

HARRISON GROUP ENVIRONMENTAL LIMITED

Document: Ground Investigation Factual Report

Project: Central Arun Crematorium

Reference No.: GL22428B

Date: February 2019

Prepared For: Trustees of the Langmead Pension Scheme c/o Landlink Estates Ltd.

Engineer: Campbell Reith Hill LLP

REPORT STATUS:

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		COMMENTS DATE 01/02/19	COMMENTS DATE 01/02/19	COMMENTS DATE 01/02/19	COMMENTS DATE 01/02/19
Revision	Comments	Prepared By	Approved By	Issued By	Audited By

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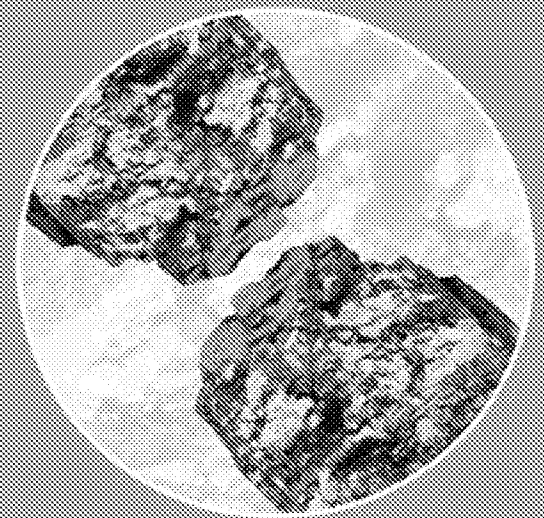
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ENGINEERING



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FOREWORD

General Conditions Relating To Site Investigation

This investigation has been devised to generally comply with the relevant principles and requirements of BS10175:2001+A2:2017 "Investigation of potentially contaminated sites - Code of practice" and where directed by the principles and application rules of Eurocode 7 (EC7 – Part 1 and Part 2). The recommendations made and opinions expressed in this report are based on the information obtained from the sources described using a methodology intended to provide reasonable consistency and robustness.

The opinions expressed in this report are based on the ground conditions revealed by the site works, together with an assessment of the site and of laboratory test results. Whilst opinions may be expressed relating to sub-soil conditions in parts of the site not investigated, for example between exploratory positions, these are only for guidance and no liability can be accepted for their accuracy.

Boring, sampling and field test procedures are undertaken in accordance with BS5930:2015 "Code of Practice for Site Investigations". Likewise in-situ and laboratory testing complies with B.S.1377, "Methods of Tests for Soils for Civil Engineering Purposes", unless stated otherwise in the text.

The groundwater conditions entered on the boring records are those observed at the time of investigation. The normal rate of boring usually does not permit the recording of an equilibrium water level for any one water strike. Moreover, groundwater levels are subject to seasonal variation or changes in local drainage conditions.

Some items of the investigation have been provided by third parties and whilst Harrison Group have no reason to doubt the accuracy, the items relied on have not been verified. No responsibility can be accepted for errors within third party items presented in this report.

This report is produced for the benefit of the client alone. No responsibility can be accepted for any consequences of this information being passed to a third party who may act upon its contents/recommendations.

**FACTUAL REPORT
ON A
GROUND INVESTIGATION
AT
CENTRAL ARUN CREMATORIUM**

1.0 TERMS OF REFERENCE AND INTRODUCTION

The work covered by this report was undertaken on behalf of Trustees of the Langmead Pension Scheme c/o Landlink Estates Ltd by Harrison Group Environmental Ltd (HGE). The work was undertaken in accordance with the relevant contract documentation and the Campbell Reith Hill LLP (Campbell Reith) Specification for Ground Investigation Tender Document Project (TET-13062-311018). Campbell Reith acted as Consulting Engineer.

The purpose of the investigation was to provide factual geotechnical and geo-environmental data from the fieldwork and subsequent laboratory testing which will be used to assist with the design for the development of the site.

This report presents the results of the fieldwork, associated laboratory testing and post fieldwork monitoring.

2.0 LOCATION AND DESCRIPTION OF SITE

The site is a partly contained arable field parcel adjacent to Grevatt's Lane West, Bilsham, BN18 0LA with a National Grid Reference of 497979E and 101697N. It is proposed to develop the site with a crematorium and associated access, car parking and landscaping.

A site location plan (GL22428B-DR001) is presented in Appendix A.

3.0 EXPECTED GEOLOGY

The site is recorded to be underlain by superficial River Terrace Deposits into Chalk bedrock. Borehole recorded indicate an initial layer of Brickearth up to ~2m bgl and Raised Beach Deposits up to ~5m bgl moving into the Upper Chalks.

4.0 FIELDWORK

The scope of the site works was generally in accordance with that proposed by CampbellReith and comprised the following:

- Utility clearance of the exploratory locations (carried out by Midland Surveys Ltd)
- Dynamic Continuous Sampling (Windowless Sampler) boreholes (2 No. to maximum depth of 5.45mbgl)

- Gas and groundwater monitoring of installations (Currently 2 of 6 No. monthly rounds completed)

The main intrusive fieldwork was carried out by HGE on the 20th December 2018. All exploratory locations are detailed on the appended drawing GL22428B - DR002 –presented in Appendix A.

In addition to consulting all available service plans, lifting all available covers and prior to intrusive activities taking place, service clearance was carried out using Ground Penetrating Radar (GPR). Service inspection pits were also dug at borehole locations to clear near surface utilities.

The sampling strategy was designed by Campbell Reith and considered local site constraints, topography of the site, the geology encountered, including made ground and the development proposals.

During and immediately following completion of the fieldwork geotechnical samples were transported to Harrison Group Geotechnical Laboratory via in house transportation where, upon arrival, they were logged into a sample management system. Following receipt of the CampbellReith geotechnical schedules, certain geotechnical samples were subsequently dispatched to laboratory subcontractors via a courier.

4.1 Dynamic Continuous Sampling (Windowless Sampler) Boreholes

2 No. dynamic sampler boreholes, BH02 and BH03 were drilled on the 20th December 2018 using a dual-purpose tracked rig. Each position was progressed to a depth of between 4.90mbgl and 5.45mbgl, in order to identify, sample and test the underlying sub-soils.

BH01 was cancelled due to the ground conditions encountered.

Upon completion, BH02 and BH03 were installed with groundwater monitoring wells (19mm), as summarised in Table 4.2.

A detailed description of all the strata encountered, in-situ testing undertaken, position and types of samples taken along, with any groundwater observations made at the time of drilling are included on the dynamic sampling borehole records presented in Appendix B.

4.2 Installations

Both boreholes were installed with standpipes for monitoring the gas and groundwater within the soils encountered. Table 4.2 below summarises these installations.

Monitoring Point I.D	Diameter of Installation (mm)	Base Depth of Installation (mbgl)	Response Zone (mbgl)	
			Top	Base
BH02	19	4.00	1.00	4.00
BH03	19	5.00	1.00	5.00

Table 4.2: Summary of Gas and Groundwater Installations.

Detailed descriptions of the installations and their corresponding backfill materials are included on the relevant exploratory borehole logs presented in Appendix B.

4.3 Surveying

Pre-intrusive works were undertaken by an independent specialist who cleared proposed exploratory locations utilising a range of techniques including Ground Penetration Radar (GPR).

4.4 Gas and Groundwater Monitoring

Two rounds of gas and groundwater monitoring have been undertaken on the HGE borehole installations on the following dates, with four further rounds planned during the winter months:

- Round 1 – 21st December 2018
- Round 2 – 8th January 2019
- Round 3 – tbc February 2019
- Round 4 – tbc March 2019
- Round 5 – tbc April 2019
- Round 6 – tbc May 2019

The results of the water strikes encountered during the intrusive works are detailed on the relevant logs presented in Appendix B. The standing groundwater water levels from the subsequent monitoring rounds detailed above are presented in Appendix C.

Gas monitoring was also undertaken on the above dates including one following a fall in atmospheric pressure (date to be confirmed). Concentrations of oxygen, methane, carbon dioxide, carbon monoxide and hydrogen sulphide were measured using a GA5000 land gas analyser. Concentrations of volatile organic compounds (VOCs) were monitored using a Tiger Particle Ionisation detector (PID). The results are presented in Appendix C.

