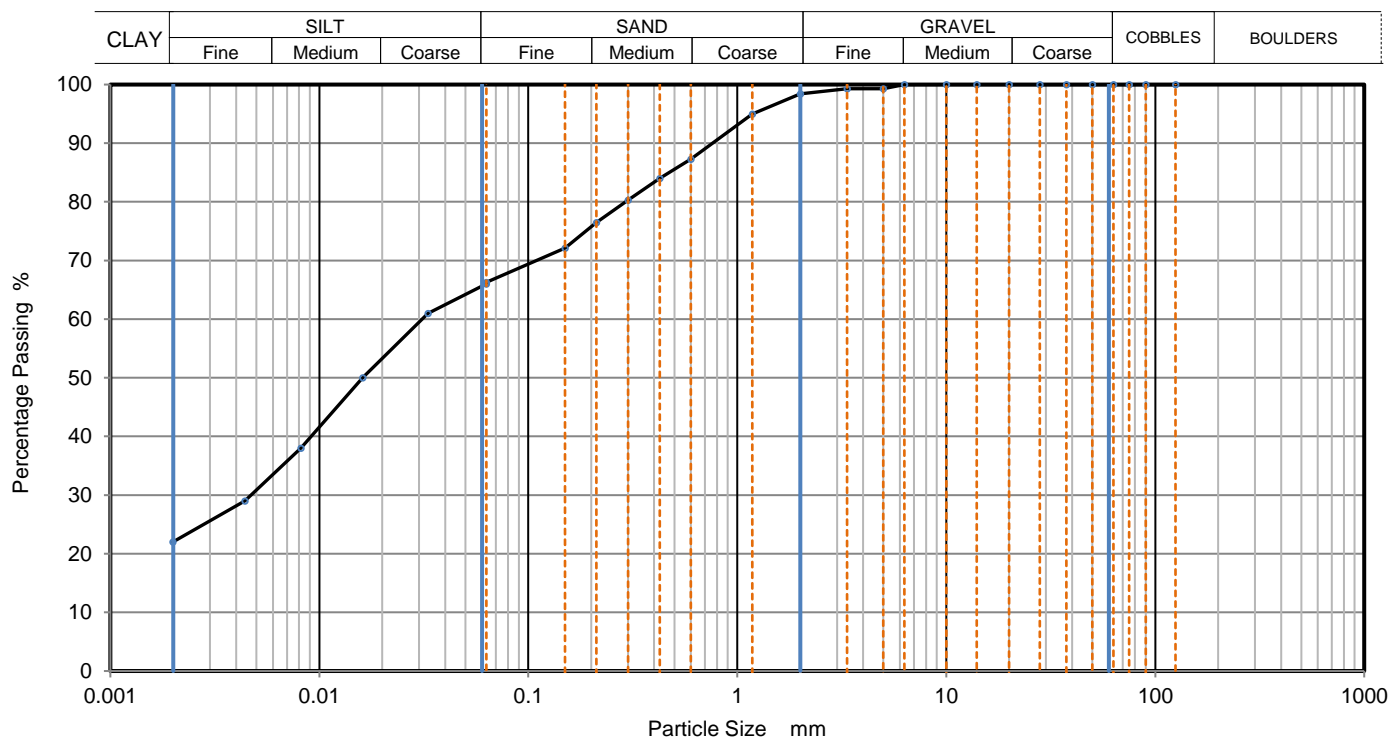
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112056



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	84		
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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH19

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

5

Soil Description

Greyish brown sandy organic clayey SILT.

Depth, m

4.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

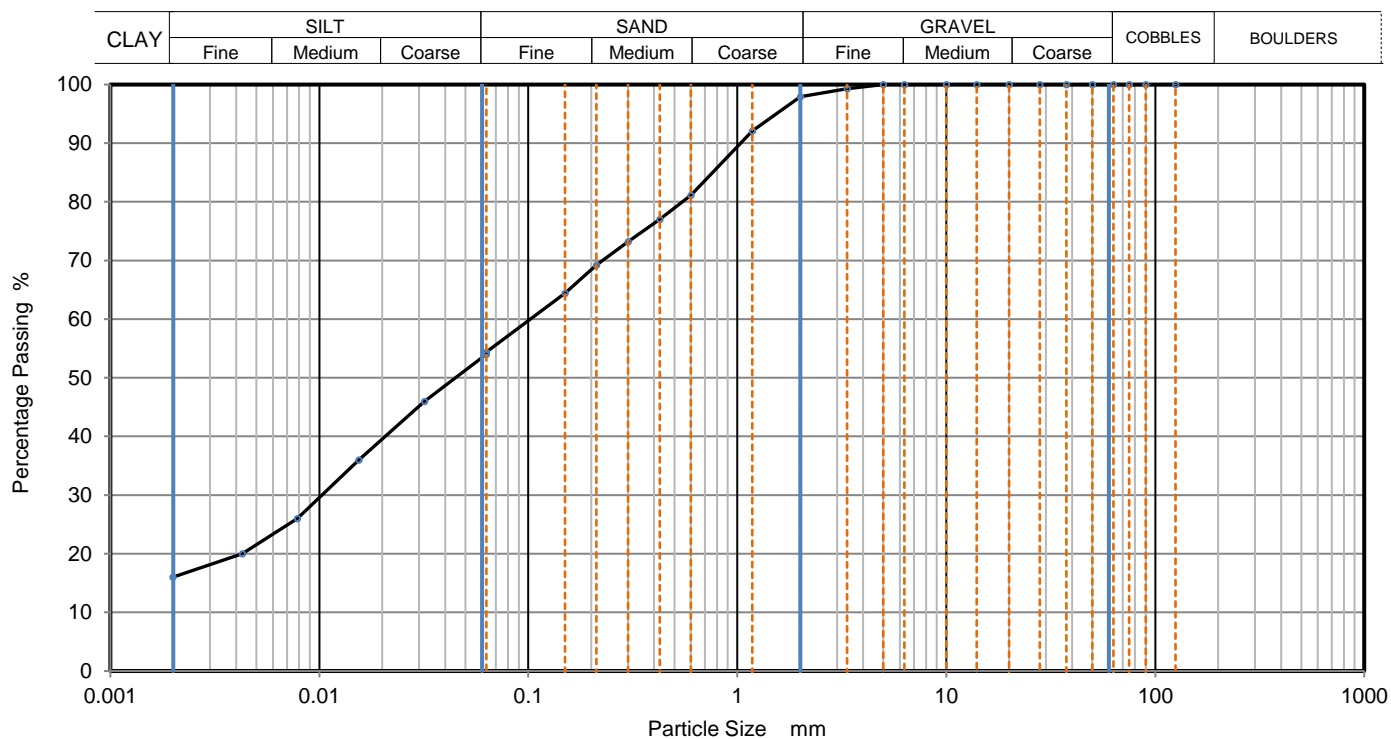
B

Test Method

BS1377:Part 2:1990, clauses 9.2 and 9.5

KeyLAB ID

Caus2017112059



Sieving		Sedimentation	
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) 2.65 Mg/m <sup>3</sup>	
0.425	77		
0.3	73		
0.212	69		
0.15	64		
0.063	54		

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
D30	mm
D10	mm
Uniformity Coefficient	
Curvature Coefficient	

Remarks

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Fig 1

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## PARTICLE SIZE DISTRIBUTION

Job Ref

17-0167

Borehole/Pit No.

BH19

Site Name

Arklow Sewerage Scheme Marine Outfall GI

Sample No.

6

Soil Description

Grey slightly sandy angular to subangular fine to coarse GRAVEL.

Depth, m

5.80

Specimen Reference

2

Specimen  
Depth

m

Sample Type

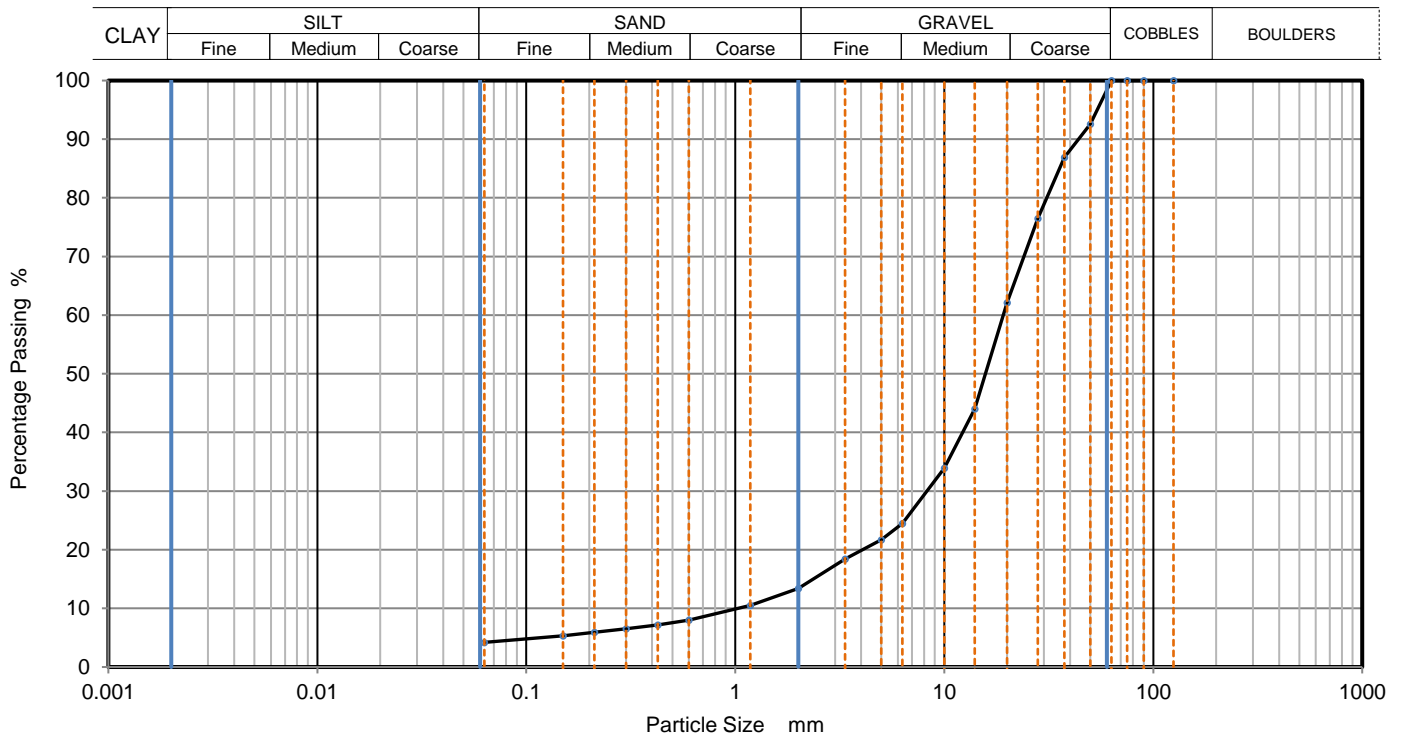
B

Test Method

BS1377:Part 2:1990, clause 9.2

KeyLAB ID

Caus2017112061



Sieving		Sedimentation	
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		
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
D30	mm
D10	mm
Uniformity Coefficient	19
Curvature Coefficient	3.5

Remarks

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Fig 1

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH11
Sample No.	17
Depth	6.00
Sample Type	U
KeyLAB ID	Caus201711205
Date of test	08/12/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey slightly sandy silty CLAY,		
Specimen Reference	2	Specimen Depth	6.30 m
Specimen Description	Stiff grey slightly sandy silty CLAY,		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

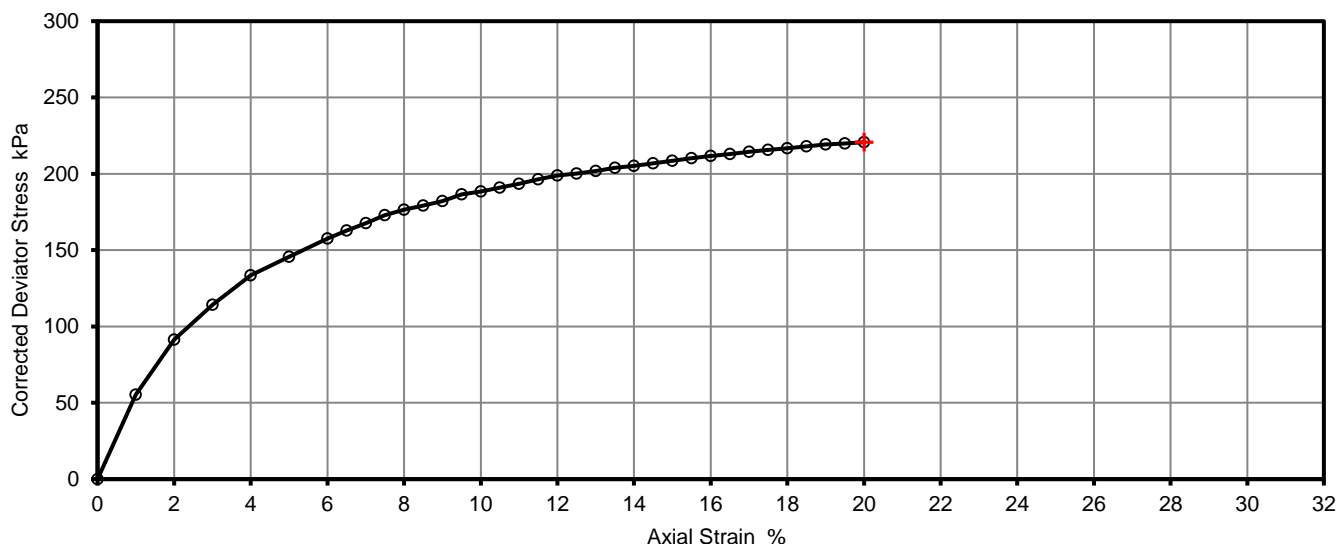
1	
200.0	mm
100.0	mm
2.19	Mg/m3
21.8	%
1.80	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

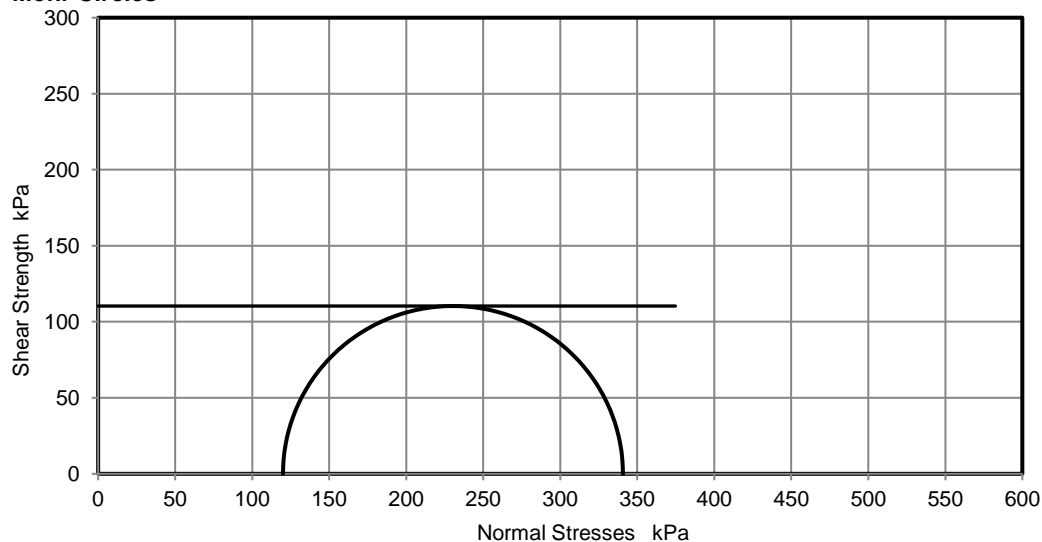
2.0	%/min
120	kPa
20.0	%
221	kPa
110	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

Stephen.Watson

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Lab Sheet Reference :

Fig. No.

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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH11
Sample No.	18
Depth	8.00
Sample Type	U
KeyLAB ID	Caus201711209
Date of test	08/12/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey slightly sandy silty CLAY,		
Specimen Reference	2	Specimen Depth	8.30 m
Specimen Description	Stiff grey slightly sandy silty CLAY,		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

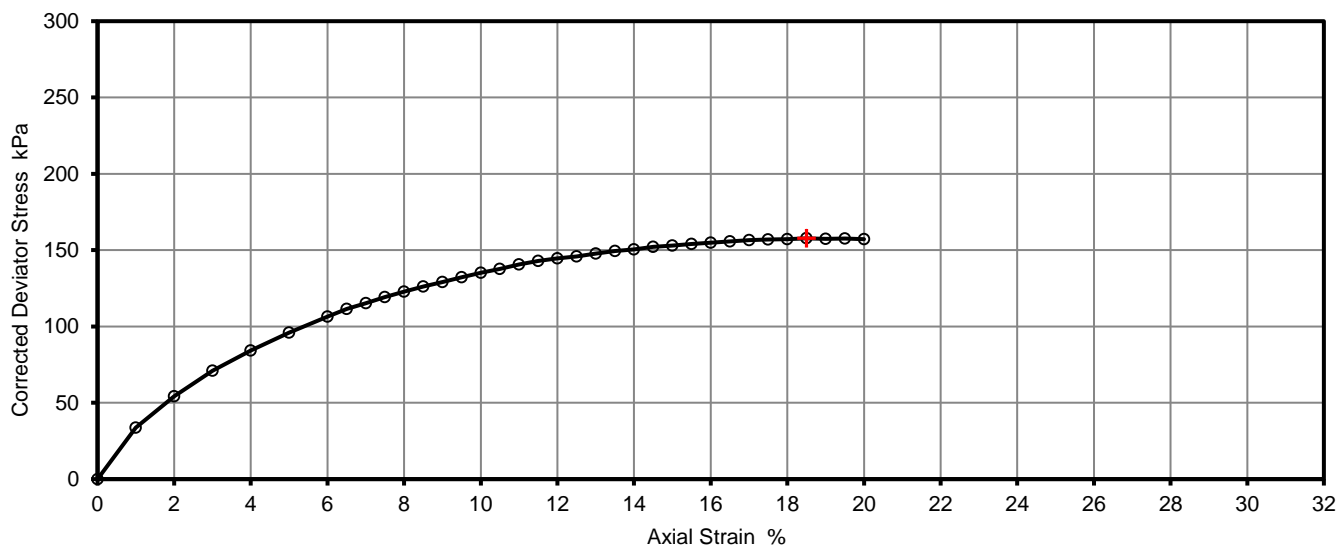
1	
200.0	mm
100.0	mm
2.11	Mg/m3
25.5	%
1.68	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

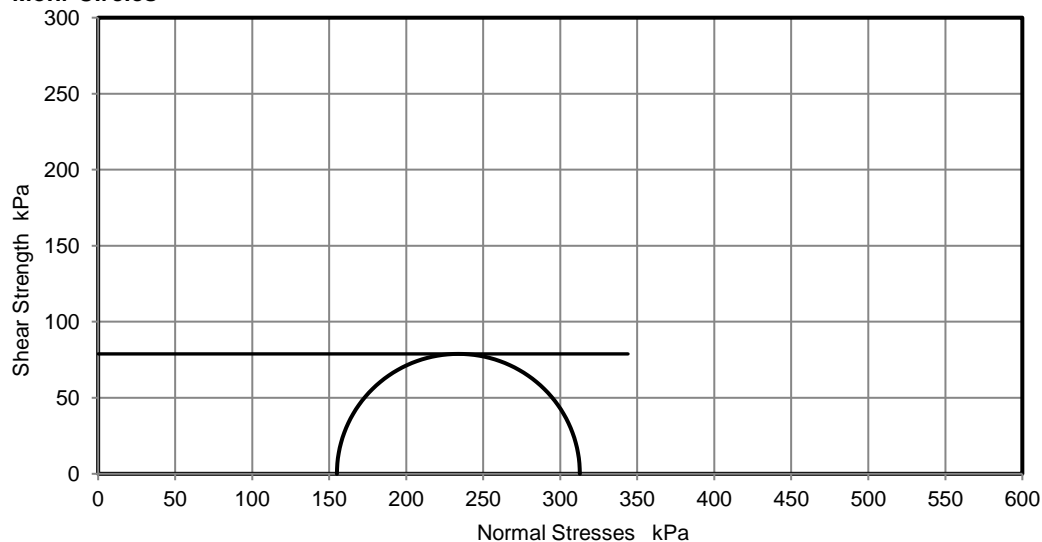
2.0	%/min
155	kPa
18.5	%
158	kPa
79	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Brittle	

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

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Lab Sheet Reference :



# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH16
Sample No.	18
Depth	2.00
Sample Type	UT
KeyLAB ID	Caus2017112016
Date of test	09/12/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey sandy slightly clayey SILT.		
Specimen Reference	2	Specimen Depth	2.30 m
Specimen Description	Very soft grey sandy slightly clayey SILT.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

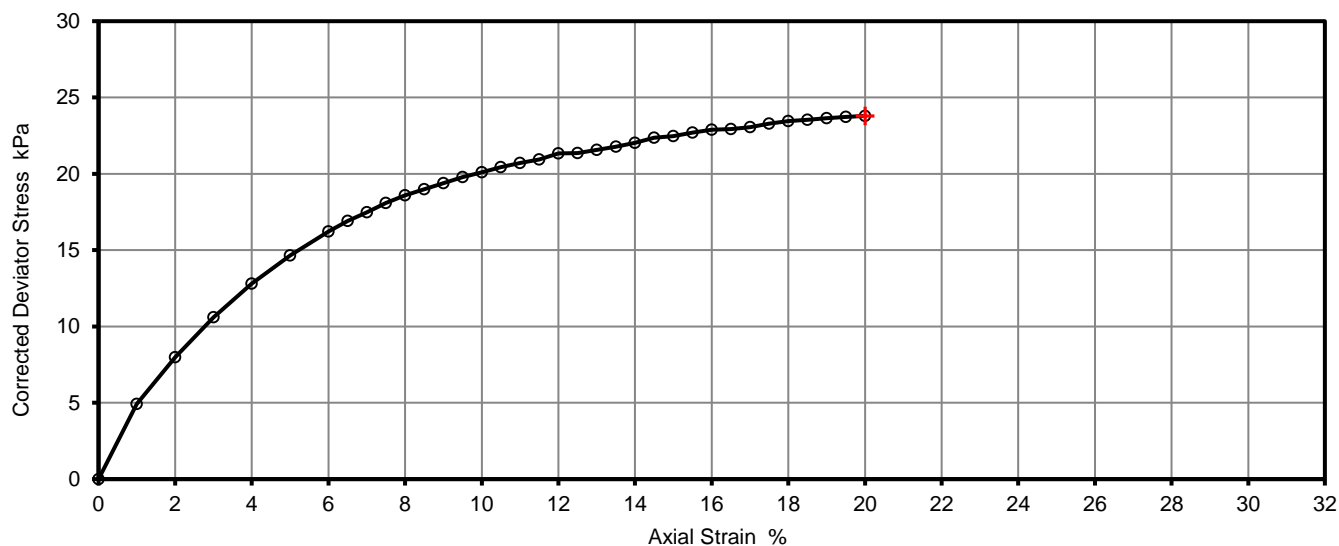
1	
200.0	mm
100.0	mm
1.35	Mg/m <sup>3</sup>
130.5	%
0.59	Mg/m <sup>3</sup>

Rate of Strain  
Cell Pressure  
At failure

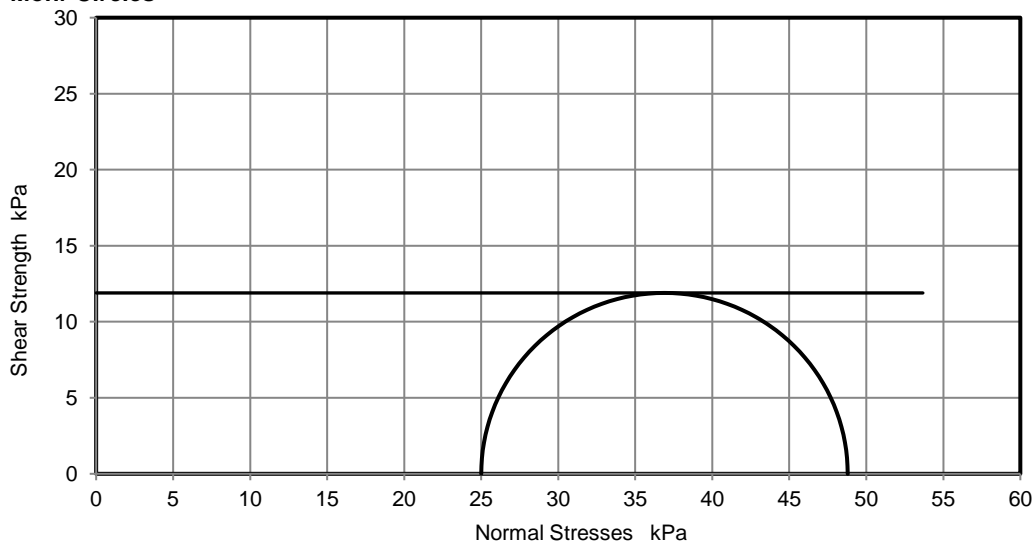
2.0	%/min
25	kPa
20.0	%
24	kPa
12	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

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Fig. No.  
1  
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# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH17
Sample No.	27
Depth	6.00
Sample Type	UT
KeyLAB ID	Caus2017112029
Date of test	09/12/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey sandy slightly gravelly clayey SILT.		
Specimen Reference	2	Specimen Depth	6.30 m
Specimen Description	Very soft to soft grey sandy slightly gravelly clayey SILT.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

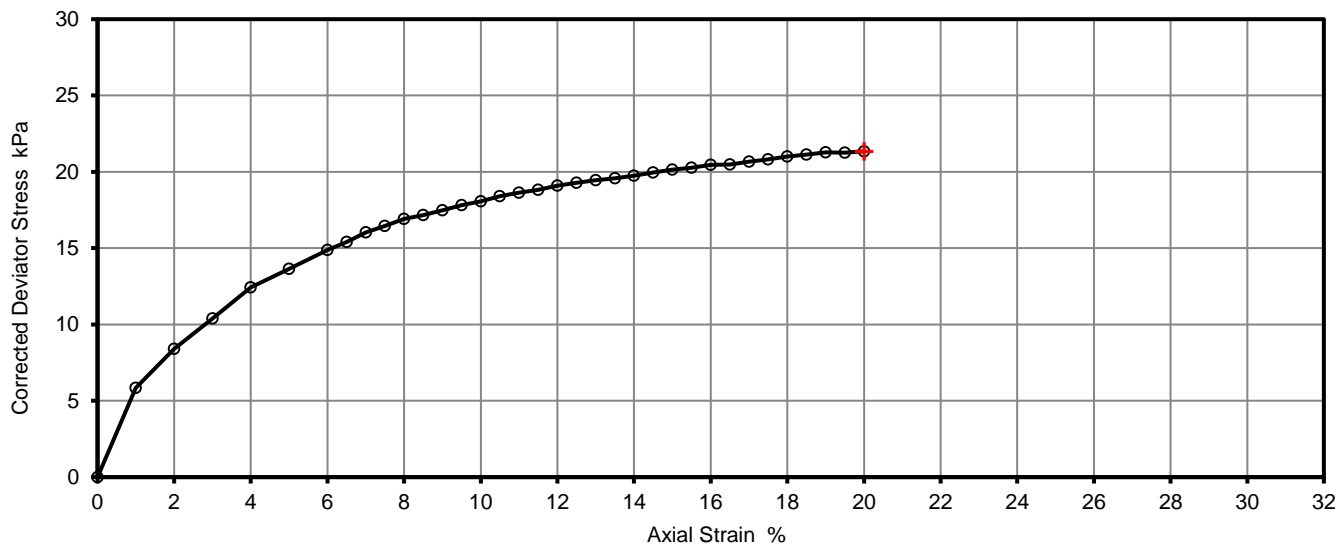
1	
200.0	mm
100.0	mm
1.57	Mg/m3
74.2	%
0.90	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

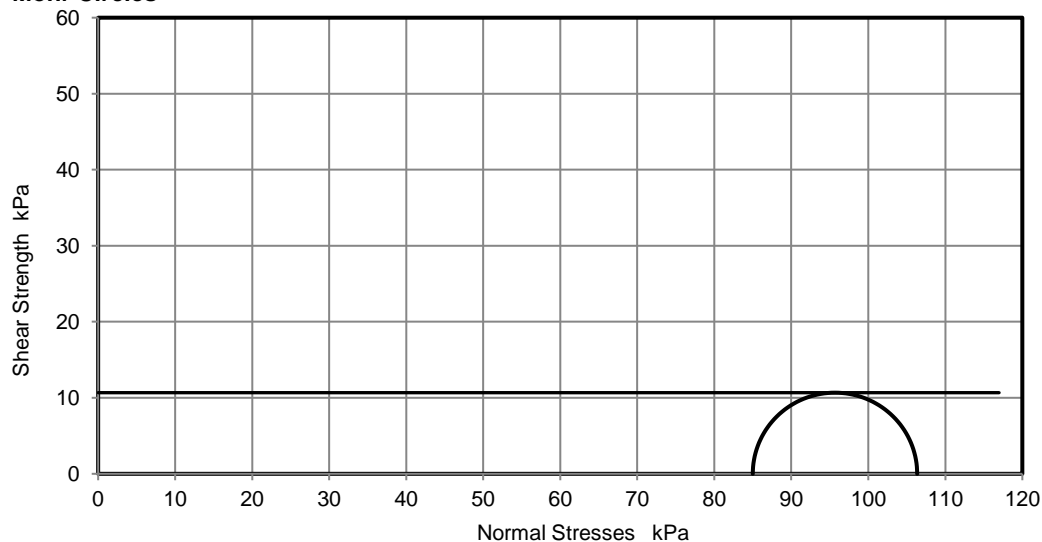
2.0	%/min
85	kPa
20.0	%
21	kPa
11	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

Stephen.Watson

## Printed

14/12/2017 18:06

Lab Sheet Reference :

Fig. No.  
1  
Sheet  
4



# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH17
Sample No.	28
Depth	8.00
Sample Type	UT
KeyLAB ID	Caus2017112033
Date of test	09/12/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey sandy slightly clayey organic SILT.		
Specimen Reference	2	Specimen Depth	8.30 m
Specimen Description	Soft grey sandy slightly clayey organic SILT.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

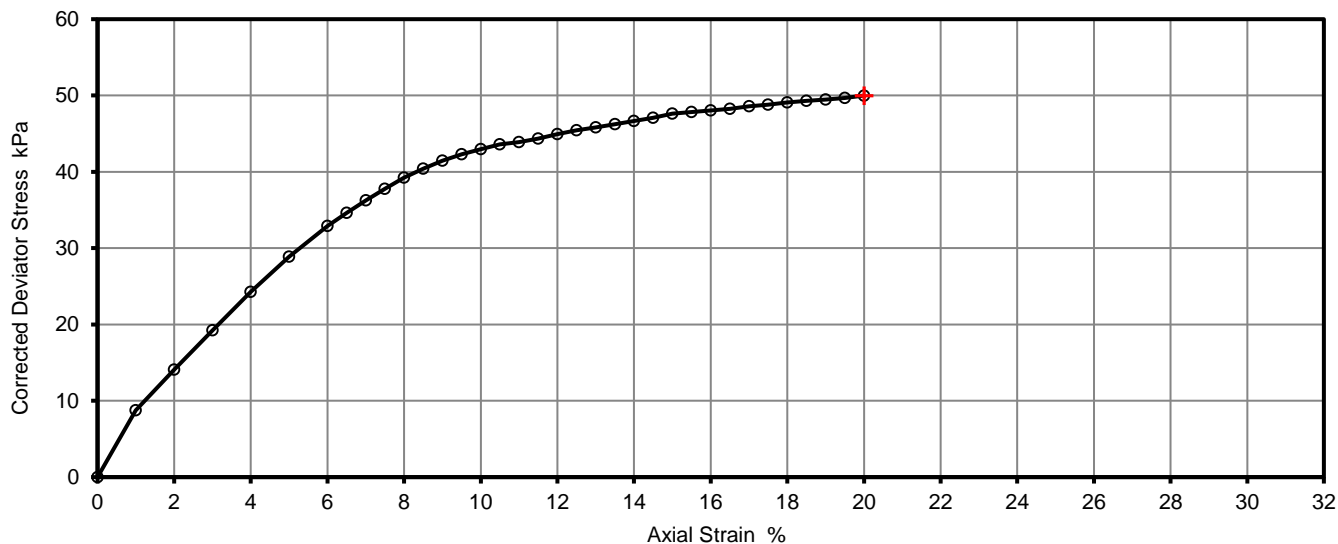
1	
200.0	mm
100.0	mm
1.31	Mg/m3
146.0	%
0.53	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

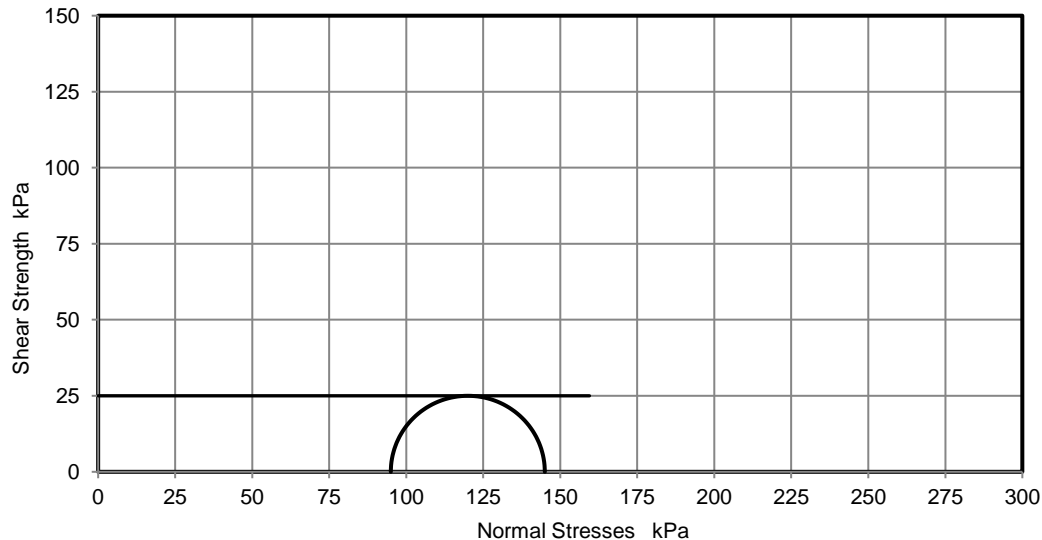
2.0	%/min
95	kPa
20.0	%
50	kPa
25	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

Stephen.Watson

## Printed

14/12/2017 18:06

Fig. No.

1

Sheet

5

Lab Sheet Reference :



# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH18
Sample No.	16
Depth	4.00
Sample Type	UT
KeyLAB ID	Caus2017112042
Date of test	11/12/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey sandy organic silty CLAY.		
Specimen Reference	2	Specimen Depth	4.30 m
Specimen Description	Soft grey sandy organic silty CLAY.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

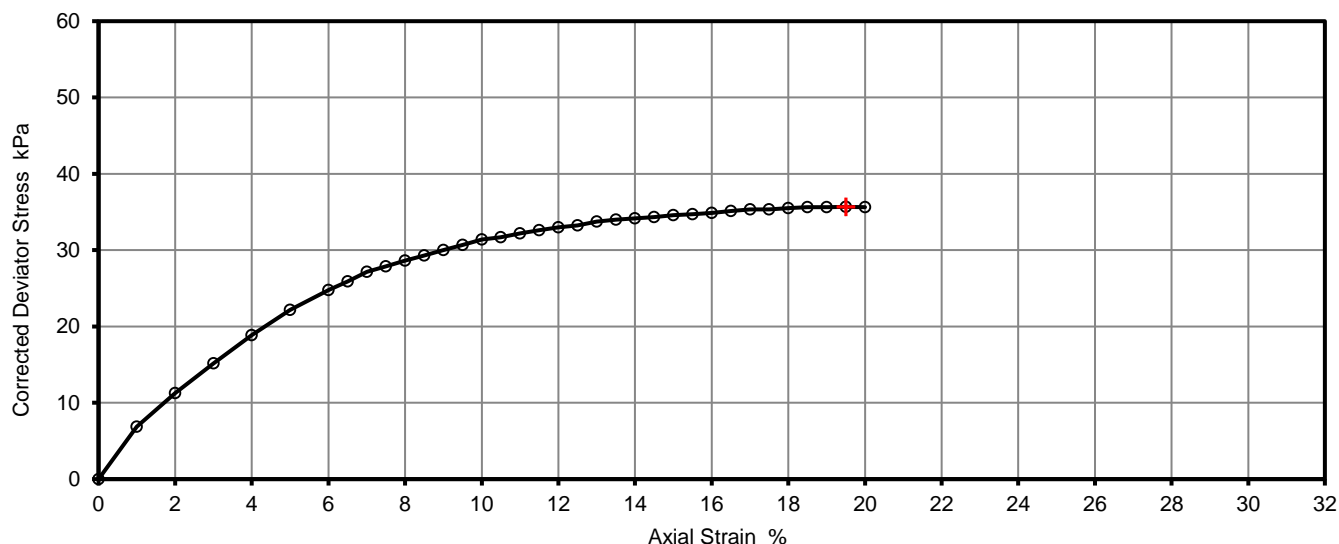
1	
200.0	mm
100.0	mm
1.33	Mg/m3
135.0	%
0.57	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

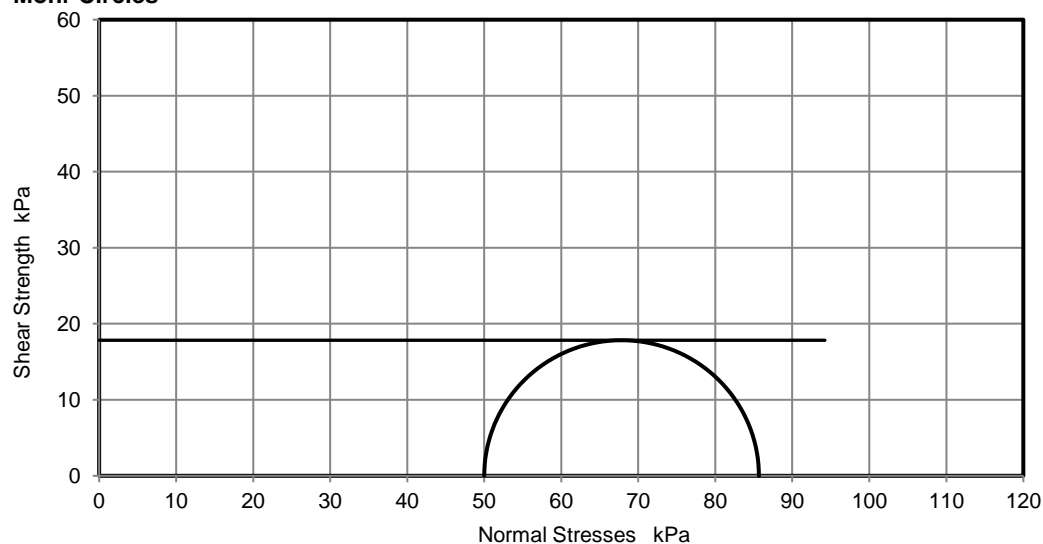
2.0	%/min
50	kPa
19.5	%
36	kPa
18	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Plastic	

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Stephen.Watson

## Printed

14/12/2017 18:06

Fig. No.

1

Sheet

6

Lab Sheet Reference :





# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH18
Sample No.	17
Depth	6.00
Sample Type	UT
KeyLAB ID	Caus2017112045
Date of test	11/12/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Grey sandy silty organic CLAY.		
Specimen Reference	2	Specimen Depth	6.30 m
Specimen Description	Very soft grey sandy silty organic CLAY.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

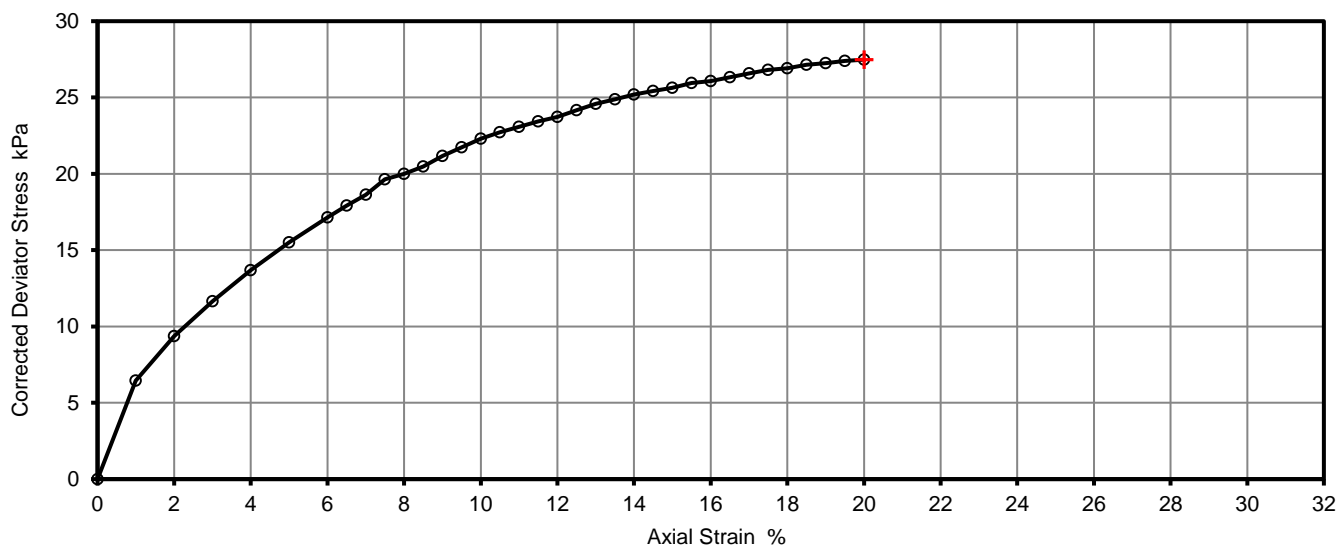
1	
200.0	mm
100.0	mm
1.67	Mg/m3
58.7	%
1.05	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

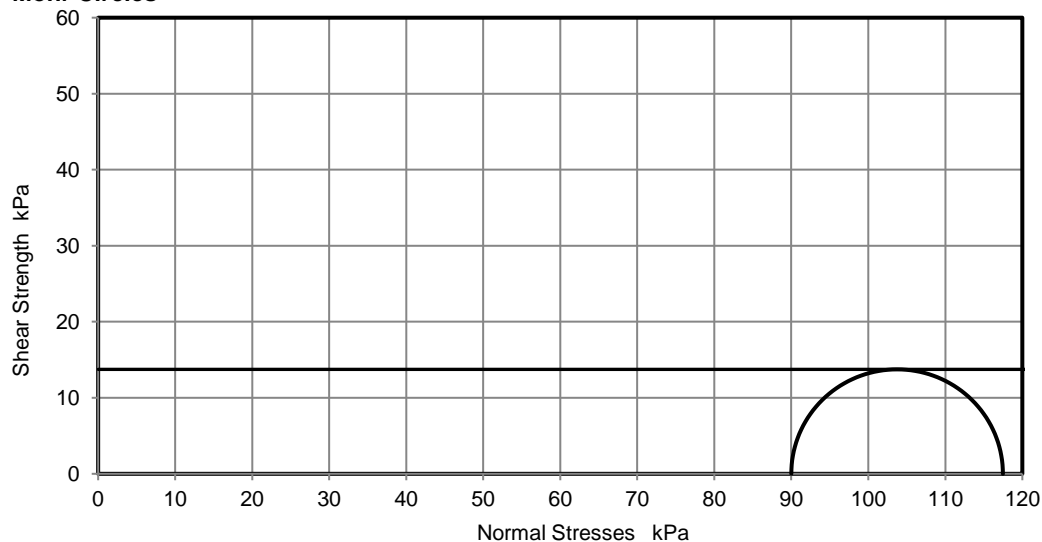
2.0	%/min
90	kPa
20.0	%
27	kPa
14	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

Stephen.Watson

## Printed

14/12/2017 18:07

Lab Sheet Reference :

Fig. No.

1

Sheet

7



# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH19
Sample No.	13
Depth	2.00
Sample Type	UT
KeyLAB ID	Caus2017112052
Date of test	11/12/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Greyish brown sandy organic silty CLAY.		
Specimen Reference	2	Specimen Depth	2.30 m
Specimen Description	Very soft greyish brown sandy organic silty CLAY.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

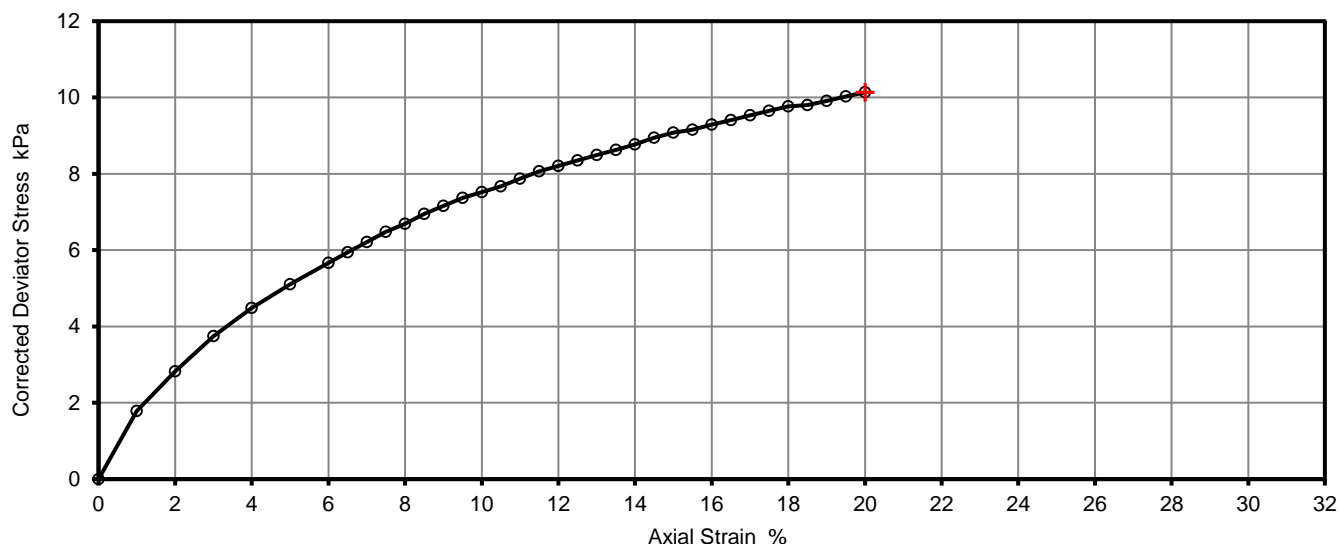
1	
200.0	mm
100.0	mm
1.45	Mg/m3
104.2	%
0.71	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

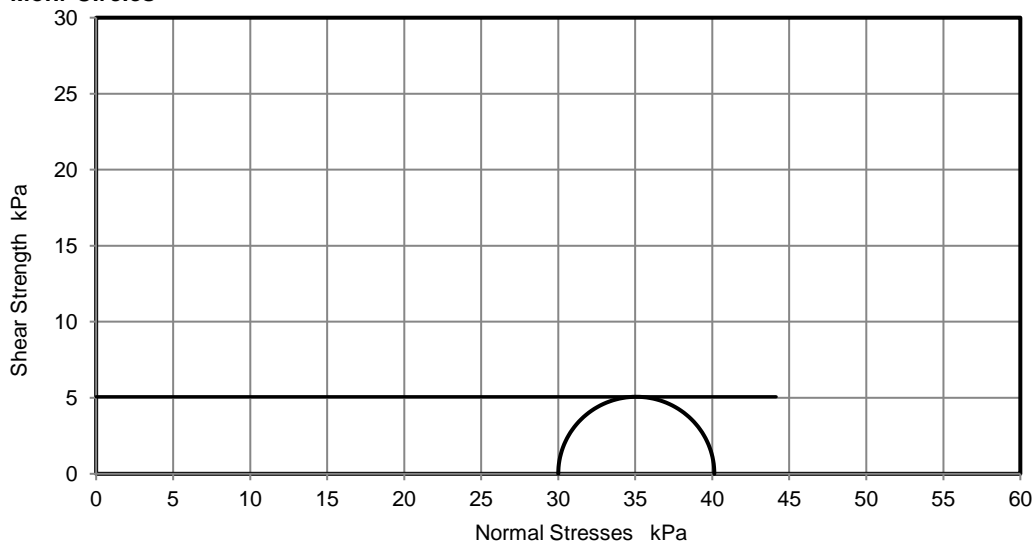
2.0	%/min
30	kPa
20.0	%
10	kPa
5	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

Stephen.Watson

## Printed

14/12/2017 18:07

Lab Sheet Reference :

Fig. No.

1

Sheet

8



# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref	17-0167
Borehole/Pit No.	BH19
Sample No.	14
Depth	4.00
Sample Type	UT
KeyLAB ID	Caus2017112057
Date of test	11/12/2017

Site Name	Arklow Sewerage Scheme Marine Outfall GI		
Soil Description	Greyish brown sandy organic clayey SILT.		
Specimen Reference	2	Specimen Depth	4.30 m
Specimen Description	Very soft greyish brown sandy organic clayey SILT.		
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen		

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

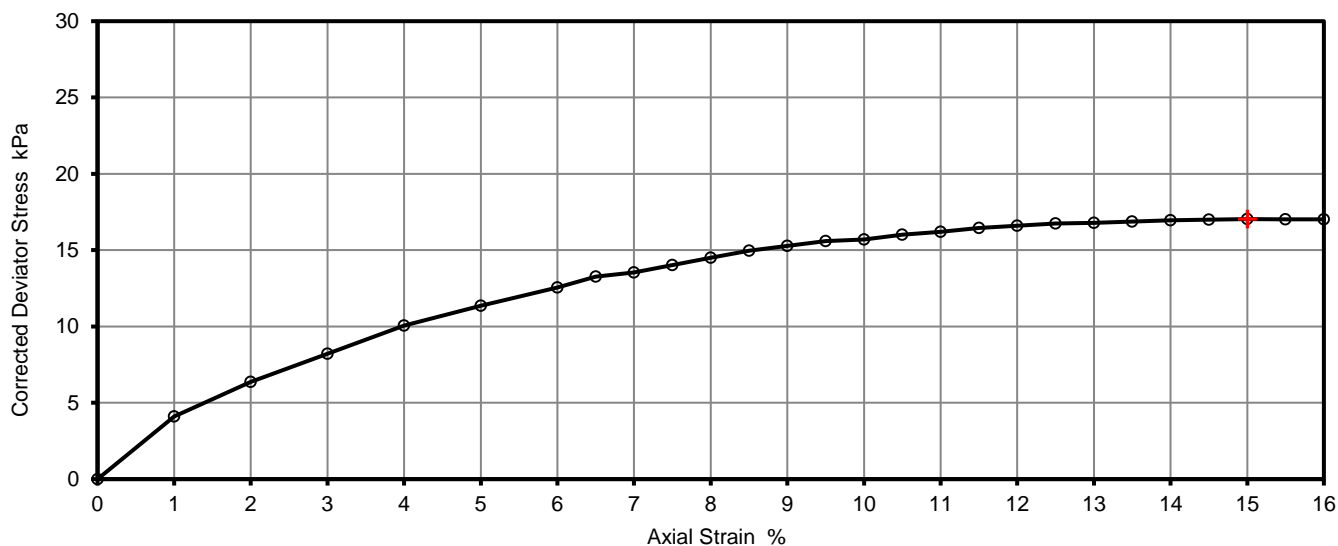
1	
200.0	mm
100.0	mm
1.23	Mg/m3
210.5	%
0.40	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

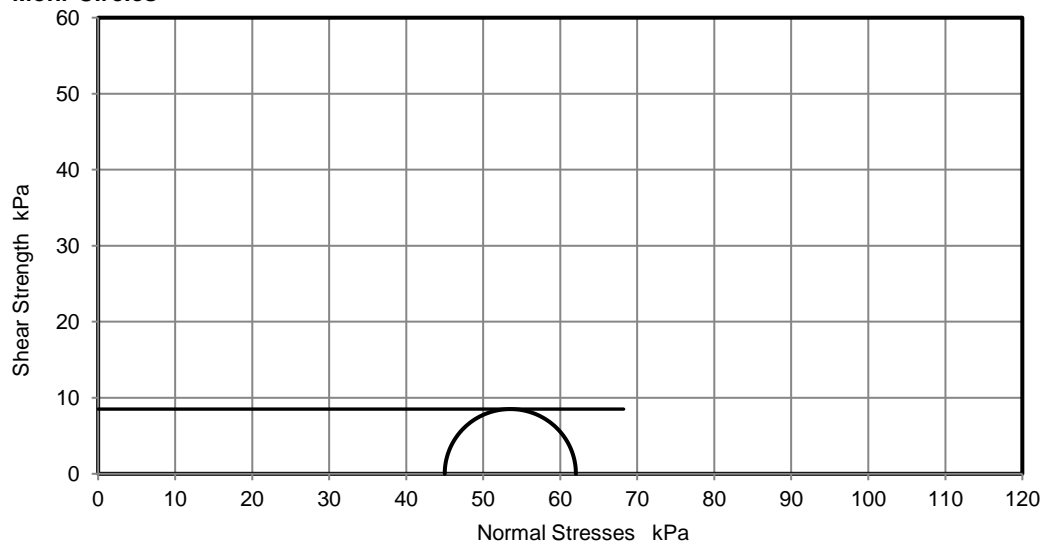
2.0	%/min
45	kPa
15.0	%
17	kPa
9	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Plastic	

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Stephen.Watson

## Printed

14/12/2017 18:07

Fig. No.

1

Sheet

9

Lab Sheet Reference :



2183

# 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.:**


**Order No.:**

**No. of Samples:** 14

**Turnaround (Wkdays):** 3

**Date Approved:** 12-Dec-2017

**Approved By:**



**Details:** Robert Monk, Technical Manager

**Date Received:** 08-Dec-2017

**Date Instructed:** 08-Dec-2017

**Results Due:** 12-Dec-2017

## Results - Soil

**Project: 17-0167 Arklow Sewerage Scheme Marina Outfall GI**

<b>Client: Causeway Geotech Ltd</b>	<b>Chemtest Job No.:</b>				17-32875	17-32875	17-32875	17-32875	17-32875	17-32875	17-32875	17-32875	17-32875
Quotation No.:	<b>Chemtest Sample ID.:</b>				552101	552102	552103	552104	552105	552106	552107	552108	552109
Order No.:	Client Location ID.:				1	5	9	20	23	26	30	1	4
	Client Sample Ref.:				BH11	BH11	BH11	BH16	BH16	BH16	BH16	BH17	BH17
	Sample Type:				SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL	SOIL
	Top Depth (m):				0.50	4.50	8.50	0.50	3.50	6.50	10.50	0.50	3.50
	Date Sampled:				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
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>									
Moisture	N	2030	%	0.020	4.2	1.7	22	4.8	59	3.4	19	5.4	4.3
pH	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**

<b>Client: Causeway Geotech Ltd</b>	<b>Chemtest Job No.:</b>				17-32875	17-32875	17-32875	17-32875	17-32875
Quotation No.:	<b>Chemtest Sample ID.:</b>				552110	552111	552112	552113	552114
Order No.:	Client Location 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
<b>Determinand</b>	<b>Accred.</b>	<b>SOP</b>	<b>Units</b>	<b>LOD</b>					
Moisture	N	2030	%	0.020	60	12	17	2.4	64
pH	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](mailto: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  
(Director)

A Watkins  
(Director)

R Berriman  
(Quality Manager)

L Knight  
(Senior Technician)

  
S Eyre  
(Senior Technician)

A Fry  
(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	B	1.80	2.20	Brown very gravelly SAND.
BH11	22	B	3.80	4.20	Brown sandy GRAVEL.
BH11	28	B	9.80	10.20	Brown sandy slightly silty GRAVEL.
BH16	13	B	6.80	7.20	Grey sandy slightly silty GRAVEL.
BH16	14	B	8.80	9.20	Brown slightly gravelly slightly silty SAND.
BH16	16	B	10.80	11.20	Brown very sandy slightly silty GRAVEL.
BH17	16	B	1.80	2.20	Brown gravelly SAND.
BH17	18	B	3.80	4.20	Brown sandy GRAVEL.
BH17	25	B	10.80	11.20	Grey gravelly SAND.
BH18	1	B	0.80	2.20	Dark grey sandy slightly silty GRAVEL.
BH18	7	B	9.80	10.20	Grey gravelly SAND.
BH19	1	B	0.80	1.20	Brown slightly sandy slightly silty GRAVEL.



Arklow Sewerage Scheme Marine Outfall GI

Contract No:

PSL17/5705

Client Ref:

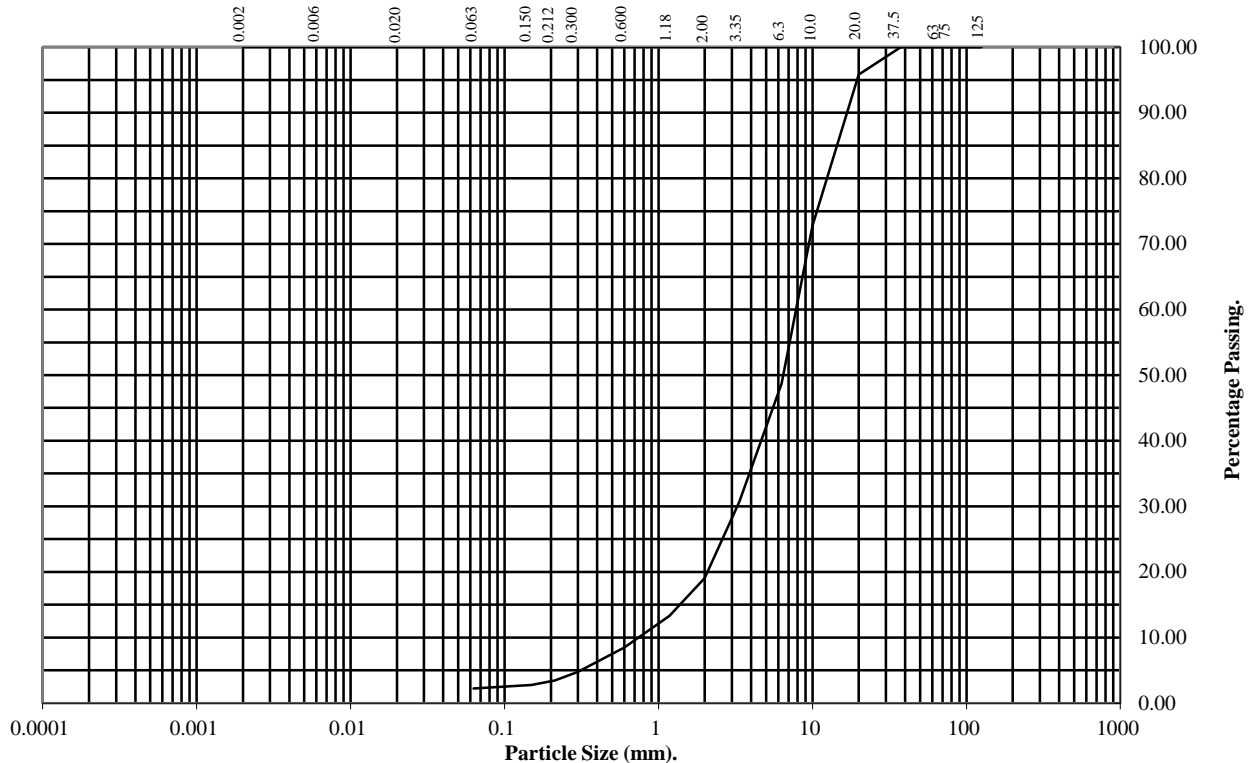
17-0167

# 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 Sieve (mm)	Percentage 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 Fraction	Total Percentage
Cobbles	0
Gravel	81
Sand	17
Silt/Clay	2

## Remarks:

See Summary of Soil Descriptions



**PSL**  
Professional Soils Laboratory

Arklow Sewerage Scheme Marine Outfall GI

Contract No:  
PSL17/5705  
Client Ref:  
17-0167

# PARTICLE SIZE DISTRIBUTION TEST

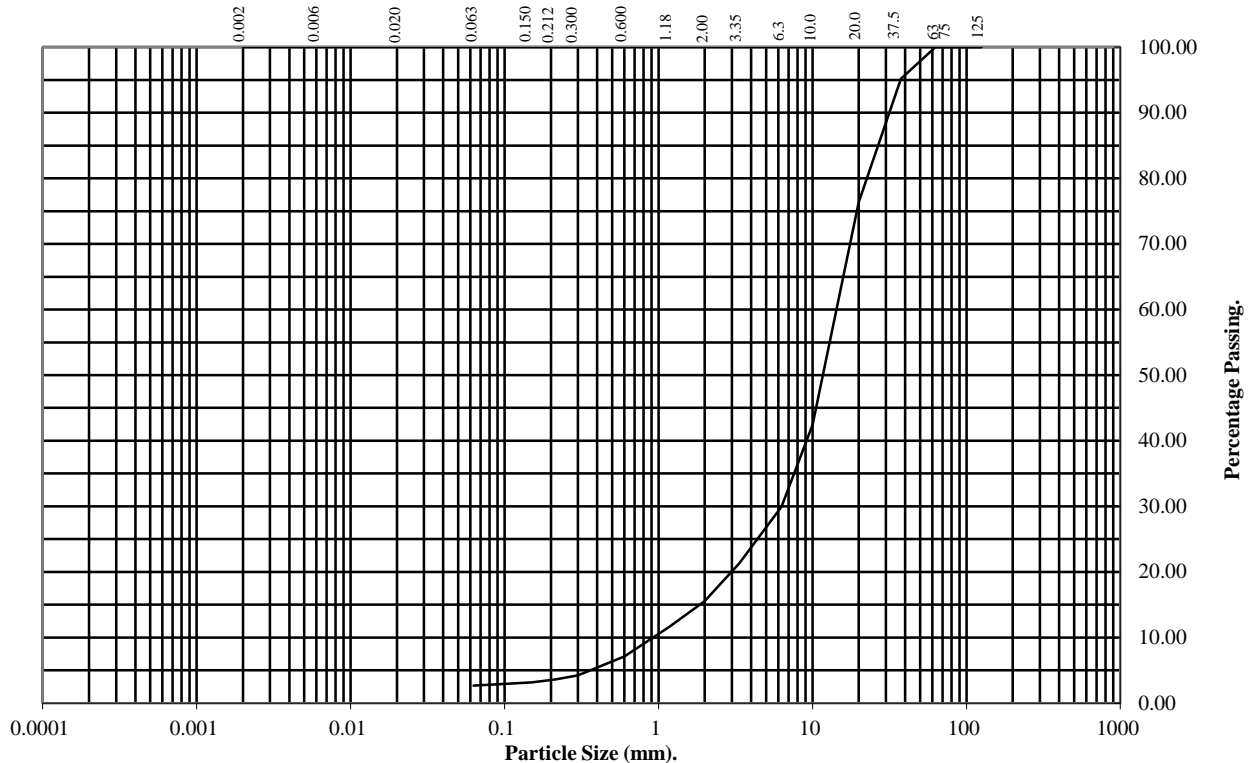
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: BH16 Top Depth (m): 6.80

Sample Number: 13 Base Depth(m): 7.20

Sample Type: B



BS Test Sieve (mm)	Percentage 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 Fraction	Total Percentage
Cobbles	0
Gravel	84
Sand	13
Silt/Clay	3

## Remarks:

See Summary of Soil Descriptions



**PSL**  
Professional Soils Laboratory

Arklow Sewerage Scheme Marine Outfall GI

Contract No:

PSL17/5705

Client Ref:

17-0167

# PARTICLE SIZE DISTRIBUTION TEST

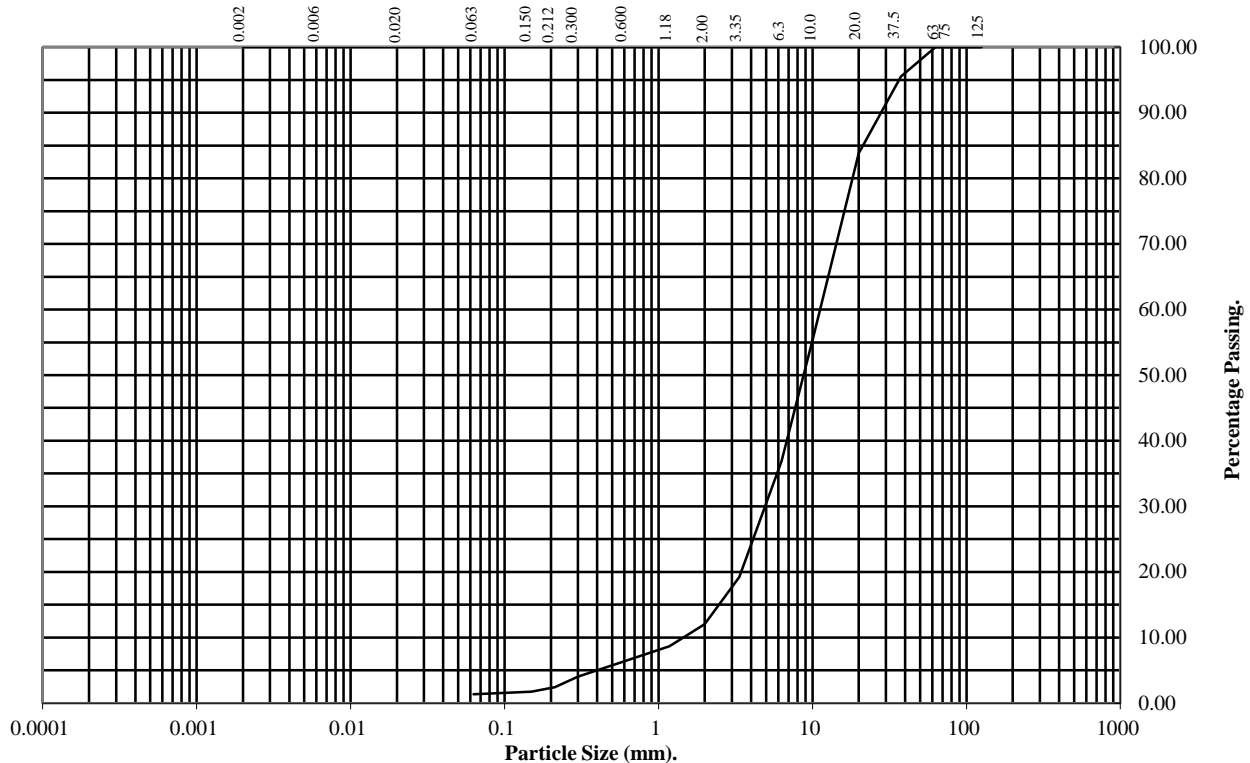
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: BH18 Top Depth (m): 0.80

Sample Number: 1 Base Depth(m): 2.20

Sample Type: B



BS Test Sieve (mm)	Percentage 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 Fraction	Total Percentage
Cobbles	0
Gravel	88
Sand	11
Silt/Clay	1

## Remarks:

See Summary of Soil Descriptions



**PSL**  
Professional Soils Laboratory

Arklow Sewerage Scheme Marine Outfall GI

Contract No:  
**PSL17/5705**  
Client Ref:  
**17-0167**

# PARTICLE SIZE DISTRIBUTION TEST

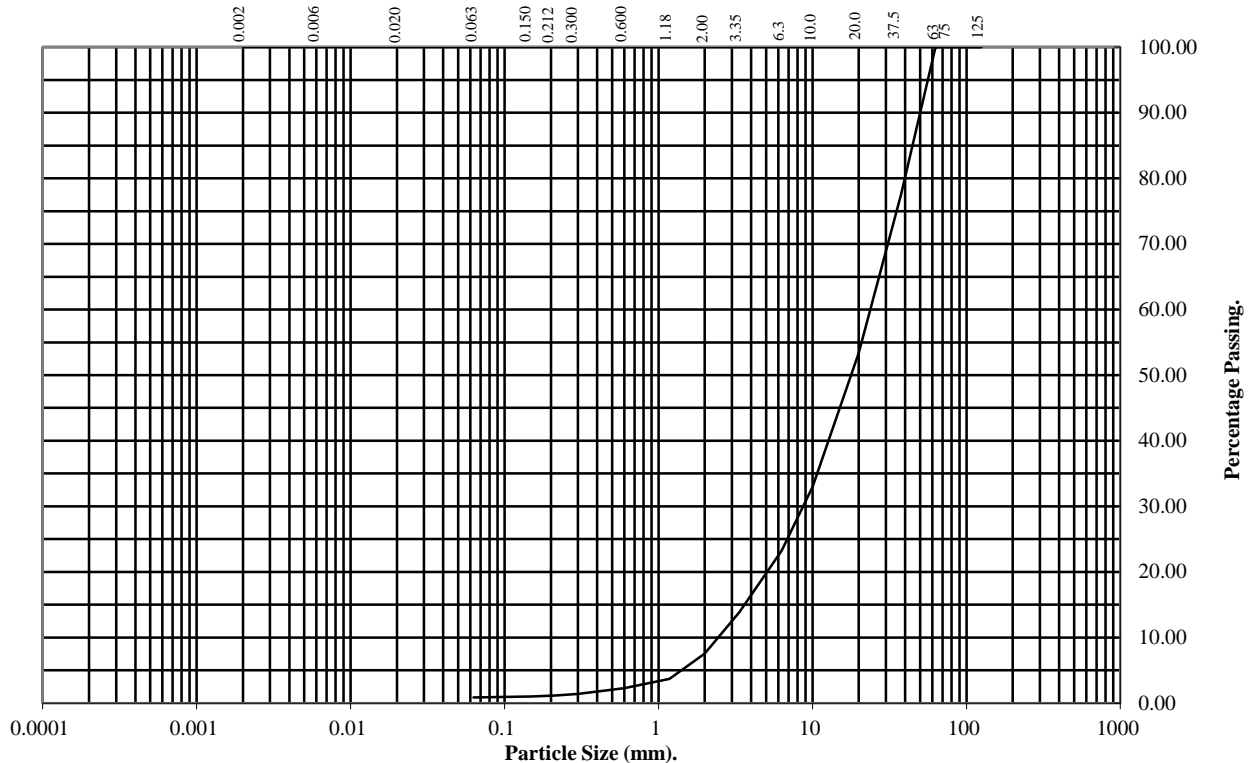
BS1377 : Part 2 : 1990

Wet Sieve, Clause 9.2

Hole Number: BH19 Top Depth (m): 0.80

Sample Number: 1 Base Depth(m): 1.20

Sample Type: B



BS Test Sieve (mm)	Percentage 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 Fraction	Total Percentage
Cobbles	0
Gravel	92
Sand	7
Silt/Clay	1

## Remarks:

See Summary of Soil Descriptions



**PSL**  
Professional Soils Laboratory

Arklow Sewerage Scheme Marine Outfall GI

Contract No:

PSL17/5705

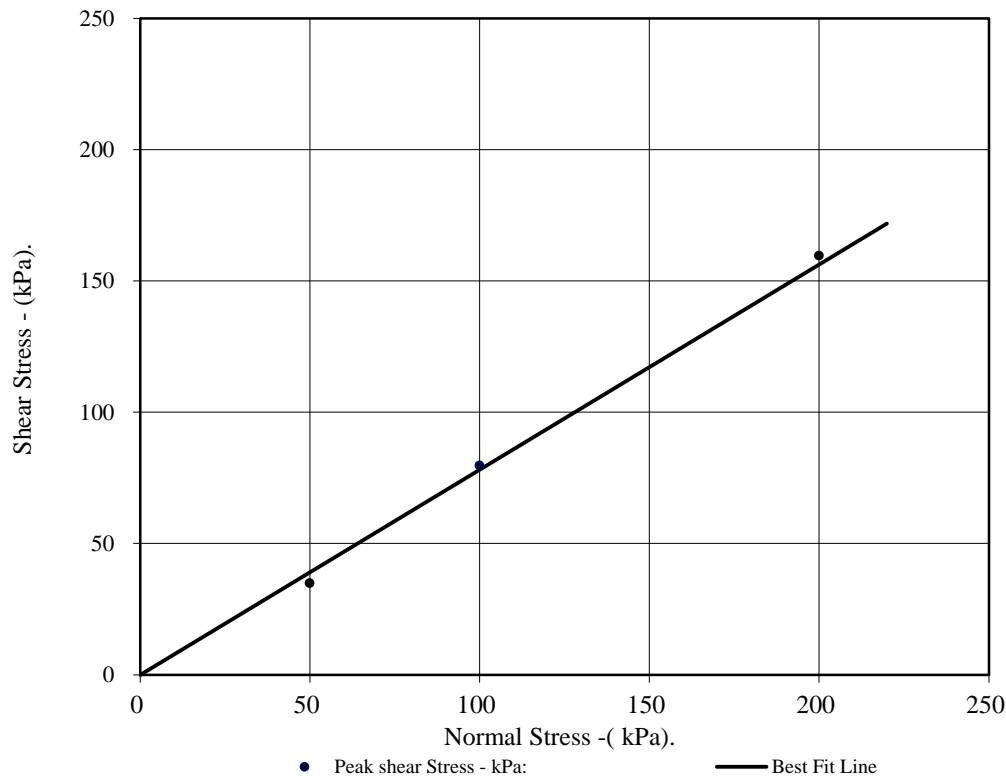
Client Ref:

17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

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	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress - mm			5.00	6.00	10.00
Peak shear Stress - kPa:			35	80	160
Final Consolidated Conditions					
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 Resistance:( $\theta$ )			38		
Effective Cohesion - kPa:			0		



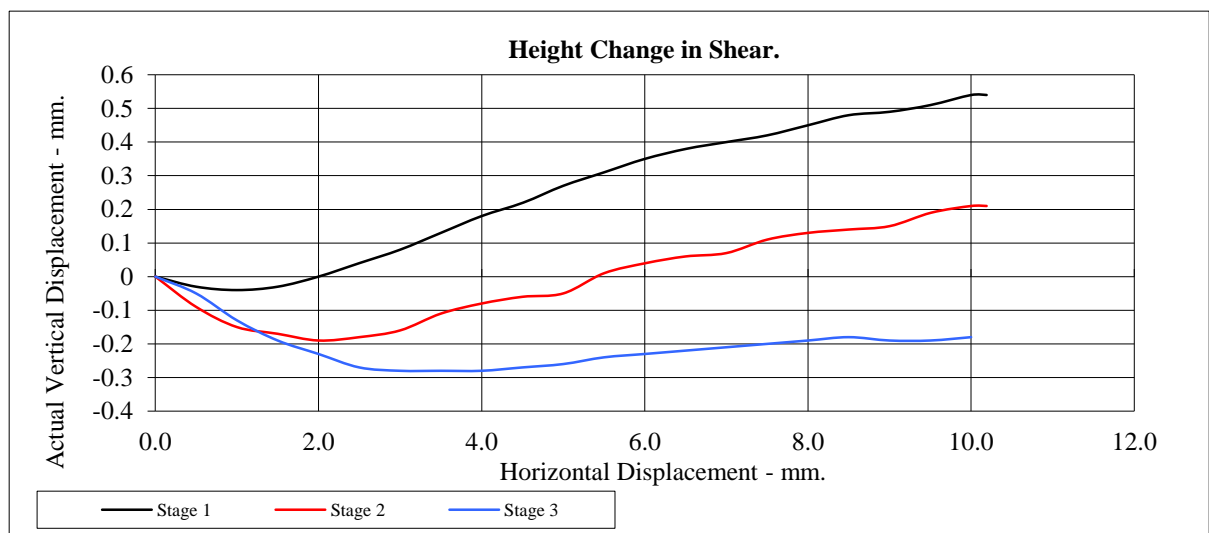
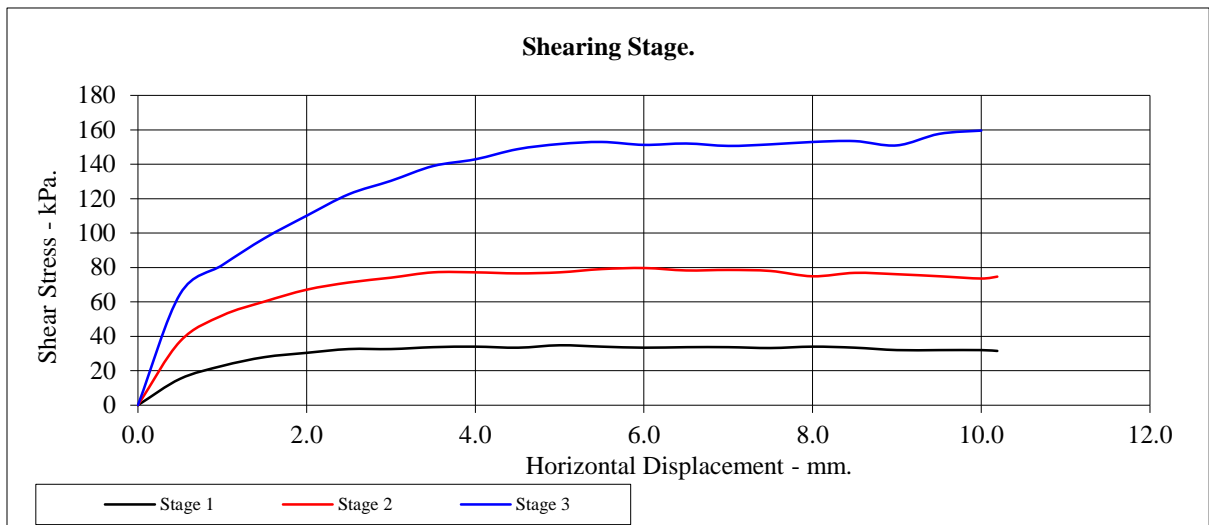
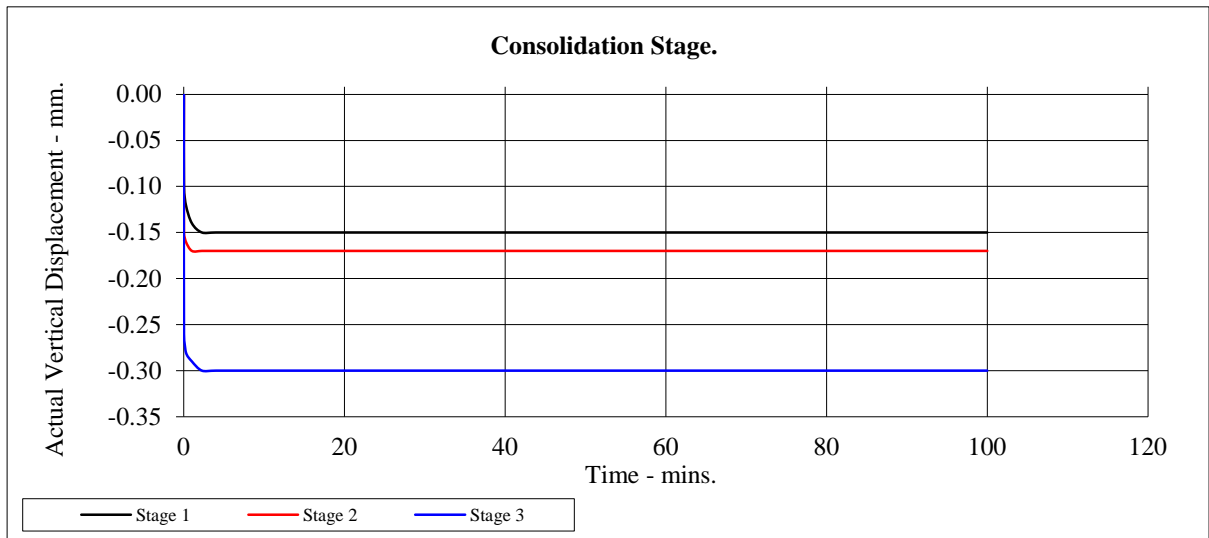
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5705
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

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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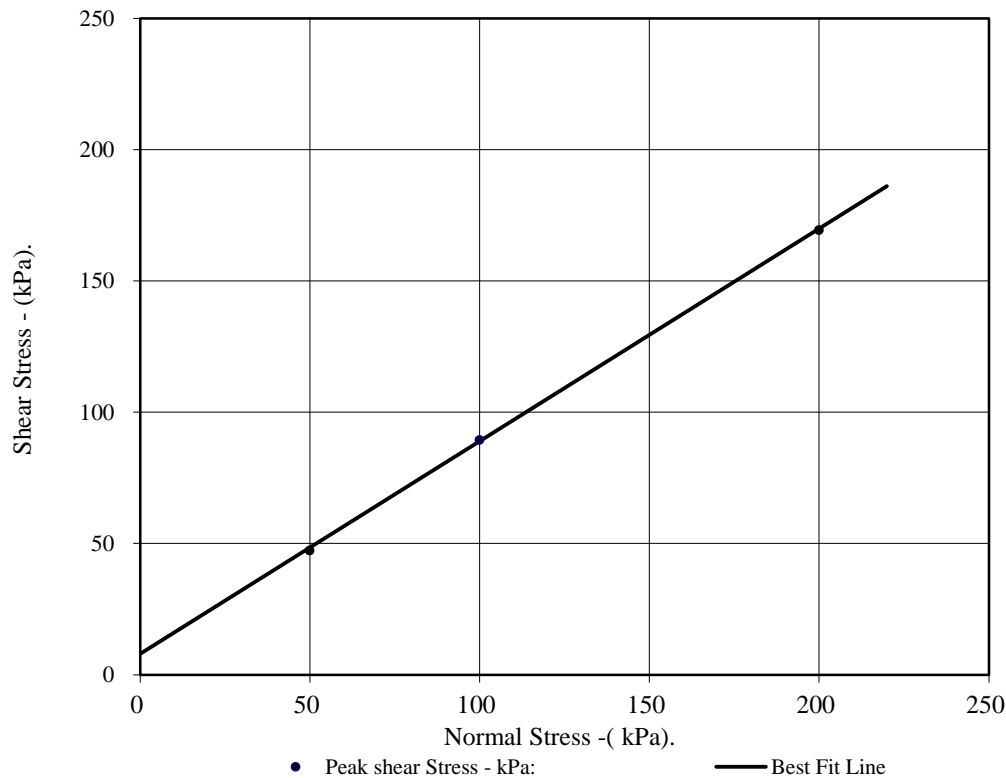
Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**  
PSL17/5705  
**Client Ref:**  
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH11		Top Depth:	3.80	
Sample Number:	22		Base Depth:	4.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress (mm)			5.00	6.00	5.00
Peak shear Stress - kPa:			47	89	169
Final Consolidated Conditions					
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
Peak					
Angle of Shearing Resistance:( $\theta$ )			39		
Effective Cohesion - kPa:			8		



Arklow Sewerage Scheme Marine Outfall GI

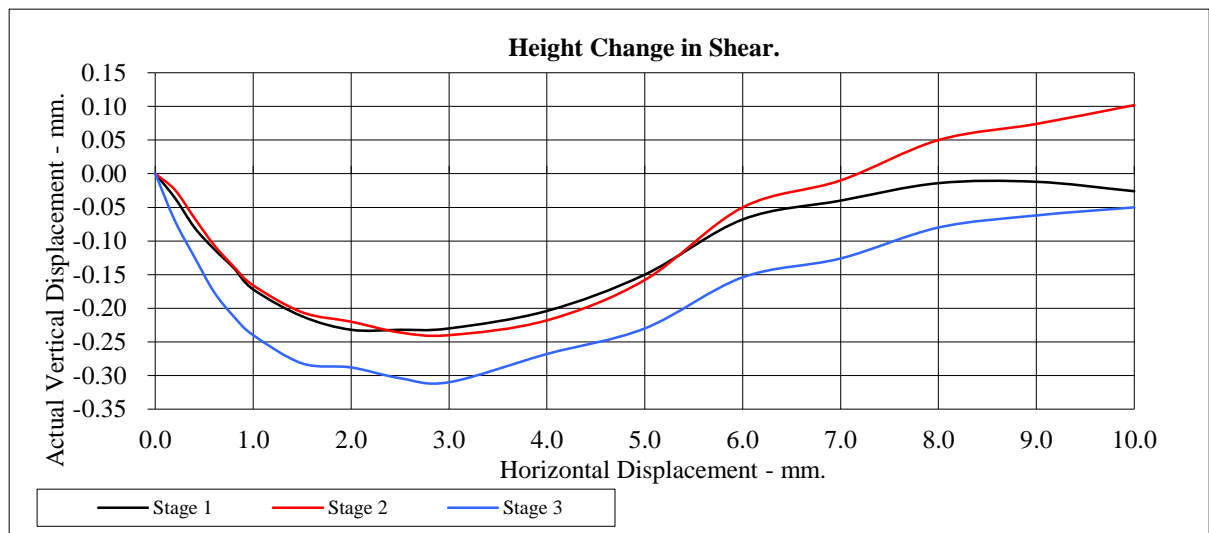
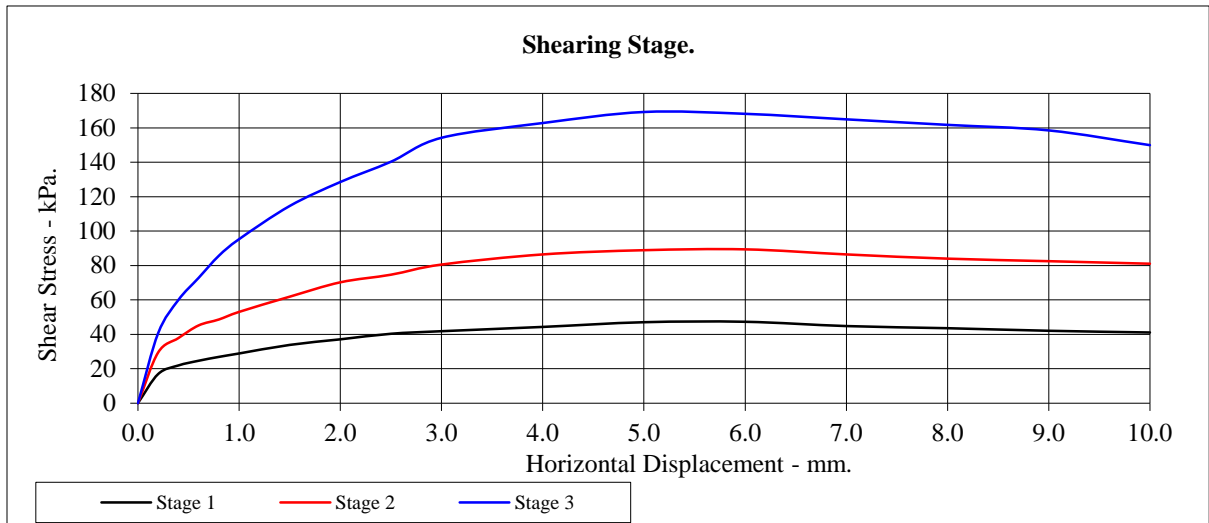
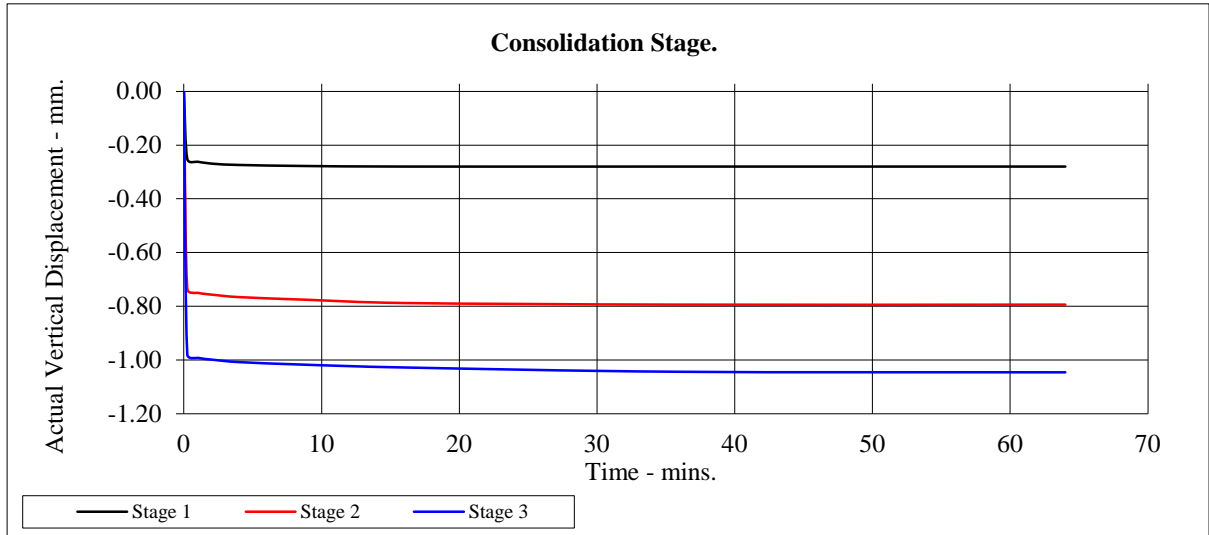
Contract No:
PSL17/5705
Client Ref:
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# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH11	Top Depth:	3.80
Sample Number:	22	Base Depth:	4.20