5.0 GEOTECHNICAL TESTING

Use of the laboratory and field tests presented below to establish geotechnical parameters should be carried out in accordance with BS EN 1997-2 Eurocode Part 2.

5.1 In-Situ Testing

In-Situ testing was undertaken for geotechnical purposes and samples were obtained for appropriate laboratory analysis. Site based geotechnical testing is presented in the Appendix B and summarised below (Table 5.1).

Test Type and Reference	Number	Comments / Limitations
Standard penetration test (BS EN ISO 22476-3:2005)	10	Standard Penetration Tests (SPTs) display a general trend of increasing in value with depth below ground level. Non calibrated SPT hammers can result in a wide variance between reported results. It should be noted we report raw SPT N values rather than corrected $N_{(60)}$ values. However, calibration certificates are provided in Appendix E so as to enable $N_{(60)}$ values to be calculated if required.

Table 5.1: Summary of In-Situ Geotechnical Testing

The dynamic continuous sampler (windowless sampler) borehole SPT Hammer Test Report (SPT Hammer Ref: 382709 / 87.82%) is presented in Appendix E.

5.2 Geotechnical Laboratory Testing

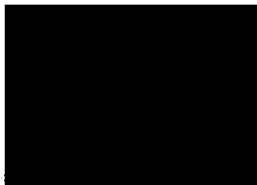
Geotechnical laboratory testing scheduled by Campbell Reith on selected soil samples recovered from the exploratory holes, was carried out to identify the physical characteristics of the soils encountered.

A summary of the results can be found overleaf (Table 5.2).

Test Type and Reference (BS 1377: 1990 unless stated)	No of tests	Results (Range)	Comments / Limitations
Water Content (BS EN ISO 17892-1: 2014)	5	20.9 - 27.2%	Determinations on disturbed samples, including those obtained from dynamic continuous sampler boreholes may not be wholly representative due to disturbance arising from the sampling process.
Liquid Limit (Part 2:5)	2	38 - 40%	Only material passing a 425micron sieve is utilised. Therefore, the results may not be wholly representative of in-situ material.
Plastic Limit (Part 2:5)		20%	Determinations on disturbed samples, including those obtained from dynamic continuous sampler boreholes may not be wholly representative due to disturbance arising from the sampling process.
Particle size distribution - Wet Sieving (Part 2:9.3)	5	n/a	The recovery of an adequate mass of coarse-grained soils for particle distribution analysis can be difficult in boreholes. In obtaining such samples from cable tool boreholes it should also be noted that some loss of fine material generally occurs due to the nature of the sampling process.
Particle size distribution – Pipette Sedimentation (Part 2:9)	2		
pH	4	8.1 - 8.6	Determination of pH in soil by addition of water followed by automated electrometric measurement.
Water Soluble Sulphate	4	0.019 - 0.036g/l	Determination of water-soluble sulphate by ICPOES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).
Acid Soluble Sulphate (Total)	4	0.026 - 0.033%	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.
Total Sulphur	4	0.010 - 0.30%	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.

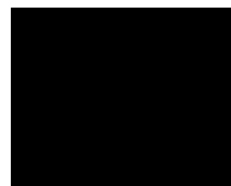
Table 5.2: Summary of Geotechnical Laboratory Testing

Report Compiled by:



Iain Reid BSc (Hons) MSc FGS
Geotechnical Engineer

Report Checked by:



Martin Cooper BEng (Hons) FGS
Principal Engineer

REFERENCES

BSI British Standard, BS5930:2015 "Code of Practice for Site Investigations".

BSI British Standard, BS1377:2016, "Methods of Test for Soils for Civil Engineering Purposes".

BS EN ISO 17892-1: 2014 Geotechnical investigation and testing. Laboratory testing of soil. Determination of water content.

BS EN 1997-1 Eurocode 7 Part 1 "General Rules"

BS EN 1997-2 Eurocode 7 Part 2 "Ground Investigation and Testing"

BS EN ISO 22475-1:2006 & 22475-2/3:2011 Geotechnical investigation and testing. Sampling methods and groundwater measurements.

BS EN ISO 22476:2005+A1:2011 Geotechnical investigation and testing. Various.

BS EN ISO 14688-2:2004 Geotechnical investigation and testing. Identification and classification of soil. Principles for a classification.

BRE Special Digest 1:2005 Concrete in Aggressive Ground.

LIST OF APPENDICES

APPENDIX A: DRAWINGS

Site Location Plan - GL22428B - DR001

Exploratory Location Plan - GL22428B - DR002

APPENDIX B: EXPLORATORY HOLE RECORDS

Data Sheet: Site Investigation Methods

Key to Site Investigation Records

Dynamic Sampling (Windowless Sampler) Borehole Records

APPENDIX C: GAS & GROUNDWATER MONITORING RECORDS

- Round 1 - 21st December 2018
- Round 2 - 8th January 2019
- Round 3 - tbc February 2019
- Round 4 - tbc March 2019
- Round 5 - tbc April 2019
- Round 6 - tbc May 2019

APPENDIX D: LABORATORY TESTING

Geotechnical Laboratory Test Results

GL22428B-01 - Test Report Transmittal

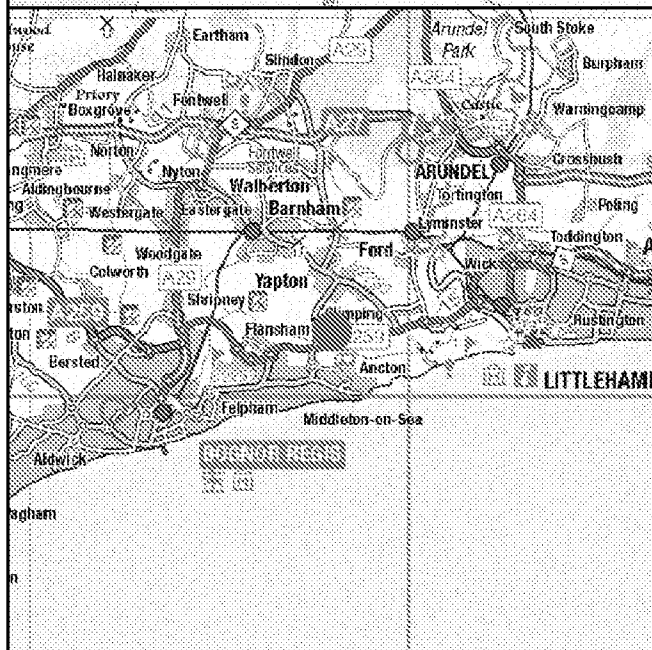
19-24444 (i2 Analytical)

APPENDIX E: LABORATORY TESTING

SPT Hammer Certificates

APPENDIX A

DRAWINGS



Client : Trustees of the Langmead Pension Scheme	
Project : Central Arun Crematorium, Grevatt's Lane	
Job No : GL22428	Date : December 2018
Drawing No : GL22428B - DR001	
Scale : 1:10000 @ A4	
Drawn by : CS	Checked by : IR
Eastings : 497970	Nothings : 101733
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Certificate Number 5933
 ISO 9001, ISO 14001

PL-H-0-101 Rev B N:\Work\Projects\London jobs\22000 jobs\GL22428\Drawings\AO Files\GL22428B - DR002.dwg



Key :

Site Boundary

Cable Percussive Borehole

Notes

Client : Trustees of the Langmead Pension Scheme

Project : Central Arun Crematorium, Grevatt's Lane

Job No : GL22428Date : December 2018

Drawing Title : Fieldwork Location Plan

Drawing No : GL22428B - DR002

Scale : 1:1000 @ A3

Drawn by : CSChecked by : IR

Eastings : 487870Northings : 101733

Revision history

Rev	Date	Revision Data

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Norwich: 01603 613111London: 020 7537 9233
Cambridge: 01223 781585Laboratory: 01603 416333

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ISO 9001
CERTIFICATION

UKAS
4031

UKAS
4031

Certificate Number 5933
ISO 9001, ISO 14001

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APPENDIX B

EXPLORATORY HOLE RECORDS

DATA SHEET: SITE INVESTIGATION METHODS

The following sheet provides basic details of the site investigation methods employed in the direct investigation phase of this report. Detailed method statements may be provided if requested or further information may be obtained from the relevant British Standard or Environment Agency publications. Prior to any excavation being undertaken, a surface sweep using a cable detector is undertaken, in order to avoid services. Details of the lithology encountered are generally presented on the relevant field record sheets, which also detail the type and depths of samples taken, the results of any in-situ tests, and any groundwater observations noted at the time. Other pertinent information may also be recorded.