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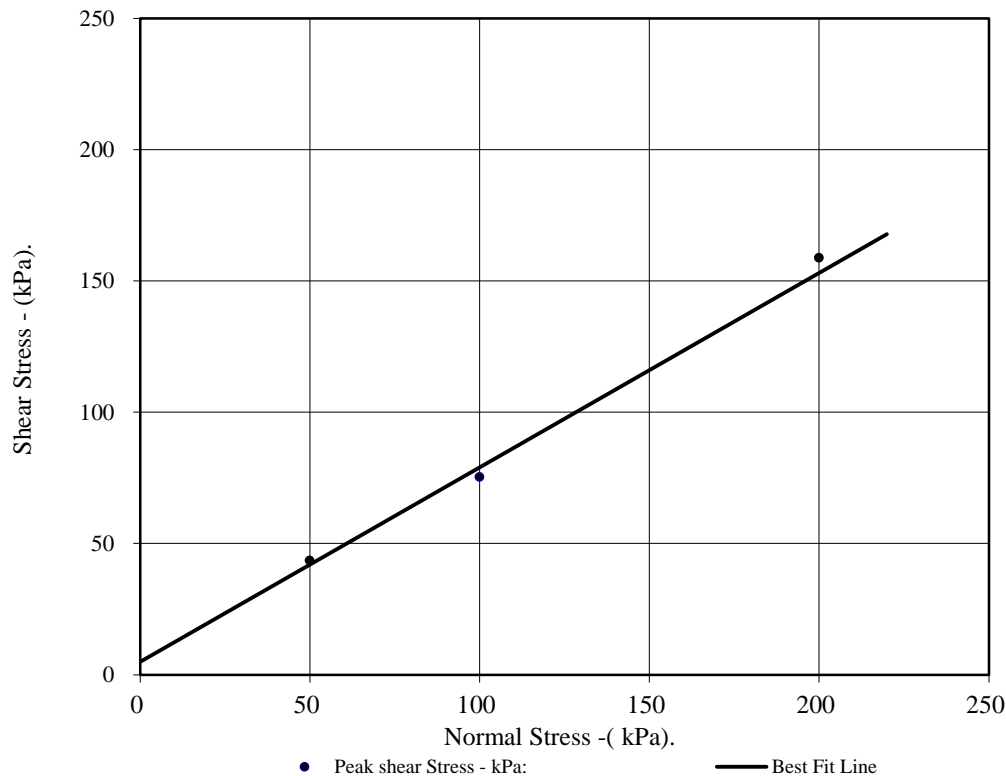
Arklow Sewerage Scheme Marine Outfall GI

<b>Contract No:</b>
<b>PSL17/5705</b>
<b>Client Ref:</b>
<b>17-0167</b>

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH11		Top Depth:	9.80	
Sample Number:	28		Base Depth:	10.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress - mm			0.00	0.00	0.00
Peak shear Stress - kPa:			44	75	159
Final Consolidated Conditions					
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:( $\theta$ )			37		
Effective Cohesion - kPa:			5		



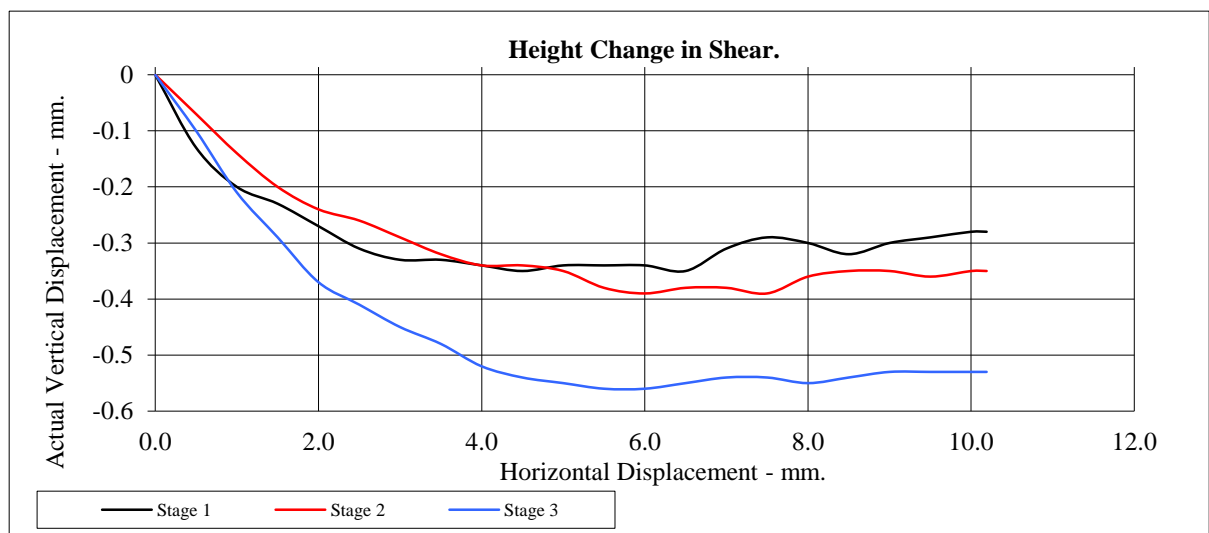
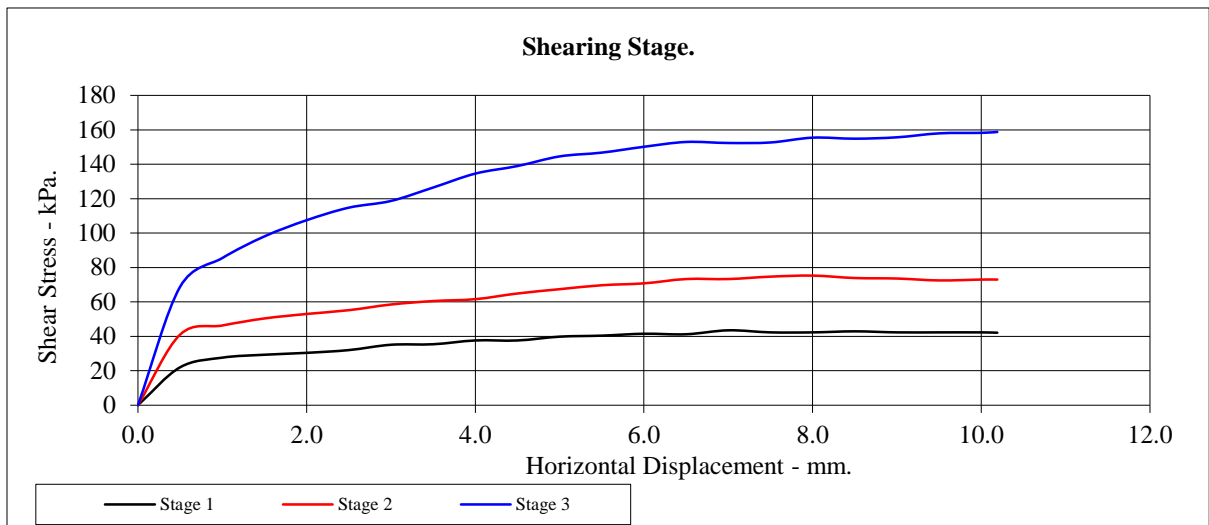
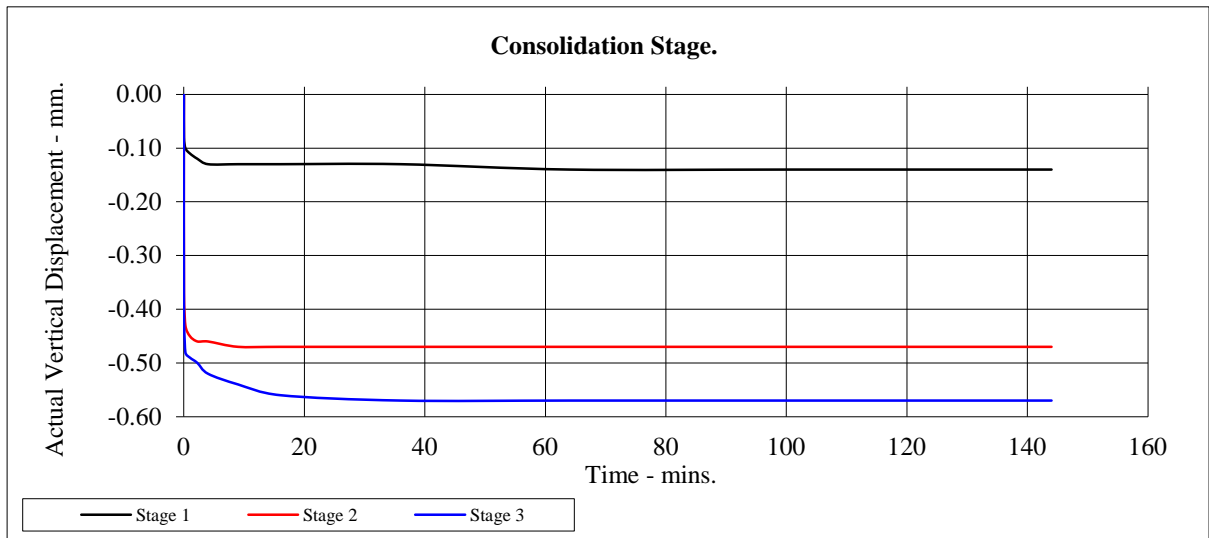
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5705
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

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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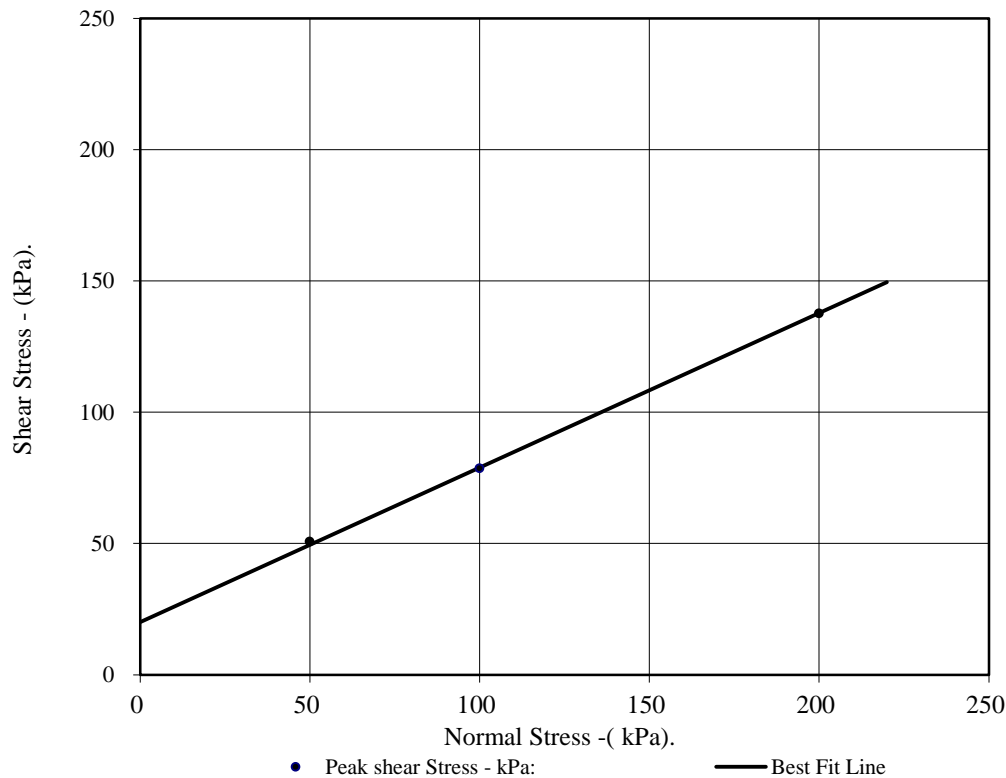
Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**  
**PSL17/5705**  
**Client Ref:**  
**17-0167**

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16		Top Depth:	6.80	
Sample Number:	13		Base Depth:	7.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress (mm)			3.00	8.00	5.00
Peak shear Stress - kPa:			51	79	138
Final Consolidated Conditions					
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:( $\theta$ )			31		
Effective Cohesion - kPa:			20		



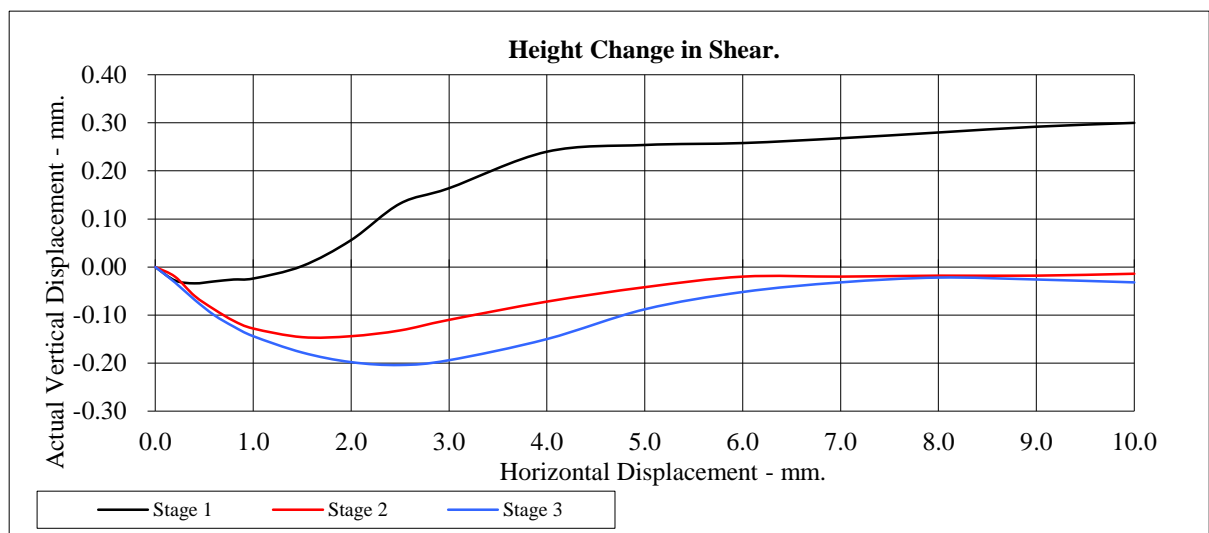
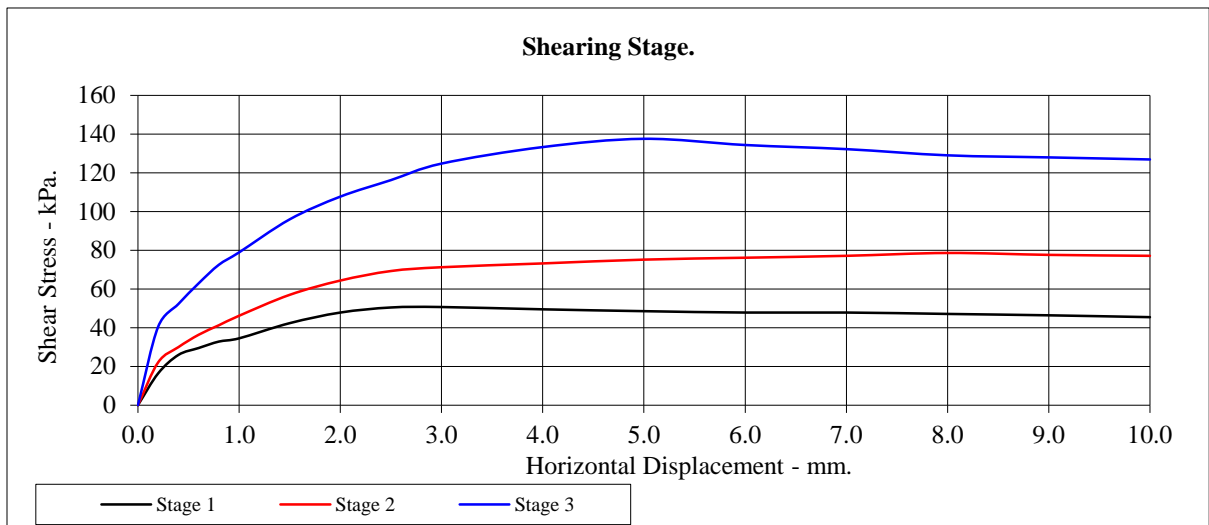
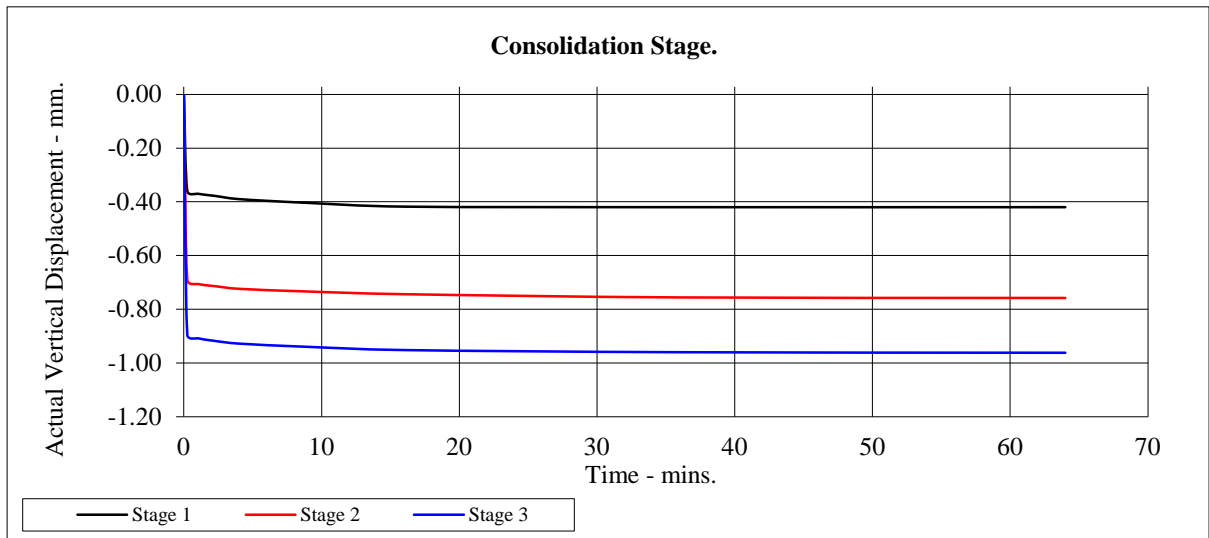
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Contract No:
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# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16	Top Depth:	6.80
Sample Number:	13	Base Depth:	7.20



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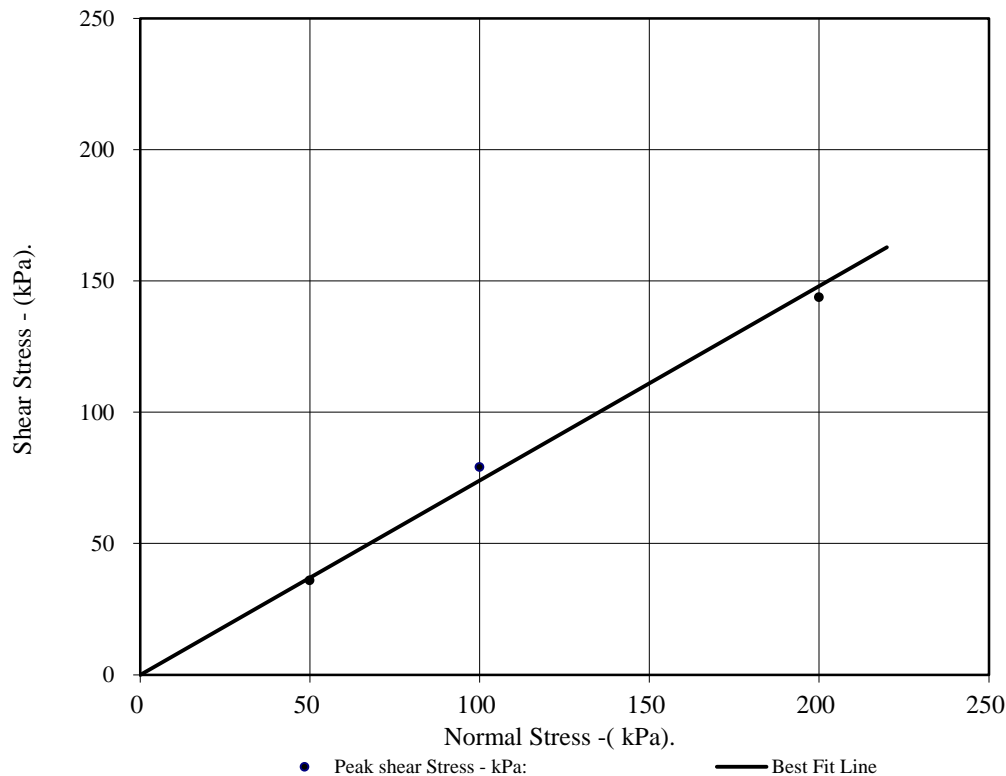
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**Contract No:**  
**PSL17/5705**  
**Client Ref:**  
**17-0167**

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16		Top Depth:	8.80	
Sample Number:	14		Base Depth:	9.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress - mm			2.00	3.00	3.50
Peak shear Stress - kPa:			36	79	144
Final Consolidated Conditions					
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:( $\theta$ )			37		
Effective Cohesion - kPa:			0		



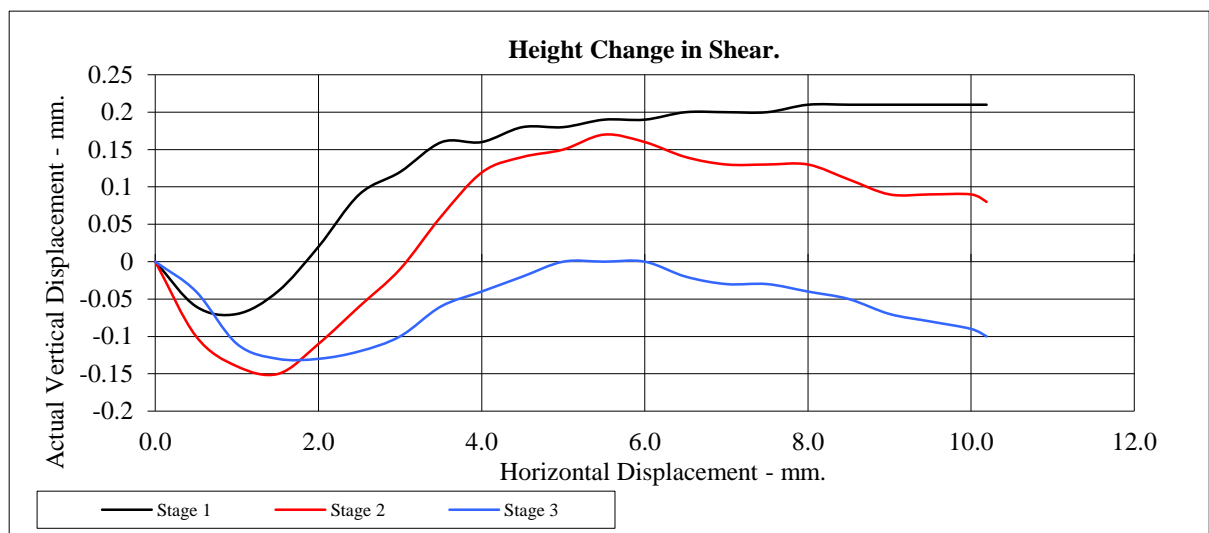
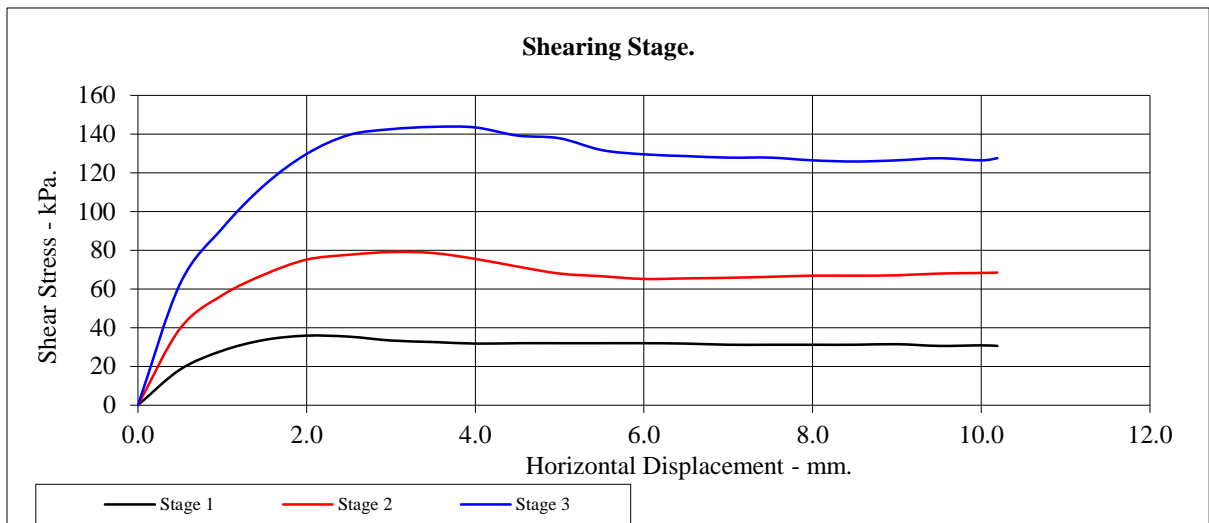
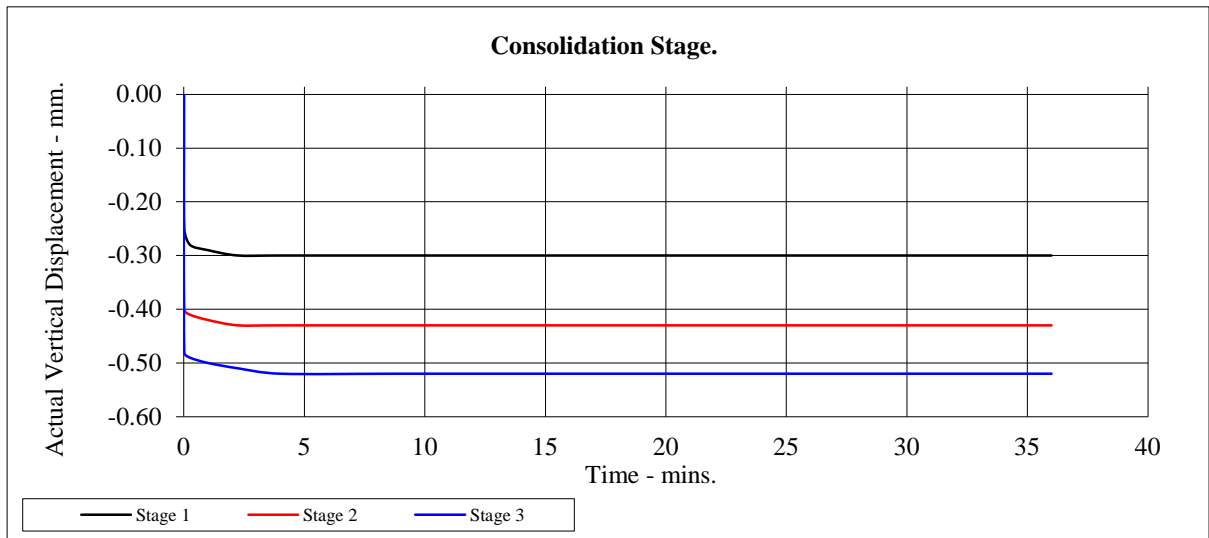
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Contract No:
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17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16	Top Depth:	8.80
Sample Number:	14	Base Depth:	9.20



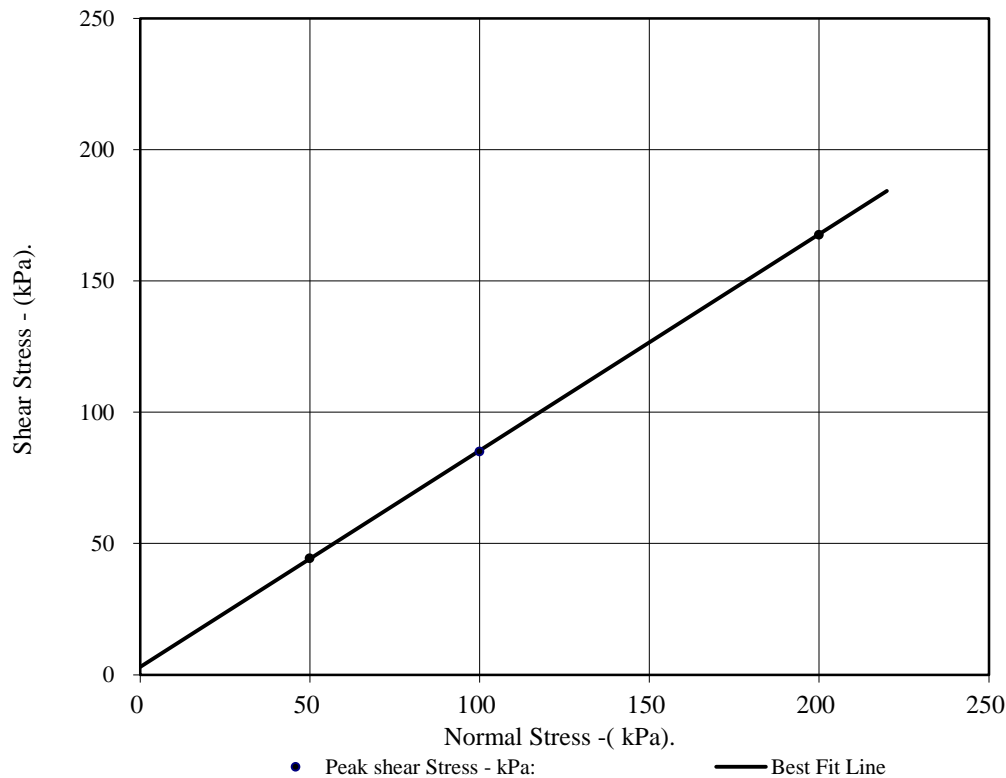
Arklow Sewerage Scheme Marine Outfall GI

<b>Contract No:</b>
<b>PSL17/5705</b>
<b>Client Ref:</b>
<b>17-0167</b>

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16		Top Depth:	10.80	
Sample Number:	16		Base Depth:	11.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress (mm)			3.00	3.00	4.00
Peak shear Stress - kPa:			44	85	167
Final Consolidated Conditions					
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
Peak					
Angle of Shearing Resistance:( $\theta$ )			40		
Effective Cohesion - kPa:			3		



Arklow Sewerage Scheme Marine Outfall GI

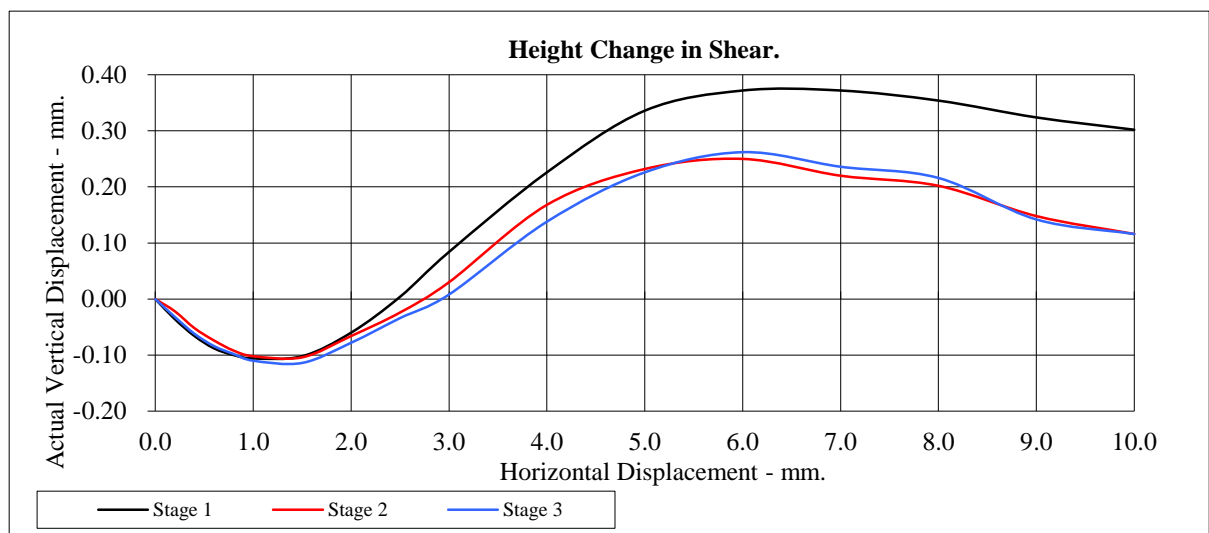
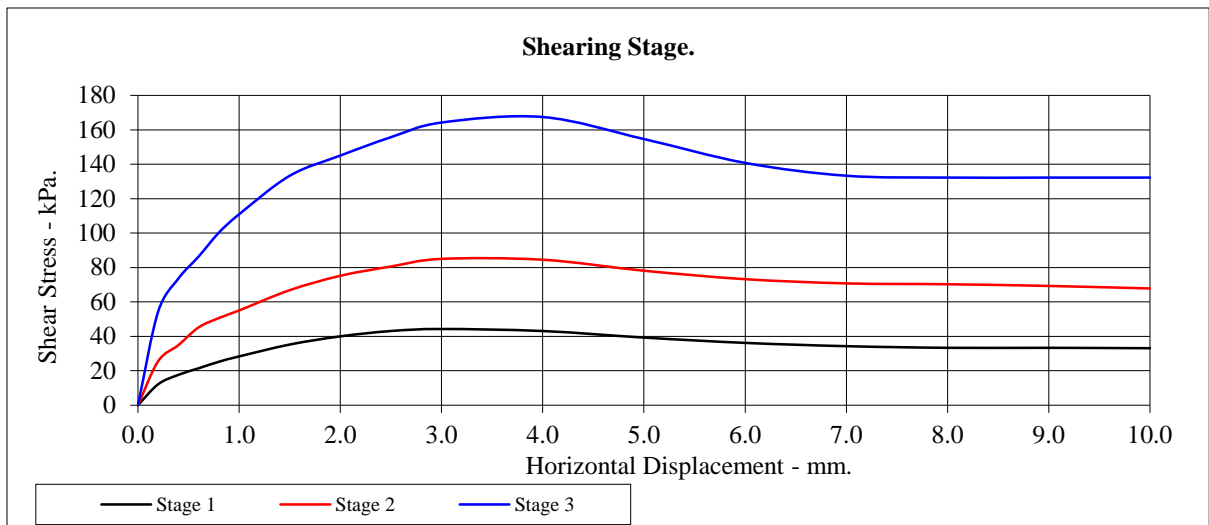
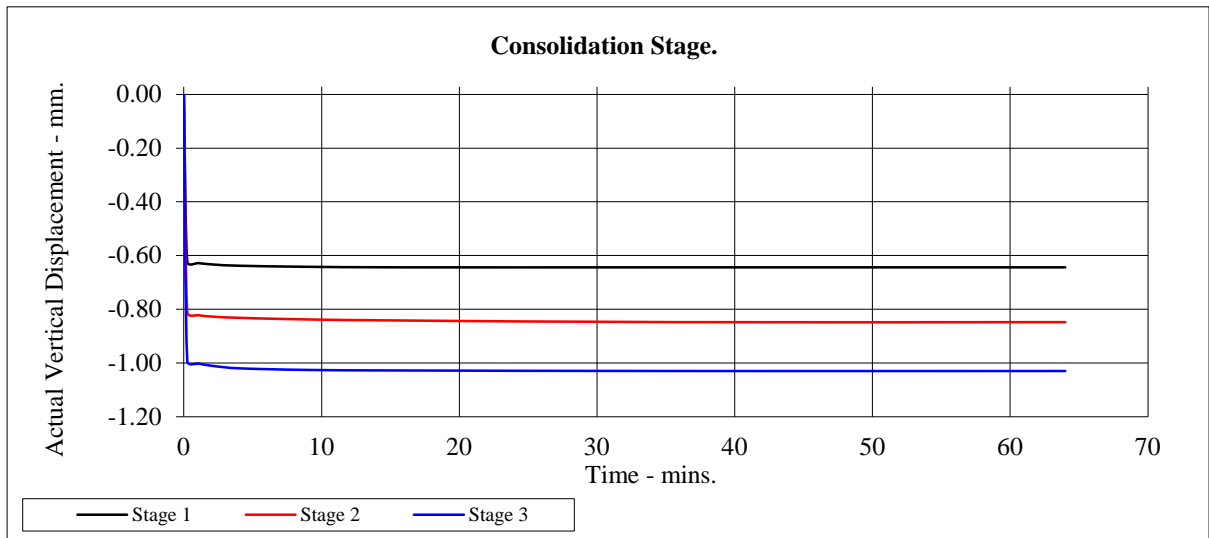
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# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH16	Top Depth:	10.80
Sample Number:	16	Base Depth:	11.20



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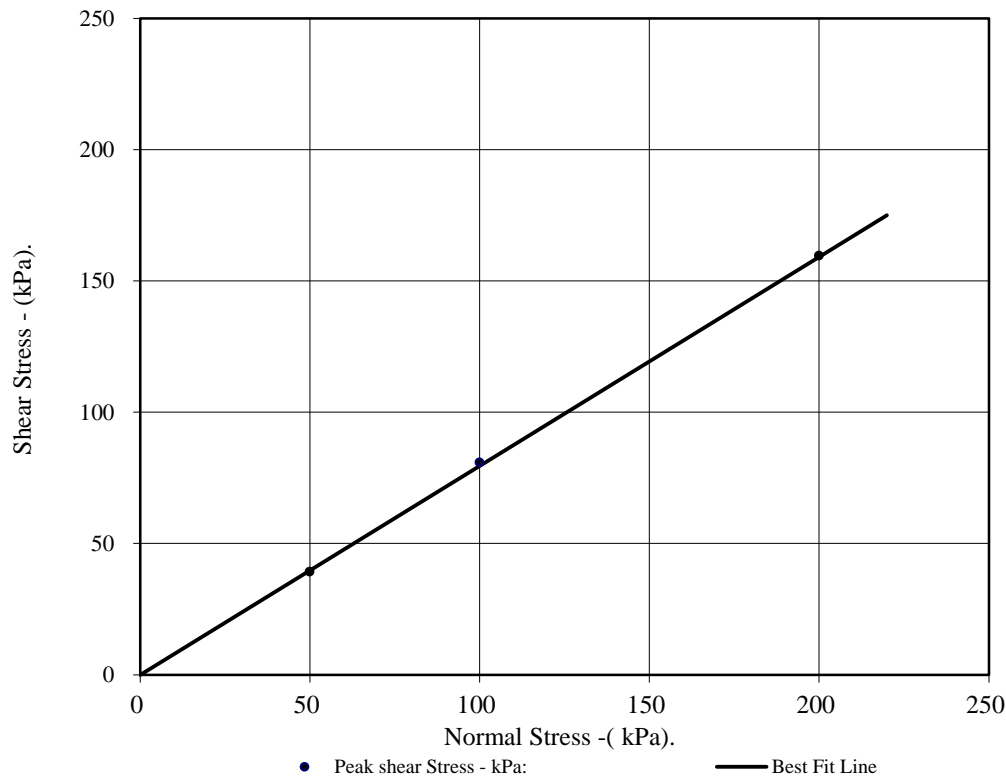
Arklow Sewerage Scheme Marine Outfall GI

<b>Contract No:</b>
<b>PSL17/5705</b>
<b>Client Ref:</b>
<b>17-0167</b>

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17		Top Depth:	1.80	
Sample Number:	16		Base Depth:	2.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress - mm			3.00	4.50	4.50
Peak shear Stress - kPa:			39	81	160
Final Consolidated Conditions					
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:( $\theta$ )			39		
Effective Cohesion - kPa:			0		



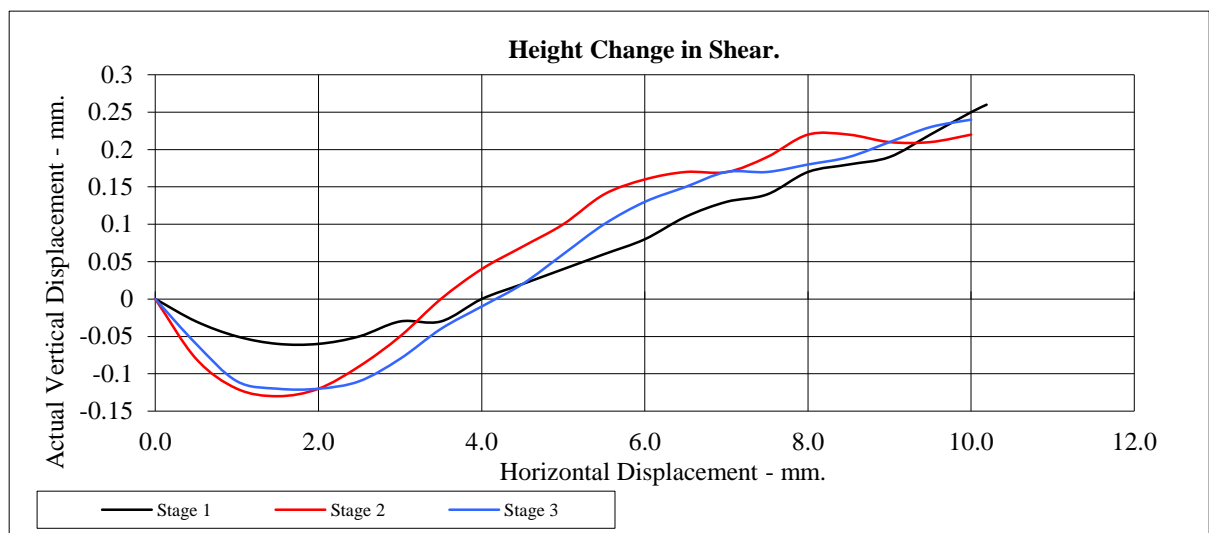
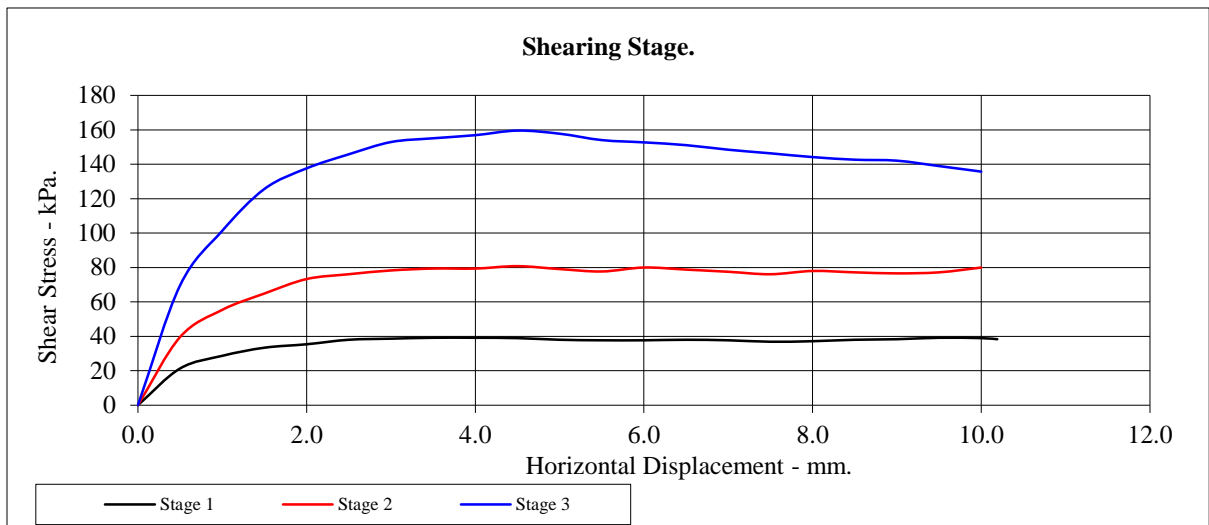
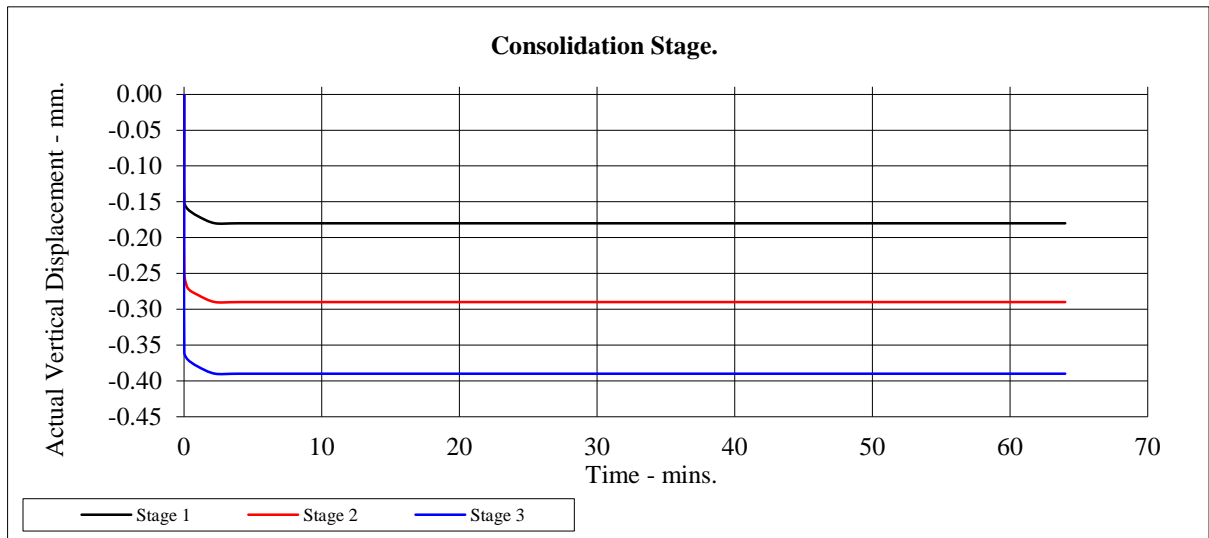
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
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# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17	Top Depth:	1.80
Sample Number:	16	Base Depth:	2.20



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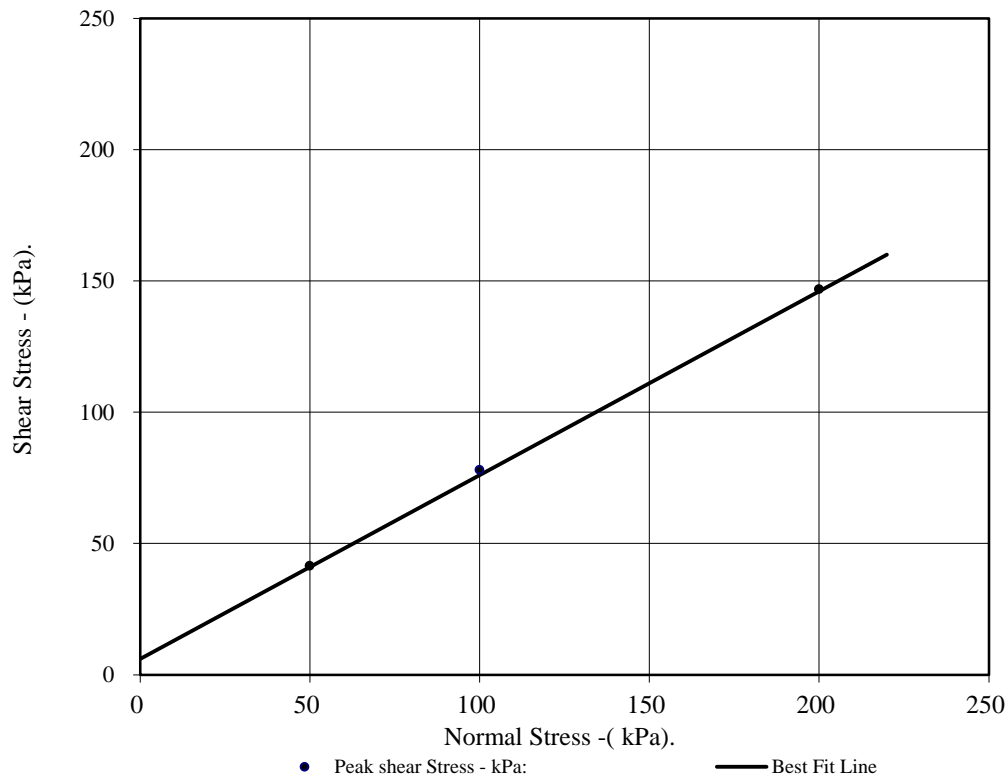
Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**  
PSL17/5705  
**Client Ref:**  
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17		Top Depth:	3.80	
Sample Number:	18		Base Depth:	4.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress - mm			6.00	10.00	9.00
Peak shear Stress - kPa:			42	78	147
Final Consolidated Conditions					
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:( $\theta$ )			35		
Effective Cohesion - kPa:			6		



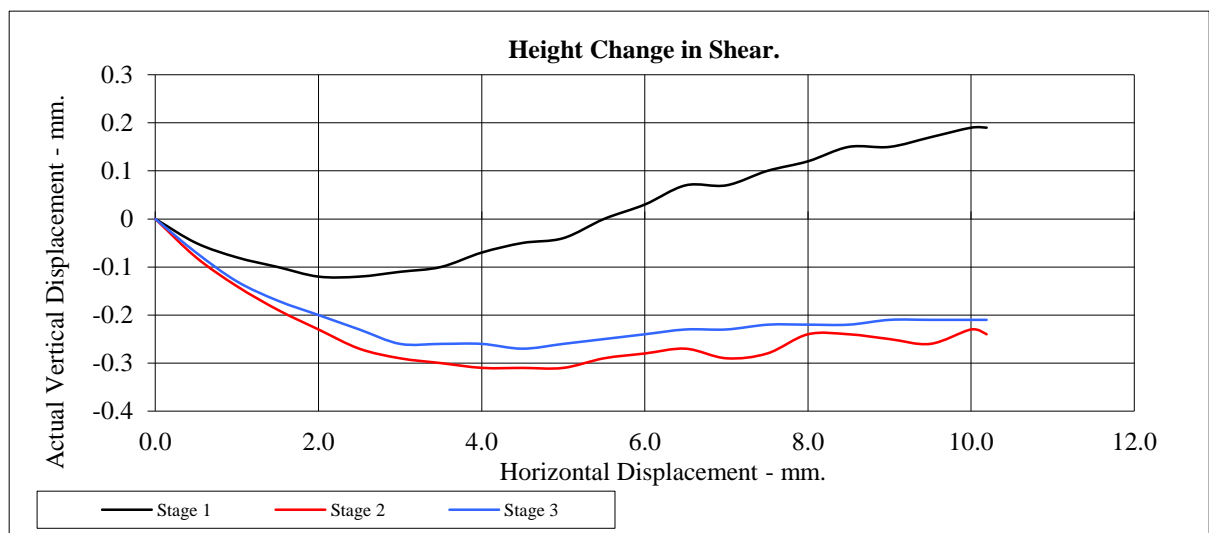
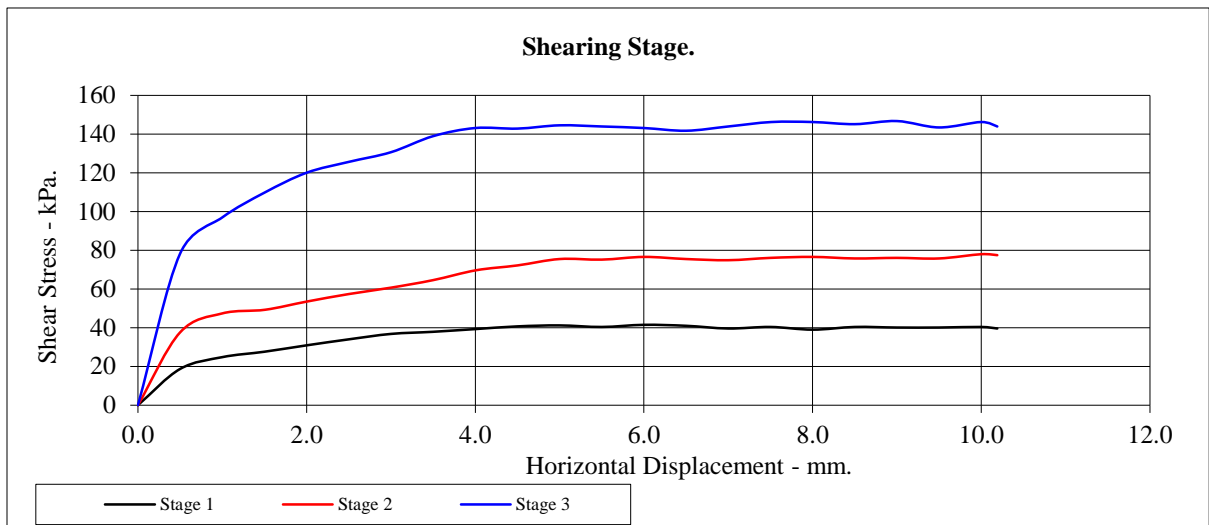
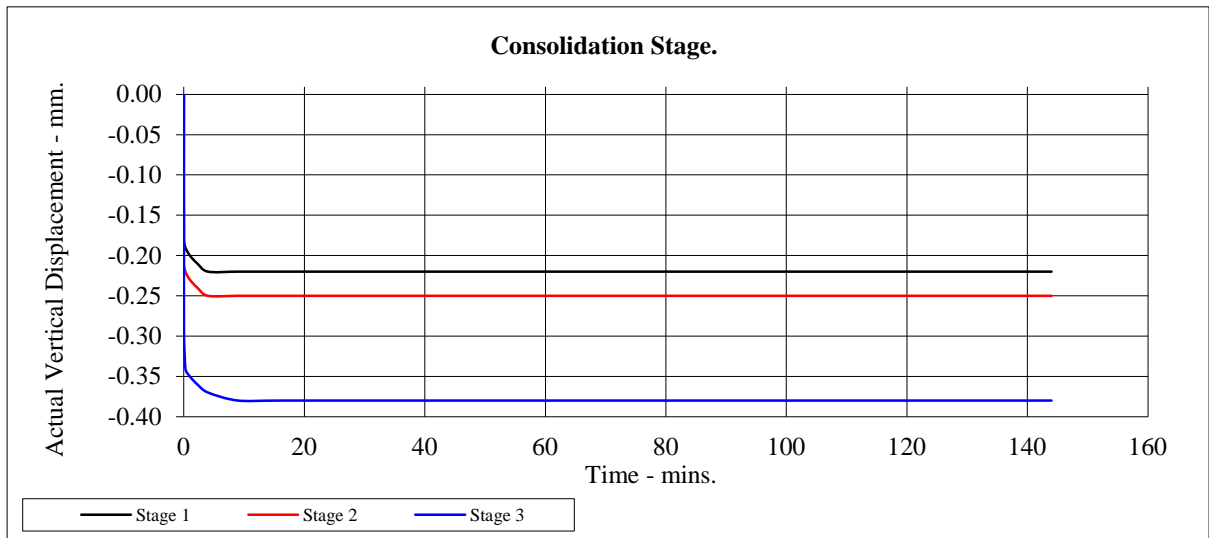
Arklow Sewerage Scheme Marine Outfall GI

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# CONSOLIDATED DRAINED SHEARBOX TEST

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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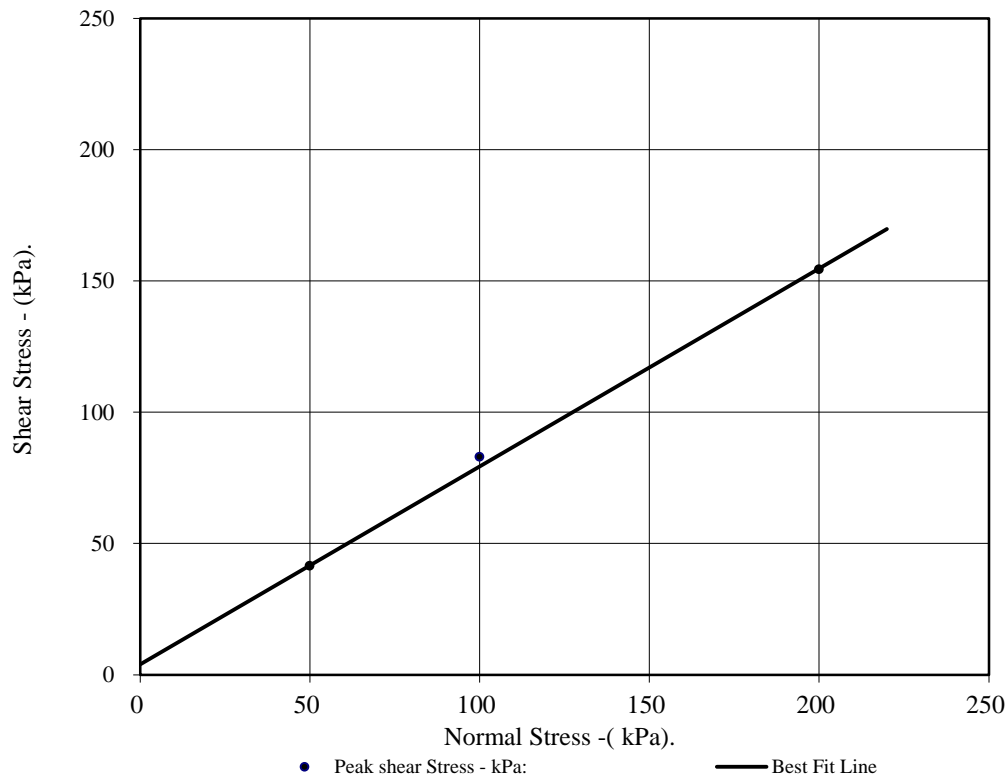
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**Contract No:**  
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**Client Ref:**  
**17-0167**

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17		Top Depth:	10.80	
Sample Number:	25		Base Depth:	11.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress - mm			5.00	4.50	4.50
Peak shear Stress - kPa:			42	83	154
Final Consolidated Conditions					
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:(θ)			37		
Effective Cohesion - kPa:			4		



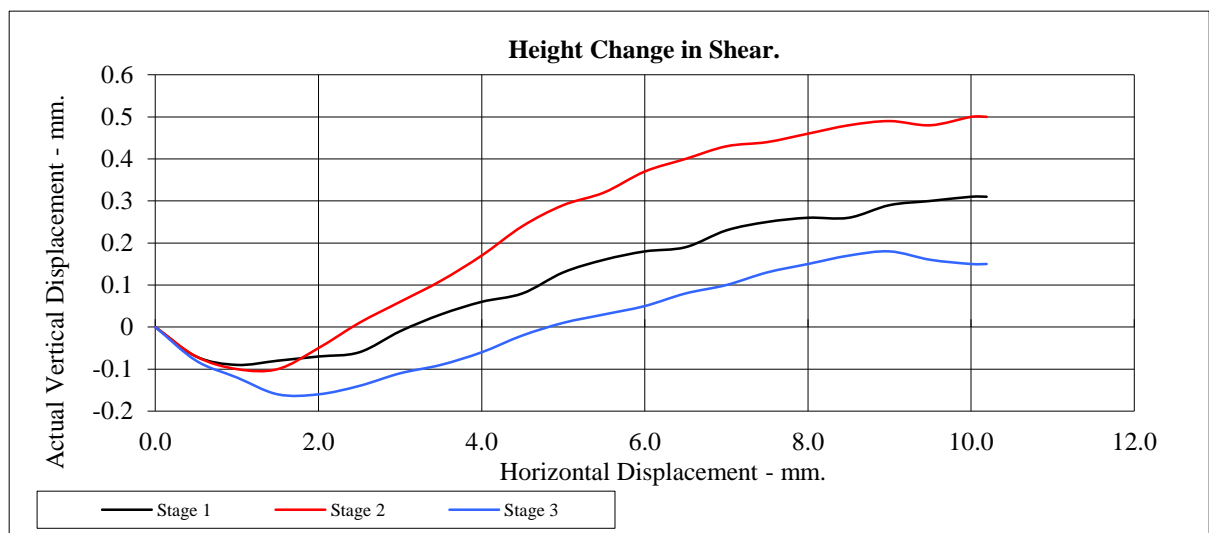
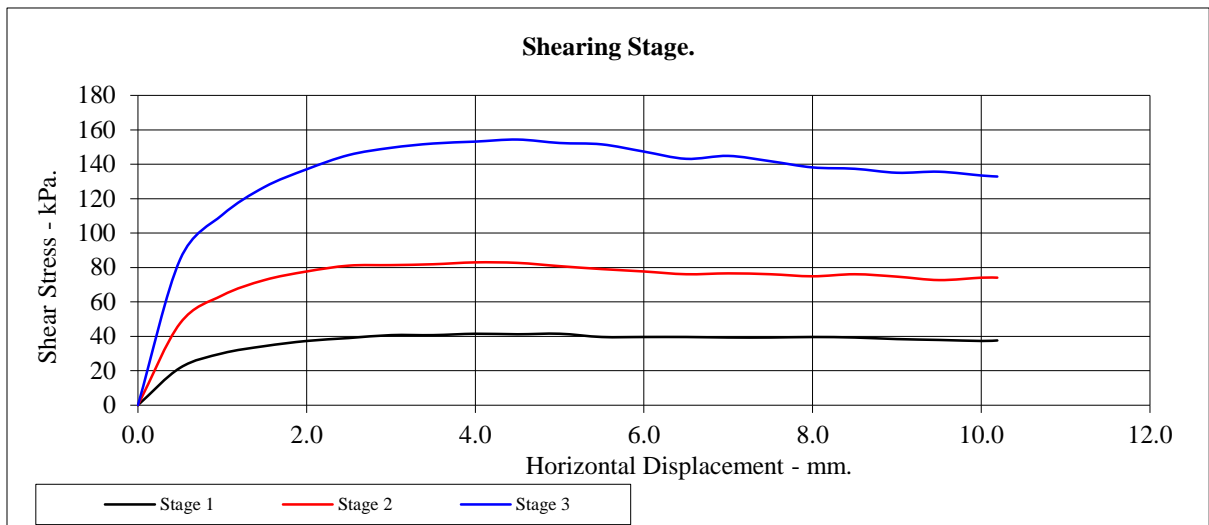
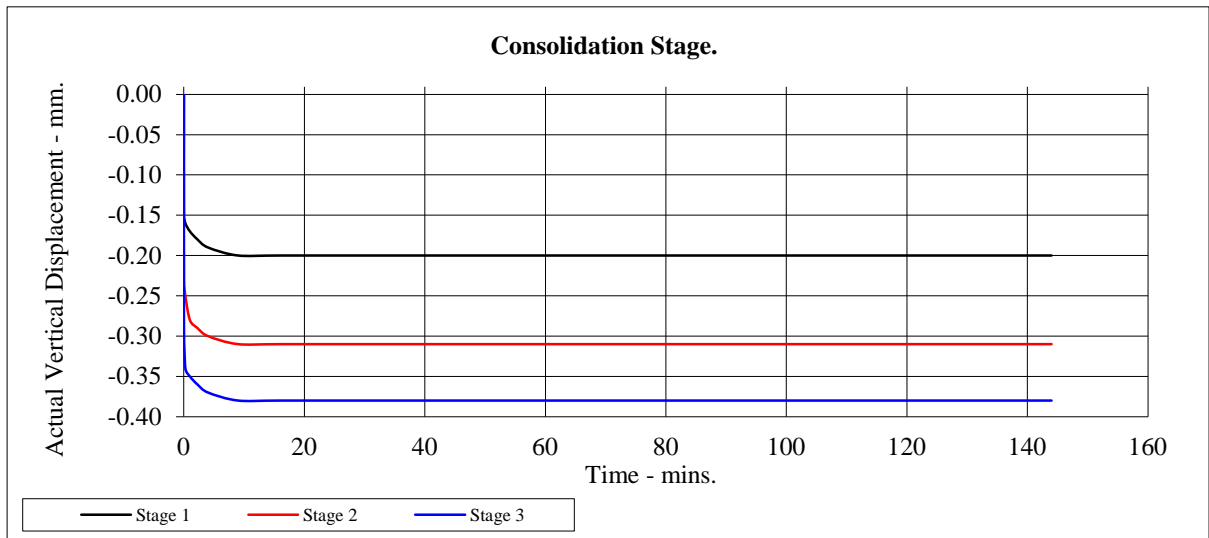
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5705
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH17	Top Depth:	10.80
Sample Number:	25	Base Depth:	11.20



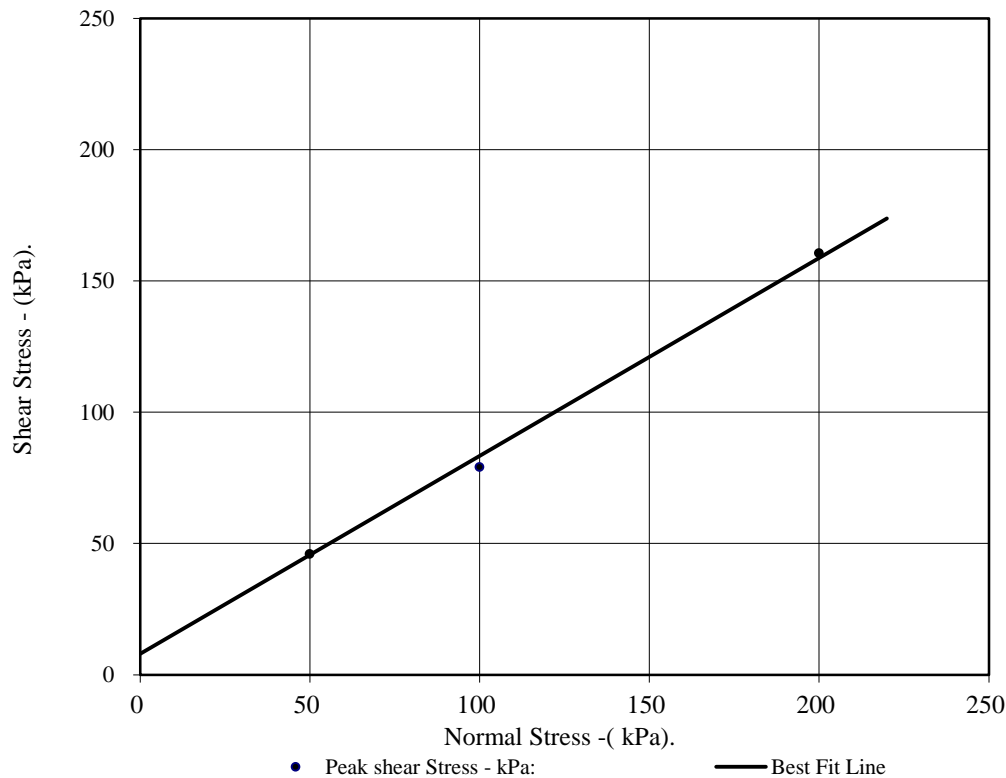
Arklow Sewerage Scheme Marine Outfall GI

<b>Contract No:</b>
<b>PSL17/5705</b>
<b>Client Ref:</b>
<b>17-0167</b>

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH18		Top Depth:	0.80	
Sample Number:	1		Base Depth:	2.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress (mm)			8.00	4.00	5.00
Peak shear Stress - kPa:			46	79	161
Final Consolidated Conditions					
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:( $\theta$ )			37		
Effective Cohesion - kPa:			8		



Arklow Sewerage Scheme Marine Outfall GI

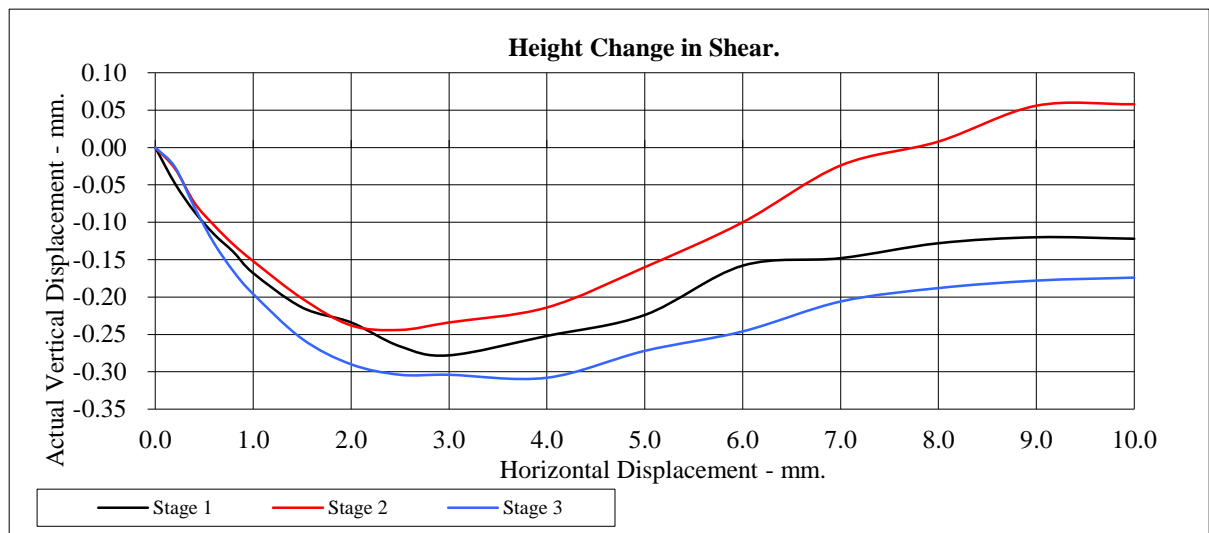
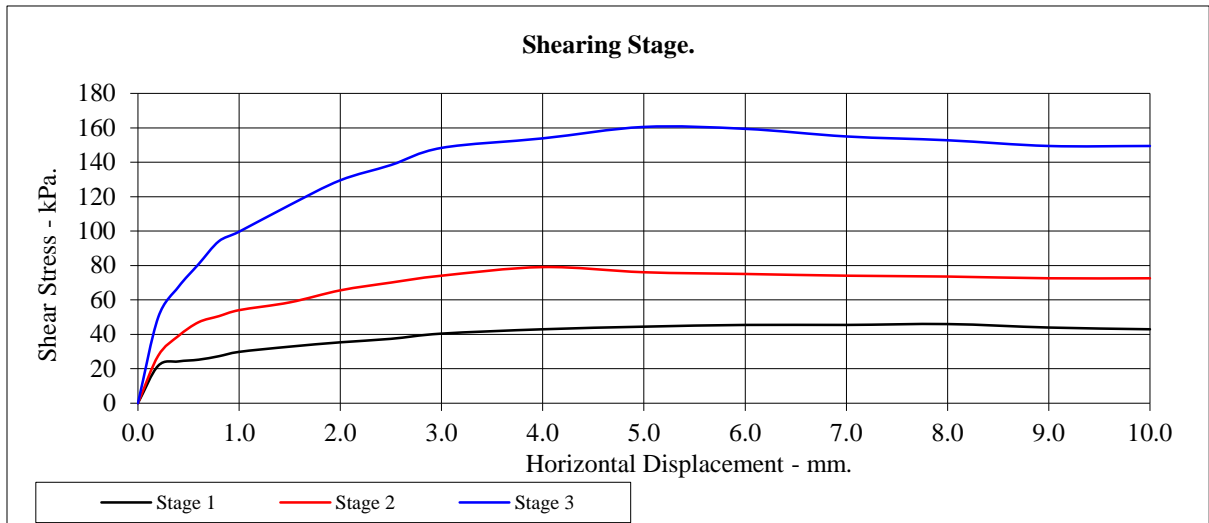
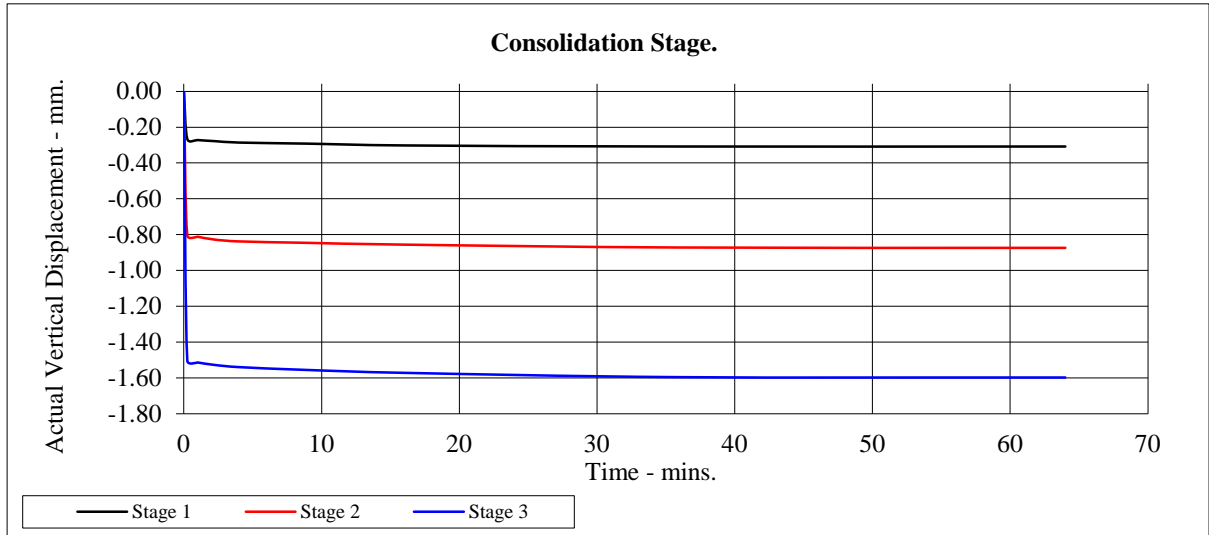
Contract No:
PSL17/5705
Client Ref:
17-0167



# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH18	Top Depth:	0.80
Sample Number:	1	Base Depth:	2.20



**PSL**  
Professional Soils Laboratory

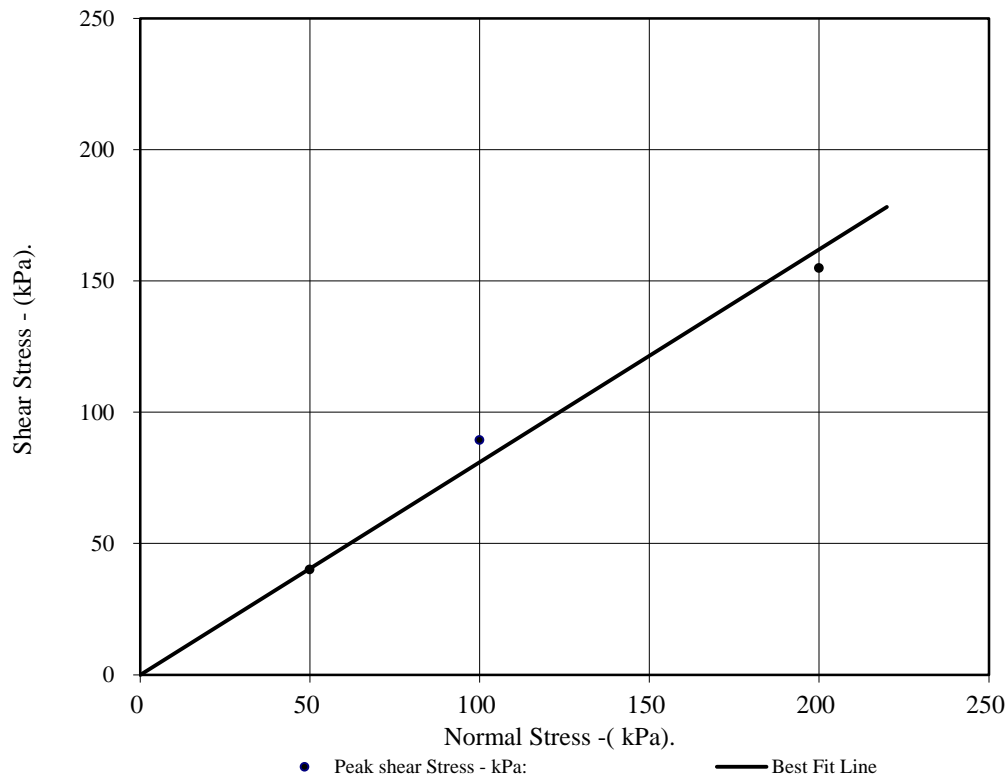
Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**  
**PSL17/5705**  
**Client Ref:**  
**17-0167**

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH18		Top Depth:	9.80	
Sample Number:	7		Base Depth:	10.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress - mm			5.50	3.50	7.00
Peak shear Stress - kPa:			40	89	155
Final Consolidated Conditions					
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:( $\theta$ )			39		
Effective Cohesion - kPa:			0		



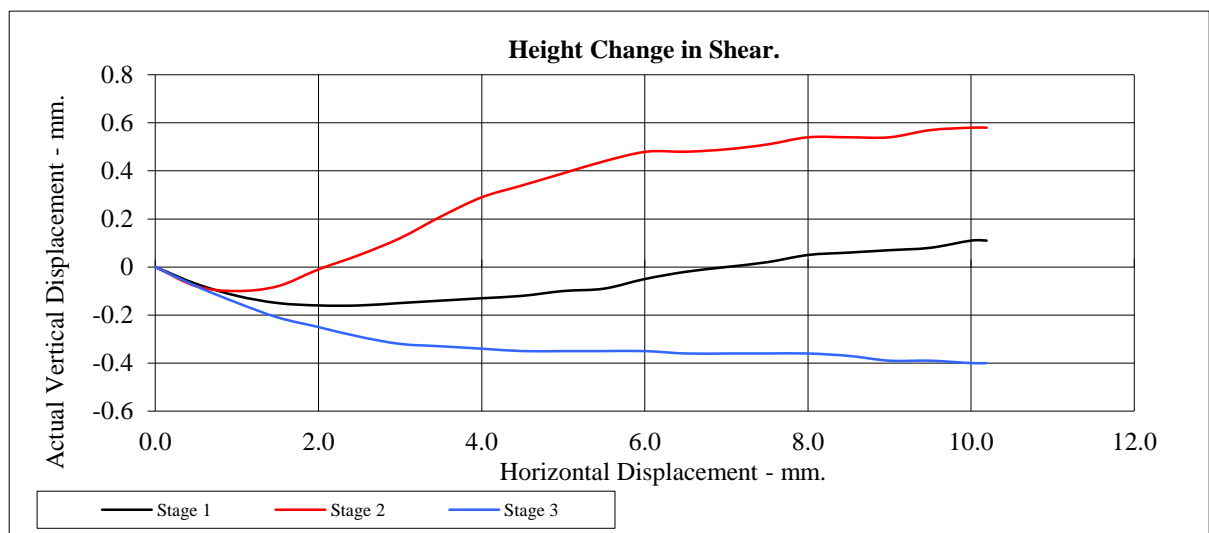
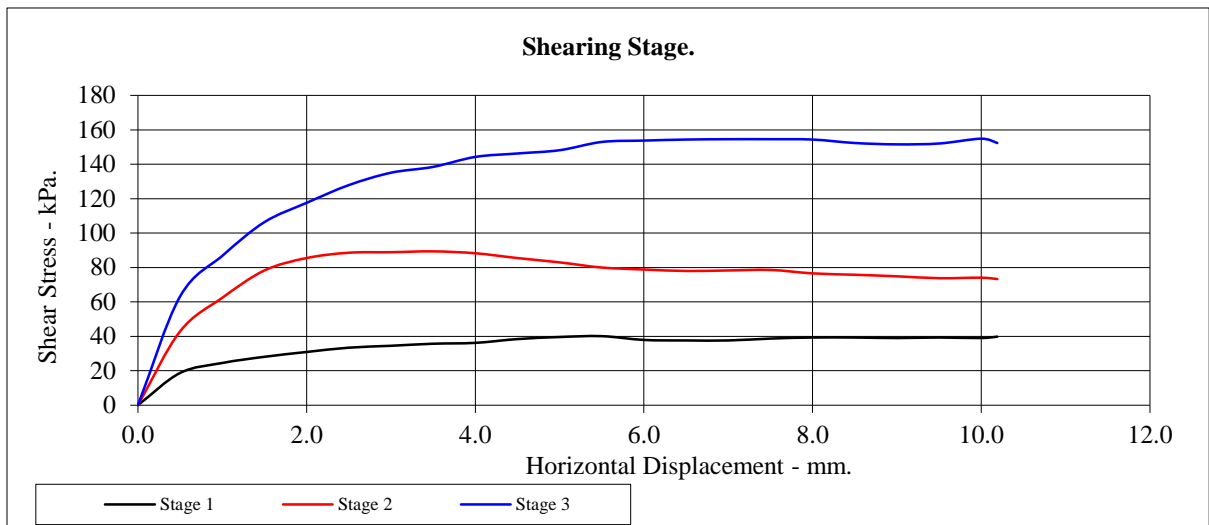
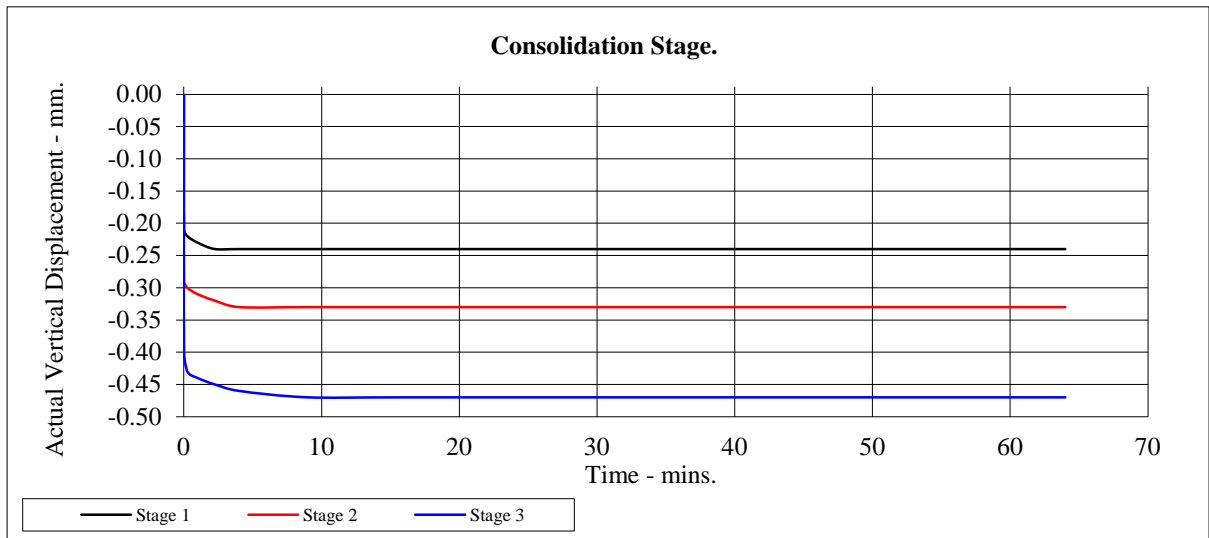
Arklow Sewerage Scheme Marine Outfall GI

<b>Contract No:</b>
<b>PSL17/5705</b>
<b>Client Ref:</b>
<b>17-0167</b>

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH18	Top Depth:	9.80
Sample Number:	7	Base Depth:	10.20



**PSL**  
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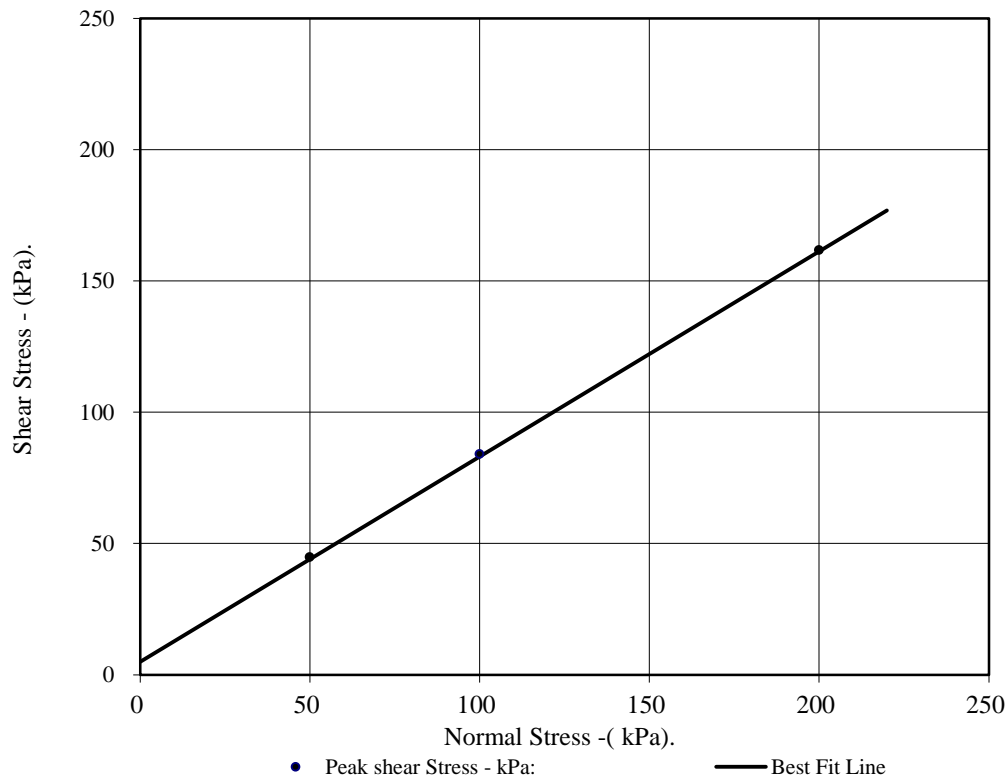
Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**  
PSL17/5705  
**Client Ref:**  
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH19		Top Depth:	0.80	
Sample Number:	1		Base Depth:	1.20	
Sample Conditions:	Submerged		Sample Type	B	
Particle Density - Mg/m3:	2.65	Assumed	Remarks:		
Sample Preparation:	Remoulded using hand tamped effort. Material tested passing 2mm sieve				
Sample Description:	See summary 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 stress (mm)			6.00	5.00	7.00
Peak shear Stress - kPa:			45	84	162
Final Consolidated Conditions					
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
Peak					
Angle of Shearing Resistance:( $\theta$ )			38		
Effective Cohesion - kPa:			5		