DYNAMIC CONTINUOUS SAMPLING (WINDOW SAMPLER) BOREHOLES

The window sampler system comprises a series of varying diameter (100mm down to 36mm) steel tubes of either 1m length, and in the case of window (rather than windowless) having a slot or window cut along the side. The tubes are driven into the ground using a light percussive hammer attached to solid rods, and withdrawn by use of a jack. The hammer may be machine mounted (wheeled or tracked) or for restricted access work, hand held. The soil sample is forced up into the tube during the driving, samples being obtained directly through the slot or window, or in the case of windowless, in plastic liners in the steel tube. The sampler generally achieves depths of around 5m in favourable soils. Use of a super heavy tracked rig allows samples to be retrieved in liners to depths of up to 10m in suitable ground conditions.

Sampling can be carried out from the boreholes in accordance with BS EN ISO 22475-1:2006 and SPT testing can be undertaken in accordance with BS EN ISO 22476-3:2005+A1:2011. In addition, small diameter standpipes/monitoring wells can be installed to facilitate the sampling and monitoring of gas and groundwater.

MONITORING WELL INSTALLATIONS

All types of boreholes can be fitted with monitoring wells to enable subsequent sampling and monitoring of groundwater and ground gas levels. Monitoring wells are usually of upvc or hdpe material, although steel may also be used in certain circumstances. Various diameters are available from 19mm upwards, depending upon the size of the borehole. 38mm or 50mm diameter wells are the most commonly used. Wells generally have slotted lower sections which may have a geomesh filter and then are surrounded with a filter medium such as single sized gravel. The upper sections are generally solid casing which is usually grouted to produce a seal with the surrounding ground. The top of the well is generally fitted with a removable cap that may include a gas valve to enable future gas monitoring. The installation is usually protected by a lockable cover set in a concrete base. Details of monitoring well installations and associated backfill are given on the relevant borehole records.

GROUNDWATER MONITORING

Groundwater monitoring is undertaken using an electronic dip meter, which records the depth to water in a standpipe or monitoring well. Alternatively, down-hole pressure transducers can be utilised which can record variations over an extended period, which is particularly useful in monitoring variations due to tidal influences or when undertaking permeability tests or draw down tests or when undertaking soakaway testing. Where a non-aqueous phase liquid (e.g. floating hydrocarbon layer) is present, an interface meter is utilised to measure the thickness.

GROUND GAS MONITORING

Ground gas composition and flow monitoring may be undertaken where monitoring wells have been installed. Both flow (litres per hour) and composition (%) are measured using a portable infra-red multi-gas meter, calibrated for methane, carbon dioxide, carbon monoxide, hydrogen sulphide and oxygen. Records are also taken of atmospheric pressure, and relative pressure. The results are presented in the appendix of the report on the relevant records.

Ground gas monitoring can also be undertaken on a continuous basis using in-situ GasClam instrumentation where specific projects warrant accurate identification and quantification of the ground gas regime.

Dynamic Continuous Sampling Borehole Record

BH02

Sheet 1 of 1

Project ID: **GL22428B**

Location: Central Arun Crematorium

Client: Trustees of the Langmead Pension Scheme

Consultant: Harrison Group Environmental Ltd

Plant used: Premier Tracked 110 Rig

E: N:

Date: 20/12/2018

SPT Hammer Serial No: 382709 (ER: 88%)

Geology Description	Legend	Depth (m)	Elevation (maOD)	Sample / In-Situ Test Information			Casing (Water)	Installation & Backfill
				Type	Depth	Results / Remarks		
TOPSOIL. Soft brown sandy CLAY.				D1	0.30			
Very soft orangish brown slightly sandy CLAY with low cobble content. Cobbles are angular to subrounded flint.		0.40		D2	0.50			
			SPT(C) B1	1.00 1.00	N=3 (1,0/1,1,0,1)	-		
			D3	1.50				
Loose light orangish brown mottled grey mottled white gravelly fine to coarse SAND. Gravel is angular to subrounded fine and medium flint.		1.70						
Orangish brown mottled light grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine and medium chalk. Rare flint gravel. Locally a slightly clayey gravelly fine to coarse sand.		2.00	SPT(C) B2	2.00 2.00	N=4 (1,1/1,1,1,1)	-		
			D4	2.50				
			B3 SPT(C)	2.90 3.00	N=6 (1,0/2,1,1,2)	-		
			D5	3.50				
			SPT(C) B4	4.00 4.00	N=4 (1,1/1,1,1,1)	-		
Drilled through by continuous SPT rod only. No recovery.		4.00						
			SPT(C)	4.45	N=11 (3,2/1,3,2,5)	-		
Borehole completed at 4.90m.		4.90						

Window or Windowless Sampling Run Details

Diameter (mm)	Top Depth (m)	Base Depth (m)	Sample Length (m)	Recovery (%)
102	1.20	2.00	0.80	100
102	2.00	3.00	1.00	100
87	3.00	4.00	1.00	100

Water Strike

Date	Strike Depth (m)	Depth Sealed (m)	Casing Depth (m)	Time Elapsed (mins)	Standing Level (m)	Remarks
20-12-2018	2.70		3.00			

Remarks:

1. Inspection pit from GL to 1.20mbgl.
2. SPT rod drilled from 4.00m to 4.90m. Two SPT tests detailed for the continuous drive depth.
3. Installation: 19mm standpipe GL to 1.00m plain, 1.00m to 4.00m slotted, fitted with cap and tophat cover.
4. Backfill: GL to 0.20m concrete, 0.20 to 1.00m bentonite pellets, 1.00 to 4.00m gravel, 4.00 to 4.90m arisings.

Norwich Office: 01603 613111

London Office: 020 7537 9233

Cambridge Office: 01223 781585

Testing Services: 01603 416333

E-mail: info@harrisingroupuk.com

Website: www.harrisingroupuk.com

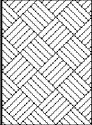
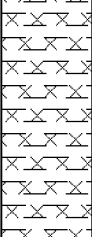
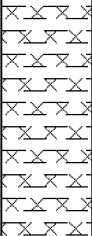
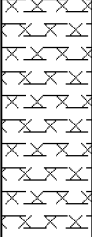
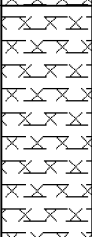
Drilled by: S. Bellchambers

Logged by: S. Hedges

Checked by: M. Cooper

Fm-Hn-R-3068-Rev C

ARUN DISTRICT COUNCIL Y/55/22/DOC

					Dynamic Continuous Sampling Borehole Record					BH03		Sheet 1 of 2		
Project ID: GL22428B					Client: Trustees of the Langmead Pension Scheme					E: N:				
Location: Central Arun Crematorium					Consultant: Harrison Group Environmental Ltd					Date: 20/12/2018				
					Plant used: Premier Tracked 110 Rig					SPT Hammer Serial No: 382709 (ER: 88%)				
Geology Description					Legend	Depth (m)	Elevation (maOD)	Sample / In-Situ Test Information			Casing (Water)	Installation & Backfill		
								Type	Depth	Results / Remarks				
TOPSOIL. Soft brown sandy CLAY.						0.50		D1	0.30					
Very soft orangish brown slightly gravelly slightly sandy CLAY. Gravel is subrounded fine to coarse flint.								D2	0.50					
Soft light orangish brown becoming grey slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse chalk. Locally a gravelly fine to coarse sand.						1.50		SPT(C) B1	1.00 1.00	N=4 (0,0/1,1,1,1)	-			
								B2 D3	1.50 - 2.50 1.50					
From 2.40m to 2.50m: Band of flint cobbles.								SPT(C)	2.00	N=7 (1,1/1,2,2,2)	-			
								B3 D4	2.50 - 3.00 2.50					
Firm grey mottled white slightly sandy slightly gravelly CLAY. Gravel is angular to subrounded fine to coarse chalk and flint. Locally a gravelly fine to coarse sand.						3.50		SPT(C) D5	3.00 3.00	N=14 (2,3/3,3,4,4)	-			
								B4	3.50 - 4.00					
						5.00		SPT(C)	5.00	N=20 (3,4/4,5,5,6)	-			
Window or Windowless Sampling Run Details					Water Strike									
Diameter (mm)	Top Depth (m)	Base Depth (m)	Sample Length (m)	Recovery (%)	Date	Strike Depth (m)	Depth Sealed (m)	Casing Depth (m)	Time Elapsed (mins)	Standing Level (m)	Remarks			
102	1.20	2.00	0.80	100	20-12-2018	2.80		3.00						
87	2.00	3.00	1.00	100										
75	3.00	4.00	1.00	100										
75	4.00	5.00	1.00	100										
Norwich Office: 01603 613111 London Office: 020 7537 9233 Cambridge Office: 01223 781585 Testing Services: 01603 416333 E-mail: info@harrisingroupuk.com Website: www.harrisingroupuk.com					Remarks: 1. Inspection pit from GL to 1.20mbgl. 2. Installation: 19mm standpipe GL to 1.00m plain, 1.00m to 5.00m slotted, fitted with cap and tophat cover. 3. Backfill: GL to 0.20m concrete, 0.20 to 1.00m bentonite pellets, 1.00 to 5.00m gravel, 5.00 to 5.45m arisings.									
Drilled by: S. Bellchambers					Logged by: S. Hedges			Checked by: M. Cooper			Fm-Hn-R-3068-Rev C			

APPENDIX C

GAS & GROUNDWATER MONITORING RECORDS



Site Name: Central Arun Crematorium Job No.: GL22428B

Site Name: Central Arun Crematorium

Job No.: GL22428B

Weather (include Temperature & Pressure): Wet, overcast

State of Ground: Wet

Harrison Group Environmental Ltd. Unit 12
Waterways Business Centre
Enfield
EN3 6JJ



Site Name: Central Arun Crematorium

Job No.: GL22428B

Client: Trustees of the Langmead Pension Scheme c/o Landlink Estates Ltd.

Weather (include Temperature & Pressure): Dry, clear

State of Ground: Dry

Harrison Group Environmental Ltd. Unit 12
Waterways Business Centre
Enfield
EN3 6JJ

APPENDIX D

LABORATORY TESTING



Harrison Group Environmental
12, Waterways Business Centre
Navigation Drive
Enfield
EN3 6JJ

For the attention of: John Keay

Page 1 of 1
Issue No: 01

Project: **Central Arun Crematorium**
Report No: **GL22428B-01**
Your Ref: **GL22428B**

Samples received: 08/01/2019
Instruction received: 08/01/2019
Testing commenced: 10/01/2019

Please find results attached as summarised below.

Item	Description	Quantity	UKAS Accredited
1	Water Content	5	Yes
2	Liquid & Plastic Limits	2	Yes
3	Particle Size Distribution - Wet Sieve Method	5	Yes
4	Particle Size Distribution - Pipette Sedimentation Method	2	Yes

Only those results indicated in this report are UKAS accredited and any opinion or interpretations expressed are outside the scope of UKAS accreditation.

Unless we are notified to the contrary, samples will be disposed after a period of one month from this date.

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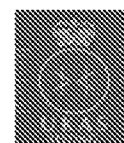
Issued by:

Date Issued:



M. Willson
Laboratory Manager

24 January 2019



4831



DETERMINATION OF WATER CONTENT

BS EN ISO 17892 - 1 : 2014

Project Name:			Central Arun Crematorium		Project Number:
Client Name:			Campbell Reith Hill LLP		GL22428B
Location	Depth m	Sample Ref	Sample Description	Water Content %	Remarks
BH02	0.50	D2	Orange brown and greenish grey slightly gravelly slightly sandy CLAY. Gravel is of flint	24.3	
BH02	1.00	B1	Orange brown slightly sandy silty CLAY	21.3	
BH02	1.50	D3	Orange brown mottled grey and greenish grey slightly gravelly slightly sandy CLAY. Gravel is of flint and chalk	20.9	
BH03	0.50	D2	Orange brown mottled grey and greenish grey slightly gravelly slightly sandy CLAY. Gravel is of flint and chalk	25.8	
BH03	1.00	B1	Orange brown mottled light brown slightly sandy very silty CLAY	27.2	

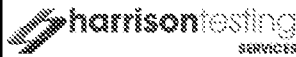
Notes:

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Remarks	Approved	Date	Sheet No.:
	MW M. Willson Laboratory Manager	24/01/2019	1 of 1

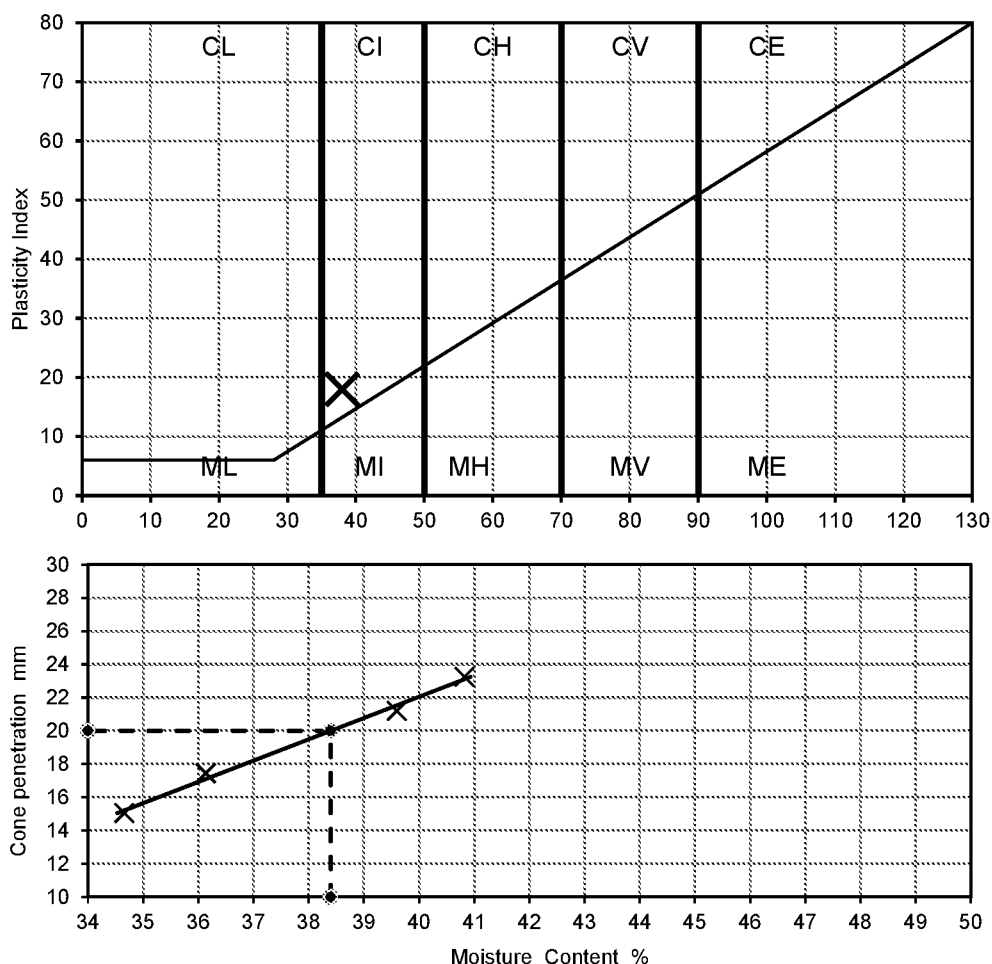
			DETERMINATION OF LIQUID LIMIT, PLASTIC LIMIT & PLASTICITY INDEX BS1377 : Part 2 : 1990						
Project Name:			Central Arun Crematorium					Project Number:	
Client Name:			Campbell Reith Hill LLP					GL22428B	
Location	Depth m	Sample Ref	Moisture Content %	Liquid Limit %	Plastic Limit %	Plasticity Index	Percentage passing 425µm %	Classification	Sample Description
BH02	0.50	D2	24	38	20	18	90	CI	Orange brown and greenish grey slightly gravelly slightly sandy CLAY. Gravel is of flint
BH03	1.00	B1	27	40	20	20	99	CI	Orange brown mottled light brown slightly sandy very silty CLAY
Notes: 1) This summary sheet is provided for convenience and in no way replaces individual test result sheets which shall, without exception, be regarded as the definitive result. Please refer to the individual test result sheets for the respective methods used. 2) Unless we are notified to the contrary, samples will be disposed after a period of one month from this date. 3) This report should not be reproduced except in full without the written approval of the laboratory. 4) Only those results indicated in this report are UKAS accredited and any opinion or interpretations expressed are outside the scope of UKAS accreditation.									
Remarks						Approved		Date	Sheet No.:
						MW M. Willson Laboratory Manager		24/01/2019	1 of 1



LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX, & LIQUIDITY INDEX

BS 1377 : Part 2 : 1990, clause 4.3 and 5

Project Name:	Central Arun Crematorium	Project Number:	GL22428B
Client Name:	Campbell Reith Hill LLP	Sample Location:	BH02
Sample Description:	Orange brown and greenish grey slightly gravelly slightly sandy CLAY. Gravel is of flint	Sample Depth (m)	0.50
		Sample Reference	D2



Preparation: Material was washed and oven dried at below 50°C

Results: As Received Moisture Content: (BS1377 : Part 2 : Clause 3 : 1990) 24 %
 Percentage Passing 425µm sieve: 90 %
 Liquid Limit: 38 %
 Plastic Limit: 20 %
 Plasticity Index: 18
 Liquidity Index: 0.22
 Modified Plasticity Index: (NHBC Standards Chapter 4.2) 16

Notes:

- 1) Modified Plasticity Index: (NHBC Standards Chapter 4.2) not covered by UKAS accreditation.
- 2) Unless we are notified to the contrary, samples will be disposed after a period of one month from this date.
- 3) This report should not be reproduced except in full without the written approval of the laboratory.
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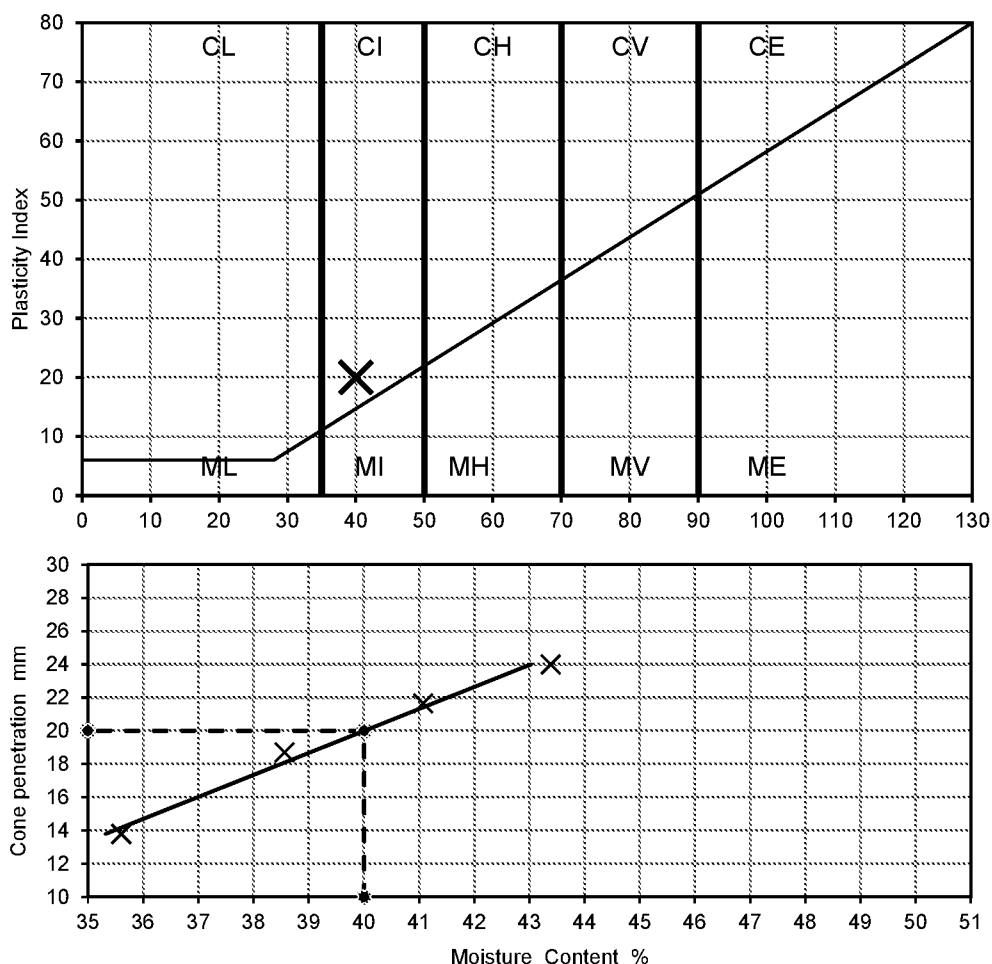


Remarks	Approved	Date	Sheet No.:
	MW M. Willson Laboratory Manager	24/01/2019	1 of 1

LIQUID LIMIT, PLASTIC LIMIT, PLASTICITY INDEX, & LIQUIDITY INDEX

BS 1377 : Part 2 : 1990, clause 4.3 and 5

Project Name:	Central Arun Crematorium	Project Number:	GL22428B
Client Name:	Campbell Reith Hill LLP	Sample Location:	BH03
Sample Description:	Orange brown mottled light brown slightly sandy very silty CLAY	Sample Depth (m)	1.00
		Sample Reference	B1



Preparation: Material was washed and oven dried at below 50°C

Results: As Received Moisture Content: (BS1377 : Part 2 : Clause 3 : 1990) 27 %
 Percentage Passing 425µm sieve: 99 %
 Liquid Limit: 40 %
 Plastic Limit: 20 %
 Plasticity Index: 20
 Liquidity Index: 0.35
 Modified Plasticity Index: (NHBC Standards Chapter 4.2) 20

Notes:

- 1) Modified Plasticity Index: (NHBC Standards Chapter 4.2) not covered by UKAS accreditation.
- 2) Unless we are notified to the contrary, samples will be disposed after a period of one month from this date.
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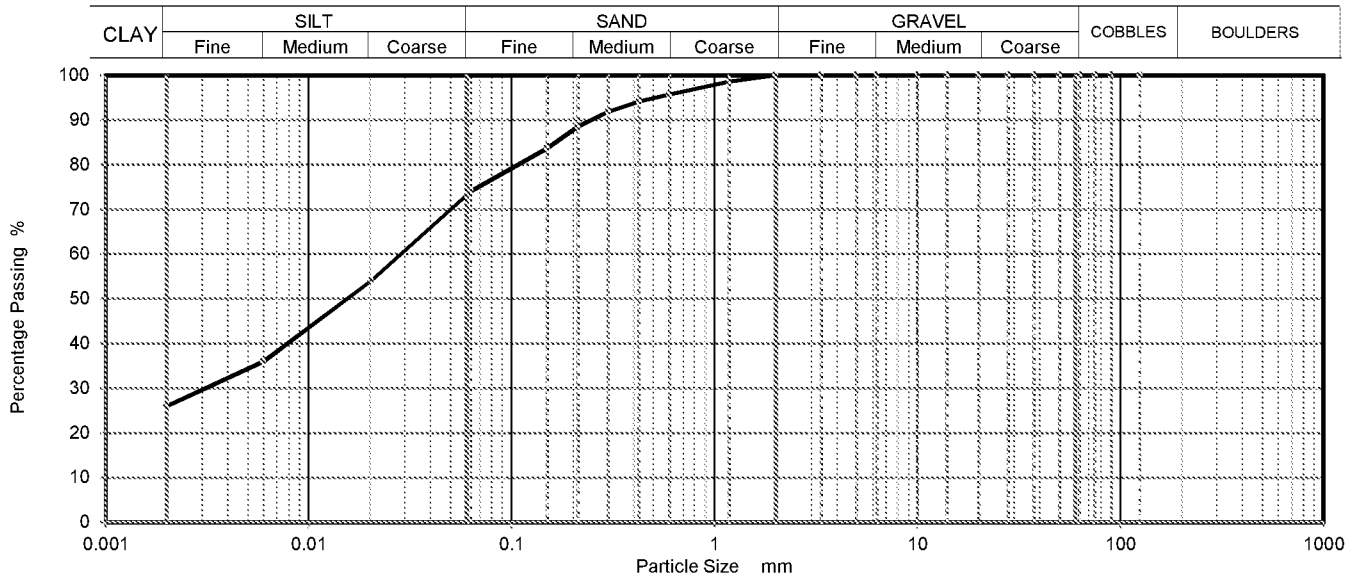
Remarks	Approved	Date	Sheet No.:
	MW M. Willson Laboratory Manager	24/01/2019	1 of 1