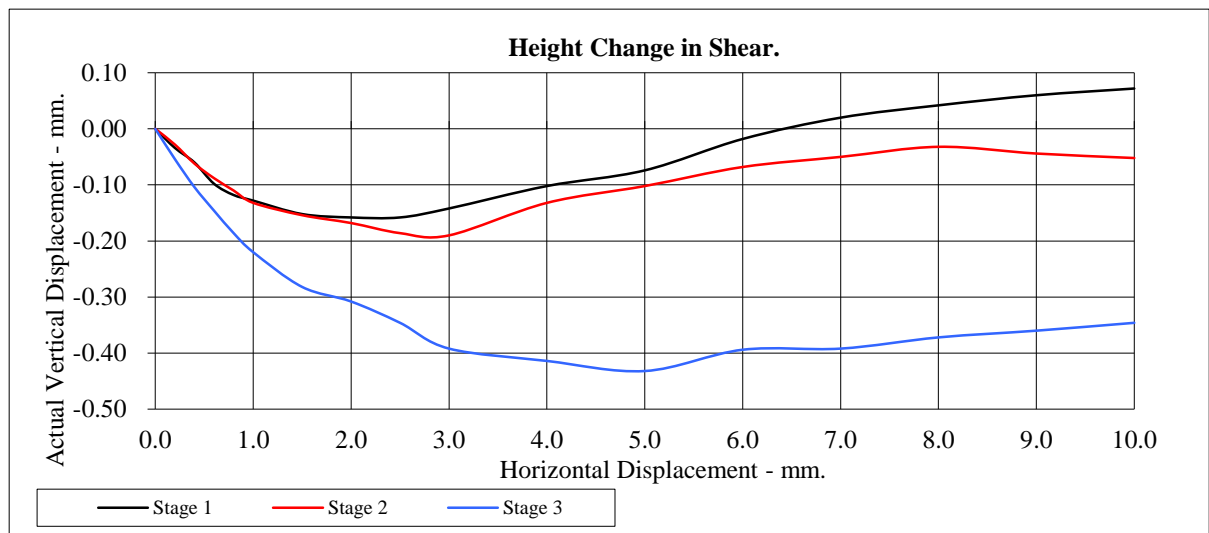
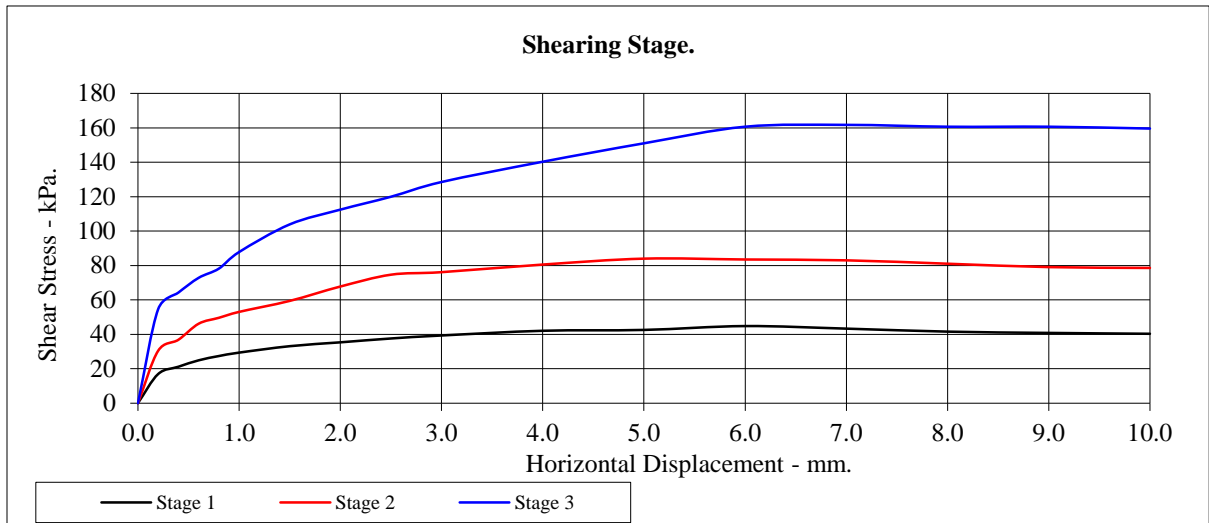
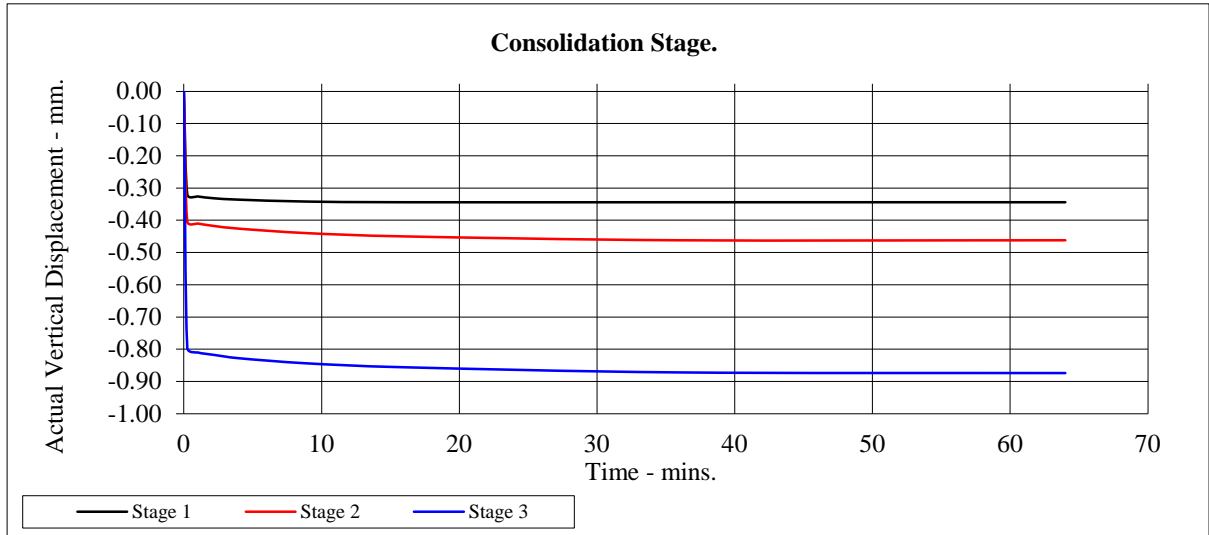
Arklow Sewerage Scheme Marine Outfall GI

Contract No:
PSL17/5705
Client Ref:
17-0167

# CONSOLIDATED DRAINED SHEARBOX TEST

BS1377:Part 7:1990 Clause 4.5.4

Hole Number:	BH19	Top Depth:	0.80
Sample Number:	1	Base Depth:	1.20



**PSL**  
Professional Soils Laboratory

Arklow Sewerage Scheme Marine Outfall GI

**Contract No:**  
PSL17/5705  
**Client Ref:**  
17-0167

## LABORATORY RESTRICTION REPORT

Project Reference	17-0167	To	Neil Haggan
Project Name	Arklow Sewerage Scheme Marine Outfall GI	Position	Project Manager
TR reference	17-0167 / 9	From	Stephen Watson
		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 Number	Sample			Test Type	Reason for Restriction	Required Action
	Number	Depth (m)	Type			
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	B	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	B	Atterberg limits	Unsuitable material for test (sandy gravel)	TESTING CANCELLED
BH19	17	2.5	D	Atterberg limits, pH & So <sub>4</sub>	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 14 December 2017	Date 14 December 2017

**SOIL AND ROCK SAMPLE ANALYSIS  
LABORATORY TEST REPORT**

<b>Client:</b>	<b>Irish Water</b>
<b>Engineer:</b>	<b>Byrne Looby ARUP J.V.</b>
<b>From:</b>	<b>Stephen Watson Laboratory Manager Causeway Geotech Ltd</b>
<b>Tel:</b>	<b>+44(0)2827666640</b>
<b>E-mail:</b>	<b>stephen.watson@causewaygeotech.com</b>
<b>Date:</b>	<b>07/12/17</b>
<b>Ref:</b>	<b>17-0167 - ROCK 1</b>

---

**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





# Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen

Job Ref 17-0167

Borehole/Pit No. BH08

Site Name Arklow Sewerage Scheme Marine Outfall GI

Sample No.

Soil Description Brown sandy gravelly slty CLAY.

Depth 15.10

Specimen Reference 1 Specimen Depth m

Sample Type C

Specimen Description Stiff brown sandy gravelly slty CLAY.

KeyLAB ID Caus2017120518

Test Method BS1377 : Part 7 : 1990, clause 8, single specimen

Date of test 06/12/2017

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

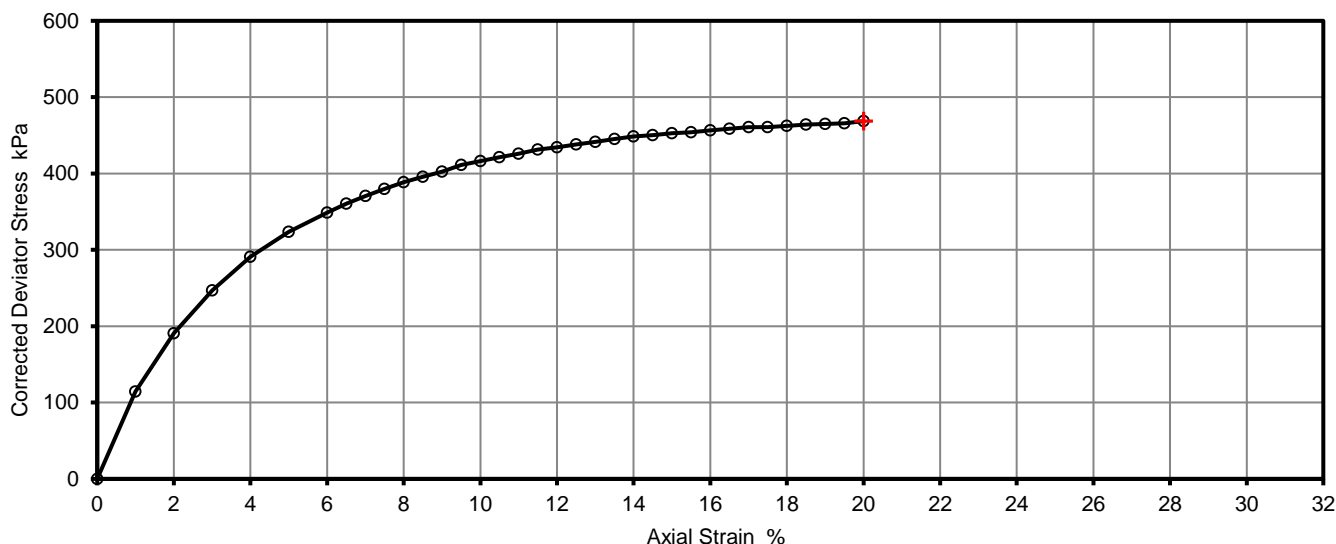
1	
200.0	mm
100.0	mm
2.49	Mg/m3
10.3	%
2.26	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

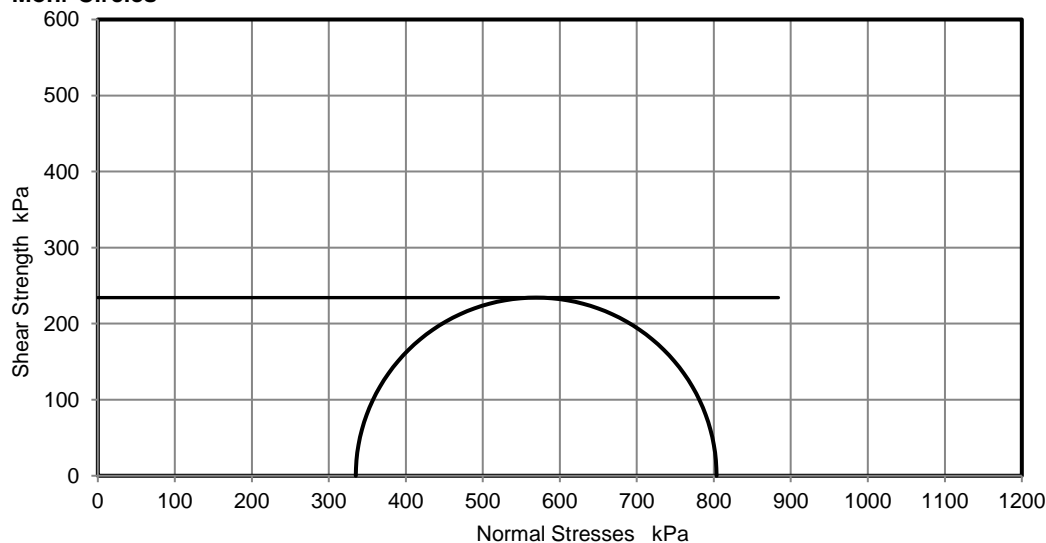
2.0	%/min
335	kPa
20.0	%
469	kPa
234	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

Deviator Stress v Axial Strain



Mohr Circles



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

Testing terminated at 20% strain

## Approved

Stephen.Watson

## Printed

07/12/2017 12:07


Lab Sheet Reference :

Fig. No.

1

Sheet

1

	<b>Unconsolidated Undrained Triaxial Compression Test without measurement of pore pressure - single specimen</b>			Job Ref	17-0167
				Borehole/Pit No.	BH08
Site Name	Arklow Sewerage Scheme Marine Outfall GI			Sample No.	
Soil Description	Light brown sandy gravelly silty CLAY.			Depth	17.00
Specimen Reference	1	Specimen Depth	m	Sample Type	C
Specimen Description	Stiff light brown sandy gravelly silty CLAY.			KeyLAB ID	Caus2017120519
Test Method	BS1377 : Part 7 : 1990, clause 8, single specimen			Date of test	06/12/2017

Test Number  
Length  
Diameter  
Bulk Density  
Moisture Content  
Dry Density

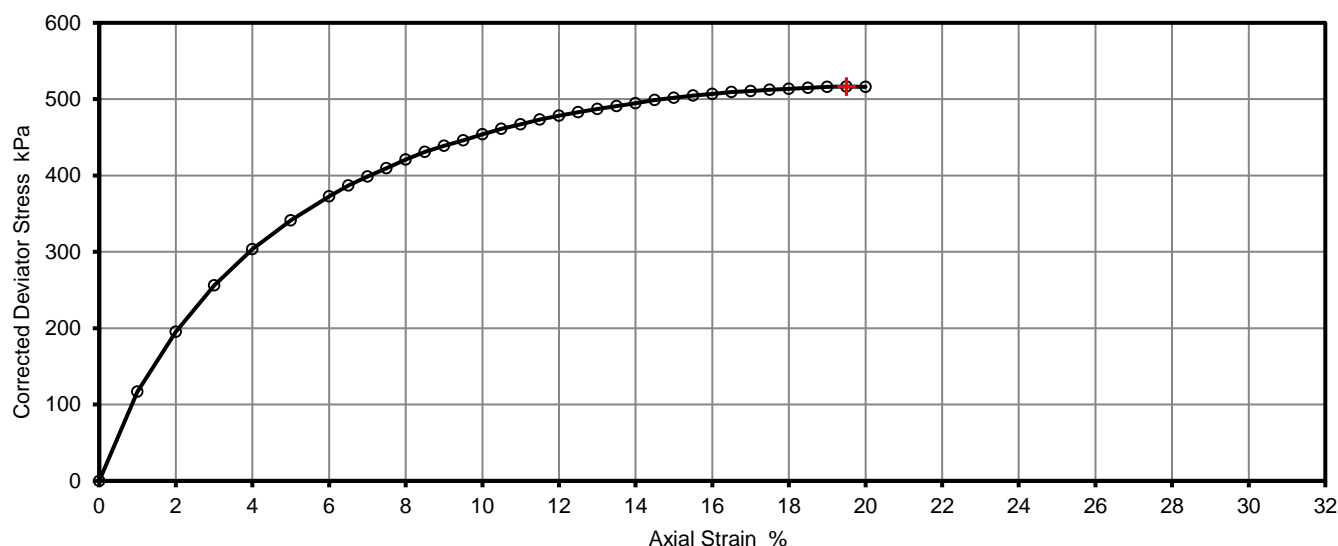
1	
200.0	mm
100.0	mm
2.41	Mg/m3
25.1	%
1.93	Mg/m3

Rate of Strain  
Cell Pressure  
At failure

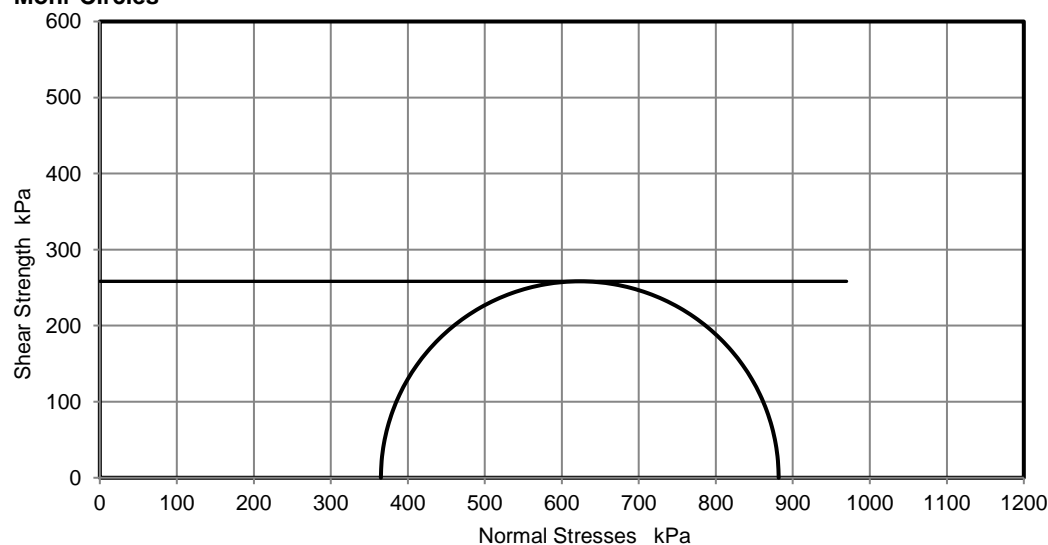
2.0	%/min
365	kPa
19.5	%
517	kPa
258	kPa $\frac{1}{2}(\sigma_1 - \sigma_3)_f$
Plastic	

Axial Strain  
Deviator Stress,  $(\sigma_1 - \sigma_3)_f$   
Undrained Shear Strength,  $c_u$   
Mode of Failure

**Deviator Stress v Axial Strain**



**Mohr Circles**



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**

Stephen.Watson

**Printed**

07/12/2017 12:07

Fig. No.

1

Sheet

2

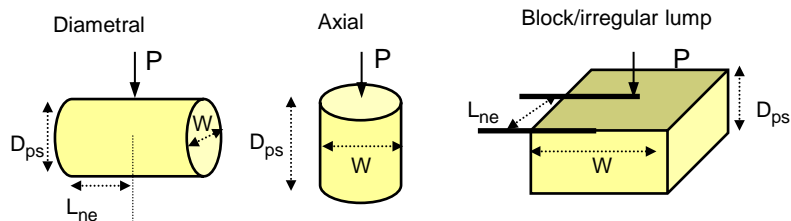
Lab Sheet Reference :

## Point Load Strength Index Tests

### Summary of Results

Project No.			Project Name															
17-0167			Arklow Sewerage Scheme Marine Outfall GI															
Borehole No.	Sample			Specimen		Rock Type	Test Type see ISRM		Failure Valid (Y/N)	Dimensions				Force P kN	Equivalent diameter, De mm	Point Load Strength Index		Remarks (including water content if measured)
	Depth m	Ref.	Type	Ref.	Depth m		Type (D, A, I, B)	Direction (L, P or U)		Lne mm	W mm	Dps mm	Dps' mm			Is MPa	Is(50) MPa	
BH02	24.70	1	C	1	24.70	AMPHOLITE	D	U	NO	132.0	102.0	101.0	95.0	38.6	98.4	4.0	5.4	
BH05	23.25	1	C	2	23.25	AMPHOLITE	I	U	YES	36.0	42.0	29.0	24.0	2.3	35.8	1.8	1.5	
BH07	14.65	1	C	3	14.65	BRECCIA	I	U	YES	99.0	78.0	63.0	60.0	0.3	77.2	0.1	0.1	
BH07	14.90	2	C	4	14.90	BRECCIA	I	U	YES	13.0	79.0	65.0	62.0	0.2	79.0	0.0	0.0	
BH09	10.60	1	C	5	10.60	AMPHIBOLITE	I	U	NO	33.0	52.0	50.0	48.0	0.4	56.4	0.1	0.1	
BH09	12.80	2	C	6	12.80	AMPHIBOLITE	I	U	YES	43.0	56.0	38.0	35.0	2.2	50.0	0.9	0.9	
BH09	13.10	3	C	7	13.10	AMPHIBOLITE	I	U	YES	111.0	98.0	78.0	72.0	19.3	94.8	2.1	2.9	
BH09	13.60	4	C	8	13.60	AMPHIBOLITE	A	U	NO		102.0	65.0	58.0	29.3	86.8	3.9	5.0	
BH10	10.70	1	C	9	10.70	SLATE	A	U	YES		102.0	50.0	47.0	0.5	78.1	0.1	0.1	
BH10	11.90	2	C	10	11.90	SLATE	A	U	NO		101.0	44.0	38.0	6.5	69.9	1.3	1.5	
BH10	12.35	3	C	11	12.35	SLATE	A	U	NO		101.0	56.0	51.0	0.9	81.0	0.1	0.2	
BH10	12.60	4	C	12	12.60	SLATE	A	U	NO		102.0	72.0	68.0	1.1	94.0	0.1	0.2	
BH10	13.00	5	C	13	13.00	SLATE	A	U	YES		102.0	63.0	60.0	1.3	88.3	0.2	0.2	
BH10	13.20	6	C	14	13.20	SLATE	A	U	NO		101.0	58.0	51.0	5.2	81.0	0.8	1.0	
BH10	13.80	7	C	15	13.80	SLATE	A	U	NO		101.0	66.0	61.0	2.3	88.6	0.3	0.4	
BH10	14.30	8	C	16	14.30	SLATE	A	U	YES		102.0	72.0	66.0	1.9	92.6	0.2	0.3	
BH10	15.60	9	C	17	15.60	SLATE	A	U	NO		101.0	48.0	41.0	3.6	72.6	0.7	0.8	
BH10	15.80	10	C	18	15.80	SLATE	A	U	NO		102.0	53.0	48.0	0.9	79.0	0.1	0.2	

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



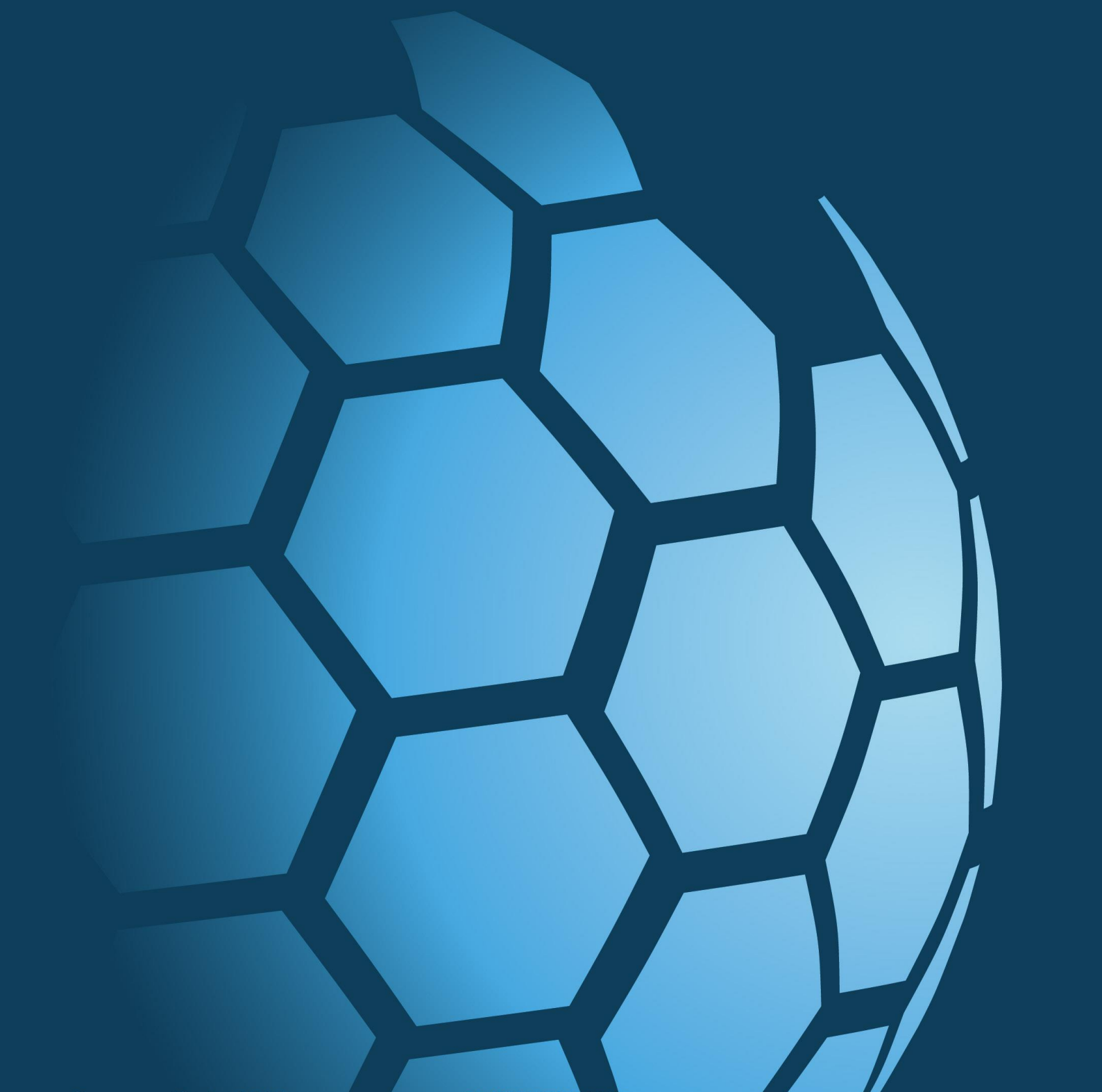
Test performed in accordance with ISRM Suggested Methods : 2007, unless noted otherwise Detailed legend for test and dimensions, based on ISRM, is shown above. Size factor, F = (De/50)0.45 for all tests.	Date Printed	Approved By	Table
	12/07/2017 00:00		1
		Stephen.Watson	sheet 1



**CAUSEWAY**  
— GEOTECH

## APPENDIX E

### Environmental laboratory results



# Sample Analysis

# ESG Environmental Chemistry - Requested Analysis

S179335

**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

WSL M59	Total Organic Carbon (Sediment)																				Yes				
TPHUSI	TPH by GC/FID (AR/SI)																				No	R	R		
TMSS	Tot.Moisture @ 105C																				No	R	R	R	
Sub005	^Tributyltin																				No	R	R	R	
	^Dibutyltin																				No	R	R	R	
PCBMS39	PCB- 7 Congeners (Marine Sediments)																				No	R	R	R	
	Organochlorine Pesticides (Marine Sediments)																				No	R	R	R	
PAHSED	PAH by MS DII																				Yes	R	R	R	
ICP50IL	Iron (Sediments)																				No	R	R	R	
	Zinc (MS) Sediments																				Yes	R	R	R	
	Nickel (MS) Sediments																				Yes	R	R	R	
	Mercury (MS) Sediments																				Yes	R	R	R	
	Manganese (MS) Sediments																				Yes	R	R	R	
	Lead (MS) Sediments																				Yes	R	R	R	
	Chromium (MS) Sediments																				Yes	R	R	R	
	Cadmium (MS) Sediments																				Yes	R	R	R	
ICPMSS	Arsenic (MS) Sediments																				Yes	R	R	R	
	Copper (MS) Sediment																				Yes	R	R	R	
GROHSA	GRO (AA) by HSA GC-FID																				No	R	R	R	
ClientServ	Report B																					R	R	R	
ANC	Carbonate %																				No	R	R	R	
MethodID	Sampled																				UKAS Accredited				
	Description																								
ID Number																									
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	
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	
CL/1777963	CRM		21/09/17			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	
CL/1777965	Reference Material (% Recovery)				R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R	

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 13:41

	<b>Method Codes</b>	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	<b>Detection Limit</b>	0.5	0.04	0.5	0.5	0.5
	<b>Units</b>	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	<b>Arsenic (MS) Sediments</b>	<b>Cadmium (MS) Sediments</b>	<b>Chromium (MS) Sediments</b>	<b>Copper (MS) Sediment</b>	<b>Lead (MS) Sediments</b>
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
S1777965	Reference Material (% Recovery)	98	100	103	96	103

	<b>Method Codes</b>	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	<b>Detection Limit</b>	0.5	0.015	0.5	2	36
	<b>Units</b>	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	<b>Manganese (MS) Sediments</b>	<b>Mercury (MS) Sediments</b>	<b>Nickel (MS) Sediments</b>	<b>Zinc (MS) Sediments</b>	<b>Iron (Sediments)</b>
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
S1777965	Reference Material (% Recovery)	100	96	100	100	102

	<b>Method Codes</b>	TMSS	WSLM59	ANC	Sub005	Sub005
	<b>Detection Limit</b>	0.1	0.02	0.12	5	2
	<b>Units</b>	%	% M/M	%	ug/kg	ug/kg
ID Number	Description	<b>Tot.Moisture @ 105C</b>	<b>Total Organic Carbon (Sediment)</b>	<b>Carbonate %</b>	<b>^Dibutyltin</b>	<b>^Tributyltin</b>
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
S1777965	Reference Material (% Recovery)		105	98	84	92

Sample ID	Client ID	Moisture (%)
CL/1777961	BH01 0.50	56.2
CL/1777962	BH01 2.50	15.9

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1777964	CL1777965	CL1777961	CL1777962	CL1777963
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	BH01 0.50	BH01 2.50	CRM
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>					
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.

	<b>Sample ID :</b>	CL1777964	CL1777965	CL1777961	CL1777962	CL1777963
		<b>Station :</b>	Reference Material (% Recovery)	BH01 0.50	BH01 2.50	CRM
<b>PAH</b>	<b>Mass</b>	QC Blank				
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_9335
<b>QC Batch Number:</b>	170010
<b>Directory:</b>	131017PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 05-Oct-17  
**Date Extracted:** 13-Oct-17  
**Date Analysed:** 13-Oct-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_9335  
**QC Batch Number:** 170010  
**Directory:** 131017.TQ1  
**Method:** Ultrasonic

**Matrix:** Sediment  
**Date Booked in:** 05-Oct-17  
**Date Extracted:** 13-Oct-17  
**Date Analysed:** 13-Oct-17  
**UKAS Accredited:** No

Compounds marked \* are not UKAS or MCerts accredited

<b>Sample ID :</b>	CL1777961	CL1777962	CL1777963	CL1777964	CL1777965
<b>Client ID :</b>	BH01 0.50	BH01 2.50	CRM	QC Blank	Reference Material (% 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.

[illegible]

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:**

Job Number:

QC Batch Number:

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

S17 9335

**Separation:** Silica gel

**Eluents:** Hexane, DCM

D:\TES\DATA\Y2017\101617TPH GC3\101617 2017-10-16 11-46-47\055B0701.D

Ultra Sonic

**Matrix:** Soil

**Date Booked in** 05-Oct-17

Date Extracted 13-Oct-17

**Date Analysed** 16-Oct-17, 13:13:56

[illegible]

## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]

## Sample Analysis

## ESG Environmental Chemistry - Requested Analysis

S178703

Customer Causeway Geotech Ltd  
 Site Arklow Sewerage Scheme Marine Outfall GI  
 Report No S178703

Consignment No S68869  
 Date Logged 14-Sep-2017

Report Due 02-Oct-2017

ID Number	Description	MethodID	ANC	CustServ	GRHSA	ICPMSS											ICP/MS	PAHSED	PCBMS30	Sub005	TMSS	TPHUSI	WSLM59
		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 Di	Organochlorine Pesticides (Marine Sediments)	PCB-7 Congeners (Marine Sediments)	^Dibutyltin	^Tributyltin	Tot.Moisture @ 105C	TPH by GC/FID (AR/SI)	Total Organic Carbon (Sediment)
		UKAS 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	C	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	C	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)		C	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

## KEY:

R Required

DO Dependent Option

C Completed

^ Subcontracted

12/12/2017 12:39



	<b>Method Codes</b>	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPMSS
	<b>Detection Limit</b>	0.5	0.04	0.5	0.5	0.5
	<b>Units</b>	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	<b>Arsenic (MS) Sediments</b>	<b>Cadmium (MS) Sediments</b>	<b>Chromium (MS) Sediments</b>	<b>Copper (MS) Sediment</b>	<b>Lead (MS) Sediments</b>
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

	<b>Method Codes</b>	ICPMSS	ICPMSS	ICPMSS	ICPMSS	ICPSOIL
	<b>Detection Limit</b>	0.5	0.015	0.5	2	36
	<b>Units</b>	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
ID Number	Description	<b>Manganese (MS) Sediments</b>	<b>Mercury (MS) Sediments</b>	<b>Nickel (MS) Sediments</b>	<b>Zinc (MS) Sediments</b>	<b>Iron (Sediments)</b>
S1775344	BH02 1.50	533	0.12	14.9	302.6	30900
S1775345	BH02 3.50	538.4	0.07	14.4	170.9	28300
S1775346	CRM	1117	0.707	31.16	306.6	27700
S1775347	QC Blank	<0.5	<0.015	<0.5	<2	<36
S1775348	Reference Material (% Recovery)	103	102	106	105	105

	<b>Method Codes</b>	TMSS	WSLM59	ANC	Sub005	Sub005
	<b>Detection Limit</b>	0.1	0.02	0.12		
	<b>Units</b>	%	% M/M	%	mg/kg	mg/kg
ID Number	Description	<b>Tot.Moisture @ 105C</b>	<b>Total Organic Carbon (Sediment)</b>	<b>Carbonate %</b>	<b>^Dibutyltin</b>	<b>^Tributyltin</b>
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 Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1775347	CL1775348	CL1775344	CL1775345	CL1775346
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	BH02 1.50	BH02 3.50	CRM
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>					
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 *			0	96	465.0	156.2	1713.9
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
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.28	0.77	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.

	<b>Sample ID :</b>	CL1775347	CL1775348	CL1775344	CL1775345	CL1775346
		QC Blank	Reference Material (% Recovery)	BH02 1.50	BH02 3.50	CRM
<b>PAH</b>	<b>Mass</b>					
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_8703
<b>QC Batch Number:</b>	170006
<b>Directory:</b>	290917PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 21-Sep-17  
**Date Analysed:** 28-Sep-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_8703  
**QC Batch Number:** 170006  
**Directory:** 270917.TQ1  
**Method:** Ultrasonic

**Matrix:** Sediment  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 27-Sep-17  
**Date Analysed:** 28-Sep-17  
**UKAS Accredited:** No

Compounds marked \* are not UKAS or MCerts accredited

<b>Sample ID :</b>	CL1775344	CL1775345	CL1775346	CL1775347	CL1775348
<b>Client ID :</b>	BH02 1.50	BH02 3.50	CRM	QC Blank	Reference Material (% 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:** S17\_8703  
**Directory:** E:\TES\DATA\2017\0921HSA GC9\092117 2017-09-21 11-30-37\113B1301.D

**Method:** Headspace GC/FID

**Matrix:** Soil  
**Date Booked in:** 14-Sep-17  
**Date extracted:** 21-Sep-17  
**Date analysed:** 21-Sep-17, 15:49:00

\* Sample data with an asterisk are not UKAS accredited.

[illegible]

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:**

**Job Number:** S17 8703

QC Batch Number: 171031

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

S17 8703

**Separation:** Silica gel

**Eluents:** Hexane, DCM

D:\TES\DATA\2017\092717\092717 2017-09-27 09-53-19\B-025-62-RMS171031ARO.D

Ultra Sonic

**Matrix:** Soil

**Date Booked in** 14-Sep-17

Date Extracted 25-Sep-17

**Date Analysed** 27-Sep-17, 15:15:31

[illegible]



## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



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## 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: S178703

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

A handwritten signature in black ink, appearing to read 'MH', written over a light grey grid background.

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.: 17-65410-2

Customer Reference: S178703

Customer Order No: 42062 BEC

Customer Sample No	S1775344	S1775345
Customer Sample ID	BH02 1.50	BH02 3.50
RPS Sample No	340618	340619
Sample Type	SOIL	SOIL
Sample Depth (m)	1.50m	3.50m
Sampling Date	29/08/2017	29/08/2017

Determinand	CAS No	Codes	SOP	Units	RL		
dibutyltin (DBT)	1002-53-5	N	in house	mg/kg as cation	0.02	< 0.02	< 0.02
tributyltin (TBT)	56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05



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**Report No.: 17-65410-2**

Customer Reference: S178703

Customer Order No: 42062 BEC

**Comments**

Job	Description	Job Comments
17-65410	2 soil samples	Blank: <RL for DBT & TBT  AQC: DBT - 100% TBT - 107%



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## Deviating Samples

**Report No.: 17-65410-2**

Customer 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-submission 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	



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## 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)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	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 as-received 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

# Sample Analysis

# ESG Environmental Chemistry - Requested Analysis

S179637

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S179637

Consignment No S69458  
 Date Logged 12-Oct-2017

Report Due 01-Nov-2017

ID Number	Description	MethodID	ANC	ClientServ	GROHSA	ICPMSS											ICPMSOIL	PAHSED	PCMSO	Sub005	TMSS	TPHUSI	WSLMS9
		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 DII	Organochlorine Pesticides (Marine Sediments)	PCB-7 Congeners (Marine Sediments)	^Dibutyltin	^Tributyltin	Tot.Moisture @ 105C	TPH by GC/FID (AR/SI)	Total Organic Carbon (Sediment)
		UKAS 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

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 13:50



	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
S1779343	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
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (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
S1779348	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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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
S1779348	Reference Material (% 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

		<b>Sample ID :</b>	CL1779346	CL1779348	CL1779343	CL1779344	CL1779345
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	BH04 0.50	BH04 2.50	CRM
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>					
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 / benzopyrenes	4	252	<1	92	<1	<1	997.0
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
C1 276 *		290	<1	N.D	<1	<1	76.3
C2 276 *		304	<1	N.D	<1	<1	31.9
Sum 276 *			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 *			#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.

	<b>Sample ID :</b>	CL1779346	CL1779348	CL1779343	CL1779344	CL1779345
		<b>Station :</b>	Reference Material (% Recovery)	BH04 0.50	BH04 2.50	CRM
<b>PAH</b>	<b>Mass</b>	QC Blank				
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_9637
<b>QC Batch Number:</b>	170011
<b>Directory:</b>	261017PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 12-Oct-17  
**Date Extracted:** 24-Oct-17  
**Date Analysed:** 27-Oct-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_9637  
**QC Batch Number:** 170011  
**Directory:** 261017.TQ1  
**Method:** Ultrasonic

**Matrix:** Sediment  
**Date Booked in:** 12-Oct-17  
**Date Extracted:** 24-Oct-17  
**Date Analysed:** 27-Oct-17  
**UKAS Accredited:** No

Compounds marked \* are not UKAS or MCerts accredited

<b>Sample ID :</b>	CL1779343	CL1779344	CL1779345	CL1779346	CL1779348
<b>Client ID :</b>	BH04 0.50	BH04 2.50	CRM	QC Blank	Reference Material (% 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  
**Method:** Headspace GCFID

**Matrix:** Soil  
**Date Booked in:** 12-Oct-17  
**Date extracted:** 17-Oct-24  
**Date Analysed:** 25-Oct-17, 19

[illegible]

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:**

**Job Number:**

QC Batch Number:

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

S17 9637

**Separation:** Silica gel

**Eluents:** Hexane, DCM

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Ultra Sonic

**Matrix:** Soil

Date Booked in 12-Oct-17

Date Extracted 26-Oct-17

**Date Analysed:** 28-Oct-17, 09:43:32

[illegible]



## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



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## 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

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## Results Summary

**Report No.: 17-66304-1**

Customer Reference: S179637

Customer Order No: 42062 BEC

Customer Sample No	S1779343	S1779344
Customer Sample ID	BH04 0.50	BH04 2.50
RPS Sample No	343731	343732
Sample Type	SEDIMENT	SEDIMENT
Sampling Date	23/09/2017	23/09/2017

Determinand	CAS No	Codes	SOP	Units	RL		
dibutyltin (DBT)	1002-53-5	U	395	ug/kg as cation	5	< 5.00	< 5.00
tributyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00



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Report No.: 17-66304-1  
Customer Reference: S179637  
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-66304	2 sediment samples	Blank <RL DBT & TBT  AQC DBT - 91% TBT - 91%  CRM DBT - 79% TBT - 81%



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Deviating Samples

Report No.: 17-66304-1

Customer 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-submission 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	



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## 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)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	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 as-received 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

# Sample Analysis

# ESG Environmental Chemistry - Requested Analysis

S179638

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S179638

Consignment No S69457  
 Date Logged 12-Oct-2017

Report Due 01-Nov-2017

ID Number	Description	MethodID	ANC	ClientServ	GROHSA	ICPMSS								ICP50IL	PAHSED	PCMS30	Sub005	TMSS	TPHUSI	WSLM59			
		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 DII	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^Tributyltin	^Dibutyltin	Total Organic Carbon (Sediment)		
		UKAS 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

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 13:58



	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
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
S1779353	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
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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	Client ID	Moisture (%)
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

		<b>Sample ID :</b>	CL1779352	CL1779353	CL1779349	CL1779350	CL1779351
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	BH05 0.50	BH05 3.50	CRM
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>					
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	1.0	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	1	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 / benzopyrenes	4	252	<1	92	<1	<1	997.0
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
C1 276 *		290	<1	N.D	<1	<1	76.3
C2 276 *		304	<1	N.D	<1	<1	31.9
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
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.

	<b>Sample ID :</b>	CL1779352	CL1779353	CL1779349	CL1779350	CL1779351
		<b>Station :</b>	Reference Material (% Recovery)	BH05 0.50	BH05 3.50	CRM
<b>PAH</b>	<b>Mass</b>	QC Blank				
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_9638
<b>QC Batch Number:</b>	170011
<b>Directory:</b>	261017PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 12-Oct-17  
**Date Extracted:** 24-Oct-17  
**Date Analysed:** 27-Oct-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_9638  
**QC Batch Number:** 170011  
**Directory:** 261017.TQ1  
**Method:** Ultrasonic

**Matrix:** Sediment  
**Date Booked in:** 12-Oct-17  
**Date Extracted:** 24-Oct-17  
**Date Analysed:** 27-Oct-17  
**UKAS Accredited:** No

Compounds marked \* are not UKAS or MCerts accredited

<b>Sample ID :</b>	CL1779349	CL1779350	CL1779351	CL1779352	CL1779353
<b>Client ID :</b>	BH05 0.50	BH05 3.50	CRM	QC Blank	Reference Material (% 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:** Soil  
**Date Booked in:** 12-Oct-17  
**Date extracted:** 17-Oct-24  
**Date Analysed:** 25-Oct-17, 22

[illegible]

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:**

**Job Number:**

QC Batch Number:

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

S17 9638

**Separation:** Silica gel

**Eluents:** Hexane, DCM

D:\TES\DATA\2017\102717\102717 2017-10-27 14-14-24\F-089-82-RMS171154ARO.D

Ultra Sonic

**Matrix:** Soil

**Date Booked in** 12-Oct-17

Date Extracted 26-Oct-17

**Date Analysed** 28-Oct-17, 09:43:32

[illegible]



## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



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## 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.