DETERMINATION OF PARTICLE SIZE DISTRIBUTION

BS1377:Part 2:1990, clauses 9.2 and 9.4

Project Name:	Central Arun Crematorium	Project Number:	GL22428B
Client Name:	Campbell Reith Hill LLP	Sample Location:	BH02
Sample Description:	Orange brown slightly sandy silty CLAY	Sample Depth (m)	1.00
		Sample Reference	B1



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	54
90	100	0.0060	36
75	100	0.0020	26
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	99		
0.6	96		
0.425	94	Particle density (assumed)	
0.3	92	2.65	Mg/m ³
0.212	89		
0.15	84		
0.063	74		

Sample Proportions	% dry mass
Very coarse	0
Gravel	0
Sand	26
Silt	48
Clay	26

Grading Analysis		
D100	mm	
D60	mm	0.028
D30	mm	0.003
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

Notes:

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4031

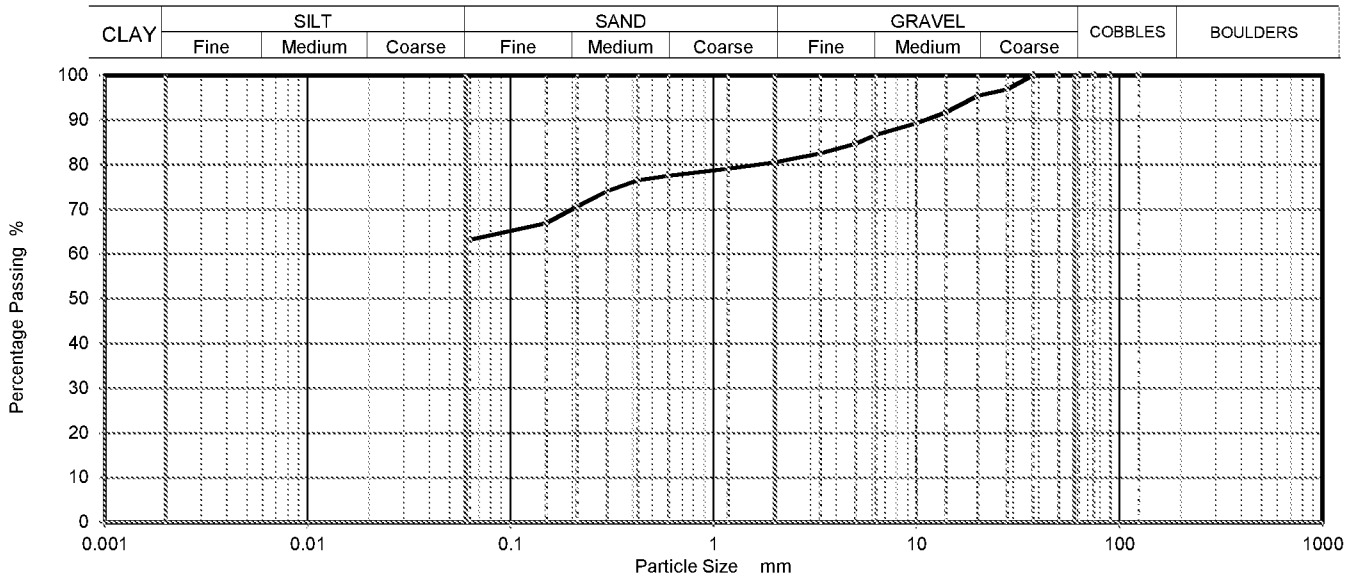
Remarks	Approved	Date	Sheet No.:
	MW M. Willson Laboratory Manager	24/01/2019	1 of 1



DETERMINATION OF PARTICLE SIZE DISTRIBUTION

BS1377:Part 2:1990, clause 9.2

Project Name:	Central Arun Crematorium	Project Number:	GL22428B
Client Name:	Campbell Reith Hill LLP	Sample Location:	BH02
Sample Description:	Yellow and orange brown mottled light grey slightly sandy slightly gravelly CLAY. Gravel is of flint and chalk.	Sample Depth (m)	2.90
		Sample Reference	B3



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	92		
10	89		
6.3	87		
5	85		
3.35	83		
2	81		
1.18	79		
0.6	78		
0.425	77		
0.3	74		
0.212	71		
0.15	67		
0.063	63		

Sample Proportions	% dry mass
Very coarse	0
Gravel	19
Sand	17
Fines <0.063mm	63

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

Notes:

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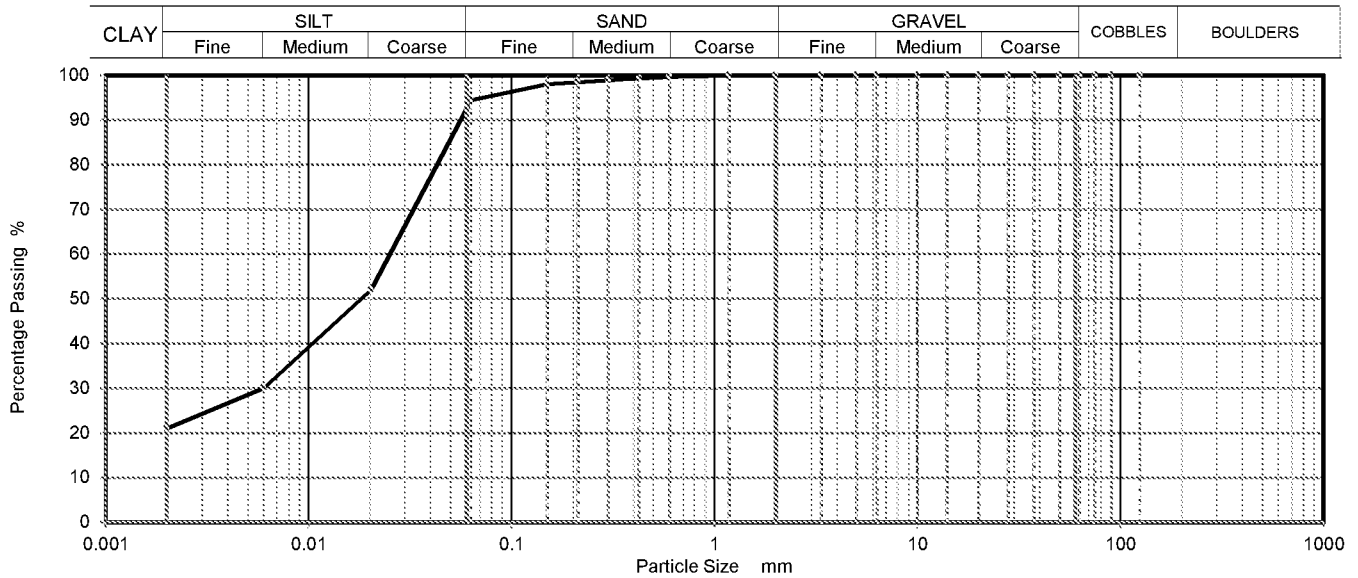
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Remarks	Approved	Date	Sheet No.:
	MW M. Willson Laboratory Manager	23/01/2019	1 of 1

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

BS1377:Part 2:1990, clauses 9.2 and 9.4

Project Name:	Central Arun Crematorium	Project Number:	GL22428B
Client Name:	Campbell Reith Hill LLP	Sample Location:	BH03
Sample Description:	Orange brown mottled light brown slightly sandy very silty CLAY	Sample Depth (m)	1.00
		Sample Reference	B1