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## Results Summary

**Report No.: 17-66305-1**

Customer Reference: S179638

Customer Order No: 42062 BEC

<b>Customer Sample No</b>	<b>S1779349</b>	<b>S1779350</b>
Customer Sample ID	BH05 0.50	BH05 3.50
RPS Sample No	343733	343734
<b>Sample Type</b>	<b>SEDIMENT</b>	<b>SEDIMENT</b>
Sampling Date	26/09/2017	26/09/2017

Determinand	CAS No	Codes	SOP	Units	RL		
dibutyltin (DBT)	1002-53-5	U	395	ug/kg as cation	5	< 5.00	< 5.00
tributyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00



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Report No.: 17-66305-1  
Customer Reference: S179638  
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-66305	2 sediment samples	Blank <RL DBT & TBT  AQC DBT - 91% TBT - 91%  CRM DBT - 79% TBT - 81%



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### Deviating Samples

Report No.: 17-66305-1

Customer 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-submission 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	



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## Report Information

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U	UKAS Accredited
M	MCERTS Accredited
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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)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	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 as-received 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

# Sample Analysis

# Socotec Environmental Chemistry - Requested Analysis

S179800

**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

ID Number	Description	MethodID	ANC	ClientServ	GROHSA	ICPMSS								ICP90IL	PAHSED	PCBMS30	Sub005	TMSS	TPHUSI	WSL459	
						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
UKAS Accredited		No		Yes	Yes									Yes	Yes	Yes	Yes	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
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
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
CL/1780174	CRM	29/09/17	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
CL/1780176	Reference Material (% Recovery)		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 14:11



	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
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
S1780176	Reference Material (% 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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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
S1780176	Reference Material (% 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

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1780175	CL1780176	CL1780171	CL1780172	CL1780173	CL1780174
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	BH06 0.50	BH06 1.50	BH06 2.50	CRM
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>						
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 *			0	87	2.7	0.0	0.0	600.0
Sum of all fractions *			0	93	33.2	0.0	0.0	6948.0
Sum of NPD fraction *			0	95	12.8	0.0	0.0	2633.2
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.26	0.63	#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.

	<b>Sample ID :</b>	CL1780175	CL1780176	CL1780171	CL1780172	CL1780173	CL1780174
		<b>Station :</b>	Reference Material (% Recovery)	BH06 0.50	BH06 1.50	BH06 2.50	CRM
<b>PAH</b>	<b>Mass</b>	QC Blank					
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_9800
<b>QC Batch Number:</b>	170011
<b>Directory:</b>	261017PCB.TQ1
<b>Method:</b>	Ultrasonic

<b>Matrix:</b>	Soil
<b>Date Booked in:</b>	17-Oct-17
<b>Date Extracted:</b>	24-Oct-17
<b>Date Analysed:</b>	27-Oct-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_9800  
**QC Batch Number:** 170011  
**Directory:** 261017.TQ1  
**Method:** Ultrasonic

**Matrix:** Sediment  
**Date Booked in:** 17-Oct-17  
**Date Extracted:** 24-Oct-17  
**Date Analysed:** 27-Oct-17  
**UKAS Accredited:** No

Compounds marked \* are not UKAS or MCerts accredited

<b>Sample ID :</b>	CL1780171	CL1780172	CL1780173	CL1780174	CL1780175	CL1780176
<b>Client ID :</b>	BH06 0.50	BH06 1.50	BH06 2.50	CRM	QC Blank	Reference Material (% 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\_9800  
**Directory:** D:\TES\DATA\2017\1024HSA\_GC9\102417 2017-10-24 12-17-32\146B4601.D  
**Method:** Headspace GCFID

**Matrix:** Soil  
**Date Booked in:** 17-Oct-17  
**Date extracted:** 17-Oct-24  
**Date Analysed:** 25-Oct-17, 01

[illegible]

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:**

**Job Number:**

QC Batch Number:

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

S17 9800

**Separation:** Silica gel

**Eluents:** Hexane, DCM

D:\TES\DATA\2017\102717\102717 2017-10-27 14-14-24\F-089-82-RMS171154ARO.D

Ultra Sonic

**Matrix:** Soil

Date Booked in 17-Oct-17

**Date Extracted** 26-Oct-17

**Date Analysed:** 28-Oct-17, 09:43:32

[illegible]



## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]

# Sample Analysis

# Socotec Environmental Chemistry - Requested Analysis

S179865

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S179865

Consignment No S\_NonCon  
 Date Logged 19-Oct-2017

Report Due 07-Nov-2017

ID Number	Description	MethodID	ANC	ClientServ	GROHSA	ICPMSS								ICPSOIL	PAHSED	PCBMS30	Sub005				TMSS	TPHUSI	WSLMS9												
						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)	PCB- 7 Congeners (Marine Sediments)	^Dibutyltin	^Tributyltin	Tot.Moisture @ 105C	TPH by GC/FID (AR/SI)	Total Organic Carbon (Sediment)				
UKAS Accredited																					No		No									Yes	Yes	Yes	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	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	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	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	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	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	R	R	R	R	R			R	R	R	R		

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 14:31

	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
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
S1780502	Reference Material (% 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)
S1780497	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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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
S1780502	Reference Material (% 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

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1780501	CL1780502	CL1780497	CL1780498	CL1780499	CL1780500
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	BH07 0.50	BH07 1.50	BH07 2.50	CRM
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>						
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	<1	<1	1.5	30.8
Sum 276 *			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.

	<b>Sample ID :</b>	CL1780501	CL1780502	CL1780497	CL1780498	CL1780499	CL1780500
		QC Blank	Reference Material (% Recovery)	BH07 0.50	BH07 1.50	BH07 2.50	CRM
<b>PAH</b>	<b>Mass</b>						
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_9865
<b>QC Batch Number:</b>	170011
<b>Directory:</b>	261017PCB.TQ1
<b>Method:</b>	Ultrasonic

<b>Matrix:</b>	Soil
<b>Date Booked in:</b>	19-Oct-17
<b>Date Extracted:</b>	24-Oct-17
<b>Date Analysed:</b>	27-Oct-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]



# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_9865  
**QC Batch Number:** 170011  
**Directory:** 261017.TQ1  
**Method:** Ultrasonic

**Matrix:** Sediment  
**Date Booked in:** 19-Oct-17  
**Date Extracted:** 24-Oct-17  
**Date Analysed:** 27-Oct-17  
**UKAS Accredited:** No

Compounds marked \* are not UKAS or MCerts accredited

<b>Sample ID :</b>	CL1780497	CL1780498	CL1780499	CL1780500	CL1780501	CL1780502
<b>Client ID :</b>	BH07 0.50	BH07 1.50	BH07 2.50	CRM	QC Blank	Reference Material (% 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	0.19	<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:** D:\TES\DATA\2017\1025HSA\_GC9\102517 2017-10-25 12-09-58\066F6601.D  
**Method:** Headspace GCFID

**Matrix:** Soil  
**Date Booked in:** 19-Oct-17  
**Date extracted:** 17-Oct-25  
**Date Analysed:** 26-Oct-17, 07

[illegible]

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:**

**Job Number:**

QC Batch Number:

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

S17 9865

**Separation:** Silica gel

**Eluents:** Hexane, DCM

D:\TES\DATA\2017\102717\102717 2017-10-27 14-14-24\F-089-82-RMS171154ARO.D

Ultra Sonic

**Matrix:** Soil

Date Booked in 19-Oct-17

Date Extracted 26-Oct-17

**Date Analysed** 28-Oct-17, 09:43:32

[illegible]

## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



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## 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

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Results reported herein relate only to the items supplied to the laboratory for testing.



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## Results Summary

**Report No.: 17-66337-1**

Customer Reference: S179865

Customer Order No: 42062 BEC

Customer Sample No						S1780497	S1780498	S1780499
Customer Sample ID						BH07 0.50	BH07 1.50	BH07 2.50
RPS Sample No						343837	343838	343839
Sample Type						SEDIMENT	SEDIMENT	SEDIMENT
Sampling Date						11/10/2017	11/10/2017	11/10/2017
Determinand	CAS No	Codes	SOP	Units	RL			
dibutyltin (DBT)	1002-53-5	U	395	ug/kg as cation	5	< 5.00	< 5.00	< 5.00
tributyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00	< 2.00



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**Report No.: 17-66337-1**  
Customer 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%  AQC recovery TBT = 109% DBT = 93%





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## Deviating Samples

**Report No.:** 17-66337-1

Customer 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-submission 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	



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## 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)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	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 as-received 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

# Sample Analysis

# Socotec Environmental Chemistry - Requested Analysis

S179862

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S179862

Consignment No S\_NonCon  
 Date Logged 19-Oct-2017

Report Due 07-Nov-2017

WSLMS9	Total Organic Carbon (Sediment)	Yes																							
TPHUSI	TPH by GC/FID (AR/SI)																								
TMSS	Tot.Moisture @ 105C																								
Sub005	^Tributyltin																								
	^Dibutyltin																								
PCBMS30	PCB- 7 Congeners (Marine Sediments)																								
	Organochlorine Pesticides (Marine Sediments)																								
PAHSED	PAH by MS Dti																								
ICP90IL	Iron (Sediments)																								
	Zinc (MS) Sediments																								
	Nickel (MS) Sediments																								
	Mercury (MS) Sediments																								
	Manganese (MS) Sediments																								
	Lead (MS) Sediments																								
	Chromium (MS) Sediments																								
	Cadmium (MS) Sediments																								
	Arsenic (MS) Sediments																								
	Copper (MS) Sediment																								
	GROISA	GRO (AA) by HSA GC-FID																							
ClientServ	Report C																								
ANC	Carbonate %																								
MethodID	Sampled																								
ID Number	Description	UKAS Accredited																							
		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

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 14:38

	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
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
S1780490	Reference Material (% 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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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
S1780490	Reference Material (% 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

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

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	<1	<1	<1	30.8
Sum 276 *			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
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.25	2.47	#DIV/0!	#DIV/0!	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

**PAHs**

Compounds marked with a \* are reported not UKAS.

	<b>Sample ID :</b>	CL1780489	CL1780490	CL1780485	CL1780486	CL1780487	CL1780488
		QC Blank	Reference Material (% Recovery)	BH08 0.50	BH08 1.50	BH08 2.50	CRM
<b>PAH</b>	<b>Mass</b>						
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_9862
<b>QC Batch Number:</b>	170011
<b>Directory:</b>	261017PCB.TQ1
<b>Method:</b>	Ultrasonic

<b>Matrix:</b>	Soil
<b>Date Booked in:</b>	19-Oct-17
<b>Date Extracted:</b>	24-Oct-17
<b>Date Analysed:</b>	27-Oct-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]



# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_9862  
**QC Batch Number:** 170011  
**Directory:** 261017.TQ1  
**Method:** Ultrasonic

**Matrix:** Sediment  
**Date Booked in:** 19-Oct-17  
**Date Extracted:** 24-Oct-17  
**Date Analysed:** 27-Oct-17  
**UKAS Accredited:** No

Compounds marked \* are not UKAS or MCerts accredited

<b>Sample ID :</b>	CL1780485	CL1780486	CL1780487	CL1780488	CL1780489	CL1780490
<b>Client ID :</b>	BH08 0.50	BH08 1.50	BH08 2.50	CRM	QC Blank	Reference Material (% 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  
**Method:** Headspace GCFID

**Matrix:** Soil  
**Date Booked in:** 19-Oct-17  
**Date extracted:** 17-Oct-24  
**Date Analysed:** 25-Oct-17, 02

[illegible]

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:**

**Job Number:**

QC Batch Number:

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

S17 9862

**Separation:** Silica gel

**Eluents:** Hexane, DCM

D:\TES\DATA\2017\102717\102717 2017-10-27 14-14-24\F-089-82-RMS171154ARO.D

Ultra Sonic

**Matrix:** Soil

**Date Booked in** 19-Oct-17

Date Extracted 26-Oct-17

**Date Analysed** 28-Oct-17, 09:43:32

[illegible]

## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



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## 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

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## Results Summary

**Report No.: 17-66334-1**

Customer Reference: S179862

Customer Order No: 42062 BEC

Customer Sample No						S1780485	S1780486	S1780487
Customer Sample ID						BH08 0.50	BH08 1.50	BH08 2.50
RPS Sample No						343819	343820	343821
Sample Type						SEDIMENT	SEDIMENT	SEDIMENT
Sampling Date						10/10/2017	10/10/2017	10/10/2017
Determinand	CAS No	Codes	SOP	Units	RL			
dibutyltin (DBT)	1002-53-5	U	395	ug/kg as cation	5	< 5.00	< 5.00	< 5.00
tributyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00	< 2.00



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**Report No.: 17-66334-1**  
Customer 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%  AQC recovery TBT = 109% DBT = 93%





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## Deviating Samples

Report No.: 17-66334-1

Customer 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-submission 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	



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## 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)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	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 as-received 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

# Sample Analysis

# Socotec Environmental Chemistry - Requested Analysis

S180512

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

WGL MS9	Total Organic Carbon (Sediment)	Yes																						
TPH/MSI	TPH by GC/FID (AR/SI)	Yes																						
TMSS	Tot. Moisture @ 105C	Yes																						
Sub005	^Tributyltin	No																						
	^Dibutyltin	No																						
PCBMS30	PCB- 7 Congeners (Marine Sediments)	No																						
	Organochlorine Pesticides (Marine	No																						
PAHSED	PAH by MS Dti	Yes																						
ICP/MSL	Iron (Sediments)	Yes																						
	Zinc (MS) Sediments	Yes																						
	Nickel (MS) Sediments	Yes																						
	Mercury (MS) Sediments	Yes																						
	Manganese (MS) Sediments	Yes																						
	Lead (MS) Sediments	Yes																						
	Chromium (MS) Sediments	Yes																						
	Cadmium (MS) Sediments	Yes																						
	Arsenic (MS) Sediments	Yes																						
	Copper (MS) Sediment	Yes																						
	GRO/MSA	GRO (AA) by HSA GC-FID	Yes																					
	Clus/Serv	Report C																						
ANC	Carbonate %	No																						
MethodID	Sampled	UKAS Accredited																						
ID Number	Description	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	
		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	
		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	
		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
		CL/1783103	QC Blank		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			R	R
		CL/1783104	Reference Material (% Recovery)		R	R	R	R	R	R	R	R	R	R	R	R	R	R					R	R

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 14:52

	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
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
S1783104	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	Manganese (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
S1783099	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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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
S1783104	Reference Material (% 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

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1783103	CL1783104	CL1783102	CL1783099	CL1783100	CL1783101
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	CRM 1941b	BH09 0.50	BH09 1.50	BH09 2.50
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>						
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 *			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	49.9	36.0	18.9
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.

	<i><b>Sample ID :</b></i>	CL1783103	CL1783104	CL1783102	CL1783099	CL1783100	CL1783101
	<i><b>Station :</b></i>	QC Blank	Reference Material (% Recovery)	CRM 1941b	BH09 0.50	BH09 1.50	BH09 2.50
<i><b>PAH</b></i>	<i><b>Mass</b></i>						
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S18_0512
<b>QC Batch Number:</b>	170015
<b>Directory:</b>	241117PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 09-Nov-17  
**Date Extracted:** 24-Nov-17  
**Date Analysed:** 28-Nov-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]





## Polychlorinated Biphenyls

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S18\_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

<b>Sample ID :</b>	CL1783099	CL1783100	CL1783101	CL1783102	CL1783103	CL1783104
<b>Client ID :</b>	BH09 0.50	BH09 1.50	BH09 2.50	CRM	QC Blank	Reference Material (% 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:** S18\_0512  
**Directory:** D:\TES\DATA\2017\1115HSA\_GC9\111517 2017-11-15 12-58-23\015F1501.D  
**Method:** Headspace GCFID

<b>Matrix:</b>	Soil
<b>Date Booked in:</b>	09-Nov-17
<b>Date extracted:</b>	17-Nov-15
<b>Date Analysed:</b>	15-Nov-17, 17:1

\* Sample data with an asterisk are not UKAS accredited.

[illegible]

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

Matrix: Soil

Date Booked in 09-Nov-17

**Date Extracted:** 16-Nov-17

**Date Analysed:** 17-Nov-17, 19:39:58

		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	
*	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

## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



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## 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.

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.



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## Results Summary

Report No.: 17-67031-1

Customer Reference: S180512

Customer Order No: 42062 BEC

Customer Sample No						S1783099	S1783100	S1783101
Customer Sample ID						BH09 0.50	BH09 1.50	BH09 2.50
RPS Sample No						346349	346350	346351
Sample Type						SEDIMENT	SEDIMENT	SEDIMENT
Sample Depth (m)						0.50m	1.50m	2.50m
Sampling Date						27/10/2017	27/10/2017	27/10/2017
Determinand	CAS No	Codes	SOP	Units	RL			
dibutyltin (DBT)	1002-53-5	U	395	ug/kg as cation	5	< 5.00	< 5.00	< 5.00
tributyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00	< 2.00



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**Report No.: 17-67031-1**  
Customer Reference: S180512  
Customer Order No: 42062 BEC

**Comments**

Job	Description	Job Comments
17-67031	3 sediment samples	BLANK: DBT <RL TBT <RL  CRM: DBT - 78% TBT - 103%





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## Deviating Samples

**Report No.: 17-67031-1**

Customer Reference: S180512

Customer Order No: 42062 BEC

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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-submission 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	



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## Report Information

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S/C (in results)	See Comments
ND (in results)	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 as-received 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

# Sample Analysis

# Socotec Environmental Chemistry - Requested Analysis

S180514

**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

WLSLMS9	Total Organic Carbon (Sediment)	Yes	Yes	Yes
TPHUSI	TPH by GC/FID (AR/SI)	Yes	Yes	Yes
TMSS	Tot.Moisture @ 105C	Yes	Yes	Yes
Sub005	^Tributyltin	No	R	R
	^Dibutyltin	No	R	R
	PCB- 7 Congeners (Marine Sediments)	No	R	R
	Organochlorine Pesticides (Marine Sediments)	No	R	R
	PCBMS30	No	R	R
PAHSED	PAH by MS Dti	Yes	R	R
ICP50IL	Iron (Sediments)	Yes	R	R
	Zinc (MS) Sediments	Yes	R	R
	Nickel (MS) Sediments	Yes	R	R
	Mercury (MS) Sediments	Yes	R	R
	Manganese (MS) Sediments	Yes	R	R
	Lead (MS) Sediments	Yes	R	R
	Chromium (MS) Sediments	Yes	R	R
	Cadmium (MS) Sediments	Yes	R	R
	Arsenic (MS) Sediments	Yes	R	R
	ICPMS5	Copper (MS) Sediment	Yes	R
GROISA	GRO (AA) by HSA GC-FID	Yes	R	R
ClientServ	Report C		R	R
ANC	Carbonate %	No	R	R
MethodID	Sampled	UKAS Accredited		
		CL/1783110	BH10 0.50	26/10/17
		CL/1783111	BH10 1.50	26/10/17
		CL/1783112	BH10 2.50	26/10/17
		CL/1783113	CRM	26/10/17
		CL/1783114	QC Blank	
		CL/1783115	Reference Material (% Recovery)	

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 15:01

	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
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)
S1783110	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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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
S1783115	Reference Material (% 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

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1783114	CL1783115	CL178313	CL1783110	CL1783111	CL1783112
			QC Blank	Reference Material (% Recovery)	CRM 1941b	BH10 0.50	BH10 1.50	BH10 2.50
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>						
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	3.1	<1
Sum 276 *			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
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.27	0.58	0.82	0.88	5.84

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.

	<b>Sample ID :</b>	CL1783114	CL1783115	CL178313	CL1783110	CL1783111	CL1783112
		QC Blank	Reference Material (% Recovery)	CRM 1941b	BH10 0.50	BH10 1.50	BH10 2.50
<b>PAH</b>	<b>Mass</b>						
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S18_0514
<b>QC Batch Number:</b>	170015
<b>Directory:</b>	241117PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 09-Nov-17  
**Date Extracted:** 24-Nov-17  
**Date Analysed:** 28-Nov-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]



# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S18\_0514  
**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

<b>Sample ID :</b>	CL1783110	CL1783111	CL1783112	CL1783113	CL1783114	CL1783115
<b>Client ID :</b>	BH10 0.50	BH10 1.50	BH10 2.50	CRM	QC Blank	Reference Material (% 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:** S18\_0514  
**Directory:** D:\TES\DATA\2017\1115HSA\_GC9\111517 2017-11-15 12-58-23\018F1801.D  
**Method:** Headspace GC/FID

**Matrix:** Soil  
**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.

[illegible]

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\_0514  
**QC Batch Number:** 181251  
**Directory:** D:\TES\DATA\2017\112317\112317 2017-11-23 12-23-21\B-078-63-RMS171251ARO.D  
**Method:** Ultra Sonic

**Matrix:** Soil  
**Date Booked in:** 09-Nov-17  
**Date Extracted:** 22-Nov-17  
**Date Analysed:** 24-Nov-17, 03:26:57

		Concentration, (mg/kg) - as wet weight											
		>C8 - C10		>C10 - C12		>C12 - C16		>C16 - C21		>C21 - C35		>C35 - 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

\* This sample data is not UKAS accredited.

## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



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## 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

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.



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## Results Summary

Report No.: 17-67032-1

Customer Reference: S180514

Customer Order No: 42062 BEC

Customer Sample No						S1783110	S1783111	S1783112
Customer Sample ID						BH10 0.50	BH10 1.50	BH10 2.50
RPS Sample No						346352	346353	346354
Sample Type						SEDIMENT	SEDIMENT	SEDIMENT
Sample Depth (m)						0.50m	1.50m	2.50m
Sampling Date						26/10/2017	26/10/2017	26/10/2017
Determinand	CAS No	Codes	SOP	Units	RL			
dibutyltin (DBT)	1002-53-5	U	395	ug/kg as cation	5	< 5.00	< 5.00	< 5.00
tributyltin (TBT)	56573-85-4	U	395	ug/kg as cation	2	< 2.00	< 2.00	< 2.00



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**Report No.: 17-67032-1**  
Customer Reference: S180514  
Customer Order No: 42062 BEC

**Comments**

Job	Description	Job Comments
17-67032	3 sediment samples	BLANK: DBT <RL TBT <RL  CRM: DBT - 78% TBT - 103%





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## Deviating Samples

**Report No.: 17-67032-1**

Customer 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-submission 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	



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## 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)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	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 as-received 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

Report Due 11-Dec-2017

WELM59	Total Organic Carbon (Sediment)	Yes
TPHUSI	TPH by GC/FID (AR/SI)	Yes
TWSS	ToI.Moisture @ 105C	Yes
PCBMSXO	PCB- 7 Congeners (Marine Sediments)	No
	Organochlorine Pesticides (Marine Sediments)	No
PAHSED	PAH by MS DII	Yes
OCNSMED	Tributyl Tin (Sediments)	No
	Dibutyl Tin (Sediments)	No
ICPISOIL	Iron (Sediments)	Yes
	Zinc (MS) Sediments	Yes
	Nickel (MS) Sediments	Yes
	Mercury (MS) Sediments	Yes
	Manganese (MS) Sediments	Yes
	Lead (MS) Sediments	Yes
	Chromium (MS) Sediments	Yes
	Cadmium (MS) Sediments	Yes
ICPMSS	Arsenic (MS) Sediments	Yes
	Copper (MS) Sediment	Yes
GROHSA	GRO (AA) by HSA GC-FID	Yes
CustServ	Report C	
ANC	Carbonate %	No
MethodID	Sampled	UKAS Accredited
ID Number	Description	
CL/1784492	BH11 1.50	02/11/17
CL/1784493	BH11 3.50	02/11/17
CL/1784494	CRM	
CL/1784495	QC Blank	
CL/1784496	Reference Material (% Recovery)	

	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
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
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (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
S1784496	Reference Material (% Recovery)	96	95	99	99	99

	Method Codes	TMSS	WSLM59	ANC	OGSNSSED	OGSNSSED
	Detection Limit	0.1	0.02	0.12	1	1
	Units	%	% M/M	%	ug Sn/kg	ug Sn/kg
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	Dibutyl Tin (Sediments)	Tributyl Tin (Sediments)
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
S1784496	Reference Material (% Recovery)		98	98	93	91

Sample ID	Client ID	Moisture (%)
CL/1784492	BH11 1.50	6.6
CL/1784493	BH11 3.50	8.0

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1784495	CL1784496	CL1784494	CL1784492	CL1784493
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	1941b	BH11 1.50	BH11 3.50
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>					
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 / benzopyrenes	4	252	<1	99	1224.0	154.0	52.7
C1 252 *		266	<1	N.D	319.9	37.3	15.9
C2 252 *		280	<1	N.D	231.3	18.9	7.7
Sum 252 *			0	99	1775.2	210.3	76.3
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.

	<b>Sample ID :</b>	CL1784495	CL1784496	CL1784494	CL1784492	CL1784493
		<b>Station :</b>	Reference Material (% Recovery)	1941b	BH11 1.50	BH11 3.50
<b>PAH</b>	<b>Mass</b>					
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S18_0837
<b>QC Batch Number:</b>	170016
<b>Directory:</b>	041217PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 21-Nov-17  
**Date Extracted:** 01-Dec-17  
**Date Analysed:** 05-Dec-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]



# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S18\_0837  
**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

<b>Sample ID :</b>	CL1784492	CL1784493	CL1784494	CL1784495	CL1784496
<b>Client ID :</b>	BH11 1.50	BH11 3.50	CRM	QC Blank	Reference Material (% 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\_0837  
**Directory:** D:\TES\DATA\Y2017\1204HSA\_GC12\171204 2017-12-04 17-22-19\043F4301.D  
**Method:** Headspace GC/FID

**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.

[illegible]

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

<b>Customer and Site Details:</b>	Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI		
<b>Job Number:</b>	S18_0837	<b>Separation:</b>	Silica gel
<b>QC Batch Number:</b>	171296	<b>Eluents:</b>	Hexane, DCM
<b>Directory:</b>	C:\CHEM32\1\DATA\120517TPH_GC15\120517 2017-12-05 18-17-42\066B2001.D		
<b>Method:</b>	Ultra Sonic		

**Matrix:** Soil  
**Date Booked in** 21-Nov-17  
**Date Extracted** 04-Dec-17  
**Date Analysed:** 05-Dec-17, 22:20:07

[illegible]

## Sample Descriptions

[illegible]

# Sample Analysis

# ESG Environmental Chemistry - Requested Analysis

S178705

Customer Causeway Geotech Ltd  
Site Arklow Sewerage Scheme Marine Outfall GI  
Report No S178705

Consignment No S68870  
Date Logged 14-Sep-2017

Report Due 02-Oct-2017

ID Number	Description	MethodID	ANC	ClusServ	GRHSA	ICPMSS									ICP50IL	PAH5ED	PCMS50	Sub005	TMSS	TPHUSI	WSLM59		
		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 DII	Organochlorine Pesticides (Marine Sediments)	PCB-7 Congeners (Marine Sediments)	^Dibutyltin	^Tributyltin	Tot.Moisture @ 105C	TPH by GC/FID (AR/SI)	Total Organic Carbon (Sediment)
		UKAS 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

KEY:  
R Required  
DO Dependent Option  
C Completed  
^ Subcontracted  
12/12/2017 12:43

	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
S1775353	BH12 1.50	12.8	0.14	17.4	20.9	10.2
S1775354	BH12 3.50	11.2	0.28	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
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
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
S1775358	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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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
S1775358	Reference Material (% 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

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1775357	CL1775358	CL1775353	CL1775354	CL1775355	CL1775356
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	BH12 1.50	BH12 3.50	BH12 5.50	CRM
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>						
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 *			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 *			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.

	<b>Sample ID :</b>	CL1775357	CL1775358	CL1775353	CL1775354	CL1775355	CL1775356
		QC Blank	Reference Material (% Recovery)	BH12 1.50	BH12 3.50	BH12 5.50	CRM
<b>PAH</b>	<b>Mass</b>						
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_8705
<b>QC Batch Number:</b>	170006
<b>Directory:</b>	290917PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 21-Sep-17  
**Date Analysed:** 28-Sep-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_8705  
**QC Batch Number:** 170006  
**Directory:** 270917.TQ1  
**Method:** Ultrasonic

**Matrix:** Sediment  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 27-Sep-17  
**Date Analysed:** 28-Sep-17  
**UKAS Accredited:** No

Compounds marked \* are not UKAS or MCerts accredited

<b>Sample ID :</b>	CL1775353	CL1775354	CL1775355	CL1775356	CL1775357	CL1775358
<b>Client ID :</b>	BH12 1.50	BH12 3.50	BH12 5.50	CRM	QC Blank	Reference Material (% 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



## ALIPHATIC / AROMATIC FRACTION BY GC/FID

**Customer and Site Details:**

**Job Number:**

QC Batch Number:

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

s17 8705

**Separation:** Silica gel

**Eluents:** Hexane, DCM

D:\TES\DATA\2017\092717\092717 2017-09-27 09-53-19\B-025-62-RMS171031ARO.D

Ultra Sonic

**Matrix:** Soil

Date Booked in 14-Sep-17

Date Extracted 25-Sep-17

**Date Analysed** 27-Sep-17, 15:15:31

[illegible]

## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



2 Shaftesbury Industrial Centre, Icknield Way, Letchworth Garden City, Hertfordshire, SG6 1HE  
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## 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: S178705

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

A handwritten signature in black ink, appearing to read 'MHickson'.

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.: 17-65411-2**

Customer Reference: S178705

Customer Order No: 42062 BEC

Customer Sample No						S1775353	S1775354	S1775355
Customer Sample ID						BH12 1.50	BH12 3.50	BH12 5.50
RPS Sample No						340620	340621	340622
Sample Type						SOIL	SOIL	SOIL
Sample Depth (m)						1.50m	3.50m	5.50m
Sampling Date						24/08/2017	24/08/2017	24/08/2017
Determinand	CAS No	Codes	SOP	Units	RL			
dibutyltin (DBT)	1002-53-5	N	in house	mg/kg as cation	0.02	< 0.02	< 0.02	< 0.02
tributyltin (TBT)	56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05	< 0.05



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Report No.: 17-65411-2  
Customer Reference: S178705  
Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-65411	3 soil samples	Blank: <RL for DBT & TBT  AQC: DBT - 100% TBT - 107%



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## Deviating Samples

Report No.: 17-65411-2

Customer 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-submission 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	



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## 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)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	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 as-received 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

# Sample Analysis

# ESG Environmental Chemistry - Requested Analysis

S178717

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S178717

Consignment No S68871  
 Date Logged 14-Sep-2017

Report Due 02-Oct-2017

ID Number	Description	MethodID	ANC	Quiserv	GRHSA	ICPMSS								ICPSOIL	PAHSED	PCMSO	Sub005	TMSS	TPHUSI	WSLM59			
		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 DII	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	^Dibutyltin	^Tributyltin	Tot.Moisture @ 105C	TPH by GC/FID (AR/SI)	Total Organic Carbon (Sediment)
		UKAS Accredited	No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	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)		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 12:50

	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
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

	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)
S1775425	BH13 2.50	370.5	0.05	15.5	35.6	20600
S1775426	BH13 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
S1775429	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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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	Client ID	Moisture (%)
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

		<b>Sample ID :</b>	CL1775428	CL1775429	CL1775425	CL1775426	CL1775427
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	BH13 2.50	BH13 5.50	CRM
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>					
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	<1	9.1	62.5
Sum 276 *			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

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.

	<b>Sample ID :</b>	CL1775428	CL1775429	CL1775425	CL1775426	CL1775427
		QC Blank	Reference Material (% Recovery)	BH13 2.50	BH13 5.50	CRM
<b>PAH</b>	<b>Mass</b>					
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_8717
<b>QC Batch Number:</b>	170007
<b>Directory:</b>	290917PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 21-Sep-17  
**Date Analysed:** 28-Sep-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_8717  
**QC Batch Number:** 170007  
**Directory:** 270917.TQ1  
**Method:** Ultrasonic

**Matrix:** Sediment  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 27-Sep-17  
**Date Analysed:** 28-Sep-17  
**UKAS Accredited:** No

Compounds marked \* are not UKAS or MCerts accredited

<b>Sample ID :</b>	CL1775425	CL1775426	CL1775427	CL1775428	CL1775429
<b>Client ID :</b>	BH13 2.50	BH13 5.50	CRM	QC Blank	Reference Material (% 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.

[illegible]

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:**

Job Number:

QC Batch Number:

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

s17 8717

**Separation:** Silica gel

**Eluents:** Hexane, DCM

D:\TES\DATA\2017\092717\092717 2017-09-27 09-53-19\B-025-62-RMS171031ARO.D

Ultra Sonic

**Matrix:** Soil

Date Booked in 14-Sep-17

Date Extracted 25-Sep-17

**Date Analysed** 27-Sep-17, 15:15:31

[illegible]

## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



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## 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.  
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## Results Summary

Report No.: **17-65414-2**

Customer Reference: S178717

Customer Order No: 42062 BEC

Customer Sample No	S1775425	S1775426
Customer Sample ID	BH13 2.50	BH13 5.50
RPS Sample No	340628	340629
Sample Type	SOIL	SOIL
Sample Depth (m)	2.50m	5.50m
Sampling Date	23/08/2017	23/08/2017

Determinand	CAS No	Codes	SOP	Units	RL		
dibutyltin (DBT)	1002-53-5	N	in house	mg/kg as cation	0.02	< 0.02	< 0.02
tributyltin (TBT)	56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05



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**Report No.: 17-65414-2**

Customer Reference: S178717

Customer Order No: 42062 BEC

**Comments**

Job	Description	Job Comments
17-65414	2 soil samples	Blank: <RL for DBT & TBT  AQC: DBT - 100% TBT - 107%



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Deviating Samples

Report No.: 17-65414-2  
Customer Reference: S178717  
Customer Order No: 42062 BEC

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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-submission 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	



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## Report Information

### Key to Report Codes

U	UKAS Accredited
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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)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	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 as-received 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

# Sample Analysis

# ESG Environmental Chemistry - Requested Analysis

S178712

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S178712

Consignment No S68872  
 Date Logged 14-Sep-2017

Report Due 02-Oct-2017

WSLM59	Total Organic Carbon (Sediment)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
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KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 12:58

	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
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)
S1775392	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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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
S1775397	Reference Material (% 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

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		Sample ID :	CL1775396	CL1775397	CL1775392	CL1775393	CL1775394	CL1775395
		Station :	QC Blank	Reference Material (% F	BH14 0.75	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 / benzopyrenes	4	252	<1	96	33593.0	1362.6	15.1	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.

	<b>Sample ID :</b>	CL1775396	CL1775397	CL1775392	CL1775393	CL1775394	CL1775395
		QC Blank	Reference Material (% Recovery)	BH14 0.75	BH14 1.75	BH14 4.00	CRM
<b>PAH</b>	<b>Mass</b>						
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_8712
<b>QC Batch Number:</b>	170007
<b>Directory:</b>	290917PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 21-Sep-17  
**Date Analysed:** 28-Sep-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# 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

<b>Sample ID :</b>	CL1775392	CL1775393	CL1775394	CL1775395	CL1775396
<b>Client ID :</b>	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.

[illegible]

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:**

Job Number:

QC Batch Number:

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

s17 8712

**Separation:** Silica gel

**Eluents:** Hexane, DCM

D:\TES\DATA\2017\092717\092717 2017-09-27 09-53-19\B-025-62-RMS171031ARO.D

Ultra Sonic

**Matrix:** Soil

Date Booked in 14-Sep-17

Date Extracted 25-Sep-01

**Date Analysed** 27-Sep-17, 15:15:31

[illegible]

## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



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## 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

A handwritten signature in black ink, appearing to read 'MHickson'.

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.: 17-65413-2

Customer Reference: S178712

Customer Order No: 42062 BEC

Customer Sample No						S1775392	S1775393	S1775394
Customer Sample ID						BH14 0.75	BH14 1.75	BH14 4.00
RPS Sample No						340625	340626	340627
Sample Type						SOIL	SOIL	SOIL
Sample Depth (m)						0.75m	1.75m	4.00m
Sampling Date						22/08/2017	22/08/2017	22/08/2017
Determinand	CAS No	Codes	SOP	Units	RL			
dibutyltin (DBT)	1002-53-5	N	in house	mg/kg as cation	0.02	< 0.02	< 0.02	< 0.02
tributyltin (TBT)	56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05	< 0.05



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Report No.: 17-65413-2

Customer Reference: S178712

Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-65413	3 soil samples	Blank: <RL for DBT & TBT  AQC: DBT - 100% TBT - 107%



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Deviating Samples

Report No.: 17-65413-2  
Customer 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-submission 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	



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## 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)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	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 as-received 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

# Sample Analysis

# ESG Environmental Chemistry - Requested Analysis

S178708

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S178708

Consignment No S68873  
 Date Logged 14-Sep-2017

Report Due 02-Oct-2017

ID Number	Description	MethodID	ANC	CustServ	GROHSA	ICPMSS									ICPSOIL	PAHSED	PCBMS3Q					TMSS	TPHUSI	WSLM59																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																					
							Sub005	^Tributyltin	^Dibutyltin	PCB- 7 Congeners (Marine Sediments)	Organochlorine Pesticides (Marine Sediments)	PAH by MS DII	Iron (Sediments)	Zinc (MS) Sediments				Nickel (MS) Sediments	Mercury (MS) Sediments	Manganese (MS) Sediments	Lead (MS) Sediments				Chromium (MS) Sediments	Cadmium (MS) Sediments	Arsenic (MS) Sediments	Copper (MS) Sediment	GRO (AA) by HSA GC-FID	Report C	Carbonate %	Sampled																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																													

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 13:10

	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
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (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
S1775385	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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	^Dibutyltin	^Tributyltin
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
S1775385	Reference Material (% 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 : Station :	CL1775384 QC Blank	CL1775385 Reference Material (% F	CL1775381 BH15 0.50	CL1775382 BH15 2.50	CL1775383 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	N.D	5.8	1.2	62.5
Sum 276 *			0	92	68.1	26.7	711.6
Sum of all fractions *			0	101	972.4	331.4	8261.9
Sum of NPD fraction *			0	107	230.7	77.9	3061.7
NPD / 4-6 ring PAH ratio *			#DIV/0!	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.

	<b>Sample ID :</b>	CL1775384	CL1775385	CL1775381	CL1775382	CL1775383
		<b>Station :</b>	Reference Material (% Recovery)	BH15 0.50	BH15 2.50	CRM
<b>PAH</b>	<b>Mass</b>	QC Blank				
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_8708
<b>QC Batch Number:</b>	170007
<b>Directory:</b>	290917PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 21-Sep-17  
**Date Analysed:** 28-Sep-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_8708  
**QC Batch Number:** 170007  
**Directory:** 270917.TQ1  
**Method:** Ultrasonic

**Matrix:** Sediment  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 27-Sep-17  
**Date Analysed:** 28-Sep-17  
**UKAS Accredited:** No

Compounds marked \* are not UKAS or MCerts accredited

<b>Sample ID :</b>	CL1775381	CL1775382	CL1775383	CL1775384	CL1775385
<b>Client ID :</b>	BH15 0.50	BH15 2.50	CRM	QC Blank	Reference Material (% 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.

[illegible]

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:**

Job Number:

QC Batch Number:

**Directory:**

**Method:**

Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI

s17 8708

**Separation:** Silica gel

**Eluents:** Hexane, DCM

D:\TES\DATA\2017\092717\092717 2017-09-27 09-53-19\B-025-62-RMS171031ARO.D

Ultra Sonic

**Matrix:** Soil

**Date Booked in** 14-Sep-17

Date Extracted 25-Sep-17

**Date Analysed** 27-Sep-17, 15:15:31

[illegible]

## Additional Report Notes

[illegible]

## Sample Descriptions

[illegible]



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## 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:** S178708

**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

A handwritten signature in black ink, appearing to read 'MH', written over a light grey grid background.

**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 Sample No	S1775381	S1775382
Customer Sample ID	BH15 0.50	BH15 2.50
RPS Sample No	340623	340624
Sample Type	SOIL	SOIL
Sample Depth (m)	0.50m	2.50m
Sampling Date	25/08/2017	25/08/2017

Determinand	CAS No	Codes	SOP	Units	RL		
dibutyltin (DBT)	1002-53-5	N	in house	mg/kg as cation	0.02	< 0.02	< 0.02
tributyltin (TBT)	56573-85-4	N	in house	mg/kg as cation	0.05	< 0.05	< 0.05



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Report No.: 17-65412-2

Customer Reference: S178708

Customer Order No: 42062 BEC

Comments

Job	Description	Job Comments
17-65412	2 soil samples	Blank: <RL for DBT & TBT  AQC: DBT - 100% TBT - 107%



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## Deviating Samples

Report No.: 17-65412-2

Customer 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-submission 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	



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## 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)	Insufficient Sample
U/S (in results)	Unsuitable Sample
S/C (in results)	See Comments
ND (in results)	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 as-received 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

# Sample Analysis

# SOCOTEC UK Ltd Environmental Chemistry - Requested Analysis

S180841

Customer Causeway Geotech Ltd  
Site Arklow Sewerage Scheme Marine Outfall GI  
Report No S180841

Consignment No S70512  
Date Logged 21-Nov-2017

Report Due 11-Dec-2017

ID Number	Description	MethodID	Sampled	ANC	Carbonte %	Report C	GROHSA	ICPMSS	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)	PCBMS30	TMS	TPHUSI	WLSM59																		
UKAS Accredited																								No		Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	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	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	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	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				R																	
CL/1784516	QC Blank			R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			R	R																	
CL/1784517	Reference Material (% Recovery)		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R			R	R																	

KEY:  
R Required  
DO Dependent Option  
C Completed  
^ Subcontracted  
12/12/2017 15:49

	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
S1784512	BH16 0.50	26.4	0.19	16.4	52.2	45
S1784513	BH16 2.50	8.8	0.85	19.2	17.9	19.3
S1784514	BH16 4.50	13.1	0.98	30.9	29.1	25.7
S1784515	CRM	17.77	1.611	62.77	56.42	81.22
S1784516	QC Blank	<0.5	<0.04	<0.5	<0.5	<0.5
S1784517	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 Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
S1784512	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	OGSNESED	OGSNESED
	Detection Limit	0.1	0.02	0.12	1	1
	Units	%	% M/M	%	ug Sn/kg	ug Sn/kg
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	Dibutyl Tin (Sediments)	Tributyl Tin (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
S1784517	Reference Material (% 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

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1784516	CL1784517	CL1784515	CL1784512	CL1784513	CL1784514
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	1941b	BH16 0.50	BH16 2.50	BH16 4.50
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>						
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	38	<1	3	4
Sum 276 *			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.