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100	0.0200	52
90	100	0.0060	30
75	100	0.0020	21
63	100		
50	100		
37.5	100		
28	100		
20	100		
14	100		
10	100		
6.3	100		
5	100		
3.35	100		
2	100		
1.18	100		
0.6	100		
0.425	99	Particle density (assumed)	
0.3	99	2.65	Mg/m ³
0.212	99		
0.15	98		
0.063	95		

Sample Proportions	% dry mass
Very coarse	0
Gravel	0
Sand	6
Silt	73
Clay	22

Grading Analysis		
D100	mm	
D60	mm	0.025
D30	mm	0.006
D10	mm	
Uniformity Coefficient		
Curvature Coefficient		

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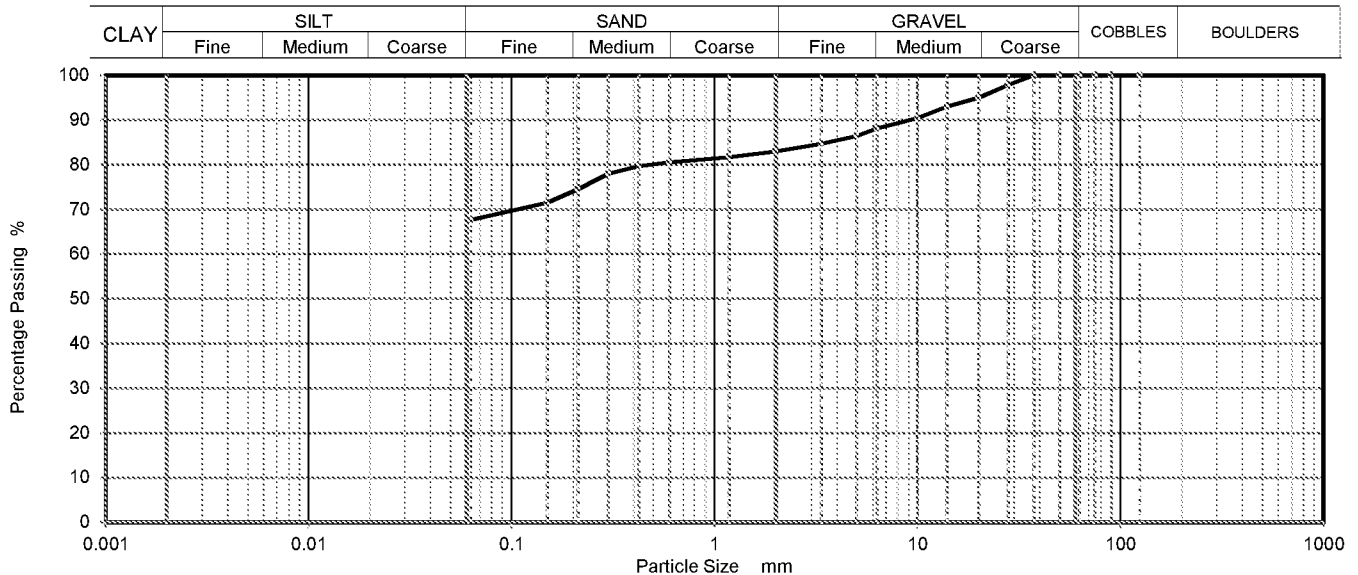
Remarks	Approved	Date	Sheet No.:
	MW M. Willson Laboratory Manager	24/01/2019	1 of 1



DETERMINATION OF PARTICLE SIZE DISTRIBUTION

BS1377:Part 2:1990, clause 9.2

Project Name:	Central Arun Crematorium	Project Number:	GL22428B
Client Name:	Campbell Reith Hill LLP	Sample Location:	BH03
Sample Description:	Yellow and orange brown mottled grey slightly gravelly slightly sandy CLAY. Gravel is of chalk and flint.	Sample Depth (m)	2.50
		Sample Reference	B3



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	98		
20	95		
14	93		
10	90		
6.3	88		
5	86		
3.35	85		
2	83		
1.18	82		
0.6	81		
0.425	80		
0.3	78		
0.212	75		
0.15	72		
0.063	68		

Sample Proportions	% dry mass
Very coarse	0
Gravel	17
Sand	15
Fines <0.063mm	68

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

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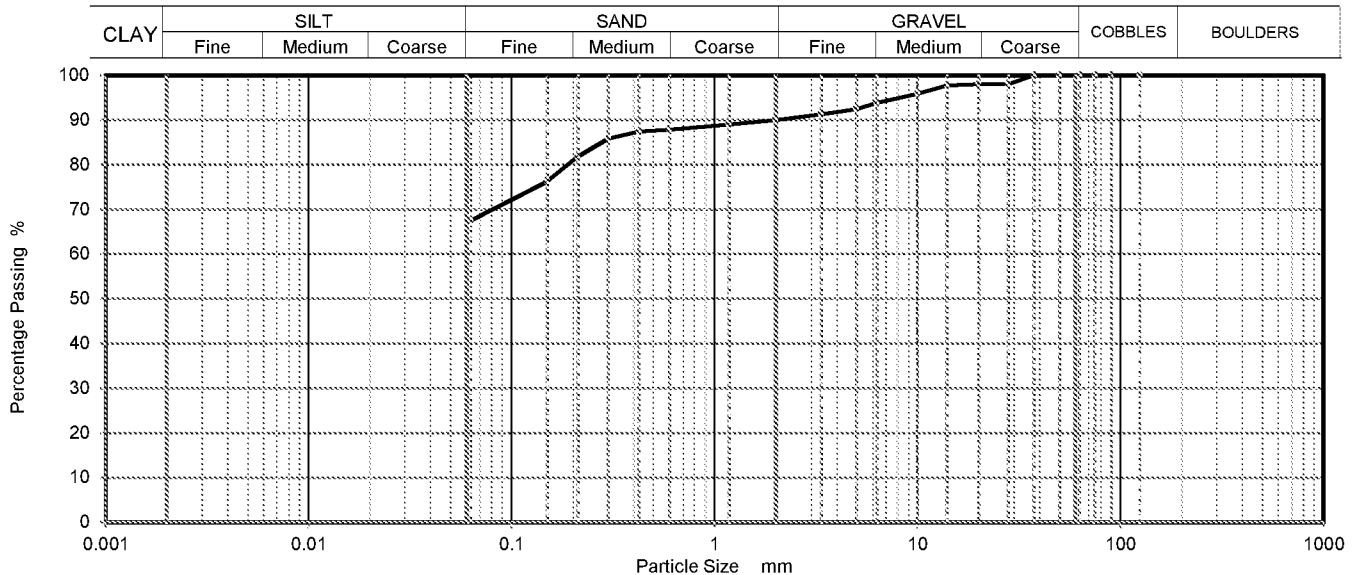
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Remarks	Approved	Date	Sheet No.:
	MW M. Willson Laboratory Manager	23/01/2019	1 of 1

DETERMINATION OF PARTICLE SIZE DISTRIBUTION

BS1377:Part 2:1990, clause 9.2

Project Name:	Central Arun Crematorium	Project Number:	GL22428B
Client Name:	Campbell Reith Hill LLP	Sample Location:	BH03
Sample Description:	Light grey mottled orange brown slightly sandy slightly gravelly CLAY. Gravel is of chalk and flint.	Sample Depth (m)	3.50
		Sample Reference	B4



Sieving		Sedimentation	
Particle Size mm	% Passing	Particle Size mm	% Passing
125	100		
90	100		
75	100		
63	100		
50	100		
37.5	100		
28	98		
20	98		
14	98		
10	96		
6.3	94		
5	93		
3.35	91		
2	90		
1.18	89		
0.6	88		
0.425	87		
0.3	86		
0.212	82		
0.15	76		
0.063	68		

Sample Proportions	% dry mass
Very coarse	0
Gravel	10
Sand	23
Fines <0.063mm	68

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

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Remarks	Approved	Date	Sheet No.:
	MW M. Willson Laboratory Manager	23/01/2019	1 of 1



4841



///CERTS



Environmental Science

Matthew Wilson

Harrison Group
Harrison Testing Services
Unit 1
Alston Road
Norwich
Norfolk
NR6 5DS

i2 Analytical Ltd.
7 Woodshots Meadow,
Croxley Green
Business Park,
Watford,
Herts,
WD18 8YS