	<b>Sample ID :</b>	CL1784516	CL1784517	CL1784515	CL1784512	CL1784513	CL1784514
		<b>Station :</b>	Reference Material (% Recovery)	1941b	BH16 0.50	BH16 2.50	BH16 4.50
<b>PAH</b>	<b>Mass</b>						
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S18_0841
<b>QC Batch Number:</b>	170016
<b>Directory:</b>	041217PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 21-Nov-17  
**Date Extracted:** 01-Dec-17  
**Date Analysed:** 05-Dec-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S18\_0841  
**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

<b>Sample ID :</b>	CL1784512	CL1784513	CL1784514	CL1784515	CL1784516	CL1784517
<b>Client ID :</b>	BH16 0.50	BH16 2.50	BH16 4.50	CRM	QC Blank	Reference Material (% 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:** S18\_0841  
**Directory:** D:\TES\DATA\Y2017\1204HSA\_GC12\171204 2017-12-04 17-22-19\049F4901.D  
**Method:** Headspace GC/FID

**Matrix:** Soil  
**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.

[illegible]

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 0841

**Separation:** Silica gel

QC Batch Number:

171301

**Eluents:** Hexane, DCM

**Directory:**

C:\CHEM32\1\DATA\120617TPH GC15\120617 2017-12-06 12-58-48\OnlineEdited--024B.D

**Method:**

Ultra Sonic

**Matrix:** Soil

**Date Booked in** 21-Nov-17

**Date Extracted** 05-Dec-17

**Date Analysed:**06-Dec-17, 17:50:19

[illegible]

## Sample Descriptions

[illegible]

# Sample Analysis

# SOCOTEC UK Ltd Environmental Chemistry - Requested Analysis

S180843

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

WLSLMS9	Total Organic Carbon (Sediment)	Yes																				
TPHUSI	TPH by GC/FID (AR/Sl)	Yes																				
TMS5	Tot.Moisture @ 105C	Yes																				
PCBMS30	PCB- 7 Congeners (Marine Sediments)	Yes																				
	Organochlorine Pesticides (Marine Sediments)	No																				
PAHSED	PAH by MS Dti	Yes																				
OGSNEED	Tributyl Tin (Sediments)	No																				
	Dibutyl Tin (Sediments)	No																				
ICP50IL	Iron (Sediments)	Yes																				
	Zinc (MS) Sediments	Yes																				
	Nickel (MS) Sediments	Yes																				
	Mercury (MS) Sediments	Yes																				
	Manganese (MS) Sediments	Yes																				
	Lead (MS) Sediments	Yes																				
	Chromium (MS) Sediments	Yes																				
	Cadmium (MS) Sediments	Yes																				
	Arsenic (MS) Sediments	Yes																				
	ICPMSS	Copper (MS) Sediment	Yes																			
GROISA	GRO (AA) by HSA GC-FID	Yes																				
ClientServ	Report C																					
ANC	Carbonate %	No																				
MethodID	Sampled	UKAS Accredited																				
ID Number	Description																					
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
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
CL/1784524	CRM	03/11/17		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
CL/1784526	Reference Material (% Recovery)		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

KEY:  
R Required  
DO Dependent Option  
C Completed  
^ Subcontracted  
12/12/2017 15:56

	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
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
ID Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (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	OGSNSSED	OGSNSSED
	Detection Limit	0.1	0.02	0.12	1	1
	Units	%	% M/M	%	ug Sn/kg	ug Sn/kg
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	Dibutyl Tin (Sediments)	Tributyl Tin (Sediments)
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
S1784526	Reference Material (% 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

		<b>Sample ID :</b>	CL1784525	CL1784526	CL1784524	CL1784522	CL1784523
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	1941b	BH17 1.50	BH17 3.50
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>					
Naphthalene	1	128	<1	104	582	<1	1.3
C1 Naphthalenes *	2	142	<1	100	326	<1	1.1
C2 Naphthalenes *		156	<1	N.D	219	<1	<1
C3 Naphthalenes *		170	<1	N.D	179	<1	<1
C4 Naphthalenes *		184	<1	N.D	120	<1	<1
Sum Naphthalenes *			0	102	1427	0	2
Phenanthrene / Anthracene	2	178	<1	105	519	<1	3.3
C1 178 *		192	<1	N.D	310	<1	1.5
C2 178 *		206	<1	N.D	244	<1	1.1
C3 178 *		220	<1	N.D	171	<1	<1
Sum 178 *			0	105	1243	0.0	5.9
Dibenzothiophene		184	<1	105	47	<1	<1
C1 Dibenzothiophenes *		198	<1	N.D	72	<1	<1
C2 Dibenzothiophenes *		212	<1	N.D	105	<1	<1
C3 Dibenzothiophenes *		226	<1	N.D	67	<1	<1
Sum Dibenzothiophenes *			0	105	291	0.0	0.0
Fluoranthene / pyrene	2	202	<1	105	1062	<1	6.2
C1 202 *		216	<1	N.D	292	<1	1.7
C2 202 *		230	<1	N.D	248	<1	<1
C3 202 *		244	<1	N.D	112	<1	<1
Sum 202 *			0	105	1713	0.0	8.0
Benzoanthracene / Chrysene	2	228	<1	104	679	<1	2.7
C1 228 *		242	<1	N.D	272	<1	1.1
C2 228 *		256	<1	N.D	147	2.1	4.2
Sum 228 *			0	104	1098	2.1	8.0
Benzofluoranthenes / benzopyrenes	4	252	<1	99	1224	<1	<1
C1 252 *		266	<1	N.D	320	<1	1.3
C2 252 *		280	<1	N.D	231	<1	<1
Sum 252 *			0	99	1775	0.0	1.3
Dibenzoanthracene / Indenopyrene / Benzoperylene	3	276	<1	97	604	<1	<1
C1 276 *		290	<1	N.D	89	<1	<1
C2 276 *		304	<1	N.D	38	<1	<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
NPD / 4-6 ring PAH ratio *			#DIV/0!	0.26	0.56	0.00	0.48

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.

	<b>Sample ID :</b>	CL1784525	CL1784526	CL1784524	CL1784522	CL1784523
		QC Blank	Reference Material (% Recovery)	1941b	BH17 1.50	BH17 3.50
<b>PAH</b>	<b>Mass</b>					
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S18_0843
<b>QC Batch Number:</b>	170016
<b>Directory:</b>	041217PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 21-Nov-17  
**Date Extracted:** 01-Dec-17  
**Date Analysed:** 05-Dec-17

**Compounds marked \* are not UKAS or MCerts accredited**

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S18\_0843  
**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

<b>Sample ID :</b>	CL1784522	CL1784523	CL1784524	CL1784525	CL1784526
<b>Client ID :</b>	BH17 1.50	BH17 3.50	CRM	QC Blank	Reference Material (% 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  
**Directory:** D:\TES\DATA\2017\1206HSA\_GC9\120617 2017-12-06 14-49-22\035F3501.D  
**Method:** Headspace GC/FID

**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.

[illegible]

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

<b>Customer and Site Details:</b>	Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI		
<b>Job Number:</b>	S18_0843	<b>Separation:</b>	Silica gel
<b>QC Batch Number:</b>	171297	<b>Eluents:</b>	Hexane, DCM
<b>Directory:</b>	D:\TES\DATA\Y2017\120117TPH_GC3\120117C 2017-12-04 16-20-01\047B5701.D		
<b>Method:</b>	Ultra Sonic		

**Matrix:** Soil  
**Date Booked in** 21-Nov-17  
**Date Extracted** 04-Dec-17  
**Date Analysed:** 05-Dec-17, 04:05:51

[illegible]

## Sample Descriptions

[illegible]



# Sample Analysis

# SOCOTEC UK Ltd Environmental Chemistry - Requested Analysis

S180834

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

WLSLMS9	Total Organic Carbon (Sediment)	Yes																		
TPHUSI	TPH by GC/FID (AR/Sl)	Yes																		
TMSS	Tot.Moisture @ 105C	Yes																		
PCBMS30	PCB- 7 Congeners (Marine Sediments)	Yes																		
	Organochlorine Pesticides (Marine Sediments)	No																		
PAHSED	PAH by MS Dti	Yes																		
OGSNEED	Tributyl Tin (Sediments)	No																		
	Dibutyl Tin (Sediments)	No																		
ICP50IL	Iron (Sediments)	Yes																		
	Zinc (MS) Sediments	Yes																		
	Nickel (MS) Sediments	Yes																		
	Mercury (MS) Sediments	Yes																		
	Manganese (MS) Sediments	Yes																		
	Lead (MS) Sediments	Yes																		
	Chromium (MS) Sediments	Yes																		
	Cadmium (MS) Sediments	Yes																		
	Arsenic (MS) Sediments	Yes																		
	ICPMSS	Copper (MS) Sediment	Yes																	
GROISA	GRO (AA) by HSA GC-FID	Yes																		
ClientServ	Report C																			
ANC	Carbonate %	No																		
MethodID	Sampled	UKAS Accredited																		
		CL/1784477	BH18 0.50	06/11/17	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
		CL/1784479	BH18 4.50	06/11/17	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
		CL/1784481	QC Blank			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

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 16:17

	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
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
S1784482	Reference Material (% 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)
S1784477	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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	Dibutyl Tin (Sediments)	Tributyl Tin (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
S1784482	Reference Material (% 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

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1784481	CL1784482	CL1784480	CL1784477	CL1784478	CL1784479
			QC Blank	Reference Material (% Recovery)	1941b	BH18 0.50	BH18 2.50	BH18 4.50
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>						
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	38	<1	<1	<1
Sum 276 *			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.

	<i>Sample ID :</i>	CL1784481	CL1784482	CL1784480	CL1784477	CL1784478	CL1784479
	<i>Station :</i>	QC Blank	Reference Material (% Recovery)	1941b	BH18 0.50	BH18 2.50	BH18 4.50
<i>PAH</i>	<i>Mass</i>						
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S18_0834
<b>QC Batch Number:</b>	170016
<b>Directory:</b>	041217PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 21-Nov-17  
**Date Extracted:** 01-Dec-17  
**Date Analysed:** 05-Dec-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S18\_0834  
**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

<b>Sample ID :</b>	CL1784477	CL1784478	CL1784479	CL1784480	CL1784481	CL1784482
<b>Client ID :</b>	BH18 0.50	BH18 2.50	BH18 4.50	CRM	QC Blank	Reference Material (% 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:** S18\_0834  
**Directory:** D:\TES\DATA\Y2017\1204HSA\_GC12\171204 2017-12-04 17-22-19\041F4101.D  
**Method:** Headspace GC/FID

**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.

[illegible]

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

<b>Customer and Site Details:</b>	Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI		
<b>Job Number:</b>	S18_0834	<b>Separation:</b>	Silica gel
<b>QC Batch Number:</b>	171296	<b>Eluents:</b>	Hexane, DCM
<b>Directory:</b>	C:\CHEM321\DATA\120517TPH_GC15\120517 2017-12-05 18-17-42\066B2001.D		
<b>Method:</b>	Ultra Sonic		

**Matrix:** Soil  
**Date Booked in** 21-Nov-17  
**Date Extracted** 04-Dec-17  
**Date Analysed:** 05-Dec-17, 22:20:07

[illegible]

## Sample Descriptions

[illegible]

# Sample Analysis

# SOCOTEC UK Ltd Environmental Chemistry - Requested Analysis

S180839

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S180839

Consignment No S70515  
 Date Logged 21-Nov-2017

Report Due 11-Dec-2017

ID Number	Description	MethodID	ANC	ClientServ	GROISA	ICPMSS									ICPSOIL	OGSNEED	PAHSED	PCBMS30	TMSS	TPHUSI	WLSLMS9	
		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)	Organochlorine Pesticides (Marine Sediments)	PCB- 7 Congeners (Marine Sediments)	Tot.Moisture @ 105C	TPH by GC/FID (AR/Sl)	Total Organic Carbon (Sediment)
UKAS Accredited			No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	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
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
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
CL/1784504	CRM	07/11/17		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
CL/1784506	Reference Material (% Recovery)		R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R	R		R	R

KEY:  
 R Required  
 DO Dependent Option  
 C Completed  
 ^ Subcontracted  
 12/12/2017 16:35

	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
S1784501	BH19 0.50	18.2	0.11	17.3	43.1	37.6
S1784502	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 Number	Description	Manganese (MS) Sediments	Mercury (MS) Sediments	Nickel (MS) Sediments	Zinc (MS) Sediments	Iron (Sediments)
S1784501	BH19 0.50	829.9	0.02	16.3	102.2	38900
S1784502	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
ID Number	Description	Tot.Moisture @ 105C	Total Organic Carbon (Sediment)	Carbonate %	Dibutyl Tin (Sediments)	Tributyl Tin (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
S1784506	Reference Material (% 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

**Polyaromatic Hydrocarbon Concentrations (ng/g dry weight basis)**

UKAS accredited?: Yes

		<b>Sample ID :</b>	CL1784505	CL1784506	CL1784504	CL1784501	CL1784502	CL1784503
		<b>Station :</b>	QC Blank	Reference Material (% Recovery)	1941b	BH19 0.50	BH19 2.50	BH19 4.50
<b>PAH Fraction</b>	<b># PAH</b>	<b>Mass</b>						
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 / 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	<1	N.D	89	<1	1.1	3.7
C2 276 *		304	<1	N.D	38	<1	<1	2.5
Sum 276 *			0	97	731	0.0	5.0	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.

	<b>Sample ID :</b>	CL1784505	CL1784506	CL1784504	CL1784501	CL1784502	CL1784503
		QC Blank	Reference Material (% Recovery)	1941b	BH19 0.50	BH19 2.50	BH19 4.50
<b>PAH</b>	<b>Mass</b>						
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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S18_0839
<b>QC Batch Number:</b>	170016
<b>Directory:</b>	041217PCB.TQ1
<b>Method:</b>	Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 21-Nov-17  
**Date Extracted:** 01-Dec-17  
**Date Analysed:** 05-Dec-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]



# Organochlorine Pesticides

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S18\_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

<b>Sample ID :</b>	CL1784501	CL1784502	CL1784503	CL1784504	CL1784505	CL1784506
<b>Client ID :</b>	BH19 0.50	BH19 2.50	BH19 4.50	CRM	QC Blank	Reference Material (% 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:** S18\_0839  
**Directory:** D:\TES\DATA\Y2017\1204HSA\_GC12\171204 2017-12-04 17-22-19\046F4601.D  
**Method:** Headspace GC/FID

**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.

[illegible]

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

<b>Customer and Site Details:</b>	Causeway Geotech Ltd : Arklow Sewerage Scheme Marine Outfall GI		
<b>Job Number:</b>	S18_0839	<b>Separation:</b>	Silica gel
<b>QC Batch Number:</b>	171296	<b>Eluents:</b>	Hexane, DCM
<b>Directory:</b>	C:\CHEM32\1\DATA\120517TPH_GC15\120517 2017-12-05 18-17-42\066B2001.D		
<b>Method:</b>	Ultra Sonic		

**Matrix:** Soil  
**Date Booked in** 21-Nov-17  
**Date Extracted** 04-Dec-17  
**Date Analysed:** 05-Dec-17, 22:20:07

[illegible]

## Sample Descriptions

[illegible]

Our Ref: EFS/179334 (Ver. 1)

Your Ref: 17-0167

October 23, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

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

A handwritten signature in blue ink, appearing to read 'Tim Barnes'.

Tim Barnes

Operations Director  
Energy & Waste Services

Date of Issue: 23-Oct-2017

Tests marked 'N' 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.



# 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  
**Directory:** 101617.MS17\ **Matrix:** Soil  
**Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: Yes

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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 **Date Extracted:** 15-Oct-17  
**Quantitation File:** Initial Calibration **Date Analysed:** 16-Oct-17  
**Directory:** 101617.MS17\ **Matrix:** Soil  
**Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: Yes

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	9.74	0.12	91
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	-	-	< 1.32	-

\* 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 **Date Extracted:** 15-Oct-17  
**Quantitation File:** Initial Calibration **Date Analysed:** 17-Oct-17  
**Directory:** 101617.MS17\ **Matrix:** Soil  
**Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

# Polycyclic Aromatic Hydrocarbons GC/MS (SIM)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Sample Details:** Reference Material (% Rec **Job Number:** 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  
**Directory:** 101617.MS17\ **Matrix:** Soil  
**Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Recovery %	% Fit
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.

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.

## Polychlorinated Biphenyls (congeners)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S17_9334
<b>QC Batch Number:</b>	171103
<b>Directory:</b>	100917PCB.GC70
<b>Method:</b>	Ultrasonic

<b>Matrix:</b>	Soil
<b>Date Booked in:</b>	05-Oct-17
<b>Date Extracted:</b>	15-Oct-17
<b>Date Analysed:</b>	17-Oct-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

<b>Client</b>	Causeway Geotech Ltd			<b>Leaching Data</b>	
				Weight of sample (kg)	0.099
<b>Contact</b>	Neil Haggan			Moisture content @ 105°C (% of Wet Weight)	10.9
				Equivalent Weight based on drying at 105°C (kg)	0.090
<b>Site</b>	Arklow Sewerage Scheme Marine Outfall GI			Volume of water required to carry out 10:1 stage (litres)	0.891
				Fraction of sample above 4 mm %	92.000
<b>Sample Description</b>		<b>Report No</b>	<b>Sample No</b>	<b>Issue Date</b>	Fraction of non-crushable material %
BH01 1.50		s17_9334	CL/1777957	23-Oct-17	0.000

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<2.6	100		
U	PHSOIL	pH (pH units)	7.9		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.12		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	606				
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	ISEF	Fluoride	0.4	4	10	150	500
U	ICPWATVAR	Sulphate as SO4	26	260	1000	20000	50000
N	WSLM27	Total Dissolved Solids	473	4730	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

## WASTE ACCEPTANCE CRITERIA TESTING BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.106
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	15.6
					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)	0.884
					Fraction of sample above 4 mm %	0.000
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	
BH01 3.50		s17_9334	CL/1777958	23-Oct-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.7	100		
U	PHSOIL	pH (pH units)	8.4		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.8		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.3	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	880				
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
N	WSLM27	Total Dissolved Solids	686	6860	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	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

## Sample Analysis

# ESG Environmental Chemistry

## Analytical and Deviating Sample Overview

S179334

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.

ID Number	Description	MethodID	ANC	BTEX-HSA	MTBE	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 GC/FID (AR)	Total Organic Carbon
			Acid Neut. Capacity	BTEX-HSA + MTBE analysis	(µg/kg)										
CL/1777957	BH01 1.50	21/09/17	E	E	E	E	E	E	E	E	E	E	E	E	E
CL/1777958	BH01 3.50	21/09/17	E	E	E	E	E	E	E	E	E	E	E	E	E
CL/1777959	QC Blank														
CL/1777960	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
- 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

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.  
 Where individual results are flagged see report notes for status.

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"

Where individual results are flagged see report notes for status.



# 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/arocloris 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 ( $\mu\text{S}/\text{cm}$ ) by electrical conductivity probe.
Water	WSLM27	As Received	Gravimetric Determination
Water	WSLM3	As Received	Determination of the pH of water samples by pH probe

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup> @ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

**▮** 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S17\_9334

Note: major constituent in upper case

Our Ref: EFS/178702 (Ver. 1)

Your Ref: 17-0167

September 29, 2017



Environmental Chemistry

ESG

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in dark ink, appearing to read 'J Chislett', written in a cursive style.

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

A handwritten signature in black ink, appearing to read 'Tim Barnes'.

Operations Director  
Energy & Waste Services

Date of Issue: 29-Sep-2017

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.

ESG accepts no responsibility for any sampling not carried out by our personnel.

Where individual results are flagged see report notes for status.



# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH02 0.50	<b>Job Number:</b>	S17_8702
<b>LIMS ID Number:</b>	CL1775339	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
Naphthalene	91-20-3	3.26	0.36	99
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	-	-	< 1.56	-

\* 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.

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:** BH02 2.50 **Job Number:** s17\_8702  
**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. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH02 5.50	<b>Job Number:</b>	S17_8702
<b>LIMS ID Number:</b>	CL1775341	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	QC Blank	<b>Job Number:</b>	S17_8702
<b>LIMS ID Number:</b>	CL1775342	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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.

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:** Reference Material (% Rec **Job Number:** S17\_8702  
**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. (min)	Recovery %	% Fit
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.

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.

# Polychlorinated Biphenyls (congeners)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_8702  
**QC Batch Number:** 171030  
**Directory:** 092517PCB.GC70  
**Method:** Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 22-Sep-17  
**Date Analysed:** 25-Sep-17

*Compounds marked \* are not UKAS or MCerts accredited*

Sample ID	Customer ID	Concentration, (µg/kg)						
		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

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.102
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	12.4
					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
					Fraction of sample above 4 mm %	45.500
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	
BH02 0.50		s17_8702	CL/1775339	29-Sep-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	<0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	46	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.87	100		
N	PHSOIL	pH (pH units)	8.2		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.4		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.3	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1060				
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	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	0.003	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

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  
 Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.114
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	20.2
					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)	0.876
					Fraction of sample above 4 mm %	19.300
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH02 2.50		s17_8702	CL/1775340	29-Sep-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.99	3	5	6
N	LOI450	Loss on Ignition (%)	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)	119	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<4.62	100		
N	PHSOIL	pH (pH units)	8.1		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.5		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.3	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1620				
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	50000
N	WSLM27	Total Dissolved Solids	1260	12600	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	4.4	44	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

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.117
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	24.0
					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)	0.873
					Fraction of sample above 4 mm %	6.000
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH02 5.50		s17_8702	CL/1775341	29-Sep-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.56	3	5	6
N	LOI450	Loss on Ignition (%)	3.5			10
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.07	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	<0.042	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	<13	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.79	100		
N	PHSOIL	pH (pH units)	8.6		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	3.3		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.4	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	430				
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	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	0.014	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	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.  
 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

## ESG Environmental Chemistry Analytical and Deviating Sample Overview

S178702

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** 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.

ID Number	Description	MethodID	ANC	BTEX-HSA	MTBE	CEN Leac(P)C	Clst Srv	LOI(P)MM	PAH(SUS)	PCB(CD)	PHSOIL	TMSS	TPH(DUS)	WLS(M9)
		Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	(µg/kg)		Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	Total Organic Carbon
CL/1775339	BH02 0.50	29/08/17		E	E				E		E		E	E
CL/1775340	BH02 2.50	29/08/17		E	E				E		E		E	E
CL/1775341	BH02 5.50	29/08/17		E	E				E		E		E	E
CL/1775342	QC Blank													
CL/1775343	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
- 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**

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.

Where individual results are flagged see report notes for status.



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

# 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/arocloris 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	ICPSW	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	SFAP1	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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup>@ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

▮ 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S17\_8702

Note: major constituent in upper case

[illegible]

Our Ref: EFS/179799 (Ver. 1)

Your Ref: 17-0167

November 1, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

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

A handwritten signature in blue ink, appearing to read 'Tim Barnes'.

Operations Director  
Energy & Waste Services

Date of Issue: 01-Nov-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.

SOCOTEC UK Limited accepts no responsibility for any sampling not carried out by our personnel.



# Polycyclic Aromatic Hydrocarbons GC/MS (SIM)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Sample Details:** BH06 0.50 **Job Number:** S17\_9799  
**LIMS ID Number:** CL1780166 **Date Booked in:** 17-Oct-17  
**QC Batch Number:** 171155 **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. (min)	Concentration mg/kg	% Fit
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	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.

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:** BH06 1.50 **Job Number:** s17\_9799  
**LIMS ID Number:** CL1780167 **Date Booked in:** 17-Oct-17  
**QC Batch Number:** 171155 **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. (min)	Concentration mg/kg	% Fit
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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH06 2.50	<b>Job Number:</b>	S17_9799
<b>LIMS ID Number:</b>	CL1780168	<b>Date Booked in:</b>	17-Oct-17
<b>QC Batch Number:</b>	171155	<b>Date Extracted:</b>	26-Oct-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	27-Oct-17
<b>Directory:</b>	102617.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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.

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\_9799  
**LIMS ID Number:** CL1780169 **Date Booked in:** 17-Oct-17  
**QC Batch Number:** 171155 **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. (min)	Concentration mg/kg	% Fit
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	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.

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:** Reference Material (% Rec **Job Number:** S17\_9799  
**LIMS ID Number:** CL1780170 **Date Booked in:** 17-Oct-17  
**QC Batch Number:** 171155 **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. (min)	Recovery %	% Fit
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

"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.

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.

# Polychlorinated Biphenyls (congeners)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_9799  
**QC Batch Number:** 171158  
**Directory:** 102617PCB.GC22  
**Method:** Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 17-Oct-17  
**Date Extracted:** 26-Oct-17  
**Date Analysed:** 27-Oct-17

\* This sample data is not UKAS or Mcerts accredited.

Sample ID	Customer ID	Concentration, (µg/kg)						
		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

## WASTE ACCEPTANCE CRITERIA TESTING BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data		
					Weight of sample (kg)	0.107	
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	14.3	
					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)	0.883	
					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		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	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

Acct	Meth	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1		
			mg/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	8.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1220				
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

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	Causeway Geotech Ltd	Leaching Data	
		Weight of sample (kg)	0.105
Contact	Neil Haggan	Moisture content @ 105°C (% of Wet Weight)	15.7
		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)	0.885
		Fraction of sample above 4 mm %	0.000
Sample Description	Report No	Sample No	Issue Date
BH06 1.50	s17_9799	CL/1780167	01-Nov-17
		Fraction of non-crushable material %	0.000

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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		
N	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

Acc	Meth	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount	Landfill Waste Acceptance Criteria Limit values for BSEN 12457/2 @ L/S 10 litre kg-1		
			mg/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1080				
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
N	WSLM27	Total Dissolved Solids	843	8430	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	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.

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

<b>Client</b>	Causeway Geotech Ltd	<b>Leaching Data</b>			
		Weight of sample (kg)			0.105
<b>Contact</b>	Neil Haggan	Moisture content @ 105°C (% of Wet Weight)			16.1
		Equivalent Weight based on drying at 105°C (kg)			0.090
<b>Site</b>	Arklow Sewerage Scheme Marine Outfall GI	Volume of water required to carry out 10:1 stage (litres)			0.885
		Fraction of sample above 4 mm %			0.000
<b>Sample Description</b>	<b>Report No</b>	<b>Sample No</b>	<b>Issue Date</b>	Fraction of non-crushable material %	
BH06 2.50	s17_9799	CL/1780168	01-Nov-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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
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		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.62	100		
N	PHSOIL	pH (pH units)	8.6		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.52		To be evaluated	To be evaluated

Acct	Meth	Leachate Analysis	10:1 Single Stage Leachate	Calculated cumulative amount	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1		
			mg/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.4	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1170				
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
N	WSLM27	Total Dissolved Solids	911	9110	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	3	30	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



Analytical and Deviating Sample Overview

Customer  
Site  
Report No

Causeway Geotech Ltd  
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

ID Number	Description	MethodID	Sampled	ANC	BTEXHSA	CEN Leach(P)C	CustServ	LOI(MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS	WSLM59	
														Total Organic Carbon	TPH by GC/FID (AR)
					BTEX-HSA + MTBE analysis	MTBE (µg/kg)	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 GC/FID (AR)	Total Organic Carbon
CL/1780166	BH06 0.50	29/09/17			E	E			E		E		E	E	E
CL/1780167	BH06 1.50	29/09/17			E	E			E		E		E	E	E
CL/1780168	BH06 2.50	29/09/17			E	E			E		E		E	E	E
CL/1780169	QC Blank														
CL/1780170	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

AThe sample was received in an inappropriate container for this analysis  
BThe sample was received without the correct preservation for this analysis  
CHeadspace present in the sample container  
DThe sampling date was not supplied so holding time may be compromised - applicable to all analysis  
ESample processing did not commence within the appropriate holding time  
FSample 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”

Where individual results are flagged see report notes for status.

# 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/arocloris 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 ( $\mu\text{S}/\text{cm}$ ) by electrical conductivity probe.
Water	WSLM27	As Received	Gravimetric Determination
Water	WSLM3	As Received	Determination of the pH of water samples by pH probe

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup> @ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

**▮** 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S17\_9799

Note: major constituent in upper case

[illegible]

Our Ref: EFS/179864 (Ver. 1)

Your Ref: 17-0167

November 2, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

J Colbourne  
Project Co-ordinator  
01283 554547

# TEST REPORT



1252

**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

Date of Issue: 02-Nov-2017

Tests marked 'N' 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.

Where individual results are flagged see report notes for status.





# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Sample Details:** BH07 0.50 **Job Number:** s17\_9864  
**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. (min)	Concentration mg/kg	% Fit
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	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.

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:** BH07 1.50 **Job Number:** S17\_9864  
**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. (min)	Concentration mg/kg	% Fit
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	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.

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:** BH07 2.50 **Job Number:** s17\_9864  
**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. (min)	Concentration mg/kg	% Fit
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.

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\_9864  
**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. (min)	Concentration mg/kg	% Fit
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	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.

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:** Reference Material (% Rec **Job Number:** s17\_9864  
**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. (min)	Recovery %	% Fit
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.

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.

# Polychlorinated Biphenyls (congeners)

**Customer and Site Details:**

**Job Number:** S17\_9864  
**QC Batch Number:** 171157  
**Directory:** 102617PCB.GC22  
**Method:** Ultrasonic

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

**Matrix:**

Soil

**Date Booked in:**

19-Oct-17

**Date Extracted:**

26-Oct-17

**Date Analysed:**

27-Oct-17

\* This sample data is not UKAS or Mcerts accredited.

Sample ID	Customer ID	Concentration, (µg/kg)						
		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

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.092
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	1.7
					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)	0.898
					Fraction of sample above 4 mm %	100.000
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH07 0.50		s17_9864	CL/1780492	02-Nov-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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 (%)	0.7			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)	<10	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.38	100		
N	PHSOIL	pH (pH units)	9.2		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.69		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	379				
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
N	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

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	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.100
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	11.9
					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)	0.890
					Fraction of sample above 4 mm %	71.500
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH07 1.50		s17_9864	CL/1780493	02-Nov-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.14	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)	14	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.54	100		
N	PHSOIL	pH (pH units)	8.8		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	3.97		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.7	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	885				
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	ICPMSW	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

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	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.106
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	19.0
					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)	0.884
					Fraction of sample above 4 mm %	71.900
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	
BH07 2.50		s17_9864	CL/1780494	02-Nov-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.37	3	5	6
N	LOI450	Loss on Ignition (%)	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)	16	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.68	100		
N	PHSOIL	pH (pH units)	8.2		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.19		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.8	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1360				
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

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

## Socotec Environmental Chemistry Analytical and Deviating Sample Overview

S179864

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S179864

Consignment No S69782  
Date Logged 19-Oct-2017  
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.

ID Number	Description	MethodID	ANC	BTEXHSA	MTBE	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 GC/FID (AR)	Total Organic Carbon
CL/1780492	BH07 0.50	11/10/17		E	E						E				
CL/1780493	BH07 1.50	11/10/17		E	E						E				
CL/1780494	BH07 2.50	11/10/17		E	E						E				
CL/1780495	QC Blank														
CL/1780496	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
- 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**

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.

Where individual results are flagged see report notes for status.

**Report Number : EFS/179864**

## Additional Report Notes

[illegible]

# 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/arocloris 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	ICPSW	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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup>@ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

**▯** 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S17\_9864

Note: major constituent in upper case

Our Ref: EFS/179861 (Ver. 1)

Your Ref: 17-0167

November 2, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

J Colbourne  
Project Co-ordinator  
01283 554547

# TEST REPORT



1252

**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

Date of Issue: 02-Nov-2017

Tests marked 'N' 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.

Where individual results are flagged see report notes for status.





# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Sample Details:** BH08 0.50 **Job Number:** s17\_9861  
**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. (min)	Concentration mg/kg	% Fit
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	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.

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:** BH08 1.50 **Job Number:** S17\_9861  
**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. (min)	Concentration mg/kg	% Fit
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	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.

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:** BH08 2.50 **Job Number:** s17\_9861  
**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. (min)	Concentration mg/kg	% Fit
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	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.

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\_9861  
**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. (min)	Concentration mg/kg	% Fit
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	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.

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:** Reference Material (% Rec **Job Number:** S17\_9861  
**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. (min)	Recovery %	% Fit
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.

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.

# Polychlorinated Biphenyls (congeners)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_9861  
**QC Batch Number:** 171157  
**Directory:** 102617PCB.GC22  
**Method:** Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 19-Oct-17  
**Date Extracted:** 26-Oct-17  
**Date Analysed:** 27-Oct-17

\* This sample data is not UKAS or Mcerts accredited.

Sample ID	Customer ID	Concentration, (µg/kg)						
		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

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd			Leaching Data	
				Weight of sample (kg)	0.100
Contact	Neil Haggan			Moisture content @ 105°C (% of Wet Weight)	13.3
				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)	0.890
				Fraction of sample above 4 mm %	43.500
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %
BH08 0.50		s17_9861	CL/1780480	02-Nov-17	0.000

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.17	3	5	6
N	LOI450	Loss on Ignition (%)	1.1			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)	18	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.57	100		
N	PHSOIL	pH (pH units)	8.6		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.97		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>oo</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>oo</sup>	7.9	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>oo</sup>	889				
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	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	0.002	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		
N	WSLM13	Dissolved Organic Carbon	1.8	18	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



# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.102
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	11.5
					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
					Fraction of sample above 4 mm %	45.200
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	
BH08 1.50		s17_9861	CL/1780481	02-Nov-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	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)	<0.06	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)	<1.54	100		
N	PHSOIL	pH (pH units)	8.5		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.88		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>oo</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>oo</sup>	7.8	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>oo</sup>	1020				
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	<0.001	<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	0.001	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	50000
N	WSLM27	Total Dissolved Solids	795	7950	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	1	10	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

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.107
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	16.7
					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)	0.883
					Fraction of sample above 4 mm %	0.000
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	
BH08 2.50		s17_9861	CL/1780482	02-Nov-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.06	3	5	6
N	LOI450	Loss on Ignition (%)	0.8			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)	13	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.63	100		
N	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	Method 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/l except <sup>oo</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>oo</sup>	7.4	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>oo</sup>	1400				
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	<0.001	<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	0.002	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	20000	50000
N	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

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

## Socotec Environmental Chemistry Analytical and Deviating Sample Overview

S179861

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S179861

Consignment No S69780  
Date Logged 19-Oct-2017  
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.

ID Number	Description	MethodID	ANC	BTEX-HSA	MTBE	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 GC/FID (AR)	Total Organic Carbon
			Acid Neut. Capacity	BTEX-HSA + MTBE analysis	(µg/kg)										
CL/1780480	BH08 0.50	10/10/17		E	E						E				
CL/1780481	BH08 1.50	10/10/17		E	E						E				
CL/1780482	BH08 2.50	10/10/17		E	E						E				
CL/1780483	QC Blank														
CL/1780484	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
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 - <b>Note: due date may be affected if triggered</b>
	No analysis scheduled
^	Analysis Subcontracted - <b>Note: due date may vary</b>

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.

Where individual results are flagged see report notes for status.

# 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.

# 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 GC/FID
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 GC/MS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GC/ECD 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 GC/FID 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 ICP/MS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using IC/POES
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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup>@ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

▮ 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S17\_9861

Note: major constituent in upper case

Our Ref: EFS/180511 (Ver. 1)

Your Ref: 17-0167

November 29, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

J Colbourne  
Project Co-ordinator  
01283 554547



# TEST REPORT



1252

**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

Date of Issue: 29-Nov-2017

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.



# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH09 0.50	<b>Job Number:</b>	S18_0511
<b>LIMS ID Number:</b>	CL1783094	<b>Date Booked in:</b>	09-Nov-17
<b>QC Batch Number:</b>	171249	<b>Date Extracted:</b>	22-Nov-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	22-Nov-17
<b>Directory:</b>	112217.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH09 1.50	<b>Job Number:</b>	s18_0511
<b>LIMS ID Number:</b>	CL1783095	<b>Date Booked in:</b>	09-Nov-17
<b>QC Batch Number:</b>	171249	<b>Date Extracted:</b>	22-Nov-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	22-Nov-17
<b>Directory:</b>	112217.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH09 2.50	<b>Job Number:</b>	S18_0511
<b>LIMS ID Number:</b>	CL1783096	<b>Date Booked in:</b>	09-Nov-17
<b>QC Batch Number:</b>	171249	<b>Date Extracted:</b>	22-Nov-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	22-Nov-17
<b>Directory:</b>	112217.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** 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. (min)	Concentration mg/kg	% Fit
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	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.

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:** Reference Material (% Rec **Job Number:** S18\_0511  
**LIMS ID Number:** CL1783098 **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. (min)	Recovery %	% Fit
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.

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.

## Polychlorinated Biphenyls (congeners)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S18_0511
<b>QC Batch Number:</b>	171249
<b>Directory:</b>	112117PCB.GC22
<b>Method:</b>	Ultrasonic

<b>Matrix:</b>	Soil
<b>Date Booked in:</b>	09-Nov-17
<b>Date Extracted:</b>	22-Nov-17
<b>Date Analysed:</b>	22-Nov-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]



WASTE ACCEPTANCE CRITERIA TESTING  
BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.103
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	14.1
					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)	0.887
					Fraction of sample above 4 mm %	7.300
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

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.06	3	5	6
N	LOI450	Loss on Ignition (%)	1.1			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)	49	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.58	100		
N	PHSOIL	pH (pH units)	8.4		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.7		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1270				
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.

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	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.108
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	16.5
					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)	0.882
					Fraction of sample above 4 mm %	11.600
Sample 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

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.06	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)	101	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.63	100		
N	PHSOIL	pH (pH units)	8.5		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.04		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1590				
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	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

WASTE ACCEPTANCE CRITERIA TESTING  
BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.102
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	18.2
					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
					Fraction of sample above 4 mm %	52.200
Sample 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

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.17	3	5	6
N	LOI450	Loss on Ignition (%)	1.4			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)	33	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.66	100		
N	PHSOIL	pH (pH units)	8.5		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.68		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	8	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1150				
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		
N	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.

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Customer

Site

Report No

Causeway Geotech Ltd  
Arklow Sewerage Scheme Marine Outfall GI  
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

ID Number	Description	MethodID	ANC	BTEXHSA		CEN Leach(P)C	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFDUS		WSLMS9
		Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)		Report C		PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GC/FID (AR)	Total Organic Carbon
CL/1783094	BH09 0.50	27/10/17		E	E				E		E		E	E	E
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)														

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

B

C

D

E

F

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**

# 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 GC/FID
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 GC/MS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GC/ECD 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 GC/FID 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 ICP/MS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using IC/POES
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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup> @ 15°C

### **Gas (Tedlar bag) Analysis**

Unless stated otherwise, results are expressed as ug/l

### **Asbestos Analysis**

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

▮ 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S18\_0511

Note: major constituent in upper case

[illegible]

Our Ref: EFS/180513 (Ver. 1)

Your Ref: 17-0167

November 29, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

J Colbourne  
Project Co-ordinator  
01283 554547



# TEST REPORT



1252

**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

Date of Issue: 29-Nov-2017

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.



# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Sample Details:** BH10 0.50 **Job Number:** 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. (min)	Concentration mg/kg	% Fit
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	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.

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:** BH10 1.50 **Job Number:** 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 **Date Analysed:** 22-Nov-17  
**Directory:** 112217.MS17\ **Matrix:** Soil  
**Dilution:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** BH10 2.50 **Job Number:** 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. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	QC Blank	<b>Job Number:</b>	S18_0513
<b>LIMS ID Number:</b>	CL1783108	<b>Date Booked in:</b>	09-Nov-17
<b>QC Batch Number:</b>	171249	<b>Date Extracted:</b>	22-Nov-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	22-Nov-17
<b>Directory:</b>	112217.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** Reference Material (% Rec **Job Number:** S18\_0513  
**LIMS ID Number:** CL1783109 **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. (min)	Recovery %	% Fit
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.

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.

## Polychlorinated Biphenyls (congeners)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S18_0513
<b>QC Batch Number:</b>	171249
<b>Directory:</b>	112117PCB.GC22
<b>Method:</b>	Ultrasonic

<b>Matrix:</b>	Soil
<b>Date Booked in:</b>	09-Nov-17
<b>Date Extracted:</b>	22-Nov-17
<b>Date Analysed:</b>	22-Nov-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]



WASTE ACCEPTANCE CRITERIA TESTING  
BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.096
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	7.2
					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)	0.894
					Fraction of sample above 4 mm %	85.200
Sample 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

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.9	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	645				
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.

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	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.141
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	40.5
					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)	0.849
					Fraction of sample above 4 mm %	17.000
Sample 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

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	4340				
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.

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	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.107
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	9.2
					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)	0.883
					Fraction of sample above 4 mm %	0.000
Sample 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

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.18	3	5	6
N	LOI450	Loss on Ignition (%)	1.4			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)	21	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.50	100		
N	PHSOIL	pH (pH units)	7.8		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.08		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.7	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	909				
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  
Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

Customer  
Site  
Report No

Causeway Geotech Ltd  
Arklow Sewerage Scheme Marine Outfall GI  
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

ID Number	Description	MethodID	ANC	BTEXHSA		CEN Leach(P)C	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFDUS		WSLMS9
		Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)		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 GC/FID (AR)	Total Organic Carbon
CL/1783105	BH10 0.50	26/10/17		E	E				E		E		E	E	E
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)														

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

AThe sample was received in an inappropriate container for this analysis  
BThe sample was received without the correct preservation for this analysis  
CHeadspace present in the sample container  
DThe sampling date was not supplied so holding time may be compromised - applicable to all analysis  
ESample processing did not commence within the appropriate holding time  
FSample 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

Where individual results are flagged see report notes for status.

# 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 GC/FID
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 GC/MS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GC/ECD 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 GC/FID 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 ICP/MS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using IC/POES
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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup> @ 15°C

### **Gas (Tedlar bag) Analysis**

Unless stated otherwise, results are expressed as ug/l

### **Asbestos Analysis**

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

▮ 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S18\_0513

Note: major constituent in upper case

Our Ref: EFS/180835 (Ver. 1)

Your Ref: 17-0167

December 6, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

J Colbourne  
Project Co-ordinator  
01283 554547



# TEST REPORT



1252

**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

Date of Issue: 06-Dec-2017

Tests marked 'N' 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.



# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Sample Details:** BH11 0.50 **Job Number:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH11 2.50	<b>Job Number:</b>	S18_0835
<b>LIMS ID Number:</b>	CL1784484	<b>Date Booked in:</b>	21-Nov-17
<b>QC Batch Number:</b>	171265	<b>Date Extracted:</b>	24-Nov-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	25-Nov-17
<b>Directory:</b>	112417.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** BH11 4.50 **Job Number:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** Reference Material (% Rec **Job Number:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Recovery %	% Fit
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.

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.

# Polychlorinated Biphenyls (congeners)

**Customer and Site Details:**

**Job Number:** S18\_0835  
**QC Batch Number:** 171265  
**Directory:** 112317PCB.GC70  
**Method:** Ultrasonic

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

**Matrix:**

Soil

**Date Booked in:**

21-Nov-17

**Date Extracted:**

23-Nov-17

**Date Analysed:**

23-Nov-17

*Compounds marked \* are not UKAS or MCerts accredited*

Sample ID	Customer ID	Concentration, (µg/kg)						
		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



# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.095
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	3.1
					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)	0.895
					Fraction of sample above 4 mm %	21.900
Sample Description		Report No	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

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.17	3	5	6
N	LOI450	Loss on Ignition (%)	0.7			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)	22	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.40	100		
N	PHSOIL	pH (pH units)	7.9		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.96		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.8	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	136				
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
N	WSLM27	Total Dissolved Solids	106	1060	4000	60000	100000
U	SFAP1	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.

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	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.092
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	6.8
					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)	0.898
					Fraction of sample above 4 mm %	93.500
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	
BH11 2.50		s18_0835	CL/1784484	06-Dec-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.33	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)	251	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.46	100		
N	PHSOIL	pH (pH units)	8		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.05		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	142				
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
N	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. 1

Landfill Waste Acceptance Criteria limit values correct as of 11th March 2009.

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# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.100
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	4.8
					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)	0.890
					Fraction of sample above 4 mm %	90.800
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	
BH11 4.50		s18_0835	CL/1784485	06-Dec-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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 (%)	0.6			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)	12	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.43	100		
N	PHSOIL	pH (pH units)	8		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.48		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.5	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	<100				
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	2	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
N	WSLM27	Total Dissolved Solids	64.6	646	4000	60000	100000
U	SFAP1	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	1.3	13	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

## Socotec Environmental Chemistry Analytical and Deviating Sample Overview

S180835

**Customer** Causeway Geotech Ltd  
**Site** Arklow Sewerage Scheme Marine Outfall GI  
**Report No** S180835

Consignment No S70496  
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.

ID Number	Description	MethodID	ANC	BTEX-HSA	MTBE	CEN Leac(P)C	Report C	L.O.I. % @ 450C	PAH(17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	TMS	TPH Band (>C10-C40)	TPH by GC/FID (AR)	Total Organic Carbon
			Acid Neut. Capacity	BTEX-HSA + MTBE analysis	(µg/kg)										
CL/1784483	BH11 0.50	02/11/17		E	E				E		E		E	E	E
CL/1784484	BH11 2.50	02/11/17		E	E				E		E		E	E	E
CL/1784485	BH11 4.50	02/11/17		E	E				E		E		E	E	E
CL/1784486	QC Blank														
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
B	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 - <b>Note: due date may be affected if triggered</b>
	No analysis scheduled
^	Analysis Subcontracted - <b>Note: due date may vary</b>

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.

Where individual results are flagged see report notes for status.

# 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 GC/FID
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 GC/MS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GC/ECD 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 GC/FID 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 ICP/MS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using IC/POES
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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup>@ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

▮ 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S18\_0835

Note: major constituent in upper case

Our Ref: EFS/178704 (Ver. 1)

Your Ref: 17-0167

September 29, 2017



Environmental Chemistry

ESG

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

Date of Issue: 29-Sep-2017

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.

ESG accepts no responsibility for any sampling not carried out by our personnel.

Where individual results are flagged see report notes for status.



# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH12 0.50	<b>Job Number:</b>	S17_8704
<b>LIMS ID Number:</b>	CL1775349	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
Naphthalene	91-20-3	3.26	0.12	96
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	-	-	< 1.32	-

\* 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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH12 4.50	<b>Job Number:</b>	s17_8704
<b>LIMS ID Number:</b>	CL1775350	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	QC Blank	<b>Job Number:</b>	s17_8704
<b>LIMS ID Number:</b>	CL1775351	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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.

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:** Reference Material (% Rec **Job Number:** S17\_8704  
**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. (min)	Recovery %	% Fit
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.

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.

## Polychlorinated Biphenyls (congeners)

### Customer and Site Details:

**Job Number:**

**QC Batch Number:**

## Directory:

### Method:

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

S17 8704

171030

092517PCB.GC70

## Ultrasonic

**Matrix:**

**Date Booked in:**

**Date Extracted:**

**Date Analysed:**

Soil

14-Sep-17

22-Sep-17

25-Sep-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.103
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	9.3
					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)	0.887
					Fraction of sample above 4 mm %	50.100
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	
BH12 0.50		s17_8704	CL/1775349	29-Sep-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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	Method 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/l except °°	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) °°	6.9	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µS/cm)	984				
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 SO4	65	650	1000	20000	50000
N	WSLM27	Total Dissolved Solids	768	7680	4000	60000	100000
U	SFAP1	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	3.2	32	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



## WASTE ACCEPTANCE CRITERIA TESTING BSEN 12457/2

<b>Client</b>	Causeway Geotech Ltd	<b>Leaching Data</b>	
		Weight of sample (kg)	0.114
<b>Contact</b>	Neil Haggan	Moisture content @ 105°C (% of Wet Weight)	19.8
		Equivalent Weight based on drying at 105°C (kg)	0.090
<b>Site</b>	Arklow Sewerage Scheme Marine Outfall GI	Volume of water required to carry out 10:1 stage (litres)	0.876
		Fraction of sample above 4 mm %	0.000
<b>Sample Description</b>	<b>Report No</b>	<b>Sample No</b>	<b>Issue Date</b>
BH12 4.50	s17_8704	CL/1775350	29-Sep-17
		Fraction of non-crushable material %	0.000

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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	Method 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/l except °°	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) °°	7.4	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µS/cm)	984				
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 SO <sub>4</sub>	45	450	1000	20000	50000
N	WSLM27	Total Dissolved Solids	768	7680	4000	60000	100000
U	SFAP1	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	2.5	25	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

# 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.

ID Number	Description	MethodID	ANC	BTEXHSA	MTBE	CEN Leac(P)C	Quiserv	L.O.I. % @ 450C	PAHMSUS	PCBECD	PHSOIL	TMS	TPHIDUS	WISMS9
		Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	(µg/kg)		Report C		PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	Total Organic Carbon
CL/1775349	BH12 0.50	24/08/17		E	E				E		E		E	E
CL/1775350	BH12 4.50	24/08/17		E	E				E		E		E	E
CL/1775351	QC Blank													
CL/1775352	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
- 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**

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.

Where individual results are flagged see report notes for status.

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

# 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 GC/FID
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 GC/MS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GC/ECD 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 GC/FID 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 ICP/MS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using IC/POES
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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup>@ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

**▯** 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S17\_8704

Note: major constituent in upper case

[illegible]

Our Ref: EFS/178716 (Ver. 1)

Your Ref: 17-0167

September 29, 2017



Environmental Chemistry

ESG

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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 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

A handwritten signature in black ink, appearing to read 'Tim Barnes'.

Operations Director  
Energy & Waste Services

Date of Issue: 29-Sep-2017

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.

ESG accepts no responsibility for any sampling not carried out by our personnel.

Where individual results are flagged see report notes for status.





# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH13 0.50	<b>Job Number:</b>	s17_8716
<b>LIMS ID Number:</b>	CL1775421	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH13 4.50	<b>Job Number:</b>	S17_8716
<b>LIMS ID Number:</b>	CL1775422	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
Naphthalene	91-20-3	3.26	2.04	100
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	-	-	< 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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	QC Blank	<b>Job Number:</b>	s17_8716
<b>LIMS ID Number:</b>	CL1775423	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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.

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:** Reference Material (% Rec **Job Number:** S17\_8716  
**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. (min)	Recovery %	% Fit
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.

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.

## Polychlorinated Biphenyls (congeners)

### Customer and Site Details:

**Job Number:**

**QC Batch Number:**

## Directory:

### Method:

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

S17 8716

171030

092517PCB.GC70

## Ultrasonic

**Matrix:**

**Date Booked in:**

**Date Extracted:**

**Date Analysed:**

Soil

14-Sep-17

22-Sep-17

25-Sep-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.100
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	6.5
					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)	0.890
					Fraction of sample above 4 mm %	6.100
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	
BH13 0.50		s17_8716	CL/1775421	29-Sep-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	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		
N	PHSOIL	pH (pH units)	8.7		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	<0.04		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	616				
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	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
N	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	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	Causeway Geotech Ltd	Leaching Data		
		Weight of sample (kg)		0.110
Contact	Neil Haggan	Moisture content @ 105°C (% of Wet Weight)		20.4
		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)		0.880
		Fraction of sample above 4 mm %		0.000
Sample Description		Report No	Sample No	Issue Date
BH13 4.50		s17_8716	CL/1775422	29-Sep-17
		Fraction of non-crushable material %		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	<0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	<13	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<4.17	100		
N	PHSOIL	pH (pH units)	8.8		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.72		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1190				
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	ICPMSW	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
N	WSLM27	Total Dissolved Solids	927	9270	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

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

ESG Environmental Chemistry  
Analytical and Deviating Sample Overview

S178716

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.

ID Number	Description	MethodID	Sampled		ANC	BTEXHSA	CEN Leach(P)C	CustServ	LOI(%)MM	PAHSUS	PCBECD	PHSOIL	TMSS	TPHFDUS	WLSM9
				Acid Neut. Capacity	BTEX-HSA + MTBE analysis										
CL/1775421	BH13 0.50	23/08/17				E				E		E		E	
CL/1775422	BH13 4.50	23/08/17				E				E		E		E	
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	
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
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

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.

Where individual results are flagged see report notes for status.

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

# 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 GC/FID
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 GC/MS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclor by hexane/acetone extraction followed by GC/ECD 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 GC/FID 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 ICP/MS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using IC/POES
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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup> @ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

**▯** 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S17\_8716

Note: major constituent in upper case

[illegible]

Our Ref: EFS/178710 (Ver. 1)

Your Ref: 17-0167

September 29, 2017



Environmental Chemistry

ESG

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Chislett', written in a cursive style.

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

A handwritten signature in black ink, appearing to read 'Tim Barnes'.

Operations Director  
Energy & Waste Services

Date of Issue: 29-Sep-2017

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.

ESG accepts no responsibility for any sampling not carried out by our personnel.

Where individual results are flagged see report notes for status.





# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH14 0.25	<b>Job Number:</b>	s17_8710
<b>LIMS ID Number:</b>	CL1775387	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH14 2.75	<b>Job Number:</b>	S17_8710
<b>LIMS ID Number:</b>	CL1775388	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
Naphthalene	91-20-3	3.26	0.09	95
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	-	-	< 1.29	-

\* 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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	QC Blank	<b>Job Number:</b>	s17_8710
<b>LIMS ID Number:</b>	CL1775389	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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.

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:** Reference Material (% Rec **Job Number:** S17\_8710  
**LIMS ID Number:** CL1775390 **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. (min)	Recovery %	% Fit
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.

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.

# Polychlorinated Biphenyls (congeners)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S17\_8710  
**QC Batch Number:** 171030  
**Directory:** 092517PCB.GC70  
**Method:** Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 14-Sep-17  
**Date Extracted:** 22-Sep-17  
**Date Analysed:** 25-Sep-17

*Compounds marked \* are not UKAS or MCerts accredited*

Sample ID	Customer ID	Concentration, (µg/kg)						
		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

## WASTE ACCEPTANCE CRITERIA TESTING

### BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.103
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	17.7
					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)	0.887
					Fraction of sample above 4 mm %	0.000
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

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	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		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.65	100		
N	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	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)		
			mg/l except <sup>oo</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>oo</sup>	7.2	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>oo</sup>	1010				
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	SFAP1	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	2.9	29	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

## WASTE ACCEPTANCE CRITERIA TESTING

### BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.110
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	18.1
					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)	0.880
					Fraction of sample above 4 mm %	0.000
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH14 2.75		s17_8710	CL/1775388	29-Sep-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	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		
N	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	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)		
			mg/l except <sup>oo</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>oo</sup>	8.1	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>oo</sup>	1180				
U	ICPMSW	Arsenic	0.018	0.18	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	0.002	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
N	WSLM27	Total Dissolved Solids	923	9230	4000	60000	100000
U	SFAP1	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

# ESG Environmental Chemistry

## Analytical and Deviating Sample Overview

S178710

Customer Causeway Geotech Ltd  
 Site Arklow Sewerage Scheme Marine Outfall GI  
 Report No S178710

Consignment No S68872  
 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.

ID Number	Description	MethodID	ANC	BTEXHSA	MTBE	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 GC/FID (AR)	Total Organic Carbon
			Acid Neut. Capacity	BTEX-HSA + MTBE analysis	(µg/kg)										
CL/1775387	BH14 0.25	22/08/17	E	E	E				E		E		E	E	
CL/1775388	BH14 2.75	22/08/17	E	E	E				E		E		E	E	
CL/1775389	QC Blank														
CL/1775390	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
- 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**

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.

Where individual results are flagged see report notes for status.



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

# 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/arocloris 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	ICPSW	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	SFAP1	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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup>@ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

**▯** 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S17\_8710

Note: major constituent in upper case

[illegible]

Our Ref: EFS/178706 (Ver. 1)

Your Ref: 17-0167

September 29, 2017



Environmental Chemistry

ESG

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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/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

A handwritten signature in cursive script, appearing to read 'Tim Barnes'.

Operations Director  
Energy & Waste Services

Date of Issue: 29-Sep-2017

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.

ESG accepts no responsibility for any sampling not carried out by our personnel.

Where individual results are flagged see report notes for status.



# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH15 1.50	<b>Job Number:</b>	S17_8706
<b>LIMS ID Number:</b>	CL1775359	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
Naphthalene	91-20-3	3.26	0.14	99
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	-	-	< 1.34	-

\* 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.

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:** BH15 3.50 **Job Number:** s17\_8706  
**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. (min)	Concentration mg/kg	% Fit
Naphthalene	91-20-3	3.26	0.50	98
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	-	-	< 1.70	-

\* 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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH15 5.50	<b>Job Number:</b>	S17_8706
<b>LIMS ID Number:</b>	CL1775361	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	QC Blank	<b>Job Number:</b>	s17_8706
<b>LIMS ID Number:</b>	CL1775362	<b>Date Booked in:</b>	14-Sep-17
<b>QC Batch Number:</b>	171030	<b>Date Extracted:</b>	22-Sep-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	26-Sep-17
<b>Directory:</b>	092517.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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.

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:** Reference Material (% Rec **Job Number:** S17\_8706  
**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. (min)	Recovery %	% Fit
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.

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.

## Polychlorinated Biphenyls (congeners)

### Customer and Site Details:

**Job Number:**

**QC Batch Number:**

## Directory:

### Method:

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

S17 8706

171030

092517PCB.GC70

## Ultrasonic

**Matrix:**

**Date Booked in:**

**Date Extracted:**

**Date Analysed:**

Soil

14-Sep-17

22-Sep-17

25-Sep-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.101
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	12.2
					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)	0.889
					Fraction of sample above 4 mm %	47.000
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		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.14	3	5	6
N	LOI450	Loss on Ignition (%)	0.8			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)	<1.62	100		
N	PHSOIL	pH (pH units)	8.4		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.49		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.3	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	964				
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
N	WSLM27	Total Dissolved Solids	752	7520	4000	60000	100000
U	SFAP1	Phenol Index	<0.05	<0.5	1		
N	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

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

<b>Client</b>	Causeway Geotech Ltd				<b>Leaching Data</b>	
					Weight of sample (kg)	0.106
<b>Contact</b>	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	18.0
					Equivalent Weight based on drying at 105°C (kg)	0.090
<b>Site</b>	Arklow Sewerage Scheme Marine Outfall GI				Volume of water required to carry out 10:1 stage (litres)	0.884
					Fraction of sample above 4 mm %	0.000
<b>Sample Description</b>		<b>Report No</b>	<b>Sample No</b>	<b>Issue Date</b>	Fraction of non-crushable material %	0.000
BH15 3.50		s17_8706	CL/1775360	29-Sep-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.09	3	5	6
N	LOI450	Loss on Ignition (%)	0.8			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)	<2.17	100		
N	PHSOIL	pH (pH units)	8.7		>6	
N	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	Calculated cumulative amount leached @ 10:1	Landfill Waste Acceptance Criteria Limit Values for BSEN 12457/2 @ L/S 10 litre kg-1		
			mg/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.2	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1360				
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	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	<0.001	<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	SFAP1	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.

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	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.113
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	47.3
					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)	0.878
					Fraction of sample above 4 mm %	0.000
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH15 5.50		s17_8706	CL/1775361	29-Sep-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.85	3	5	6
N	LOI450	Loss on Ignition (%)	5.1			10
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.12	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	<0.056	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	25	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<2.58	100		
N	PHSOIL	pH (pH units)	8.6		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	5.01		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.5	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	1490				
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	1000	20000	50000
N	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.

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

ESG Environmental Chemistry  
Analytical and Deviating Sample Overview

S178706

Customer Causeway Geotech Ltd  
Site Arklow Sewerage Scheme Marine Outfall GI  
Report No S178706

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.

ID Number	Description	MethodID	ANC	BTEXHSA	CEN Leac(P)C	LOI(%)	PAH(17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GC/FID (AR)	Total Organic Carbon
		Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)	Report C	L.O.I. % @ 450C						
CL/1775359	BH15 1.50	25/08/17		E	E			E			E	E	
CL/1775360	BH15 3.50	25/08/17		E	E			E			E	E	
CL/1775361	BH15 5.50	25/08/17		E	E			E			E	E	
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
B	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

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.

Where individual results are flagged see report notes for status.

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

# 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/aroclor 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	ICPSW	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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup>@ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

**▯** 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S17\_8706

Note: major constituent in upper case

[illegible]

Our Ref: EFS/180840 (Ver. 1)

Your Ref: 17-0167

December 6, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

J Colbourne  
Project Co-ordinator  
01283 554547

# TEST REPORT



1252

**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

Date of Issue: 06-Dec-2017

Tests marked 'N' 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.

Where individual results are flagged see report notes for status.





# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Sample Details:** BH16 1.50 **Job Number:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** Reference Material (% Rec **Job Number:** S18\_0840  
**LIMS ID Number:** CL1784511 **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. (min)	Recovery %	% Fit
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.

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.

# Polychlorinated Biphenyls (congeners)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S18\_0840  
**QC Batch Number:** 171265  
**Directory:** 112317PCB.GC70  
**Method:** Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 21-Nov-17  
**Date Extracted:** 23-Nov-17  
**Date Analysed:** 23-Nov-17

*Compounds marked \* are not UKAS or MCerts accredited*

Sample ID	Customer ID	Concentration, (µg/kg)						
		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

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

<b>Client</b>	Causeway Geotech Ltd			<b>Leaching Data</b>	
<b>Contact</b>	Neil Haggan			Weight of sample (kg)	0.148
<b>Site</b>	Arklow Sewerage Scheme Marine Outfall GI			Moisture content @ 105°C (% of Wet Weight)	36.5
				Equivalent Weight based on drying at 105°C (kg)	0.090
				Volume of water required to carry out 10:1 stage (litres)	0.842
<b>Sample Description</b>		<b>Report No</b>	<b>Sample No</b>	<b>Issue Date</b>	Fraction of sample above 4 mm %
BH16 1.50		s18_0840	CL/1784507	06-Dec-17	6.300
					Fraction of non-crushable material %
					0.000

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	1.84	3	5	6
N	LOI450	Loss on Ignition (%)	5.8			10
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.11	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	<0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	39	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<2.14	100		
N	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	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.7	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	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	50	100
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	20000	50000
N	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.  
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	Causeway Geotech Ltd				Leaching Data	
					Weight of sample (kg)	0.231
Contact	Neil Haggan				Moisture content @ 105°C (% of Wet Weight)	60.9
					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)	0.759
					Fraction of sample above 4 mm %	0.000
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	
BH16 3.50		s18_0840	CL/1784508	06-Dec-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	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	50	100
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	20000	50000
N	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.  
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

<b>Client</b>	Causeway Geotech Ltd			<b>Leaching Data</b>	
				Weight of sample (kg)	0.243
<b>Contact</b>	Neil Haggan			Moisture content @ 105°C (% of Wet Weight)	62.2
				Equivalent Weight based on drying at 105°C (kg)	0.090
<b>Site</b>	Arklow Sewerage Scheme Marine Outfall GI			Volume of water required to carry out 10:1 stage (litres)	0.747
				Fraction of sample above 4 mm %	0.000
<b>Sample Description</b>	<b>Report No</b>	<b>Sample No</b>	<b>Issue Date</b>	Fraction of non-crushable material %	0.000
BH16 5.50	s18_0840	CL/1784509	06-Dec-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.68		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.7	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	3760				
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	50	100
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
N	WSLM27	Total Dissolved Solids	2930	29300	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	19	190	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

Socotec Environmental Chemistry  
Analytical and Deviating Sample Overview

S180840

Customer Causeway Geotech Ltd  
Site Arklow Sewerage Scheme Marine Outfall GI  
Report No 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.

ID Number	Description	MethodID	ANC	BTEX-HSA	MTBE	CEN Leac(P)C	Clst Srvy	LOI(P)MM	PAH(SUS)	PCB(CD)	PHSOIL	TMSS	TPH(BUS)	WLS(M9)
		Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	(µg/kg)		Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	Total Organic Carbon
CL/1784507	BH16 1.50	05/11/17		E	E						E			E
CL/1784508	BH16 3.50	05/11/17		E	E						E			E
CL/1784509	BH16 5.50	05/11/17		E	E						E			E
CL/1784510	QC Blank													
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
B	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

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.

Where individual results are flagged see report notes for status.

# 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 GC/FID
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 GC/MS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GC/ECD 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 GC/FID 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 ICP/MS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using IC/POES
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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup>@ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

▮ 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S18\_0840

Note: major constituent in upper case

Our Ref: EFS/180842 (Ver. 1)

Your Ref: 17-0167

December 6, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

J Colbourne  
Project Co-ordinator  
01283 554547

# TEST REPORT



1252

**Report No. EFS/180842 (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: 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

Date of Issue: 06-Dec-2017

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.





# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH17 2.50	<b>Job Number:</b>	S18_0842
<b>LIMS ID Number:</b>	CL1784518	<b>Date Booked in:</b>	21-Nov-17
<b>QC Batch Number:</b>	171265	<b>Date Extracted:</b>	24-Nov-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	25-Nov-17
<b>Directory:</b>	112417.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH17 4.50	<b>Job Number:</b>	s18_0842
<b>LIMS ID Number:</b>	CL1784519	<b>Date Booked in:</b>	21-Nov-17
<b>QC Batch Number:</b>	171265	<b>Date Extracted:</b>	24-Nov-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	25-Nov-17
<b>Directory:</b>	112417.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	QC Blank	<b>Job Number:</b>	S18_0842
<b>LIMS ID Number:</b>	CL1784520	<b>Date Booked in:</b>	21-Nov-17
<b>QC Batch Number:</b>	171265	<b>Date Extracted:</b>	24-Nov-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	25-Nov-17
<b>Directory:</b>	112417.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** Reference Material (% Rec **Job Number:** s18\_0842  
**LIMS ID Number:** CL1784521 **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. (min)	Recovery %	% Fit
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.

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.

## Polychlorinated Biphenyls (congeners)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI
<b>Job Number:</b>	S18_0842
<b>QC Batch Number:</b>	171265
<b>Directory:</b>	112317PCB.GC70
<b>Method:</b>	Ultrasonic

<b>Matrix:</b>	Soil
<b>Date Booked in:</b>	21-Nov-17
<b>Date Extracted:</b>	23-Nov-17
<b>Date Analysed:</b>	23-Nov-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

WASTE ACCEPTANCE CRITERIA TESTING  
BSEN 12457/2

Client	Causeway Geotech Ltd				Leaching Data	
Contact	Neil Haggan				Weight of sample (kg)	0.095
					Moisture content @ 105°C (% of Wet Weight)	8.4
					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)	0.895
					Fraction of sample above 4 mm %	11.200
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %	0.000
BH17 2.50		s18_0842	CL/1784518	06-Dec-17		

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	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		
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)	<1.48	100		
N	PHSOIL	pH (pH units)	8		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.81		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.5	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	314				
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.

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	Causeway Geotech Ltd				Leaching Data	
Contact	Neil Haggan				Weight of sample (kg)	0.100
					Moisture content @ 105°C (% of Wet Weight)	8.2
					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)	0.890
					Fraction of sample above 4 mm %	37.300
Sample 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

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.13	3	5	6
N	LOI450	Loss on Ignition (%)	0.8			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)	15	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.48	100		
N	PHSOIL	pH (pH units)	8.6		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.97		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	436				
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		
N	WSLM13	Dissolved Organic Carbon	1.7	17	500	800	1000

Template Ver. 1Landfill 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

Customer

Site

Report No

Causeway Geotech Ltd

Arklow Sewerage Scheme Marine Outfall GI

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.

ID Number	Description	MethodID	ANC	BTEXHSA		CEN Leacac(P)C	CustServ	LOI(%MM)	PAHMSUS	PCBECD	PHSOIL	TMSS	TPHFIDUS		WSLMS9
		Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)		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 GC/FID (AR)	Total Organic Carbon
CL/1784518	BH17 2.50	03/11/17		E	E				E		E		E	E	E
CL/1784519	BH17 4.50	03/11/17		E	E				E		E		E	E	E
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
B	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 - <b>Note: due date may be affected if triggered</b>
	No analysis scheduled
^	Analysis Subcontracted - <b>Note: due date may vary</b>

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.

Where individual results are flagged see report notes for status.



# 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 GC/FID
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 GC/MS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GC/ECD 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 GC/FID 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 ICP/MS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using IC/POES
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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup> @ 15°C

### **Gas (Tedlar bag) Analysis**

Unless stated otherwise, results are expressed as ug/l

### **Asbestos Analysis**

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

▮ 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S18\_0842

Note: major constituent in upper case

Our Ref: EFS/180830 (Ver. 1)

Your Ref: 17-0167

December 5, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

J Colbourne  
Project Co-ordinator  
01283 554547

# TEST REPORT



1252

**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

Date of Issue: 05-Dec-2017

Tests marked 'N' 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.

Where individual results are flagged see report notes for status.



# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Sample Details:** BH18 1.50 **Job Number:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** BH18 3.50 **Job Number:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** Reference Material (% Rec **Job Number:** 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. (min)	Recovery %	% Fit
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.

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.

## Polychlorinated Biphenyls (congeners)

### Customer and Site Details:

**Job Number:**

**QC Batch Number:**

## Directory:

### Method:

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

S18 0830

171265

112317PCB.GC70

## Ultrasonic

**Matrix:**

**Date Booked in:**

**Date Extracted:**

**Date Analysed:**

Soil

21-Nov-17

23-Nov-17

23-Nov-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

## Polychlorinated Biphenyls (congeners)

### Customer and Site Details:

Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI

**Matrix:**

## Soil

**Job Number:**

S18 0830

**Date Booked in:**

21-Nov-17

QC Batch Number:

171265

**Date Extracted:**

24-Nov-17

## Directory:

112717PCB.GC22

**Date Analysed:**

28-Nov-17

**Method:**

## Ultrasonic

**Date Analysed:**

28-Nov-17

**Compounds marked \* are not UKAS or MCerts accredited**

[illegible]

## WASTE ACCEPTANCE CRITERIA TESTING BSEN 12457/2

Client	Causeway Geotech Ltd			Leaching Data	
				Weight of sample (kg)	0.095
Contact	Neil Haggan			Moisture content @ 105°C (% of Wet Weight)	5.5
				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)	0.895
				Fraction of sample above 4 mm %	93.500
				Fraction of non-crushable material %	0.000
Sample Description		Report No	Sample No	Issue Date	
BH18 1.50		s18_0830	CL/1784463	05-Dec-17	

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.06	6		
N	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		
N	PHSOIL	pH (pH units)	8.5		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.9		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.7	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	342				
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
U	ICPWATVAR	Sulphate as SO4	76	760	1000	20000	50000
N	WSLM27	Total Dissolved Solids	267	2670	4000	60000	100000
U	SFAP1	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.

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	Causeway Geotech Ltd			Leaching Data	
				Weight of sample (kg)	0.100
Contact	Neil Haggan			Moisture content @ 105°C (% of Wet Weight)	10.9
				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)	0.890
				Fraction of sample above 4 mm %	30.200
Sample Description		Report No	Sample No	Issue Date	Fraction of non-crushable material %
BH18 3.50		s18_0830	CL/1784464	05-Dec-17	0.000

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.13	3	5	6
N	LOI450	Loss on Ignition (%)	0.7			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)	18	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.53	100		
N	PHSOIL	pH (pH units)	8.7		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.37		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.4	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	569				
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
U	ICPWATVAR	Sulphate as SO4	135	1350	1000	20000	50000
N	WSLM27	Total Dissolved Solids	443	4430	4000	60000	100000
U	SFAP1	Phenol Index	<0.05	<0.5	1		
N	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.

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	Causeway Geotech Ltd			Leaching Data	
				Weight of sample (kg)	0.134
Contact	Neil Haggan			Moisture content @ 105°C (% of Wet Weight)	33.4
				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)	0.856
				Fraction of sample above 4 mm %	0.000
				Fraction of non-crushable material %	0.000
Sample Description		Report No	Sample No	Issue Date	
BH18 5.50		s18_0830	CL/1784465	05-Dec-17	

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.11	6		
N	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		
N	PHSOIL	pH (pH units)	8		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	2.36		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)			
U	WSLM3	pH (pH units) <sup>00</sup>	7.6	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	2710				
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	SFAP1	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.

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

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.

ID Number	Description	MethodID	ANC	BTEXHSA	CEN Leach	CUServ	LOC(MM)	PAHMSUS	PCBECD	PHSOIL	TMS	TPHIDUS	WSLMS9
		Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)	CEN Leach(P/C)	Report C	L.O.I. % @ 450C	PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	Total Organic Carbon
CL/1784463	BH18 1.50	06/11/17	E	E	E					E			
CL/1784464	BH18 3.50	06/11/17	E	E	E					E			
CL/1784465	BH18 5.50	06/11/17	E	E	E					E			
CL/1784466	QC Blank												
CL/1784467	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
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

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.

Where individual results are flagged see report notes for status.

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

# 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 GC/FID
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 GC/MS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclor by hexane/acetone extraction followed by GC/ECD 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 GC/FID 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 ICP/MS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using IC/POES
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	SFAP1	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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup>@ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

▮ 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S18\_0830

Note: major constituent in upper case

[illegible]

Our Ref: EFS/180838 (Ver. 1)

Your Ref: 17-0167

November 30, 2017



Environmental Chemistry

SOCOTEC UK Limited

Bretby Business Park

Ashby Road

Burton-on-Trent

Staffordshire

DE15 0YZ

Telephone: 01283 554400

Facsimile: 01283 554422

Neil Haggan  
Causeway Geotech Ltd  
8 Drumahiskey Road  
Ballymoney  
United Kingdom  
BT53 7QL

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

A handwritten signature in black ink, appearing to read 'J Colbourne'.

J Colbourne  
Project Co-ordinator  
01283 554547

# TEST REPORT



1252

**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 Director  
Energy & Waste Services

Date of Issue: 30-Nov-2017

Tests marked 'N' 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.

Where individual results are flagged see report notes for status.





# Polycyclic Aromatic Hydrocarbons

## GC/MS (SIM)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Sample Details:** BH19 1.50 **Job Number:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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)

<b>Customer and Site Details:</b>	Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI		
<b>Sample Details:</b>	BH19 3.50	<b>Job Number:</b>	S18_0838
<b>LIMS ID Number:</b>	CL1784498	<b>Date Booked in:</b>	21-Nov-17
<b>QC Batch Number:</b>	171265	<b>Date Extracted:</b>	24-Nov-17
<b>Quantitation File:</b>	Initial Calibration	<b>Date Analysed:</b>	25-Nov-17
<b>Directory:</b>	112417.MS17\	<b>Matrix:</b>	Soil
<b>Dilution:</b>	1.0	<b>Ext Method:</b>	Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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.

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:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Concentration mg/kg	% Fit
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	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.

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:** Reference Material (% Rec **Job Number:** 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:** 1.0 **Ext Method:** Ultrasonic

UKAS accredited?: No

Target Compounds	CAS #	R.T. (min)	Recovery %	% Fit
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.

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.

# Polychlorinated Biphenyls (congeners)

**Customer and Site Details:** Causeway Geotech Ltd: Arklow Sewerage Scheme Marine Outfall GI  
**Job Number:** S18\_0838  
**QC Batch Number:** 171265  
**Directory:** 112317PCB.GC70  
**Method:** Ultrasonic

**Matrix:** Soil  
**Date Booked in:** 21-Nov-17  
**Date Extracted:** 23-Nov-17  
**Date Analysed:** 23-Nov-17

*Compounds marked \* are not UKAS or MCerts accredited*

Sample ID	Customer ID	Concentration, (µg/kg)						
		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

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

<b>Client</b>	Causeway Geotech Ltd	<b>Leaching Data</b>		
		Weight of sample (kg)		0.101
<b>Contact</b>	Neil Haggan	Moisture content @ 105°C (% of Wet Weight)		4.4
		Equivalent Weight based on drying at 105°C (kg)		0.090
<b>Site</b>	Arklow Sewerage Scheme Marine Outfall GI	Volume of water required to carry out 10:1 stage (litres)		0.889
		Fraction of sample above 4 mm %		11.200
<b>Sample Description</b>	<b>Report No</b>	<b>Sample No</b>	<b>Issue Date</b>	<b>Fraction of non-crushable material %</b>
BH19 1.50	s18_0838	CL/1784497	30-Nov-17	0.000

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				Inert Waste Landfill	Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill	Hazardous Waste Landfill
N	WSLM59	Total Organic Carbon (% M/M)	0.12	3	5	6
N	LOI450	Loss on Ignition (%)	0.8			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)	16	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<1.42	100		
N	PHSOIL	pH (pH units)	7.6		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	0.81		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.1	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	124				
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
N	WSLM27	Total Dissolved Solids	96.9	969	4000	60000	100000
U	SFAPI	Phenol Index	<0.05	<0.5	1		
N	WSLM13	Dissolved Organic Carbon	1.8	18	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

# WASTE ACCEPTANCE CRITERIA TESTING

## BSEN 12457/2

<b>Client</b>	Causeway Geotech Ltd	<b>Leaching Data</b>		
		Weight of sample (kg)		0.220
<b>Contact</b>	Neil Haggan	Moisture content @ 105°C (% of Wet Weight)		58.8
		Equivalent Weight based on drying at 105°C (kg)		0.090
<b>Site</b>	Arklow Sewerage Scheme Marine Outfall GI	Volume of water required to carry out 10:1 stage (litres)		0.770
		Fraction of sample above 4 mm %		5.600
		Fraction of non-crushable material %		0.000
	<b>Sample Description</b>	<b>Report No</b>	<b>Sample No</b>	<b>Issue Date</b>
	BH19 3.50	s18_0838	CL/1784498	30-Nov-17

Note: The >4mm fraction is crushed using a disc mill

Accreditation	Method Code	Solid Waste Analysis (Dry Basis)	Concentration in Solid (Dry Weight Basis)	Landfill Waste Acceptance Criteria Limit Values		
				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
N	LOI450	Loss on Ignition (%)	18.9			10
N	BTEXHSA	Sum of BTEX (mg/kg)	<0.13	6		
N	PCBUSECD	Sum of 7 Congener PCB's (mg/kg)	<0.035	1		
N	TPHFIDUS	Mineral Oil (mg/kg)	102	500		
N	PAHMSUS	PAH Sum of 17 (mg/kg)	<3.30	100		
N	PHSOIL	pH (pH units)	7.5		>6	
N	ANC	Acid Neutralisation Capacity (mol/kg) @pH 7	1.02		To be evaluated	To be evaluated

Accreditation	Method 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/l except <sup>00</sup>	mg/kg (dry weight)	mg/kg (dry weight)		
U	WSLM3	pH (pH units) <sup>00</sup>	7.5	Calculated data not UKAS Accredited			
U	WSLM2	Conductivity (µs/cm) <sup>00</sup>	3580				
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	ICPMSW	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
N	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.

Tests where the accreditation is set to U are UKAS accredited, those where the accreditation is set to N are not UKAS accredited

Customer

Site

Report No

Causeway Geotech Ltd

Arklow Sewerage Scheme Marine Outfall GI

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

ID Number	Description	MethodID	ANC	BTEXHSA		CENLeac(P)C	CustServ	LOI(%MM)	PAHSUS	PCBEC	PHSOIL	TMSS	TPHFIUS		WSLM59
		Sampled	Acid Neut. Capacity	BTEX-HSA + MTBE analysis	MTBE (µg/kg)		Report C		PAH (17) by GCMS	PCB-7 Congeners Analysis	pH units (AR)	Tot.Moisture @ 105C	TPH Band (>C10-C40)	TPH by GC/FID (AR)	Total Organic Carbon
CL/1784497	BH19 1.50	07/11/17		E	E						E				
CL/1784498	BH19 3.50	07/11/17		E	E						E				
CL/1784499	QC Blank														
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
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 - <b>Note: due date may be affected if triggered</b>
	No analysis scheduled
^	Analysis Subcontracted - <b>Note: due date may vary</b>



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

# 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 GC/FID
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 GC/MS detection
Soil	PCBECD	As Received	Determination of Polychlorinated Biphenyl (PCB) congeners/aroclors by hexane/acetone extraction followed by GC/ECD 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 GC/FID 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 ICP/MS
Water	ICPWATVAR	As Received	Direct determination of Metals and Sulphate in water samples using IC/POES
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

Where individual results are flagged see report notes for status.

# 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/cm<sup>3</sup>@ 15°C

### Gas (Tedlar bag) Analysis

Unless stated otherwise, results are expressed as ug/l

### Asbestos Analysis

**CH** Denotes Chrysotile

**TR** Denotes Tremolite

**CR** Denotes Crocidolite

**AC** Denotes Actinolite

**AM** Denotes Amosite

**AN** Denotes Anthophyllite

**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

▮ 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.

## Sample Descriptions

**Client :** Causeway Geotech Ltd  
**Site :** Arklow Sewerage Scheme Marine Outfall GI  
**Report Number :** S18\_0838

Note: major constituent in upper case



**CAUSEWAY**  
— GEOTECH

## APPENDIX F

### SPT hammer energy measurement results



# SPT Calibration Report



## Hammer Energy Measurement Report

Type of Hammer SPT HAMMER  
 Client CAUSEWAY GEOTECH  
 Test No EQU1763  
 Test Depth (m) 7.50  
 Date of Test **18 February 2017**  
 Valid until **18 February 2018**  
 Hammer ID **EQU1763**

Mass of the hammer  $m = 63.5\text{kg}$   
 Falling height  $h = 0.76\text{m}$   
 $E_{\text{theor}} = m \times g \times h = 473\text{J}$   
**Characteristics of the instrumented rod**  
 Diameter  $d_r = 0.052\text{m}$   
 Length of the instrumented rod  $0.558\text{m}$   
 Area  $A = 11.61\text{cm}^2$   
 Modulus  $E_a = 206843\text{MPa}$

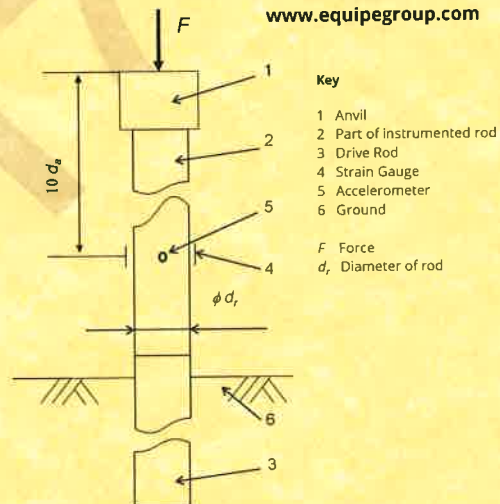
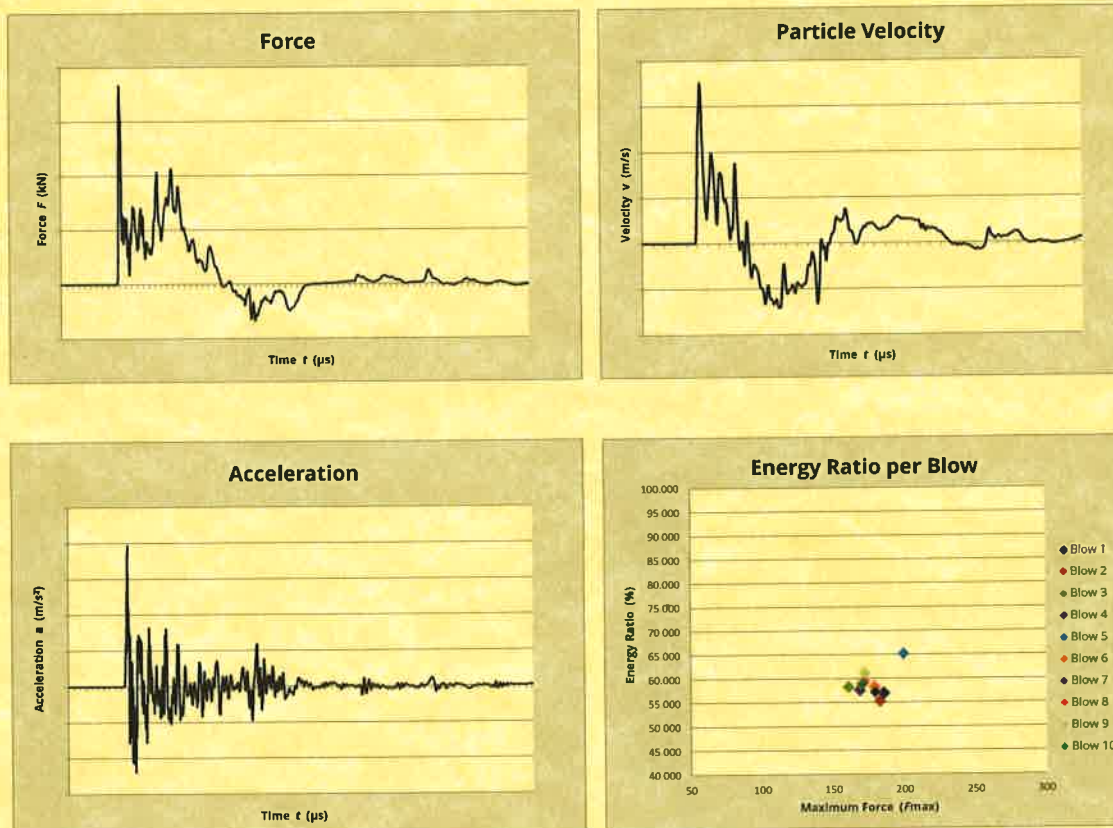


Fig. B.1 and B.2 BS EN ISO 22476-3: 2005 + A1: 2011



Observations:  
 1.

$E_{\text{meas}} = 0.277\text{ kN-m}$   
 $E_{\text{theor}} = 0.473\text{ kN-m}$

Energy Ratio  $= \frac{E_{\text{meas}}}{E_{\text{theor}}} = 58.61\%$

Equipe SPT Analyzer Operators:

AF

Prepared by:

*[Signature]*

Checked by:

*[Signature]*

Date

02/03/2017



**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

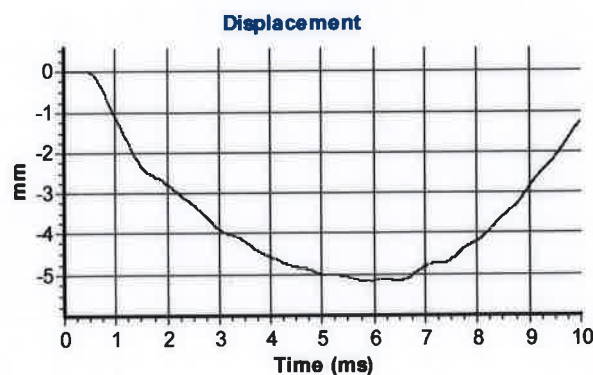
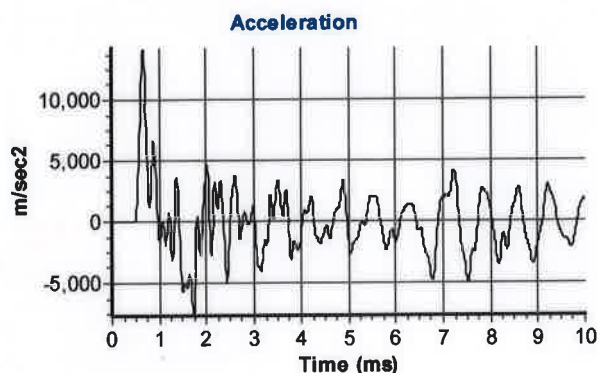
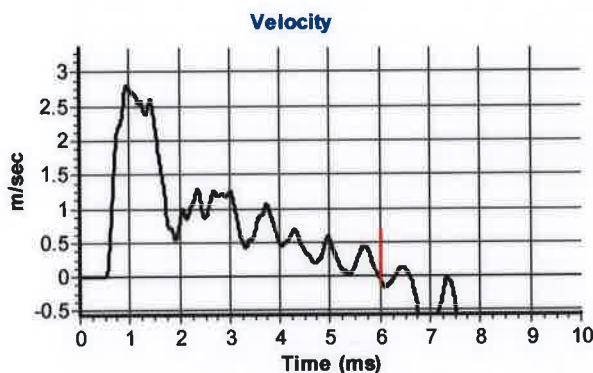
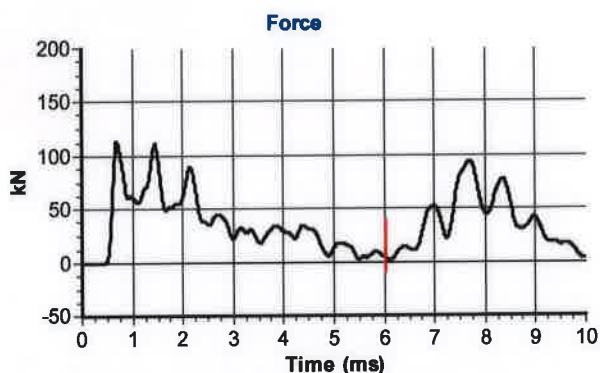
Diameter  $d_r$  (mm): 54  
Wall Thickness  $t_r$  (mm): 6.0  
Assumed Modulus  $E_a$  (GPa): 200  
Accelerometer No.1: 6458  
Accelerometer No.2: 9607

## 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 ( $\text{mm}^2$ ): 905  
Theoretical Energy  $E_{\text{theor}}$  (J): 473  
Measured Energy  $E_{\text{meas}}$  (J): 287

**Energy Ratio  $E_r$  (%):** **61**

Signed: Neil Burrows  
Title: Field Operations Manager

The recommended calibration interval is 12 months