Analytical Report Number : 19-24444

Project / Site name:	Central Arun Crematorium	Samples received on:	11/01/2019
Your job number:	GL22428B	Samples instructed on:	11/01/2019
Your order number:	PO-32900-GB	Analysis completed by:	17/01/2019
Report Issue Number:	1	Report issued on:	17/01/2019
Samples Analysed:	4 soil samples		

Signed

Rexona Rahman
Head of Customer Services
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41 -711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :	soils	- 4 weeks from reporting
	leachates	- 2 weeks from reporting
	waters	- 2 weeks from reporting
	asbestos	- 6 months from reporting

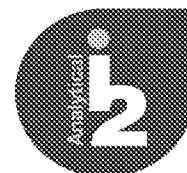
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MCERTS



Environmental Science

Analytical Report Number: 19-24444

Project / Site name: Central Arun Crematorium

Your Order No: PO-32900-GB

Lab Sample Number				1128601	1128602	1128603	1128604	
Sample Reference				BH02	BH02	BH03	BH03	
Sample Number				B1	B4	D2	B4	
Depth (m)				1.00-1.00	4.00-4.00	0.50-0.50	3.50-4.00	
Date Sampled				08/01/2019	08/01/2019	08/01/2019	08/01/2019	
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	
Moisture Content	%	N/A	NONE	15	15	19	14	
Total mass of sample received	kg	0.001	NONE	0.61	0.56	0.43	0.47	

General Inorganics

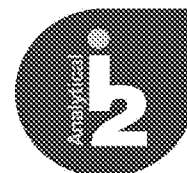
pH - Automated	pH Units	N/A	MCERTS	8.1	8.6	8.4	8.6	
Total Sulphate as SO ₄	%	0.005	MCERTS	0.031	0.026	0.033	0.033	
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.021	0.036	0.019	0.030	
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	21.3	36.4	19.0	29.9	
Total Sulphur	%	0.005	MCERTS	0.014	0.010	0.015	0.030	
Organic Matter	%	0.1	MCERTS	0.5	-	-	-	



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MCERTS



Environmental Science

Analytical Report Number : 19-24444**Project / Site name: Central Arun Crematorium**

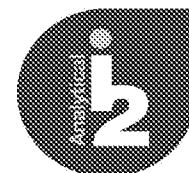
* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
1128601	BH02	B1	1.00-1.00	Brown clay.
1128602	BH02	B4	4.00-4.00	Light brown clay and sand with gravel.
1128603	BH03	D2	0.50-0.50	Light brown clay and sand.
1128604	BH03	B4	3.50-4.00	Grey clay with chalk.



4841



Environmental Science

Analytical Report Number : 19-24444**Project / Site name: Central Arun Crematorium****Water matrix abbreviations: Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Water (PrW)**

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically.	In-house method based on BS1377 Part 2, 1990, Chemical and Electrochemical Tests	L019-UK/PL	W	NONE
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	BS1377 Part 3, 1990, Chemical and Electrochemical Tests ^{***}	L009-PL	D	MCERTS
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests, 2:1 water:soil extraction, analysis by ICP-OES.	L038-PL	D	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, Chemical and Electrochemical Tests ^{***}	L038	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In-house method based on BS1377 Part 3, 1990, and MEWAM 2006 Methods for the Determination of Metals in Soil	L038	D	MCERTS

For method numbers ending in 'UK' analysis have been carried out in our laboratory in the United Kingdom.**For method numbers ending in 'PL' analysis have been carried out in our laboratory in Poland.****Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.**

APPENDIX E

RIG CERTIFICATES

SPT Calibration Report

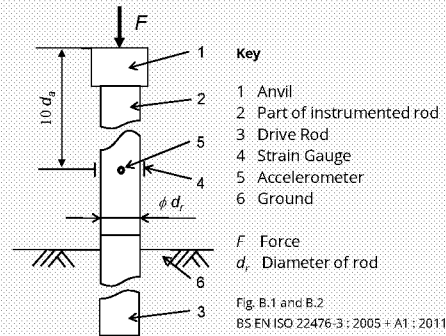
Hammer Energy Measurement Report

Type of Hammer PREMIER
Client GEOTECHNICAL SERVICES
Test No EQU2030

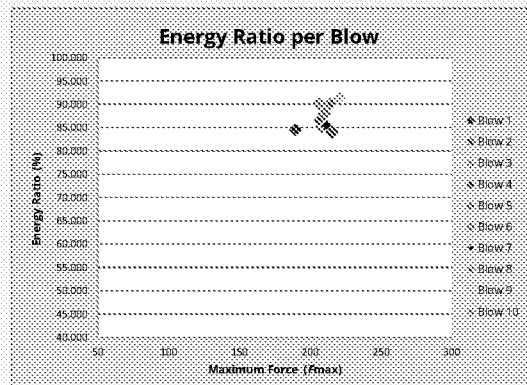
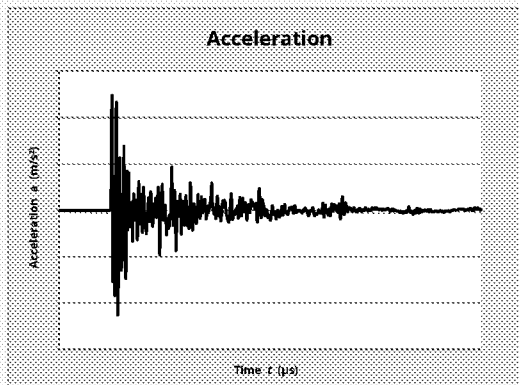
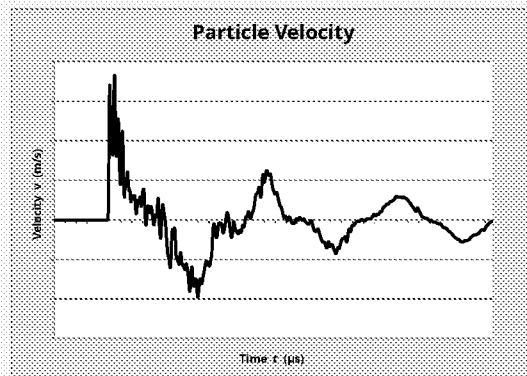
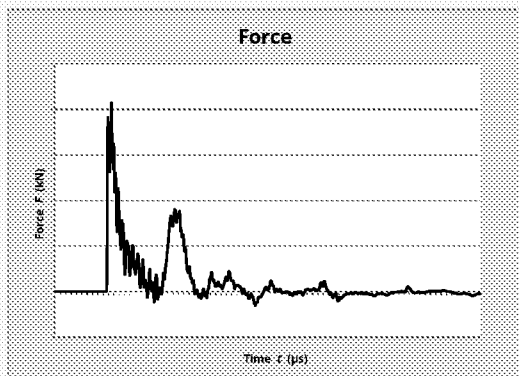
Test Depth (m) 8.70
Mass of hammer $m = 63.5\text{kg}$
Falling height $h = 0.76\text{m}$
 $E_{\text{theor}} = m \times g \times h = 473\text{J}$

Characteristics of the instrumented rod

Diameter $d_r = 0.052\text{m}$
Length of instrumented rod 0.558 m
Area $A = 11.61\text{cm}^2$
Modulus $E_s = 206843\text{MPa}$



DATE OF TEST	VALID UNTIL	HAMMER ID
29/01/2018	29/01/2019	382709



Observations:

1.

$E_{\text{meas}} = 0.415\text{ kN-m}$
 $E_{\text{theor}} = 0.473\text{ kN-m}$

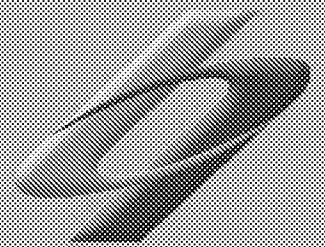
Energy Ratio = $\frac{E_{\text{meas}}}{E_{\text{theor}}}$ **87.82%**

Equipe SPT Analyzer Operators: JML

Prepared by:

Checked by:

Date: 01/02/2018



Norwich (Registered Office)

Kimberley Street
Norwich
Norfolk
NR2 2RJ

London

12 Waterways Business Centre
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Future Business Centre
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Cambridge
CB4 2HY

Colchester

Colchester Business Centre
1 George Williams Way
Colchester
CO1 2JS